TYPE 251

To meet the users' demands for smaller and high-function portable information devices, we developed compact and low profile tantalum capacitors with appropriately designed mounting area for high-density mounting ahead of other companies.
The capacitors are widely used in portable information and telecommunication equipment, such as mobile phones, smart phones, hearing aids
and high functionally compact portable devices. The tantalum capacitors designed for high-density mounting will considerably contribute to miniaturization and improvement of performance of these portable multimedia devices.

FEATURES

1. Using the face-down terminal structure makes it possible to design the land in almost the same size as the terminal. As the result of this, parts can be downsized, and the mounting area can be reduced to 1/2 to 1/3 of that required by conventional structures.
2. Type 251 in size 1005 to 3216L are applicable to a wide capacitance range from 0.47 to 330 µF.
3. This type of capacitors is suitable for ultra miniaturized, such as DVC, DSC, SSD, smart phones, hearing aids and high functionally compact portable devices.
4. Case M (face-down terminal type 1608) and case S (face-down terminal type 2012) of this type are listed in the Surface Mounting Device-Outline Registration System of Electronic Device Registration Center of JEITA.
5. Lead-free and RoHS Compliant.

RATING

Item	Rating	Remarks
Category Temperature Range (Operating Temperature Range)	-55 ~ +125°C	To be used at derated voltage when temperature exceeds 85°C (At 125°C, 2/3 × rated voltage)
Rated Temperature (Max. Operating Temp. at Rated Voltage)	+85°C	
Rated Voltage	2.0 ~ 35 VDC	See CATALOG NUMBERS AND RATING
Nominal Capacitance	0.47~ 330 µF	
Capacitance Tolerance	±20%(M), ±10%(K)	
Failure Rate Level	1%/1000 h	To be used at derated voltage when temperature.

ORDERING INFORMATION

251	M	4001	107	M	R	10S	500
TYPE	SERIES	RATED VOLTAGE	NOMINAL CAPACITANCE	CAPACITANCE TOLERANCE	STYLE OF REELED PACKAGE	CASE CODE	SPECIFICATION NUNBER

Marking	Rated voltage
2001	2VDC
2501	2.5VDC
3001	3VDC
4001	4DVC
6301	6.3DVC
8001	8VDC
1002	10VDC
1602	16VDC
2002	20VDC
2502	25VDC
3502	35VDC

Marking	NOMINAL CAPACITANCE
474	0.47 µF
684	0.68 µF
105	1.0 µF
155	1.5 µF
225	2.2 µF
335	3.3 µF
475	4.7 µF
685	6.8 µF
106	10 µF
156	15 µF
226	22 µF
336	33 µF
476	47 µF
686	68 µF
107	100 µF
157	150 µF
227	220 µF
337	330 µF

Capacitance Tolerance	Marking
±20%	M
±10%	K

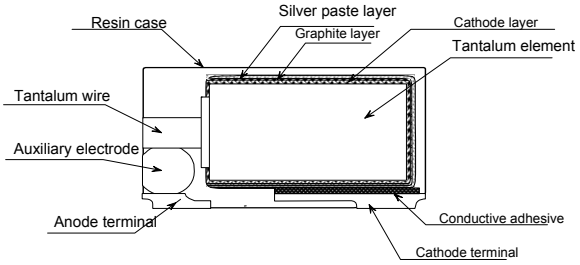
(Taping specification)

Anode Notation	Reel size	Code
Feed hole: –	φ180	R

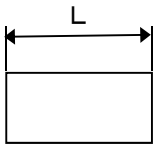
Case code	Max. height	EIA Code
06U	0.6	1005
09M	0.9	1608
10M	1.0	1608
09S	0.9	2012
10S	1.0	2012
12S	1.2	2012
13S	1.3	2012
09A	0.9	3216L
10A	1.0	3216L
12A	1.2	3216L
13A	1.3	3216

Specification Nunber
Blanks or 500

STRUCTURE(TYPICAL)



DIMENSIONS

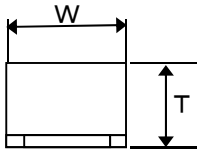


[U case] (mm)

Case Code	Max. height	L ±0.05	W ±0.05	T ±0.05	P1 ±0.1	P2 ±0.1	C ±0.1
06U	0.6	1.05	0.55	0.55	0.3	0.45	0.4

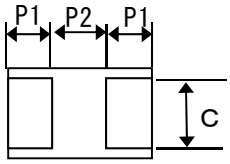
[M case] (mm)

Case Code	Max. height	L ±0.1	W ±0.1	T ±0.1	P1 ±0.1	P2 ±0.1	C ±0.1
09M	0.9	1.6	0.85	0.8	0.5	0.65	0.7



[S case] (mm)

Case Code	Max. height	L ±0.1	W ±0.1	T ±0.1	P1 ±0.1	P2 ±0.1	C ±0.1
09S	0.9	2.0	1.25	0.8	0.5	1.05	0.9
10S	1.0	2.0	1.25	0.9	0.5	1.05	0.9
12S	1.2	2.0	1.25	1.1	0.5	1.05	0.9
13S	1.3	2.0	1.25	1.2	0.5	1.05	0.9



[A case] (mm)

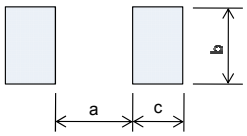
Case Code	Max. height	L ±0.1	W ±0.1	T ±0.1	P1 ±0.1	P2 ±0.1	C ±0.1
09A	0.9	3.2	1.6	0.8	0.8	1.65	1.2
10A	1.0	3.2	1.6	0.9	0.8	1.65	1.2
12A	1.2	3.2	1.6	1.1	0.8	1.65	1.2
13A	1.3	3.2	1.6	1.2	0.8	1.65	1.2

[SPECIFICATION NUMBER 500 PRODUCTS] ※Dimensional Tolerance of Specification Number 500 is as bel (mm)

Case Code	Max. height	L	W	T ±0.1	P1 ±0.1	P2 ±0.1	C ±0.1
06U	0.6	$1.1^{+0.15}_{-0.05}$	$0.55^{+0.15}_{-0.05}$	0.55 ±0.05	0.35	0.45	0.4
09M	0.9	$1.6^{+0.2}_{0}$	$0.85^{+0.2}_{0}$	0.8	0.5	0.75	0.65 ±0.07
10M	1.0	$1.6^{+0.2}_{0}$	$0.85^{+0.2}_{0}$	0.9	0.5	0.75	0.65 ±0.07
09S	0.9	$2.0^{+0.2}_{0}$	$1.25^{+0.2}_{0}$	0.8	0.5	1.15	0.9

※Product height is difference depending on the description.Please refer to "CATALOG NUMBER AND RATING "for the details.

RECOMMENDED SOLDER PAD LAYOUT



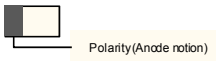
(mm)

Case Size	EIA Code	a	b	c	Mask Thickness
06U	1005	0.30≦	0.3	0.45	≦100 μm
06U（Spec. Number 500）		0.35≦			
09M	1608	0.50≦	0.65	0.65	≦100 μm
09M,10M（Spec. Number 500）				0.75	
09S,10S,12S,13S	2012	0.50≦	0.8	1.05	≦100 μm
09S（Spec. Number 500）				1.15	
09A,10A,12A	3216L	0.80≦	1.1	1.65	≦100 μm
13A	3216	0.80≦	1.1	1.65	≦100 μm

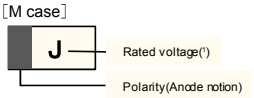
In order to expect the self alignment effect, it is recommended that land width is almost the same size as terminal of capacitor, and space between lands (c) nearly equal to the space between terminals for appropriate soldering.

MARKING

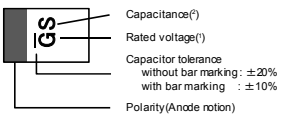
［U case］



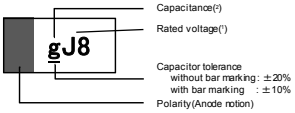
［M case］



［S case］



［A case］



(1) Rated voltage is indicated with one alphabetic letter.

Rated voltage (VDC)	2.5	4	6.3	8	10	16	20	25	35
Mcase ,Scase	e	G	J	K	A	C	D	E	V
Acase	e	g	j	k	A	C	D	E	V

(2) Capacitance is shown by the code below.

