INTRODUCTION
Tantalum electrolytic capacitors are the preferred choice in applications where volumetric efficiency, stable electrical parameters, high reliability, and long service life are primary considerations. The stability and resistance to elevated temperatures of the tantalum/tantalum oxide/manganese dioxide system make solid tantalum capacitors an appropriate choice for today's surface mount assembly technology.

Vishay Polytech has been a pioneer and leader in this field, producing a large variety of tantalum capacitor types for consumer, industrial, automotive, military, and aerospace electronic applications.

Tantalum is not found in its pure state. Rather, it is commonly found in a number of oxide minerals, often in combination with Columbium ore. This combination is known as “tantalite” when its contents are more than one-half tantalum. Important sources of tantalite include Australia, Brazil, Canada, China, and several African countries. Synthetic tantalite concentrates produced from tin slags in Thailand, Malaysia, and Brazil are also a significant raw material for tantalum production.

Electronic applications, and particularly capacitors, consume the largest share of world tantalum production. Other important applications for tantalum include cutting tools (tantalum carbide), high temperature super alloys, chemical processing equipment, medical implants, and military ordnance.

Vishay Polytech is a major user of tantalum materials in the form of powder and wire for capacitor elements and rod and sheet for high temperature vacuum processing.

THE BASICS OF TANTALUM CAPACITORS
Most metals form crystalline oxides which are non-protecting, such as rust on iron or black oxide on copper. A few metals form dense, stable, tightly adhering, electrically insulating oxides. These are the so-called “valve” metals and include titanium, zirconium, niobium, tantalum, hafnium, and aluminum. Only a few of these permit the accurate control of oxide thickness by electrochemical means. Of these, the most valuable for the electronics industry are aluminum and tantalum.

Capacitors are basic to all kinds of electrical equipment, from radios and television sets to missile controls and automobile ignitions. Their function is to store an electrical charge for later use.

Capacitors consist of two conducting surfaces, usually metal plates, whose function is to conduct electricity. They are separated by an insulating material or dielectric. The dielectric used in all tantalum electrolytic capacitors is tantalum pentoxide.
In the tantalum electrolytic capacitor, the distance between the plates is very small since it is only the thickness of the tantalum pentoxide film. As the dielectric constant of the tantalum pentoxide is high, the capacitance of a tantalum capacitor is high if the area of the plates is large:

\[ C = \frac{\varepsilon A}{t} \]

where
- \( C \) = Capacitance
- \( \varepsilon \) = Dielectric constant
- \( A \) = Surface area of the dielectric
- \( t \) = Thickness of the dielectric

**SOLID ELECTROLYTE TANTALUM CAPACITORS**

Solid electrolyte tantalum capacitors contain either liquid or solid electrolytes. In solid electrolyte capacitors, a dry material (manganese dioxide) forms the cathode plate. A tantalum lead is embedded in or welded to the pellet, which is in turn connected to a termination or lead wire. The drawings show the construction details of the surface mount types of tantalum capacitors shown in this catalog.

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**SOLID TANTALUM POLYMER CAPACITORS**

<table>
<thead>
<tr>
<th>SERIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TYPE</strong></td>
</tr>
<tr>
<td>TANTAMOUNT®, molded case, high performance polymer</td>
</tr>
<tr>
<td><strong>TEMPERATURE RANGE</strong></td>
</tr>
<tr>
<td>Operating Temperature: -55 °C to +105 °C (above 85 °C, voltage derating is required)</td>
</tr>
<tr>
<td><strong>CASE SIZES</strong></td>
</tr>
<tr>
<td>J, P, A, T, B</td>
</tr>
<tr>
<td><strong>CAPACITANCE RANGE</strong></td>
</tr>
<tr>
<td>3.3 μF to 330 μF</td>
</tr>
<tr>
<td><strong>VOLTAGE RANGE</strong></td>
</tr>
<tr>
<td>2.5 V to 10 V</td>
</tr>
<tr>
<td><strong>CAPACITANCE TOLERANCE</strong></td>
</tr>
<tr>
<td>± 20 %</td>
</tr>
<tr>
<td><strong>DISSIPATION FACTOR</strong></td>
</tr>
<tr>
<td>10 % maximum</td>
</tr>
<tr>
<td><strong>ESR</strong></td>
</tr>
<tr>
<td>30 mΩ to 500 mΩ</td>
</tr>
<tr>
<td><strong>TERMINATION</strong></td>
</tr>
<tr>
<td>Cases J, P, A: 100 % tin</td>
</tr>
<tr>
<td>Cases B, T: Ni/Pd/Au</td>
</tr>
</tbody>
</table>
PACKING AND STORAGE

