HIGH VOLTAGE CERAMIC CAPACITOR 250V–6.3kV

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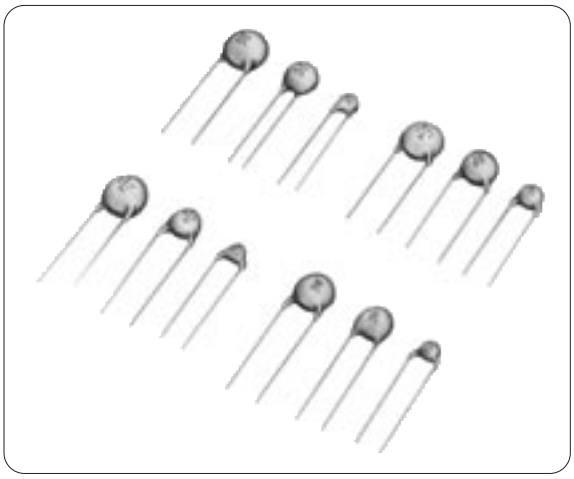


muRata *Innovator in Electronics*

Murata Manufacturing Co., Ltd.

Cat.No.C84E-6

■ CONTENTS

■ GENERAL DESCRIPTION OF CERAMIC CAPACITORS

Ceramic capacitor is a sandwich of two sheets of electrode with a middle layer of titanium oxide (TiO_2) or barium titanate ($BaTiO_3$) between two electrodes. Special features include high reliability, compact size, large capacitance, excellent high-frequency characteristics, and simple mass production. Furthermore, their low cost enables wide application in electronic circuits designed for by-pass, coupling, and resonant functions.

Ceramic capacitors are divided into two distinctive types according to structure—monolithic and disk type. The latter type is available in a larger variety, with rated voltages of 50V,250V, 500V, 1kV, 2kV, 3.15kV, and 6.3kV, besides AC voltage. Murata has meanwhile developed its original BC capacitors—semiconductive ceramic capacitors which are much more compact in size and much larger in capacitance than conventional ceramic capacitors. BC capacitors are available in rated voltages of 12V, 16V, 25V, and 50V.

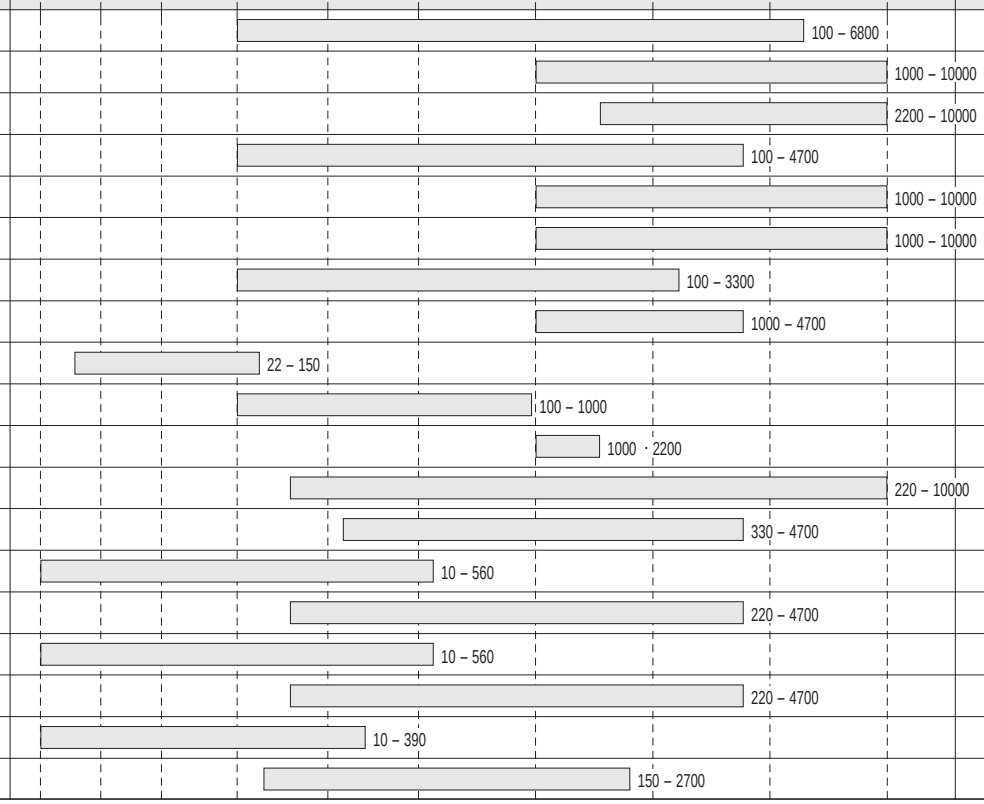
■ MURATA'S DISC TYPE CERAMIC CAPACITORS

DESCRIPTION	SERIES	TYPE 1	TYPE 2	TYPE 3	RATED VOLTAGE	CAPACITANCE RANGE (pF)
CERAMIC CAPACITOR	DD100 DD10	○	○	–	50V 500V	1 – 47000
BC CAPACITOR	DD300 DD400	–	–	○	12V 16V 25V 50V	1000 – 470000
HIGH-VOLTAGE CERAMIC CAPACITOR	CONVENTIONAL HIGH-VOLTAGE HR	○	○	○	250V 500V 1kV 2kV 3.15kV 6.3kV	10 – 10000
SAFETY STANDARD RECOGNIZED CERAMIC CAPACITOR	KH KX MX PRODUCTS WHICH ARE BASED ON THE STANDARDS OF THE ELECTRICAL APPLIANCE AND MATERIAL CONTROL LAW OF JAPAN	–	○	–	125VAC 250VAC	100 – 10000

■ MURATA'S HIGH VOLTAGE DISC TYPE CERAMIC CAPACITORS

1. Table of Capacitance Range

	Rated Voltage (VDC)	Temp. Char.	Nominal Capacitance rang (pF)
Conventional High Voltage	1k	B	100 – 6800
		E	1000 – 10000
		F	2200 – 10000
	2k	B	100 – 4700
		E	1000 – 10000
		F	1000 – 10000
	3.15k	B	100 – 3300
		E	1000 – 4700
	6.3k	SL	22 – 150
		B	100 – 1000
		E	1000 · 2200
HR Series	250	R	220 – 10000
	500	C	330 – 4700
	1k	SL	10 – 560
		R	220 – 4700
	2k	SL	10 – 560
		R	220 – 4700
	3.15k	SL	10 – 390
		R	150 – 2700

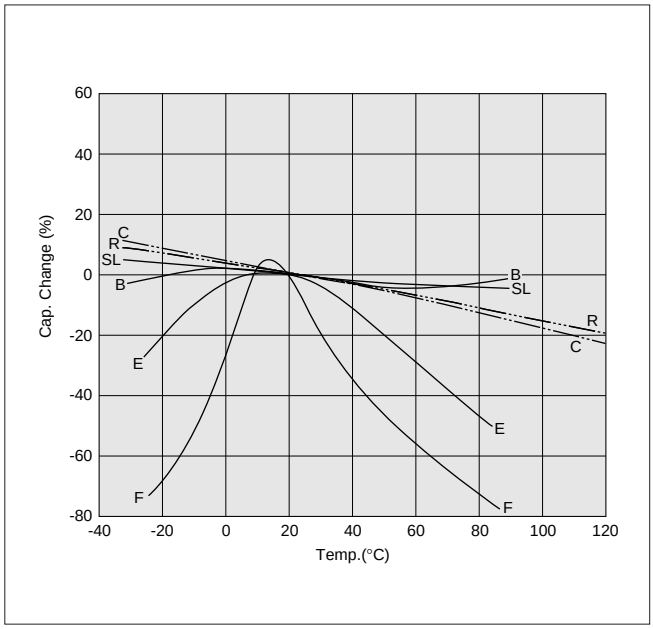


· In case commercial AC voltage is applied, Murata's Safety Standard Recognized Capacitors are Recommended.