Capacitance (μF)	1.0	1.5	2.2	3.3	4.7	6.8	10	15	22	33	47	68	100	150	220	330
Scase	A	E	J	N	S	W	$\overline{A}$	$\overline{E}$	$\overline{J}$	$\overline{N}$	$\overline{S}$	$\overline{W}$	$\underline{A}$	$\underline{E}$	$\underline{J}$	$\underline{N}$
Acase	A6	E6	J6	N6	S6	W6	A7	E7	J7	N7	S7	W7	A8	E8	J8	N8

RATING AND CASE SIZE

Jul. ,2018

[U case]

R.V. / Cap.	2	2.5	3	4	6.3	8	10	16	20	25	35
0.47							06U				
0.68											
1					06U		06U				
1.5							06U				
2.2			06U		06U		06U				
3.3											
4.7	06U			06U			06U				
6.8											
10	06U	06U		06U							
15			06U								
22			06U	06U							

[M case]

R.V. / Cap.	2	2.5	3	4	6.3	8	10	16	20	25	35
0.47							09M	09M			
0.68											
1				09M	09M		09M	09M			
1.5				09M	09M		09M	09M			
2.2				09M	09M		09M	09M			
3.3				09M	09M		09M	09M			
4.7				09M	09M		09M	09M			
6.8				09M	09M		09M				
10				09M	09M		09M				
15				09M	09M		09M				
22				09M	09M						
33				09M	09M						
47				09M							

[S case]

R.V. / Cap.	2	2.5	3	4	6.3	8	10	16	20	25	35
1									12S	12S	12S
1.5									12S	12S	
2.2									12S		
3.3										10S	
4.7										12S	
6.8								10S,12S			
10							10S,12S	10S,12S			
15							10S,12S	13S			
22					10S,12S		10S,12S				
33					10S,12S		10S,13S				
47				10S,12S	10S,12S		10S,13S				
8				10S,12S	12S						
100		10S,12S		09S,10S,12S	13S						
150		12S		13S							
220		12S		12S,13S							

[A case]

R.V. / Cap.	2	2.5	3	4	6.3	8	10	16	20	25	35
2.2											10A,12A
3.3										12A	12A
4.7										09A,10A	
6.8										12A	
10											
15											
22								13A			
33							10A,12A				
47					10A		10A,12A				
68					10A		13A				
100				10A	10A,12A	13A					
150				10A,12A	10A						
220				09A,10A,12A,13A	12A						
330		12A									

[SPECIFICATION NUMBER 500 Series]

R.V. / Cap.	2	2.5	3	4	6.3	8	10	16	20	25	35
22							10M				
33			06U								
47					10M						
68											
100		10M		09M,10M							
220			09S								
330											

CATALOG NUMBERS AND RATING

Jul.,2018

Catalog number[1][2]	Rated voltage (VDC)	Surge voltage 85℃	Surge voltage 125℃	Capacitance (μF)	Tolerance (±%)	Case code	Lct. (μA) 20℃	Lct. (μA) 85℃	Lct. (μA) 125℃	Capacitance change (ΔC/C) (%) -55℃	Capacitance change (ΔC/C) (%) 85℃	Capacitance change (ΔC/C) (%) 125℃	Max. Dissipation factor -55℃	Max. Dissipation factor 20℃	Max. Dissipation factor 85℃	Max. Dissipation factor 125℃	ESR Ω 100 kHz	Surge Lct.[3]	Surge ΔC/C%	Surge DF[4]	Resistance to soldering heat Lct.[3]	Resistance to soldering heat ΔC/C%	Resistance to soldering heat DF[4]	Rapid change of temp.&Damp heat ΔC/C%	Rapid change of temp.&Damp heat DF[4]	Endurance Lct.[3]	Endurance ΔC/C%	Endurance DF[4]
251 M 2001 475 M _[2] 06U	2	2.3	1.5	4.7	20	06U	0.5	5	6.3	-30/0	0/+20	0/+20	0.36	0.12	0.24	0.24	15	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 2001 106 M _[2] 06U	↓	↓	↓	10	20	06U	0.5	5	6.3	-30/0	0/+20	0/+20	0.45	0.15	0.30	0.30	15	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 2501 106 M _[2] 06U	2.5	2.8	1.9	10	20	06U	0.5	5	6.3	-30/0	0/+20	0/+20	0.45	0.15	0.30	0.30	15	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 2501 107 M _[2] 10M 500	↓	↓	↓	100	20	10M	25	250	312	-30/0	0/+15	0/+30	0.80	0.40	0.40	0.60	2	B	±30	C	B	±30	C	±30	C	B	±30	C
251 M 2501 107 M _[2] 10S	↓	↓	↓	100	20	10S	2.5	50	62	-30/0	0/+20	0/+20	0.40	0.20	0.30	0.30	4	B	±20	A	A	±20	A	±20	B	B	±30	B
251 M 2501 107 M _[2] 12S	↓	↓	↓	100	20	12S	2.5	50	62	-30/0	0/+20	0/+20	0.40	0.20	0.30	0.30	4	B	±20	A	A	±20	A	±20	B	B	±30	B
251 M 2501 157 M _[2] 12S	↓	↓	↓	150	20	12S	3.7	75	93	-30/0	0/+20	0/+20	0.40	0.20	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 2501 227 M _[2] 12S	↓	↓	↓	220	20	12S	5.5	110	137	-30/0	0/+20	0/+20	0.60	0.30	0.36	0.36	2	B	±30	A	B	±20	A	±20	B	B	±30	B
251 M 2501 337 M _[2] 12A	↓	↓	↓	330	20	12A	8.2	165	206	-30/0	0/+20	0/+20	0.60	0.30	0.40	0.40	1	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 3001 225 M _[2] 06U	3	3.45	2.3	2.2	20	06U	0.5	5	6.3	-30/0	0/+20	0/+20	0.18	0.06	0.12	0.12	15	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 3001 156 M _[2] 06U	↓	↓	↓	15	20	06U	2.3	9	11	-30/0	0/+20	0/+20	0.45	0.15	0.30	0.30	15	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 3001 226 M _[2] 06U	↓	↓	↓	22	20	06U	6.6	13.2	16.5	-30/0	0/+20	0/+20	0.60	0.30	0.40	0.40	15	B	±40	A	B	±40	A	±40	B	B	±40	B
251 M 3001 336 M _[2] 06U 500	↓	↓	↓	33	20	06U	9.9	99	123	-30/0	0/+15	0/+30	1.00	0.40	0.40	0.40	10	B	±30	C	B	±30	C	±30	C	C	±30	C
251 M 3001 227 M _[2] 09S 500	↓	↓	↓	220	20	09S	66	660	825	-30/0	0/+20	0/+20	0.90	0.60	0.60	0.60	2	B	±40	B	B	±30	B	±30	B	B	±40	B
251 M 4001 105 M _[2] 09M	4	4.6	3	1	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 4001 155 M _[2] 09M	↓	↓	↓	1.5	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 4001 225 M _[2] 09M	↓	↓	↓	2.2	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 4001 335 M _[2] 09M	↓	↓	↓	3.3	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 4001 475 _[1][2] 06U	↓	↓	↓	4.7	10,20	06U	0.5	5	6.3	-30/0	0/+20	0/+20	0.36	0.12	0.24	0.24	15	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 475 M _[2] 09M	↓	↓	↓	4.7	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	10	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 4001 685 M _[2] 09M	↓	↓	↓	6.8	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.15	0.08	0.15	0.15	8	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 4001 106 M _[2] 06U	↓	↓	↓	10	20	06U	0.5	5	6.3	-30/0	0/+20	0/+20	0.45	0.15	0.30	0.30	15	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 106 M _[2] 09M	↓	↓	↓	10	20	09M	0.5	8	10	-15/0	0/+10	0/+15	0.15	0.08	0.15	0.15	8	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 4001 156 M _[2] 09M	↓	↓	↓	15	20	09M	0.6	12	15	-30/0	0/+20	0/+20	0.30	0.20	0.30	0.30	8	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 226 M _[2] 06U	↓	↓	↓	22	20	06U	8.8	176	220	-30/0	0/+20	0/+20	0.60	0.30	0.40	0.40	15	B	±40	A	D	±40	B	±40	B	D	±40	B
251 M 4001 226 _[1][2] 09M	↓	↓	↓	22	10,20	09M	0.9	18	22	-15/0	0/+10	0/+15	0.30	0.106	0.30	0.30	4	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 4001 336 M _[2] 09M	↓	↓	↓	33	20	09M	1.3	26	33	-30/0	0/+20	0/+20	0.40	0.20	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 476 M _[2] 09M	↓	↓	↓	47	20	09M	1.9	38	47	-30/0	0/+20	0/+20	0.60	0.20	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 476 M _[2] 10S	↓	↓	↓	47	20	10S	1.9	38	47	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 476 M _[2] 12S	↓	↓	↓	47	20	12S	1.9	38	47	-15/0	0/+10	0/+15	0.30	0.15	0.30	0.30	4	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 4001 686 M _[2] 10S	↓	↓	↓	68	20	10S	2.7	54	68	-30/0	0/+20	0/+20	0.40	0.20	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 686 M _[2] 12S	↓	↓	↓	68	20	12S	2.7	54	68	-30/0	0/+20	0/+20	0.40	0.20	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 107 M _[2] 09M 500	↓	↓	↓	100	20	09M	80	800	1000	-30/0	0/+15	0/+20	1.00	0.60	0.60	0.80	3	B	±30	C	B	±30	C	±30	C	B	±30	C
251 M 4001 107 _[1][2] 10M 500	↓	↓	↓	100	10,20	10M	40	400	500	-30/0	0/+15	0/+20	0.80	0.40	0.40	0.60	2	B	±30	C	B	±30	C	±30	C	B	±30	C
251 M 4001 107 M _[1] 09S	↓	↓	↓	100	20	09S	20	80	100	-30/0	0/+20	0/+20	0.60	0.30	0.40	0.40	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 107 M _[2] 10S	↓	↓	↓	100	20	10S	4.0	80	100	-30/0	0/+20	0/+20	0.40	0.20	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 107 M _[2] 12S	↓	↓	↓	100	20	12S	4.0	80	100	-30/0	0/+20	0/+20	0.40	0.20	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 107 M _[2] 10A	↓	↓	↓	100	20	10A	4.0	80	100	-30/0	0/+20	0/+20	0.36	0.18	0.30	0.30	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 157 M _[2] 13S	↓	↓	↓	150	20	13S	6.0	120	150	-30/0	0/+20	0/+20	0.48	0.24	0.30	0.30	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 157 M _[2] 10A	↓	↓	↓	150	20	10A	6.0	120	150	-30/0	0/+20	0/+20	0.48	0.24	0.30	0.30	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 157 M _[2] 12A	↓	↓	↓	150	20	12A	6.0	120	150	-30/0	0/+20	0/+20	0.48	0.24	0.30	0.30	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 227 M _[2] 12S	↓	↓	↓	220	20	12S	88	176	220	-30/0	0/+20	0/+20	0.80	0.40	0.50	0.50	2	B	±40	A	B	±40	B	±40	B	B	±40	B
251 M 4001 227 M _[2] 13S	↓	↓	↓	220	20	13S	44	176	220	-30/0	0/+20	0/+20	0.80	0.40	0.50	0.50	2	B	±40	A	B	±40	A	±40	B	B	±40	B
251 M 4001 227 M _[2] 09A	↓	↓	↓	220	20	09A	44	176	220	-30/0	0/+20	0/+20	0.80	0.40	0.50	0.50	2	B	±30	A	B	±30	B	±30	B	B	±30	B
251 M 4001 227 M _[2] 10A	↓	↓	↓	220	20	10A	8.8	176	220	-30/0	0/+20	0/+20	0.48	0.24	0.30	0.30	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 227 _[1][2] 12A	↓	↓	↓	220	10,20	12A	8.8	176	220	-30/0	0/+20	0/+20	0.48	0.24	0.30	0.30	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 4001 227 M _[2] 13A	↓	↓	↓	220	20	13A	8.8	176	220	-30/0	0/+20	0/+20	0.48	0.24	0.30	0.30	2	B	±20	A	B	±20	A	±20	B	B	±30	B

