

# TPM Multianode

## Tantalum Ultra Low ESR Capacitor



### FEATURES

- Multi-anode construction
- Super low ESR
- CV range: 10-2200 $\mu$ F / 2.5-50V
- 4 case sizes available
- "Mirror" multi-anode construction used with D, Y case capacitors reduces ESL to half

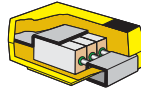
### APPLICATIONS

- High power DC/DC general applications

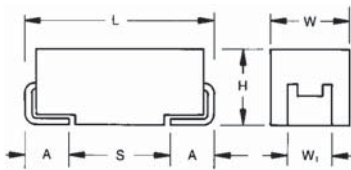


*SnPb termination option is not RoHS compliant.*

### MULTIANODE CONSTRUCTION

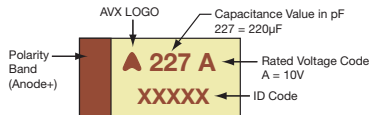


### MULTIANODE TPM D, Y LOW SELF INDUCTANCE CONSTRUCTION "MIRROR" DESIGN



### MARKING

#### D, E, V, Y CASE



### CASE DIMENSIONS: millimeters (inches)

| Code | EIA Code | EIA Metric | L $\pm$ 0.20 (0.008) | W $\pm$ 0.20 (0.008)<br>-0.10 (0.004) | H $\pm$ 0.20 (0.008)<br>-0.10 (0.004) | W $\pm$ 0.20 (0.008) | A $\pm$ 0.30 (0.012)<br>-0.20 (0.008) | S Min.       |
|------|----------|------------|----------------------|---------------------------------------|---------------------------------------|----------------------|---------------------------------------|--------------|
| D    | 2917     | 7343-31    | 7.30 (0.287)         | 4.30 (0.169)                          | 2.90 (0.114)                          | 2.40 (0.094)         | 1.30 (0.051)                          | 4.40 (0.173) |
| E    | 2917     | 7343-43    | 7.30 (0.287)         | 4.30 (0.169)                          | 4.10 (0.162)                          | 2.40 (0.094)         | 1.30 (0.051)                          | 4.40 (0.173) |
| V    | 2924     | 7361-38    | 7.30 (0.287)         | 6.10 (0.240)                          | 3.55 (0.140)                          | 3.10 (0.120)         | 1.30 (0.051)                          | 4.40 (0.173) |
| Y    | 2917     | 7343-20    | 7.30 (0.287)         | 4.30 (0.169)                          | 2.00 (0.079) max                      | 2.40 (0.094)         | 1.30 (0.051)                          | 4.40 (0.173) |

W1 dimension applies to the termination width for A dimensional area only.

### HOW TO ORDER

**TPM**

Type

**E**

Case Size  
See table above

**108**

Capacitance Code  
pF code: 1st two digits represent significant figures, 3rd digit represents multiplier (number of zeros to follow)

**M**

Tolerance  
K=±10%  
M=±20%

**004**

Rated DC Voltage  
002=2.5Vdc  
004=4Vdc  
006=6.3Vdc  
010=10Vdc  
016=16Vdc  
020=20Vdc  
025=25Vdc  
035=35Vdc  
050=50Vdc

**R**

Packaging  
R = Pure Tin 7" Reel  
S = Pure Tin 13" Reel  
H = Tin Lead 7" Reel (Contact Manufacturer)  
K = Tin Lead 13" Reel (Contact Manufacturer)  
H, K = Non RoHS

**0018**

ESR in m $\Omega$

### TECHNICAL SPECIFICATIONS

Technical Data:

All technical data relate to an ambient temperature of +25°C

Capacitance Range: 10  $\mu$ F to 2200  $\mu$ F

Capacitance Tolerance: ±10%, ±20%

|                            |                             |     |     |     |    |    |    |    |    |    |  |
|----------------------------|-----------------------------|-----|-----|-----|----|----|----|----|----|----|--|
| Rated Voltage ( $V_R$ )    | $\leq +85^\circ\text{C}$ :  | 2.5 | 4   | 6.3 | 10 | 16 | 20 | 25 | 35 | 50 |  |
| Category Voltage ( $V_C$ ) | $\leq +125^\circ\text{C}$ : | 1.7 | 2.7 | 4   | 7  | 10 | 13 | 17 | 23 | 33 |  |
| Surge Voltage ( $V_S$ )    | $\leq +85^\circ\text{C}$ :  | 3.3 | 5.2 | 8   | 13 | 20 | 26 | 32 | 46 | 65 |  |
| Surge Voltage ( $V_S$ )    | $\leq +125^\circ\text{C}$ : | 2.2 | 3.4 | 5   | 8  | 13 | 16 | 20 | 28 | 40 |  |

