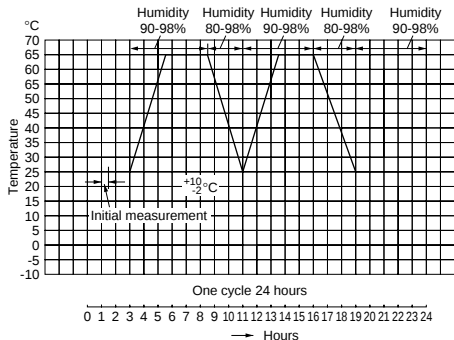


GCM Series Specification and Test Methods

No.	AEC-Q200 Test Item	Specifications		AEC-Q200 Test Method															
		Temperature Compensating Type	High Dielectric Type																
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 <table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp. (°C)</td><td>-55+0/-3</td><td>Room Temp.</td><td>125+3/-0 (ΔC/R7/C7)</td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>15±3</td><td>1</td><td>15±3</td><td>1</td></tr></table> • Initial measurement for high dielectric constant type Perform a heat treatment at 150 ± 5 °C for one hour and then let sit for 24±2 hours at room temperature. Perform the initial measurement.	Step	1	2	3	4	Temp. (°C)	-55+0/-3	Room Temp.	125+3/-0 (ΔC/R7/C7)	Room Temp.	Time (min.)	15±3	1	15±3	1
	Step	1	2		3	4													
	Temp. (°C)	-55+0/-3	Room Temp.		125+3/-0 (ΔC/R7/C7)	Room Temp.													
	Time (min.)	15±3	1		15±3	1													
	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+ $\frac{C}{2}$ 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+ $\frac{C}{3}$ 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+ $\frac{5}{C}$ C 10pFmax.: Q≥200+10C 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		
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 monomethyl ether 1 part (by volume) of monoethanolamine
		Capacitance Change	Within the specified tolerance		
		Q/D.F.	30pFmin.: Q≥1000 30pFmax.: Q≥400+20C C: Nominal Capacitance (pF)	W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max. *1	
		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)	W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max. *1	
		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)	W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max. *1	
		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±5°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)		W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max. *1
		I.R.	More than 10,000MΩ or 500Ω · 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											
14	Thermal Shock	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 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><td>Step</td><td>1</td><td>2</td></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 ⁺³ ₋₀ °C for one hour and then let sit for 24±2 hours at room temperature. Perform the initial measurement.	Step	1	2	Temp. (°C)	-55+0/-3	125+3/-0 (5C, C7, R7)	Time (min.)	15±3	15±3	
		Step	1		2									
		Temp. (°C)	-55+0/-3		125+3/-0 (5C, C7, R7)									
		Time (min.)	15±3		15±3									
		Appearance	No marking defects											
Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	Within ±10.0%												
Q/D.F.	30pF min.: Q≥1000 30pF max.: Q≥400+20C C: Nominal Capacitance (pF)	W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max. *1												
	I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller) *1												
15	ESD	Appearance	No marking defects		Per AEC-Q200-002									
		Capacitance Change	Within the specified tolerance											
		Q/D.F.	30pF min.: Q≥1000 30pF max.: Q≥400+20C C: Nominal Capacitance (pF)	W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max. *1										
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller) *1											
16	Solderability	95% of the terminations is to be soldered evenly and continuously.		(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.										
				(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.										
				(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.										
17	Electrical Characterization	Appearance	No defects or abnormalities		Visual inspection.									
		Capacitance Change	Within the specified tolerance		The capacitance/Q/D.F. should be measured at 25°C at the frequency and voltage shown in the table. (1) Temperature Compensating Type									
		Q/D.F.	30pF min.: Q≥1000 30pF max.: Q≥400+20C C: Nominal Capacitance (pF)	W.V.: 25V min.: 0.025 max. W.V.: 16V: 0.035 max *1	<table><tr><td>Capacitance</td><td>Frequency</td><td>Voltage</td></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>	Capacitance	Frequency	Voltage	C≤1000pF	1±0.1MHz	0.5 to 5Vrms	C>1000pF	1±0.1kHz	1±0.2Vrms
					Capacitance	Frequency	Voltage							
		C≤1000pF	1±0.1MHz	0.5 to 5Vrms										
		C>1000pF	1±0.1kHz	1±0.2Vrms										
(2) High Dielectric Type														
<table><tr><td>Capacitance</td><td>Frequency</td><td>Voltage</td></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>		Capacitance	Frequency	Voltage	C≤10μF	1±0.1kHz	1±0.2Vrms	C>10μF	120±24Hz	0.5±0.1Vrms				
Capacitance	Frequency	Voltage												
C≤10μF	1±0.1kHz	1±0.2Vrms												
C>10μF	120±24Hz	0.5±0.1Vrms												
I.R.	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)	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) *1	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.											
	Dielectric Strength	No failure		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.										

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No.	AEC-Q200 Test Item		Specifications		AEC-Q200 Test Method												
			Temperature Compensating Type	High Dielectric Type													
21	Capacitance Temperature Characteristics	Capacitance Change	Within the specified tolerance (Table A)	C7: Within $\pm 22\%$ (-55°C to +125°C) R7: Within $\pm 15\%$ (-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. <table><tr><th>Step</th><th>Temperature (°C)</th></tr><tr><td>1</td><td>25±2</td></tr><tr><td>2</td><td>-55±3</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>125±3</td></tr><tr><td>5</td><td>25±2</td></tr></table> (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.	Step	Temperature (°C)	1	25±2	2	-55±3	3	25±2	4	125±3	5	25±2
		Step	Temperature (°C)														
		1	25±2														
2	-55±3																
3	25±2																
4	125±3																
5	25±2																
Temperature Coefficient	Within the specified tolerance (Table A)																
Capacitance Drift	Within $\pm 0.2\%$ or ± 0.05 pF (Whichever is larger) * Do not apply to 1X/25V																

*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 $\pm$ 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).