Catalog number[1][2]	Rated voltage	Surge voltage		Capacitance	Tolerance	Case code	Lct. (μA)			Capacitance change (ΔC/C) (%)			Max. Dissipation factor				ESR Ω	Surge			Resistance to soldering heat			Rapid change of temp.&Damp heat		Endurance		
	(VDC)	85℃	125℃	(μF)	(±%)		20℃	85℃	125℃	-55℃	85℃	125℃	-55℃	20℃	85℃	125℃	100 kHz	Lct.[3]	ΔC/C%	DF[4]	Lct.[3]	ΔC/C%	DF[4]	ΔC/C%	DF[4]	Lct.[3]	ΔC/C%	DF[4]
251 M 6301 105 _[1] _[2] 06U	6.3	7.2	4.8	1	10,20	06U	0.5	5	6.3	-30/0	0/+20	0/+20	0.18	0.06	0.12	0.12	15	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 6301 105 M _[2] 09M	↓	↓	↓	1	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 6301 155 M _[2] 09M	↓	↓	↓	1.5	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 6301 225 M _[2] 06U	↓	↓	↓	2.2	20	06U	0.5	5	6.3	-30/0	0/+20	0/+20	0.18	0.06	0.12	0.12	15	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 6301 225 M _[2] 09M	↓	↓	↓	2.2	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 6301 335 M _[2] 09M	↓	↓	↓	3.3	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 6301 475 M _[2] 09M	↓	↓	↓	4.7	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	10	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 6301 685 M _[2] 09M	↓	↓	↓	6.8	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.15	0.08	0.15	0.15	8	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 6301 106 M _[2] 09M	↓	↓	↓	10	20	09M	0.6	6	7.9	-15/0	0/+10	0/+15	0.15	0.08	0.15	0.15	8	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 6301 156 M _[2] 09M	↓	↓	↓	15	20	09M	0.9	19	24	-30/0	0/+20	0/+20	0.30	0.20	0.30	0.30	8	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 6301 226 M _[2] 09M	↓	↓	↓	22	20	09M	1.4	28	35	-30/0	0/+20	0/+20	0.40	0.20	0.30	0.30	8	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 6301 226 M _[2] 10S	↓	↓	↓	22	20	10S	1.4	28	35	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 6301 226 M _[2] 12S	↓	↓	↓	22	20	12S	1.4	14	17	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	A	±20	A	A	±20	A	±20	B	B	±30	B
251 M 6301 336 M _[2] 09M	↓	↓	↓	33	20	09M	2.1	42	52	-30/0	0/+20	0/+20	0.40	0.20	0.30	0.30	8	B	±30	A	B	±30	A	±30	B	B	±30	B
251 M 6301 336 M _[2] 10S	↓	↓	↓	33	20	10S	2.1	42	52	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 6301 336 M _[2] 12S	↓	↓	↓	33	20	12S	2.1	42	52	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 6301 476 M _[2] 10M 500	↓	↓	↓	47	20	10M	29.7	297	372	-30/0	0/+15	0/+20	0.60	0.30	0.30	0.40	2	B	±30	C	B	±30	C	±30	C	B	±30	C
251 M 6301 476 M _[2] 10S	↓	↓	↓	47	20	10S	3.0	59	74	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 6301 476 M _[2] 12S	↓	↓	↓	47	20	12S	3.0	59	74	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 6301 476 M _[2] 10A	↓	↓	↓	47	20	10A	3.0	59	74	-30/0	0/+20	0/+20	0.28	0.14	0.28	0.28	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 6301 686 M _[2] 12S	↓	↓	↓	68	20	12S	4.2	85	107	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	0.8	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 6301 686 M _[2] 10A	↓	↓	↓	68	20	10A	4.2	85	107	-30/0	0/+20	0/+20	0.32	0.16	0.32	0.32	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 6301 107 M _[2] 13S	↓	↓	↓	100	20	13S	6.3	126	157	-30/0	0/+20	0/+20	0.48	0.30	0.30	0.30	2	B	±20	A	B	±30	A	±20	B	B	±35	B
251 M 6301 107 M _[2] 10A	↓	↓	↓	100	20	10A	6.3	126	157	-30/0	0/+20	0/+20	0.36	0.18	0.30	0.30	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 6301 107 M _[2] 12A	↓	↓	↓	100	20	12A	6.3	126	157	-30/0	0/+20	0/+20	0.36	0.18	0.30	0.30	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 6301 157 M _[2] 10A	↓	↓	↓	150	20	10A	18	189	237	-20/0	0/+20	0/+25	0.80	0.40	0.50	0.50	2	B	±20	A	B	±20	A	±20	B	D	±30	B
251 M 6301 227 M _[2] 12A	↓	↓	↓	220	20	12A	69	277	347	-15/0	0/+15	0/+20	0.80	0.30	0.30	0.40	1	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 8001 107 M _[2] 13A	8	9.2	6.1	100	20	13A	40.0	80	100	-30/0	0/+20	0/+20	0.60	0.30	0.40	0.40	0.6	B	±30	A	B	±30	A	±30	B	B	±30	B
251 M 1002 474 _[1] _[2] 06U	10	11.5	7.6	0.47	10,20	06U	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	30	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 1002 474 _[1] _[2] 09M	↓	↓	↓	0.47	10,20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 1002 105 _[1] _[2] 06U	↓	↓	↓	1	10,20	06U	0.5	5	6.3	-30/0	0/+20	0/+20	0.18	0.06	0.12	0.12	15	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1002 105 M _[2] 09M	↓	↓	↓	1	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 1002 155 M _[2] 06U	↓	↓	↓	1.5	20	06U	0.5	5	6.3	-30/0	0/+20	0/+20	0.18	0.06	0.12	0.12	15	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1002 155 M _[2] 09M	↓	↓	↓	1.5	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 1002 225 M _[2] 06U	↓	↓	↓	2.2	20	06U	0.5	5	6.3	-30/0	0/+20	0/+20	0.18	0.06	0.12	0.12	15	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1002 225 M _[2] 09M	↓	↓	↓	2.2	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 1002 335 M _[2] 09M	↓	↓	↓	3.3	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 1002 475 M _[2] 06U	↓	↓	↓	4.7	20	06U	2.5	10	12.5	-30/0	0/+20	0/+20	0.36	0.12	0.24	0.24	15	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1002 475 _[1] _[2] 09M	↓	↓	↓	4.7	10,20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	10	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 1002 685 M _[2] 09M	↓	↓	↓	6.8	20	09M	0.7	14	17	-30/0	0/+20	0/+20	0.30	0.20	0.30	0.30	8	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1002 106 M _[2] 09M	↓	↓	↓	10	20	09M	1.0	20	25	-30/0	0/+20	0/+20	0.30	0.20	0.30	0.30	8	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1002 106 M _[2] 10S	↓	↓	↓	10	20	10S	1.0	20	25	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1002 106 M _[2] 12S	↓	↓	↓	10	20	12S	1.0	10	13	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	4	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 1002 156 M _[2] 09M	↓	↓	↓	15	20	09M	1.5	30	38	-30/0	0/+20	0/+20	0.60	0.30	0.45	0.45	8	B	±30	A	B	±30	A	±30	B	B	±30	B
251 M 1002 156 M _[2] 10S	↓	↓	↓	15	20	10S	1.5	30	38	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1002 156 M _[2] 12S	↓	↓	↓	15	20	12S	1.5	15	19	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	A	±20	A	A	±20	A	±20	B	B	±30	B
251 M 1002 226 M _[2] 10M 500	↓	↓	↓	22	20	10M	11	110	138	-30/0	0/+15	0/+20	0.60	0.30	0.30	0.40	2	B	±30	C	B	±30	C	±30	C	B	±30	C
251 M 1002 226 M _[2] 10S	↓	↓	↓	22	20	10S	2.2	44	55	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B