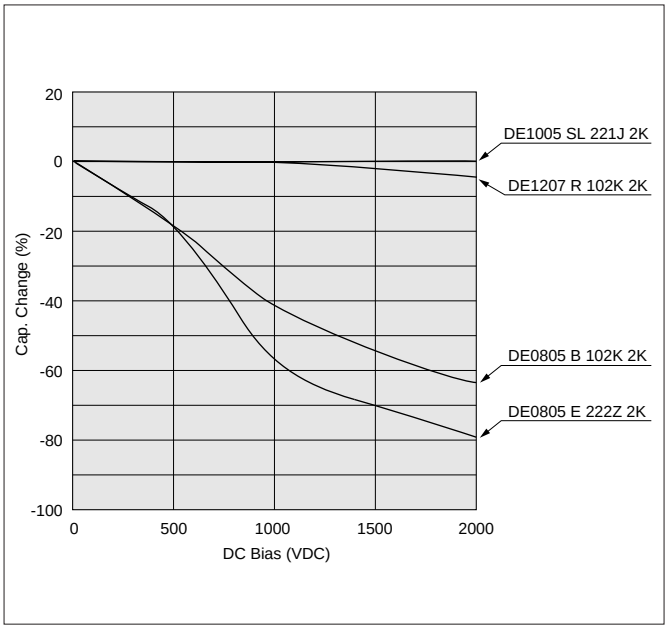
	Photo	Special Feature and Application Fields
		· Large assortment of rated voltages from 1kV DC to 6.3kV DC, in combination with temperature characteristics SL, B, E, and F, this series permits wide application in meeting consumer requirements. · Each component in the series is coated with flame-retardant epoxy resin (equivalent to UL94V-0 standards).
		· For pulse circuit. · Operating temperature range guaranteed up to 125 °C. · Low dielectric loss; reduced heat dissipation. · Recommended especially for snubber circuits in switching power supplies. · Each component in the series is coated with flame-retardant epoxy resin (equivalent to UL94V-0 standards).

2. Characteristics Data

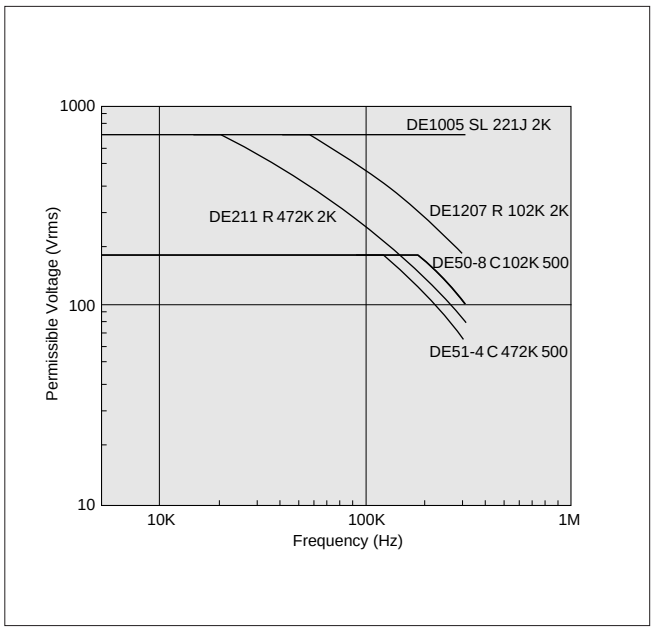
■Capacitance—Temp. Char.



■DC Bias Char.



■Power Capacity



The maximum amplitude value or AC voltage or pulse voltage is determined by the permissible voltage of the capacitor.
Please consult us for further information.

3. Part Numbering (✻Please specify the part number when ordering.)

(Example) **DE0405** **-979** **B** **101** **K** **1K**
❶ ❷ ❸ ❹ ❺ ❻

❶Type

Series	Code
Conventional high voltage	DE×××× The first two digits denote maximum body diameter ; the next two digits denote lead space. (Example) DE04 05 — Lead space : 5mm; Maximum body dia. : 4.5mm
HR series	≪Rated voltage : 1 to 3.15kVDC≫ DE×××× The first two digits denote maximum body diameter ; the next two digits denote lead space. (Example) DE04 05 — Lead space : 5mm; Maximum body dia : 4.5mm
	≪Rated voltage : 250VDC≫ DE5×× ×× : Maximum body diameter (Example) DE5 10 — Maximum body dia. : 10mm
	≪Rated voltage : 500VDC≫ DE5×−× ×−× : Maximum body diameter (Example) DE5 1-0 — Maximum body dia. : 10mm

❷Lead Configuration

Code	Configuration
No Code	Straight Long
-1	Straight Short
-979 -486 -477	Straight Taping

❸Temperature Characteristics

Code	Cap. Change or Temp. Coef.	Temp.Range(°C)
SL	+350 to −1000 (ppm/°C)	+20 to + 85
B	Within±10%	−25 to + 85
R	Within±15%	−25 to + 85
	Within±$^{15}_{30}$%	+85 to +125
C	Within±20%	−25 to + 85
	Within±$^{15}_{30}$%	+85 to +125
E	Within±$^{20}_{55}$%	−25 to + 85
F	Within±$^{30}_{80}$%	−25 to + 85

❹Capacitance

The first two digits denote significant figures ; the last digit denotes the multiplier of 10 in pF.
(Example)
472 = 47×10^2 = 4700pF

❺Capacitance Tolerance

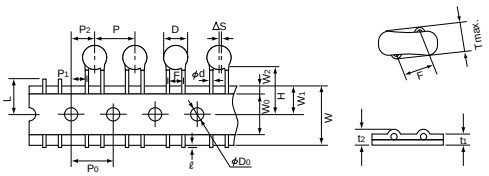
Code	Tolerance
D	±0.5pF
J	±5%
K	±10%
Z	+$^{80}_{20}$%

❻Rated Voltage

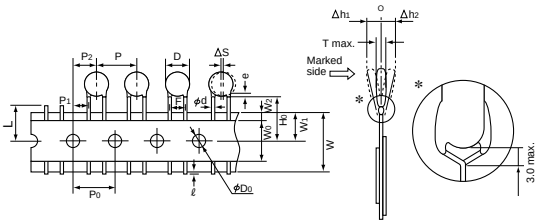
Code	Rated Voltage (VDC)
250	250
500	500
1K	1k
2K	2k
3K	3.15k
6K	6.3k

4. Taping Specification

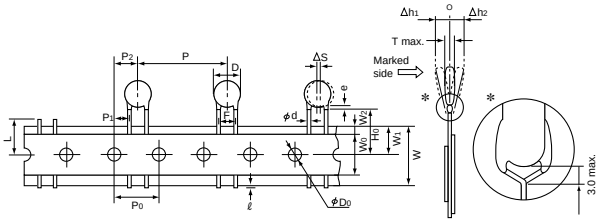
●15.0mm pitch/lead spacing 7.5mm taping
(Lead Code : -486) ✻Dia. ϕ 6mm and under



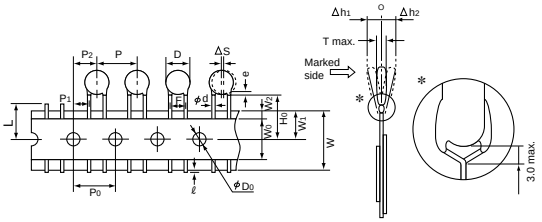
●15.0mm pitch/lead spacing 7.5mm taping
(Lead Code : -486) Vertical crimped type
✻Except for Dia. ϕ 6mm and under



●30.0mm pitch/lead spacing 7.5mm taping
(Lead Code : -477) Vertical crimped type



●12.7mm pitch / lead spacing 5.0mm taping
(Lead Code : —979) Vertical crimped type



✻Apply to Dia. ϕ 6mm and under.

