## ■ Specifications and test methods for NME ( Noble Metal Electrode ) series

| No. | Item | | Specification: Temperature compensating type | Specification: High dielectric constant type | Test Method |
|---|---|---|---|---|---|
| 1 | Operating Temperature Range | | NP0: -55 to 125 degree C | X7R: -55 to 125 degree C | --- |
| 2 | Rated Voltage | | See the previous pages | | The rated voltage is defined as the maximum voltage, which may be applied continuously to the capacitor. |
| 3 | Appearance | | No defects or abnormalities. | | Visual inspection |
| 4 | Dimensions | | Within the specified dimension. | | Using calipers |
| 5 | Dielectric Strength (Flash) | | No defects or abnormalities. | | No failure shall be observed when 250% of the rated voltage is applied between the terminations for 1 to 5 seconds, the charge and discharge current is less than 50mA. |
| 6 | Insulation Resistance ( I.R.) | | I.R. ≧100GΩ or R* C ≧ 1000 Ω-F ( whichever is smaller) | | The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at 25℃ and 75%RH max, and within 1 minute of charging. |
| 7 | Capacitance | | Within the specified tolerance at 5000 hours | | The capacitance / D.F. shall be measured at 25℃ at the frequency and voltage shown in the tables. |
| 8 | Dissipation Factor ( D.F.) | | If C≦30pF, DF≦1/(400+20C)<br>If C >30pF, DF≦0.1% | X7R<br>DF=2.5% max for RV≧25V | |
| 9 | Capacitance Temperature Characteristics | | Capacitance change<br>NPO within ± 30 PPM/℃ | Capacitance change<br>X7R within ±15% | 1. Temperature compensating type: The capacitance value at 25℃ and 85℃ shall be measured and calculated from the formula given below.<br>$T.C.=(C_{85}-C_{25})/C_{25}*\Delta T*10^6(PPM/℃)$<br>2. High dielectric constant type: The ranges of capacitance change compared with the 25℃ value over the temperature ranges shall be within the specified ranges. |
| 10 | Deflection (Bending Strength) | | No cracking or marking defects shall occur at 1mm deflection | | Solder the capacitor to the test jig(glass epoxy boards) shown in Fig.a using a eutectic solder. Then apply a force in the direction shown in Fig.b. The soldering shall be done with the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock. |
| 11 | Solderability of Termination | | 90% of the terminations is to be soldered evenly and continuously. | | Immerse the test capacitor into a methanol solution containing rosin for 3 to 5 seconds, preheat it 150 to 180℃ for 2 to 3 minutes and immerse it into molten solder of 230 ± 5℃ for 5±1seconds. |
| 12 | Resistance to Soldering Heat | Appearance | No marking defects | | Preheat the capacitor at 120 to 150℃ for 1 minute. Immerse the capacitor in an eutectic solder solution at 270±5℃ for 10±0.5 seconds. Let sit at room temperature for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type), then measure. |
| | | Cap. Change | NP0 within ±2.5% or 0.25pF (whichever is larger) | X7R within ±7.5% | |
| | | D.F. | If C≦30pF, DF≦1/(400+20C)<br>If C >30pF, DF≦0.1% | X7R<br>DF=2.5% max for RV≧25V | |
| | | I.R. | To satisfy the specified initial value | | |

| Item | Class I (≦1,000pF) | Class I ( >1,000pF) | Class II |
|---|---|---|---|
| Frequency | 1±0.2MHz | 1±0.2KHz | 1±0.2KHz |
| Voltage | 1±0.2Vrms | 1±0.2Vrms | 1±0.2Vrms |