Catalog number[1][2]	Rated voltage	Surge voltage		Capacitance	Tolerance	Case code	Lct. (μA)			Capacitance change (ΔC/C) (%)			Max. Dissipation factor				ESR Ω	Surge			Resistance to soldering heat			Rapid change of temp.&Damp heat		Endurance		
	(VDC)	85℃	125℃	(μF)	(±%)		20℃	85℃	125℃	-55℃	85℃	125℃	-55℃	20℃	85℃	125℃	100 kHz	Lct.[3]	ΔC/C%	DF[4]	Lct.[3]	ΔC/C%	DF[4]	ΔC/C%	DF[4]	Lct.[3]	ΔC/C%	DF[4]
251 M 1002 226 M _[2] 12S	10	11.5	7.6	22	20	12S	2.2	44	55	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1002 336 M _[2] 10S	↓	↓	↓	33	20	10S	3.3	66	82	-30/0	0/+20	0/+20	0.40	0.20	0.30	0.30	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1002 336 M _[2] 13S	↓	↓	↓	33	20	13S	3.3	66	82.5	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1002 336 M _[2] 10A	↓	↓	↓	33	20	10A	3.3	66	82	-30/0	0/+20	0/+20	0.24	0.12	0.24	0.24	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1002 336 M _[2] 12A	↓	↓	↓	33	20	12A	3.3	66	82	-30/0	0/+20	0/+20	0.24	0.12	0.24	0.24	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1002 476 M _[2] 10S	↓	↓	↓	47	20	10S	9.4	94	117	-30/0	0/+20	0/+20	0.60	0.24	0.40	0.40	2	B	±20	A	B	±20	B	±20	B	B	±30	B
251 M 1002 476 M _[2] 13S	↓	↓	↓	47	20	13S	4.7	94	117	-30/0	0/+20	0/+20	0.60	0.30	0.40	0.40	2	B	±30	A	B	±30	B	±30	B	B	±30	B
251 M 1002 476 M _[2] 10A	↓	↓	↓	47	20	10A	4.7	94	117	-30/0	0/+20	0/+20	0.28	0.14	0.28	0.28	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1002 476 M _[2] 12A	↓	↓	↓	47	20	12A	4.7	94	117	-30/0	0/+20	0/+20	0.28	0.14	0.28	0.28	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1002 686 M _[2] 13A	↓	↓	↓	68	20	13A	6.8	136	170	-30/0	0/+20	0/+20	0.30	0.12	0.24	0.24	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1602 474 _[1] _[2] 09M	16	18.4	12.2	0.47	10,20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 1602 105 M _[2] 09M	↓	↓	↓	1	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 1602 155 M _[2] 09M	↓	↓	↓	1.5	20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 1602 225 _[1] _[2] 09M	↓	↓	↓	2.2	10,20	09M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 1602 335 M _[2] 09M	↓	↓	↓	3.3	20	09M	0.5	5.2	6.6	-15/0	0/+10	0/+15	0.20	0.10	0.20	0.20	10	A	±20	A	A	±20	A	±20	B	B	±20	B
251 M 1602 475 M _[2] 09M	↓	↓	↓	4.7	20	09M	0.8	8	9.4	-30/0	0/+20	0/+20	0.24	0.12	0.24	0.24	10	B	±30	A	B	±30	A	±30	B	E	±30	B
251 M 1602 685 M _[2] 10S	↓	↓	↓	6.8	20	10S	1.1	22	27	-30/0	0/+20	0/+20	0.14	0.10	0.10	0.12	4	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1602 685 M _[2] 12S	↓	↓	↓	6.8	20	12S	1.1	22	27	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	2	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 1602 106 M _[2] 10S	↓	↓	↓	10	20	10S	1.6	32	40	-30/0	0/+20	0/+20	0.14	0.10	0.10	0.12	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1602 106 M _[2] 12S	↓	↓	↓	10	20	12S	1.6	32	40	-30/0	0/+20	0/+20	0.14	0.10	0.10	0.12	2	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1602 156 M _[2] 13S	↓	↓	↓	15	20	13S	2.4	48	60	-30/0	0/+20	0/+20	0.18	0.12	0.12	0.14	1.5	B	±20	A	B	±20	A	±20	B	B	±30	B
251 M 1602 226 M _[2] 13A	↓	↓	↓	22	20	13A	3.5	70	88	-30/0	0/+15	0/+20	0.40	0.20	0.30	0.30	2	B	±30	A	B	±30	B	±30	B	B	±30	B
251 M 2002 105 M _[2] 12S	20	23	15.3	1	20	12S	0.5	5	6.3	-15/0	0/+10	0/+15	0.10	0.05	0.10	0.10	8	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 2002 155 M _[2] 12S	↓	↓	↓	1.5	20	12S	0.5	5	6.3	-15/0	0/+10	0/+15	0.10	0.05	0.10	0.10	8	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 2002 225 M _[2] 12S	↓	↓	↓	2.2	20	12S	0.5	5	6.3	-15/0	0/+10	0/+15	0.10	0.05	0.10	0.10	8	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 2502 105 M _[2] 12S	25	28.7	19.1	1	20	12S	0.5	5	6.3	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	6	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 2502 155 _[1] _[2] 12S	↓	↓	↓	1.5	10,20	12S	0.5	5	6.3	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	6	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 2502 335 M _[2] 10S	↓	↓	↓	3.3	20	10S	0.8	8	10	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	6	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 2502 335 M _[2] 12A	↓	↓	↓	3.3	20	12A	0.8	8	10	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	6	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 2502 475 M _[2] 12S	↓	↓	↓	4.7	20	12S	1.2	12	15	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	4	A	±10	A	A	±10	A	±10	B	B	±10	B
251 M 2502 475 M _[2] 09A	↓	↓	↓	4.7	20	09A	1.2	12	15	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	4	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 2502 475 M _[2] 10A	↓	↓	↓	4.7	20	10A	1.2	12	15	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	4	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 2502 685 M _[2] 12A	↓	↓	↓	6.8	20	12A	1.7	17	21	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	4	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 3502 105 M _[2] 12S	35	40.2	26.8	1	20	12S	0.5	5	6.3	-15/0	0/+10	0/+15	0.10	0.05	0.10	0.10	8	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 3502 225 M _[2] 10A	↓	↓	↓	2.2	20	10A	0.8	8	9.6	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	6	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 3502 225 M _[2] 12A	↓	↓	↓	2.2	20	12A	0.8	8	9.6	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	6	A	±15	A	A	±15	A	±15	B	B	±15	B
251 M 3502 335 M _[2] 12A	↓	↓	↓	3.3	20	12A	1.2	12	14	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	6	A	±15	A	A	±15	A	±15	B	B	±15	B

Note1 : Catalog number[1]: For Capacitance Tolerance, insert “K” or “M” into 1.

