



## Molded Chip Tantalum Capacitors

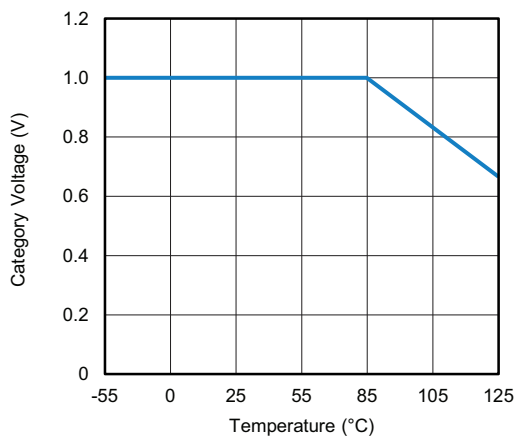
| CAPACITOR ELECTRICAL PERFORMANCE CHARACTERISTICS                     |                                                                                                                                                                                                                                                                                                                                                                                           |                          |                                     |                          |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-------------------------------------|--------------------------|
| ITEM                                                                 | PERFORMANCE CHARACTERISTICS                                                                                                                                                                                                                                                                                                                                                               |                          |                                     |                          |
| Category temperature range                                           | -55 °C to +85 °C (to +125 °C with voltage derating)                                                                                                                                                                                                                                                                                                                                       |                          |                                     |                          |
| Capacitance tolerance                                                | ± 20 %, ± 10 %. Tested via bridge method, at +25 °C, 120 Hz                                                                                                                                                                                                                                                                                                                               |                          |                                     |                          |
| Dissipation factor                                                   | Limit per Standard Ratings table. Tested via bridge method, at 25 °C, 120 Hz                                                                                                                                                                                                                                                                                                              |                          |                                     |                          |
| ESR                                                                  | Limit per Standard Ratings table. Tested via bridge method, at 25 °C, 100 kHz                                                                                                                                                                                                                                                                                                             |                          |                                     |                          |
| Leakage current                                                      | After application of rated voltage applied to capacitors for 5 min using a steady source of power with 1 kΩ resistor in series with the capacitor under test, leakage current at 25 °C is not more than 0.01 CV or 0.5 μA, whichever is greater. <i>Note that the leakage current varies with temperature and applied voltage. See graph below for the appropriate adjustment factor.</i> |                          |                                     |                          |
| Capacitance change by temperature                                    | +20 % max. (at +125 °C)<br>+10 % max. (at +85 °C)<br>-10 % max. (at -55 °C)                                                                                                                                                                                                                                                                                                               |                          |                                     |                          |
| Reverse voltage                                                      | Capacitors are capable of withstanding peak voltages in the reverse direction equal to:<br>10 % of the DC rating at +25 °C<br>5 % of the DC rating at +85 °C<br>Vishay does not recommend intentional or repetitive application of reverse voltage                                                                                                                                        |                          |                                     |                          |
| Ripple current                                                       | For maximum ripple current values (at 25 °C) refer to relevant datasheet. If capacitors are to be used at temperatures above +25 °C, the permissible RMS ripple current (or voltage) shall be calculated using the derating factors: 1.0 at +25 °C; 0.9 at +85 °C; 0.4 at +125 °C                                                                                                         |                          |                                     |                          |
| Maximum operating and surge voltages vs. temperature                 | +85 °C                                                                                                                                                                                                                                                                                                                                                                                    |                          | +125 °C                             |                          |
|                                                                      | <b>RATED VOLTAGE (V)</b>                                                                                                                                                                                                                                                                                                                                                                  | <b>SURGE VOLTAGE (V)</b> | <b>CATEGORY VOLTAGE (V)</b>         | <b>SURGE VOLTAGE (V)</b> |
|                                                                      | 4                                                                                                                                                                                                                                                                                                                                                                                         | 5.2                      | 2.7                                 | 3.4                      |
|                                                                      | 6.3                                                                                                                                                                                                                                                                                                                                                                                       | 8                        | 4                                   | 5                        |
|                                                                      | 10                                                                                                                                                                                                                                                                                                                                                                                        | 13                       | 7                                   | 8                        |
|                                                                      | 16                                                                                                                                                                                                                                                                                                                                                                                        | 20                       | 10                                  | 12                       |
|                                                                      | 20                                                                                                                                                                                                                                                                                                                                                                                        | 26                       | 13                                  | 16                       |
|                                                                      | 25 <sup>(1)</sup>                                                                                                                                                                                                                                                                                                                                                                         | 32                       | 17                                  | 20                       |
|                                                                      | 25 <sup>(2)</sup>                                                                                                                                                                                                                                                                                                                                                                         | 27                       | 17                                  | 20                       |
|                                                                      | 35 <sup>(3)</sup>                                                                                                                                                                                                                                                                                                                                                                         | 46                       | 23                                  | 28                       |
|                                                                      | 35 <sup>(4)</sup>                                                                                                                                                                                                                                                                                                                                                                         | 42                       | 23                                  | 28                       |
|                                                                      | 50                                                                                                                                                                                                                                                                                                                                                                                        | 65                       | 33                                  | 40                       |
|                                                                      | 50 <sup>(5)</sup>                                                                                                                                                                                                                                                                                                                                                                         | 60                       | 33                                  | 40                       |
|                                                                      | 63                                                                                                                                                                                                                                                                                                                                                                                        | 75                       | 42                                  | 50                       |
|                                                                      | 75 <sup>(6)</sup>                                                                                                                                                                                                                                                                                                                                                                         | 75                       | 50                                  | 50                       |
| Recommended voltage derating guidelines (below 85 °C) <sup>(7)</sup> | <b>VOLTAGE RAIL (V)</b>                                                                                                                                                                                                                                                                                                                                                                   |                          | <b>CAPACITOR VOLTAGE RATING (V)</b> |                          |
|                                                                      | ≤ 3.3                                                                                                                                                                                                                                                                                                                                                                                     |                          | 6.3                                 |                          |
|                                                                      | 5                                                                                                                                                                                                                                                                                                                                                                                         |                          | 10                                  |                          |
|                                                                      | 10                                                                                                                                                                                                                                                                                                                                                                                        |                          | 20                                  |                          |
|                                                                      | 12                                                                                                                                                                                                                                                                                                                                                                                        |                          | 25                                  |                          |
|                                                                      | 15                                                                                                                                                                                                                                                                                                                                                                                        |                          | 35                                  |                          |
|                                                                      | 24                                                                                                                                                                                                                                                                                                                                                                                        |                          | 50 or series configuration          |                          |
|                                                                      | 28                                                                                                                                                                                                                                                                                                                                                                                        |                          | 63 or series configuration          |                          |
|                                                                      | ≥ 32                                                                                                                                                                                                                                                                                                                                                                                      |                          | 75 or series configuration          |                          |

