

# vPolyTan™ Solid Tantalum Surface Mount Chip Capacitors, Molded Case, High Performance Polymer Type



## PERFORMANCE / ELECTRICAL CHARACTERISTICS

**Operating Temperature:** -55 °C to +105 °C  
(above 85 °C, voltage derating is required)

**Capacitance Range:** 3.3 μF to 330 μF

**Capacitance Tolerance:** ± 20 %

**Voltage Rating:** 2.5 V<sub>DC</sub> to 10 V<sub>DC</sub>

## FEATURES

- Ultra-low ESR
- Molded case available in 5 case codes
- Terminations:  
cases J, P, and A: 100 % tin  
cases B and T: Ni/Pd/Au
- Compatible with “high volume” automatic pick and place equipment
- Moisture sensitivity level 3
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS COMPLIANT**  
HALOGEN FREE  
**GREEN**  
(5-2008)

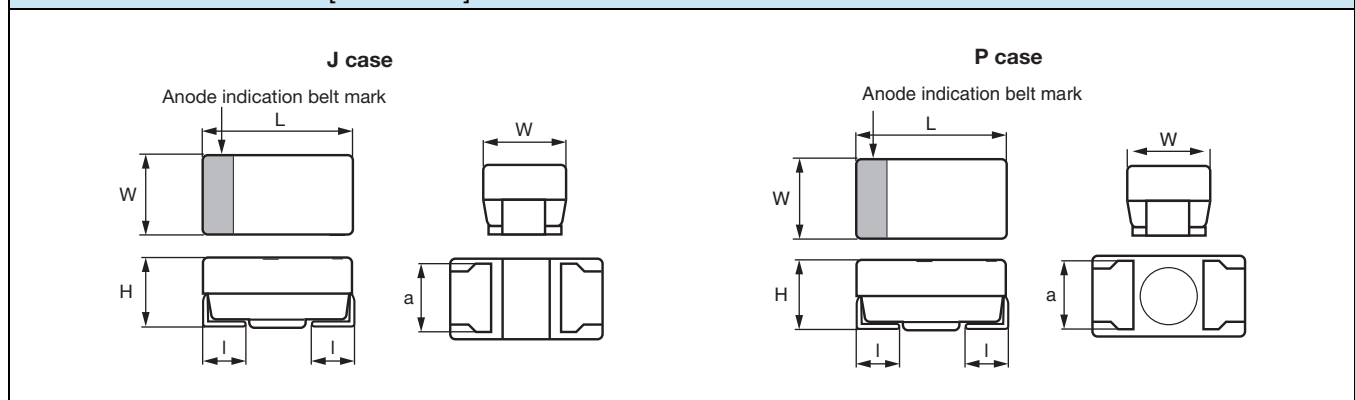
## APPLICATIONS

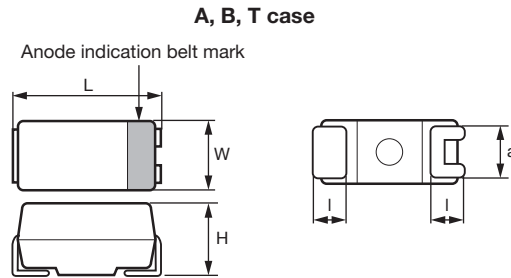
- Decoupling, smoothing, filtering
- Bulk energy storage in wireless cards
- Infrastructure equipment
- Storage and networking
- Computer motherboards
- Smartphones and tablets

## ORDERING INFORMATION

| T55<br>TYPE | B<br>CASE CODE                   | 156<br>CAPACITANCE   | M<br>CAPACITANCE TOLERANCE | 6R3<br>DC VOLTAGE RATING AT +85 °C  | C<br>TERMINATION / PACKAGING                   | 0500<br>ESR               |
|-------------|----------------------------------|--|----------------------------|---|--|---------------------------|
|             | See Ratings and Case Codes table | This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow. | M = ± 20 %                 | This is expressed in volts. To complete the three-digit block, zeros precede the voltage rating. A decimal point is indicated by an “R” (6R3 = 6.3 V) | C = lead (Pb)-free solderable coating, 7" reel | Maximum 100 kHz ESR in mΩ |

