

# SuperTan® Wet Tantalum Capacitors with Hermetic Seal



Vishay ST represents a major breakthrough in wet tantalum capacitor technology. Its unique cathode system provides the highest capacitance per unit volume. The design facilitates a doubling of capacitance, lower ESR and higher ripple current rating compared with conventional wet tantalum products. Moreover, the ST has the capacitance stability of a solid tantalum capacitor and there are no circuit impedance restrictions.

The ST is housed in an all tantalum, hermetically sealed case and is manufactured to withstand hazardous environments. The ST is used widely in the defense and aerospace industries and whenever there is a space problem.

## PERFORMANCE CHARACTERISTICS

**Operating Temperature:** -55 °C to +85 °C  
(to +125 °C with voltage derating)

**Capacitance Tolerance:** at 120 Hz, +25 °C.  
± 20 % standard. ± 10 % available as special.

## FEATURES

- Very high capacitance
- 10 µF to 1800 µF
- 25 V<sub>DC</sub> to 125 V<sub>DC</sub>
- Very low ESR
- High ripple current
- All tantalum case
- Hermetically sealed
- Low DCL
- Axial through-hole terminations: standard tin / lead (Sn / Pb), 100 % tin (RoHS-compliant) available
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



## Note

\* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non-RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details.

## APPLICATION NOTES

- No continuous reverse voltage permissible.
- The peak of the applied AC ripple and the applied DC voltage must not exceed the DC voltage rating of the capacitor.
- Ripple current ratings by part number at 85 °C and 40 kHz are included in the table. Ripple current correction factors for other temperatures and frequencies are given on the next page.
- Transient reverse voltage surges are acceptable under the following conditions:  
the peak reverse voltage does not exceed 1.5 V and the peak current times the duration of the reverse transient does not exceed 0.05 As. In addition, the repetition frequency of the reverse voltage surge is less than 10 Hz.

## DIMENSIONS in inches [millimeters]



| CASE CODE | D ± 0.016 [0.41] | MAX. INSULATED (DIA.) | L <sub>1</sub> + 0.031 / - 0.016 [+ 0.79 / - 0.41] UNINSULATED | E ± 0.250 [6.3] MAX. |
|-----------|------------------|-----------------------|----------------------------------------------------------------|----------------------|
| T1        | 0.188 [4.78]     | 0.219 [5.56]          | 0.453 [11.51]                                                  | 1.500 [38.10]        |
| T2        | 0.281 [7.14]     | 0.312 [7.92]          | 0.641 [16.28]                                                  | 2.250 [57.15]        |
| L2        | 0.281 [7.14]     | 0.312 [7.92]          | 1.008 [25.60]                                                  | 2.250 [57.15]        |
| T3        | 0.375 [9.52]     | 0.406 [10.31]         | 0.766 [19.46]                                                  | 2.250 [57.15]        |
| T4        | 0.375 [9.52]     | 0.406 [10.31]         | 1.062 [26.97]                                                  | 2.250 [57.15]        |

## Notes

- Material at egress is Tantalum
- Insulation sleeving will lap over the ends of the capacitor case
- Approx. weight:  
T1: 2.3 g, T2: 5.7 g,  
T3: 9.4 g, T4: 14.8 g

**ORDERING INFORMATION**

| ST                                    | 220               | 100                       | T4        | M                        | I                                | E3                                                                                              |
|---------------------------------------|-------------------|---------------------------|-----------|--------------------------|----------------------------------|-------------------------------------------------------------------------------------------------|
| Super Tan®<br>COMMERCIAL<br>CAP. TYPE | CAPACITANCE<br>μF | 85 °C RATED<br>DC VOLTAGE | CASE CODE | CAPACITANCE<br>TOLERANCE | INSULATING<br>SLEEVE             | RoHS-compliant                                                                                  |
|                                       |                   |                           |           | M = ± 20 %<br>K = ± 10 % | I = insulated<br>X = uninsulated | E3 = 100 % tin termination<br>(RoHS compliant)<br>Blank = SnPb termination<br>(standard design) |