Note2 : Catalog number[2]: For Reeled Package, insert “R” into 2.

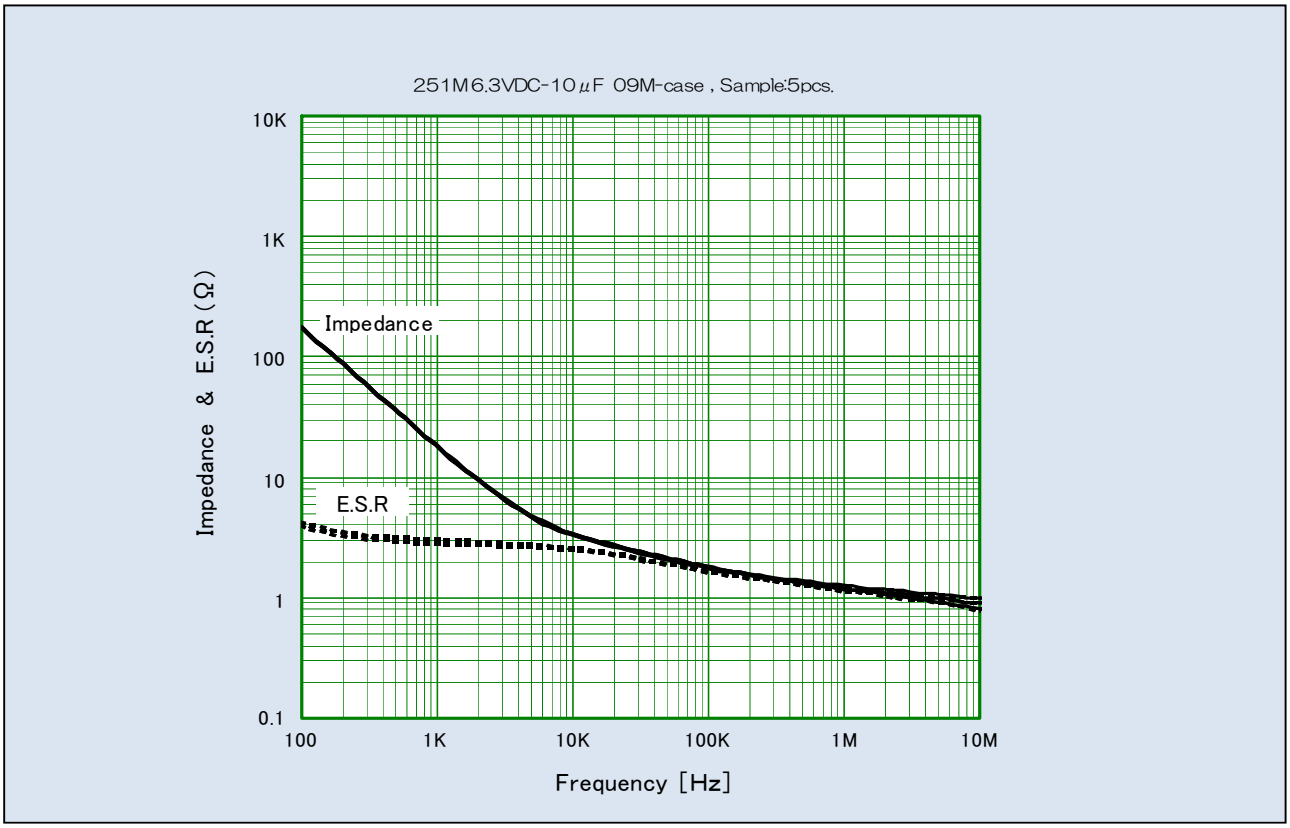
Note3 : Lct.[3] : A=Shall not exceed the value of initial specification., B=Shall not exceed 2 times the value of initial specification. , C=Shall not exceed 4 times the value of initial specification. , D=Shall not exceed 5 times the value of initial specification. , E=Shall not exceed 20 times the value of initial specification.

Note4 : DF[4] : A=Shall not exceed the value of initial specification., B=Shall not exceed 1.5 times the value of initial specification.,C=Shall not exceed 2 times the value of initial specification.