## DIMENSIONS in inches [millimeters]



**DIMENSIONS** in inches [millimeters]


| CASE CODE | EIA SIZE | L                            | W                             | H                            | l                             | a                            |
|-----------|----------|------------------------------|-------------------------------|------------------------------|-------------------------------|------------------------------|
| J         | 1608-09  | 0.063 ± 0.004<br>[1.6 ± 0.1] | 0.031 ± 0.004<br>[0.8 ± 0.1]  | 0.031 ± 0.004<br>[0.8 ± 0.1] | 0.012 ± 0.006<br>[0.3 ± 0.15] | 0.024 ± 0.004<br>[0.6 ± 0.1] |
| P         | 2012-12  | 0.080 ± 0.008<br>[2.0 ± 0.2] | 0.049 ± 0.008<br>[1.25 ± 0.2] | 0.047 max.<br>[1.2 max.]     | 0.020 ± 0.008<br>[0.5 ± 0.2]  | 0.035 ± 0.004<br>[0.9 ± 0.1] |
| A         | 3216-18  | 0.126 ± 0.008<br>[3.2 ± 0.2] | 0.063 ± 0.008<br>[1.6 ± 0.2]  | 0.063 ± 0.008<br>[1.6 ± 0.2] | 0.028 ± 0.012<br>[0.7 ± 0.3]  | 0.047 ± 0.008<br>[1.2 ± 0.2] |
| T         | 3528-12  | 0.138 ± 0.008<br>[3.5 ± 0.2] | 0.110 ± 0.008<br>[2.8 ± 0.2]  | 0.047 max.<br>[1.2 max.]     | 0.030 ± 0.012<br>[0.8 ± 0.3]  | 0.087 ± 0.008<br>[2.2 ± 0.2] |
| B         | 3528-21  | 0.138 ± 0.008<br>[3.5 ± 0.2] | 0.110 ± 0.008<br>[2.8 ± 0.2]  | 0.075 ± 0.008<br>[1.9 ± 0.2] | 0.030 ± 0.012<br>[0.8 ± 0.3]  | 0.087 ± 0.008<br>[2.2 ± 0.2] |

**RATINGS AND CASE CODES**

| μF  | 2.5 V | 4.0 V     | 6.3 V     | 10 V      |
|-----|-------|-----------|-----------|-----------|
| 3.3 |       |           | J / P     | J / P     |
| 4.7 |       |           | J / P / A | P / A     |
| 6.8 |       |           | P / A     | A         |
| 10  |       | J / P / A | P / A     | A         |
| 15  |       | P / A     | A         | A         |
| 22  |       | A / B     | A         | A / T / B |
| 33  |       | A / B     | A / T / B | A / T / B |
| 47  |       | A / T / B | A / T / B | B         |
| 68  |       | A / T / B | T / B     |           |
| 100 |       | T / B     | A / B     |           |
| 150 |       | B         | B         |           |
| 220 | B     | B         | B         |           |
| 330 | B     |           |           |           |

**MARKING**

**VOLTAGE CODE**

| V   | CODE |
|-----|------|
| 2.5 | e    |
| 4   | G    |
| 6.3 | J    |
| 10  | A    |

**CAPACITANCE CODE**

| CAP, µF | CODE |
|---------|------|
| 3.3     | N6   |
| 4.7     | S6   |
| 6.8     | W6   |
| 10      | A7   |
| 15      | E7   |
| 22      | J7   |
| 33      | N7   |
| 47      | S7   |
| 68      | W7   |
| 100     | A8   |
| 150     | E8   |
| 220     | J8   |
| 330     | N8   |

**J, P case**

**RATED VOLTAGE**
**CAPACITANCE**
**MARKING**

|     |     |    |
|-----|-----|----|
| 4   | 10  | AG |
| 4   | 15  | EG |
| 6.3 | 3.3 | NJ |
| 6.3 | 4.7 | SJ |
| 6.3 | 6.8 | WJ |
| 6.3 | 10  | AJ |
| 10  | 3.3 | NA |
| 10  | 4.7 | SA |

**DATE CODE**

| YEAR | MONTH |   |   |   |   |   |   |   |   |    |    |    |
|------|-------|---|---|---|---|---|---|---|---|----|----|----|
|      | 1     | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 2013 | A     | B | C | D | E | F | G | H | J | K  | L  | M  |
| 2014 | N     | P | Q | R | S | T | U | V | W | X  | Y  | Z  |
| 2015 | a     | b | c | d | e | f | g | h | j | k  | l  | m  |
| 2016 | n     | p | q | r | s | t | u | v | w | x  | y  | z  |