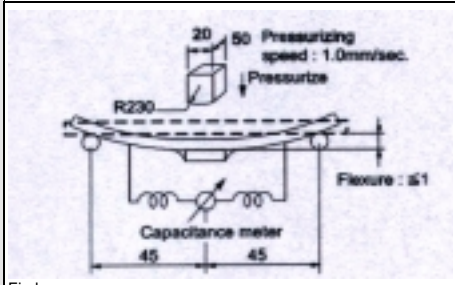


Fig.b

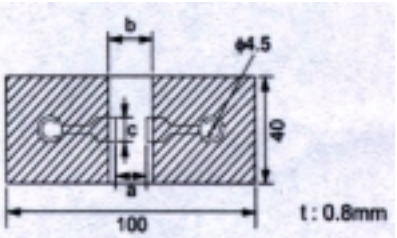


Fig.a

<table>
<tr><td rowspan="4">13</td><td rowspan="4">Temperature cycle (Thermal shock)</td><td>Appearance</td><td colspan="2">No marking defects</td><td rowspan="4">1. Fix the capacitor to supporting jig (glass epoxy board) and perform the five cycles according to the four heat treatments listed in the following table.<br>2. Initial measurement for high dielectric constant type, perform a heat treatment at 150℃ for one hour and then let sit for 48±4 hours at room temperature then perform the initial measurement.<br><table><tr><th colspan="2">Type / Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td rowspan="2">NP0&X7R</td><td>Temp.(℃)</td><td>-55℃</td><td>Room temp.</td><td>+125</td><td>Room temp.</td></tr><tr><td>Time (min)</td><td>30±3</td><td>1 to 2</td><td>30±3</td><td>1 to 2</td></tr><tr><td rowspan="2">Y5V</td><td>Temp.(℃)</td><td>-30℃</td><td>Room temp.</td><td>+85℃</td><td>Room temp.</td></tr><tr><td>Time (min)</td><td>30±3</td><td>1 to 2</td><td>30±3</td><td>1 to 2</td></tr></table></td></tr>
<tr><td>Cap. Change</td><td>NP0 within ±2.5% or 0.25pF (whichever is larger)</td><td>X7R within ±10%</td></tr>
<tr><td>D.F.</td><td>If C≦30pF, DF≦1/(400+20C)<br>If C >30pF, DF≦0.1%</td><td>X7R<br>DF=2.5% max for RV≧25V</td></tr>
<tr><td>I.R.</td><td>More than 10GΩ or $R_iC_R$ >100sec( whichever is smaller )</td><td>More than 1 GΩ or $R_iC_R$ >10sec( whichever is smaller )</td></tr>
<tr><td rowspan="4">14</td><td rowspan="4">Humidity load</td><td>Appearance</td><td colspan="2">No marking defects</td><td rowspan="4">Apply the rated voltage at 40±2℃ and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. The charge/discharge current is less than 50mA.</td></tr>
<tr><td>Cap. Change</td><td>NP0 within ±7.5% or 0.75pF (whichever is larger)</td><td>X7R within ±15%</td></tr>
<tr><td>D.F.</td><td>2* specified value</td><td>X7R<br>DF=5% max for RV≧25V</td></tr>
<tr><td>I.R.</td><td>More than 2.5 GΩ or $R_iC_R$≧25 sec (whichever is smaller)</td><td>More than 1 GΩ or $R_iC_R$≧10 sec (whichever is smaller)</td></tr>
<tr><td rowspan="4">15</td><td rowspan="4">High temperature load life test</td><td>Appearance</td><td colspan="2">No marking defects</td><td rowspan="4">Apply 200% of the rated voltage for 500±12 hours at the maximum operating temperature ± 3℃. Let sit for 24± 2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. The charge/discharge current is less than 50mA.</td></tr>
<tr><td>Cap. Change</td><td>NP0 within ±7.5% or 0.75pF (whichever is large)</td><td>X7R within ±20%</td></tr>
<tr><td>D.F.</td><td>2* specified value</td><td>X7R<br>DF=5% max for RV≧25V<br>Y5V<br>DF≦7.5% for RV≧25V</td></tr>
<tr><td>I.R.</td><td>More than 5 GΩ or $R_iC_R$≧50 sec (whichever is smaller)</td><td>More than 1 GΩ or $R_iC_R$≧10 sec (whichever is smaller)</td></tr>
</table>

