No. P-251-007
DATE 2008-10

PRODUCTS DATA SHEET

Face-down terminal structure

TANTALUM SOLID ELECTROLYTIC CAPACITOR

RoHS COMPLIANT
LEAD FREE

Type 251

MATSUO ELECTRIC CO., LTD.

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 and PHS, digital video cameras, digital still cameras and portable AV equipment. The tantalum capacitors designed for high-density mounting will considerably contribute to miniaturization and improvement of performance of these portable multimedia devices.

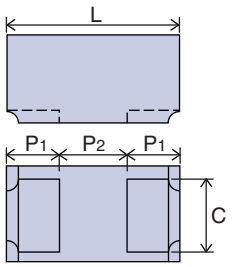
FEATURES

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 3528L are applicable to a wide capacitance range from 1 to 330 µF.
3. This type of capacitors is suitable for ultra miniaturized, such as DVC, DSC and PCMCIA cards, and high-function compact portable devices, such as mobile phones and PHS.
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 OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS.
Capacitance	1.0 ~ 330 µF	
Capacitance Tolerance	± 20%(M), ± 10%(K)	
Failure Rate Level	1%/1000 h	85°C, rated voltage, 1000 hrs., Circuit resistance of 0.5 Ω/V

DIMENSIONS



[STANDARD PRODUCTS] (mm)

Case Code	EIA Code	Max. height	L ± 0.1	W ± 0.1	T ± 0.1	P1 ± 0.1	P2 ± 0.1	C ± 0.1
U	1005	0.55	1.05 ± 0.05	0.55 ± 0.05	0.5 ± 0.05	0.3	0.45	0.4
M	1608	0.9	1.6	0.85	0.8	0.5	0.65	0.7
S	2012	1.2	2.0	1.25	1.1	0.5	1.05	0.9
A	3216L	1.2	3.2	1.6	1.1	0.8	1.65	1.2
B	3528L	1.2	3.5	2.8	1.1	0.8	1.95	2.2

[LOW PROFILE PRODUCTS] (mm)

Case Code	EIA Code	Max. height	L ± 0.1	W ± 0.1	T ± 0.1	P1 ± 0.1	P2 ± 0.1	C ± 0.1
S	2012	1.0	2.0	1.25	0.9	0.5	1.05	0.9
A	3216L	1.0	3.2	1.6	0.9	0.8	1.65	1.2
B	3528L	1.0	3.5	2.8	0.9	0.8	1.95	2.2

[CUSTOM PRODUCTS] (mm)

Case Code	EIA Code	Max. height	L ± 0.1	W ± 0.1	T ± 0.1	P1 ± 0.1	P2 ± 0.1	C ± 0.1
S	2012	1.3	2.0	1.25	1.2	0.5	1.05	0.9
A	3216L	0.9	3.2	1.6	0.8	0.8	1.65	1.2
		1.3	3.2	1.6	1.2	0.8	1.65	1.2

※The component height varies according to rating. For the details, see CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS, LOW PROFILE PRODUCTS or CUSTOM PRODUCTS.

ORDERING INFORMATION

251	M	4001	107	M	R	0	S
TYPE	SERIES	RATED VOLTAGE	CAPACITANCE	CAPACITANCE TOLERANCE	STYLE OF REELED PACKAGE	HEIGHT	CASE CODE

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

Marking	Capacitance
105	1 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

(Taping specification)

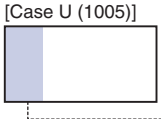
Code	Reel size	Anode notation
R	φ180	Feed hole: –

Case code	Max. height (mm)	Height code
U	0.55	Blank
M	0.9	Blank
S	1.3	3
	1.2	2
	1.0	0
A	1.3	3
	1.2	2
	1.0	0
	0.9	9
B	1.2	2
	1.0	0

Case code	EIA Code
U	1005
M	1608
S	2012
A	3216L
B	3528L

MARKING

[Case U (1005)]

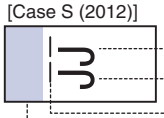


Polarity (anode notation)
Mark anode notation only.

[Case M (1608)]

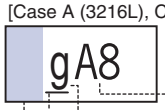
Rated Voltage (1)
Polarity
(anode notation)

[Case S (2012)]



Capacitance (2)
Rated Voltage (1)
Capacitance Tolerance
(Without bar : ±20%
With bar : ±10%)
Polarity (anode notation)

[Case A (3216L), Case B (3528L)]



Capacitance (3)
Rated Voltage (1)
Capacitance Tolerance
(Without bar : ±20%
With bar : ±10%)
Polarity (anode notation)

(1) The rated voltage is indicated with one alphabetic letter.

Rated voltage (VDC)	2.5	4	6.3	10	16	20	25	35
Rated voltage code	e	G*	J*	A	C	D	E	V

* The rated voltage of case A, B is indicated with a small letter g (4 V) or j (6.3 V).

(2) The capacitance is indicated with one alphabetic letter or the alphabetic letter with an overbar or underbar.

Capacitance (µF)	1	1.5	2.2	3.3	4.7	6.8
Code	A	E	J	N	S	W

To indicate a capacitance not listed above, _ (1/10), ¯ (10 times) or = (100 times) is used. (Ex.: J indicates 1/10 of J (2.2), 0.22).

(3) The capacitance is indicated with one alphabetic letter and one numeral.

Code	A6	E6	J6	N6	S6	W6
Capacitance (µF)	1.0	1.5	2.2	3.3	4.7	6.8
Code	A7	E7	J7	N7	S7	W7
Capacitance (µF)	10	15	22	33	47	68
Code	A8	E8	J8	N8	S8	W8
Capacitance (µF)	100	150	220	330	470	680

CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS

October, 2008

Catalog number (1) (2)	Rated voltage (VDC)	Surge voltage (VDC)		Capacitance (μF)	Tolerance (±%)	Case code	Lct. (μA)			Capacitance change (ΔC/C) (%)			Max. Dissipation factor				ESR Ω	Surge		Resistance to soldering heat		Rapid change of temperature high temperature/Moisture	Endurance
		85°C	125°C				20°C	85°C	125°C	-55°C	85°C	125°C	-55°C	20°C	85°C	125°C	100 kHz	Lct. (3)	ΔC/C %	Lct. (3)	ΔC/C %	ΔC/C%	ΔC/C%
251 M 2001 475 M _2 U	2	2.3	1.5	4.7	20	U	0.5	5	6.3	-30/0	0/+20	0/+20	0.36	0.12	0.24	0.24	15	B	± 20	B	± 20	± 20	± 30
251 M 2001 106 M _2 U	↓	↓	↓	10	20	U	0.5	5	6.3	-30/0	0/+20	0/+20	0.45	0.15	0.30	0.30	↓	B	± 20	B	± 20	± 20	± 30
251 M 2501 106 M _2 U	2.5	2.8	1.9	10	20	U	0.5	5	6.3	-30/0	0/+20	0/+20	0.45	0.15	0.30	0.30	15	B	± 20	B	± 20	± 20	± 30
251 M 2501 107 M _2 2S	↓	↓	↓	100	20	S	2.5	50	62	-30/0	0/+20	0/+20	0.40	0.20	↓	↓	4	B	± 20	A	± 20	± 20	± 30
251 M 2501 157 M _2 2S	↓	↓	↓	150	20	S	3.7	75	93	-30/0	0/+20	0/+20	↓	↓	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 2501 227 M _2 2S	↓	↓	↓	220	20	S	5.5	110	137	-30/0	0/+20	0/+20	0.60	0.30	0.36	0.36	2	B	± 20	B	± 20	± 20	± 30
251 M 2501 337 M _2 2A	↓	↓	↓	330	20	A	8.2	165	206	-30/0	0/+20	0/+20	↓	↓	0.40	0.40	1	B	± 20	B	± 20	± 20	± 30
251 M 3001 225 M _2 U	3	3.45	2.3	2.2	20	U	0.5	5	6.3	-30/0	0/+20	0/+20	0.18	0.06	0.12	0.12	15	B	± 20	B	± 20	± 20	± 30
251 M 3001 106 M _2 U	↓	↓	↓	10	20	U	0.5	5	6.3	-30/0	0/+20	0/+20	0.45	0.15	0.30	0.30	↓	B	± 20	B	± 20	± 20	± 30
251 M 4001 105 M _2 M	4	4.6	3	1	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	± 15	A	± 15	± 15	± 15
251 M 4001 155 M _2 M	↓	↓	↓	1.5	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	↓	↓	↓	↓	↓	A	± 15	A	± 15	± 15	± 15
251 M 4001 225 M _2 M	↓	↓	↓	2.2	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	↓	↓	↓	↓	↓	A	± 15	A	± 15	± 15	± 15
251 M 4001 335 M _2 M	↓	↓	↓	3.3	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	↓	↓	↓	↓	↓	A	± 15	A	± 15	± 15	± 15
251 M 4001 475 _1 _2 U	↓	↓	↓	4.7	10,20	U	0.5	5	6.3	-30/0	0/+20	0/+20	0.36	0.12	0.24	0.24	↓	B	± 20	B	± 20	± 20	± 30
251 M 4001 475 M _2 M	↓	↓	↓	4.7	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	10	A	± 15	A	± 15	± 15	± 15
251 M 4001 685 M _2 U	↓	↓	↓	6.8	20	U	0.5	5	6.3	-30/0	0/+20	0/+20	0.36	0.12	0.24	0.24	15	B	± 20	B	± 20	± 20	± 30
251 M 4001 685 M _2 M	↓	↓	↓	6.8	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	0.15	0.08	0.15	0.15	8	A	± 15	A	± 15	± 15	± 15
251 M 4001 106 M _2 U	↓	↓	↓	10	20	U	0.5	5	6.3	-30/0	0/+20	0/+20	0.45	0.15	0.30	0.30	15	B	± 20	B	± 20	± 20	± 30
251 M 4001 106 M _2 M	↓	↓	↓	10	20	M	0.5	8	10	-15/0	0/+10	0/+15	0.15	0.08	0.15	0.15	8	A	± 15	A	± 15	± 15	± 15
251 M 4001 156 M _2 M	↓	↓	↓	15	20	M	0.6	12	15	-30/0	0/+20	0/+20	0.30	0.20	0.30	0.30	↓	B	± 20	B	± 20	± 20	± 30
251 M 4001 226 _1 _2 M	↓	↓	↓	22	10,20	M	0.9	18	22	-15/0	0/+10	0/+15	↓	0.106	↓	↓	4	A	± 15	A	± 15	± 15	± 15
251 M 4001 336 M _2 M	↓	↓	↓	33	20	M	1.3	26	33	-30/0	0/+20	0/+20	0.40	0.20	↓	↓	4	B	± 20	B	± 20	± 20	± 30
251 M 4001 476 M _2 2S	↓	↓	↓	47	20	S	1.9	38	47	-15/0	0/+10	0/+15	0.30	0.15	↓	↓	↓	A	± 15	A	± 15	± 15	± 15
251 M 4001 686 M _2 2S	↓	↓	↓	68	20	S	2.7	54	68	-30/0	0/+20	0/+20	0.40	0.20	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 4001 107 M _2 2S	↓	↓	↓	100	20	S	4.0	80	100	-30/0	0/+20	0/+20	↓	↓	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 4001 157 M _2 2A	↓	↓	↓	150	20	A	6.0	120	150	-30/0	0/+20	0/+20	0.48	0.24	↓	↓	2	B	± 20	B	± 20	± 20	± 30
251 M 4001 227 _1 _2 2A	↓	↓	↓	220	10,20	A	8.8	176	220	-30/0	0/+20	0/+20	↓	↓	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 4001 227 M _2 2B	↓	↓	↓	220	20	B	8.8	176	220	-30/0	0/+20	0/+20	0.32	0.16	0.32	0.32	1	B	± 20	B	± 20	± 20	± 30
251 M 6301 105 _1 _2 U	6.3	7.2	4.8	1	10,20	U	0.5	5	6.3	-30/0	0/+20	0/+20	0.18	0.06	0.12	0.12	15	B	± 20	B	± 20	± 20	± 30
251 M 6301 105 M _2 M	↓	↓	↓	1	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	↓	A	± 15	A	± 15	± 15	± 15
251 M 6301 155 M _2 M	↓	↓	↓	1.5	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	↓	↓	↓	↓	↓	A	± 15	A	± 15	± 15	± 15
251 M 6301 225 M _2 U	↓	↓	↓	2.2	20	U	0.5	5	6.3	-30/0	0/+20	0/+20	0.18	0.06	0.12	0.12	↓	B	± 20	B	± 20	± 20	± 30
251 M 6301 225 M _2 M	↓	↓	↓	2.2	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	↓	A	± 15	A	± 15	± 15	± 15
251 M 6301 335 M _2 U	↓	↓	↓	3.3	20	U	0.5	5	6.3	-30/0	0/+20	0/+20	0.30	0.10	0.20	0.20	↓	B	± 20	B	± 20	± 20	± 30
251 M 6301 335 M _2 M	↓	↓	↓	3.3	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	↓	A	± 15	A	± 15	± 15	± 15
251 M 6301 475 M _2 U	↓	↓	↓	4.7	20	U	0.5	5	6.3	-30/0	0/+20	0/+20	0.36	0.12	0.24	0.24	↓	B	± 20	B	± 20	± 20	± 20
251 M 6301 475 M _2 M	↓	↓	↓	4.7	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	10	A	± 15	A	± 15	± 15	± 15
251 M 6301 685 M _2 M	↓	↓	↓	6.8	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	0.15	0.08	0.15	0.15	8	A	± 15	A	± 15	± 15	± 15