## Notes

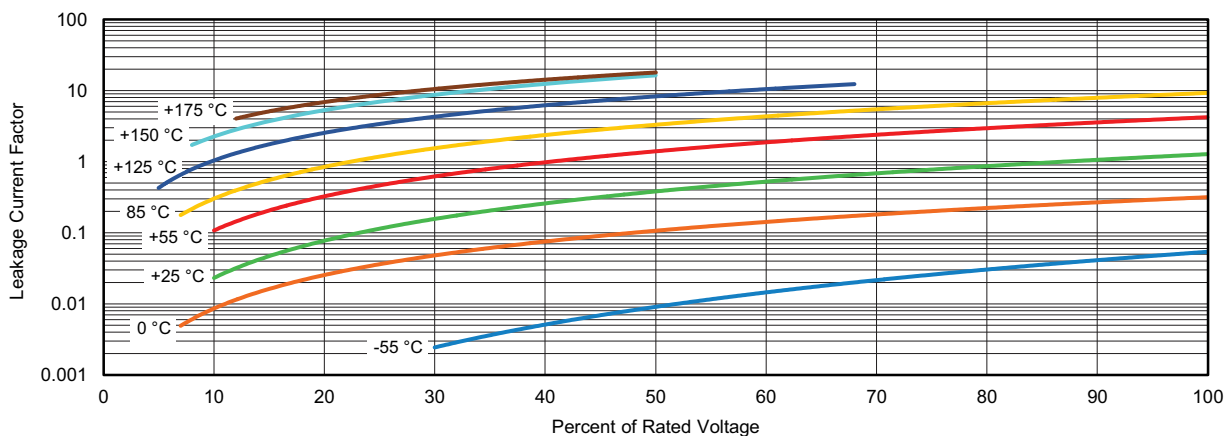
- All information presented in this document reflects typical performance characteristics
  - For more information about recommended voltage derating see: [www.vishay.com/doc?40246](http://www.vishay.com/doc?40246)
- (1) Capacitance values lower than 100 μF  
 (2) Capacitance values 100 μF and higher  
 (3) Capacitance values lower than 33 μF  
 (4) Capacitance values 33 μF and higher  
 (5) Capacitance values 15 μF and higher  
 (6) For 293D and TR3 only  
 (7) For temperatures above +85 °C the same voltage derating ratio is recommended, but with respect to category voltage: up to +85 °C: category voltage = rated voltage; at +125 °C: category voltage = 2/3 of rated voltage, between these temperatures it decreases linearly - see graph below



