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lead-free

SPECIFICATIONS

Tantalum Capacitors

278-Series

Version January 2020

Type 278

(No.P-278-E004)

Type 278 tantalum chip capacitors is ultra miniature tantalum chip capacitors with case size 2012 (2.0 × 1.25 × 1.2mm thick). The capacitors are designed to meet the demands for further miniature of devices.

FEATURES

1. Suitable for surface mounting with high precise dimensional accuracy
2. Soldering:260℃ for 10 seconds by reflow or flow soldering.
3. Type 278 is suitable for miniature applications such as DVC, DSC and PCMCIA cards, and high-function compact portable devices such as mobile phones and smartphones.
4. Lead-free and RoHS Compliant
5. Halogen and antimony free product is available upon requect.

RATING

Item	Rating
Category temperature range (Operating temperature)	-55 ~ +125°C
Rated Temperature (Maximum operating temperature for DC rated Voltage)	+85°C [(1)]
DC rated voltage range ［U_R］	See CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS
Rated capacitance (Normal capacitance range ［C_R］)	
Rated capacitance tolerance	
Failure rate level	1%/1000 h

Note[(1)]: For operation 125℃,derate voltage linearly to 67% of 85℃ voltage rating.

ORDERING INFORMATION

278	M	1002	106	M	R
TYPE	SERIES	RATED VOLTAGE	CAPACITANCE	CAPACITANCE TOLERANCE	STYLE OF REELED PACKAGE

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

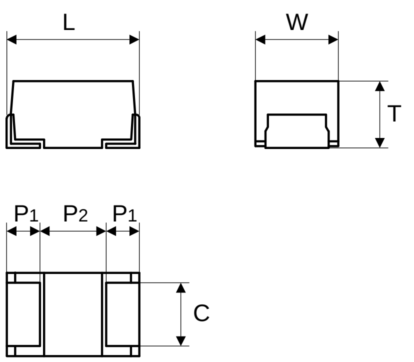
Marking	Capacitance	Marking	Capacitance	Marking	Capacitance
104	0.1 μF	105	1.0 μF	106	10 μF
154	0.15 μF	155	1.5 μF	156	15 μF
224	0.22 μF	225	2.2 μF	226	22 μF
334	0.33 μF	335	3.3 μF	336	33 μF
474	0.47 μF	475	4.7 μF	476	47 μF
684	0.68 μF	685	6.8 μF		

Marking	Capacitance Tolerance
M	±20%
K	±10%

（Taping specification）

Code	Reel Size	Anode Notation
L	φ 180 Reel	Feed hole: +
R	φ 180 Reel	Feed hole: -
N	φ 330 Reel	Feed hole: +
P	φ 330 Reel	Feed hole: -

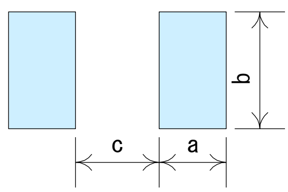
DIMENSIONS



（mm）

Case Code	EIA Code	L ±0.2	W ±0.2	T max	P_1 ±0.2	P_2 min.	C ±0.1
S	2012	2.0	1.25	1.2	0.5	0.8	0.9

RECOMMENDED SOLDER PAD LAYOUT

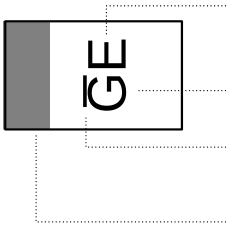


（mm）

Case Code	EIA Code	a		b	c
		Flow	Reflow		
S	2012	2.2	1.4	1.2	0.9

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



Rated capacitance ([2])

Rated voltage ([1])

Capacitor tolerance (In case that capacitance tolerance is +/-10%, there is a bar marking)

Polarity (Anode notion)

Note([1]) Rated voltage is described by alphabet, as shown below.
Rated voltage codes.

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

([2]) Rated capacitance is described by alphabet or alphabet attached upper-bar or under-bar, as shown below.
Rated capacitance codes.