**STANDARD RATINGS**

| CAPACITANCE<br>AT 25 °C<br>AND 120 Hz<br>(μF)                  | CASE<br>CODE | MAX.<br>ESR<br>120 Hz<br>(Ω) | MAX. DCL AT<br>+25 °C<br>(μA) | MAX. DCL AT<br>+85 °C /<br>+125 °C<br>(μA) | MAX. IMP.<br>AT -55 °C<br>AND 120 Hz<br>(Ω) | MAX. CAPACITANCE<br>CHANGE AT<br>-55 °C<br>(%) | MAX. CAPACITANCE<br>CHANGE AT<br>+85 °C<br>(%) | MAX. CAPACITANCE<br>CHANGE AT<br>+125 °C<br>(%) | AC RIPPLE<br>85 °C<br>40 kHz<br>(mA)<br>RMS | PART NUMBER   |
|----------------------------------------------------------------|--------------|------------------------------|-------------------------------|--------------------------------------------|---------------------------------------------|------------------------------------------------|------------------------------------------------|-------------------------------------------------|---------------------------------------------|---------------|
| <b>25 V<sub>DC</sub> AT 85 °C; 15 V<sub>DC</sub> AT 125 °C</b> |              |                              |                               |                                            |                                             |                                                |                                                |                                                 |                                             |               |
| 120                                                            | T1           | 1.3                          | 1                             | 5                                          | 25                                          | -42                                            | +8                                             | +12                                             | 1250                                        | ST120-25T1MI  |
| 560                                                            | T2           | 0.83                         | 2                             | 10                                         | 12                                          | -65                                            | +10                                            | +15                                             | 2100                                        | ST560-25T2MI  |
| 1100                                                           | L2           | 0.5                          | 3                             | 25                                         | 7                                           | -60                                            | +20                                            | +45                                             | 3200                                        | ST1100-25L2MI |
| 1200                                                           | T3           | 0.65                         | 5                             | 20                                         | 7                                           | -70                                            | +12                                            | +18                                             | 2600                                        | ST1200-25T3MI |
| 1800                                                           | T4           | 0.5                          | 6                             | 25                                         | 7                                           | -72                                            | +12                                            | +20                                             | 3100                                        | ST1800-25T4MI |
| <b>30 V<sub>DC</sub> AT 85 °C; 20 V<sub>DC</sub> AT 125 °C</b> |              |                              |                               |                                            |                                             |                                                |                                                |                                                 |                                             |               |
| 100                                                            | T1           | 1.3                          | 1                             | 5                                          | 25                                          | -38                                            | +8                                             | +12                                             | 1200                                        | ST100-30TMI   |
| 470                                                            | T2           | 0.85                         | 2                             | 10                                         | 15                                          | -65                                            | +10                                            | +18                                             | 1800                                        | ST470-30T2MI  |
| 950                                                            | L2           | 0.5                          | 5                             | 30                                         | 7                                           | -55                                            | +18                                            | +35                                             | 3200                                        | ST950-30L2MI  |
| 1000                                                           | T3           | 0.7                          | 7                             | 25                                         | 7                                           | -70                                            | +10                                            | +18                                             | 2500                                        | ST1000-30T3MI |
| 1500                                                           | T4           | 0.6                          | 12                            | 35                                         | 6                                           | -72                                            | +10                                            | +20                                             | 3000                                        | ST1500-30T4MI |
| <b>50 V<sub>DC</sub> AT 85 °C; 30 V<sub>DC</sub> AT 125 °C</b> |              |                              |                               |                                            |                                             |                                                |                                                |                                                 |                                             |               |
| 68                                                             | T1           | 1.5                          | 1                             | 5                                          | 35                                          | -25                                            | +8                                             | +15                                             | 1050                                        | ST68-50T1MI   |
| 220                                                            | T2           | 0.9                          | 2                             | 10                                         | 17.5                                        | -50                                            | +8                                             | +15                                             | 1800                                        | ST220-50T2MI  |
| 450                                                            | L2           | 0.6                          | 3                             | 25                                         | 7.5                                         | -45                                            | +12                                            | +30                                             | 2900                                        | ST450-50L2MI  |
| 470                                                            | T3           | 0.75                         | 3                             | 25                                         | 10                                          | -45                                            | +8                                             | +15                                             | 2100                                        | ST470-50T3MI  |
| 680                                                            | T4           | 0.7                          | 5                             | 40                                         | 8                                           | -58                                            | +10                                            | +20                                             | 2750                                        | ST680-50T4MI  |
| <b>60 V<sub>DC</sub> AT 85 °C; 40 V<sub>DC</sub> AT 125 °C</b> |              |                              |                               |                                            |                                             |                                                |                                                |                                                 |                                             |               |
| 47                                                             | T1           | 2.0                          | 1                             | 5                                          | 44                                          | -25                                            | +8                                             | +12                                             | 1050                                        | ST47-60T1MI   |
| 150                                                            | T2           | 1.1                          | 2                             | 10                                         | 20                                          | -40                                            | +8                                             | +15                                             | 1800                                        | ST150-60T2MI  |
| 370                                                            | L2           | 0.6                          | 3                             | 25                                         | 9                                           | -33                                            | +9                                             | +20                                             | 2900                                        | ST370-60L2MI  |
| 390                                                            | T3           | 0.9                          | 3                             | 25                                         | 15                                          | -45                                            | +8                                             | +15                                             | 2100                                        | ST390-60T3MI  |
| 560                                                            | T4           | 0.8                          | 5                             | 40                                         | 10                                          | -58                                            | +8                                             | +15                                             | 2750                                        | ST560-60T4MI  |
| <b>75 V<sub>DC</sub> AT 85 °C; 50 V<sub>DC</sub> AT 125 °C</b> |              |                              |                               |                                            |                                             |                                                |                                                |                                                 |                                             |               |
| 33                                                             | T1           | 2.5                          | 1                             | 5                                          | 66                                          | -25                                            | +5                                             | +9                                              | 1050                                        | ST33-75T1MI   |
| 110                                                            | T2           | 1.3                          | 2                             | 10                                         | 24                                          | -35                                            | +6                                             | +10                                             | 1650                                        | ST110-75T2MI  |
| 250                                                            | L2           | 0.8                          | 5                             | 30                                         | 12                                          | -30                                            | +6                                             | +15                                             | 2500                                        | ST250-75L2MI  |
| 330                                                            | T3           | 1.0                          | 3                             | 30                                         | 12                                          | -45                                            | +6                                             | +10                                             | 2100                                        | ST330-75T3MI  |
| 470                                                            | T4           | 0.9                          | 5                             | 50                                         | 12                                          | -50                                            | +6                                             | +10                                             | 2750                                        | ST470-75T4MI  |