## CATEGORY VOLTAGE VS. TEMPERATURE



## TYPICAL LEAKAGE CURRENT TEMPERATURE FACTOR



### Note

- At +25 °C, the leakage current shall not exceed the value listed in the Standard Ratings table.
- At +85 °C, the leakage current shall not exceed 10 times the value listed in the Standard Ratings table.
- At +125 °C, the leakage current shall not exceed 12 times the value listed in the Standard Ratings table.
- At +150 °C, the leakage current shall not exceed 15 times the value listed in the Standard Ratings table.
- At +175 °C, the leakage current shall not exceed 18 times the value listed in the Standard Ratings table.



| ENVIRONMENTAL PERFORMANCE CHARACTERISTICS |                                                                                                                                                                                |      |                                                             |                                                                                                                          |                                                                                                                                              |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| ITEM                                      | CONDITION                                                                                                                                                                      |      | POST TEST PERFORMANCE                                       |                                                                                                                          |                                                                                                                                              |
| Surge voltage                             | Post application of surge voltage (as specified in the table above) in series with a 33 Ω resistor at the rate of 30 s ON, 30 s OFF, for 1000 successive test cycles at 85 °C. |      | Capacitance change<br>Dissipation factor<br>Leakage current | Within ± 10 % of initial value<br>Initial specified limit<br>Initial specified limit                                     |                                                                                                                                              |
| Life test at +85 °C                       | 1000 h application of rated voltage at 85 °C. MIL-STD-202, method 108                                                                                                          |      | Capacitance change<br>Dissipation factor<br>Leakage current | Within -20 % / +10 % of initial value<br>Initial specified limit<br>Shall not exceed 125 % of initial limit              |                                                                                                                                              |
| Life test at +125 °C                      | 1000 h application 2/3 of rated voltage at 125 °C. MIL-STD-202, method 108                                                                                                     |      | Capacitance change<br>Dissipation factor<br>Leakage current | Within -20 % / +10 % of initial value<br>Initial specified limit<br>Shall not exceed 125 % of initial limit              |                                                                                                                                              |
| Humidity tests                            | At 60 °C / 90 % RH 1000 h, biased                                                                                                                                              |      | Capacitance change<br>Dissipation factor<br>Leakage current | Within -10 % / +20 % of initial value<br>Not to exceed 150 % of initial limit<br>Shall not exceed 200 % of initial limit |                                                                                                                                              |
| Thermal shock                             | MIL-STD-202, method 107, test condition A (-55 °C / +85 °C, for 1000 cycles)                                                                                                   |      | Capacitance change<br>Dissipation factor<br>Leakage current | Within ± 10 % of initial value<br>Initial specified limit<br>Initial specified limit                                     |                                                                                                                                              |
| Temperature stability                     | EIA-717                                                                                                                                                                        | STEP | TEMPERATURE                                                 | TEST LIMITS                                                                                                              |                                                                                                                                              |
|                                           |                                                                                                                                                                                | 1    | 25 °C                                                       | Capacitance change<br>Dissipation factor<br>Leakage current                                                              | Within tolerance specified<br>Initial specified limit<br>Initial specified limit                                                             |
|                                           |                                                                                                                                                                                | 2    | -55 °C                                                      | Capacitance change<br>Dissipation factor<br>Leakage current                                                              | Within ± 10 % of initial measured value<br>Not to exceed 150 % of initial specified limit<br>Initial specified limit                         |
|                                           |                                                                                                                                                                                | 3    | 25 °C                                                       | Capacitance change<br>Dissipation factor<br>Leakage current                                                              | Within ± 10 % of initial measured value<br>Not to exceed 150 % of initial specified limit<br>Initial specified limit                         |
|                                           |                                                                                                                                                                                | 4    | 85 °C                                                       | Capacitance change<br>Dissipation factor<br>Leakage current                                                              | Within ± 10 % of initial measured value<br>Not to exceed 115 % of initial specified limit<br>Not to exceed 1000 % of initial specified limit |
|                                           |                                                                                                                                                                                | 5    | 125 °C                                                      | Capacitance change<br>Dissipation factor<br>Leakage current                                                              | Within ± 20 % of initial measured value<br>Not to exceed 115 % of initial specified limit<br>Not to exceed 1200 % of initial specified limit |
|                                           |                                                                                                                                                                                | 6    | 25 °C                                                       | Capacitance change<br>Dissipation factor<br>Leakage current                                                              | Within ± 10 % of initial measured value<br>Initial specified limit<br>Initial specified limit                                                |