Item	Code	—486	—477	—979
Pitch of component	P	15.0	30.0	12.7
Pitch of sprocket hole	P_0	15.0±0.3		12.7±0.3
Lead spacing	F	7.5±1.0		$5.0^{+0.8}_{-0.2}$
Length from hole center to component center	P_2	7.5±1.5		6.35±1.3
Length from hole center to lead	P_1	3.75±1.0		3.85±0.7
Body diameter	D	See the individual product specification		
Deviation along tape, left or right	ΔS	0±2.0		0±1.0
Carrier tape width	W	18.0±0.5		
Position of sprocket hole	W_1	9.0±0.5		
Lead distance between reference and bottom planes	H	$20.0^{+1.5}_{-1.0}$		———
	H_0	$18.0^{+2.0}_{-0}$		
Protrusion length	ℓ	+0.5 to −1.0		
Diameter of sprocket hole	ϕD_0	4.0±0.1		
Lead diameter	ϕd	$0.6^{+0.06}_{-0.05}$		
Total tape thickness	t_1	0.6±0.3		
Total thickness, tape and lead wire	t_2	1.5 max.		
Body thickness	T	See the individual product specification		
Portion to cut in case of defect	L	$11.0^{+0}_{-1.0}$		
Hold down tape width	W_0	11.5 min.		
Hold down tape position	W_2	1.5±1.5		
Coating extension on lead	e	3.0max. (Vertical crimped type : Up to the end of crimp)		
Deviation across tape	Δh_1	2.0 max.		1.0 max.
	Δh_2			

5. Packaging Styles

Bulk	Taping
Polyethylene Bag	Flat Pack
	

■MINIMUM QUANTITY (Order in Sets Only)

[Bulk] 1,000 pcs.
[Taping]
1,500 pcs. (Lead Code : —979)
1,000 pcs. (Lead Code : —486✻)
500 pcs. (Lead Code : —477)
✻900 pcs. for 2kV and 3.15kV

■MINIMUM ORDER QUANTITY

2,000 pcs.

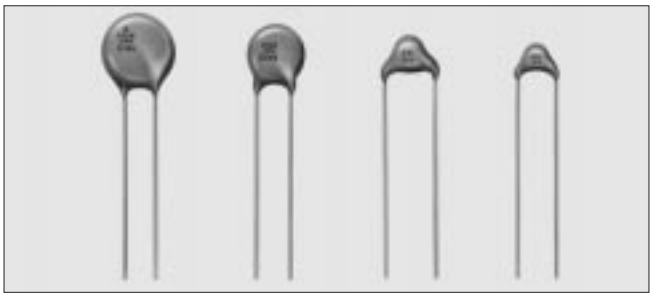
✻ “Minimum Quantity” means the numbers of units of each delivery or order. The quantity should be an integral multiple of the “minimum quantity” . (Please note that the actual delivery quantity in a package may change sometimes.)

HIGH VOLTAGE CERAMIC CAPACITOR

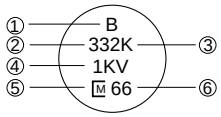
TC / HiK High Voltage Ceramic Capacitors

■FEATURES

1. Extremely small diameter to ϕ4.5mm.
2. Lead distance of 1kV and 2kV is 5mm, marking it well-suited to high density mounting.
3. Coated with flame-retardant epoxy resin (equivalent to UL94V-0 standards.)
4. Automatic insertion can be, and save costs.

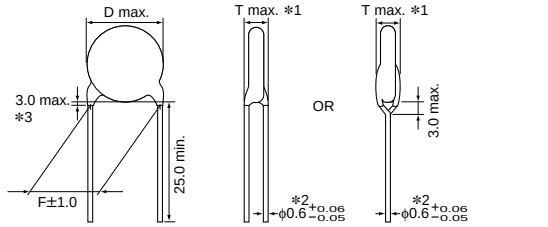
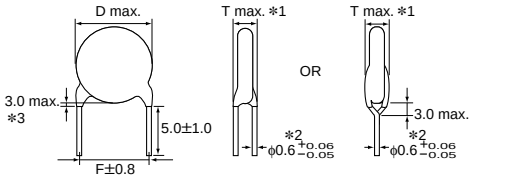


■MARKING

Example	Item
	①Temperature Characteristic [Identified by code for B and E (Rated voltage 3.15kV and under .) Omitted for maximum body diameter ϕ9mm and under.]
	②Nominal Capacitance (Under 100pF : Actual value, 100pF and over : Identified by 3 figures code.)
	③Capacitance Tolerance (Omitted for maximum body diameter ϕ6mm and under.)
	④Rated Voltage (For 3.15kV...3kV, 6.3kV...6kV)
	⑤Manufacter's Identification (Omitted for maximum body diameter ϕ9mm and under.)
	⑥Manufactured Date Code (Omitted for maximum body diameter ϕ9mm and under.)

■DIMENSION

•Bulk

Configuration	Straight Long	Straight Short
Lead Code	No Code	−1
Dimension (in mm)		

· Please see "STANDARD LIST" on nominal body diameter (D) and lead spacing (F) .

∗1 Thickness of Body(T)

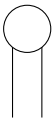
Rated Voltage (VDC)	Thickness of Body T (mm)
1k	4.0
2k	5.0
3.15k	6.0
6.3k	7.0

∗2 ϕ0.5±0.05mm in case of nominal body diameter ϕ5mm and under (Type : DE04□,DE05□) .

∗3 Vertical crimped type : Up to the end of crimp.

■STANDARD LIST Conventional High-Voltage

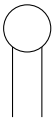
SL Characteristic

Nominal Capacitance (pF)	Max. Body Dia. D(mm)	Lead Spacing F(mm)	Rated Voltage (kVDC)	Part Number (□ : means optional lead code shown on the right.)	Lead Configuration / Lead Code: Straight Long 
22	9	10.0	6.3	DE0910 □ SL 220 J 6K	No Code
27				DE0910 □ SL 270 J 6K	
33				DE0910 □ SL 330 J 6K	
39				DE0910 □ SL 390 J 6K	
47				DE0910 □ SL 470 J 6K	
56	10			DE1010 □ SL 560 J 6K	
68	12			DE1210 □ SL 680 J 6K	
82				DE1210 □ SL 820 J 6K	
100	13			DE1310 □ SL 101 J 6K	
120	14			DE1410 □ SL 121 J 6K	
150	15			DE1510 □ SL 151 J 6K	

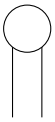
•Please contact us for details.

•Please see page 13 for SL char (1 to 3.15kV) .

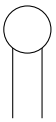
B Characteristic

Nominal Capacitance (pF)	Max. Body Dia. D(mm)	Lead Spacing F(mm)	Rated Voltage (kVDC)	Part Number (□ : means optional lead code shown on the right.)	Lead Configuration / Lead Code: Straight Long 	Straight Short 	Taping: Lead spacing F : 5.0, Pitch of component P : 12.7 	Taping: Lead spacing F : 7.5, Pitch of component P : 15.0 	Taping: Lead spacing F : 7.5, Pitch of component P : 30.0 
100	4.5	5.0	1	DE0405 □ B 101 K 1 K	No Code	−1	−979	–	–
150				DE0405 □ B 151 K 1 K					
220				DE0405 □ B 221 K 1 K					
330				DE0405 □ B 331 K 1 K					
470	5			DE0505 □ B 471 K 1 K					
680	6			DE0605 □ B 681 K 1 K					
1000				DE0605 □ B 102 K 1 K					
1500	8			DE0805 □ B 152 K 1 K					
2200	9			DE0905 □ B 222 K 1 K					
3300	10			DE1005 □ B 332 K 1 K					
4700	12	7.5		DE1207 □ B 472 K 1 K			–	−486	
6800	15			DE1507 □ B 682 K 1 K				–	−477
100	4.5	5.0	2	DE0405 □ B 101 K 2 K			−979	–	–
150				DE0405 □ B 151 K 2 K					
220				DE0405 □ B 221 K 2 K					
330	5			DE0505 □ B 331 K 2 K					
470	6			DE0605 □ B 471 K 2 K					
680	7			DE0705 □ B 681 K 2 K					
1000	8			DE0805 □ B 102 K 2 K					
1500	9			DE0905 □ B 152 K 2 K					
2200	10			DE1005 □ B 222 K 2 K					
3300	12	7.5		DE1207 □ B 332 K 2 K			–	−486	
4700	15			DE1507 □ B 472 K 2 K				–	−477
100	5	7.5	3.15	DE0507 □ B 101 K 3 K			–	−486	–
150				DE0507 □ B 151 K 3 K					
220				DE0507 □ B 221 K 3 K					
330	6			DE0607 □ B 331 K 3 K					
470	7			DE0707 □ B 471 K 3 K					
680	8			DE0807 □ B 681 K 3 K					
1000	9			DE0907 □ B 102 K 3 K					
1500	11			DE1107 □ B 152 K 3 K					
2200	13			DE1307 □ B 222 K 3 K					
3300	15			DE1507 □ B 332 K 3 K					−477
100	9	10.0	6.3	DE0910 □ B 101 K 6 K		–	–	–	–
150				DE0910 □ B 151 K 6 K					
220				DE0910 □ B 221 K 6 K					
330				DE0910 □ B 331 K 6 K					
470	10			DE1010 □ B 471 K 6 K					
680	11			DE1110 □ B 681 K 6 K					
1000	13			DE1310 □ B 102 K 6 K					