| STANDARD RATINGS   |           |                  |                                    |                                      |  |   |
|--|-----------|------------------|------------------------------------|--------------------------------------|--|---|
| CAPACITANCE<br>( $\mu$ F)  | CASE CODE | PART NUMBER      | MAX. DCL<br>AT 25 °C<br>( $\mu$ A) | MAX. DF<br>AT 25 °C<br>120 Hz<br>(%) | MAX. ESR<br>AT + 25 °C<br>100 kHz<br>(m $\Omega$ ) | MAX. RIPPLE,<br>100 kHz I <sub>RMS</sub><br>(A) |
| <b>2.5 V<sub>DC</sub> AT +85 °C, 2 V<sub>DC</sub> AT +105 °C</b> |           |                  |                                    |                                      |  |   |
| 220  | B         | T55B227M2R5C0070 | 55.0                               | 10                                   | 70   | 1.17  |
| 220  | B         | T55B227M2R5C0035 | 55.0                               | 10                                   | 35   | 1.65  |
| 220  | B         | T55B227M2R5C0030 | 55.0                               | 10                                   | 30   | 1.78  |
| 330  | B         | T55B337M2R5C0070 | 82.5                               | 10                                   | 70   | 1.17  |
| 330  | B         | T55B337M2R5C0035 | 82.5                               | 10                                   | 35   | 1.65  |
| <b>4 V<sub>DC</sub> AT +85 °C, 3.2 V<sub>DC</sub> AT +105 °C</b> |           |                  |                                    |                                      |  |   |
| 10   | J         | T55J106M004C0500 | 10.0                               | 10                                   | 500  | 0.32  |
| 10   | P         | T55P106M004C0500 | 5.0                                | 10                                   | 500  | 0.36  |
| 10   | P         | T55P106M004C0200 | 5.0                                | 10                                   | 200  | 0.56  |
| 10   | A         | T55A106M004C0500 | 4.0                                | 10                                   | 500  | 0.40  |
| 10   | A         | T55A106M004C0200 | 4.0                                | 10                                   | 200  | 0.62  |
| 15   | P         | T55P156M004C0500 | 10.0                               | 10                                   | 500  | 0.36  |
| 15   | P         | T55P156M004C0200 | 10.0                               | 10                                   | 200  | 0.56  |
| 15   | A         | T55A156M004C0500 | 6.0                                | 10                                   | 500  | 0.40  |
| 15   | A         | T55A156M004C0200 | 6.0                                | 10                                   | 200  | 0.62  |
| 22   | A         | T55A226M004C0500 | 8.8                                | 10                                   | 500  | 0.40  |
| 22   | A         | T55A226M004C0200 | 8.8                                | 10                                   | 200  | 0.62  |
| 22   | B         | T55B226M004C0200 | 8.8                                | 10                                   | 200  | 0.70  |
| 33   | A         | T55A336M004C0500 | 13.2                               | 10                                   | 500  | 0.40  |
| 33   | A         | T55A336M004C0200 | 13.2                               | 10                                   | 200  | 0.62  |
| 33   | B         | T55B336M004C0200 | 13.2                               | 10                                   | 200  | 0.70  |
| 47   | A         | T55A476M004C0500 | 18.8                               | 10                                   | 500  | 0.40  |
| 47   | A         | T55A476M004C0200 | 18.8                               | 10                                   | 200  | 0.62  |
| 47   | T         | T55T476M004C0200 | 18.8                               | 10                                   | 200  | 0.59  |
| 47   | T         | T55T476M004C0070 | 18.8                               | 10                                   | 70   | 1.00  |
| 47   | B         | T55B476M004C0150 | 18.8                               | 10                                   | 150  | 0.80  |
| 47   | B         | T55B476M004C0070 | 18.8                               | 10                                   | 70   | 1.17  |
| 68   | A         | T55A686M004C0500 | 27.2                               | 10                                   | 500  | 0.40  |
| 68   | A         | T55A686M004C0200 | 27.2                               | 10                                   | 200  | 0.62  |
| 68   | T         | T55T686M004C0200 | 27.2                               | 10                                   | 200  | 0.59  |
| 68   | T         | T55T686M004C0070 | 27.2                               | 10                                   | 70   | 1.00  |
| 68   | B         | T55B686M004C0150 | 27.2                               | 10                                   | 150  | 0.80  |
| 68   | B         | T55B686M004C0070 | 27.2                               | 10                                   | 70   | 1.17  |
| 100  | T         | T55T107M004C0070 | 40.0                               | 10                                   | 70   | 1.00  |
| 100  | B         | T55B107M004C0070 | 40.0                               | 10                                   | 70   | 1.17  |
| 100  | B         | T55B107M004C0045 | 40.0                               | 10                                   | 45   | 1.46  |
| 150  | B         | T55B157M004C0070 | 60.0                               | 10                                   | 70   | 1.17  |
| 150  | B         | T55B157M004C0035 | 60.0                               | 10                                   | 35   | 1.65  |
| 220  | B         | T55B227M004C0070 | 88.0                               | 10                                   | 70   | 1.17  |
| 220  | B         | T55B227M004C0035 | 88.0                               | 10                                   | 35   | 1.65  |
| <b>6.3 V<sub>DC</sub> AT +85 °C, 5 V<sub>DC</sub> AT +105 °C</b> |           |                  |                                    |                                      |  |   |
| 3.3  | J         | T55J335M6R3C0500 | 10.0                               | 10                                   | 500  | 0.32  |
| 3.3  | P         | T55P335M6R3C0500 | 5.0                                | 10                                   | 500  | 0.36  |
| 4.7  | J         | T55J475M6R3C0500 | 10.0                               | 10                                   | 500  | 0.32  |
| 4.7  | P         | T55P475M6R3C0500 | 5.0                                | 10                                   | 500  | 0.36  |
| 4.7  | A         | T55A475M6R3C0500 | 3.0                                | 10                                   | 500  | 0.40  |
| 6.8  | P         | T55P685M6R3C0500 | 5.0                                | 10                                   | 500  | 0.36  |
| 6.8  | A         | T55A685M6R3C0500 | 4.2                                | 10                                   | 500  | 0.40  |
| 10   | P         | T55P106M6R3C0500 | 10.0                               | 10                                   | 500  | 0.36  |
| 10   | P         | T55P106M6R3C0200 | 10.0                               | 10                                   | 200  | 0.56  |
| 10   | A         | T55A106M6R3C0500 | 6.3                                | 10                                   | 500  | 0.40  |
| 10   | A         | T55A106M6R3C0200 | 6.3                                | 10                                   | 200  | 0.62  |
| 15   | A         | T55A156M6R3C0500 | 9.4                                | 10                                   | 500  | 0.40  |
| 15   | A         | T55A156M6R3C0200 | 9.4                                | 10                                   | 200  | 0.62  |