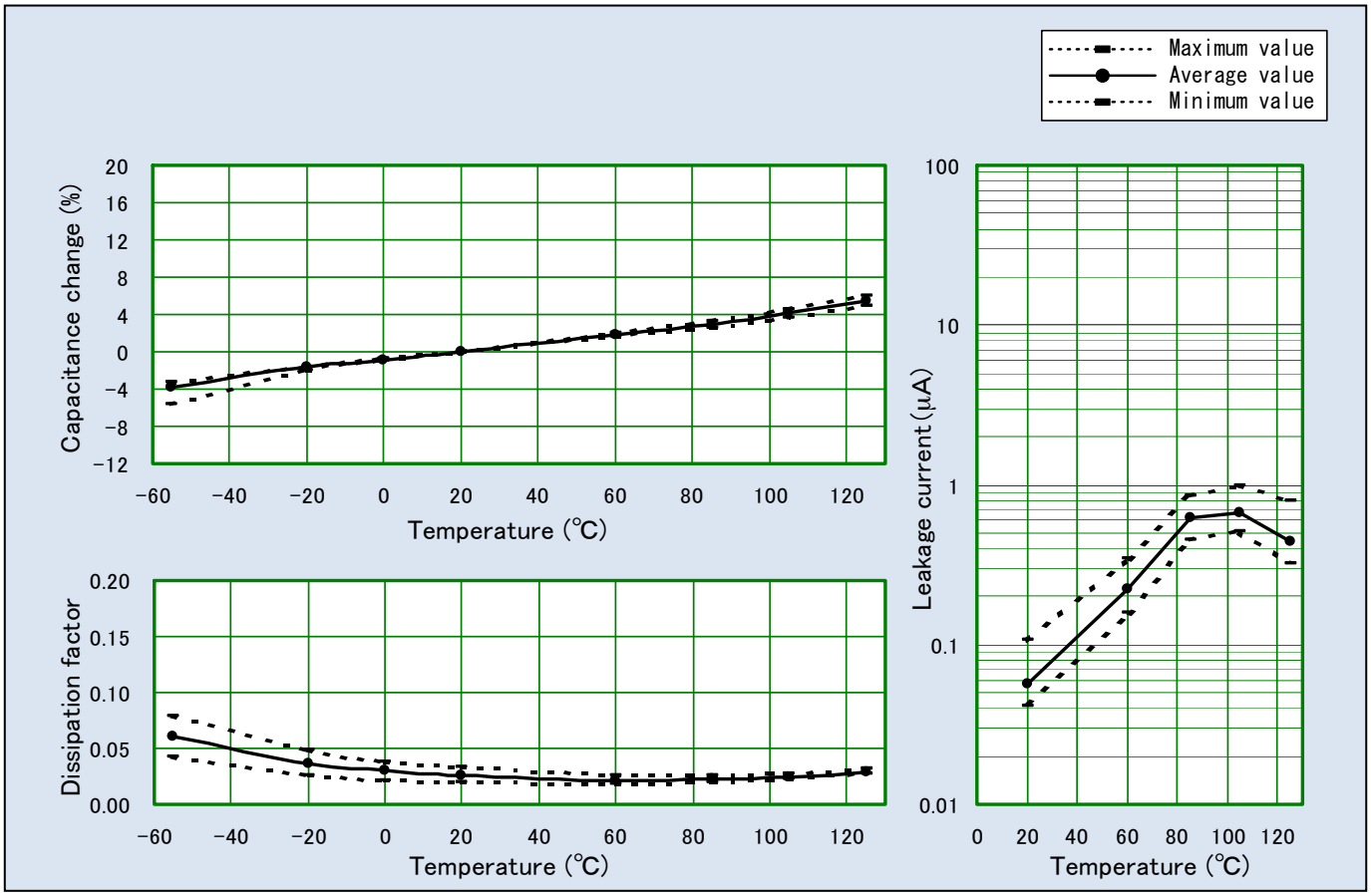
PERFORMANCE

No	Item		Performanc	Test method
1	Leakage Current (μA)		Shall not exceed the values shown in CATALOG NUMBERS AND RATING.	JIS C 5101-1, 4.9 Applied voltage : Rated voltage Duration : 5 min Measuring temperature : Room temperature
2	Capacitance (μF)		Shall be within the specified tolerance.	JIS C 5101-1, 4.7 Measuring frequency : 120 Hz ±20% Measuring voltage : 0.5 Vrms +1.5 to 2 VDC Measuring temperature : Room temperature
3	Dissipation Factor		Shall not exceed the values shown in CATALOG NUMBERS AND RATING.	JIS C 5101-1, 4.8 Measuring frequency : 120 Hz ±20% Measuring voltage : 0.5 Vrms +1.5 to 2 VDC Measuring temperature : Room temperature
4	ESR(Equivalent series resistance)		Shall not exceed the values shown in CATALOG NUMBERS AND RATING.	JIS C 5101-1, 4.8 Measuring frequency : 100kHz ±10% Measuring voltage : 0.5Vrms or less Measuring temperature : Room temperature
5	Characteristics at High and Low Temperature			JIS C 5101-1, 4.29
	Step1	Leakage Current Capacitance Change Dissipation Factor	Shall not exceed the value in No.1. Shall be within the specified tolerance. Shall not exceed the value in No.3.	Measuring temperature : 20 ±2°C
	Step2	Capacitance Change Dissipation Factor	Shown in CATALOG NUMBERS AND RATING. Shall not exceed the values shown in CATALOG NUMBERS AND RATING.	Measuring temperature : -55 ±3°C
	Step3	Leakage Current Capacitance Change Dissipation Factor	Shall not exceed the values shown in CATALOG NUMBERS AND RATING. Shall be within ± 2% of the value at Step 1. Shall not exceed the values shown in CATALOG NUMBERS AND RATING.	Measuring temperature : 20 ±2°C
	Step4	Leakage Current Capacitance Change Dissipation Factor	Shall not exceed the values shown in CATALOG NUMBERS AND RATING. Shown in CATALOG NUMBERS AND RATING. Shall not exceed the values shown in CATALOG NUMBERS AND RATING.	Measuring temperature : 85 ±2°C
	Step5	Leakage Current Capacitance Change Dissipation Factor	Shall not exceed the values shown in CATALOG NUMBERS AND RATING. Shown in CATALOG NUMBERS AND RATING. Shall not exceed the values shown in CATALOG NUMBERS AND RATING.	Measuring temperature : 125 ±2°C Measuring voltage : Derated voltage at 125°C
	Step6	Leakage Current Capacitance Change Dissipation Factor	Shall not exceed the values shown in CATALOG NUMBERS AND RATING. Shown in CATALOG NUMBERS AND RATING. Shall not exceed the values shown in CATALOG NUMBERS AND RATING.	Measuring temperature : 20 ±2°C
6	Surge	Leakage Current Capacitance Change Dissipation Factor Appearance	Shall not exceed the values shown in CATALOG NUMBERS AND RATING. Shown in CATALOG NUMBERS AND RATING. Shall not exceed the values shown in CATALOG NUMBERS AND RATING. There shall be no evidence of mechanical damage.	IS C 5101-1, 4.26 Test temperature and applied voltage : To each half of specimens • 85 ±2°C, rated voltage × 1.15 • 125 ±2°C, 2/3 × rated voltage × 1.15 Series protective resistance : 1000 Ω Discharge resistance : 1000 Ω
7	Shear Test		There shall be no evidence of mechanical damage.	JIS C 5101-1, 4.34 Capacitors mounted under the following conditions are used as specimens. • Indirect heating method (reflow) • Temperature : 240 ±10°C / Time : Less than 10 sec Pressure : Case U : 2N , 1N (Spec. Number 500) Case M, S, A : 5N Duration : 10 ±1 sec
8	Substrate Bending Test(Terminal Strength)	Capacitance Appearance	Initial value to remain steady during measurement. There shall be no evidence of mechanical damage.	JIS C 5101-1, 4.35 Bending : 1 mm
9	Vibration (Vibration Resistance)	Capacitance Appearance	Initial value to remain steady during measurement. There shall be no evidence of mechanical damage.	JIS C 5101-1, 4.17 Frequency range : 10 ~ 55 Hz Swing width : 1.5 mm Vibration direction : 3 directions with mutually right-angled Duration : 2 hours in each of these mutually perpendicular directions (total 6 hours) Mounting : Solder terminal to the printed board
10	Shock		There shall be no intermittent contact of 0.5 ms or greater, short, or open. Nor shall there be any spark discharge, insulation breakdown, or evidence of mechanical damage.	JIS C 5101-1, 4.19 Peak acceleration : 490 m/s^2 Duration : 11 ms Wave form : Half-sine
11	Solderability		Solder shall completely cover the terminal surface (there shall be no pin holes,Non-wetting or solder repelling).	JIS C 5101-1, 4.15 Solder temperature : 235 ±5°C Dipping time : 2 ±0.5 sec Dipping depth : Terminal shall be dipped into melted solder.
12	Resistance to Soldering Heat	Leakage Current Capacitance Change Dissipation Factor Appearance	Shall not exceed the values shown in CATALOG NUMBERS AND RATING. Shown in CATALOG NUMBERS AND RATING. Shall not exceed the values shown in CATALOG NUMBERS AND RATING. There shall be no evidence of mechanical damage.	IR reflow method Preheating : 130 to 160°C for about 60 sec Reflow : 200°C, less than 60 sec, 260°C max. Number of cycles : 2
13	Component solvent resistance	Leakage Current Capacitance Change Dissipation Factor	Shall not exceed the values shown in CATALOG NUMBERS AND RATING. Within ±15% of initial value Shall not exceed the values shown in CATALOG NUMBERS AND RATING.	JIS C 5101-1, 4.31 Temperature : 23 ±5℃ Dipping time : 5 ±0.5 min. Conditioning : JIS C 0052 method 2 Solvent : Isopropyl alcohol
14	Solvent resistance of marking	Appearance	After the test the marking shall be legible.	JIS C 5101-1, 4.32 Temperature : 23 ±5℃ Dipping time : 5 ±0.5 min. Conditioning : JIS C 0052 method 1 Solvent : Isopropyl alcohol Rubbing material : cotton wool
15	Rapid change of temperature	Leakage Current Capacitance Change Dissipation Factor Appearance	Shall not exceed the values shown in CATALOG NUMBERS AND RATING. Shown in CATALOG NUMBERS AND RATING. Shall not exceed the values shown in CATALOG NUMBERS AND RATING. There shall be no evidence of mechanical damage.	JIS C 5101-1, 4.16 Number of cycles : 5 Step 1 : -55 ±3℃,30 ±3 min. Step 2 : 25$^{+10}_{-5}$ ℃,3 min. max. Step 3 : +125 ±2℃,30 ±3 min. Step 4 : 25$^{+10}_{-5}$ ℃,3 min. max.
16	Damp heat , steady state	Leakage Current Capacitance Change Dissipation Factor Appearance	Shall not exceed the values shown in CATALOG NUMBERS AND RATING. Shown in CATALOG NUMBERS AND RATING. Shall not exceed the values shown in CATALOG NUMBERS AND RATING. There shall be no evidence of mechanical damage.	JIS C 5101-1, 4.22 Temperature : 40 ±2℃ Moisture : 90 to 95% R.H. Duration : 500 $^{+24}_{0}$ h
17	Endurance	Leakage Current Capacitance Change Dissipation Factor Appearance	Shall not exceed the values shown in CATALOG NUMBERS AND RATING. Shown in CATALOG NUMBERS AND RATING. Shall not exceed the values shown in CATALOG NUMBERS AND RATING. There shall be no evidence of mechanical damage, and marking shall be legible.	JIS C 5101-1, 4.23 Test temperature and applied voltage :85±°C and rated voltage or125 ±3°C and 2/3×rated voltage Duration : 2000$^{+72}_{0}$ hrs Power supply impedance : 3Ω or less

