NCC

PRODUCTS DATA SHEET

No. P-278-001
DATE 2004-03

TANTALUM CAPACITORS

Type 278

MATSUO ELECTRIC CO., LTD.

Type 278 is ultra miniature chip tantalum capacitor with case size 2012 (2.0X1.25X1.2mm) and responds to market needs of miniaturization from electronics equipments.

FEATURES

1. Type 278 is suitable for high density SMT due to the precise dimensions.
2. Soldering: 260°C for 10 seconds by re-flow or flow soldering.
3. Type 278 is suitable for some ultra miniaturized applications such as handy phone, mobile phone, pager, PCMCIA card, etc.
4. Lead-free products.

CHARACTERISTICS

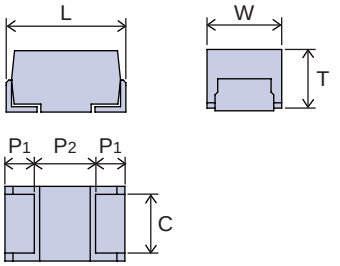
ITEM	CHARACTERISTICS
Failure rate level	1%/1000h (M)
Operating temperature	-55 ~ +125°C (voltage derating when exceeding +85°C) When +125°C, 2/3XRV
Rated voltage	2.5-4-6.3-10-16-20-25 VDC
Capacitance range	0.1 ~ 33 µF
Capacitance tolerance	±10%(K), ±20%(M)

RATINGS

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

( ): Under development.

DIMENSIONS

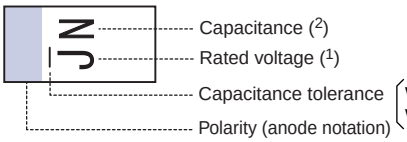


Case Size	Case Code	L±0.1	W±0.1	T±0.1	P1±0.1	P2±0.1	C±0.1
S	2012	2.0	1.25	1.2	0.5	0.8	0.9

(mm)

MARKING

[S Case]



(1)

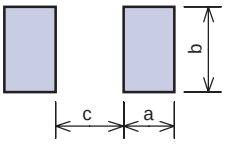
Rated voltage VDC	2.5	4	6.3	10	16	20	25
Rated voltage code	e	G	J	A	C	D	E

(2)

Rated capacitance µF	1	1.5	2.2	3.3	4.7	6.8
Rated capacitance code	A	E	J	N	S	W

Mark of rated capacitance except above: _(1/10), ¯(×10)
(e.g. J indicates 0.22 (J(2.2)×1/10))