T55 capacitors meet moisture sensitivity level rating (MSL) of 3 as specified in IPC/JEDEC J-STD-020D.1 and are dry packaged in moisture barrier bags (MBB) per J-STD-033. Level 3 specifies a floor life (out of bag) of 168 h at 30 °C maximum and 60 % relative humidity (RH). Unused capacitors should be re-sealed in the MMB with fresh desiccant. A moisture strip (humidity indicator card) is included in the bag to assure dryness. To remove excess moisture, capacitors can be dried at 40 °C (standard “dry box” conditions).

For detailed recommendations please refer to J-STD-033.
RECOMMENDED REFLOW PROFILES

PROFILE FEATURE | LEAD (Pb)-FREE ASSEMBLY
---|---
**PREHEAT AND SOAK** | 
Temperature min. ($T_{\text{Smin.}}$) | 150 °C
Temperature max. ($T_{\text{Smax.}}$) | 200 °C
Time ($t_{S}$) from ($T_{\text{Smin.}}$ to $T_{\text{Smax.}}$) | 60 s to 120 s

**RAMP UP** | 
Ramp-up rate ($T_{L}$ to $T_{P}$) | 3 °C/s maximum
Liquidous temperature ($T_{L}$) | 217 °C
Time ($t_{L}$) maintained above $T_{L}$ | 60 s to 150 s
Peak package body temperature ($T_{P}$) max. | 260 °C
Time ($t_{p}$) within 5 °C of the peak max. temperature | 5 s

**RAMP DOWN** | 
Ramp-down rate ($T_{P}$ to $T_{L}$) | 6 °C/s maximum
Time from 25 °C to peak temperature | 8 min maximum

**Note**
- T55 capacitors are process sensitive. PSL classification to JEDEC J-STD-075: R4G.

**PAD DIMENSIONS** in millimeters

<table>
<thead>
<tr>
<th>CASE/ DIMENSIONS</th>
<th>CAPACITOR SIZE</th>
<th>PAD DIMENSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>W</td>
</tr>
<tr>
<td>J</td>
<td>1.6</td>
<td>0.8</td>
</tr>
<tr>
<td>P</td>
<td>2.0</td>
<td>1.25</td>
</tr>
<tr>
<td>A</td>
<td>3.2</td>
<td>1.6</td>
</tr>
<tr>
<td>T/B</td>
<td>3.5</td>
<td>2.8</td>
</tr>
</tbody>
</table>
GUIDE TO APPLICATION

1. **AC Ripple Current**: the maximum allowable ripple current shall be determined from the formula:

   \[ I_{\text{RMS}} = \sqrt{\frac{P}{R_{\text{ESR}}}} \]

   where,
   - \( P \) = power dissipation in watts at +25 °C as given in the tables in the product datasheets (Power Dissipation)
   - \( R_{\text{ESR}} \) = the capacitor equivalent series resistance at the specified frequency

2. **AC Ripple Voltage**: the maximum allowable ripple voltage shall be determined from the formula:

   \[ V_{\text{RMS}} = Z \sqrt{\frac{P}{R_{\text{ESR}}}} \]

   or, from the formula:

   \[ V_{\text{RMS}} = I_{\text{RMS}} \times Z \]

   where,
   - \( P \) = power dissipation in watts at +25 °C as given in the tables in the product datasheets (Power Dissipation)
   - \( R_{\text{ESR}} \) = the capacitor equivalent series resistance at the specified frequency
   - \( Z \) = the capacitor impedance at the specified frequency

2.1 The tantalum capacitors must be used in such a condition that the sum of the working voltage and ripple voltage peak values does not exceed the rated voltage.