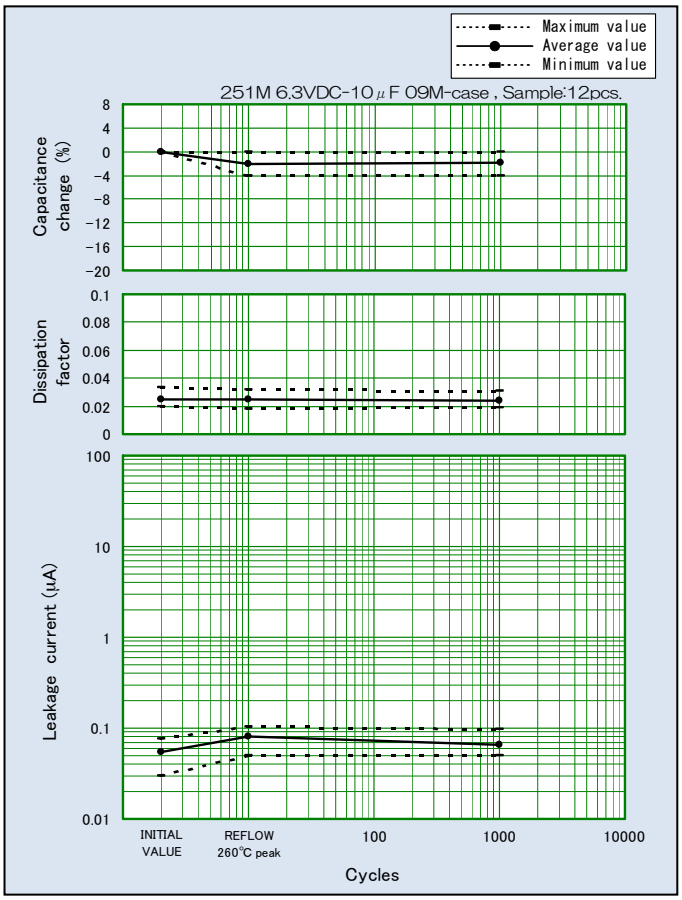
FREQUENCY CHARACTERISTICS



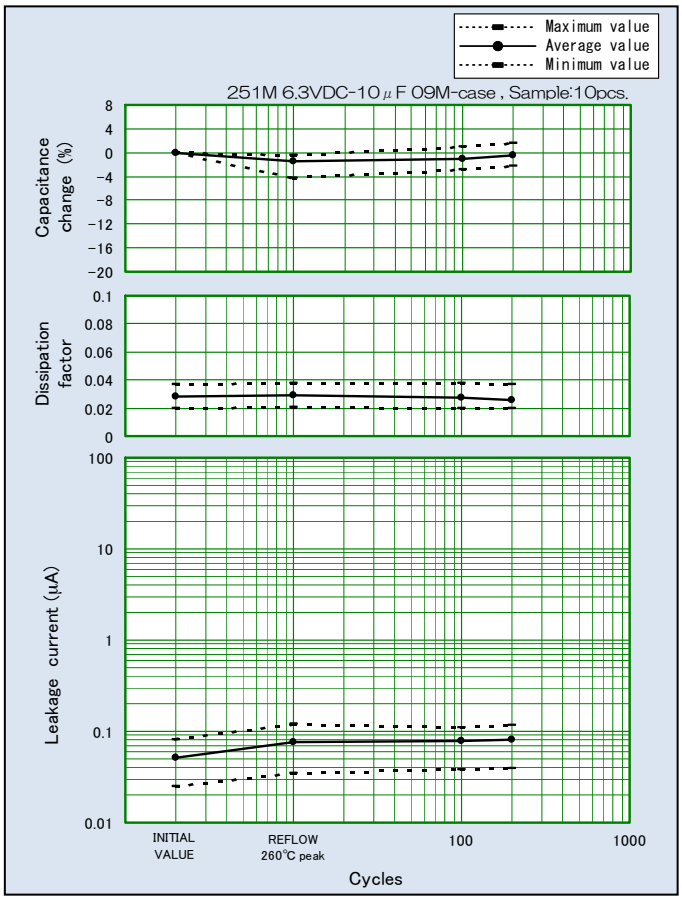
TEMPERATURE CHARACTERISTICS



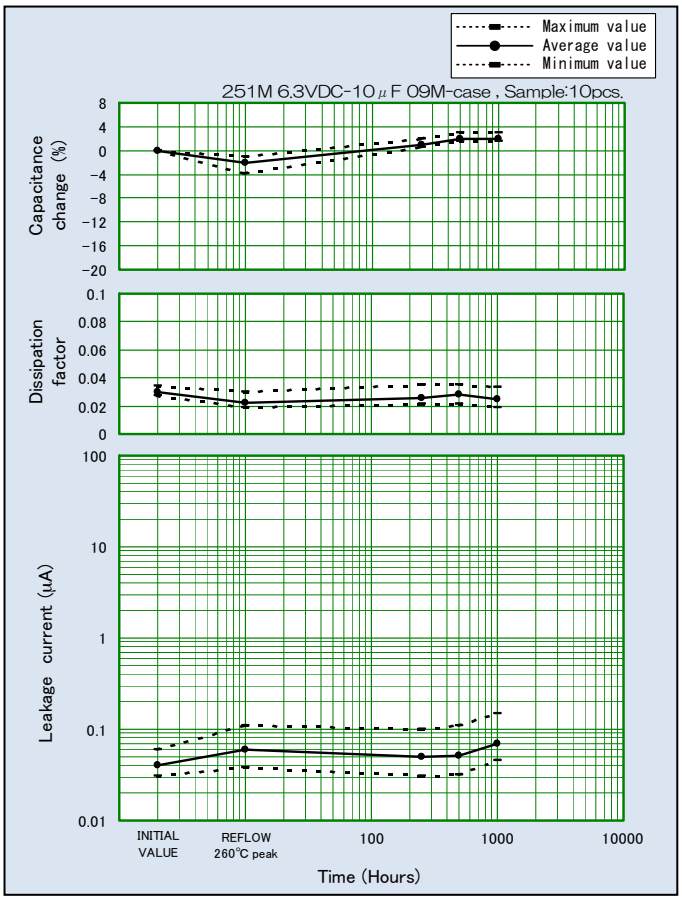
SURGE VOLTAGE 85℃,RATED VOLTAGE×1.15



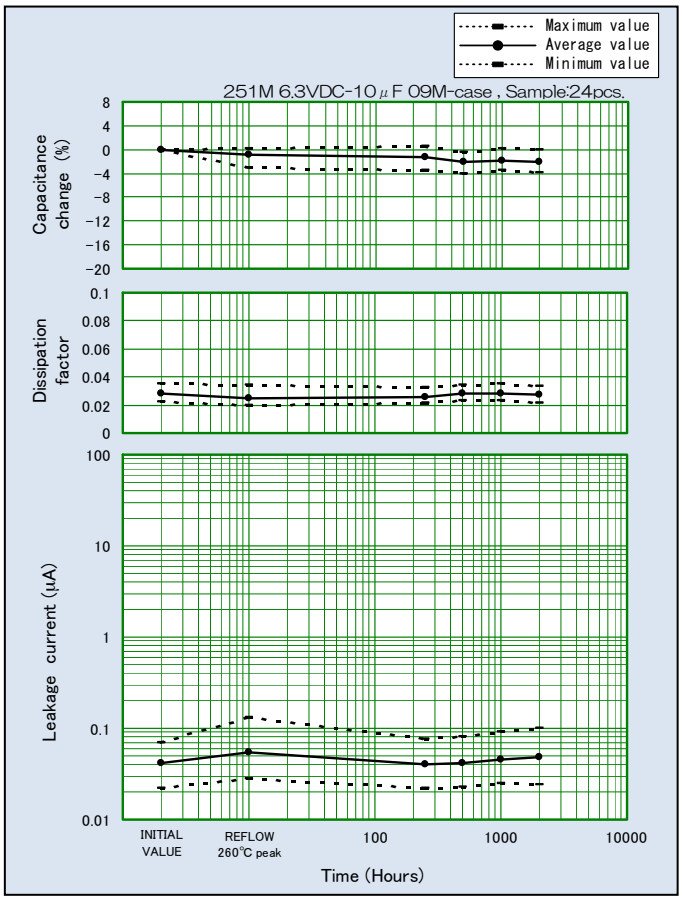
THERMAL SHOCK -55/+125℃



MOISTURE RESISTANCE 40℃,95%RH



HIGH TEMPERATURE LOAD 85℃,RATED VOLTAGE



Application Notes for Tantalum Solid Electrolytic Capacitor

1. Operating Voltage

Tantalum Solid Electrolytic Capacitor shall be operated at the rated voltage or lower.
Rated voltage: The "rated voltage" refers to the maximum DC voltage that is allowed to be continuously applied between the capacitor terminals at the rated temperature.
Surge voltage: The "surge voltage" refers to the voltage that is allowed to be instantaneously applied to the capacitor at the rated temperature or the maximum working temperature. The capacitor shall withstand the voltage when a 30-second cycle of application of the voltage through a 1000 Ω series resistance is repeated 1000 times in 6-minute periods.
When designing the circuit, the equipment's required reliability must be considered and appropriate voltage derating must be performed.

2. Application that contain AC Voltage

Special attention to the following 3 items.
(1) The sum of the DC bias voltage and the positive peak value of the AC voltage should not exceed the rated voltage.
(2) Reverse voltage should not exceed the allowable values of the negative peak AC voltage.
(3) Ripple current should not exceed the allowable values.

3. Reverse Voltage

Tantalum solid electrolytic capacitor is polarity. Please do not impress reverse voltage. As well, please confirm the potential of the tester beforehand when both ends of the capacitor are checked with the tester etc.