RECOMMENDED PAD DIMENSIONS

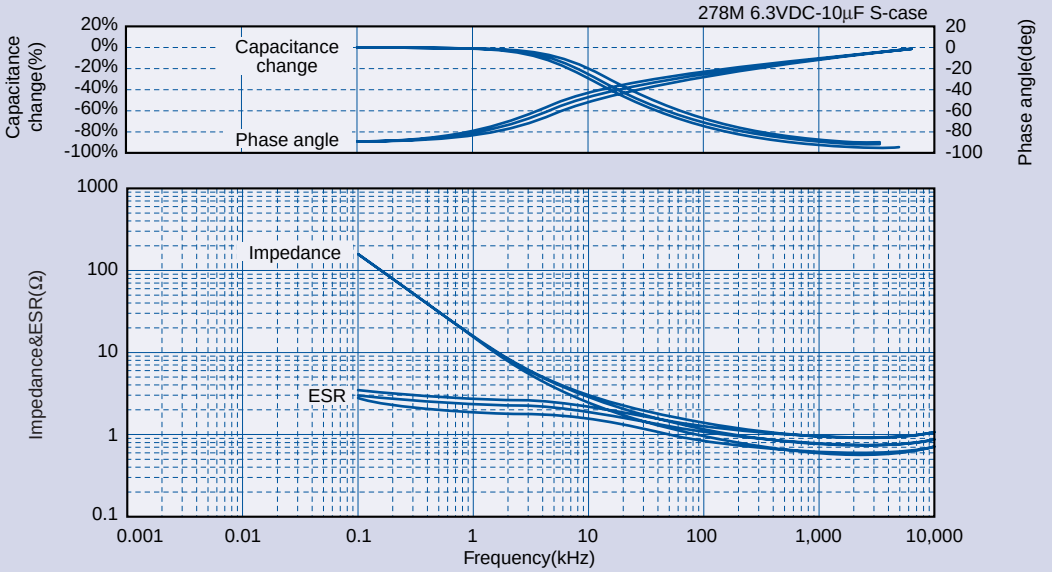


Case Size	Case Code	a		b	c
		Flow	Reflow		
S	2012	2.2	1.4	1.2	0.9

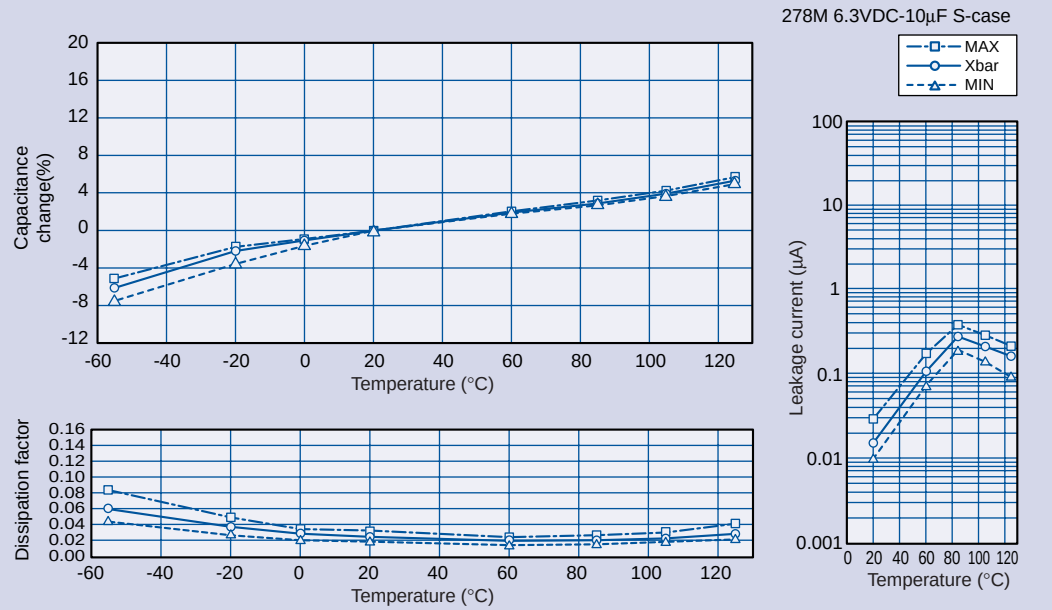
(mm)

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

FREQUENCY CHARACTERISTICS



TEMPERATURE CHARACTERISTICS



PERFORMANCE AND TEST METHOD

Note: Values of [ ] indicate that in case of performance of 4V-22μF, 6.3V-15μF and 10V-10μF is different from other specifications.