## ■ Specifications and test methods for BME ( Base Metal Electrode ) series

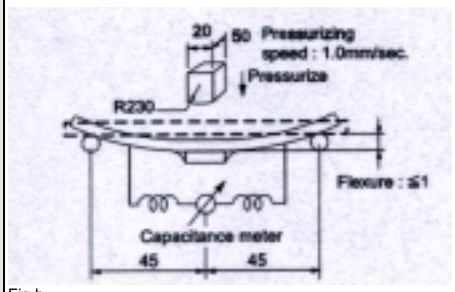
<table>
<tr><th colspan="3" rowspan="2">No. / Item</th><th>Specification</th><th rowspan="2">Test Method</th></tr>
<tr><th>High dielectric constant type</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature Range</td><td>X7R: -55 to 125℃<br>Y5V: -30 to 85℃<br>X5R: -55 to 85℃</td><td>---</td></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.</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 dimension.</td><td>Using calipers</td></tr>
<tr><td>5</td><td colspan="2">Dielectric Strength (Flash)</td><td>No defects or abnormalities.</td><td>No failure shall be observed when 250% of the rated voltage is applied between the terminations for 5 seconds. The charge and discharge current is less than 50mA.</td></tr>
<tr><td>6</td><td colspan="2">Insulation Resistance (I.R.)</td><td>I.R. ≧10GΩ or R*C ≧ 500 Ω-F ( whichever is smaller)</td><td>The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at 25℃ and 75%RH max, and within 1 minute of charging.</td></tr>
<tr><td>7</td><td colspan="2">Capacitance</td><td>Within the specified tolerance at 5000 hours</td><td rowspan="2">The capacitance / D.F. shall be measured at 25℃ at the frequency and voltage shown in bellow:<br>Frequency: 1±0.2 kHz<br>Voltage: 1±0.2 Vrms</td></tr>
<tr><td>8</td><td colspan="2">Dissipation Factor (D.F.)</td><td>Please see table 1.
<table>
<tr><th>Char./max</th><th>50Vmin</th><th>25V</th><th>16V</th><th>10V</th></tr>
<tr><td>X7R</td><td>2.5% Max</td><td>3.5% Max</td><td>3.5% Max</td><td>5% Max</td></tr>
<tr><td>X5R</td><td>3.5% Max</td><td>3.5% Max</td><td>3.5% Max</td><td>5% Max</td></tr>
<tr><td>Y5V</td><td>Table 2</td><td>Table 2</td><td>Table 2</td><td>Table 2</td></tr>
</table>
Table 1</td></tr>
<tr><td>9</td><td colspan="2">Capacitance Temperature Characteristics</td><td>Capacitance change<br>X7R: within ±15%<br>Y5V: -82 to + 22%<br>X5R: within ±15%</td><td>1. High dielectric constant type: The ranges of capacitance change compared with the 25℃ value over the temperature ranges shall be within the specified ranges.</td></tr>
<tr><td>10</td><td colspan="2">Deflection (Bending Strength)</td><td>No cracking or marking defects shall occur at 1mm deflection<br> 

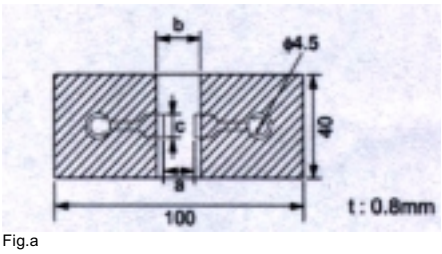
Fig.b</td><td>Solder the capacitor to the test jig(glass epoxy boards) shown in Fig.a using a eutectic solder. Then apply a force in the direction shown in Fig.b. The soldering shall be done with the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.<br> 

Fig.a</td></tr>
<tr><td>11</td><td colspan="2">Solderability of Termination</td><td>90% of the terminations is to be soldered evenly and continuously.</td><td>Immerse the test capacitor into a methanol solution containing rosin for 3 to 5 seconds, preheat it 150 to 180℃ for 2 to 3 minutes and immerse it into molten solder of 230 ± 5℃ for 5±1seconds.</td></tr>
<tr><td rowspan="4">12</td><td rowspan="4">Resistance to Soldering Heat</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Preheat the capacitor at 120 to 150℃ for 1 minute. Immerse the capacitor in an eutectic solder solution at 270±5℃ for 10±0.5 seconds. Let sit at room temperature foe 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type), then measure.</td></tr>
<tr><td>Cap. Change</td><td>X7R within ±7.5%<br>Y5V within ±20%<br>X5R within ±7.5%</td></tr>
<tr><td>D.F.</td><td>Please see table 1.</td></tr>
<tr><td>I.R.</td><td>To satisfy the specified initial value</td></tr>
</table>