Code	$\underline{A}$	$\underline{E}$	$\underline{J}$	$\underline{N}$	$\underline{S}$	$\underline{W}$
Rated capacitance μF	0.1	0.15	0.22	0.33	0.47	0.68
Code	A	E	J	N	S	W
Rated capacitance μF	1	1.5	2.2	3.3	4.7	6.8
Code	$\overline{A}$	$\overline{E}$	$\overline{J}$	$\overline{N}$	$\overline{S}$	
Rated capacitance μF	10	15	22	33	47	

STANDARD RATING

R.V.(VDC) / Cap.(μF)	2.5	4	6.3	10	16	20	25	35
0.1						S		
0.15						S		
0.22						S		
0.33						S		S
0.47					S	S	S	S
0.68				S	S	S	S	
1.0			S	S	S	S	S	
1.5		S	S	S	S	S		
2.2	S	S	S	S	S			
3.3	S	S	S	S	S			
4.7	S	S	S	S				
6.8	S	S	S	S				
10	S	S	S	S				
15	S	S	S					
22	S	S	S					
33	S	S	S					
47	S	S						

CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS

February, 2011

Catalog Number [1][2]	U_R VDC	U_S VDC		C_R µF	Case code	Leakage current(DCL) µA			Variation rate of cap.(ΔC/C)%			Dissipation factor				Surge,Resistance to soldering heat & Damp heat		Component solvent resistance		Rapid Change of Temp.		Endurance	
		85℃	125℃			20℃	85℃	125℃	-55℃	85℃	125℃	-55℃	20℃	85℃	125℃	DCL[3]	ΔC/C%	DCL[3]	ΔC/C%	DCL[3]	ΔC/C%	DCL[3]	ΔC/C%
278M 2501 225 _[1] _[2]	2.5	3.3	2.2	2.2	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.08	0.06	0.06	0.06	A	±5	A	±3	A	±5	B	±10
278M 2501 335 _[1] _[2]	↓	↓	↓	3.3	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	↓	↓	↓	A	±5	A	±3	A	±5	B	±10
278M 2501 475 _[1] _[2]	↓	↓	↓	4.7	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.12	0.08	0.08	0.10	A	±5	A	±3	A	±5	B	±10
278M 2501 685 _[1] _[2]	↓	↓	↓	6.8	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	↓	↓	↓	A	±5	A	±3	A	±5	B	±10
278M 2501 106 _[1] _[2]	↓	↓	↓	10	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	↓	↓	↓	A	±5	A	±3	A	±5	B	±10
278M 2501 156 _[1] _[2]	↓	↓	↓	15	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.20	0.10	0.10	0.12	A	±10	A	±3	A	±10	B	±10
278M 2501 226 _[1] _[2]	↓	↓	↓	22	S	0.6	6	6.9	-10/+10	-10/+10	-15/+15	↓	↓	↓	↓	A	±10	A	±3	A	±10	B	±10
278M 2501 336 _[1] _[2]	↓	↓	↓	33	S	0.8	16.5	20.6	-20/+20	-20/+20	-30/+30	0.30	0.20	0.20	0.30	C	±20	C	±3	C	±20	C	±20
278M 2501 476 _[1] _[2]	↓	↓	↓	47	S	1.1	23.5	29.3	-20/+20	-20/+20	-20/+20	↓	↓	↓	0.20	C	±20	C	±3	C	±20	C	±30
278M 4001 155 _[1] _[2]	4	5	3.2	1.5	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.08	0.06	0.06	0.06	A	±5	A	±3	A	±5	B	±10
278M 4001 225 _[1] _[2]	↓	↓	↓	2.2	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	↓	↓	↓	A	±5	A	±3	A	±5	B	±10
278M 4001 335 _[1] _[2]	↓	↓	↓	3.3	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.12	0.08	0.08	0.10	A	±5	A	±3	A	±5	B	±10
278M 4001 475 _[1] _[2]	↓	↓	↓	4.7	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	↓	↓	↓	A	±5	A	±3	A	±5	B	±10
278M 4001 685 _[1] _[2]	↓	↓	↓	6.8	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	↓	↓	↓	A	±5	A	±3	A	±5	B	±10
278M 4001 106 _[1] _[2]	↓	↓	↓	10	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.15	↓	↓	↓	A	±10	A	±3	A	±10	B	±10
278M 4001 156 _[1] _[2]	↓	↓	↓	15	S	0.6	6	7.5	-10/+10	-10/+10	-15/+15	0.20	0.10	0.10	0.12	A	±10	A	±3	A	±10	B	±10
278M 4001 226 _[1] _[2]	↓	↓	↓	22	S	0.9	18	22	-30/0	-20/+20	-20/+20	0.30	0.20	0.20	0.20	C	±20	C	±3	C	±20	C	±20
278M 4001 336 _[1] _[2]	↓	↓	↓	33	S	1.3	13.2	16.5	-20/+20	-20/+20	-30/+30	↓	↓	↓	0.30	C	±20	C	±20	C	±20	C	±20
278M 4001 476 _[1] _[2]	↓	↓	↓	47	S	1.8	37.6	47	-20/+20	-20/+20	-20/+20	↓	↓	↓	0.20	C	±20	C	±3	C	±20	C	±30
278M 6301 105 _[1] _[2]	6.3	8	5	1.0	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.05	0.04	0.04	0.05	A	±5	A	±3	A	±5	B	±10
278M 6301 155 _[1] _[2]	↓	↓	↓	1.5	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.08	0.06	0.06	0.06	A	±5	A	±3	A	±5	B	±10
278M 6301 225 _[1] _[2]	↓	↓	↓	2.2	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.12	0.08	0.08	0.10	A	±5	A	±3	A	±5	B	±10
278M 6301 335 _[1] _[2]	↓	↓	↓	3.3	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.12	0.08	0.08	0.10	A	±5	A	±3	A	±5	B	±10
278M 6301 475 _[1] _[2]	↓	↓	↓	4.7	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.12	0.08	0.08	0.10	A	±5	A	±3	A	±5	B	±10
278M 6301 685 _[1] _[2]	↓	↓	↓	6.8	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.15	↓	↓	↓	A	±10	A	±3	A	±10	B	±10
278M 6301 106 _[1] _[2]	↓	↓	↓	10	S	0.6	6	7.9	-10/+10	-10/+10	-15/+15	↓	0.06	0.06	0.06	A	±10	A	±3	A	±10	B	±10
278M 6301 156 _[1] _[2]	↓	↓	↓	15	S	0.9	19	24	-30/0	-20/+20	-20/+20	0.30	0.20	0.20	0.20	C	±20	C	±3	C	±20	C	±20
278M 6301 226 _[1] _[2]	↓	↓	↓	22	S	2.8	28	35	-20/+20	-20/+20	-30/+30	0.38	↓	↓	0.22	C	±20	C	±20	C	±20	C	±20
278M 6301 336 _[1] _[2]	↓	↓	↓	33	S	2.0	41.5	51.9	-20/+20	-20/+20	-20/+20	0.30	↓	↓	0.20	C	±20	C	±3	C	±20	C	±30