251 M 6301 106 M _2 M	↓	↓	↓	10	20	M	0.6	6	7.9	-15/0	0/+10	0/+15	↓	↓	↓	↓	↓	A	± 15	A	± 15	± 15	± 15
251 M 6301 156 M _2 M	↓	↓	↓	15	20	M	0.9	19	24	-30/0	0/+20	0/+20	0.30	0.20	0.30	0.30	↓	B	± 20	B	± 20	± 20	± 30
251 M 6301 226 M _2 M	↓	↓	↓	22	20	M	1.4	28	35	-30/0	0/+20	0/+20	0.40	↓	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 6301 226 M _2 2S	↓	↓	↓	22	20	S	1.4	14	17	-30/0	0/+20	0/+20	0.30	0.15	↓	↓	4	A	± 20	A	± 20	± 20	± 30
251 M 6301 336 M _2 2S	↓	↓	↓	33	20	S	2.1	42	52	-30/0	0/+20	0/+20	↓	↓	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 6301 476 M _2 2S	↓	↓	↓	47	20	S	3.0	59	74	-30/0	0/+20	0/+20	↓	↓	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 6301 686 M _2 2S	↓	↓	↓	68	20	S	4.2	85	107	-30/0	0/+20	0/+20	↓	↓	↓	↓	0.8	B	± 20	B	± 20	± 20	± 30
251 M 6301 107 M _2 2A	↓	↓	↓	100	20	A	6.3	126	157	-30/0	0/+20	0/+20	0.36	0.18	0.32	0.32	2	B	± 20	B	± 20	± 20	± 30
251 M 6301 157 M _2 2B	↓	↓	↓	150	20	B	9.5	189	236	-30/0	0/+20	0/+20	0.28	0.14	0.28	0.28	1	B	± 20	B	± 20	± 20	± 30
251 M 1002 105 _1 _2 U	10	11.5	7.6	1	10,20	U	0.5	5	6.3	-30/0	0/+20	0/+20	0.18	0.06	0.12	0.12	15	B	± 20	B	± 20	± 20	± 30
251 M 1002 105 M _2 M	↓	↓	↓	1	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	↓	A	± 15	A	± 15	± 15	± 15
251 M 1002 155 M _2 U	↓	↓	↓	1.5	20	U	0.5	5	6.3	-30/0	0/+20	0/+20	0.18	0.06	0.12	0.12	↓	B	± 20	B	± 20	± 20	± 30
251 M 1002 155 M _2 M	↓	↓	↓	1.5	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	↓	A	± 15	A	± 15	± 15	± 15
251 M 1002 225 M _2 U	↓	↓	↓	2.2	20	U	0.5	5	6.3	-30/0	0/+20	0/+20	0.18	0.06	0.12	0.12	↓	B	± 20	B	± 20	± 20	± 30
251 M 1002 225 M _2 M	↓	↓	↓	2.2	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	↓	A	± 15	A	± 15	± 15	± 15
251 M 1002 335 M _2 M	↓	↓	↓	3.3	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	↓	↓	↓	↓	↓	A	± 15	A	± 15	± 15	± 15
251 M 1002 475 M _2 M	↓	↓	↓	4.7	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	10	A	± 15	A	± 15	± 15	± 15
251 M 1002 685 M _2 M	↓	↓	↓	6.8	20	M	0.7	14	17	-30/0	0/+20	0/+20	0.30	0.20	0.30	0.30	8	B	± 20	B	± 20	± 20	± 30
251 M 1002 106 M _2 M	↓	↓	↓	10	20	M	1.0	20	25	-30/0	0/+20	0/+20	↓	↓	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 1002 106 M _2 2S	↓	↓	↓	10	20	S	1.0	10	13	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	4	A	± 15	A	± 15	± 15	± 15
251 M 1002 156 M _2 2S	↓	↓	↓	15	20	S	1.5	15	19	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	↓	A	± 20	A	± 20	± 20	± 30
251 M 1002 226 M _2 2S	↓	↓	↓	22	20	S	2.2	44	55	-30/0	0/+20	0/+20	↓	↓	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 1002 336 M _2 2A	↓	↓	↓	33	20	A	3.3	66	82	-30/0	0/+20	0/+20	0.24	0.12	0.24	0.24	2	B	± 20	B	± 20	± 20	± 30
251 M 1002 476 M _2 2A	↓	↓	↓	47	20	A	4.7	94	117	-30/0	0/+20	0/+20	0.28	0.14	0.28	0.28	↓	B	± 20	B	± 20	± 20	± 30
251 M 1002 107 M _2 2B	↓	↓	↓	100	20	B	10	200	250	-30/0	0/+20	0/+20	0.20	0.10	0.20	0.20	1	B	± 20	B	± 20	± 20	± 30
251 M 1602 105 M _2 M	16	18.4	12.2	1	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	0.16	0.08	0.16	0.16	15	A	± 15	A	± 15	± 15	± 15
251 M 1602 155 M _2 M	↓	↓	↓	1.5	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	↓	↓	↓	↓	↓	A	± 15	A	± 15	± 15	± 15
251 M 1602 225 M _2 M	↓	↓	↓	2.2	20	M	0.5	5	6.3	-15/0	0/+10	0/+15	↓	↓	↓	↓	↓	A	± 15	A	± 15	± 15	± 15
251 M 1602 685 M _2 2S	↓	↓	↓	6.8	20	S	1.1	22	27	-15/0	0/+10	0/+15	↓	↓	↓	↓	2	A	± 15	A	± 15	± 15	± 15
251 M 1602 106 M _2 2S	↓	↓	↓	10	20	S	1.6	32	40	-30/0	0/+20	0/+20	0.14	0.10	0.10	0.12	↓	B	± 20	B	± 20	± 20	± 30
251 M 2002 105 M _2 2S	20	23	15.3	1	20	S	0.5	5	6.3	-15/0	0/+10	0/+15	0.10	0.05	0.10	0.10	8	A	± 15	A	± 15	± 15	± 15
251 M 2002 155 M _2 2S	↓	↓	↓	1.5	20	S	0.5	5	6.3	-15/0	0/+10	0/+15	↓	↓	↓	↓	↓	A	± 15	A	± 15	± 15	± 15
251 M 2002 225 M _2 2S	↓	↓	↓	2.2	20	S	0.5	5	6.3	-15/0	0/+10	0/+15	↓	↓	↓	↓	↓	A	± 15	A	± 15	± 15	± 15
251 M 2002 335 M _2 2A	↓	↓	↓	3.3	20	A	0.7	6.6	8.3	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	6	A	± 15	A	± 15	± 15	± 15
251 M 2002 475 M _2 2A	↓	↓	↓	4.7	20	A	0.9	9.4	12	-15/0	0/+10	0/+15	↓	↓	↓	↓	4	A	± 15	A	± 15	± 15	± 15
251 M 2502 105 M _2 2S	25	28.7	19.1	1	20	S	0.5	5	6.3	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	6	A	± 15	A	± 15	± 15	± 15
251 M 2502 155 M _2 2S	↓	↓	↓	1.5	20	S	0.5	5	6.3	-15/0	0/+10	0/+15	↓	↓	↓	↓	↓	A	± 15	A	± 15	± 15	± 15
251 M 2502 225 M _2 2A	↓	↓	↓	2.2	20	A	0.6	5.5	6.9	-15/0	0/+10	0/+15	↓	↓	↓	↓	↓	A	± 15	A	± 15	± 15	± 15
251 M 2502 335 M _2 2A	↓	↓	↓	3.3	20	A	0.8	8	10	-15/0	0/+10	0/+15	↓	↓	↓	↓	↓	A	± 15	A	± 15	± 15	± 15
251 M 2502 475 M _2 2A	↓	↓	↓	4.7	20	A	1.2	12	15	-15/0	0/+10	0/+15	↓	↓	↓	↓	4	A	± 15	A	± 15	± 15	± 15
251 M 3502 105 M _2 2S	35	40.2	26.8	1	20	S	0.5	5	6.3	-15/0	0/+10	0/+15	0.10	0.05	0.10	0.10	8	A	± 15	A	± 15	± 15	± 15
251 M 3502 225 M _2 2A	↓	↓	↓	2.2	20	A	0.8	8	9.6	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	6	A	± 15	A	± 15	± 15	± 15