| | | | | |
|---|---|---|---|---|
| 13 | **Temperature cycle (Thermal shock)** | **Appearance** | No marking defects | 1. Fix the capacitor to supporting jig (glass epoxy board) and perform the five cycles according to the four heat treatments listed in the following table.<br>2. Initial measurement for high dielectric constant type, perform a heat treatment at 150℃ for one hour and then let sit for 48±4 hours at room temperature then perform the initial measurement. |
| | | **Cap. Change** | X7R within ±7.5%<br>Y5V within ±20%<br>X5R within ±7.5% | |
| | | **D.F.** | Please see table 1. | |
| | | **I.R.** | I.R. ≧500MΩ or R*C ≧ 25 Ω-F ( whichever is smaller) | |
| 14 | **Humidity load** | **Appearance** | No marking defects | Apply the rated voltage at 40±2℃ and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours (temperature compensating type) or 48±4hours (high dielectric constant type) at room temperature, then measure.The charge/discharge current is less than 50mA.<br>Initial measurement for high dielectric type. Apply the rated DC voltage for 1 hour at 40±2℃. Remove and let sit for 48±4 hours at room temperature then perform initial measurement. |
| | | **Cap. Change** | X7R within ±12.5%<br>Y5V within ±30%<br>X5R within ±12.5% | |
| | | **D.F.** | X7R 200% max of initial value<br>Y5V 150% max of initial value<br>X5R 200% max of initial value | |
| | | **I.R.** | I.R. ≧500MΩ or R*C ≧ 25 Ω-F ( whichever is smaller) | |
| 15 | **High temperature load life test** | **Appearance** | No marking defects | Apply 200% of the rated voltage for 500±12 hours at the maximum operating temperature ± 3℃. Let sit for 24± 2 hours(temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. The charge/discharge current is less than 50mA.<br>Initial measurement for high dielectric constant type. Apply 200% of the rated DC voltage for one hour at the maximum operating temperature ± 3℃. Remove and let sit for 48±4 hours at room temperature then perform initial measurement. |
| | | **Cap. Change** | X7R within ±12.5%<br>Y5V within ±30%<br>X5R within ±12.5% | |
| | | **D.F.** | X7R 200% max of initial value<br>Y5V 150% max of initial value<br>X5R 200% max of initial value | |
| | | **I.R.** | I.R. ≧500MΩ or R*C ≧ 25 Ω-F ( whichever is smaller) | |

| Type / Step | | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| X7R | Temp.(℃) | -55℃ | Room temp. | +125 | Room temp. |
| | Time (min) | 30±3 | 1 to 2 | 30±3 | 1 to 2 |
| Y5V | Temp.(℃) | -30℃ | Room temp. | +85℃ | Room temp. |
| | Time (min) | 30±3 | 1 to 2 | 30±3 | 1 to 2 |
| X5R | Temp.(℃) | -55℃ | Room temp. | +85 | Room temp. |
| | Time (min) | 30±3 | 1 to 2 | 30±3 | 1 to 2 |

**Notice: When mounting capacitor on 500V rated voltage, perform the epoxy resin coating (min. 1.0mm thickness)**

**Table2**

| Material | Rated Voltage | Size | Capacitance | Frequency | D.F. |
|---|---|---|---|---|---|
| Y5V | 10V | ALL | ALL | 1 KHz / 1 ±0.2 VRMS | ≦ 16% |
| | 16V | 0402 | ALL | | ≦ 12.5% |
| | | 0603 | ≦ 100n | | ≦ 7% |
| | | | 100n＜Cp≦220n | | ≦ 9% |
| | | | ＞ 220n | | ≦ 16% |
| | | 0805 | ≦ 1u | | ≦ 9% |
| | | | ＞ 1u | | ≦ 12.5% |
| | | 1206 | ≦ 2.2u | | ≦ 9% |
| | | | ＞ 2.2u | | ≦ 12.5% |
| | 25V/50V | 0603 | ＜ 100n | | ≦ 5% |
| | | | 100n | | ≦ 7% |
| | | | ＞ 100n | | ≦ 9% |
| | | 0805 | ＜ 330n | | ≦ 5% |
| | | | 330n | | ≦ 7% |
| | | | ＞ 330n | | ≦ 9% |
| | | 1206 | ＜ 1u | | ≦ 5% |
| | | | 1u | | ≦ 7% |
| | | | ＞ 1u | | ≦ 9% |