**Notes**

- (K = ± 10 %, M = ± 20 %) and insulation letter (I = insulation, X = uninsulated)
- Part numbers shown are for units with ± 20 % capacitance tolerance and uninsulated capacitors. For ± 10 units, change the digit following the letter "X" from "0" to "9". For units with outer plastic-film insulation, substitute "2" for "0" at the end of the part number
- For RoHS-compliant add "E3" for suffix

**STANDARD RATINGS**

| CAPACITANCE<br>AT 25 °C<br>AND 120 Hz<br>(μF)              | CASE<br>CODE | MAX.<br>ESR<br>120 Hz<br>(Ω) | MAX. DCL AT    |                             | MAX. IMP.<br>AT -55 °C<br>AND 120 Hz<br>(Ω) | MAX. CAPACITANCE<br>CHANGE AT |               |                | AC RIPPLE<br>85 °C<br>40 kHz<br>(mA)<br>RMS | PART NUMBER   |
|------------------------------------------------------------|--------------|------------------------------|----------------|-----------------------------|---------------------------------------------|-------------------------------|---------------|----------------|---------------------------------------------|---------------|
|                                                            |              |                              | +25 °C<br>(μA) | +85 °C /<br>+125 °C<br>(μA) |                                             | -55 °C<br>(%)                 | +85 °C<br>(%) | +125 °C<br>(%) |                                             |               |
| 100 V <sub>DC</sub> AT 85 °C; 65 V <sub>DC</sub> AT 125 °C |              |                              |                |                             |                                             |                               |               |                |                                             |               |
| 15                                                         | T1           | 3.5                          | 1              | 5                           | 125                                         | -18                           | +3            | +10            | 1050                                        | ST15-100T1MI  |
| 68                                                         | T2           | 2.1                          | 2              | 10                          | 37                                          | -30                           | +4            | +12            | 1650                                        | ST68-100T2MI  |
| 120                                                        | L2           | 1.0                          | 3              | 25                          | 20.5                                        | -30                           | +4            | +12            | 2200                                        | ST120-100L2MI |
| 150                                                        | T3           | 1.6                          | 3              | 25                          | 22                                          | -35                           | +6            | +12            | 2100                                        | ST150-100T3MI |
| 220                                                        | T4           | 1.2                          | 5              | 50                          | 15                                          | -40                           | +6            | +12            | 2750                                        | ST220-100T4MI |
| 125 V <sub>DC</sub> AT 85 °C; 85 V <sub>DC</sub> AT 125 °C |              |                              |                |                             |                                             |                               |               |                |                                             |               |
| 10                                                         | T1           | 5.5                          | 1              | 5                           | 175                                         | -15                           | +3            | +10            | 1050                                        | ST10-125T1MI  |
| 47                                                         | T2           | 2.3                          | 2              | 10                          | 47                                          | -25                           | +5            | +12            | 1650                                        | ST47-125T2MI  |
| 90                                                         | L2           | 1.3                          | 5              | 25                          | 25                                          | -22                           | +4            | +15            | 2000                                        | ST90-125L2MI  |
| 82                                                         | T3           | 1.8                          | 3              | 25                          | 40                                          | -35                           | +5            | +12            | 1950                                        | ST82-125T3MI  |
| 100                                                        | T3           | 1.8                          | 3              | 25                          | 35                                          | -35                           | +5            | +12            | 2100                                        | ST100-125T3MI |
| 150                                                        | T4           | 1.6                          | 5              | 50                          | 20                                          | -35                           | +6            | +12            | 2750                                        | ST150-125T4MI |

