

Medium-High Voltage Multilayer Ceramic Capacitor for General Electronic Equipment for Consumer
Medium-High Voltage Multilayer Ceramic Capacitor
for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

■ RELIABILITY DATA

1. Operating Temperature Range		
Specified Value	Temperature Compensating(Class1)	C0G, C0H : -55 to +125°C
	High Permittivity (Class2)	X7R, X7S : -55 to +125°C X5R : -55 to +85°C B : -25 to +85°C SD : -55 to +125°C
2. Storage Temperature Range		
Specified Value	Temperature Compensating(Class1)	C0G, C0H : -55 to +125°C
	High Permittivity (Class2)	X7R, X7S : -55 to +125°C X5R : -55 to +85°C B : -25 to +85°C SD : -55 to +125°C
3. Rated Voltage		
Specified Value	Temperature Compensating(Class1)	100VDC(Code:H)
	High Permittivity (Class2)	100VDC(Code:H), 250VDC(Code:Q), 630VDC(Code:S), 2000VDC(Code:X)
4. Withstanding Voltage (Between terminals)		
Specified Value	No breakdown or damage	
Test Methods and Remarks	Applied voltage : Rated voltage (H) × 2.5, Rated voltage (Q) × 2, Rated voltage (S, X) × 1.2 Duration : 1 to 5sec. Charge/discharge current : 50mA max.	
5. Insulation Resistance		
Specified Value	Temperature Compensating(Class1)	10000 MΩ min.
	High Permittivity (Class2)	100MΩ · μF or 10GΩ, whichever is smaller.
Test Methods and Remarks	Applied voltage : Rated voltage (H, Q), 500V (S, X) Duration : 60±5sec. Charge/discharge current : 50mA max.	
6. Capacitance (Tolerance)		
Specified Value	Temperature Compensating(Class1)	C ≤ 10pF : ±0.5pF C > 10pF : ±5% (C: Nominal capacitance)
	High Permittivity (Class2)	±10%, ±20%
Test Methods and Remarks	Temperature Compensating(Class1)	Measuring frequency : 1MHz ± 10% Measuring voltage : 0.5~5Vrms Bias application : None
	High Permittivity (Class2)	Measuring frequency : 1kHz ± 10%, 1MHz ± 10% (SD: 1608type(H), 2012type(Q)) Measuring voltage : 1 ± 0.2Vrms Bias application : None

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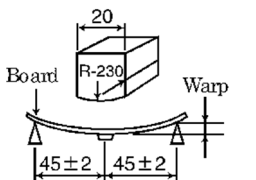
7. Q or Dissipation Factor

Specified Value	Temperature Compensating(Class1)	C < 30pF : Q ≥ 400 + 20C C ≥ 30pF : Q ≥ 1000 (C: Nominal capacitance)
	High Permittivity (Class2)	3.5%max(H: 1608type min), 2.5%max(H: 1005type,Q, S, X), 0.1type max (SD)
Test Methods and Remarks	Temperature Compensating(Class1)	Measuring frequency : 1MHz ± 10% Measuring voltage : 0.5 ~ 5Vrms Bias application : None
	High Permittivity (Class2)	Measuring frequency : 1kHz ± 10%, 1MHz ± 10% (SD:1608type(H), 2012type(Q)) Measuring voltage : 1 ± 0.2Vrms Bias application : None

8. Temperature Characteristic of Capacitance

Specified Value	Temperature Compensating(Class1)	C0G : 0 ± 30ppm/°C (-55 to +125°C) C0H : 0 ± 60ppm/°C (-55 ~ +125°C)											
	High Permittivity (Class2)	B : ± 10% (-25 to +85°C) X5R : ± 15% (-55 to +85°C) X7R : ± 15% (-55 to +125°C) X7S : ± 22% (-55 to +125°C)											
Test Methods and Remarks	<p>Class 1 Capacitance at 20°C and 85°C shall be measured in thermal equilibrium, and the temperature characteristic shall be calculated from the following equation.</p> $\frac{(C_{85} - C_{20})}{C_{20} \times \Delta T} \times 10^6 \text{ (ppm/°C)} \quad \Delta T = 65$												
	<p>Class 2 Capacitance at each step shall be measured in thermal equilibrium, and the temperature characteristic shall be calculated from the following equation.</p> <table border="1"> <thead> <tr> <th>Step</th> <th>B</th> <th>X5R, X7R, X7S</th> </tr> </thead> <tbody> <tr> <td>1</td> <td colspan="2">Minimum operating temperature</td> </tr> <tr> <td>2</td> <td>20°C</td> <td>25°C</td> </tr> <tr> <td>3</td> <td colspan="2">Maximum operating temperature</td> </tr> </tbody> </table> $\frac{(C - C_2)}{C_2} \times 100 \text{ (%)}$ <p>C : Capacitance value in Step 1 or Step 3 C2 : Capacitance value in Step 2</p>		Step	B	X5R, X7R, X7S	1	Minimum operating temperature		2	20°C	25°C	3	Maximum operating temperature
Step	B	X5R, X7R, X7S											
1	Minimum operating temperature												
2	20°C	25°C											
3	Maximum operating temperature												