Notes (1) _1: Permissible tolerance K (± 10%) or M (± 20%)
(2) _2: No code for single item. "R" for taping specification.
(3) Lct. A: Not exceeding the initial specification, B: Not exceeding twice the initial specification

CATALOG NUMBERS AND RATING OF LOW PROFILE PRODUCTS

October, 2008

Catalog number (1) (2)	Rated voltage (VDC)	Surge voltage (VDC)		Capacitance (μF)	Tolerance (±%)	Case code	Lct. (μA)			Capacitance change (ΔC/C) (%)			Max. Dissipation factor				ESR Ω	Surge		Resistance to soldering heat		Rapid change of temperature high temperature/Moisture	Endurance
		85°C	125°C				20°C	85°C	125°C	-55°C	85°C	125°C	-55°C	20°C	85°C	125°C	100 kHz	Lct. (3)	ΔC/C %	Lct. (3)	ΔC/C %	ΔC/C%	ΔC/C%
251 M 2501 107 M _2 0S	2.5	2.8	1.9	100	20	S	2.5	50	62	-30/0	0/+20	0/+20	0.40	0.20	0.30	0.30	4	B	± 20	A	± 20	± 20	± 30
251 M 4001 476 M _2 0S	4	4.6	3	47	20	S	1.9	38	47	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	B	± 20	B	± 20	± 20	± 30
251 M 4001 686 M _2 0S	↓	↓	↓	68	20	S	2.7	54	68	-30/0	0/+20	0/+20	0.40	0.20	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 4001 107 M _2 0S	↓	↓	↓	100	20	S	4.0	80	100	-30/0	0/+20	0/+20	↓	↓	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 4001 107 M _2 0A	↓	↓	↓	100	20	A	4.0	80	100	-30/0	0/+20	0/+20	0.36	0.18	↓	↓	2	B	± 20	B	± 20	± 20	± 30
251 M 4001 157 M _2 0A	↓	↓	↓	150	20	A	6.0	120	150	-30/0	0/+20	0/+20	0.48	0.24	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 4001 227 M _2 0A	↓	↓	↓	220	20	A	8.8	176	220	-30/0	0/+20	0/+20	↓	↓	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 6301 226 M _2 0S	6.3	7.2	4.8	22	20	S	1.4	28	35	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	B	± 20	B	± 20	± 20	± 30
251 M 6301 336 M _2 0S	↓	↓	↓	33	20	S	2.1	42	52	-30/0	0/+20	0/+20	↓	↓	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 6301 476 M _2 0S	↓	↓	↓	47	20	S	3.0	59	74	-30/0	0/+20	0/+20	↓	↓	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 6301 476 M _2 0A	↓	↓	↓	47	20	A	3.0	59	74	-30/0	0/+20	0/+20	0.28	0.14	0.28	0.28	2	B	± 20	B	± 20	± 20	± 30
251 M 6301 686 M _2 0A	↓	↓	↓	68	20	A	4.2	85	107	-30/0	0/+20	0/+20	0.32	0.16	0.32	0.32	↓	B	± 20	B	± 20	± 20	± 30
251 M 6301 107 M _2 0A	↓	↓	↓	100	20	A	6.3	126	157	-30/0	0/+20	0/+20	0.36	0.18	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 1002 106 M _2 0S	10	11.5	7.6	10	20	S	1.0	20	25	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	B	± 20	B	± 20	± 20	± 30
251 M 1002 156 M _2 0S	↓	↓	↓	15	20	S	1.5	30	38	-30/0	0/+20	0/+20	↓	↓	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 1002 226 M _2 0S	↓	↓	↓	22	20	S	2.2	44	55	-30/0	0/+20	0/+20	↓	↓	↓	↓	↓	B	± 20	B	± 20	± 20	± 30
251 M 1002 336 M _2 0A	↓	↓	↓	33	20	A	3.3	66	82	-30/0	0/+20	0/+20	0.24	0.12	0.24	0.24	2	B	± 20	B	± 20	± 20	± 30
251 M 1002 476 M _2 0A	↓	↓	↓	47	20	A	4.7	94	117	-30/0	0/+20	0/+20	0.28	0.14	0.28	0.28	↓	B	± 20	B	± 20	± 20	± 30
251 M 1602 685 M _2 0S	16	18.4	12.2	6.8	20	S	1.1	22	27	-30/0	0/+20	0/+20	0.14	0.10	0.10	0.12	4	B	± 20	B	± 20	± 20	± 30
251 M 1602 106 M _2 0S	↓	↓	↓	10	20	S	1.6	32	40	-30/0	0/+20	0/+20	↓	↓	↓	↓	2	B	± 20	B	± 20	± 20	± 30
251 M 2002 335 M _2 0A	20	23	15.3	3.3	20	A	0.7	6.6	8.3	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	6	A	± 15	A	± 15	± 15	± 15
251 M 2002 475 M _2 0A	↓	↓	↓	4.7	20	A	0.9	9.4	12	-15/0	0/+10	0/+15	↓	↓	↓	↓	4	A	± 15	A	± 15	± 15	± 15
251 M 2502 225 M _2 0A	25	28.7	19.1	2.2	20	A	0.6	5.5	6.9	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	6	A	± 15	A	± 15	± 15	± 15
251 M 2502 335 M _2 0A	↓	↓	↓	3.3	20	A	0.8	8	10	-15/0	0/+10	0/+15	↓	↓	↓	↓	↓	A	± 15	A	± 15	± 15	± 15
251 M 2502 475 M _2 0A	↓	↓	↓	4.7	20	A	1.2	12	15	-15/0	0/+10	0/+15	↓	↓	↓	↓	4	A	± 15	A	± 15	± 15	± 15
251 M 2502 685 M _2 0B	↓	↓	↓	6.8	20	B	1.7	17	21	-15/0	0/+10	0/+15	↓	↓	↓	↓	1	A	± 15	A	± 15	± 15	± 15
251 M 2502 106 M _2 0B	↓	↓	↓	10	20	B	2.5	25	31	-15/0	0/+10	0/+15	↓	↓	↓	↓	↓	A	± 15	A	± 15	± 15	± 15
251 M 3502 225 M _2 0A	35	40.2	26.8	2.2	20	A	0.8	8	9.6	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	6	A	± 15	A	± 15	± 15	± 15