E Characteristic

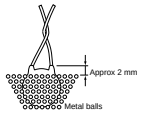
Nominal Capacitance (pF)	Max. Body Dia. D(mm)	Lead Spacing F(mm)	Rated Voltage (kVDC)	Part Number (□ : means optional lead code shown on the right.)	Lead Configuration / Lead Code				
					Straight Long	Straight Short	Taping		
							 Lead spacing F : 5.0 Pitch of component P : 12.7	 Lead spacing F : 7.5 Pitch of component P : 15.0	 Lead spacing F : 7.5 Pitch of component P : 30.0
1000	5	5.0	1	DE0505 □ E 102 Z 1 K	No Code	−1	−979	−	−
2200	7			DE0705 □ E 222 Z 1 K					
4700	9			DE0905 □ E 472 Z 1 K					
10000	13	7.5		DE1307 □ E 103 Z 1 K			−	−486	
1000	6	5.0	2	DE0605 □ E 102 Z 2 K			−979	−	
2200	8			DE0805 □ E 222 Z 2 K					
4700	11			DE1105 □ E 472 Z 2 K					
10000	16	7.5		DE1607 □ E 103 Z 2 K			−		−477
1000	7	7.5	3.15	DE0707 □ E 102 Z 3 K			−	−486	−
2200	10			DE1007 □ E 222 Z 3 K					
4700	13			DE1307 □ E 472 Z 3 K					
1000	11	10.0	6.3	DE1110 □ E 102 Z 6 K		−		−	
2200	15			DE1510 □ E 222 Z 6 K					

F Characteristic

Nominal Capacitance (pF)	Max. Body Dia. D(mm)	Lead Spacing F(mm)	Rated Voltage (kVDC)	Part Number (□ : means optional lead code shown on the right.)	Lead Configuration / Lead Code			
					Straight Long	Straight Short	Taping	
							 Lead spacing F : 5.0 Pitch of component P : 12.7	 Lead spacing F : 7.5 Pitch of component P : 15.0
2200	6	5.0	1	DE0605 □ F 222 Z 1K	No Code	−1	−979	−
4700	7			DE0705 □ F 472 Z 1K				
10000	10			DE1005 □ F 103 Z 1K				
1000	5	5.0	2	DE0505 □ F 102 Z 2K				
2200	7			DE0705 □ F 222 Z 2K				
4700	9			DE0905 □ F 472 Z 2K				
10000	12	7.5		DE1207 □ F 103 Z 2K			−	−486

Please contact us for details.

■SPECIFICATION AND TEST METHOD

	Item		Specification: Temp. Compensating	Specification: High Dielectric Constant	Testing Method
1	Operating Temperature Range		−25 to +85℃	−25 to +85℃	———
2	Capacitance		Within the specified tolerance.	Within the specified tolerance.	The capacitance shall be measured at 20℃ with 1±0.2kHz (SL : 1±0.2MHz) and 5Vrms max.
3	Q Dissipation Factor (D. F.)		SL: C≧30pF : Q≧1000; C<30pF : Q≧400+20C[1)]	B, E: D. F.≦2.5%; F: D. F.≦5.0%	Same condition as capacitance.
4	Insulation Resistance (I. R.)	Between Lead wires	10000MΩ min.	10000MΩ min.	The insulation resistance shall be measured with 500±50VDC within 60±5 sec. of charging.
5	Dielectric Strength	Between Lead wires	No failure.	No failure.	The capacitors shall not be damage when DC voltage of 200% of the rated voltage are applied between the lead wires for 1 to 5 sec. (Charge/discharge current≦50mA)
		Body Insulation	No failure.	No failure.	The capacitor is placed in the container with metal balls of diameter 1mm so that each lead wire, shortcircuited, is kept approximately 2mm off the balls as shown in the figure, and DC voltages of 1.3kV is applied for 1 to 5 sec. between capacitor lead wires and small metals. (Charge / discharge current≦50mA) 
6	Temperature Characteristic		T. C.: SL — Temp. Coefficient: +350 to −1000pm / ℃ (Temp. Range : +20 to +85℃)	T.C.: B — Cap. Change: within±10%; E — within$^{+20}_{-55}$%; F — within$^{+30}_{-80}$%	The capacitance measurement shall be made at each step specified in table. Capacitance change from the value of step 3 shall not exceed the limit specified. Step: 1 (20±2℃), 2 (−25±3℃), 3 (20±2℃), 4 (85±2℃), 5 (20±2℃). Pre-treatment : Capacitor shall be stored at 85±2℃ for 1 hour, then placed at [2)] room condition for 24±2 hours before initial measurements. (B,E,F)
7	Vibration Resistance	Appearance	No marked defect.	No marked defect.	The capacitor shall firmly be soldered to the supporting lead wire and vibration which is 10 to 55Hz in the vibration frequency range, 1.5mm in total amplitude, and about 1 minute in the rate of vibration change from 10Hz to 55Hz and back to 10Hz is applied for a total of 6 hours; 2 hours each in 3 mutually perpendicular directions.
		Capacitance	Within the specified tolerance.	Within the specified tolerance.	
		Q. D. F.	SL: C≧30pF : Q≧1000; C<30pF : Q≧400+20C[1)]	B, E: D. F.≦2.5%; F: D. F.≦5.0%	
8	Soldering Effect	Appearance	No marked defect.	No marked defect.	The lead wire shall be immersed into the melted solder of 350±10℃ (Body of ϕ5 and under : 270±5℃) up to about 1.5 to 2mm from the main body for 3.5±0.5 sec. (Body of ϕ5 and under : 5±0.5sec.) . Pre-treatment : Capacitor shall be stored at 85±2℃ for 1 hour, then placed at [2)] room condition for 24±2 hours before initial measurements. (B,E,F) Post-treatment : Capacitor shall be stored for 1 to 2 hours at [2)] room condition. (SL) Post-treatment : Capacitor shall be stored for 24±2 hours at [2)] room condition. (B,E,F)
		Capacitance Change	SL: within±2.5%	B: within±5%; E: within±15%; F: within±20%	
		Dielectric Strength (Between lead wires)	Pass the item No. 5.	Pass the item No. 5.	
9	Humidity (Under Steady State)	Appearance	No marked defect.	No marked defect.	Set the capacitor for 500 $^{+24}_{-0}$ hours at 40±2℃ in 90 to 95% humidity. Pre-treatment : Capacitor shall be stored at 85±2℃ for 1 hour, then placed at [2)] room condition for 24±2 hours before initial measurements. (B,E,F) Post-treatment : Capacitor shall be stored for 1 to 2 hours at [2)] room condition.
		Capacitance Change	SL: within±5%	B: within±10%; E: within±20%; F: within±30%	
		Q. D. F.	SL: C≧30pF : Q≧350; C<30pF : Q≧275+$\frac{5}{2}$C[1)]	B, E: D. F.≦5.0%; F: D. F.≦7.5%	
		I. R.	1000MΩ min.	1000MΩ min.	
10	Humidity Loading	Appearance	No marked defect.	No marked defect.	Apply the rated voltage for 500 $^{+24}_{-0}$ hours at 40±2℃ in 90 to 95% humidity. (Charge / discharge current≦50mA) Pre-treatment : Capacitor shall be stored at 85±2℃ for 1 hour, then placed at [2)] room condition for 24±2 hours before initial measurements. (B,E,F) Post-treatment : Capacitor shall be stored for 1 to 2 hours at [2)] room condition. (SL) Post-treatment : Capacitor shall be stored at 85±2℃ for 1 hour, then placed at [2)] room condition for 24±2 hours. (B,E,F)
		Capacitance Change	SL: within±7.5%	B: within±10%; E: within±20%; F: within±30%	
		Q D. F.	SL: C≧30pF : Q≧200; C<30pF : Q≧100+$\frac{10}{3}$C[1)]	B, E: D. F.≦5.0%; F: D. F.≦7.5%	
		I. R.	500MΩ min.	500MΩ min.	
11	Life	Appearance	No marked defect.	No marked defect.	Apply a DC voltage of 150% of the rated voltage for 1000 $^{+48}_{-0}$ hours at 85±2℃. (Charge/discharge current≦50mA) Pre-treatment : Capacitor shall be stored at 85±2℃ for 1 hour, then placed at [2)] room condition for 24±2 hours before initial measurements. (B,E,F) Pos-treatment : Capacitor shall be stored for 1 to 2 hours at [2)] room condition. (SL) Pos-treatment : Capacitor shall be stored at 85±2℃ for 1 hour, then placed at [2)] room condition for 24±2 hours. (B,E,F)
		Capacitance Change	SL: within±3%	B: within±10%; E: within±20%; F: within±30%	
		Q D. F.	SL: C≧30pF : Q≧350; C<30pF : Q≧275+$\frac{5}{2}$C[1)]	B E: D. F.≦4.0%; F: D. F.≦7.5%	
		I. R.	2000MΩ min.	2000MΩ min.	
12	Strength of Lead	Pull	Lead wire shall not cut off. Capacitor shall not be broken.		As a figure, fix the body of capacitor,apply a tensile weight gradually to each lead wire in the radial direction of capacitor up to 10N (1.0kgf) 5N (0.51kgf) for Lead diameter ϕ 0.5) ,and keep it for 10±1 sec. 
		Bending			Each lead wire shall be subjected to 5N (0.51kgf) 2.5N (0.25kgf) for Lead diameter ϕ0.5) weight and then a 90° bend, at the point of egress, in one direction, return to original position, and then a 90° bend in the opposite direction at the rate of one bend in 2 to 3 seconds.
13	Solderbility of Leads		Lead wire shall be soldered with uniformly coated on the axial direction over $\frac{3}{4}$ of the circumferential direction.		The lead wire of a capacitor shall be dipped into a methanol solution of 25wt% rosin and then into molten solder of 235±5℃ for 2±0.5 seconds. In both cases the depth of dipping is up to about 1.5 to 2mm from the root of lead wires.