Temperature Range: -55°C to +125°C

Reliability: 1% per 1000 hours at 85°C,  $V_R$  with 0.1 $\Omega$ /V series impedance, 60% confidence level



### CAPACITANCE AND RATED VOLTAGE RANGE (LETTER DENOTES CASE SIZE)

| Capacitance |      | Rated Voltage DC (V <sub>R</sub> ) to 85°C |                             |                                              |                      |          |          |             |                    |                  |
|-------------|------|--------------------------------------------|-----------------------------|----------------------------------------------|----------------------|----------|----------|-------------|--------------------|------------------|
| μF          | Code | 2.5V (e)                                   | 4V (G)                      | 6.3V (J)                                     | 10V (A)              | 16V (C)  | 20V (D)  | 25V (E)     | 35V (V)            | 50V (T)          |
| 6.8         | 685  |                                            |                             |                                              |                      |          |          |             |                    |                  |
| 10          | 106  |                                            |                             |                                              |                      |          |          |             |                    | D(140)<br>E(120) |
| 15          | 156  |                                            |                             |                                              |                      |          |          |             |                    | E(75,100)        |
| 22          | 226  |                                            |                             |                                              |                      |          |          |             | D(70)<br>E(60,100) | E(75,100)        |
| 33          | 336  |                                            |                             |                                              |                      |          |          | D(65)       | E(50,65)           |                  |
| 47          | 476  |                                            |                             |                                              |                      | D(100)   | D(45,55) | D(55)/E(65) | E(55,65)           |                  |
| 68          | 686  |                                            |                             |                                              |                      | D(40,50) |          | E(45,55)    |                    |                  |
| 100         | 107  |                                            |                             |                                              | Y(45) <sup>(M)</sup> | D(40,50) | E(35,45) |             |                    |                  |
| 150         | 157  |                                            |                             |                                              | Y(45) <sup>(M)</sup> | E(30,40) | E(35)    |             |                    |                  |
| 220         | 227  |                                            |                             | Y(30) <sup>(M)</sup>                         | D(35)                | E(25,40) |          |             |                    |                  |
| 330         | 337  |                                            | D(25,35)                    | D(25,35)                                     | D(35)<br>E(23,35)    | E(50)*   |          |             |                    |                  |
| 470         | 477  |                                            | D(25,35)                    | D(30)<br>E(18,23,30)                         | E(23,30)             |          |          |             |                    |                  |
| 680         | 687  |                                            | D(25)<br>E(18,23)           | E(18,23)<br>V(23)                            |                      |          |          |             |                    |                  |
| 1000        | 108  | D(25)                                      | D(25,45)<br>E(18,23), V(18) | E(25) <sup>(M)</sup><br>V(20) <sup>(M)</sup> |                      |          |          |             |                    |                  |
| 1500        | 158  | E(12,15,18)                                | E(15,18)                    |                                              |                      |          |          |             |                    |                  |
| 2200        | 228  | E(18) <sup>(M)</sup>                       |                             |                                              |                      |          |          |             |                    |                  |

Released codes <sup>(M tolerance only)</sup>

Engineering samples - please contact manufacturer

\*Codes under development - subject to change

Note: Voltage ratings are minimum values. AVX reserves the right to supply higher ratings in the same case size, to the same reliability standards.