Notes (1) _1: Permissible tolerance K (± 10%) or M (± 20%)
(2) _2: No code for single item. "R" for taping specification.
(3) Lct. A: Not exceeding the initial specification, B: Not exceeding twice the initial specification

CATALOG NUMBERS AND RATING OF CUSTOM PRODUCTS

October, 2008

Catalog number (1) (2)	Rated voltage (VDC)	Surge voltage (VDC)		Capacitance (μF)	Tolerance (±%)	Case code	Lct. (μA)			Capacitance change (ΔC/C) (%)			Max. Dissipation factor				ESR Ω	Surge		Resistance to soldering heat		Rapid change of temperature high temperature/Moisture	Endurance
		85°C	125°C				20°C	85°C	125°C	-55°C	85°C	125°C	-55°C	20°C	85°C	125°C	100 kHz	Lct. (3)	ΔC/C %	Lct. (3)	ΔC/C %	ΔC/C%	ΔC/C%
251 M 4001 157 M _2 3S	4	4.6	3	150	20	S	6.0	120	150	-30/0	0/+20	0/+20	0.48	0.24	0.30	0.30	2	B	± 20	B	± 20	± 20	± 30
251 M 4001 227 M _2 3S	↓	↓	↓	220	20	S	44	176	220	-30/0	0/+20	0/+20	0.80	0.40	0.50	0.50	↓	B	± 40	B	± 40	± 40	± 40
251 M 4001 227 M _2 3A	↓	↓	↓	220	20	A	8.8	176	220	-30/0	0/+20	0/+20	0.48	0.24	0.30	0.30	↓	B	± 20	B	± 20	± 20	± 20
251 M 6301 107 M _2 3S	6.3	7.2	4.8	100	20	S	6.3	126	157	-30/0	0/+20	0/+20	0.48	0.30	0.30	0.30	2	B	± 20	B	± 30	± 20	± 35
251 M 1002 336 M _2 3S	10	11.5	7.6	33	20	S	3.3	66	82.5	-30/0	0/+20	0/+20	0.30	0.15	0.30	0.30	4	B	± 20	B	± 20	± 20	± 30
251 M 1002 686 M _2 3A	↓	↓	↓	68	20	A	6.8	136	170	-30/0	0/+20	0/+20	↓	0.12	0.24	0.24	2	B	± 20	B	± 20	± 20	± 30
251 M 1602 156 M _2 3S	16	18.4	12.2	15	20	S	2.4	48	60	-30/0	0/+20	0/+20	0.18	0.12	0.12	0.14	1.5	B	± 20	B	± 20	± 20	± 30
251 M 2502 475 M _2 9A	25	28.7	19.1	4.7	20	A	1.2	12	15	-15/0	0/+10	0/+15	0.12	0.06	0.12	0.12	4	A	± 15	A	± 15	± 15	± 15

Notes (1) _1: Permissible tolerance K (± 10%) or M (± 20%)
(2) _2: No code for single item. "R" for taping specification.
(3) Lct. A: Not exceeding the initial specification, B: Not exceeding twice the initial specification

STANDARD RATING

October, 2008

R.V. (VDC) / Cap. (μF)	2	2.5	3	4	6.3	10	16	20	25	35
1.0				M	U, M	U, M	M	S	S	S
1.5				M	M	U, M	M	S	S	
2.2			U	M	U, M	U, M	M	S	A	A
3.3				M	U, M	M		A	A	
4.7	U			U, M	U, M	M		A	A	
6.8				U, M	M	M	S			
10	U	U	U	U, M	M	M, S	S			
15				M	M	S				
22				M	M, S	S				
33				M	S	A				
47				S	S	A				
68				S	S					
100		S		S	A	B				
150		S		A	B					
220		S		A, B						
330		A								

LOW PROFILE PRODUCT RATING

October, 2008

R.V. (VDC) / Cap. (μF)	2	2.5	3	4	6.3	10	16	20	25	35
1.0										
1.5										
2.2									A(1.0)	A(1.0)
3.3								A(1.0)	A(1.0)	
4.7								A(1.0)	A(1.0)	
6.8							S(1.0)		B(1.0)	
10						S(1.0)	S(1.0)		B(1.0)	
15						S(1.0)				
22					S(1.0)	S(1.0)				
33					S(1.0)	A(1.0)				
47				S(1.0)	S(1.0), A(1.0)	A(1.0)				
68				S(1.0)	A(1.0)					
100		S(1.0)		S(1.0), A(1.0)	A(1.0)					
150				A(1.0)						
220				A(1.0)						
330										

The parenthesized values show the component heights (maximum values in mm).

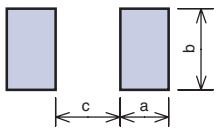
CUSTOM PRODUCTS RATING

October, 2008

R.V. (VDC) / Cap. (μF)	2	2.5	3	4	6.3	10	16	20	25	35
2.2										
3.3										
4.7									A(0.9)	
6.8										
10										
15							S(1.3)			
22										
33						S(1.3)				
47										
68						A(1.3)				
100					S(1.3)					
150				S(1.3)						
220				S(1.3), A(1.3)						
330										

The parenthesized values show the component heights (maximum values in mm).

RECOMMENDED PAD DIMENSIONS

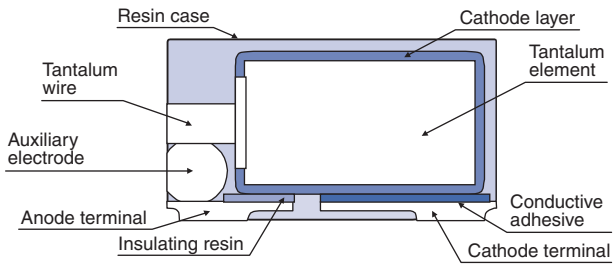


(mm)

Case size	EIA Code	a	b	c	Mask Thickness
U	1005	More than 0.30	0.3	0.45	≦100μm
M	1608	More than 0.50	0.65	0.65	≦100μm
S	2012	More than 0.50	0.8	1.05	≦100μm
A	3216L	More than 0.80	1.1	1.65	≦100μm
B	3528L	More than 0.80	2.1	1.95	≦100μm

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.