3. **Temperature Derating**: if these capacitors are to be operated at temperatures above +25 °C, the permissible RMS ripple current or voltage shall be calculated using the derated power dissipation values as shown in Table 1 of next section.

4. **Power Dissipation**: power dissipation will be affected by the heat sinking capability of the mounting surface. Non-sinusoidal ripple current may produce heating effects which differ from those shown. It is important that the equivalent \( I_{\text{RMS}} \) value be established when calculating permissible operating levels. (Power dissipation calculated using +25 °C temperature rise.)

5. **Reverse Voltage**: these capacitors are capable of withstanding peak voltages in the reverse direction equal to 10 % of the DC rating at +25 °C, 5 % of the DC rating at +25 °C, 5 % of the DC rating at +85 °C, and 1 % of the DC rating at +105 °C.

6. **Mounting Precautions**

   6.1 **Limit Pressure on Capacitor Installation with Mounter**: Pressure must not exceed 4.9 N with a tool end diameter of 1.5 mm when applied to the capacitors using an absorber, centering tweezers, or similar (maximum permitted pressurization time: 5 seconds). An excessively low absorber setting position would result in not only the application of undue force to the capacitors but capacitor and other component scattering, circuit board wiring breakage, and/or cracking as well, particularly when the capacitors are mounted together with other chips having a height of 1 mm or less.

   6.2 **Flux Selection**:

   - Select a flux that contains a minimum of chlorine and amine.
   - After flux use, the chlorine and amine in the flux remain must be removed.

   6.3 **Cleaning after Mounting**: The following solvents are usable when cleaning the capacitors after mounting. Never use a highly active solvent.

   - Halogen organic solvent (HCFC225, etc.)
   - Alcoholic solvent (IPA, ethanol, etc.)
   - Petroleum solvent, alkali saponifying agent, water, etc.

Circuit board cleaning must be conducted at a temperature of not higher than 50 °C and for an immersion time of not longer than 30 minutes. When an ultrasonic cleaning method is used, cleaning must be conducted at a frequency of 48 kHz or lower, at an vibrator output of 0.02 W/cm³, at a temperature of not higher than 40 °C, and for a time of 5 minutes or shorter.

**Notes**

- Care must be exercised in cleaning process so that the mounted capacitor will not come into contact with any cleaned object or the like or will not get rubbed by a stiff brush or similar. If such precautions are not taken particularly when the ultrasonic cleaning method is employed, terminal breakage may occur.
- When performing ultrasonic cleaning under conditions other than stated above, conduct adequate advance checkout.

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**Table 1 - Maximum Permissible Power Loss Values (P\text{max}) by Case Size**

<table>
<thead>
<tr>
<th>AMBIENT TEMPERATURE (°C)</th>
<th>J</th>
<th>P</th>
<th>A</th>
<th>T, B</th>
</tr>
</thead>
<tbody>
<tr>
<td>+25</td>
<td>0.050</td>
<td>0.064</td>
<td>0.078</td>
<td>0.096</td>
</tr>
<tr>
<td>+55</td>
<td>0.032</td>
<td>0.045</td>
<td>0.051</td>
<td>0.062</td>
</tr>
<tr>
<td>+85</td>
<td>0.018</td>
<td>0.023</td>
<td>0.029</td>
<td>0.035</td>
</tr>
</tbody>
</table>

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For technical questions, contact: polytech@vishay.com

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