# TPM Multianode



## Tantalum Ultra Low ESR Capacitor

### RATINGS & PART NUMBER REFERENCE

| AVX<br>Part No.  | Case<br>Size | Capacitance<br>(µF) | Rated<br>Voltage<br>(V) | Rated<br>Temperature<br>(°C) | Category<br>Voltage<br>(V) | Category<br>Temperature<br>(°C) | DCL<br>(µA)<br>Max. | DF<br>%<br>Max. | ESR<br>Max. (mΩ)<br>@ 100kHz | MSL | 100kHz RMS Current (A) |       |       |  |
|------------------|--------------|---------------------|-------------------------|------------------------------|----------------------------|---------------------------------|---------------------|-----------------|------------------------------|-----|------------------------|-------|-------|--|
|                  |              |                     |                         |                              |                            |                                 |                     |                 |                              |     | 25°C                   | 85°C  | 125°C |  |
| 2.5 Volt @ 85°C  |              |                     |                         |                              |                            |                                 |                     |                 |                              |     |                        |       |       |  |
| TPMD108*002#0025 | D            | 1000                | 2.5                     | 85                           | 1.7                        | 125                             | 25                  | 8               | 25                           | 3   | 3.194                  | 2.874 | 1.277 |  |
| TPME158*002#0012 | E            | 1500                | 2.5                     | 85                           | 1.7                        | 125                             | 38                  | 6               | 12                           | 3   | 4.743                  | 4.269 | 1.897 |  |
| TPME158*002#0015 | E            | 1500                | 2.5                     | 85                           | 1.7                        | 125                             | 38                  | 6               | 15                           | 3   | 4.243                  | 3.818 | 1.697 |  |
| TPME158*002#0018 | E            | 1500                | 2.5                     | 85                           | 1.7                        | 125                             | 38                  | 6               | 18                           | 3   | 3.873                  | 3.486 | 1.549 |  |
| TPME228M002#0018 | E            | 2200                | 2.5                     | 85                           | 1.7                        | 125                             | 44                  | 10              | 18                           | 3   | 3.873                  | 3.486 | 1.549 |  |
| 4 Volt @ 85°C    |              |                     |                         |                              |                            |                                 |                     |                 |                              |     |                        |       |       |  |
| TPMD337*004#0025 | D            | 330                 | 4                       | 85                           | 2.7                        | 125                             | 13.2                | 8               | 25                           | 3   | 3.194                  | 2.874 | 1.277 |  |
| TPMD337*004#0035 | D            | 330                 | 4                       | 85                           | 2.7                        | 125                             | 13.2                | 8               | 35                           | 3   | 2.699                  | 2.429 | 1.080 |  |
| TPMD477*004#0025 | D            | 470                 | 4                       | 85                           | 2.7                        | 125                             | 18.8                | 8               | 25                           | 3   | 3.194                  | 2.874 | 1.277 |  |
| TPMD477*004#0035 | D            | 470                 | 4                       | 85                           | 2.7                        | 125                             | 18.8                | 8               | 35                           | 3   | 2.699                  | 2.429 | 1.080 |  |
| TPMD687*004#0025 | D            | 680                 | 4                       | 85                           | 2.7                        | 125                             | 27.2                | 8               | 25                           | 3   | 3.194                  | 2.874 | 1.277 |  |
| TPME687*004#0018 | E            | 680                 | 4                       | 85                           | 2.7                        | 125                             | 27                  | 6               | 18                           | 3   | 3.873                  | 3.486 | 1.549 |  |
| TPME687*004#0023 | E            | 680                 | 4                       | 85                           | 2.7                        | 125                             | 27                  | 6               | 23                           | 3   | 3.426                  | 3.084 | 1.370 |  |
| TPMD108*004#0025 | D            | 1000                | 4                       | 85                           | 2.7                        | 125                             | 40                  | 8               | 25                           | 3   | 3.194                  | 2.874 | 1.277 |  |
| TPMD108*004#0045 | D            | 1000                | 4                       | 85                           | 2.7                        | 125                             | 40                  | 8               | 45                           | 3   | 2.380                  | 2.142 | 0.952 |  |
| TPME108*004#0018 | E            | 1000                | 4                       | 85                           | 2.7                        | 125                             | 40                  | 6               | 18                           | 3   | 3.873                  | 3.486 | 1.549 |  |
| TPME108*004#0023 | E            | 1000                | 4                       | 85                           | 2.7                        | 125                             | 40                  | 6               | 23                           | 3   | 3.426                  | 3.084 | 1.370 |  |
| TPMV108*004#0018 | V            | 1000                | 4                       | 85                           | 2.7                        | 125                             | 40                  | 6               | 18                           | 3   | 3.979                  | 3.581 | 1.592 |  |
| TPME158*004#0015 | E            | 1500                | 4                       | 85                           | 2.7                        | 125                             | 40                  | 6               | 15                           | 3   | 4.243                  | 3.818 | 1.697 |  |
| TPME158*004#0018 | E            | 1500                | 4                       | 85                           | 2.7                        | 125                             | 40                  | 6               | 18                           | 3   | 3.873                  | 3.486 | 1.549 |  |
| 6.3 Volt @ 85°C  |              |                     |                         |                              |                            |                                 |                     |                 |                              |     |                        |       |       |  |
