

# Tantalum Solid Electrolytic Capacitor

## Application Notes for 251 series



### 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  | 55                  | 85                  | 125                 |
|-----------------------------|---|---------------------|---------------------|---------------------|
| Permissible reverse voltage | 10% of rated voltage                            | 6% of rated voltage | 3% of rated voltage | 1% of rated voltage |
|                             | The above voltage or 0.5V, 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 0.1Ω/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.

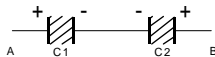
#### 6. Non Polar Application

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:  $(C1 \times C2) / (C1 + C2)$

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.

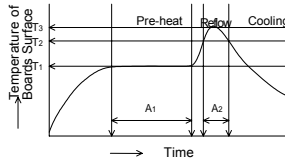
##### b) Near and Far IR Ray

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) Convection 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..

##### (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<sup>2</sup>.
- (3) The cleaning time should be kept to a minimum. Also, samples must be swang in the solvent. 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 (JEITA). For the details of the instructions (explanation, reasons and concrete examples), please refer to this guideline, or consult our Sales Department.



**MATSUO ELECTRIC CO., LTD.**