NO	TEST ITEM			PERFORMANCE	TEST METHOD
1	Leakage Current (μA)			Shall not exceed 0.01CV or 0.5 whichever is greater	Applied voltage: Rated voltage for 5 minutes
2	Capacitance			Shall be within tolerance of the nominal value specified.	Frequency: 120Hz ±20% Voltage: 0.5Vrms+1.5-2VDC
3	Dissipation Factor			Shall not exceed the value in Table 1.	
4	Characteristics at High and Low Temperature	Step 1	Leakage Current (μA) Capacitance Dissipation Factor	Shall not exceed the value in No 1. Shall be within tolerance of the nominal value specified. Shall not exceed the value in Table 1.	Temperature: 20±2°C
		Step 2	Capacitance Dissipation Factor	Within ±10% of the value in Step 1. [Within -30%] Shall not exceed the value in Table 1.	Temperature: -55 (-3/+0)°C
		Step 3	Leakage Current (μA) Capacitance Dissipation Factor	Shall not exceed the value in No 1. Within ±2% of the value in Step 1. Shall not exceed the value in Table 1.	Temperature: 20±2°C
		Step 4	Leakage Current (μA) Capacitance Dissipation Factor	Shall not exceed 0.1CV or 5 whichever is greater. [Shall not exceed 0.2CV.] Within ±10% of the value in Step 1. [Within ±20%] Shall not exceed the value in Table 1.	Temperature: 85 (-3/0)°C
		Step 5	Leakage Current (μA) Capacitance Dissipation Factor	Shall not exceed 0.125CV or 6.3 whichever is greater. [Shall not exceed 0.25CV.] Within -0/+15% of the value in Step 1. [Within ±20%] Shall not exceed the value in Table 1.	Temperature: 125 (-0/+3)°C Voltage: 125°C voltage derating
		Step 6	Leakage Current (μA) Capacitance Dissipation Factor	Shall not exceed the value in No 1. Within ±2% of the value in Step 1. Shall not exceed the value in Table 1.	Temperature: 20±2°C
5	Surge		Leakage Current (μA) Capacitance Dissipation Factor Visual Examination	Shall not exceed the value in No 1. [Shall not exceed 200% of the value in No 1.] Within the value of (A) in Table 1 of the initial value. Shall not exceed the value in Table 1. There shall be no evidence of mechanical damage.	Temperature, Applied voltage: half of the samples each •85±2°C, rated voltage×1.15 •125±2°C, 2/3×rated voltage×1.15 Series protective resistance: 1000Ω Discharge resistance: 1000Ω
6	Shear (formerly adhesion) Test			No exfoliation between lead terminal and board.	Samples are mounted with the following conditions. •Indirect heating method (reflow) •Temperature: 240±10°C/Time: 10seconds or less Applied pressure: 5N Duration: 5±1seconds
7	Substrate Bending Test		Capacitance Visual Examination	Initial value to remain steady during measurement. There shall be no evidence of mechanical damage.	Bend: 3mm
8	Vibration		Capacitance Visual Examination	Initial value to remain steady during measurement. There shall be no evidence of mechanical damage.	Frequency range: 10-55Hz Total swing width:1.5mm Vibration direction: 3 directions with mutually right-angled. Duration: 2 hours in each of these mutually perpendicular directions (total of 6 hours) Mounting: Solder terminal to the printed board
9	Shock (specified pulse)			There shall be no intermittent contact of 0.5ms or greater, short, or open. Nor shall there be any spark discharge, insulation breakdown, or evidence of mechanical damage.	Peak acceleration: 490m/s^2 Duration: 11ms Wave form: Half-sine
10	Solderability			The dipped portion of the lead shall be covered more than 3/4 with new solder.	Solder temperature: 235±5°C Dipping time: 3-5seconds Dipping depth: Capacitor terminal shall be dipped into melted solder
11	Resistance to Soldering Heat		Leakage Current (μA) Capacitance Dissipation Factor Visual Examination	Shall not exceed the value in No 1. Within the value of (A) in Table 1 of the initial value. Shall not exceed the value in Table 1. There shall be no evidence of mechanical damage.	Solder temperature: 260±5°C Duration: 10±1seconds
12	Rapid Change of Temperature		Leakage Current (μA) Capacitance Dissipation Factor Visual Examination	Shall not exceed the value in No 1. [Shall not exceed 200% of the value in No 1.] Within the value of (A) in Table 1 of the initial value. Shall not exceed 150% of the value in Table 1. There shall be no evidence of mechanical damage.	Step 1: -55 (-3/+0) °C 30±3minutes Step 2: 25 (-5/+10) °C, 3minutes or less Step 3: 125 (-3/+0) °C, 30±3minutes Step 4: 25 (-5/+10) °C, 3minutes or less Number of cycle: 5
13	Damp heat, Steady state		Leakage Current (μA) Capacitance Dissipation Factor Visual Examination	Shall not exceed the value in No 1. [Shall not exceed 200% of the value in No 1.] Within the value of (A) in Table 1 of the initial value. Shall not exceed the value in Table 1. There shall be no evidence of mechanical damage.	Temperature: 40±2°C Moisture: 90-95%R.H. Duration: 500 (-0/+24) hours
14	Endurance		Leakage Current (μA) Capacitance Dissipation Factor Visual Examination	Shall not exceed 125% of the value in No 1. [Shall not exceed 200% of the value in No 1.] Within ±10% of the value before the test. [Within ±30%] Shall not exceed the value in Table 1. There shall be no evidence of mechanical damage.	Temperature, applied voltage: 85±2°C, DC rated voltage or 125±3°C, 2/3×rated voltage Duration: 2000 (-0/+72) hours Series resistance: do not exceed 3Ω

ORDERING INFORMATION

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

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

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

(Taping Specification)

	Reel	Anode notation
R	ϕ180	Feed hole side: -
L	↓	Feed hole side: +
N	ϕ330	Feed hole side: -
P	↓	Feed hole side: +

