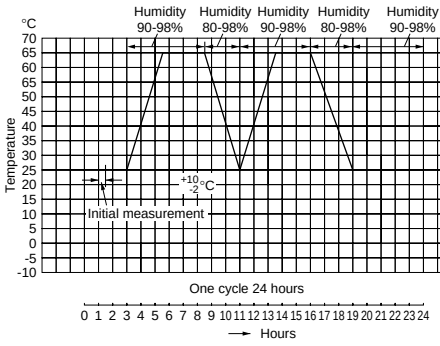
GCM Series Specification and Test Methods

No.	AEC-Q200 Test Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric Type	AEC-Q200 Test Method
1	Pre-and Post-Stress Electrical Test		–		
2	High Temperature Exposure (Storage)		The measured and observed characteristics should satisfy the specifications in the following table.		Sit the capacitor for 1000±12 hours at 150±3°C. Let sit for 24±2 hours at room temperature, then measure.
		Appearance	No marking defects		
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	Within ±10.0%	
		Q/D.F.	30pFmin.: Q≧1000 30pFmax.: Q≧400+20C C: Nominal Capacitance (pF)	W.V.: 25Vmin.: 0.03 max. W.V.: 16V: 0.05 max. *1	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller) *1		
3	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 (18). Perform the 1000 cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours at room temperature, then measure Step / 1 / 2 / 3 / 4 Temp. (℃) / -55+0/-3 / Room Temp. / 125+3/-0 (ΔC/R7/C7) / Room Temp. Time (min.) / 15±3 / 1 / 15±3 / 1 • Initial measurement for high dielectric constant type 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.
		Appearance	No marking defects		
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	Within ±10.0%	
		Q/D.F.	30pFmin.: Q≧1000 30pFmax.: Q≧400+20C C: Nominal Capacitance (pF)	W.V.: 25Vmin.: 0.03 max. W.V.: 16V: 0.05 max. *1	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller) *1		
4	Destructive Physical Analysis		No defects or abnormalities		Per EIA-469
5	Moisture Resistance		The measured and observed characteristics should satisfy the specifications in the following table.		Apply the 24-hour heat (25 to 65°C) and humidity (80 to 98%) treatment shown below, 10 consecutive times. Let sit for 24±2 hours at room temperature, then measure. 
		Appearance	No marking defects		
		Capacitance Change	Within ±3.0% or ±0.30pF (Whichever is larger)	Within ±12.5%	
		Q/D.F.	30pFmin.: Q≧350 10pF and over, 30pF and below: Q≧275+ $\frac{5}{2}$ C 10pFmax.: Q≧200+10C C: Nominal Capacitance (pF)	W.V.: 25Vmin.: 0.03 max. W.V.: 16V: 0.05 max. *1	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller) *1		
6	Biased Humidity		The measured and observed characteristics should satisfy the specifications in the following table.		Apply the rated voltage and 1.3+0.2/-0Vdc (add 6.8k Ω resistor) at 85±3°C and 80 to 85% humidity for 1000±12 hours. Remove and let sit for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.
		Appearance	No marking defects		
		Capacitance Change	Within ±3.0% or ±0.30pF (Whichever is larger)	Within ±12.5%	
		Q/D.F.	30pF and over: Q≧200 30pF and below: Q≧100+ $\frac{10}{3}$ C C: Nominal Capacitance (pF)	W.V.: 25Vmin.: 0.035 max. W.V.: 16V: 0.05 max. *1	
		I.R.	More than 1,000MΩ or 50Ω · F (Whichever is smaller) *1		