## Specifications and test methods for HV ( High Voltage ) series

| No. | Item | | Specification: Temperature compensating type | Specification: High dielectric constant type | Test Method |
|---|---|---|---|---|---|
| 1 | **Operating Temperature Range** | | NP0: -55 to 125℃ | X7R: -55 to 125℃ | --- |
| 2 | **Rated Voltage** | | See the previous pages | | The rated voltage is defined as the maximum voltage, which may be applied continuously to the capacitor. |
| 3 | **Appearance** | | No defects or abnormalities. | | Visual inspection |
| 4 | **Dimensions** | | Within the specified dimension. | | Using calipers |
| 5 | **Dielectric Strength (Flash)** | | No defects or abnormalities. | | V ≧ 1KV : 120% of rated voltage for 1 to 5 seconds.<br>500V≦V<1KV: 800V rated voltage for 1 to 5 seconds<br>250V≦V<500V: 800V rated voltage for 1 to 5 seconds<br>No greater than 200V: 800V rated voltage for 1 to 5 seconds<br>The charge and discharge current is less than 50mA. |
| 6 | **Insulation Resistance ( I.R.)** | | If C≦10,000pF, IR≧100GΩ<br>If C>10,000pF, IR≧1000/C Ω | | The insulation resistance shall be measured with a DC voltage 800 voltage at 25℃ and 75%RH max, and within 1 minute of charging. |
| 7 | **Capacitance** | | Within the specified tolerance at 5000 hours | | The capacitance / D.F. shall be measured at 25℃ at the frequency and voltage shown in the tables. |
| 8 | **Dissipation Factor ( D.F.)** | | If C≦30pF, DF≦1/(400+20C)<br>If C >30pF, DF≦0.1% | X7R<br>DF=2.5%max | |
| 9 | **Capacitance Temperature Characteristics** | | Capacitance change<br>NPO within ± 30 PPM/℃ | Capacitance change<br>X7R within ±15% | 1. Temperature compensating type: The capacitance value at 25℃ and 85℃ shall be measured and calculated from the formula given below.<br>$T.C.=(C_{85}-C_{25})/C_{25}*\Delta T*10^6(PPM/℃)$<br>2. High dielectric constant type: The ranges of capacitance change compared with the 25℃ value over the temperature ranges shall be within the specified ranges. |
| 10 | **Deflection (Bending Strength)** | | No cracking or marking defects shall occur at 1mm deflection | | Solder the capacitor to the test jig(glass epoxy boards) shown in Fig.a using a eutectic solder. Then apply a force in the direction shown in Fig.b. The soldering shall be done with the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock. |
| 11 | **Solderability of Termination** | | 90 %of the terminations is to be soldered evenly and continuously. | | Immerse the test capacitor into a methanol solution containing rosin for 3 to 5 seconds, preheat it 150 to 180℃ for 2 to 3 minutes and immerse it into molten solder of 230 ± 5℃ for 5±1seconds. |
| 12 | **Resistance to Soldering Heat** | **Appearance** | No marking defects | | Preheat the capacitor at 120 to 150℃ for 1 minute and 170 to 200℃ for 1 minute. Immerse the capacitor in a eutectic solder solution at 270±5℃ for 10±0.5 seconds. Let sit at room temperature foe 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type), then measure. |
| | | **Cap. Change** | NP0 within ±2.5% or 0.25pF ( whichever is larger ) | X7R within ±7.5% | |
| | | **D.F.** | If C≦30pF, DF≦1/(400+20C)<br>If C >30pF, DF≦0.1% | 3.5%max | |
| | | **I.R.** | More than 10GΩ or $R_iC_R$≧100 sec(whichever is smaller) | More than 1 GΩ or $R_iC_R$≧10 sec(whichever is smaller) | |

| Item | (1,000pF and below) | ( more than 1,000pF) | Class II |
|---|---|---|---|
| Frequency | 1±0.2MHz | 1±0.2KHz | 1±0.2KHz |
| Voltage | 1±0.2Vrms | 1±0.2Vrms | 1±0.2Vrms |