**Notes**

- (K =  $\pm 10$  %, M =  $\pm 20$  %) and insulation letter (I = insulation, X = uninsulated)
- Part numbers shown are for units with  $\pm 20$  % capacitance tolerance and uninsulated capacitors. For  $\pm 10$  units, change the digit following the letter "X" from "0" to "9". For units with outer plastic-film insulation, substitute "2" for "0" at the end of the part number
- For RoHS-compliant add "E3" for suffix

**RIPPLE CURRENT MULTIPLIERS VS. FREQUENCY, TEMPERATURE, AND APPLIES PEAK VOLTAGE**

| FREQUENCY<br>OF APPLIED<br>RIPPLE<br>CURRENT |          | 120 Hz    |      |      |      | 800 Hz    |      |      |      | 1 kHz     |      |      |      | 10 kHz    |      |      |      | 40 kHz    |      |      |      | 100 kHz   |      |      |      |
|----------------------------------------------|----------|-----------|------|------|------|-----------|------|------|------|-----------|------|------|------|-----------|------|------|------|-----------|------|------|------|-----------|------|------|------|
|                                              |          | $\leq 55$ | 85   | 105  | 125  | $\leq 55$ | 85   | 105  | 125  | $\leq 55$ | 85   | 105  | 125  | $\leq 55$ | 85   | 105  | 125  | $\leq 55$ | 85   | 105  | 125  | $\leq 55$ | 85   | 105  | 125  |
| % of<br>85 °C<br>rated<br>peak<br>voltage    | 100 %    | 0.60      | 0.39 | -    | -    | 0.71      | 0.43 | -    | -    | 0.72      | 0.46 | -    | -    | 0.88      | 0.55 | -    | -    | 1.0       | 0.63 | -    | -    | 1.1       | 0.69 | -    | -    |
|                                              | 90 %     | 0.60      | 0.46 | -    | -    | 0.71      | 0.55 | -    | -    | 0.72      | 0.55 | -    | -    | 0.88      | 0.67 | -    | -    | 1.0       | 0.77 | -    | -    | 1.1       | 0.85 | -    | -    |
|                                              | 80 %     | 0.60      | 0.52 | 0.35 | -    | 0.71      | 0.62 | 0.42 | -    | 0.72      | 0.62 | 0.42 | -    | 0.88      | 0.76 | 0.52 | -    | 1.0       | 0.87 | 0.59 | -    | 1.1       | 0.96 | 0.65 | -    |
|                                              | 70 %     | 0.60      | 0.58 | 0.44 | -    | 0.71      | 0.69 | 0.52 | -    | 0.72      | 0.70 | 0.52 | -    | 0.88      | 0.85 | 0.64 | -    | 1.0       | 0.97 | 0.73 | -    | 1.1       | 1.07 | 0.80 | -    |
|                                              | 66 2/3 % | 0.60      | 0.60 | 0.46 | 0.27 | 0.71      | 0.71 | 0.55 | 0.32 | 0.72      | 0.72 | 0.55 | 0.32 | 0.88      | 0.88 | 0.68 | 0.40 | 1.0       | 1.0  | 0.77 | 0.45 | 1.1       | 1.1  | 0.85 | 0.50 |