Catalog Number ([1])([2])	U_R VDC	U_S VDC		C_R µF	Case code	Leakage current(DCL) µA			Variation rate of cap.(ΔC/C)%			Dissipation factor				Surge,Resistance to soldering heat & Damp heat		Component solvent resistance		Rapid Change of Temp.		Endurance	
		85℃	125℃			20℃	85℃	125℃	-55℃	85℃	125℃	-55℃	20℃	85℃	125℃	DCL(3)	ΔC/C%	DCL(3)	ΔC/C%	DCL(3)	ΔC/C%	DCL(3)	ΔC/C%
278M 1002 684 _[1] _[2]	10	13	8	0.68	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.05	0.04	0.04	0.05	A	±5	A	±3	A	±5	B	±10
278M 1002 105 _[1] _[2]	↓	↓	↓	1.0	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	↓	↓	↓	A	±5	A	±3	A	±5	B	±10
278M 1002 155 _[1] _[2]	↓	↓	↓	1.5	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.12	0.08	0.08	0.10	A	±5	A	±3	A	±5	B	±10
278M 1002 225 _[1] _[2]	↓	↓	↓	2.2	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	↓	↓	↓	A	±5	A	±3	A	±5	B	±10
278M 1002 335 _[1] _[2]	↓	↓	↓	3.3	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.15	↓	↓	↓	A	±10	A	±3	A	±10	B	±10
278M 1002 475 _[1] _[2]	↓	↓	↓	4.7	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	↓	↓	↓	A	±10	A	±3	A	±10	B	±10
278M 1002 685 _[1] _[2]	↓	↓	↓	6.8	S	0.7	14	17	-30/0	-20/+20	-20/+20	0.30	0.20	0.20	0.20	C	±20	C	±3	C	±20	C	±30
278M 1002 106 _[1] _[2]	↓	↓	↓	10	S	1	20	25	-30/0	-20/+20	-20/+20	↓	↓	↓	↓	C	±20	C	±3	C	±20	C	±30
278M 1602 474 _[1] _[2]	16	20	13	0.47	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.05	0.04	0.04	0.05	A	±5	A	±3	A	±5	B	±10
278M 1602 684 _[1] _[2]	↓	↓	↓	0.68	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.08	0.06	0.06	0.06	A	±5	A	±3	A	±5	B	±10
278M 1602 105 _[1] _[2]	↓	↓	↓	1.0	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.12	0.08	0.08	0.10	A	±5	A	±3	A	±5	B	±10
278M 1602 155 _[1] _[2]	↓	↓	↓	1.5	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	↓	↓	↓	A	±5	A	±3	A	±5	B	±10
278M 1602 225 _[1] _[2]	↓	↓	↓	2.2	S	0.5	5	6.3	-20/+20	-10/+10	-15/+15	0.15	0.10	0.10	0.12	A	±10	A	±3	A	±20	B	±20
278M 1602 335 _[1] _[2]	↓	↓	↓	3.3	S	0.5	5	6.6	-20/+20	-10/+10	-15/+15	↓	↓	↓	↓	A	±10	A	±3	A	±20	B	±20
278M 2002 104 _[1] _[2]	20	26	16	0.1	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.08	0.04	0.04	0.05	A	±5	A	±3	A	±5	B	±10
278M 2002 154 _[1] _[2]	↓	↓	↓	0.15	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	↓	↓	↓	A	±5	A	±3	A	±5	B	±10
278M 2002 224 _[1] _[2]	↓	↓	↓	0.22	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	↓	↓	↓	A	±5	A	±3	A	±5	B	±10
278M 2002 334 _[1] _[2]	↓	↓	↓	0.33	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	↓	↓	↓	A	±5	A	±3	A	±5	B	±10
278M 2002 474 _[1] _[2]	↓	↓	↓	0.47	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	0.06	0.06	0.06	A	±5	A	±3	A	±5	B	±10
278M 2002 684 _[1] _[2]	↓	↓	↓	0.68	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.12	0.08	0.08	0.10	A	±5	A	±3	A	±5	B	±10
278M 2002 105 _[1] _[2]	↓	↓	↓	1.0	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	↓	↓	↓	A	±5	A	±3	A	±5	B	±10
278M 2002 155 _[1] _[2]	↓	↓	↓	1.5	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	0.10	0.10	↓	A	±5	A	±3	A	±5	B	±10
278M 2502 474 _[1] _[2]	25	32	20	0.47	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.06	0.04	0.04	0.05	A	±15	A	±3	A	±15	B	±15
278M 2502 684 _[1] _[2]	↓	↓	↓	0.68	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.08	0.06	0.06	0.06	A	±15	A	±3	A	±15	B	±15
278M 2502 105 _[1] _[2]	↓	↓	↓	1.0	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.10	0.08	0.08	0.08	A	±5	A	±3	A	±5	B	±10
278M 3502 334 _[1] _[2]	35	44	28	0.33	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	0.06	0.04	0.04	0.05	A	±15	A	±3	A	±15	B	±15
278M 3502 474 _[1] _[2]	↓	↓	↓	0.47	S	0.5	5	6.3	-10/+10	-10/+10	-15/+15	↓	↓	↓	↓	A	±15	A	±3	A	±15	B	±15