| TPMY227M006#0030 | Y            | 220                 | 6.3                     | 85                           | 4                          | 125                             | 13.2                | 6               | 30                           | 3   | 2.646                  | 2.381 | 1.058 |  |
| TPMD337*006#0025 | D            | 330                 | 6.3                     | 85                           | 4                          | 125                             | 19.8                | 8               | 25                           | 3   | 3.194                  | 2.874 | 1.277 |  |
| TPMD337*006#0035 | D            | 330                 | 6.3                     | 85                           | 4                          | 125                             | 19.8                | 8               | 35                           | 3   | 2.699                  | 2.429 | 1.080 |  |
| TPMD477*006#0030 | D            | 470                 | 6.3                     | 85                           | 4                          | 125                             | 28.2                | 8               | 30                           | 3   | 2.915                  | 2.624 | 1.166 |  |
| TPME477*006#0018 | E            | 470                 | 6.3                     | 85                           | 4                          | 125                             | 28                  | 6               | 18                           | 3   | 3.873                  | 3.486 | 1.549 |  |
| TPME477*006#0023 | E            | 470                 | 6.3                     | 85                           | 4                          | 125                             | 28                  | 6               | 23                           | 3   | 3.426                  | 3.084 | 1.370 |  |
| TPME477*006#0030 | E            | 470                 | 6.3                     | 85                           | 4                          | 125                             | 28                  | 6               | 30                           | 3   | 3.000                  | 2.700 | 1.200 |  |
| TPME687*006#0018 | E            | 680                 | 6.3                     | 85                           | 4                          | 125                             | 41                  | 6               | 18                           | 3   | 3.873                  | 3.486 | 1.549 |  |
| TPME687*006#0023 | E            | 680                 | 6.3                     | 85                           | 4                          | 125                             | 41                  | 6               | 23                           | 3   | 3.426                  | 3.084 | 1.370 |  |
| TPMV687*006#0023 | V            | 680                 | 6.3                     | 85                           | 4                          | 125                             | 41                  | 6               | 23                           | 3   | 3.520                  | 3.168 | 1.408 |  |
| TPME108M006#0025 | E            | 1000                | 6.3                     | 85                           | 4                          | 125                             | 63                  | 8               | 25                           | 3   | 3.286                  | 2.958 | 1.315 |  |
| TPMV108M006#0020 | V            | 1000                | 6.3                     | 85                           | 4                          | 125                             | 63                  | 8               | 20                           | 3   | 3.775                  | 3.397 | 1.510 |  |
| 10 Volt @ 85°C   |              |                     |                         |                              |                            |                                 |                     |                 |                              |     |                        |       |       |  |
| TPMY107M010#0045 | Y            | 100                 | 10                      | 85                           | 7                          | 125                             | 10                  | 8               | 45                           | 3   | 2.160                  | 1.944 | 0.864 |  |
| TPMY157M010#0045 | Y            | 150                 | 10                      | 85                           | 7                          | 125                             | 15                  | 8               | 45                           | 3   | 2.160                  | 1.944 | 0.864 |  |
| TPMD227*010#0035 | D            | 220                 | 10                      | 85                           | 7                          | 125                             | 22                  | 8               | 35                           | 3   | 2.699                  | 2.429 | 1.080 |  |
| TPMD337*010#0035 | D            | 330                 | 10                      | 85                           | 7                          | 125                             | 33                  | 8               | 35                           | 3   | 2.699                  | 2.429 | 1.080 |  |
| TPME337*010#0023 | E            | 330                 | 10                      | 85                           | 7                          | 125                             | 33                  | 6               | 23                           | 3   | 3.426                  | 3.084 | 1.370 |  |
| TPME337*010#0035 | E            | 330                 | 10                      | 85                           | 7                          | 125                             | 33                  | 6               | 35                           | 3   | 2.777                  | 2.500 | 1.111 |  |
| TPME477*010#0023 | E            | 470                 | 10                      | 85                           | 7                          | 125                             | 47                  | 6               | 23                           | 3   | 3.426                  | 3.084 | 1.370 |  |
| TPME477*010#0030 | E            | 470                 | 10                      | 85                           | 7                          | 125                             | 47                  | 6               | 30                           | 3   | 3.000                  | 2.700 | 1.200 |  |
| 16 Volt @ 85°C   |              |                     |                         |                              |                            |                                 |                     |                 |                              |     |                        |       |       |  |
| TPMD476*016#0100 | D            | 47                  | 16                      | 85                           | 10                         | 125                             | 7.5                 | 8               | 100                          | 3   | 1.597                  | 1.437 | 0.639 |  |
| TPMD686*016#0040 | D            | 68                  | 16                      | 85                           | 10                         | 125                             | 10.9                | 8               | 40                           | 3   | 2.525                  | 2.272 | 1.010 |  |
| TPMD686*016#0050 | D            | 68                  | 16                      | 85                           | 10                         | 125                             | 10.9                | 8               | 50                           | 3   | 2.258                  | 2.032 | 0.903 |  |