Note

- Termination code "C": cases J, P, and A - 100 % matte tin; cases B and T - NiPdAu plate.



| STANDARD RATINGS   |           |                  |                                    |                                      |  |   |
|--|-----------|------------------|------------------------------------|--------------------------------------|--|---|
| CAPACITANCE<br>( $\mu$ F)  | CASE CODE | PART NUMBER      | MAX. DCL<br>AT 25 °C<br>( $\mu$ A) | MAX. DF<br>AT 25 °C<br>120 Hz<br>(%) | MAX. ESR<br>AT + 25 °C<br>100 kHz<br>(m $\Omega$ ) | MAX. RIPPLE,<br>100 kHz I <sub>RMS</sub><br>(A) |
| <b>6.3 V<sub>DC</sub> AT +85 °C, 5 V<sub>DC</sub> AT +105 °C</b> |           |                  |                                    |                                      |  |   |
| 22   | A         | T55A226M6R3C0500 | 13.8                               | 10                                   | 500  | 0.40  |
| 22   | A         | T55A226M6R3C0200 | 13.8                               | 10                                   | 200  | 0.62  |
| 33   | A         | T55A336M6R3C0500 | 20.7                               | 10                                   | 500  | 0.40  |
| 33   | A         | T55A336M6R3C0200 | 20.7                               | 10                                   | 200  | 0.62  |
| 33   | T         | T55T336M6R3C0200 | 20.7                               | 10                                   | 200  | 0.59  |
| 33   | T         | T55T336M6R3C0070 | 20.7                               | 10                                   | 70   | 1.00  |
| 33   | B         | T55B336M6R3C0200 | 20.7                               | 10                                   | 200  | 0.70  |
| 33   | B         | T55B336M6R3C0070 | 20.7                               | 10                                   | 70   | 1.17  |
| 47   | A         | T55A476M6R3C0500 | 29.6                               | 10                                   | 500  | 0.40  |
| 47   | A         | T55A476M6R3C0200 | 29.6                               | 10                                   | 200  | 0.62  |
| 47   | T         | T55T476M6R3C0200 | 29.6                               | 10                                   | 200  | 0.59  |
| 47   | T         | T55T476M6R3C0070 | 29.6                               | 10                                   | 70   | 1.00  |
| 47   | B         | T55B476M6R3C0150 | 29.6                               | 10                                   | 150  | 0.80  |
| 47   | B         | T55B476M6R3C0070 | 29.6                               | 10                                   | 70   | 1.17  |
| 68   | T         | T55T686M6R3C0200 | 42.8                               | 10                                   | 200  | 0.59  |
| 68   | T         | T55T686M6R3C0070 | 42.8                               | 10                                   | 70   | 1.00  |
| 68   | B         | T55B686M6R3C0150 | 42.8                               | 10                                   | 150  | 0.80  |
| 68   | B         | T55B686M6R3C0070 | 42.8                               | 10                                   | 70   | 1.17  |
| 100  | A         | T55A107M6R3C0150 | 63.0                               | 10                                   | 150  | 0.72  |
| 100  | A         | T55A107M6R3C0070 | 63.0                               | 10                                   | 70   | 1.05  |
| 100  | B         | T55B107M6R3C0100 | 63.0                               | 10                                   | 100  | 0.98  |
| 100  | B         | T55B107M6R3C0070 | 63.0                               | 10                                   | 70   | 1.17  |
| 100  | B         | T55B107M6R3C0045 | 63.0                               | 10                                   | 45   | 1.46  |
| 100  | B         | T55B107M6R3C0040 | 63.0                               | 10                                   | 40   | 1.55  |
| 100  | B         | T55B107M6R3C0035 | 63.0                               | 10                                   | 35   | 1.65  |
| 150  | B         | T55B157M6R3C0100 | 94.5                               | 10                                   | 100  | 0.98  |
| 150  | B         | T55B157M6R3C0070 | 94.5                               | 10                                   | 70   | 1.17  |
| 150  | B         | T55B157M6R3C0040 | 94.5                               | 10                                   | 40   | 1.55  |
| 150  | B         | T55B157M6R3C0035 | 94.5                               | 10                                   | 35   | 1.65  |
| 220  | B         | T55B227M6R3C0070 | 138.6                              | 10                                   | 70   | 1.17  |
| <b>10 V<sub>DC</sub> AT +85 °C, 8 V<sub>DC</sub> AT +105 °C</b>  |           |                  |                                    |                                      |  |   |
| 3.3  | J         | T55J335M010C0500 | 10.0                               | 10                                   | 500  | 0.32  |
| 3.3  | P         | T55P335M010C0500 | 5.0                                | 10                                   | 500  | 0.36  |
| 4.7  | P         | T55P475M010C0500 | 10.0                               | 10                                   | 500  | 0.36  |
| 4.7  | P         | T55P475M010C0200 | 10.0                               | 10                                   | 200  | 0.56  |
| 4.7  | A         | T55A475M010C0500 | 4.7                                | 10                                   | 500  | 0.40  |
| 4.7  | A         | T55A475M010C0200 | 4.7                                | 10                                   | 200  | 0.62  |
| 6.8  | A         | T55A685M010C0500 | 6.8                                | 10                                   | 500  | 0.40  |
| 6.8  | A         | T55A685M010C0200 | 6.8                                | 10                                   | 200  | 0.62  |
| 10   | A         | T55A106M010C0500 | 10.0                               | 10                                   | 500  | 0.40  |
| 10   | A         | T55A106M010C0200 | 10.0                               | 10                                   | 200  | 0.62  |
| 15   | A         | T55A156M010C0500 | 15.0                               | 10                                   | 500  | 0.40  |
| 15   | A         | T55A156M010C0200 | 15.0                               | 10                                   | 200  | 0.62  |
| 22   | A         | T55A226M010C0500 | 22.0                               | 10                                   | 500  | 0.40  |
| 22   | A         | T55A226M010C0200 | 22.0                               | 10                                   | 200  | 0.62  |
| 22   | T         | T55T226M010C0200 | 22.0                               | 10                                   | 200  | 0.59  |
| 22   | T         | T55T226M010C0070 | 22.0                               | 10                                   | 70   | 1.00  |
| 22   | B         | T55B226M010C0200 | 22.0                               | 10                                   | 200  | 0.70  |
| 22   | B         | T55B226M010C0070 | 22.0                               | 10                                   | 70   | 1.17  |
| 33   | A         | T55A336M010C0500 | 33.0                               | 10                                   | 500  | 0.40  |
| 33   | A         | T55A336M010C0200 | 33.0                               | 10                                   | 200  | 0.62  |
| 33   | T         | T55T336M010C0200 | 33.0                               | 10                                   | 200  | 0.59  |
| 33   | T         | T55T336M010C0070 | 33.0                               | 10                                   | 70   | 1.00  |
| 33   | B         | T55B336M010C0200 | 33.0                               | 10                                   | 200  | 0.70  |
| 33   | B         | T55B336M010C0070 | 33.0                               | 10                                   | 70   | 1.17  |
| 47   | B         | T55B476M010C0150 | 47.0                               | 10                                   | 150  | 0.80  |
| 47   | B         | T55B476M010C0070 | 47.0                               | 10                                   | 70   | 1.17  |