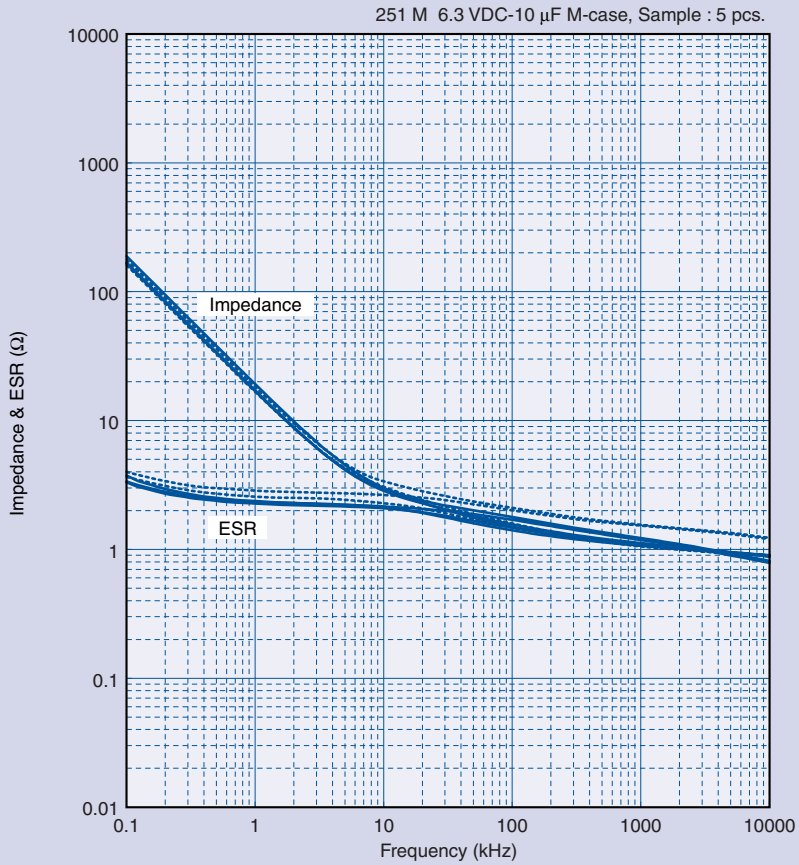
STRUCTURE (TYPICAL)