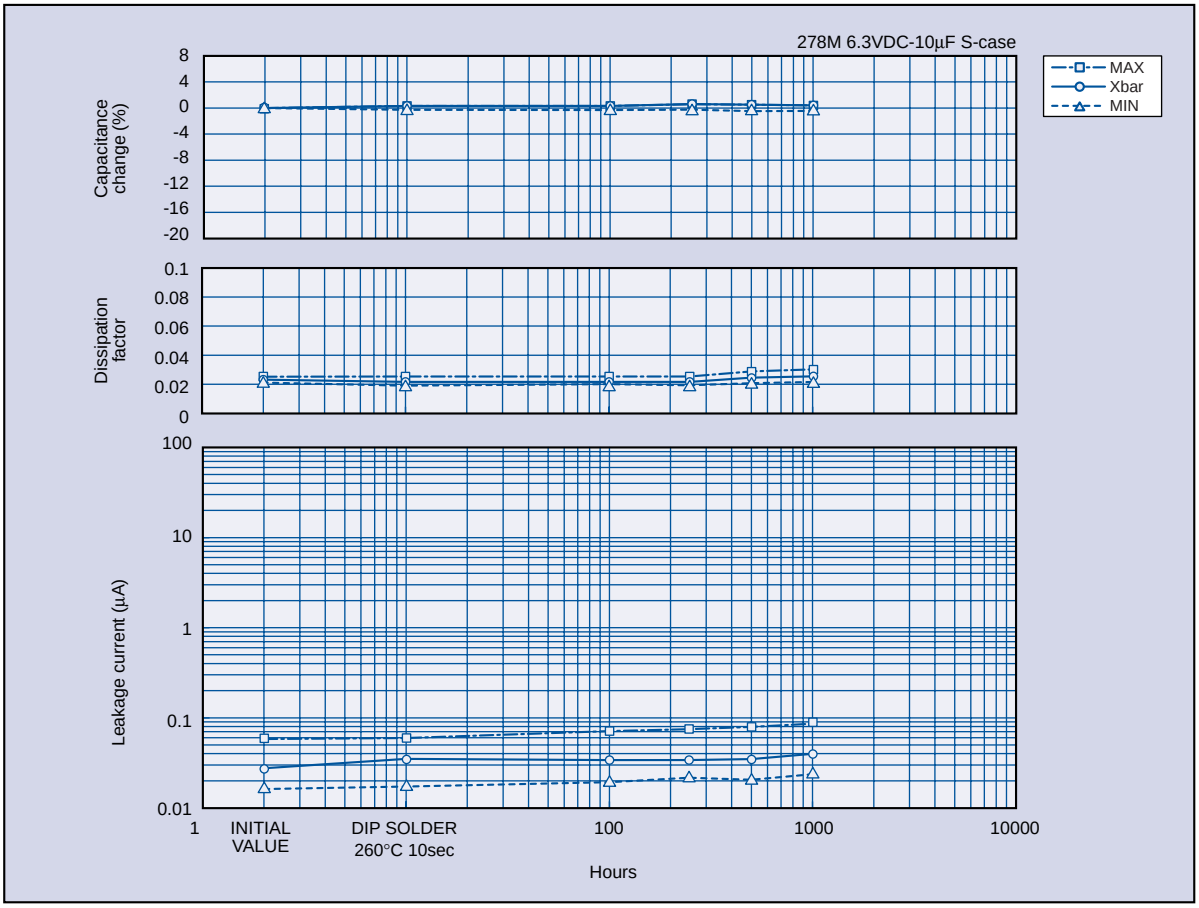
CATALOG NUMBERS AND RATINGS

Table-1

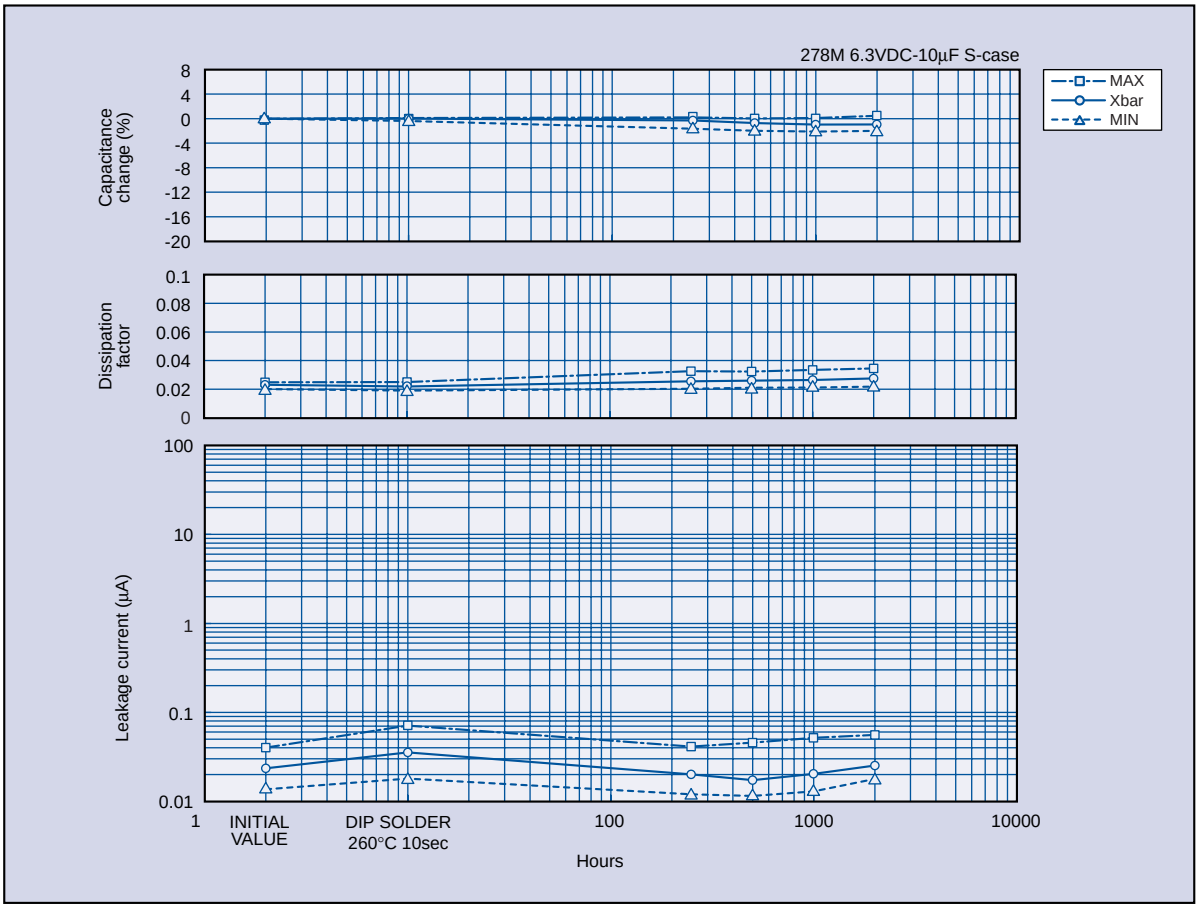
Catalog number	Rated Voltage VDC	Surge Voltage VDC	Capacitance μF	Case Code	Max DC Lct. μA			Max dissipation factor				(A)
					20°C	85°C	125°C	-55°C	20°C	85°C	125°C	
◎ 278 M 2501 336 _1 _2	2.5	3.3	33	S	0.8	17	21	0.30	0.20	0.20	0.20	
278 M 4001 226 _1 _2	4	5	22	S	0.9	18	22	0.30	0.20	0.20	0.20	±20
278 M 6301 685 _1 _2	6.3	8	6.8	S	0.5	5	6.3	0.15	0.08	0.08	0.10	±10
278 M 6301 106 _1 _2	↓	↓	10	S	0.6	6	7.9	0.15	0.06	0.06	0.06	±10
278 M 6301 156 _1 _2	↓	↓	15	S	0.9	19	24	0.30	0.20	0.20	0.20	±20
278 M 1002 155 _1 _2	10	13	1.5	S	0.5	5	6.3	0.12	0.08	0.08	0.10	±5
278 M 1002 225 _1 _2	↓	↓	2.2	S	0.5	5	6.3	0.12	0.08	0.08	0.10	±5
278 M 1002 335 _1 _2	↓	↓	3.3	S	0.5	5	6.3	0.15	0.08	0.08	0.10	±10
278 M 1002 475 _1 _2	↓	↓	4.7	S	0.5	5	6.3	0.15	0.08	0.08	0.10	±10