1) “C” expresses nominal capacitance value (pF) .

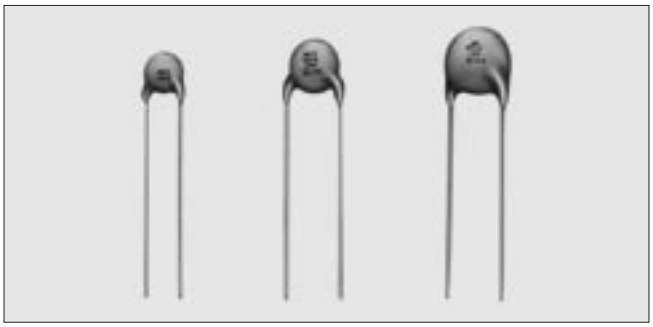
2) “room condition” temperature : 15 to 35℃, humidity : 45 to 75%, atmospheric pressure : 86 to 106kPa

HIGH VOLTAGE CERAMIC CAPACITOR

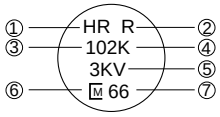
High Temperature Guaranteed HR Series

■FEATURES

1. For pulse circuit.
2. Improved heat resistance realized by the epoxy resin coating.
3. Reduced heat dissipation permitted due to small dielectric loss of the ceramic material.
4. Coated with flame-retardant epoxy resin (equivalent to UL94V-0 standards.)
5. Automatic insertion can be, and save costs.

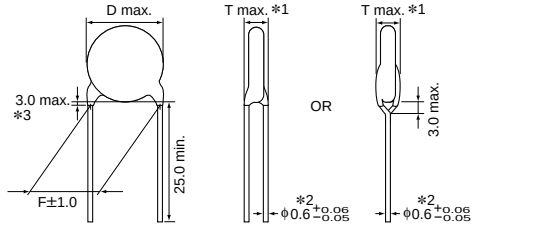
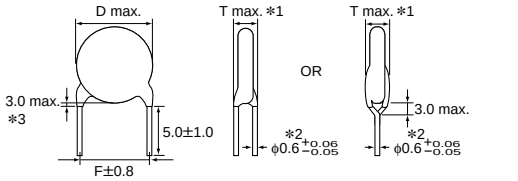


■MARKING

Example	Item
	①High Temperature Guaranteed Code.(Omitted for SL characteristic)
	②Temperature Characteristic (Omitted for SL characteristic,rated voltage 250V of R characteristic and maximum body diameter ϕ6mm and under of C characteristic.)
	③Nominal Capacitance (Under 100pF:Actual value,100pF and over : Identified by 3-figure code.)
	④Capacitance Tolerance (Omitted for maximum body diameter ϕ6mm and under.)
	⑤Rated Voltage (Marked with horizontal line over nominal capacitance for rated voltage 250V. Omitted for the rated voltage 500V. For 3.15kV...3kV.)
	⑥Manufacturer's Identification (Omitted for maximum body diameter ϕ9mm and under.)
	⑦Manufactured Date Code (Omitted for maximum body diameter ϕ9mm and under.)

■DIMENSION

•Bulk

Configuration	Straight Long	Straight Short
Lead Code	No Code	−1
Dimension (in mm)		

Non vertical crimped type : Apply to DE0405/DE0505/DE0507/ DE0607 and rated voltage of 6.3kV

Vertical crimped type : Except for DE0405/DE0505/DE0507/ DE0607 and rated voltage of 6.3kV

Non vertical crimped type : Apply to DE0405/DE0505/DE0507/ DE0607 and rated voltage of 6.3kV

Vertical crimped type : Except for DE0405/DE0505/DE0507/ DE0607 and rated voltage of 6.3kV

•Please see “STANDARD LIST” for nominal body diameter (D) and lead spacing (F) .

∗1 Thickness of Body (T)

Rated Voltage (VDC)		Thickness of Body T (mm)
250, 500		4.0
1k	SL Char.	
	R Char.	4.5
2k		5.0
3.15k		6.0

∗2 ϕ0.5±0.05mm in case of nominal body diameter ϕ5mm and under (Type:DE04□,DE05□).

∗3 Vertical crimped type : Up to the end of crimp.