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No.	AEC-Q200 Test Item		Specifications		AEC-Q200 Test Method
			Temperature Compensating Type	High Dielectric Type	
7	Operational Life		The measured and observed characteristics should satisfy the specifications in the following table.		Apply 200% of the rated voltage for 1000±12 hours at 125±3°C. Let sit for 24±2 hours at room temperature, then measure. *2 The charge/discharge current is less than 50mA. • Initial measurement for high dielectric constant type. Apply 200% of the rated DC voltage for one hour at the maximum operating temperature ±3°C. Remove and let sit for 24±2 hours at room temperature. Perform initial measurement. *2
		Appearance	No marking defects		
		Capacitance Change	Within ±3.0% or ±0.30pF (Whichever is larger)	Within ±12.5%	
		Q/D.F.	30pFmin.: Q≧350 10pF and over, 30pF and below: Q≧275+ $\frac{5}{2}$ C 10pFmax.: Q≧200+10C C: Nominal Capacitance (pF)	*1 W.V.: 25Vmin.: 0.035 max. W.V.: 16V: 0.05 max.	
		I.R.	More than 1,000MΩ or 50Ω · F (Whichever is smaller)	*1	
8	External Visual		No defects or abnormalities		Visual inspection
9	Physical Dimension		Within the specified dimensions		Using calipers
10	Resistance to Solvents	Appearance	No marking defects		Per MIL-STD-202 Method 215 Solvent 1: 1 part (by volume) of isopropyl alcohol 3 parts (by volume) of mineral spirits Solvent 2: Terpene defluxer Solvent 3: 42 parts (by volume) of water 1 part (by volume) of propylene glycol monomethylether 1 part (by volume) of monoethanolomine
		Capacitance Change	Within the specified tolerance		
		Q/D.F.	30pFmin.: Q≧1000 30pFmax.: Q≧400+20C C: Nominal Capacitance (pF)	*1 W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max.	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller)	*1	
11	Mechanical Shock	Appearance	No marking defects		Three shocks in each direction should be applied along 3 mutually perpendicular axes of the test specimen (18 shocks). The specified test pulse should be Half-sine and should have a duration: 0.5ms, peak value: 1500g and velocity change: 4.7m/s.
		Capacitance Change	Within the specified tolerance		
		Q/D.F.	30pFmin.: Q≧1000 30pFmax.: Q≧400+20C C: Nominal Capacitance (pF)	*1 W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max.	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller)	*1	
12	Vibration	Appearance	No defects or abnormalities		Solder the capacitor to the test jig (glass epoxy board) in the same manner and under the same conditions as (19). 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 2000Hz. The frequency range, from 10 to 2000Hz and return to 10Hz, should be traversed in approximately 20 minutes. This motion should be applied for 12 items in each 3 mutually perpendicular directions (total of 36 times).
		Capacitance Change	Within the specified tolerance		
		Q/D.F.	30pFmin.: Q≧1000 30pFmax.: Q≧400+20C C: Nominal Capacitance (pF)	*1 W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max.	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller)	*1	
13	Resistance to Soldering Heat		The measured and observed characteristics should satisfy the specifications in the following table.		Immerse the capacitor in a eutectic solder solution at 260±5°C for 10±1 seconds. Let sit at room temperature for 24±2 hours, then measure. • Initial measurement for high dielectric constant type 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.
		Appearance	No marking defects		
		Capacitance Change	Within the specified tolerance		
		Q/D.F.	30pFmin.: Q≧1000 30pFmax.: Q≧400+20C C: Nominal Capacitance (pF)	*1 W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max.	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller)	*1	

Continued on the following page.

