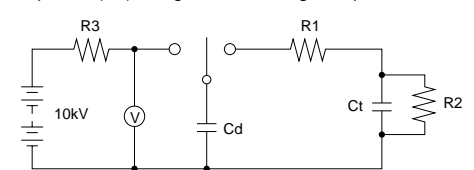
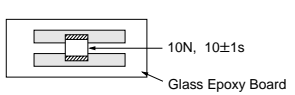


# Safety Standard Certified Type GC/GD/GF/GB Specifications and Test Methods

No.	Item	Specifications	Test Method																				
1	Operating Temperature Range	-55 to +125°C	—																				
2	Appearance	No defects or abnormalities	Visual inspection																				
3	Dimensions	Within the specified dimensions	Using calipers and micrometers																				
4	Dielectric Strength	No defects or abnormalities	<p>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.</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr style="background-color: #f2f2f2;"> <th colspan="2">Test Voltage</th> </tr> </thead> <tbody> <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> </tbody> </table>	Test Voltage		Type GB	DC1075V	Type GC/GD	AC1500V (r.m.s.)	Type GF	AC2000V (r.m.s.)												
Test Voltage																							
Type GB	DC1075V																						
Type GC/GD	AC1500V (r.m.s.)																						
Type GF	AC2000V (r.m.s.)																						
5	Pulse Voltage (Application: Type GD/GF)	No self healing breakdowns or flash-overs have taken place in the capacitor.	<p>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</p>																				
6	Insulation Resistance (I.R.)	More than 6,000MΩ	The insulation resistance should be measured with DC500±50V and within 60±5 sec. of charging.																				
7	Capacitance	Within the specified tolerance																					
8	Dissipation Factor (D.F.) Q	<table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr style="background-color: #f2f2f2;"> <th>Char.</th> <th>Specification</th> </tr> </thead> <tbody> <tr> <td>X7R</td> <td>D.F. ≤ 0.025</td> </tr> <tr> <td rowspan="2">SL</td> <td>Q ≥ 400 + 20C*2 (C &lt; 30pF)</td> </tr> <tr> <td>Q ≥ 1000 (C ≥ 30pF)</td> </tr> </tbody> </table>	Char.	Specification	X7R	D.F. ≤ 0.025	SL	Q ≥ 400 + 20C*2 (C < 30pF)	Q ≥ 1000 (C ≥ 30pF)	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.)													
Char.	Specification																						
X7R	D.F. ≤ 0.025																						
SL	Q ≥ 400 + 20C*2 (C < 30pF)																						
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9	Capacitance Temperature Characteristics	<table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr style="background-color: #f2f2f2;"> <th>Char.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <tr> <td>X7R</td> <td>Within ±15%</td> </tr> </tbody> </table> <p>Temperature characteristic guarantee is -55 to +125°C</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr style="background-color: #f2f2f2;"> <th>Char.</th> <th>Temperature Coefficient</th> </tr> </thead> <tbody> <tr> <td>SL</td> <td>+350 to -1000ppm/°C</td> </tr> </tbody> </table> <p>Temperature characteristic guarantee is +20 to +85°C</p>	Char.	Capacitance Change	X7R	Within ±15%	Char.	Temperature Coefficient	SL	+350 to -1000ppm/°C	<p>The capacitance measurement should be made at each step specified in the Table.</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr style="background-color: #f2f2f2;"> <th>Step</th> <th>Temperature (°C)</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>SL char. :                      The capacitance should be measured at even 85°C between step 3 and step 4.                      •Pretreatment for X7R char.                      Perform a heat treatment at 150±18°C for 60±5 min. and then let sit for 24±2 hrs. at room condition.*1</p>	Step	Temperature (°C)	1	25±2 (20±2 for SL char.)	2	Min. Operating Temp.±3	3	25±2 (20±2 for SL char.)	4	Max. Operating Temp.±2	5	25±2 (20±2 for SL char.)
Char.	Capacitance Change																						
X7R	Within ±15%																						
Char.	Temperature Coefficient																						
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4	Max. Operating Temp.±2																						
5	25±2 (20±2 for SL char.)																						
10	Appearance	No defects or abnormalities	<p>As in Fig., discharge is made 50 times at 5 sec. intervals from the capacitor (Cd) charged at DC voltage of specified.</p>  <p style="text-align: center;">Ct: Capacitor under test Cd: 0.001µF                      R1: 1,000Ω R2: 100MΩ R3: Surge resistance</p>																				
	I.R.	More than 1,000MΩ																					
	Dielectric Strength	In accordance with item No.4																					
11	Adhesive Strength of Termination	No removal of the terminations or other defect should occur.	<p>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.</p>  <p style="text-align: right;">10N, 10±1s Glass Epoxy Board</p> <p style="text-align: center;">Fig. 1</p>																				

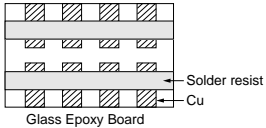
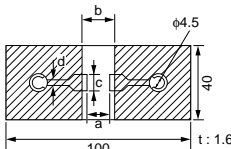
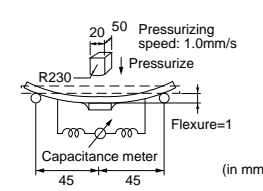
\*1 "Room condition" Temperature: 15 to 35°C, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa

\*2 "C" expresses nominal capacitance value (pF).