■STANDARD LIST HR Series

SL Characteristic

Nominal Capacitance (pF)	Max. Body Dia. D(mm)	Lead Spacing F(mm)	Rated Voltage (kVDC)	Part Number (□ : means optional lead code shown on the right.)	Lead Configuration / Lead Code: Straight Long	Straight Short	Taping: Lead spacing F : 5.0 Pitch of component P : 12.7	Taping: Lead spacing F : 7.5 Pitch of component P : 15.0	Taping: Lead spacing F : 7.5 Pitch of component P : 30.0
10	4.5	5.0	1	DE0405□SL 100 D 1K	No Code	−1	−979	−	−
12				DE0405□SL 120 J 1K					
15				DE0405□SL 150 J 1K					
18				DE0405□SL 180 J 1K					
22				DE0405□SL 220 J 1K					
27				DE0405□SL 270 J 1K					
33				DE0405□SL 330 J 1K					
39				DE0405□SL 390 J 1K					
47				DE0405□SL 470 J 1K					
56	5			DE0505□SL 560 J 1K					
68				DE0505□SL 680 J 1K					
82	6			DE0605□SL 820 J 1K					
100				DE0605□SL 101 J 1K					
120				DE0605□SL 121 J 1K					
150	7			DE0705□SL 151 J 1K					
180				DE0705□SL 181 J 1K					
220	8			DE0805□SL 221 J 1K					
270	9			DE0905□SL 271 J 1K					
330	10			DE1005□SL 331 J 1K					
390				DE1005□SL 391 J 1K					
470	11			DE1105□SL 471 J 1K					
560	12	7.5		DE1207□SL 561 J 1K			−	−486	
10	4.5	5.0	2	DE0405□SL 100 D 2K			−979	−	
12				DE0405□SL 120 J 2K					
15				DE0405□SL 150 J 2K					
18				DE0405□SL 180 J 2K					
22				DE0405□SL 220 J 2K					
27				DE0405□SL 270 J 2K					
33				DE0405□SL 330 J 2K					
39	5			DE0505□SL 390 J 2K					
47	6			DE0605□SL 470 J 2K					
56				DE0605□SL 560 J 2K					
68				DE0605□SL 680 J 2K					
82	7			DE0705□SL 820 J 2K					
100				DE0705□SL 101 J 2K					
120	8			DE0805□SL 121 J 2K					
150				DE0805□SL 151 J 2K					
180	9			DE0905□SL 181 J 2K					
220	10			DE1005□SL 221 J 2K					
270	11			DE1105□SL 271 J 2K					
330	12	7.5		DE1207□SL 331 J 2K			−	−486	
390	13			DE1307□SL 391 J 2K					
470	14			DE1407□SL 471 J 2K				−	−477
560	15			DE1507□SL 561 J 2K					
10	5	7.5	3.15	DE0507□SL 100 D 3K			−	−486	−
12				DE0507□SL 120 J 3K					
15				DE0507□SL 150 J 3K					
18				DE0507□SL 180 J 3K					
22				DE0507□SL 220 J 3K					
27	6			DE0607□SL 270 J 3K					
33				DE0607□SL 330 J 3K					
39				DE0607□SL 390 J 3K					
47	7			DE0707□SL 470 J 3K					
56				DE0707□SL 560 J 3K					
68	8			DE0807□SL 680 J 3K					
82				DE0807□SL 820 J 3K					
100	9			DE0907□SL 101 J 3K					
120	10			DE1007□SL 121 J 3K					
150	11			DE1107□SL 151 J 3K					
180				DE1107□SL 181 J 3K					
220	12			DE1207□SL 221 J 3K					
270	14			DE1407□SL 271 J 3K					
330	15			DE1507□SL 331 J 3K				−	−477
390	16			DE1607□SL 391 J 3K					

R Characteristic [250V]

Nominal Capacitance (pF)	Max. Body Dia. D(mm)	Lead Spacing F(mm)	Rated Voltage (VDC)	Part Number (□ : means optional lead code shown on the right.)	Lead Configuration / Lead Code: Straight Long	Straight Short	Taping: Lead spacing F : 5.0 Pitch of component P : 12.7
220	6	5.0	250	DE506□R 221 K 250	No Code	−1	−979
330				DE506□R 331 K 250			
470				DE506□R 471 K 250			
680				DE506□R 681 K 250			
1000				DE506□R 102 K 250			
1500	7			DE507□R 152 K 250			
2200	8			DE508□R 222 K 250			
3300	9			DE509□R 332 K 250			
4700	10			DE510□R 472 K 250			
6800	12			DE512□R 682 K 250			
10000				DE512□R 103 K 250			

Please contact us for details.

R Characteristic [1 to 3.15kV]

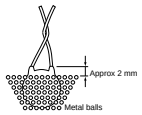
Nominal Capacitance (pF)	Max. Body Dia. D(mm)	Lead Spacing F(mm)	Rated Voltage (kVDC)	Part Number (□ : means optional lead code shown on the right.)	Lead Configuration / Lead Code: Straight Long	Straight Short	Taping: Lead spacing F : 5.0 Pitch of component P : 12.7	Taping: Lead spacing F : 7.5 Pitch of component P : 15.0	Taping: Lead spacing F : 7.5 Pitch of component P : 30.0
220	7	5.0	1	DE0705□R 221 K 1K	No Code	–1	–979	–	–
330				DE0705□R 331 K 1K					
470				DE0705□R 471 K 1K					
680	8			DE0805□R 681 K 1K					
1000	9			DE0905□R 102 K 1K					
1500	11			DE1105□R 152 K 1K					
2200	13	7.5		DE1307□R 222 K 1K			–	–486	
3300	15			DE1507□R 332 K 1K				–	–477
4700	17			DE1707□R 472 K 1K					
220	7	7.5	2	DE0707□R 221 K 2K			–	–486	–
270				DE0707□R 271 K 2K					
330	8			DE0807□R 331 K 2K					
390				DE0807□R 391 K 2K					
470	9			DE0907□R 471 K 2K					
560				DE0907□R 561 K 2K					
680	10			DE1007□R 681 K 2K					
820	11			DE1107□R 821 K 2K					
1000	12			DE1207□R 102 K 2K					
1200				DE1207□R 122 K 2K					
1500				DE1207□R 152 K 2K					
1800	14			DE1407□R 182 K 2K				–486	–
2200	15			DE1507□R 222 K 2K					
2700	17			DE1707□R 272 K 2K					–477
3300	19	10.0		DE1910□R 332 K 2K				–	
3900	20			DE2010□R 392 K 2K					
4700	21			DE2110□R 472 K 2K					
150	7	7.5	3.15	DE0707□R 151 K 3K					
180				DE0707□R 181 K 3K					
220				DE0707□R 221 K 3K					
270				DE0707□R 271 K 3K					
330	8			DE0807□R 331 K 3K				–486	
390	9			DE0907□R 391 K 3K					
470	10			DE1007□R 471 K 3K					
560				DE1007□R 561 K 3K					
680	11			DE1107□R 681 K 3K					
820	12			DE1207□R 821 K 3K					
1000	13			DE1307□R 102 K 3K					
1200	14			DE1407□R 122 K 3K				–	–477
1500	15			DE1507□R 152 K 3K					
1800	16			DE1607□R 182 K 3K					
2200	17			DE1707□R 222 K 3K					
2700	19	10.0		DE1910□R 272 K 3K					–

C Characteristic

Nominal Capacitance (pF)	Max. Body Dia. D(mm)	Lead Spacing F(mm)	Rated Voltage (VDC)	Part Number (□ : means optional lead code shown on the right.)	Lead Configuration / Lead Code: Straight Long	Straight Short	Taping: Lead spacing F : 5.0 Pitch of component P : 12.7
330	6	5.0	500	DE50-6□C 331 K 500	No Code	–1	–979
470				DE50-6□C 471 K 500			
680	7			DE50-7□C 681 K 500			
1000	8			DE50-8□C 102 K 500			
1500	9			DE50-9□C 152 K 500			
2200	10			DE51-0□C 222 K 500			
3300	12			DE51-2□C 332 K 500			
4700	14	10.0		DE51-4□C 472 K 500			–

Please contact us for details.