9. Deflection

Specified Value	Temperature Compensating(Class1)	Appearance : No abnormality Capacitance change : Within ± 5% or ± 0.5 pF, whichever is larger.
	High Permittivity (Class2)	Appearance : No abnormality Capacitance change : ± 10%, ± 5%, (SD)
Test Methods and Remarks	<p>Warp : 1mm Duration : 10sec. Test board : Glass epoxy-resin substrate Thickness : 1.6mm</p>	 <p>(Unit: mm)</p> <p>Capacitance measurement shall be conducted with the board bent.</p>

10. Adhesive Strength of Terminal Electrodes

Specified Value	Temperature Compensating(Class1)	No terminal separation or its indication.
	High Permittivity (Class2)	
Test Methods and Remarks	Applied force : 5N	
	Duration : 30 ± 5sec.	

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11. Vibration			
Specified Value	Temperature Compensating(Class1)	Initial performance shall be satisfied.	
	High Permittivity (Class2)		
Test Methods and Remarks	Preconditioning : Thermal treatment(at 150°C for 1hr) Note1 (Only High permittivity)		
	Frequency range : 10 to 55 Hz		
	Overall amplitude : 1.5 mm		
	Sweeping method : 10 to 55 to 10 Hz for 1 min		
	Two hours each in X, Y, Z directions: 6 hrs in total		
12. Solderability			
Specified Value	Temperature Compensating(Class1)	At least 95% of terminal electrode is covered by new solder	
	High Permittivity (Class2)		
Test Methods and Remarks		Eutectic solder	Lead-free solder
	Solder type	H60A or H63A	Sn-3.0Ag-0.5Cu
	Solder temperature	230±5°C	245±3°C
	Duration	4±1 sec.	
13. Resistance to Soldering			
Specified Value	Temperature Compensating(Class1)	Appearance : No abnormality	
		Capacitance change : Within ±2.5% or ±0.25pF, whichever is larger.	
		Q : Initial value	
		Insulation resistance : Initial value	
		Withstanding voltage (between terminals) : No abnormality	
Specified Value	High Permittivity (Class2)	Appearance : No abnormality	
		Capacitance change : Within±7.5%(H: 1005type), ±15%(H: 1608type min) ±10%(Q, S, X), ±2.5%(SD)	
		Dissipation facto : Initial value	
		Insulation resistance : Initial value	
		Withstanding voltage (between terminals) : No abnormality	
Test Methods and Remarks	Temperature Compensating(Class1)		
	Preconditioning	None	
	Solder temperature	270±5°C	
	Duration	3±0.5sec.	
	Preheating conditions	80 to 100°C, 2 to 5 min. 150 to 200°C, 2 to 5min.	
	Recovery	24±2hrs under the standard condition Note3	
	High Permittivity (Class2)		
	Preconditioning	Thermal treatment(at 150°C for 1hr) Note1	
	Solder temperature	270±5°C	
	Duration	3±0.5sec.	
	Preheating conditions	80 to 100°C, 2 to 5 min.(2012type max), 5 to 10 min(3216type min) 150 to 200°C, 2 to 5min.(2012type max), 5 to 10 min(3216type min)	
	Recovery	24±2hrs under the standard condition Note3	

14. Temperature Cycle (Thermal Shock)

Specified Value	Temperature Compensating(Class1)	Appearance : No abnormality Capacitance change : Within $\pm 2.5\%$ or $\pm 0.25\text{pF}$, whichever is larger. Q : Initial value Insulation resistance : Initial value Withstanding voltage (between terminals) : No abnormality	
	High Permittivity (Class2)	Appearance : No abnormality Capacitance change : Within $\pm 7.5\%$ (H: 1005type), $\pm 15\%$ (H: 1608type min) $\pm 10\%$ (Q, S, X), $\pm 2.5\%$ (SD) Dissipation facto : Initial value Insulation resistance : Initial value Withstanding voltage (between terminals) : No abnormality	
Test Methods and Remarks	Class 1		
	Preconditioning	None	
	1 cycle	Step	Temperature ($^{\circ}\text{C}$)
		1	Minimum operating temperature
		2	Normal temperature
		3	Maximum operating temperature
4	Normal temperature		
Time (min.)	30 \pm 3		
Number of cycles	5 times		
Recovery	24 \pm 2 hrs (Standard condition) Note 3		