Continued on the following page.

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

Continued from the preceding page.

No.	Item	Specifications	Test Method																						
12	Appearance	No defects or abnormalities	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.).																						
	Capacitance	Within the specified tolerance																							
12	D.F. Q	<table border="1"> <thead> <tr> <th>Char.</th> <th>Specification</th> </tr> </thead> <tbody> <tr> <td>X7R</td> <td>D.F. ≤ 0.025</td> </tr> <tr> <td>SL</td> <td>Q ≥ 400 + 20C*2 (C &lt; 30pF) Q ≥ 1000 (C ≥ 30pF)</td> </tr> </tbody> </table>	Char.	Specification	X7R	D.F. ≤ 0.025	SL	Q ≥ 400 + 20C*2 (C < 30pF) Q ≥ 1000 (C ≥ 30pF)																	
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X7R	D.F. ≤ 0.025																								
SL	Q ≥ 400 + 20C*2 (C < 30pF) Q ≥ 1000 (C ≥ 30pF)																								
13	Deflection	No marking defects	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. 2 <table border="1"> <thead> <tr> <th rowspan="2">LxW (mm)</th> <th colspan="3">Dimension (mm)</th> <th rowspan="2">d</th> </tr> <tr> <th>a</th> <th>b</th> <th>c</th> </tr> </thead> <tbody> <tr> <td>4.5x2.0</td> <td>3.5</td> <td>7.0</td> <td>2.4</td> <td rowspan="4">1.0</td> </tr> <tr> <td>4.5x3.2</td> <td>3.5</td> <td>7.0</td> <td>3.7</td> </tr> <tr> <td>5.7x2.8</td> <td>4.5</td> <td>8.0</td> <td>3.2</td> </tr> <tr> <td>5.7x5.0</td> <td>4.5</td> <td>8.0</td> <td>5.6</td> </tr> </tbody> </table>		LxW (mm)	Dimension (mm)			d	a	b	c	4.5x2.0	3.5	7.0	2.4	1.0	4.5x3.2	3.5	7.0	3.7	5.7x2.8	4.5	8.0	3.2	5.7x5.0
LxW (mm)	Dimension (mm)				d																				
	a	b	c																						
4.5x2.0	3.5	7.0	2.4	1.0																					
4.5x3.2	3.5	7.0	3.7																						
5.7x2.8	4.5	8.0	3.2																						
5.7x5.0	4.5	8.0	5.6																						
			 Fig. 3 <p>(in mm)</p>																						
14	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). 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																						
15	Appearance	No marking defects	Preheat the capacitor as in table. Immerse the capacitor in solder solution at 260±5°C 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±8°C for 60±5 min. and then let sit for 24±2 hrs. at room condition.*1																						
	Capacitance Change	<table border="1"> <thead> <tr> <th>Char.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <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> </tbody> </table>		Char.	Capacitance Change	X7R	Within ±10%	SL	Within ±2.5% or ±0.25pF (Whichever is larger)																
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Step	Temperature	Time																							
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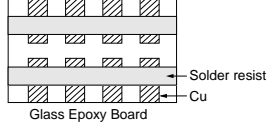
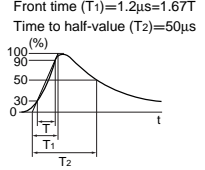
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Continued on the following page. ↗

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

Continued from the preceding page.