■SPECIFICATION AND TEST METHOD

	Item		Specification	Testing Method
1	Operating Temperature Range		−25 to +125℃	———
2	Capacitance		Within the specified tolerance.	The capacitance shall be measured at 20℃ with1±0.2kHz (SL : 1±0.2MHz) and 5Vrms max.
3	Q Dissipation Factor (D. F.)		C≧30pF : Q≧1000 D.F.≦0.4% (R [250V]) C<30pF : Q≧400+20C[1] (SL) D.F.≦0.2% (R [1 to 3.15kV]) D.F.≦0.3% (C)	Same condition as capacitance.
4	Insulation Resistance (I. R.)	Between lead wires	10000MΩ min.(SL,R[1 to 3.15kV] ,C) 1000MΩ min(R [250V])	The insulation resistance shall be measured with 500±50VDC (R [250V] : 100±15V) within 60±5 sec.of charging.
5	Dielectric Strength	Between lead wires	No failure.	The capacitors shall not be damage when DC voltage of 200% of the rated voltage (In case of rated voltage : 1 to 3.15kV) or DC voltage of 250% of the rated voltage (In case of rated voltage : 250V,500V) are applied between the lead wires for 1 to 5 sec. (Charge / discharge current≦50mA)
		Body Insulation	No failure.	The capacitors is placed in the container with metal balls of diameter 1mm so that each lead wire, shortcircuited, is kept approximately 2mm off the balls as shown in the figure, and AC voltage of 1250V is applied for 1 to 5 sec.between capacitor lead wires and small metals. (Charge / discharge current≦50mA) 
6	Temperature Characteristic		T.C: SL — Temp. Coefficient: +350 to −1000pm / ℃ (Temp. Range : +20 to +85℃) Temp. range: −25 to +85℃ — Cap. Change: within ±20% (C), within ±15% (R) Temp. range: +85 to +125℃ — Cap. Change: within +15 −5%	The capacitance measurement shall be made at each step specified in table. Capacitance change from the value of step 3 shall not exceed the limit specified. Step: 1 (20±2℃) / 2 (−25±3℃) / 3 (20±2℃) / 4 (85±2℃ / 125±2℃) / 5 (20±2℃) Pre-treatment : Capacitor shall be stored at 125±3℃ for 1 hour, then placed at [2] room condition for 24±2 hours before initial measurements (R,C) .
7	Temperature Cycling	Appearance	No marked defect.	The capacitor shall be introduced into the test chamber, and shall be exposed to the temperature conditions of step 1 to 4 as shown in Table at 5 cycles. Step 1: Temperature (℃) −25±3, Time (min.) 30±3 Step 2: Temperature (℃) room temp., Time (min.) 3 max. Step 3: Temperature (℃) +125±3, Time (min.) 30±3 Step 4: Temperature (℃) room temp., Time (min.) 3 max. Pre-treatment : Capacitor shall be stored at 125±3℃ for 1 hour, then placed at room condition for 24±2 hours before initial measurements(R,C) Post-treatment : Capacitor shall be stored for 1 to 2 hours at [2] room condition(SL) . Post-treatment : Capacitor shall be stored for 24±2 hours at [2] room condition(R,C) . Measurement Order : I.R.•Dielectric Strength→Pre-treatment→Capacitance,D.F. →Temperature cycling test →Post-treatment→ Capacitance,D.F.,I.R., Dielectric Strength(R [250V])
		Capacitance	within ±5%(SL) within ±10% (R, C)	
		Q D. F.	C≧30pF : Q≧350 D.F.≦0.4% (R, C) C<30pF : Q≧275+5/2C[1] (SL)	
		I. R.	1000MΩ min.	
		Dielectric Strength (Between lead wires)	Pass the item No. 5.	
8	Vibration Resistance	Appearance	No marked defect.	The capacitor shall firmly be soldered to the supporting lead wire and vibration which is 10 to 55Hz in the vibration frequency range, 1.5mm in total amplitude,and about 1 minute in the rate of vibration change from 10Hz to 55Hz and back to 10Hz is applied for a total of 6 hours; 2 hours each in 3 mutually perpendicular directions.
		Capacitance Change	Within the specified tolerance.	
		Q D. F.	C≧30pF : Q≧1000 D.F.≦0.4% (R [250V]) C<30pF : Q≧400+20C[1] (SL) D.F.≦0.2% (R [1 to 3.15kV]) D.F.≦0.3% (C)	
9	Soldering Effect	Appearance	No marked defect.	The lead wire shall be immersed into the melted solder of 350±10℃ (Body of ϕ5 and under : 270±5℃) up to about 1.5 to 2mm from the main body for 3.5±0.5 sec. (Body of ϕ5 and under : 5±5 sec.) Pre-treatment : Capacitor shall be stored at 125±3℃ for 1 hour, then placed at [2] room condition for 24±2 hours before initial measurements. (R,C) Post-treatment : Capacitor shall be stored for 1 to 2 hours at [2] room condition. (SL) Post-treatment : Capacitor shall be stored for 24±2 hours at [2] room condition. (R,C) Measurement Order : Dielectric Strength→Pretreatment→Capacitance→ Soldering Effect test→Post-treatment→Capacitance, Dielectric Strength (R [250V])
		Capacitance Change	within ±2.5%(SL) within ±10%(R, C)	
		Dielectric Strength (Between lead wires)	Pass the item No. 5.	
10	Humidity (Under Steady State)	Appearance	No marked defect.	Set the capacitor for 500 +24 −0 hours at 40±2℃ in 90 to 95% humidity. Pre-treatment : Capacitor shall be stored at 125± 3℃ for 1 hour, then placed at [2] room condition for 24±2 hours before initial measurements (R,C) . Post-treatment : Capacitor shall be stored for 1 to 2 hours at [2] room condition. Measurement Order : I.R.→Pre-treatment→Capacitance • D.F.→Humidity test→Post-treatment→Capacitance,D.F.,I.R(R [250V]) (Charge/discharge current≦50mA)
		Capacitance Change	within ±5% (SL) within ±10%(R, C)	
		Q D. F.	C≧30pF : Q≧350 D.F.≦0.4% (R, C) C<30pF : Q≧275+5/2C[1] (SL)	
		I. R.	1000MΩ min.	
11	Life	Appearance	No marked defect.	Apply a DC voltage of 200% of the rated voltage (In case of rated voltage : 250V,500V) or DC voltage of 150% of the rated voltage (In case of rated voltage : 1 to 3.15kV) for 1000 +48 −0 hours at 125±2℃. Pre-treatment : Capacitor shall be stored at 125±3℃ for 1 hour, then placed at [2] room condition for 24±2 hours before initial measurements (R,C) . Post-treatment : Capacitor shall be stored for 1 to 2 hours at [2] room condition (SL) . Post-treatment : Capacitor shall be stored at 125±3℃ for 1 hour, then placed at [2] room condition for 24±2 hours(R,C) . Measurement Order : I.R.→Pre-treatment→Capacitance,D.F.→Life test→I.R.★→Post-treatment→Capacitance,D.F(R [250V]) (Charge/discharge current≦50mA)
		Capacitance Change	within ±3% (SL) within ±10%(R, C)	
		Q D. F.	C≧30pF : Q≧350 D.F.≦0.4% (R, C) C<30pF : Q≧275+5/2C[1] (SL)	
		I. R.	2000MΩ min(SL, R [1 to 3.15kV] , C) 1000MΩ min(R [250V])	
12	Strength of Lead	Pull	Lead wire shall not cut off. Capacitor shall not be broken.	As a figure, fix the body of capacitor, apply a tensile weight gradually to each lead wire in the radial direction of capacitor up to 10N(1.0kgf)5N(0.51kgf) for lead diameter ϕ0.5) , and keep it for 10±1 sec. 
		Bending		Each lead wire shall be subjected to 5N(0.51kgf) 2.5N(0.25kgf) for lead diameter ϕ0.5) weight and then a 90° bend, at the point of egress, in one direction, return to original position, and then a 90° bend in the opposite direction at the rate of one bend in 2 to 3 seconds.
13	Solderbility of Leads		Lead wire shall be soldered with uniformly coated on the axial direction over 3/4 of the circumferential direction.	The lead wire of a capacitor shall be dipped into a methanol solution of 25wt% rosin and then into molten solder of 235±5℃ for 2±0.5 seconds. In both cases the depth of dipping is up to about 1.5 to 2mm from the root of lead wires.