| MECHANICAL PERFORMANCE CHARACTERISTICS         |                                                                                                                                                                 |  |                                                                                                                                                                                               |                                                                                          |
|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| TEST CONDITION                                 | CONDITION                                                                                                                                                       |  | POST TEST PERFORMANCE                                                                                                                                                                         |                                                                                          |
| Terminal strength / shear force test           | Apply a pressure load of 17.7 N for 60 s horizontally to the center of capacitor side body.                                                                     |  | Capacitance change<br>Dissipation factor<br>Leakage current                                                                                                                                   | Within $\pm 10$ % of initial value<br>Initial specified limit<br>Initial specified limit |
|                                                |                                                                                                                                                                 |  | There shall be no mechanical or visual damage to capacitors post-conditioning.                                                                                                                |                                                                                          |
| Vibration                                      | MIL-STD-202, method 204, condition D, 10 Hz to 2000 Hz, 20 g peak, 8 h, at rated voltage                                                                        |  | Electrical measurements are not applicable, since the same parts are used for shock (specified pulse) test.<br>There shall be no mechanical or visual damage to capacitors post-conditioning. |                                                                                          |
| Shock (specified pulse)                        | MIL-STD-202, method 213, condition I, 100 g peak                                                                                                                |  | Capacitance change<br>Dissipation factor<br>Leakage current                                                                                                                                   | Within $\pm 10$ % of initial value<br>Initial specified limit<br>Initial specified limit |
|                                                |                                                                                                                                                                 |  | There shall be no mechanical or visual damage to capacitors post-conditioning.                                                                                                                |                                                                                          |
| Resistance to soldering heat                   | Recommended reflow profiles temperatures and durations are located within the Capacitor Series Guides MIL-STD-202, method 210, condition B                      |  | Capacitance change<br>Dissipation factor<br>Leakage current                                                                                                                                   | Within $\pm 10$ % of initial value<br>Initial specified limit<br>Initial specified limit |
|                                                |                                                                                                                                                                 |  | There shall be no mechanical or visual damage to capacitors post-conditioning.                                                                                                                |                                                                                          |
| Solderability and dissolution of metallization | MIL-STD-202, method 208, ANSI/J-STD-002, test B (SnPb) and B1 (lead (Pb)-free). Dissolution of metallization: method D.<br>Does not apply to gold terminations. |  | There shall be no mechanical or visual damage to capacitors post-conditioning.                                                                                                                |                                                                                          |
| Flammability                                   | Encapsulation materials meet UL 94 V-0 with an oxygen index of 32 %.                                                                                            |  |                                                                                                                                                                                               |                                                                                          |