GCM Series Specification and Test Methods

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<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">AEC-Q200
Test Item</th><th colspan="2">Specifications</th><th rowspan="2">AEC-Q200 Test Method</th></tr>
<tr><th>Temperature Compensating Type</th><th>High Dielectric Type</th></tr>
<tr><td rowspan="4">14</td><td rowspan="4">Thermal Shock</td><td></td><td colspan="2">The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="4">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (18). Perform the 300 cycles according to the two heat treatments listed in the following table (Maximum transfer time is 20 seconds). Let sit for 24±2 hours at room temperature, then measure.
<table><tr><th>Step</th><th>1</th><th>2</th></tr><tr><td>Temp. (°C)</td><td>-55+0/-3</td><td>125+3/-0 (5C, C7, R7)</td></tr><tr><td>Time (min.)</td><td>15±3</td><td>15±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 let sit for 24±2 hours at room temperature.
Perform the initial measurement.</td></tr>
<tr><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td><td>Within ±10.0%</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.: Q≧1000
30pF max.: Q≧400+20C
C: Nominal Capacitance (pF)</td><td>*1
W.V.: 25Vmin.: 0.025 max.
W.V.: 16V: 0.035 max.</td></tr>
<tr><td rowspan="3">15</td><td rowspan="3">ESD</td><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω · F (Whichever is smaller) *1</td><td rowspan="3">Per AEC-Q200-004</td></tr>
<tr><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td>Capacitance Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td></td><td>Q/D.F.</td><td>30pF min.: Q≧1000
30pF max.: Q≧400+20C
C: Nominal Capacitance (pF)</td><td>*1
W.V.: 25Vmin.: 0.025 max.
W.V.: 16V: 0.035 max.</td></tr>
<tr><td></td><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω · F (Whichever is smaller) *1</td></tr>
<tr><td rowspan="3">16</td><td rowspan="3" colspan="2">Solderability</td><td colspan="2" rowspan="3">95% of the terminations is to be soldered evenly and continuously.</td><td>(a) Preheat at 155°C for 4 hours. After preheating, immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5°C.</td></tr>
<tr><td>(b) Should be placed into steam aging for 8 hours±15 minutes. After preheating, immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5°C.</td></tr>
<tr><td>(c) Should be placed into steam aging for 8 hours±15 minutes. After preheating, immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 120 ±5 seconds at 260±5°C.</td></tr>
<tr><td rowspan="5">17</td><td rowspan="5">Electrical Chatacteri-zation</td><td>Appearance</td><td colspan="2">No defects or abnormalities</td><td>Visual inspection.</td></tr>
<tr><td>Capacitance Change</td><td colspan="2">Within the specified tolerance</td><td rowspan="2">The capacitance/Q/D.F. should be measured at 25°C at the frequency and voltage shown in the table.
(1) Temperature Compensating Type
<table><tr><th>Capacitance</th><th>Frequency</th><th>Voltage</th></tr><tr><td>C≦1000pF</td><td>1±0.1MHz</td><td>0.5 to 5Vrms</td></tr><tr><td>C＞1000pF</td><td>1±0.1kHz</td><td>1±0.2Vrms</td></tr></table>(2) High Dielectric Type
<table><tr><th>Capacitance</th><th>Frequency</th><th>Voltage</th></tr><tr><td>C≦10μF</td><td>1±0.1kHz</td><td>1±0.2Vrms</td></tr><tr><td>C＞10μF</td><td>120±24Hz</td><td>0.5±0.1Vrms</td></tr></table></td></tr>
<tr><td>Q/D.F.</td><td>30pF min.: Q≧1000
30pF max.: Q≧400+20C
C: Nominal Capacitance (pF)</td><td>*1
W.V.: 25V min.: 0.025 max.
W.V.: 16V: 0.035 max</td></tr>
<tr><td>I.R.</td><td>25°C
More than 100,000MΩ or 1,000Ω · F (Whichever is smaller)

Max. Operating Temperature···125°C
More than 10,000MΩ or 100Ω · F (Whichever is smaller)</td><td>*1
25°C
More than 10,000MΩ or 500Ω · F (Whichever is smaller)

Max. Operating Temperature···125°C
More than 1,000MΩ or 10Ω · F (Whichever is smaller)</td><td>The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25°C and 125°C and within 2 minutes of charging.</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td><td></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>
</table>

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<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">AEC-Q200
Test Item</th><th colspan="2">Specifications</th><th rowspan="2">AEC-Q200 Test Method</th></tr>
<tr><th>Temperature Compensating Type</th><th>High Dielectric Type</th></tr>
<tr><td rowspan="4">18</td><td rowspan="4">Board
Flex</td><td>Appearance</td><td colspan="2">No marking defects</td><td rowspan="4">Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 1 using a eutectic solder. Then apply a force in the direction shown in Fig. 2 for 5±1sec. 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.

Type | a | b | c
GCM03 | 0.3 | 0.9 | 0.3
GCM15 | 0.5 | 1.5 | 0.6
GCM18 | 0.6 | 2.2 | 0.9
GCM21 | 0.8 | 3.0 | 1.3
GCM31 | 2.0 | 4.4 | 1.7
GCM32 | 2.0 | 4.4 | 2.6
(in mm)

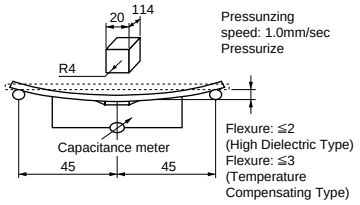
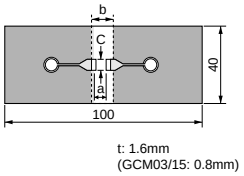
 