| TPMD107*016#0040 | D            | 100                 | 16                      | 85                           | 10                         | 125                             | 16                  | 8               | 40                           | 3   | 2.525                  | 2.272 | 1.010 |  |
| TPMD107*016#0050 | D            | 100                 | 16                      | 85                           | 10                         | 125                             | 16                  | 8               | 50                           | 3   | 2.258                  | 2.032 | 0.903 |  |
| TPME157*016#0030 | E            | 150                 | 16                      | 85                           | 10                         | 125                             | 24                  | 6               | 30                           | 3   | 3.000                  | 2.700 | 1.200 |  |
| TPME157*016#0040 | E            | 150                 | 16                      | 85                           | 10                         | 125                             | 24                  | 6               | 40                           | 3   | 2.598                  | 2.338 | 1.039 |  |
| TPME227*016#0025 | E            | 220                 | 16                      | 85                           | 10                         | 125                             | 35                  | 6               | 25                           | 3   | 3.286                  | 2.958 | 1.315 |  |
| TPME227*016#0040 | E            | 220                 | 16                      | 85                           | 10                         | 125                             | 35                  | 6               | 40                           | 3   | 2.598                  | 2.338 | 1.039 |  |
| TPME337*016#0050 | E            | 330                 | 16                      | 85                           | 10                         | 125                             | 52.8                | 10              | 50                           | 3   | 2.324                  | 2.091 | 0.930 |  |
| 20 Volt @ 85°C   |              |                     |                         |                              |                            |                                 |                     |                 |                              |     |                        |       |       |  |
| TPMD476*020#0045 | D            | 47                  | 20                      | 85                           | 13                         | 125                             | 9.4                 | 8               | 45                           | 3   | 2.380                  | 2.142 | 0.952 |  |
| TPMD476*020#0055 | D            | 47                  | 20                      | 85                           | 13                         | 125                             | 9.4                 | 8               | 55                           | 3   | 2.153                  | 1.938 | 0.861 |  |
| TPME107*020#0035 | E            | 100                 | 20                      | 85                           | 13                         | 125                             | 20                  | 6               | 35                           | 3   | 2.777                  | 2.500 | 1.111 |  |
| TPME107*020#0045 | E            | 100                 | 20                      | 85                           | 13                         | 125                             | 20                  | 6               | 45                           | 3   | 2.449                  | 2.205 | 0.980 |  |
| TPME157*020#0035 | E            | 150                 | 20                      | 85                           | 13                         | 125                             | 30                  | 10              | 35                           | 3   | 2.777                  | 2.500 | 1.111 |  |
| 25 Volt @ 85°C   |              |                     |                         |                              |                            |                                 |                     |                 |                              |     |                        |       |       |  |
| TPMD336*025#0065 | D            | 33                  | 25                      | 85                           | 17                         | 125                             | 8.3                 | 8               | 65                           | 3   | 1.981                  | 1.783 | 0.792 |  |
| TPMD476*025#0055 | D            | 47                  | 25                      | 85                           | 17                         | 125                             | 11.8                | 8               | 55                           | 3   | 2.153                  | 1.938 | 0.861 |  |
| TPME476*025#0065 | E            | 47                  | 25                      | 85                           | 17                         | 125                             | 11.8                | 6               | 65                           | 3   | 2.038                  | 1.834 | 0.815 |  |
| TPME686*025#0045 | E            | 68                  | 25                      | 85                           | 17                         | 125                             | 17                  | 6               | 45                           | 3   | 2.449                  | 2.205 | 0.980 |  |
| TPME686*025#0055 | E            | 68                  | 25                      | 85                           | 17                         | 125                             | 17                  | 6               | 55                           | 3   | 2.216                  | 1.994 | 0.886 |  |
| 35 Volt @ 85°C   |              |                     |                         |                              |                            |                                 |                     |                 |                              |     |                        |       |       |  |
| TPMD226*035#0070 | D            | 22                  | 35                      | 85                           | 23                         | 125                             | 7.7                 | 8               | 70                           | 3   | 1.909                  | 1.718 | 0.763 |  |
| TPME226*035#0060 | E            | 22                  | 35                      | 85                           | 23                         | 125                             | 8                   | 6               | 60                           | 3   | 2.121                  | 1.909 | 0.849 |  |
| TPME226*035#0100 | E            | 22                  | 35                      | 85                           | 23                         | 125                             | 8                   | 6               | 100                          | 3   | 1.643                  | 1.479 | 0.657 |  |
| TPME336*035#0050 | E            | 33                  | 35                      | 85                           | 23                         | 125                             | 12                  | 6               | 50                           | 3   | 2.324                  | 2.091 | 0.930 |  |
| TPME336*035#0065 | E            | 33                  | 35                      | 85                           | 23                         | 125                             | 12                  | 6               | 65                           | 3   | 2.038                  | 1.834 | 0.815 |  |