**Note**

- Termination code "C": cases J, P, and A - 100 % matte tin; cases B and T - NiPdAu plate.



| <b>RECOMMENDED VOLTAGE DERATING GUIDELINES</b> (for temperature below +85 °C) |                   |
|---|-------------------|
| CAPACITOR VOLTAGE RATING  | OPERATING VOLTAGE |
| 2.5   | 2.0               |
| 4.0   | 3.2               |
| 6.3   | 5.0               |
| 10  | 8.0               |

| <b>POWER DISSIPATION</b> |   |
|--------------------------|---|
| CASE CODE                | MAXIMUM PERMISSIBLE POWER DISSIPATION AT +25 °C (W) IN FREE AIR |
| J                        | 0.050   |
| P                        | 0.064   |
| A                        | 0.078   |
| T                        | 0.096   |
| B                        | 0.096   |

| <b>STANDARD PACKAGING QUANTITY</b> |                   |
|------------------------------------|-------------------|
| CASE CODE                          | UNITS PER 7" REEL |
| J                                  | 4000              |
| P                                  | 3000              |
| A                                  | 2000              |
| T                                  | 3000              |
| B                                  | 2000              |

| <b>PERFORMANCE CHARACTERISTICS</b> |  |  |   |              |  |
|------------------------------------|--|--|---|--------------|--|
| ITEM                               | CONDITION  | POST TEST PERFORMANCE                                      |   |              |  |
|                                    |  |  | Specified initial value                           | -55 °C       | +105 °C                                      |
| Temperature characteristics        | Measure the specified characteristics in each stage  | Capacitance change   | -   | -20 % to 0 % | 0 % to 30 %                                  |
|                                    |  | Dissipation factor shown in Standard Ratings table or less | 10  | 14           | -  |
|                                    |  | Leakage current  | Refer to Standard Ratings table                   | -            | Not more than 1 CV or 30 µA which is greater |
| Solder heat resistance             | Reflow board surface peak temperature: less than 260 °C<br>Time: 5 s max.  | Capacitance change   | Within ± 20 % of initial value                    |              |  |
|                                    |  | Dissipation factor   | Initial specified value or less                   |              |  |
|                                    |  | Leakage current  | Shall not exceed 300 % of initial specified value |              |  |
| Moisture resistance no load        | Leave at 40 °C and 90 % to 95 % RH for 500 h   | Capacitance change   | Within +40 % -20 % of initial value               |              |  |
|                                    |  | Dissipation factor   | Initial specified value or less                   |              |  |
|                                    |  | Leakage current  | Shall not exceed 300 % of initial specified value |              |  |
| High temperature load              | 85 °C. The rated voltage is applied through a protective resistor of 3 Ω for 1000 h  | Capacitance change   | Within ± 20 % of initial value                    |              |  |
|                                    |  | Dissipation factor   | Initial specified value or less                   |              |  |
|                                    |  | Leakage current  | Shall not exceed 300 % of initial specified value |              |  |
| Thermal shock                      | Leave at -55 °C, normal temperature, 105 °C, and normal temperature for 30 min., 15 min. 30 min., and 15 min. Repeat this operation 5 times running. | Capacitance change   | Within ± 20 % of initial value or less            |              |  |
|                                    |  | Dissipation factor   | Initial specified value or less                   |              |  |
|                                    |  | Leakage current  | Shall not exceed 300 % of initial specified value |              |  |
| Failure rate                       | 85 °C. The rated voltage is applied through a protective resistor of 1 Ω/V.  | 1 % / 1000 h   |   |              |  |

**Note**

- Test conditions per JIS C5101-1



# Guide for Tantalum Solid Electrolyte Chip Capacitors with Polymer Cathode

## 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 Sprague 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 Sprague 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.

Tantalum pentoxide compound possesses high-dielectric strength and a high-dielectric constant. As capacitors are being manufactured, a film of tantalum pentoxide is applied to their electrodes by means of an electrolytic process. The film is applied in various thicknesses and at various voltages and although transparent to begin with, it takes on different colors as light refracts through it. This coloring occurs on the tantalum electrodes of all types of tantalum capacitors.

Rating for rating, tantalum capacitors tend to have as much as three times better capacitance/volume efficiency than aluminum electrolytic capacitors. An approximation of the capacitance/volume efficiency of other types of capacitors may be inferred from the following table, which shows the dielectric constant ranges of the various materials used in each type. Note that tantalum pentoxide has a dielectric constant of 26, some three times greater than that of aluminum oxide. This, in addition to the fact that extremely thin films can be deposited during the electrolytic process mentioned earlier, makes the tantalum capacitor extremely efficient with respect to the number of microfarads available per unit volume. The capacitance of any capacitor is determined by the surface area of the two conducting plates, the distance between the plates, and the dielectric constant of the insulating material between the plates.

| COMPARISON OF CAPACITOR DIELECTRIC CONSTANTS |                                   |
|--|-----------------------------------|
| DIELECTRIC                                   | $\epsilon$<br>DIELECTRIC CONSTANT |
| Air or vacuum                                | 1.0                               |
| Paper  | 2.0 to 6.0                        |
| Plastic                                      | 2.1 to 6.0                        |
| Mineral oil                                  | 2.2 to 2.3                        |
| Silicone oil                                 | 2.7 to 2.8                        |
| Quartz                                       | 3.8 to 4.4                        |
| Glass  | 4.8 to 8.0                        |
| Porcelain                                    | 5.1 to 5.9                        |
| Mica   | 5.4 to 8.7                        |
| Aluminum oxide                               | 8.4                               |
| <b>Tantalum pentoxide</b>                    | <b>26</b>                         |
| Ceramic                                      | 12 to 400K                        |

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:

$$C = \frac{\epsilon A}{t}$$

where

C = capacitance

$\epsilon$  = dielectric constant

A = surface area of the dielectric

t = thickness of the dielectric

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.

## SOLID ELECTROLYTE TANTALUM CAPACITORS

Solid electrolyte polymer capacitors utilize high performance polymer as cathode system, which is formed on the tantalum pentoxide dielectric layer.

The pellet is then coated with graphite, followed by a layer of metallic silver, which provides a conductive surface between the pellet and the outer termination (leadframe or other).

Molded chip polymer tantalum capacitor encases the element in plastic resins, such as epoxy materials. After assembly, the capacitors are tested and inspected to assure long life and reliability. It offers excellent reliability and high stability for consumer and commercial electronics.