1) "C" expresses nominal capacitance value (pF) .

2) "room condition" temperature : 15 to 35℃, humidity : 45 to 75%, atmospheric pressure : 86 to 106kPa

★The measurement of I.R. will be held in 12 to 24 hours after Life test.

■PRECAUTION

1. Operating voltage

Be sure to use a capacitor only within its rated operating voltage range.

When DC-rated capacitors are to be used in AC or ripple voltage circuits, be sure to maintain the Vp-p value of the applied voltage within the rated voltage range.

2. Operating temperature and self-generated heat

Keep the surface temperature of a capacitor within the rated operating temperature range.Be sure to take into account the heat produced by the capacitor itself.

When a capacitor is used in a high-frequency circuit, pulse voltage circuit or the like, it may produce heat due to dielectric loss. Keep such self-generated temperature below 20℃.

3. Operating and storage environment

The insulating coating of capacitors does not form a perfect seal ; therefore, do not use or store capacitors in a corrosive atmosphere, especially where chloride gas, sulfide gas, acid,alkali, salt or the like are present. Avoid exposure to moisture.

Before cleaning, bonding, or molding this product, verify that these processes do not affect product quality by testing the performance of a cleaned, bonded or molded product in the intended equipment.

Store the capacitors where the temperature and relative humidity do not exceed 5 to 40℃ and 20 to 70% RH. Use capacitors within 6 months.

4. Vibration and impact

Do not expose a capacitor or its leads to excessive shock or vibration during use.

Failure to follow the above cautions may result, worst case, in a short circuit and fuming when the product is used.

■NOTICE

Soldering

When soldering this product to a PC board, do not exceed the solder heat resistance specification (written in specification and test method :P11,P15) of the capacitor. Subjecting this product to excessive heating could melt the internal junction solder and may result in thermal shocks that can crack the ceramic element.

■ISO9000 CERTIFICATIONS

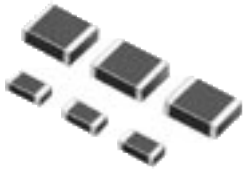
Manufacturing plants of these products in this catalog have obtained the ISO9000 quality system certificate.

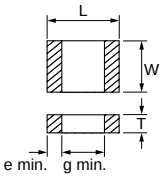
Plant	Certified Date	Organization	Registration No.	Applied Standard
Izumo Murata Manufacturing Co.,Ltd	May. 11. '95	RCJ ★1	RCJ-93M-05A	ISO9001
Taiwan Murata Electronics Co.,Ltd	Nov. 26. '93	BCIQ ★2	5E8Y001-00	ISO9002

★1 RCJ : Reliability Center for Electronic Component of Japan
★2 BCIQ : Bureau of Commodity Inspection & Quarantine

■MURATA'S HIGH VOLTAGE MONOLITHIC CERAMIC CAPACITOR

●High-Voltage Type GHM 1000 / 1500 Series





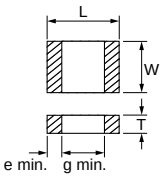
(in mm)

Type	e	g
GHM1030	0.3	1.5
GHM1038	0.3	2.9
GHM1040	0.3	2.9
GHM1525	0.3	0.7
GHM1530	0.3	1.5
GHM1535	0.3	1.5
GHM1540	0.3	2.5
GHM1545	0.3	3.5

Part Number	Temp. Char.① / Cap.Value (pF) ② / Rated Voltage④					Dimensions (mm)		
	R	B		SL		L	W	T
	630V	250V	630V	2kV	3.15kV			
GHM1030①②③④PT	100–330	–	–	–	–	3.2±0.15	1.6±0.15	$1.0^{+0}_{-0.2}$
	470–1000	–	–	–	–			$1.25^{+0}_{-0.2}$
GHM1038①②③④PT	–	–	–	–	10–82	4.5±0.4	2.0±0.2	$2.0^{+0.3}_{-0.3}$
GHM1040①②③④PT	–	–	–	120–220	–	4.5±0.3	3.2±0.3	$2.0^{+0}_{-0.3}$
	–	–	–	–	100			$2.5^{+0}_{-0.3}$
GHM1525①②③④PT	–	1000–6800	–	–	–	2.0±0.2	1.25±0.2	$1.0^{+0}_{-0.3}$
	–	10000	–	–	–			$1.25^{+0.2}_{-0.2}$
GHM1530①②③④PT	–	15000 • 22000	–	–	–	3.2±0.2	1.6±0.2	$1.0^{+0}_{-0.3}$
	–	33000	1000–10000	–	–			$1.25^{+0}_{-0.3}$
	–	47000	–	–	–			$1.6^{+0.2}_{-0.2}$
GHM1535①②③④PT	–	68000	15000 • 22000	–	–	3.2±0.3	2.5±0.2	$1.5^{+0}_{-0.3}$
	–	100000	–	–	–			$2.0^{+0}_{-0.3}$
GHM1540①②③④PT	–	–	33000 • 47000	–	–	4.5±0.4	3.2±0.3	$1.5^{+0}_{-0.3}$
	–	150000	68000	–	–			$2.0^{+0}_{-0.3}$
	–	220000	–	–	–			$2.5^{+0}_{-0.3}$
	–	–	100000	–	–			$2.6^{+0}_{-0.3}$
GHM1545①②③④PT	–	330000 • 470000	150000	–	–	5.7±0.4	5.0±0.4	$2.0^{+0}_{-0.3}$
	–	–	220000	–	–			$2.7^{+0}_{-0.3}$

Operating Temp. Range : −55 to +125℃

●250VAC Type GHM2000 Series



(in mm)

Type	e	g
GHM2143	0.3	3.5
GHM2145	0.3	3.5
GHM2243	0.3	3.5

Part Number	Temp. Char.① / Cap.Value (pF) ② / Rated Voltage④	Dimensions (mm)			Remarks
	B / 250VAC	L	W	T	
GHM2143①②③④PT	10000–47000	5.7±0.4	2.8±0.3	2.0±0.3	For X Capacitor (Across the line)
GHM2145①②③④PT	100000	5.7±0.4	5.0±0.4	2.0±0.3	Test Voltage : 575VAC, 60sec.
GHM2243①②③④PT	470–4700	5.7±0.4	2.8±0.3	2.0±0.3	For Y Capacitor (Line by pass) Test Voltage : 1500VAC, 60sec.

•This type is based on the standard of the electrical appliance and material control low of Japan.

Operating Temp. Range : −25 to +85℃

Note:

1. Export Control
   〈For customers outside Japan〉
   Murata products should not be used or sold for use in the development, production, stockpiling or utilization of any conventional weapons or mass-destructive weapons (nuclear weapons, chemical or biological weapons, or missiles), or any other weapons.
   〈For customers in Japan〉
   For products which are controlled items subject to "the Foreign Exchange and Foreign Trade Control Law" of Japan, the export license specified by the law is required for export.
2. Please contact our sales representatives or engineers before using our products listed in this catalog for the applications requiring especially high reliability what defects might directly cause damage to other party's life, body or property (listed below) or for other applications not specified in this catalog.
   ① Aircraft equipment
   ② Aerospace equipment
   ③ Undersea equipment
   ④ Medical equipment
   ⑤ Transportation equipment (automobiles, trains, ships,etc.)
   ⑥ Traffic signal equipment
   ⑦ Disaster prevention / crime prevention equipment
   ⑧ Data-processing equipment
   ⑨ Applications of similar complexity or with reliability requirements comparable to the applications listed in the above
3. Product specifications in this catalog are as of April 1997, and are subject to change or stop the supply without notice. Please confirm the specifications before ordering any product. If there are any questions, please contact our sales representatives or engineers.
4. The categories and specifications listed in this catalog are for information only. Please confirm detailed specifications by checking the product specification document or requesting for the approval sheet for product specification, before ordering.
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6. None of ozone depleting substances (ODS) under the Montreal Protocol is used in manufacturing process of us.

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