### RATINGS & PART NUMBER REFERENCE

| AVX Part No.          | Case Size | Capacitance (μF) | Rated Voltage (V) | Rated Temperature (°C) | Category Voltage (V) | Category Temperature (°C) | DCL (μA) Max. | DF % Max. | ESR Max. (mΩ) @ 100kHz | MSL | 100kHz RMS Current (A) |       |       |
|-----------------------|-----------|------------------|-------------------|------------------------|----------------------|---------------------------|---------------|-----------|------------------------|-----|------------------------|-------|-------|
|                       |           |                  |                   |                        |                      |                           |               |           |                        |     | 25°C                   | 85°C  | 125°C |
| TPME476*035#0055      | E         | 47               | 35                | 85                     | 23                   | 125                       | 16            | 6         | 55                     | 3   | 2.216                  | 1.994 | 0.886 |
| TPME476*035#0065      | E         | 47               | 35                | 85                     | 23                   | 125                       | 16            | 6         | 65                     | 3   | 2.038                  | 1.834 | 0.815 |
| <b>50 Volt @ 85°C</b> |           |                  |                   |                        |                      |                           |               |           |                        |     |                        |       |       |
| TPMD106*050#0140      | D         | 10               | 50                | 85                     | 33                   | 125                       | 5             | 8         | 140                    | 3   | 1.350                  | 1.215 | 0.540 |
| TPME106*050#0120      | E         | 10               | 50                | 85                     | 33                   | 125                       | 5             | 6         | 120                    | 3   | 1.500                  | 1.350 | 0.600 |
| TPME156*050#0075      | E         | 15               | 50                | 85                     | 33                   | 125                       | 7.5           | 6         | 75                     | 3   | 1.897                  | 1.708 | 0.759 |
| TPME156*050#0100      | E         | 15               | 50                | 85                     | 33                   | 125                       | 7.5           | 6         | 100                    | 3   | 1.643                  | 1.479 | 0.657 |
| TPME226*050#0075      | E         | 22               | 50                | 85                     | 33                   | 125                       | 11            | 8         | 75                     | 3   | 1.897                  | 1.708 | 0.759 |
| TPME226*050#0100      | E         | 22               | 50                | 85                     | 33                   | 125                       | 11            | 8         | 100                    | 3   | 1.643                  | 1.479 | 0.657 |

Moisture Sensitivity Level (MSL) is defined according to J-STD-020

All technical data relates to an ambient temperature of +25°C. Capacitance and DF are measured at 120Hz, 0.5V RMS with a maximum DC bias of 2.2 volts.

DCL is measured at rated voltage after 5 minutes.

The EIA & CECC standards for low ESR Solid Tantalum Capacitors allow an ESR movement to 1.25 times catalogue limit post mounting.

For typical weight and composition see page 202.