Surface mount designs of T55 Solid Tantalum Polymer capacitors use lead frames.



| <b>SOLID TANTALUM CAPACITORS - MOLDED CASE</b> |   |
|--|---|
| <b>SERIES</b>                                  | T55   |
| <b>PRODUCT IMAGE</b>                           |   |
| <b>TYPE</b>                                    | VPolyTan™, molded case, high performance polymer  |
| <b>TEMPERATURE RANGE</b>                       | Operating temperature: -55 °C to +105 °C<br>(above 85 °C, voltage derating is required) |
| <b>CASE SIZES</b>                              | J, P, A, T, B   |
| <b>CAPACITANCE RANGE</b>                       | 3.3 μF to 330 μF  |
| <b>VOLTAGE RANGE</b>                           | 2.5 V to 10 V   |
| <b>CAPACITANCE TOLERANCE</b>                   | ± 20 %  |
| <b>DISSIPATION FACTOR</b>                      | 10 % maximum  |
| <b>ESR</b>                                     | 30 mΩ to 500 mΩ   |
| <b>TERMINATION</b>                             | Cases J, P, A: 100 % tin<br>Cases B, T: Ni/Pd/Au  |



### REEL PACKAGING in millimeters

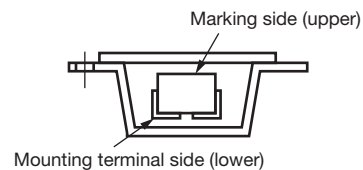
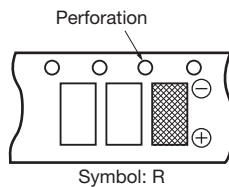
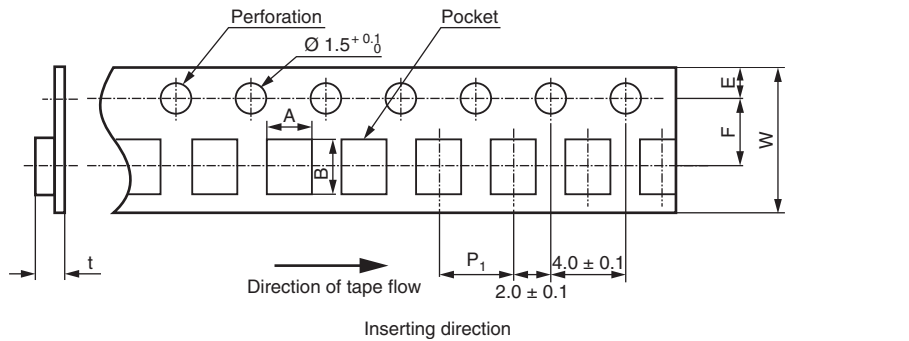


| TAPE WIDTH  | 8     | 12   |
|-------------|-------|------|
| A + 0 / - 3 | Ø 180 | ←    |
| B + 1 / 0   | Ø 60  | ←    |
| C ± 0.2     | Ø 13  | ←    |
| D ± 0.5     | Ø 21  | ←    |
| E ± 0.5     | 2.0   | ←    |
| W ± 0.3     | 9.0   | 13.0 |

#### Note

- A reel diameter of 330 mm is also applicable.