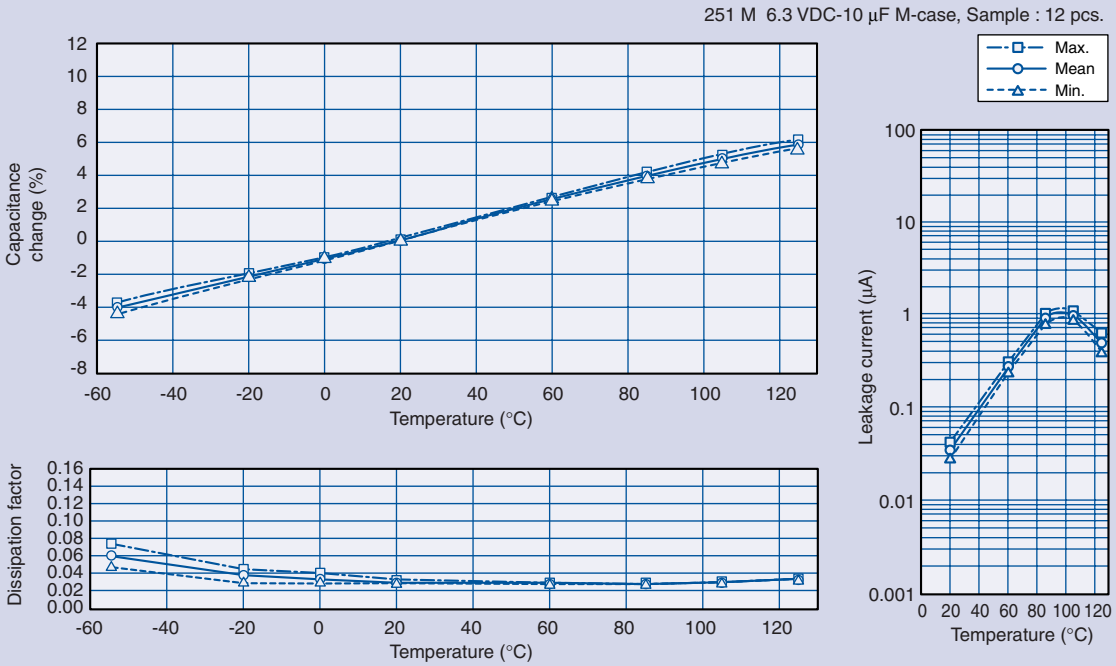
PERFORMANCE

No.	Item (1)		Performance	Test method
1	Leakage Current (μA)		Larger value of 0.01 CV or 0.5 μA	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 ~ 2 VDC Measuring temperature : Room temperature
3	Dissipation Factor		Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS.	JIS C 5101-1, 4.8 Measuring frequency : 120 Hz ± 20% Measuring voltage : 0.5 Vrms +1.5 ~ 2 VDC Measuring temperature : Room temperature
4	Characteristics at High and Low Temperature			JIS C 5101-1, 4.29
	Step 1	Leakage Current Capacitance Dissipation Factor	Shall not exceed the value in No.1. Shall be within the specified tolerance. Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS.	Measuring temperature : 20 ± 2°C
	Step 2	Capacitance Change Dissipation Factor	Shall be within any of the following ranges and specified according to CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. • Within $^{0}_{-15}$% of the value at Step 1 • Within $^{0}_{-30}$% of the value at Step 1 Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS.	Measuring temperature : -55 ± 3°C
	Step 3	Leakage Current Capacitance Change Dissipation Factor	Shall not exceed the value in No.1. Shall be within ± 2% of the value at Step 1. Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS.	Measuring temperature : 20 ± 2°C
	Step 4	Leakage Current Capacitance Change Dissipation Factor	Shall be within any of the following ranges and specified according to CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. • Larger value of 0.1 CV or 5 μA • 0.2 CV or less Shall be within any of the following ranges and specified according to CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. • Within $^{+10}_{0}$% of the value at Step 1 • Within $^{+20}_{0}$% of the value at Step 1 Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS.	Measuring temperature : 85 ± 2°C
	Step 5	Leakage Current Capacitance Change Dissipation Factor	Shall be within any of the following ranges and specified according to CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. • Larger value of 0.125 CV or 6.3 μA • 0.25 CV or less Shall be within any of the following ranges and specified according to CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. • Within $^{+15}_{0}$% of the value at Step 1 • Within $^{+20}_{0}$% of the value at Step 1 Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS.	Measuring temperature : 125 ± 2°C Measuring voltage : Derated voltage at 125°C
	Step 6	Leakage Current Capacitance Change Dissipation Factor	Shall not exceed the value in No.1. Shall be within ± 2% of the value at Step 1. Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS.	Measuring temperature : 20 ± 2°C
5	Surge (Surge Voltage)	Leakage Current Capacitance Change Dissipation Factor Appearance	Shall be within any of the following ranges and specified according to CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. • Not exceeding the value in No.1 : Leakage current code A • Not exceeding twice the value in No.1 : Leakage current code B Shall be within any of the following ranges and specified according to CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. • Within ± 15% of the value before test • Within ± 20% of the value before test Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. There shall be no evidence of mechanical damage.	JIS 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
6	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 Case M, S, A, B : 5N Duration : 10 ± 1 sec
7	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
8	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
9	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
10	Solderability		Solder shall completely cover the terminal surface (there shall be no pin holes, nonwetting 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.
11	Resistance to Soldering Heat	Leakage Current Capacitance Change Dissipation Factor Appearance	Shall be within any of the following ranges and specified according to CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. • Not exceeding the value in No.1 : Leakage current code A • Not exceeding twice the value in No.1 : Leakage current code B Shall be within any of the following ranges and specified according to CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. • Within ± 15% of the value before test • Within ± 20% of the value before test Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. There shall be no evidence of mechanical damage.	IR reflow method Preheating : 130 ~ 160°C for about 60 sec Reflow : 200°C, less than 60 sec, 260°C max. Number of cycles : 2
12	Rapid Change of Temperature (Temperature Cycle)	Leakage Current Capacitance Change Dissipation Factor Appearance	Shall not exceed twice the value in No.1. Shall be within any of the following ranges and specified according to CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. • Within ± 15% of the value before test • Within ± 20% of the value before test Shall not exceed 150% of the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. There shall be no evidence of mechanical damage.	JIS C 5101-1, 4.16 Step 1 : -55 ± 3°C, 30 ± 3 min Step 2 : 25 $^{+10}_{-5}$°C, 3 min or less Step 3 : 125 ± 2°C, 30 ± 3 min Step 4 : 25 $^{+10}_{-5}$°C, 3 min or less Number of cycles : 5
13	High Temperature/ Moisture (Moisture Resistance)	Leakage Current Capacitance Change Dissipation Factor Appearance	Shall not exceed twice the value in No.1. Shall be within any of the following ranges and specified according to CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. • Within ± 15% of the value before test • Within ± 20% of the value before test Shall not exceed 150% of the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. There shall be no evidence of mechanical damage, and marking shall be legible.	JIS C 5101-1, 4.22 Temperature : 40 ± 2°C Moisture : 90 ~ 95%RH Duration : 500 $^{+24}_{0}$ hrs
14	Endurance (High Temperature Load)	Leakage Current Capacitance Change Dissipation Factor Appearance	Shall not exceed twice the value in No.1. Shall be within any of the following ranges and specified according to CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. • Within ± 15% of the value before test • Within ± 30% of the value before test Shall not exceed 150% of the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS or LOW PROFILE PRODUCTS. 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 ± 2°C and rated voltage or 125 ± 3°C and 2/3 × rated voltage Duration : 2000 $^{+72}_{0}$ hrs Power supply impedance : 3 Ω or less