**NOTE: AVX reserves the right to supply a higher voltage rating or tighter tolerance part in the same case size, to the same reliability standards.**

### QUALIFICATION TABLE

| TEST                  | TPM series (Temperature range -55°C to +125°C)                                                                                                                                                                                                                                                 |               |               |                    |                              |           |       |           |            |       |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------|--------------------|------------------------------|-----------|-------|-----------|------------|-------|
|                       | Condition                                                                                                                                                                                                                                                                                      |               |               | Characteristics    |                              |           |       |           |            |       |
| Endurance             | Determine after application of rated voltage for 2000 +48/-0 hours at 85±2°C and then leaving 1-2 hours at room temperature. Also determine of 125°C temperature, category voltage for 2000 +48/-0 hours and then leaving 1-2 hours at room temperature. Power supply impedance to be ≤0.1Ω/V. |               |               | Visual examination | no visible damage            |           |       |           |            |       |
|                       |                                                                                                                                                                                                                                                                                                |               |               | DCL                | initial limit                |           |       |           |            |       |
|                       |                                                                                                                                                                                                                                                                                                |               |               | ΔC/C               | within ±10% of initial value |           |       |           |            |       |
|                       |                                                                                                                                                                                                                                                                                                |               |               | DF                 | initial limit                |           |       |           |            |       |
|                       |                                                                                                                                                                                                                                                                                                |               |               | ESR                | 1.25 x initial limit         |           |       |           |            |       |
| Humidity              | Determine after storage without applied voltage at 65±2°C and 95±2% relative humidity for 500 hours and then recovery 1-2 hours at room temperature.                                                                                                                                           |               |               | Visual examination | no visible damage            |           |       |           |            |       |
|                       |                                                                                                                                                                                                                                                                                                |               |               | DCL                | 1.5 x initial limit          |           |       |           |            |       |
|                       |                                                                                                                                                                                                                                                                                                |               |               | ΔC/C               | within ±10% of initial value |           |       |           |            |       |
|                       |                                                                                                                                                                                                                                                                                                |               |               | DF                 | 1.2 x initial limit          |           |       |           |            |       |
|                       |                                                                                                                                                                                                                                                                                                |               |               | ESR                | 1.25 x initial limit         |           |       |           |            |       |
| Temperature Stability | Step                                                                                                                                                                                                                                                                                           | Temperature°C | Duration(min) |                    | +20°C                        | -55°C     | +20°C | +85°C     | +125°C     | +20°C |
|                       | 1                                                                                                                                                                                                                                                                                              | +20±2         | 15            | DCL                | IL*                          | n/a       | IL*   | 10 x IL*  | 12.5 x IL* | IL*   |
|                       | 2                                                                                                                                                                                                                                                                                              | -55+0/-3      | 15            | ΔC/C               | n/a                          | +0/-10%   | ±5%   | +10/-0%   | +12/-0%    | ±5%   |
|                       | 3                                                                                                                                                                                                                                                                                              | +20±2         | 15            | DF                 | IL*                          | 1.5 x IL* | IL*   | 1.5 x IL* | 2 x IL*    | IL*   |
|                       | 4                                                                                                                                                                                                                                                                                              | +85+3/-0      | 15            |                    |                              |           |       |           |            |       |
|                       | 5                                                                                                                                                                                                                                                                                              | +125+3/-0     | 15            |                    |                              |           |       |           |            |       |
| Surge Voltage         | Test temperature: 125°C±3/0°C<br>Test voltage: Category voltage at 125°C<br>Surge voltage: 1.3 x category voltage at 125°C<br>Series protection resistance 1000±100Ω<br>Discharge resistance: 1000Ω<br>Number of cycles: 1000x<br>Cycle duration: 6 min; 30 sec charge, 5 min 30 sec discharge |               |               | Visual examination | no visible damage            |           |       |           |            |       |
|                       |                                                                                                                                                                                                                                                                                                |               |               | DCL                | initial limit                |           |       |           |            |       |
|                       |                                                                                                                                                                                                                                                                                                |               |               | ΔC/C               | within ±5% of initial value  |           |       |           |            |       |
|                       |                                                                                                                                                                                                                                                                                                |               |               | DF                 | initial limit                |           |       |           |            |       |
|                       |                                                                                                                                                                                                                                                                                                |               |               | ESR                | 1.25 x initial limit         |           |       |           |            |       |

\*Initial Limit