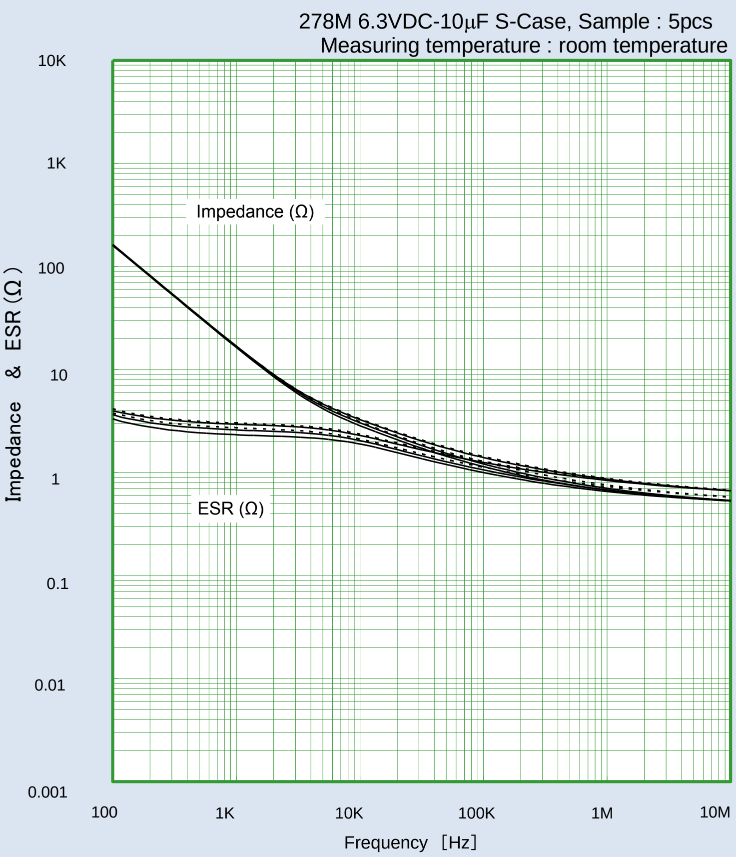
＊U_R = Rated Voltage U_S = Surge Voltage C_R = Capacitance
Note1 : For Capacitance Tolerance , insert "K" or "M" into _[1]
Note2 : For Reeled Package , insert "R" , "L" , "P" or "N" into _[2]
Note3 : DCL(3) code: A=Shall not exceed the value of intial specificaton. , B=Shall not exceed 1.25 time the value of intial specification. , C=Shall not exceed 2 time the value of intial specification.