278 M 1002 106 _1 _2	↓	↓	10	S	1.0	20	25	0.30	0.20	0.20	0.20	±20
278 M 1602 105 _1 _2	16	20	1.0	S	0.5	5	6.3	0.12	0.08	0.08	0.10	±5
◎ 278 M 1602 155 _1 _2	↓	↓	1.5	S	0.5	5	6.3	0.21	0.08	0.08	0.10	
278 M 2002 104 _1 _2	20	26	0.1	S	0.5	5	6.3	0.08	0.04	0.04	0.05	±5
278 M 2002 154 _1 _2	↓	↓	0.15	S	0.5	5	6.3	0.08	0.04	0.04	0.05	±5
278 M 2002 224 _1 _2	↓	↓	0.22	S	0.5	5	6.3	0.08	0.04	0.04	0.05	±5
278 M 2002 334 _1 _2	↓	↓	0.33	S	0.5	5	6.3	0.08	0.04	0.04	0.05	±5
278 M 2002 474 _1 _2	↓	↓	0.47	S	0.5	5	6.3	0.08	0.06	0.06	0.06	±5
278 M 2002 684 _1 _2	↓	↓	0.68	S	0.5	5	6.3	0.12	0.08	0.08	0.10	±5
◎ 278 M 2502 105 _1 _2	25	32	1.0	S	0.5	5	6.3	0.15	0.10	0.10	0.12	

(1) _1: Put code “K” (±10%) or “M” (±20%) for capacitance tolerance.
(2) _2: No code for single item. Put code “R (N)” or “L (P)” for taping specification.
Standard feed hole side: -R (N).
(3) ◎ are under development.

