Medium-High Voltage Multilayer Ceramic Capacitor for General Purpose

■RELIABILITY DATA

1. Operating Temperature Range		
Specified Value	Temperature Compensating(Class1)	C0G, C0H : −55 to +125℃
	High Permittivity (Class2)	X7R, X7S : −55 to +125℃ X5R : −55 to +85℃ B : −25 to +85℃ SD : −55 to +125℃

2. Storage Temperature Range		
Specified Value	Temperature Compensating(Class1)	C0G, C0H : −55 to +125℃
	High Permittivity (Class2)	X7R, X7S : −55 to +125℃ X5R : −55 to +85℃ B : −25 to +85℃ SD : −55 to +125℃

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 Duration Charge/discharge current	: Rated voltage(H)×2.5, Rated voltage(Q)×2, Rated voltage(S, X)×1.2 : 1 to 5sec. : 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 Duration Charge/discharge current	: Rated voltage(H, Q), 500V(S, X) : 60±5sec. : 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

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/℃(−55 to +125℃) C0H :0±60ppm/℃(−55～+125℃)
	High Permittivity (Class2)	B : ±10%(−25 to +85℃) X5R : ±15%(−55 to +85℃) X7R : ±15%(−55 to +125℃ X7S : ±22%(−55 to +125℃)
Test Methods and Remarks	Class 1 Capacitance at 20℃ and 85℃ shall be measured in thermal equilibrium, and the temperature characteristic shall be calculated from the following equation. $\frac{(C_{85}-C_{20})}{C_{20}\times\Delta T}\times 10^6(\mathrm{ppm/℃})$ $\Delta T=65$ Class 2 Capacitance at each step shall be measured in thermal equilibrium, and the temperature characteristic shall be calculated from the following equation.	

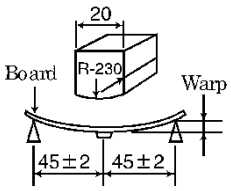
Step	B	X5R、X7R、X7S
1	Minimum operating temperature	
2	20℃	25℃
3	Maximum operating temperature	

$\frac{(C-C_2)}{C_2}\times 100(\%)$

C : Capacitance value in Step 1 or Step 3

C2 : Capacitance value in Step 2

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	Warp : 1mm Duration : 10sec. Test board : Glass epoxy-resin substrate Thickness : 1.6mm Capacitance measurement shall be conducted with the board bent.	 (Unit: mm)

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.	

11. Vibration

Specified Value	Temperature Compensating(Class1)	Initial performance shall be satisfied.
	High Permittivity (Class2)	

Test Methods and Remarks	Preconditioning : Thermal treatment (at 150℃ 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) High Permittivity (Class2)	At least 95% of terminal electrode is covered by new solder

Test Methods and Remarks

	Eutectic solder	Lead-free solder
Solder type	H60A or H63A	Sn-3.0Ag-0.5Cu
Solder temperature	230±5℃	245±3℃
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
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℃
Duration	3±0.5sec.
Preheating conditions	80 to 100℃, 2 to 5 min. 150 to 200℃, 2 to 5min.
Recovery	24±2hrs under the standard condition Note3

	High Permittivity (Class2)
Preconditioning	Thermal treatment (at 150℃ for 1hr) Note1
Solder temperature	270±5℃
Duration	3±0.5sec.
Preheating conditions	80 to 100℃, 2 to 5 min. (2012type max), 5 to 10 min(3216type min) 150 to 200℃, 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 ±2.5% or ±0.25pF, 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±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

	Class 1	Class 2
Preconditioning	None	Thermal treatment （at 150℃ for 1 hr） Note 1
1 cycle	Step 1: Minimum operating temperature, 30±3 Step 2: Normal temperature, 2 to 3 Step 3: Maximum operating temperature, 30±3 Step 4: Normal temperature, 2 to 3	
Number of cycles	5 times	
Recovery	24±2 hrs （Standard condition） Note 3	