PERFORMANCE

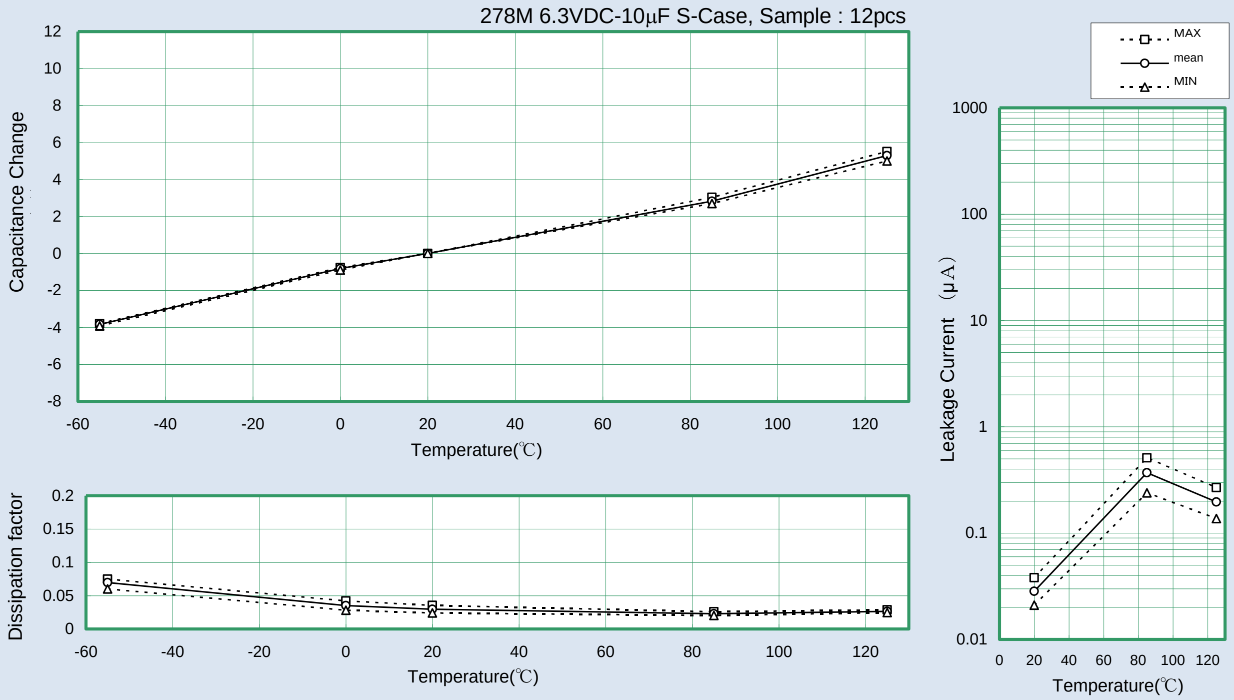
No.	Item		Performance	Test method
1	Leakage Current (μA)		Leakage current shall be selected in accordance with the detail specification from the following classifications. ・Shall not exceed 0.01 CV or 0.5 whichever is greater. ・Shall not exceed 0.02 CV.	JIS C 5101-1, 4.9 Applied Voltage : Rated Voltage for 5 min. Temperature : 20°C
2	Capacitance (μF)		Shall be within tolerance of the nominal value specified.	JIS C 5101-1, 4.7 Frequency : 120 Hz± 20% Voltage : 0.5Vrms+1.5 ~2VDC Temperature : 20°C
3	Dissipation Factor		Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS.	JIS C 5101-1, 4.8 Frequency : 120 Hz± 20% Voltage : 0.5Vrms+1.5 ~2VDC Temperature : 20°C
4	Characteristics at High and LowTemperature			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.	Measuring temperature : 20±2°C
	Step 2	Capacitance Change Dissipation Factor	Shall be within the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS. Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD 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.	Measuring temperature : 20±2°C
	Step 4	Leakage Current Capacitance Change Dissipation Factor	Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS. Shall be within the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS. Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS.	Measuring temperature : 85±2°C
	Step 5	Leakage Current Capacitance Change Dissipation Factor	Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS. Shall be within the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS. Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD 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.	Measuring temperature : 20±2°C
5	Surge	Leakage Current Capacitance Change Dissipation Factor Appearance	Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS. Shall be within the values shown in CATALOGNUMBERS AND RATING OF STANDARD PRODUCTS. Shall not exceed the value in No.3. 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, ・ 125 ± 2°C Applied Voltage :DC surge voltage Series protective resistance : 1000 Ω Discharge resistance : 1000 Ω
6	Shear Test		No exfoliation between lead terminal and board.	JIS C 5101-1, 4.34 Capacitors mounted under conditions JIS C 5101-1, 4.33 are used as specimens. Pressure : 5N Duration : 10 ± 1 s
7	Substrate Bending Test	Capacitance Appearance	Initial value to remain steady during measurement. There shall be no evidence of mechanical damage.	JIS C 5101-1, 4.35 Bending : 3 mm Duration:5s
8	Vibration	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		Shall be covered to over 3/4 of terminal surface by new soldering.	JIS C 5101-1, 4.15 Solder temperature : 230 ± 5°C Dipping time : 3 to 5 s Dipping depth : Terminal shall be dipped into melted solder.
11	Resistance to Soldering Heat	Leakage Current Capacitance Change Dissipation Factor Appearance	Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS. Shall be within the values shown in CATALOGNUMBERS AND RATING OF STANDARD PRODUCTS. Shall not exceed the value in No.3. There shall be no evidence of mechanical damage.	JIS C 5101-1, 4.14 One of the following methods (a) Complete dipping method Solder temperature: 260 ± 5°C Dipping time: 10 ± 1 s (b) Terminal dipping method Solder temperature: 260 ± 5°C Dipping time: 10 ± 1 s