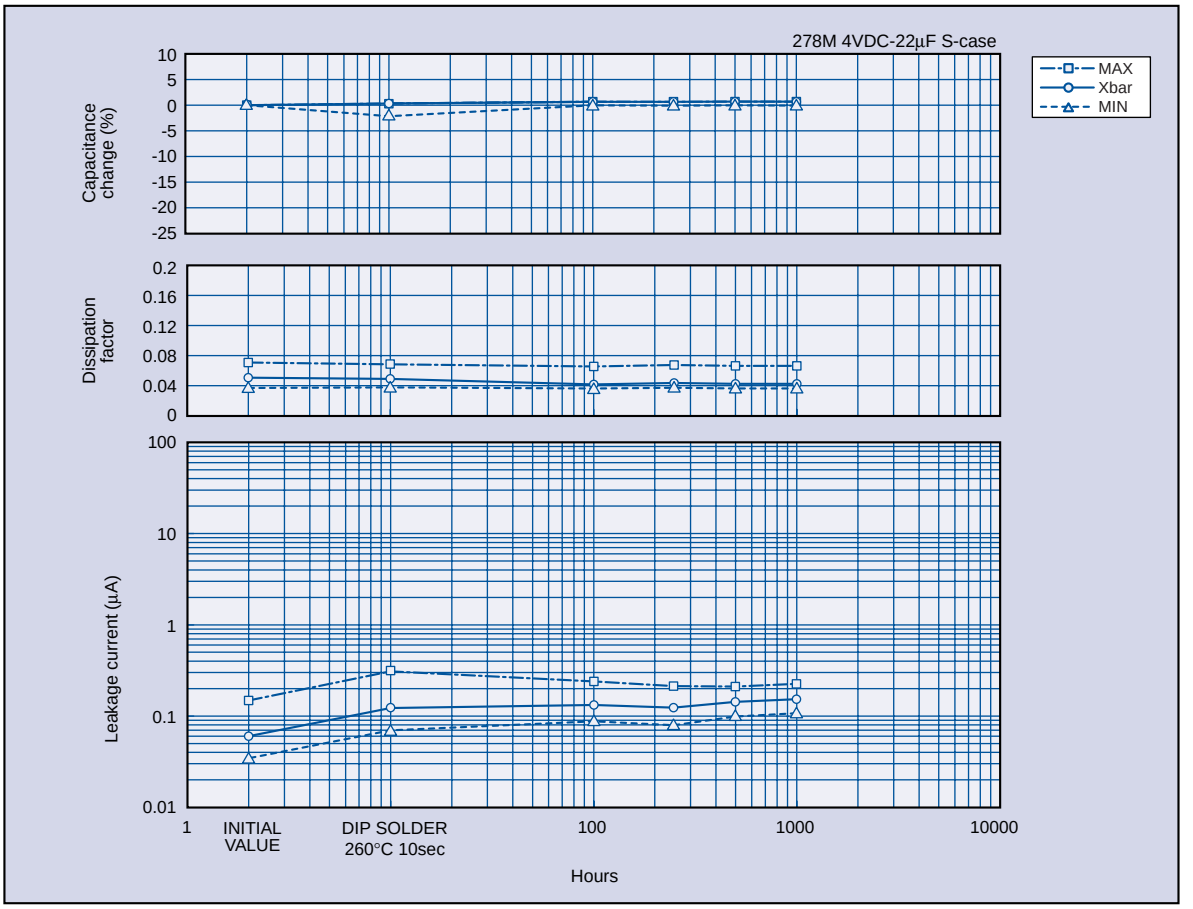
DAMP HEAT 40°C, 95%



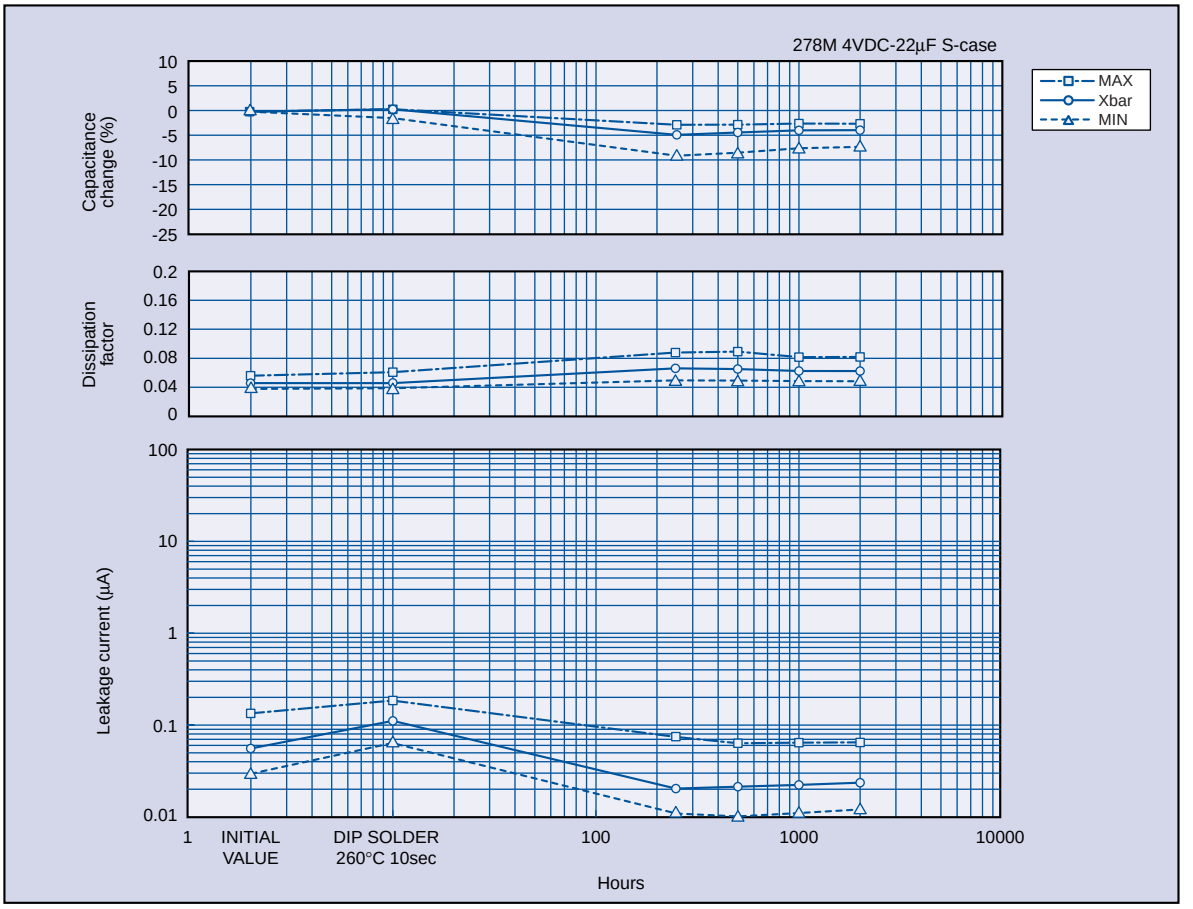
ENDURANCE 85°C



DAMP HEAT 40°C, 95%



ENDURANCE 85°C



■Application Notes for Tantalum Capacitors

1. Operating Voltage

Tantalum capacitors shall be operated at the rated voltage or lower.
Rated voltage: Maximum value of DC voltage which can apply continuously to capacitor's terminals at rated temperature
Surge voltage: The voltage which can apply instantaneously to capacitors at rated temperature or maximum high temperature. Also, the voltage which can endure 1000 times cycle through 1000Ω of series resistance for 30 seconds at 6 minutes cycle.
When designing the circuit, the equipment's required reliability must be considered and appropriate voltage derating must be performed.

2. Applications 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 (refer page 3).
(3) Ripple voltage should not exceed the allowable values (refer page 4).

3. Permissible Reverse Voltage

To avoid an increase in failure rate and changes in leakage current, reverse voltage should be kept below the values listed in the following table. In order to avoid the reverse voltage exceeding allowable value, add bias voltage when necessary.

Ambient Temperature	25°C	55°C	85°C	125°C
Permissible Reverse Voltage	R. V. × 10%	R. V. × 6%	R. V. × 3%	R. V. × 1%
	or 0.5V whichever is greater.			

Note: The above information in the table applies to circuits with incidental reverse voltage being applied.
For constant reverse voltage in a circuit, a non-polar device is always recommended.

4. Permissible Ripple Voltage

Permissible ripple voltage is determined by the heat loss of the element and heat radiation of the lead wire, and is influenced by capacitance, ESR, operating temperature, and frequency of ripple. Please consult Matsuo's Engineering Bulletin for details on calculating permissible ripple current values.