No.	Item	Specifications	Test Method															
16	Temperature Cycle	Appearance	No marking defects															
		Capacitance Change	Char. X7R	Capacitance Change Within $\pm 15\%$														
			SL	Within $\pm 2.5\%$ or $\pm 0.25\text{pF}$ (Whichever is larger)														
		D.F. Q	Char. X7R	Specification D.F. $\leq 0.05$														
			SL	$Q \geq 400 + 20C^{*2}$ ( $C < 30\text{pF}$ ) $Q \geq 1000$ ( $C \geq 30\text{pF}$ )														
I.R.	More than 3,000M $\Omega$																	
Dielectric Strength	In accordance with item No.4																	
			<p>Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig. 4.</p> <p>Perform the 5 cycles according to the 4 heat treatments listed in the following table.</p> <p>Let sit for 24<math>\pm</math>2 hrs. at room condition,*1 then measure.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Step</th> <th>Temperature (°C)</th> <th>Time (min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. Operating Temp. <math>\pm 3</math></td> <td>30<math>\pm</math>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. <math>\pm 2</math></td> <td>30<math>\pm</math>3</td> </tr> <tr> <td>4</td> <td>Room Temp.</td> <td>2 to 3</td> </tr> </tbody> </table> <p>•Pretreatment for X7R char. Perform a heat treatment at 150<math>\pm</math>18°C for 60<math>\pm</math>5 min. and then let sit for 24<math>\pm</math>2 hrs. at room condition.*1</p> <div style="text-align: center;">  <p>Fig. 4</p> </div>	Step	Temperature (°C)	Time (min.)	1	Min. Operating Temp. $\pm 3$	30 $\pm$ 3	2	Room Temp.	2 to 3	3	Max. Operating Temp. $\pm 2$	30 $\pm$ 3	4	Room Temp.	2 to 3
Step	Temperature (°C)	Time (min.)																
1	Min. Operating Temp. $\pm 3$	30 $\pm$ 3																
2	Room Temp.	2 to 3																
3	Max. Operating Temp. $\pm 2$	30 $\pm$ 3																
4	Room Temp.	2 to 3																
17	Humidity (Steady State)	Appearance	No marking defects															
		Capacitance Change	Char. X7R	Capacitance Change Within $\pm 15\%$														
			SL	Within $\pm 5.0\%$ or $\pm 0.5\text{pF}$ (Whichever is larger)														
		D.F. Q	Char. X7R	Specification D.F. $\leq 0.05$														
			SL	$Q \geq 275 + 5/2C^{*2}$ ( $C < 30\text{pF}$ ) $Q \geq 350$ ( $C \geq 30\text{pF}$ )														
I.R.	More than 3,000M $\Omega$																	
Dielectric Strength	In accordance with item No.4																	
			<p>Before this test, the test shown in the following is performed.</p> <p>-Item 11 Adhesive Strength of Termination (applied force is 5N)</p> <p>-Item 13 Deflection</p> <p>Let the capacitor sit at 40<math>\pm</math>2°C and relative humidity of 90 to 95% for 500<math>\pm</math>24 hrs.</p> <p>Remove and let sit for 24<math>\pm</math>2 hrs. at room condition,*1 then measure.</p> <p>•Pretreatment for X7R char. Perform a heat treatment at 150<math>\pm</math>18°C for 60<math>\pm</math>5 min. and then let sit for 24<math>\pm</math>2 hrs. at room condition.*1</p>															
18	Life	Appearance	No marking defects															
		Capacitance Change	Char. X7R	Capacitance Change Within $\pm 20\%$														
			SL	Within $\pm 3.0\%$ or $\pm 0.3\text{pF}$ (Whichever is larger)														
		D.F. Q	Char. X7R	Specification D.F. $\leq 0.05$														
			SL	$Q \geq 275 + 5/2C^{*2}$ ( $C < 30\text{pF}$ ) $Q \geq 350$ ( $C \geq 30\text{pF}$ )														
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Dielectric Strength	In accordance with item No.4																	
			<p>Before this test, the test shown in the following is performed.</p> <p>-Item 11 Adhesive Strength of Termination (apply force is 5N)</p> <p>-Item 13 Deflection</p> <p>Impulse Voltage</p> <p>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.</p> <div style="text-align: center;">  <p>Front time (T<sub>1</sub>)=1.2<math>\mu</math>s=1.67T Time to half-value (T<sub>2</sub>)=50<math>\mu</math>s</p> </div> <p>Apply voltage as in Table for 1,000 hrs. at 125<math>\pm</math>2°C, relative humidity 50% max.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Type</th> <th>Applied Voltage</th> </tr> </thead> <tbody> <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</td> <td rowspan="2">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> <tr> <td>GF</td> </tr> <tr> <td>GD</td> <td></td> </tr> </tbody> </table> <p>Let sit for 24<math>\pm</math>2 hrs. at room condition,*1 then measure.</p> <p>•Pretreatment for X7R char. Perform a heat treatment at 150<math>\pm</math>18°C for 60<math>\pm</math>5 min. and then let sit for 24<math>\pm</math>2 hrs. at room condition.*1</p>	Type	Applied Voltage	GB	AC312.5V (r.m.s.), except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1 sec.	GC	AC425V (r.m.s.), except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1 sec.	GF	GD							
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Continued on the following page.