### TAPE SIZE in millimeters

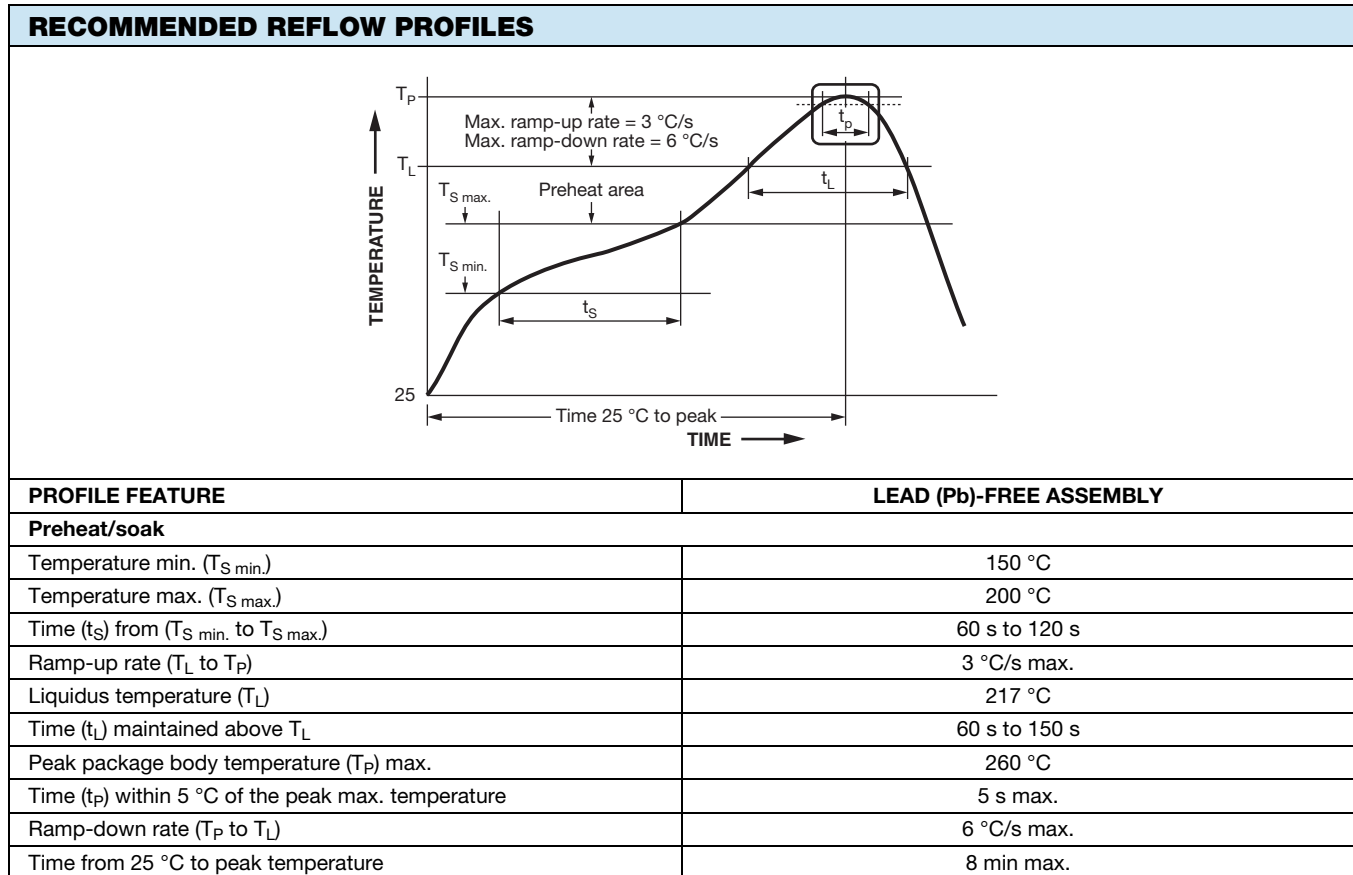


| CASE CODE | A ± 0.2 | B ± 0.2 | W ± 0.3 | F ± 0.1 | E ± 0.1 | P <sub>1</sub> ± 0.1 | t <sub>max.</sub> |
|-----------|---------|---------|---------|---------|---------|----------------------|-------------------|
| J         | 1.0     | 1.8     | 8.0     | 3.5     | 1.75    | 4.0                  | 1.3               |
| P         | 1.4     | 2.2     | 8.0     | 3.5     | 1.75    | 4.0                  | 1.6               |
| A         | 1.9     | 3.5     | 8.0     | 3.5     | 1.75    | 4.0                  | 2.5               |
| T         | 3.1     | 3.8     | 8.0     | 3.5     | 1.75    | 4.0                  | 1.7               |
| B         | 3.1     | 3.8     | 8.0     | 3.5     | 1.75    | 4.0                  | 2.5               |

### 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 hours 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.



#### Note

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

| PAD DIMENSIONS in millimeters |                |      |                |          |          |          |
|-------------------------------|----------------|------|----------------|----------|----------|----------|
|                               |                |      |                |          |          |          |
| CASE / DIMENSIONS             | CAPACITOR SIZE |      | PAD DIMENSIONS |          |          |          |
|                               | L              | W    | G (max.)       | Z (min.) | X (min.) | Y (Ref.) |
| J                             | 1.6            | 0.8  | 0.7            | 2.5      | 1.0      | 0.9      |
| P                             | 2.0            | 1.25 | 0.5            | 2.6      | 1.2      | 1.05     |
| A                             | 3.2            | 1.6  | 1.1            | 3.8      | 1.5      | 1.35     |
| T / B                         | 3.5            | 2.8  | 1.4            | 4.1      | 2.7      | 1.35     |