No.	Item		Performance	Test method
12	Component solvent resistance	Leakage Current Capacitance Change Dissipation Factor	Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS. Shall be within the values shown in CATALOGNUMBERS AND RATING OF STANDARD PRODUCTS. Shall not exceed the value in No.3.	JIS C 5101-1, 4.31 Temperature : 23 ± 5°C Dipping time : 5 ± 0.5 min. Conditioning : JIS C 0052 method 1 Solvent : 2-propanol (Isopropyl alcohol)
13	Solvent resistance of marking	Visual examination	After the test the marking shall be legible.	JIS C 5101-1, 4.32 Temperature : 23 ± 5°C Dipping time : 5 ± 0.5 min. Conditioning : JIS C 0052 method 1 Solvent : 2-propanol (Isopropyl alcohol) Rubbing material : cotton wool
14	Rapid Change of Temperature	Leakage Current Capacitance Change Dissipation Factor Appearance	Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS. Shall be within the values shown in CATALOGNUMBERS AND RATING OF STANDARD PRODUCTS. Shall not exceed the value in No.3. 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. max. Step 3 : 125 ± 2°C, 30 ± 3 min. Step 4 : 25 $^{+10}_{-5}$ °C, 3 min. max. Number of cycles : 5
15	Damp heat, Steady state	Leakage Current Capacitance Change Dissipation Factor Appearance	Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS. Shall be within the values shown in CATALOGNUMBERS AND RATING OF STANDARD PRODUCTS. Shall not exceed the value in No.3. There shall be no evidence of mechanical damage.	JIS C 5101-1, 4.22 Temperature : 40 ± 2°C Moisture : 90 ~ 95%RH Duration : 500 $^{+24}_{0}$ h
16	Endurance	Leakage Current Capacitance Change Dissipation Factor Appearance	Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS. Shall be within the values shown in CATALOGNUMBERS AND RATING OF STANDARD PRODUCTS. Shall not exceed the value in No.3. There shall be no evidence of mechanical damage.	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 $^{+72}_{0}$ h Power supply impedance : 3 Ω or less

