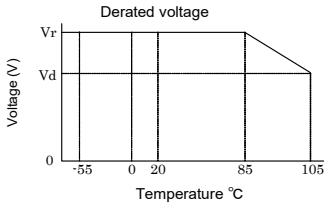
Application Notes for Tantalum Solid Electrolytic Capacitor with Conductive Polymer Type TCB

1. Operating voltage

The capacitors shall be operated at the rated voltage or lower. Over rated voltage applied even for a short time may cause short failure. When designing the circuit, the equipment's required reliability must be considered and appropriate voltage derating must be performed.

- Recommended operating voltage : 80% or less of the rated voltage
- When the operating temperature exceeds rated temperature, derate the applied voltage. The voltage derating formula of rated temperature 85℃ is shown below.



Derating voltage Vt at any temperature T between 85℃ and 105℃ shall be calculated by the follwing formula.

$$Vt = Vr - \frac{Vr-Vd}{20} \quad (T-85)$$

Vr : Rated voltage
Vd : Derating voltage at 105℃

Property value of the specification number

Specification Number	Rated Temperature			Rated voltage (VDC)			
			Temperature	2.5	4.0	6.3	10.0
Blanks,50	+85℃	Derated voltage Vd(VDC)	+105℃	2.0	3.2	5.0	8.0
08	+65℃		+85℃	-	-	4.5	-
			+105℃	-	-	3.3	-

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. Reverse voltage

Special attention to the polar character. Reverse Voltage should not be applied.

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 for each case code (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.

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

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

$$\text{Permissible ripple voltage } Emax = \sqrt{\frac{P\ max}{ESR}} \times Z = Imax \times Z \ (Vrms)$$

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

Table 1 Permissible power loss for each case code

Case Code	Pmax（W）
09M	0.057
10M（Specification Number 50）	0.057
10S,12S,13S	0.063
12S（Specification Number 50）	0.066
10A,12A,13A	0.077

Table 2 Pmax multiplier at each operating temperature

Operating temperature（℃）	Multiplier
20	1.0
55	0.9
65	0.86
85	0.8
105	0.4

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

5. Non Polar Connection

The capacitor cannot be used as a non-polar unit.

6. Soldering

6.1 Preheating

To obtain optimal reliability, lowering the heat shock during the soldering process is favorable. Capacitors should be pre-heated at 150～200℃ for approximately 60～180 seconds.

6.2 Soldering

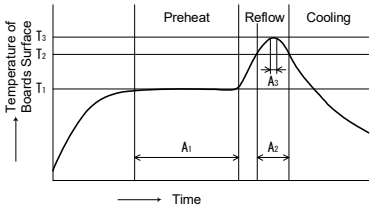
The body of the capacitor should not exceed 260℃ during soldering. Leakage current can be increased slightly due to the soldering heat. In this case, leakage current will be decreased gradually when leaving capacitors in the normal temperature and humidity adequately.

(1) Reflow Soldering

Reflow soldering is a process in which the capacitors are mounted on a printed circuit board with solder paste. Two methods of Reflow Soldering: Direct and Atmospheric Heat.

- Direct Heat (Hot plate)
- Atmospheric Heat
  a) Near and Far IR Ray
  b) Convection Oven

Vapor Phase Soldering and Flow Soldering are not recommended.
Recommended condition by IR Re-flow procedure is shown in picture-1.



Temperature	Time
T1= 150℃～200℃	A1=180sec.(max.)
T2= 217℃	A2=90sec.(max.)
T3= 260℃	A3=5sec.(max.)

- Number of cycles : 2

(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 capacitor's terminals, and the temperature of the soldering iron should never exceed 350 C. The application of the iron should not exceed 3 seconds and 30 watt.

(3) Please consult us for other methods.

7. 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.

8. 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 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 solvent. Please consult us.

9. Storage

The plastic reel (made of PS) used for packaging the product is intended for use in ambient temperatures (5-35℃). To prevent issues during automated insertion due to reel deformation or other factors, please keep the reel away from direct sunlight and heat sources, and ensure it does not reach high temperatures (above 60℃), including during transportation. Capacitors should be tightly sealed in moisture prevention bag and stored with supplied reel. After unpacking, capacitors should be used within the floor life listed in Table 3.

Moisture Sensitivity Level ：Table 3 shows the moisture sensitivity level and the floor life of the dampproof wrapping products.

Table 3 MSL&Floor Life

JEDEC MSL	Floor Life
3	168hrs.(7days)
	Less than 30℃/60%RH

（Reference IPC/JEDEC J-STD-020C July 2004）

10. Inapplicable circuits

The capacitors may cause nonconformity if they are used on the following circuits.

(1) High-impedance voltage holding circuits

(2) Coupling circuits

(3) Time constant circuits

(4) Circuits significantly affected by leakage current

If a short circuit occurs, the capacitors may generate heat or smoke depending on the short-circuit current. When designing a circuit, take the instructions stated herein into consideration, and take as much redundant measures as possible.

11. Additional Notes

Wear-out failure（Lifetime）

When the operating time exceeded the specified guarantee time of Endurance and Damp heat, the electric characteristics changes significantly and the open circuit might by the degradation of electrolyte.

Please note that the electric characteristics of capacitance and ESR might change within the specified range in specifications when it used under the condition of electric and mechanical performance.

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

MATSUO ELECTRIC CO., LTD.

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

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