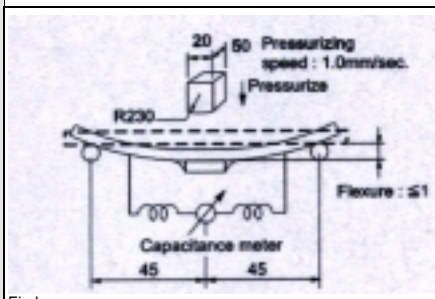


Fig.b

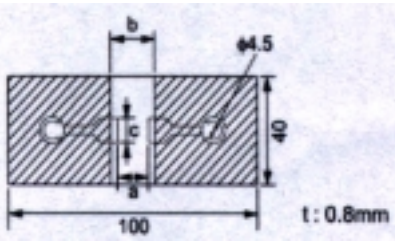


Fig.a

<table>
<tr><td rowspan="4">13</td><td rowspan="4">Temperature cycle (Thermal shock)</td><td>Appearance</td><td colspan="2">No marking defects</td><td rowspan="4">1. Fix the capacitor to supporting jig (glass epoxy board) and perform the five cycles according to the four heat treatments listed in the following table.<br>2. Initial measurement for high dielectric constant type, perform a heat treatment at 150℃ for one hour and then let sit for 48±4 hours at room temperature then perform the initial measurement.<br><table><tr><td colspan="2">Type / Step</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td rowspan="2">NP0&X7R</td><td>Temp.(℃)</td><td>-55℃</td><td>Room temp.</td><td>+125</td><td>Room temp.</td></tr><tr><td>Time (min)</td><td>30±3</td><td>1 to 2</td><td>30±3</td><td>1 to 2</td></tr></table></td></tr>
<tr><td>Cap. Change</td><td>NP0 within ±2.5% or 0.25pF ( whichever is larger )</td><td>X7R within ±7.5%</td></tr>
<tr><td>D.F.</td><td>If C≦30pF, DF≦1/(400+20C)<br>If C >30pF, DF≦0.1%</td><td>3.5%max.</td></tr>
<tr><td>I.R.</td><td>More than 10GΩ or $R_iC_R$≧100 sec (whichever is smaller)</td><td>More than 1 GΩ or $R_iC_R$≧10 sec (whichever is smaller)</td></tr>
<tr><td rowspan="4">14</td><td rowspan="4">Humidity steady state</td><td>Appearance</td><td colspan="2">No marking defects</td><td rowspan="4">Sit the capacitor at 40± 2℃ and 90 to 95% humidity for 500± 12 hours.<br>Remove and let sit for 24± 2 hours(NP0) or 48± 4 hours (high dielectric constant type) at room temperature, then measure.</td></tr>
<tr><td>Cap. Change</td><td>NP0 within ±7.5% or 0.75pF ( whichever is larger )</td><td>X7R within ±12.5%</td></tr>
<tr><td>D.F.</td><td>2* specified value</td><td>5%max</td></tr>
<tr><td>I.R.</td><td>More than 5 GΩ or $R_iC_R$≧50 sec (whichever is smaller)</td><td>More than 1 GΩ or $R_iC_R$≧10 sec (whichever is smaller)</td></tr>
<tr><td rowspan="4">15</td><td rowspan="4">High temperature load life test</td><td>Appearance</td><td colspan="2">No marking defects</td><td rowspan="4">Apply the rated voltage for 500±12 hours at the maximum operating temperature ± 3℃. Let sit for 24± 2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. The charge/discharge current is less than 50mA.</td></tr>
<tr><td>Cap. Change</td><td>NP0 within ±7.5% or 0.75pF ( whichever is larger )</td><td>X7R within ±12.5%</td></tr>
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<tr><td>I.R.</td><td>More than 5 GΩ or $R_iC_R$≧50 sec (whichever is smaller)</td><td>More than 1 GΩ or $R_iC_R$≧10 sec (whichever is smaller)</td></tr>
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