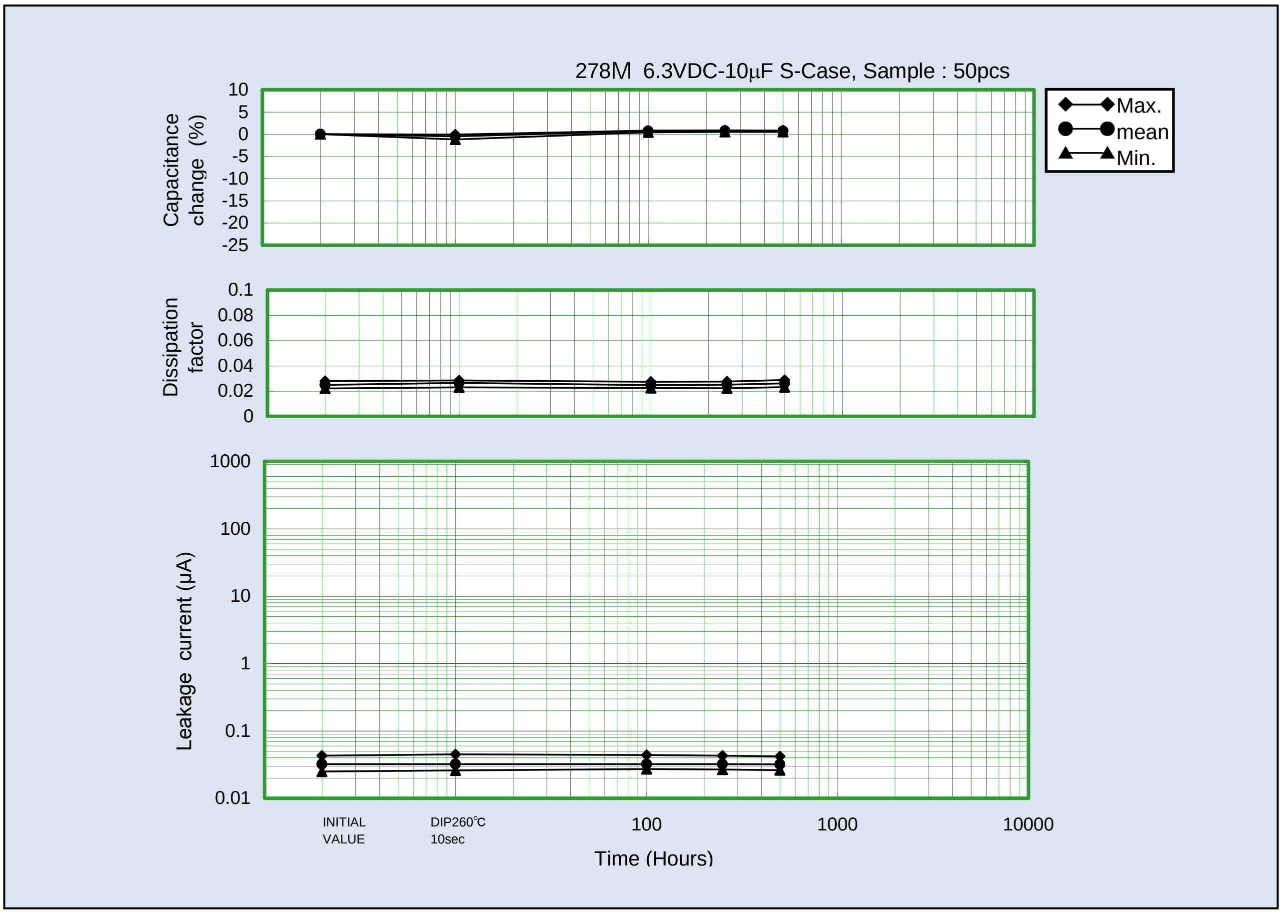
FREQUENCY CHARACTERISTICS



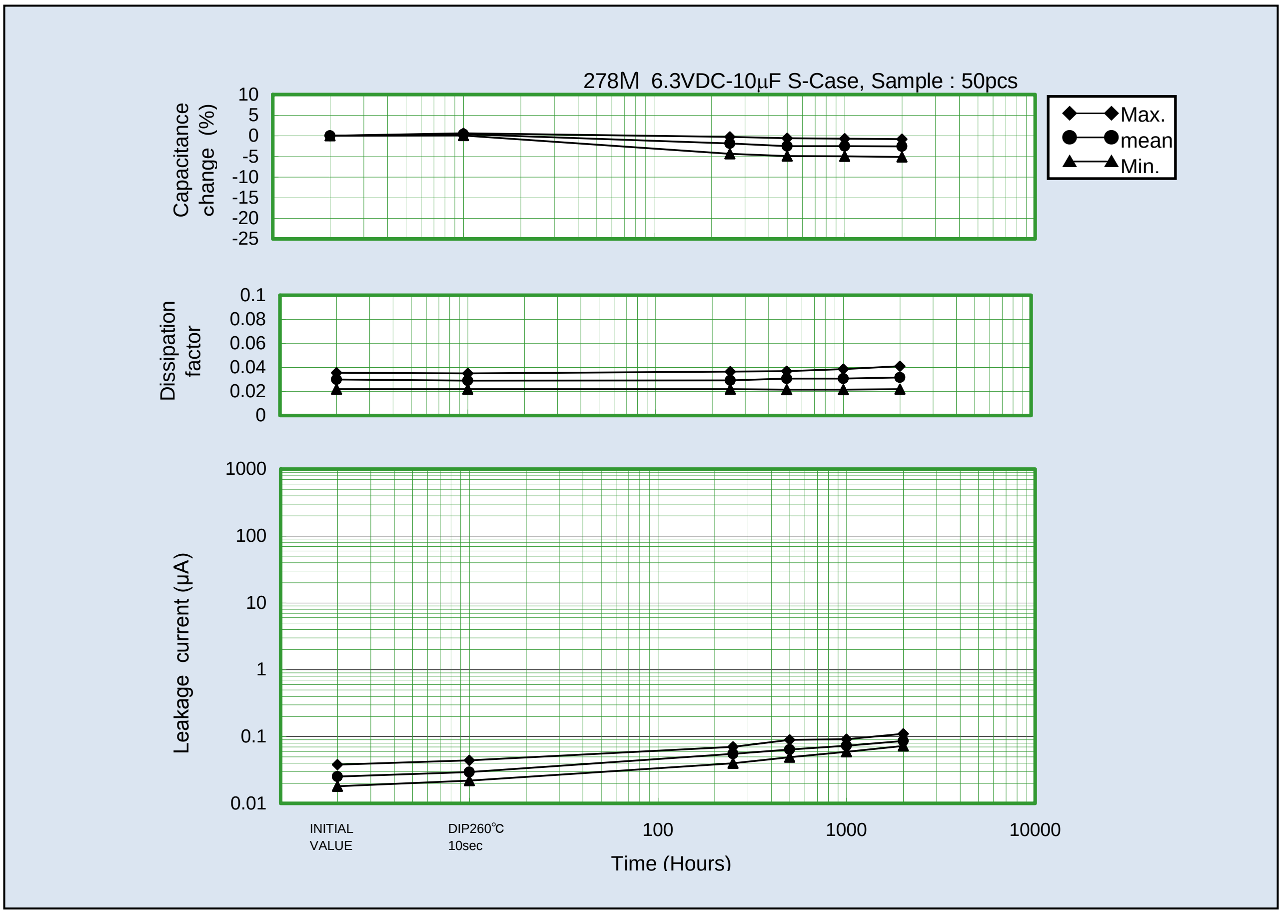
TEMPERATURE CHARACTERISTICS



DAMP HEAT, STEADY STATE 40℃, 95%RH



ENDURANCE 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 $P = \dfrac{E^2 \times ESR}{Z^2}$

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

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

$= Imax \times Z\ (Vrms)$

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）
S	0.043

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.

Table 2 Pmax multiplier at each operating temperature

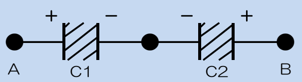
Operating temperature (℃)	Multiplier
25	1.0
55	0.9
85	0.8
125	0.4

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.

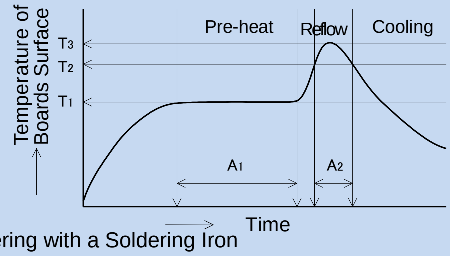
b) Near and Far IR Ray

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-2386) 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.