Fig. 2</td></tr>
<tr><td>Capacitance
Change</td><td>Within ±5.0% or ±0.5pF
(Whichever is larger)</td><td>Within ±10.0%</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.: Q≧1000
30pF max.: Q≧400+20C
C: Nominal Capacitance (pF)</td><td>*1
W.V.: 25Vmin.: 0.025 max.
W.V.: 16V: 0.035 max.</td></tr>
<tr><td>I.R.</td><td>*1
More than 10,000MΩ or 500Ω · F
(Whichever is smaller)</td><td> 

t: 1.6mm
(GCM03/15: 0.8mm)
Fig. 1</td></tr>
<tr><td rowspan="4">19</td><td rowspan="4">Terminal
Strength</td><td>Appearance</td><td colspan="2">No marking defects</td><td rowspan="4">Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 3 using a eutectic solder. Then apply *18N force in parallel with the test jig for 60sec.
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.
*2N (GCM03/15)

Type | a | b | c
GCM03 | 0.3 | 0.9 | 0.3
GCM15 | 0.4 | 1.5 | 0.5
GCM18 | 1.0 | 3.0 | 1.2
GCM21 | 1.2 | 4.0 | 1.65
GCM31 | 2.2 | 5.0 | 2.0
GCM32 | 2.2 | 5.0 | 2.9
(in mm)

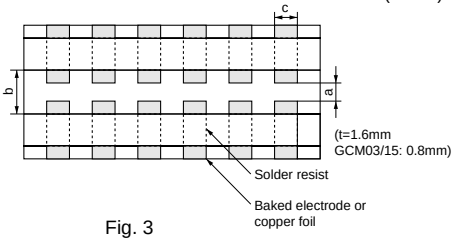
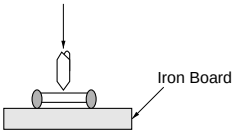
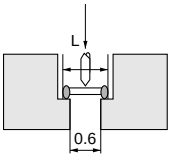
 

Fig. 3</td></tr>
<tr><td>Capacitance
Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.: Q≧1000
30pF max.: Q≧400+20C
C: Nominal Capacitance (pF)</td><td>*1
W.V.: 25Vmin.: 0.025 max.
W.V.: 16V: 0.035 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">*1
More than 10,000MΩ or 500Ω · F
(Whichever is smaller)</td></tr>
<tr><td>20</td><td colspan="2">Beam Load Test</td><td colspan="2">The chip endure following force.
< Chip L dimension: 2.5mm max. >
Chip thickness > 0.5mm rank: 20N
Chip thickness ≦ 0.5mm rank: 8N
< Chip L dimension: 3.2mm min. >
Chip thickness < 1.25mm rank: 15N
Chip thickness ≧ 1.25mm rank: 54.5N</td><td>Place the capacitor in the beam load fixture as Fig. 4.
Apply a force.
< Chip Length: 2.5mm max. >

Speed supplied the Stress Load: 0.5mm / sec.

< Chip Length: 3.2mm min. >

Speed supplied the Stress Load: 2.5mm / sec.

Fig. 4</td></tr>
</table>

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No.	AEC-Q200 Test Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric Type	AEC-Q200 Test Method
21	Capacitance Temperature Character-istics	Capacitance Change	Within the specified tolerance (Table A)	C7: Withn ±22% (-55°C to +125°C) R7: Withn ±15% (-55°C to +125°C)	The capacitance change should be measured after 5 min. at each specified temperature stage. (1) Temperature Compensating Type The temperature coefficient is determined using the capacitance measured in step 3 as a reference. When cycling the temperature sequentially from step1 through 5 (ΔC: +25°C to +125°C: other temp. coeffs.: +25°C to +85°C) the capacitance should be within the specified tolerance for the temperature coefficient and capacitance change as shown in Table A. The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in steps 1, 3 and 5 by the capacitance value in step 3.
		Temperature Coefficent	Within the specified tolerance (Table A)		
		Capacitance Drift	Within ±0.2% or ±0.05 pF (Whichever is larger) * Do not apply to 1X/25V		

Step	Temperature (°C)
1	25±2
2	-55±3
3	25±2
4	125±3
5	25±2

(2) High Dielectric Constant Type
The ranges of capacitance change compared with the above 25°C value over the temperature ranges shown in the table should be within the specified ranges.
· 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.

*1: The figure indicates typical inspection. Please refer to individual specifications.
*2: Some of the parts are applicable in rated voltage x 150%. Please refer to individual specifications.

Table A

Char.	Nominal Values (ppm/°C) Note1	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

Note 1: Nominal values denote the temperature coefficient within a range of 25°C to 125°C (for 5C)