15. Humidity (Steady state)

Specified Value	Temperature Compensating(Class1)	Appearance : No abnormality Capacitance change : Within $\pm 5\%$ or $\pm 0.5\text{pF}$, whichever is larger. Q : $C < 10\text{pF} : Q \geq 200 + 10C$ $10 \leq C < 30\text{pF} : Q \geq 275 + 2.5C$ $C \geq 30\text{pF} : Q \geq 350$ (C:Nominal capacitance) Insulation resistance : 1000 M Ω min.
	High Permittivity (Class2)	Appearance : No abnormality Capacitance change : $\pm 12.5\%$ max(1005type), $\pm 15\%$ max(1608type min), $\pm 5\%$ max(SD) Dissipation factor : 5%max(H: 1005type,Q, S, X), 7%max(H: 1608type min), 0.5%max(SD). Insulation resistance : 25M Ω μF or 1000M Ω , whichever is smaller.
Test Methods and Remarks	Preconditioning	: Thermal treatment(at 150 $^{\circ}\text{C}$ for 1hr) Note1 (Only High permittivity)
	Temperature	: 40 \pm 2 $^{\circ}\text{C}$
	Humidity	: 90 to 95%RH
	Duration	: 500 +24/-0 hrs
	Recovery	: 24 \pm 2hrs under the standard condition Note3

16. Humidity Loading

Specified Value	Temperature Compensating(Class1)	Appearance : No abnormality Capacitance change : Within $\pm 7.5\%$ or $\pm 0.75\text{pF}$, whichever is larger Q : $C < 30\text{pF} : Q \geq 100 + 10C/3$ $C \geq 30\text{pF} : Q \geq 200$ (C:Nominal capacitance) Insulation resistance : 500 M Ω min.
	High Permittivity (Class2)	Appearance : No abnormality Capacitance change : $\pm 12.5\%$ max(1005type), $\pm 15\%$ max(1608type min), $\pm 7.5\%$ max(SD) Dissipation factor : 5%max(H: 1005type,Q, S, X), 7%max(H: 1608type min), 0.5%max(SD) Insulation resistance : 10M Ω μF or 500M Ω , whichever is smaller.
Test Methods and Remarks	Preconditioning	: Voltage treatment(Rated voltage are applied for 1 hour at 40 $^{\circ}\text{C}$)Note 2 (Only High permittivity)
	Temperature	: 40 \pm 2 $^{\circ}\text{C}$
	Humidity	: 90 to 95%RH
	Duration	: 500 +24/-0 hrs
	Applied voltage	: Rated voltage
	Charge/discharge current	: 50mA max.
	Recovery	: 24 \pm 2hrs under the standard condition Note3

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17. High Temperature Loading

Specified Value	Temperature Compensating(Class1)	Appearance : No abnormality Capacitance change : Within $\pm 3\%$ or $\pm 0.3\text{pF}$, whichever is larger Q : $C < 10\text{pF}$: $Q \geq 200 + 10C$ $10 \leq C < 30\text{pF}$: $Q \geq 275 + 2.5C$ $C \geq 30\text{pF}$: $Q \geq 350$ (C:Nominal capacitance) Insulation resistance : $1000 \text{ M}\Omega$ min.
	High Permittivity (Class2)	Appearance : No abnormality Capacitance change : $\pm 12.5\% \text{max}(1005\text{type})$, $\pm 15\% \text{max}(1608\text{type min})$, $\pm 3\% \text{max}(SD)$ Dissipation factor : $5\% \text{max}(H: 1005\text{type}, Q, S, X)$, $7\% \text{max}(H: 1608\text{type min})$, $0.35\% \text{max}(SD)$ Insulation resistance : $50 \text{ M}\Omega \mu\text{F}$ or $1000 \text{ M}\Omega$, whichever is smaller.
Test Methods and Remarks	Preconditioning : Voltage treatment(Twice the rated voltage shall be applied for 1 hour at 85°C or 125°C) Note 2 (Only High permittivity) Temperature : Maximum operating temperature Duration : $1000 + 24/-0$ hrs Applied voltage : Rated voltage(H) $\times 2$, Rated voltage(Q) $\times 1.5$, Rated voltage $\times 1.2$ (S, X) $\times 1.2$ Charge/discharge current : 50mA max. Recovery : 24 ± 2 hrs under the standard condition Note3	
Note1 Thermal treatment : Initial value shall be measured after test sample is heat-treated at $150 \pm 0/-10^\circ\text{C}$ for an hour and kept at room temperature for 24 ± 2 hours. Note2 Voltage treatment : Initial value shall be measured after test sample is voltage-treated for an hour at both the temperature and voltage specified in the test conditions, and kept at room temperature for 24 ± 2 hours. Note3 Standard condition : Temperature: 5 to 35°C , Relative humidity: 45 to 85% RH, Air pressure: 86 to 106kPa When there are questions concerning measurement results, in order to provide correlation data, the test shall be conducted under the following condition. Temperature: $20 \pm 2^\circ\text{C}$, Relative humidity: 60 to 70% RH, Air pressure: 86 to 106kPa Unless otherwise specified, all the tests are conducted under the "standard condition".		