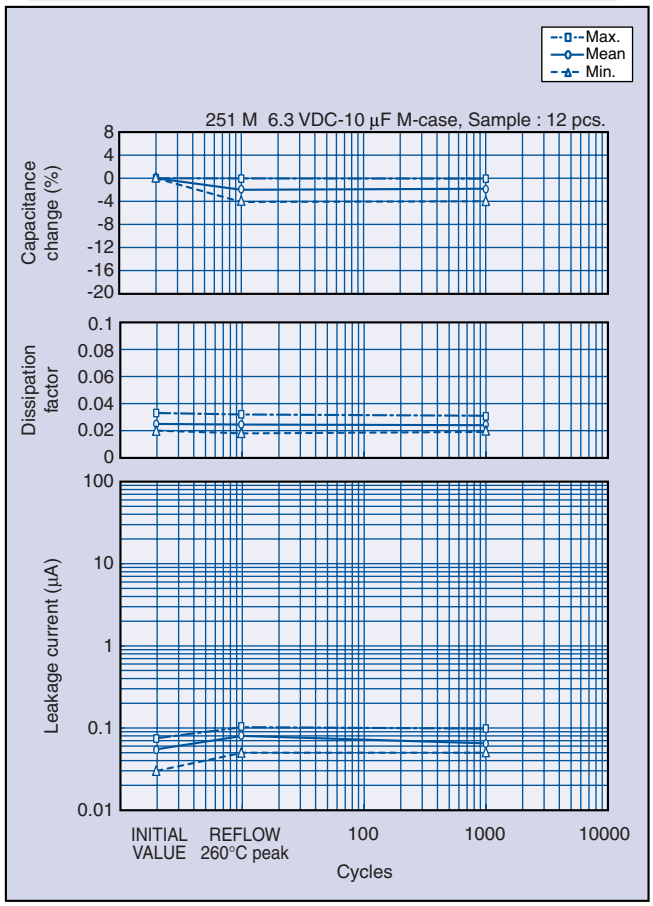
FREQUENCY CHARACTERISTICS



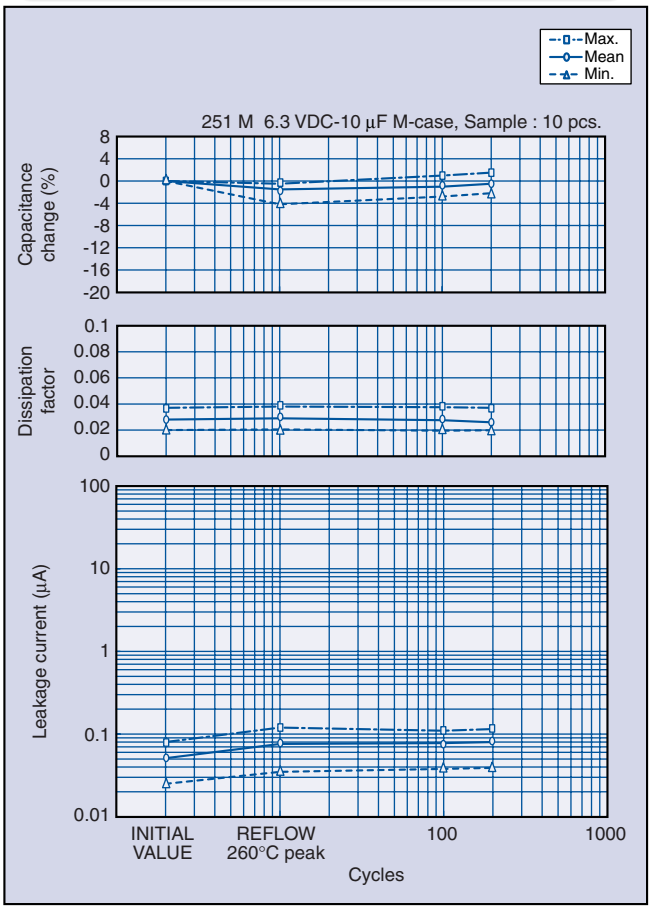
TEMPERATURE CHARACTERISTICS



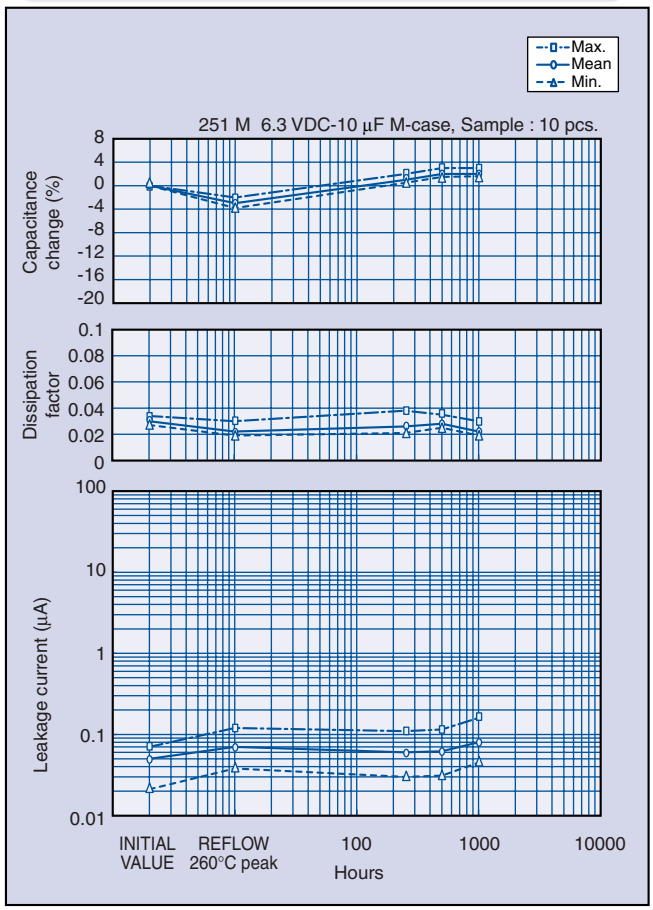
SURGE VOLTAGE 85°C, RATED VOLTAGE × 1.15



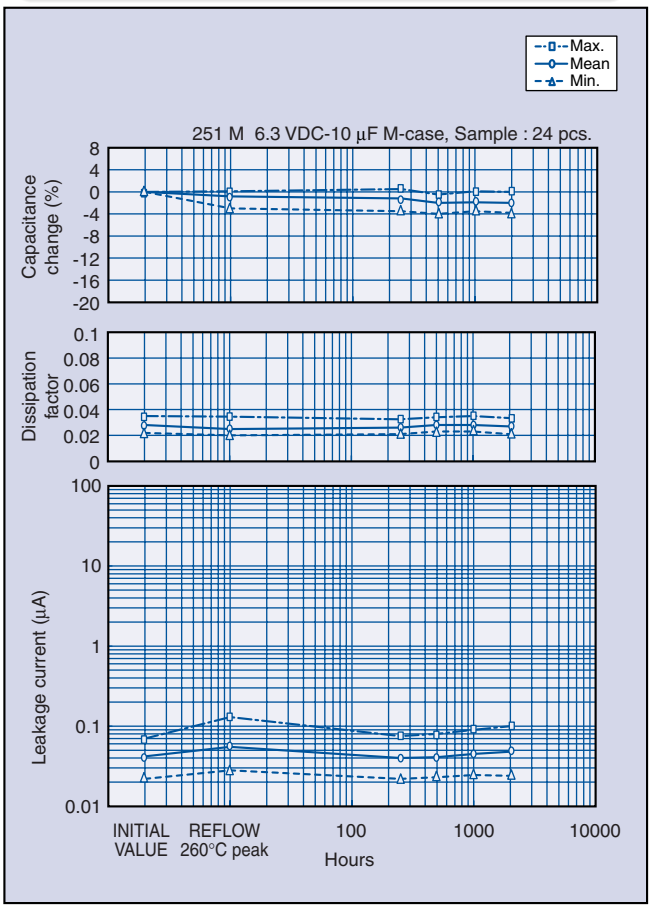
THERMAL SHOCK –55/+125°C



MOISTURE RESISTANCE 40°C, 95%RH



HIGH TEMPERATURE LOAD 85°C, 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 voltage should not exceed the allowable values.

3. Permissible Reverse Voltage

If reverse voltage exceeding the value shown in the following table is applied to the capacitor, there is a fear of a fluctuation of leakage current and an increase in failure rate.
To avoid the permissible reverse voltage, use the capacitor under bias voltage as required.

Ambient temperature	25°C	55°C	85°C	125°C
Permissible reverse voltage	10% of rated voltage	6% of rated voltage	3% of rated voltage	1% of rated voltage
	The above voltage or 0.5 V, whichever is greater.			

The above specifications apply for accidental reverse voltage. If reverse voltage is constantly applied to the capacitor, use it with non-polar connection.

4. Permissible Ripple Voltage

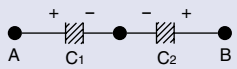
Permissible ripple voltage is determined by the loss of element and heat radiation of case and lead wire.
This is influenced by capacitance, frequency of ripple, ESR and operating temperature.
The permissible ripple voltage values are shown in our technical document.

5. Application on low-impedance circuit

The failure rate of low impedance circuit at 0.1 Ω/V is about five times greater than that of a 1 Ω/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, 1/3 of the rated voltage is recommended.

6. Non Polar Application

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 C_1 or C_2 (This will be the same, as the capacitors should be identical.)
Capacitance: $\frac{C_1 \times C_2}{C_1 + C_2}$
Leakage Current: If terminal A is (+), the Leakage Current will be equal to C_1's Leakage Current.
If terminal B is (+), the Leakage Current will be equal to C_2's Leakage Current.



7. Soldering

7.1. Preheating
To obtain optimal reliability and solderability conditions, capacitors should be pre-heated at 170 to 190°C for approximately 1 minute.
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.
(3) 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 290°C. The application of the iron should not exceed 3 seconds.
(4) Please consult us for other methods.

8. Solvent 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 Industrial 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-2386) issued by Japan Electronics and Information Technology Industries Association (EIAJ). 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 the Tantalum Solid Electrolytic Capacitor.

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URL:	http://www.ncc-matsuo.co.jp/		