5. Low Impedance Applications

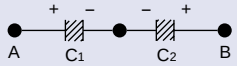
The failure rate of a low impedance circuit at 0.1Ω/V is about five times greater than that of 1Ω/V circuit. To curtail this higher failure rate, the operating voltage of tantalum capacitors used in low impedance circuits, such as filters for power supplies (particularly switching power supplies) or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

6. Non Polar Application

Tantalum capacitors can be used as a non-polar unit if two capacitors are connected "BACK-TO-BACK" in a circuit when reverse voltage is applied at more than permissible value or in a purely AC circuit. Please pay attention to the following points when connecting two capacitors "BACK-TO-BACK".
Ripple Voltage: Permissible Ripple Voltage shall not exceed the value allowed for either C_1 or C_2.

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. Pre-heating

To obtain optimal reliability, lowering the heat shock during the soldering process is favorable. Capacitors should be pre-heated at 130-160°C for approximately 60 seconds.

7.2. Soldering

The body of the capacitor should 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.
Two methods of Reflow Soldering: Direct Heat 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 on a hot plate. The capacitor maintains a lower temperature than the printed board, which in turn stays at a lower temperature than the hot plate.

· Atmospheric Heat
a) VPS(Vapor Phase Soldering)
During VPS, the printed board is heated by inert liquid with a high boiling point. The temperature of the capacitor's body and the temperature of the printed board are about the same as the atmosphere. Please set this temperature 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. To prevent the capacitor's internal temperature from exceeding 260°C, temperature of the oven shall be set lower, or perform air or nitrogen circulation (refer to the next item C) at the same time.
c) Convection Oven
An infrared ray is the main source of heat in this process. The temperature of the printed board and the capacitors can be maintained at similar level by the circulation of heated air, or inert gas.

(2)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 capacitors' terminals, and the temperature of the soldering iron should never exceed 290°C. The application of the iron should not exceed 3 seconds.
(3) Please consult Matsuo's Sales Department 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 Matsuo's Sales Department.

9. Protective Resin Coating

If molded with resin coating after assembly on printed board, the heat generated by resin causes it to harden, and the inner stress caused by temperature change after hardenings may cause failure. Sufficient advance test shall be done before selecting resin or buffer coating.

10. Vibration

When a capacitor is dropped to a concrete floor from 1 meter height, approximately 2940m/s^2 shall be applied to the capacitor. Although capacitors are made to withstand this drop test, stress from falling shock can cause damage to the capacitors and may increase the failure rate.

11. Ultrasonic Cleaning

Ultrasonic cleaning under severe condition may break terminals. Also, from an electrical characteristics aspect, it is unfavorable. Therefore, please do not use ultrasonic cleaning if possible. 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 a 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 shook.
Please consult Matsuo's Sales Department before use.

12. Additional Notes

· When connecting two or more capacitors in series, connect the resistors in parallel to share the voltage evenly to each capacitor.
· Cutting of capacitor's wrapping material must not be done because of the limitation of the mounting space.
· During a customer's aging process, voltage should remain under the capacitor's rated voltage at all times.
· Capacitors should never be touched or manipulated while operating.
· Capacitors should not be dismantled.
· When testing capacitors, please examine the power source before conducting tests to insure the tester's polarity. When checking by applying electrode while turning on electricity, please do not touch the polarity of other components.
· In the event of a capacitor burning, smoking, or emitting an offensive smell during operation, please cut the power supply or unplug. Keep away from the burned capacitor.
· When capacitors are shorted, they become very hot and tantalum capacitor elements may ignite. It may burn the printed circuit board and other parts.
· Capacitors should be stored at room temperature under normal humidity and packaged to avoid direct sunlight and dust. Capacitors exceeding shelf life shall be disposed of.
· Equipment with capacitors shall be stored at normal temperature and humidity. If they are operated in a humid environment, they should be moisture proof. Avoid condensation on capacitors. Capacitors shall be coated under the operation in active gasses so that the gasses will not touch the capacitors directly. Capacitors should not be operated in environments containing acids and alkalis.
· When capacitors are disposed of as "scrap" or waste, they should be treated as Industrial Waste since they contain various metals and resin.
· Capacitors submitted as samples should not be used for equipment coming onto the market. We provide samples for only specific purpose (configuration sample, check for electric characteristics, etc.).

MATSUO ELECTRIC CO., LTD.

Please feel free to ask our Sales Department for more information of the Tantalum Capacitors.

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USA	Matsuo Electronics of America, Inc. 2134 Main Street, Suite 200, Huntington Beach, CA 92648	Tel : 714-969-2491	Fax : 714-960-6492
URL	http://www.ncc-matsuo.co.jp/		