15. Humidity （Steady state）

Specified Value	Temperature Compensating(Class1)	Appearance : No abnormality Capacitance change : Within ±5% or ±0.5pF, whichever is larger. Q : C＜10pF : Q≧200＋10C 10≦C＜30pF : Q≧275＋2.5C C≧30pF:Q≧350 （C:Nominal capacitance） Insulation resistance : 1000 MΩ min.
	High Permittivity （Class2）	Appearance : No abnormality Capacitance change :±12.5%max(1005type), ±15%max(1608type min), ±5%max(SD) Dissipation factor : 5%max(H: 1005type,Q, S, X), 7%max(H: 1608type min), 0.5%max(SD). Insulation resistance : 25MΩ μF or 1000MΩ, whichever is smaller.

Test Methods and Remarks

Preconditioning : Thermal treatment(at 150℃ for 1hr) Note1 (Only High permittivity)
Temperature : 40±2℃
Humidity : 90 to 95%RH
Duration : 500 ＋24/－0 hrs
Recovery : 24±2hrs under the standard condition Note3

16. Humidity Loading

Specified Value	Temperature Compensating(Class1)	Appearance : No abnormality Capacitance change : Within ±7.5% or ±0.75pF, whichever is larger Q : C＜30pF:Q≧100＋10C/3 C≧30pF:Q≧200 （C:Nominal capacitance） Insulation resistance : 500 MΩ min.
	High Permittivity （Class2）	Appearance : No abnormality Capacitance change :±12.5%max(1005type), ±15%max(1608type min), ±7.5%max(SD) Dissipation factor : 5%max(H:1005type,Q, S, X), 7%max(H:1608type min), 0.5%max(SD) Insulation resistance : 10MΩ μF or 500MΩ, whichever is smaller.

Test Methods and Remarks

Preconditioning : Voltage treatment(Rated voltage are applied for 1 hour at 40℃)Note 2 (Only High permittivity)
Temperature : 40±2℃
Humidity : 90 to 95%RH
Duration : 500 ＋24/－0 hrs
Applied voltage : Rated voltage
Charge/discharge current : 50mA max.
Recovery : 24±2hrs under the standard condition Note3

17. High Temperature Loading

Specified Value	Temperature Compensating(Class1)	Appearance : No abnormality Capacitance change : Within ±3% or ±0.3pF, whichever is larger

		Q : C＜10pF： Q≧200＋10C 10≦C＜30pF： Q≧275＋2.5C C≧30pF： Q≧350 （C：Nominal capacitance） Insulation resistance : 1000 MΩ min.
	High Permittivity （Class2）	Appearance : No abnormality Capacitance change :±12.5%max（1005type）, ±15%max（1608type min）, ±3%max（SD） Dissipation factor : 5%max（H：1005type,Q, S, X）, 7%max（H：1608type min）, 0.35%max（SD） Insulation resistance : 50MΩ μF or 1000MΩ, whichever is smaller.
Test Methods and Remarks	Preconditioning : Voltage treatment（Twice the rated voltage shall be applied for 1 hour at 85℃ or 125℃） Note 2 （Only High permittivity） Temperature : Maximum operating temperature Duration : 1000 ＋24/－0 hrs Applied voltage : Rated voltage(H)×2, Rated voltage（Q）×1.5, Rated voltage×1.2（S, X）×1.2 Charge/discharge current : 50mA max. Recovery : 24±2hrs under the standard condition Note3	

Note1 Thermal treatment : Initial value shall be measured after test sample is heat-treated at 150＋0/－10℃ for an hour and kept at room temperature for 24±2hours.

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±2hours.

Note3 Standard condition : Temperature: 5 to 35℃, 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±2℃, Relative humidity: 60 to 70 % RH, Air pressure: 86 to 106kPa
Unless otherwise specified, all the tests are conducted under the ″standard condition″.