## GUIDE TO APPLICATION

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

$$I_{RMS} = \sqrt{\frac{P}{R_{ESR}}}$$

where,

P = power dissipation in W at +25 °C as given in the tables in the product datasheets. (power dissipation)

R<sub>ESR</sub> = the capacitor equivalent series resistance at the specified frequency.

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

$$V_{RMS} = Z \sqrt{\frac{P}{R_{ESR}}}$$

or, from the formula:

$$V_{RMS} = I_{RMS} \times Z$$

where,

P = power dissipation in W at +25 °C as given in the tables in the product datasheets. (power dissipation)

R<sub>ESR</sub> = The capacitor equivalent series resistance at the specified frequency.

Z = The capacitor impedance at the specified frequency.

- 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 as shown in figure below.



- 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 of next section "Power Dissipation".

- 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<sub>RMS</sub> value be established when calculating permissible operating levels (power dissipation calculated using +25 °C temperature rise).

| MAXIMUM PERMISSIBLE POWER LOSS VALUES (P <sub>max.</sub> ) BY CASE SIZE |                       |       |       |       |
|---|-----------------------|-------|-------|-------|
| AMBIENT TEMPERATURE (°C)  | P <sub>max.</sub> (W) |       |       |       |
|   | J                     | P     | A     | T, B  |
| +25   | 0.050                 | 0.064 | 0.078 | 0.096 |
| +55   | 0.032                 | 0.045 | 0.051 | 0.062 |
| +85   | 0.018                 | 0.023 | 0.029 | 0.035 |

- 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.

- Mounting Precautions:**

- 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 s). 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.

- Flux Selection**

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

- 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/cm<sup>3</sup>, 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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