**TYPICAL PERFORMANCE CHARACTERISTICS OF ST CAPACITORS**

| <b>ELECTRICAL CHARACTERISTICS</b> |                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ITEM</b>                       | <b>PERFORMANCE CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                                                                        |
| Operating temperature range       | -55 °C to +85 °C (to +125 °C with voltage derating)                                                                                                                                                                                                                                                                                                                       |
| Capacitor tolerance               | ± 20 %, ± 10 % at 120 Hz, at +25 °C                                                                                                                                                                                                                                                                                                                                       |
| Capacitor change by temperature   | Limit per Standard Ratings table                                                                                                                                                                                                                                                                                                                                          |
| ESR                               | Limit per Standard Ratings table, at +25 °C, 120 Hz                                                                                                                                                                                                                                                                                                                       |
| Impedance                         | Limit per Standard Ratings table, at -55 °C, 120 Hz                                                                                                                                                                                                                                                                                                                       |
| DCL (leakage current)             | Limit per Standard Ratings table                                                                                                                                                                                                                                                                                                                                          |
| AC ripple current                 | Limit per Standard Ratings table, at +85 °C and 40 kHz                                                                                                                                                                                                                                                                                                                    |
| Reverse voltage                   | There shall be no continuous reverse voltage. Transient reverse voltage surges are acceptable under the following conditions:<br>a) The peak reverse voltage is equal to or less than 1.5 V and the product of the peak current times the duration of the reverse transient is 0.05 As or less<br>b) The repetition rate of the reverse voltage surges is less than 10 Hz |
| Surge voltage                     | Surge voltage shall be in accordance with MIL-PRF-39006 and Table II of DSCC93026.<br>The DC rated surge voltage is the maximum voltage to which the capacitors can be subjected under any conditions including transients and peak ripple at the highest line voltage.<br>The DC surge voltage is 115 % of rated DC voltage.                                             |

| <b>PERFORMANCE CHARACTERISTICS</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ITEM</b>                        | <b>PERFORMANCE CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Life testing                       | Capacitors shall be capable of withstanding a 2000 h life test at a temperature +85 °C at rated voltage, or a 2000 h life test at 125 °C test at derated voltage.<br>After the test, the capacitors shall meet the following requirements:<br>a) DC leakage at 85 °C and 125 °C shall not exceed 125 % of the specified value<br>b) DC leakage at 25 °C shall not exceed the specified value<br>c) Capacitance shall be within +10 %, -20 % of initial value<br>d) ESR shall not exceed 200 % of the specified value |

| <b>ENVIRONMENTAL CHARACTERISTICS</b> |                                      |                                                                                                          |
|--------------------------------------|--------------------------------------|----------------------------------------------------------------------------------------------------------|
| <b>ITEM</b>                          | <b>CONDITION</b>                     | <b>COMMENTS</b>                                                                                          |
| Seal                                 | MIL-PRF-39006                        | When the capacitors are tested as specified in MIL-PRF-39006, there shall be no evidence of leakage.     |
| Moisture resistance                  | MIL-PRF-39006                        | Moisture resistance shall be in accordance with MIL-PRF-39006.<br>Number of cycles: 10 continuous cycles |
| Barometric pressure (reduced)        | MIL-STD-202, method 105, condition E | Altitude 150 000 feet                                                                                    |

**MECHANICAL CHARACTERISTICS**

| ITEM                      | CONDITION                                        | COMMENTS                                                                                                                                                                                                                                                       |
|---------------------------|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Shock (specified pulse)   | MIL-STD-202, method 213, condition I (100 g)     | The capacitors shall meet the requirements of MIL-PRF-39006.                                                                                                                                                                                                   |
| Vibration, high frequency | MIL-STD-202, method 204, condition D (20 g peak) | The capacitors shall meet the requirements of MIL-PRF-39006.                                                                                                                                                                                                   |
| Thermal shock             | MIL-STD-202, method 107, condition A             | Thermal shock shall be in accordance with MIL-PRF-39006 when tested for 30 cycles.                                                                                                                                                                             |
| Solderability             | MIL-STD-202, method 208, ANSI/J-STD-002, test A  | Solderability shall be in accordance with MIL-PRF-39006.                                                                                                                                                                                                       |
| Terminal strength         | MIL-STD-202, method 211                          | Terminal strength shall be in accordance with MIL-PRF-39006.                                                                                                                                                                                                   |
| Resistance to solder heat | MIL-STD-202, method 210, condition C             | The capacitors shall meet the requirements of MIL-PRF-39006.                                                                                                                                                                                                   |
| Terminals                 | MIL-STD-1276                                     | Terminals shall be as specified in MIL-STD-1276. The length and diameter of the terminals shall be as specified in Dimensions table. All terminals shall be permanently secured internally and externally, as applicable. All external joints shall be welded. |
| Marking                   | MIL-STD-1285                                     | Marking of capacitors conforms to method I of MIL-STD-1285 and include capacitance (in $\mu\text{F}$ ), capacitance tolerance letter, rated voltage, date code, lot symbol and Vishay trademark.                                                               |

**SELECTOR GUIDES**

|                            |                                                                        |
|----------------------------|------------------------------------------------------------------------|
| Tantalum Selector Guide    | <a href="http://www.vishay.com/doc?49054">www.vishay.com/doc?49054</a> |
| Parameter Comparison Guide | <a href="http://www.vishay.com/doc?42088">www.vishay.com/doc?42088</a> |



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## Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**