4. Permissible Ripple Current

The permissible ripple current and voltage at about 100 kHz or higher can be determined by the following formula from the permissible power loss (Pmax value)shown in Table 1 and the specified ESR value. However, when the expected
operating temperature is higher than room temperature, determine the permissible values multiplying the Pmax value by the specified multiplier (Table 2). For the permissible values at different frequencies, consult our Sales Department.

$P=I^2 \times ESR$ or $P=\frac{E^2 \times ESR}{Z^2}$

Permissible ripple current $Imax=\sqrt{\frac{P\max}{ESR}}\ (Arms)$

Permissible ripple voltage $Emax=\sqrt{\frac{P\,max}{ESR}} \times Z$

$= Imax \times Z\ (Vrms)$

Imax : Permissible ripple current at regulated frequency (Arms : RMS value)
Emax : Permissible ripple voltage at regulated frequency (Vrms : RMS value)
Pmax : Permissible power loss (W)
ESR : Specified ESR value at regulated frequency (Ω)
Z : Impedance at regulated frequency (Ω)

Table 1 Permissible power loss

Case size	Pmax（W）
06U	0.030
09M	0.050
09M,10M（Specification Number 500）	0.057
09S,10S,12S,13S	0.065
09A,10A,12A,13A	0.078

Table 2 Pmax multiplier at each operating temperature

Operating temperature（℃）	Multiplier
25	1.0
55	0.9
85	0.8
125	0.4

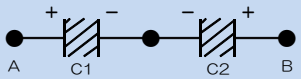
Note: Above values are measured at 0.8t glass epoxy board mounting in free air and may be changed depending on the kind of board, packing density, and air convection condition. Please consult us if calculated power loss value is different from above list of P max value.

5. Application on low-impedance circuit

The failure rate of low impedance circuit at 0.1Ω/V is about five times greater than that of a 1Ω/V circuit. To curtail this higher failure rate, tantalum capacitors used in low impedance circuits, such as filters for power supplies, particularly switching power supplies, or for noise by-passing, require that operating voltage be derated to less than half of the rated voltage. Actually, less than 1/3 of the rated voltage is recommended.

6. Non Polar Application(BACK TO BACK)

Tantalum capacitors can be used as a non-polar unit if two capacitors are connected "BACK-TO-BACK" when reserve voltage is applied at a more than permissible value, or in a purely AC circuit. The two capacitors should both be of the same rated voltage and capacitance tolerance, and they should both be twice the required capacitance value.



Ripple Voltage: Permissible Ripple Voltage shall not exceed the value allowed for either C1 or C2 (This will be the same, as the capacitors should be identical.)
Capacitance: (C1 × C2) / (C1 + C2)
Leakage Current: If terminal A is (+), the Leakage Current will be equal to C1's Leakage Current.
If terminal B is (+), the Leakage Current will be equal to C2's Leakage Current.

7. Soldering

7.1. Preheating

To obtain optimal reliability and solderability conditions, capacitors should be pre-heated at 130 to 200 °C for approximately 60 to 120 seconds.

7.2. Soldering

The body of the capacitor shall not exceed 260 °C during soldering.
(1) Reflow Soldering
Reflow soldering is a process in which the capacitors are mounted on a printed board with solder paste. There are two methods of Reflow Soldering: Direct and Atmospheric Heat.
· Direct Heat (Hot plate)
During the Direct Heat method, the capacitor has been positioned on a printed board, which is then placed upon a hot plate. The capacitor maintains a lower temperature than the substrate, which in turn stays at a lower temperature than the hot plate.

· Atmospheric Heat

a) VPS (Vapor Phase Soldering)

During VPS,the substrate is heated by an inert liquid with a high boiling point. The temperature of the capacitor's body and the temperature of the substrate are about the same as the atmosphere. This temperature should be below 240°C.

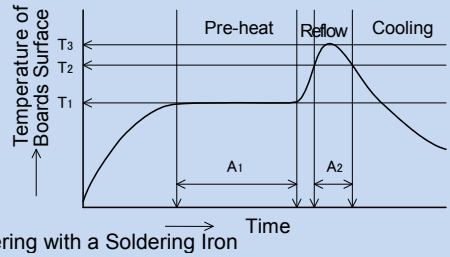
b) Near and Far IR Ray

Due to the heat absorption of the capacitor's body, the internal temperature of the capacitors may be 20 ~ 30°C higher than the setting temperature and may exceed 260°C.

Temperature control is crucial in maintaining a temperature of 260 °C or lower.

c) Convention Oven

An infrared ray is the main source of heat in this process. The temperature of the substrate and the capacitors can be maintained at a similar level by the circulation of heated air, or an inert gas.



Temperature	Time
T1=130℃～200℃	A1= 60～120sec.
T2=220℃～230℃	A2＜60sec.
T3=～260℃	10 sec. or less than 10

Number of times：2 times max..

(2) Soldering with a Soldering Iron

Soldering with a soldering iron cannot be recommended due to the lack of consistency in maintaining temperatures and process times. If this method should be necessary, the iron should never touch the capacitor's terminals, and the temperature of the soldering iron should never exceed 350°C. The application of the iron should not exceed 5 seconds.

(3) Please consult us for other methods.

8. Cleaning

Cleaning by organic solvent may damage capacitor's appearance and performance.However, our capacitors are not effected even when soaked at 20 ~ 30°C 2-propanol for 5 minutes. When introducing new cleaning methods or changing the cleaning term, please consult us.

9. Protective Resin Coating

After components are assembled to substrate, a protective resin coating is sometimes applied. As this resin coating cures, it gives mechanical and thermal stress to Tantalum capacitors. This stress can cause damage to the capacitors, which affects their reliability. Before using a resin coating, proper research must be done in regards to the material and process to insure that excessive stress will not be applied to capacitors and other components.

10. Vibration

Approximately 300 G shall be applied to a capacitor, when dropped from 1 meter to a concrete floor.
Although capacitors are made to withstand this drop test, stress from shock due to falling or striking does cause damage to the capacitors and increases failure rates. Do not subject capacitors to this type of mechanical stress.

11. Ultrasonic cleaning

Matsuo does not recommend Ultrasonic cleaning. This may cause damage to the capacitors, and may even cause broken terminals. If the Ultrasonic cleaning process will be used, please note the following:
(1)The solvent should not be boiled. (Lower the ultrasonic wave output or use solvent with The high boiling point.)
(2)The recommended wattage is less than 0.5 watts per cm^2.
(3)The cleaning time should be kept to a minimum. Also, samples must be swang in the solvlent. Please consult us.

12. Additional Notes

· When more than one capacitor is connected in series, a resistor that can distribute the voltage equally to the capacitors shall be connected in parallel.
· The capacitor cases shall not be cut even if the mounting space is insufficient.
· During a customers aging process, voltage should remain under the rated voltage at all times.
· Capacitors should never be touched or manipulated while operating.
· Capacitors are not meant to be dismantled.
· When testing capacitors, please examine the power source before conducting test to insure the tester's polarity and applied voltage.
· In the event of a capacitor burning, smoking, or emitting an offensive smell during operation, please turn the circuit "off" and keep hands and face away from the burning capacitor.
· If a capacitor be electrical shorted, it becomes hot, and the capacitor element may ignite. In this case, the printed board may be burnt out.
· Capacitors should be stored at room temperature under low humidity. Capacitors should never be stored under direct sunlight, and should be stored in an environment containing dust.
· If the capacitors will be operated in a humid environment, they should be sealed with a compound under proper conditions.
· Capacitors should not be stored or operated in environments containing acids, alkalis or active gasses.
· When capacitors are disposed of as "scrap" or waste, they should be treated as Industria Waste since they contain various metals and polymers.
· Capacitors submitted as samples should not be used for production purposes.

These application notes are prepared based on "Guideline of notabilia for fixed tantalum electrolytic capacitors with solid electrolyte for use in electronic equipment" (EIAJ RCR-2368) issued by Japan Electronics and Information Technology Industries Association (JEITA). For the details of the instructions (explanation, reasons and concrete examples), please refer to this guideline, or consult our Sales Department.

MATSUO ELECTRIC CO., LTD.

Please feel free to ask our Sales Department for more information on Tantalum Solid Electrolytic Capacitor.

Overseas Sales 5-3,3-Chome,Sennari-cho,Toyonaka-shi,Osaka 561-8558,Japan Tel:06-6332-0883 Fax:06-6332-0920
Head office 5-3,3-Chome,Sennari-cho,Toyonaka-shi,Osaka 561-8558,Japan Tel:06-6332-0871 Fax:06-6331-1386
URL http://www.ncc-matsuo.co.jp/