



## Solid Tantalum Chip Capacitors MIDGET® Conformal Coated



### FEATURES

- 8mm, 12mm, 16mm tape and reel packaging available per EIA-481-1 and reeling per IEC 286-3, 7" [178mm] standard.

### PERFORMANCE CHARACTERISTICS

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

**Capacitance Range:** .10µF - 150µF

**Capacitance Tolerance:** ± 10%, ± 20% standard.

**Voltage Rating:** 4 WVDC to 50WVDC.

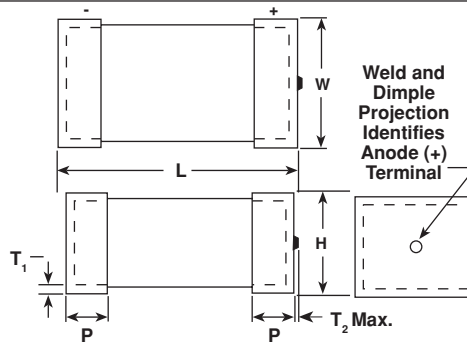
### ORDERING INFORMATION

194D TYPE	225 CAPACITANCE	X0 CAPACITANCE TOLERANCE	004 DC VOLTAGE RATING AT + 85°C	A CASE CODE	2 TERMINATION	T PACKAGING
This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	<b>X0 = ± 20%</b> X9 = ± 10% X5 = ± 5% Special Order.	This is expressed in volts. To complete the three-digit block, zeros precede the voltage rating.	See Ratings and Case Codes Table.	<b>2 = Gold Plate, Standard. (50µ Inch minimum)</b> 8 = 60/40 Solder Plated 7 = Hot Solder Dipped	<b>T = Tape and Reel 7" [178] Reel standard. (1/2 reel minimum)</b> See Tape and Reel Specifications.	

**Note:** Preferred Tolerance and reel sizes are in bold.

We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size. Voltage substitutions will be marked with the higher voltage rating.

### DIMENSIONS in inches [millimeters]



CASE CODE	W	L	H	P	T <sub>1</sub>	T <sub>2</sub> (Max.)
A	0.050 ± 0.015 [1.27 ± 0.38]	0.100 ± 0.015 [2.54 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
B	0.050 ± 0.015 [1.27 ± 0.38]	0.150 ± 0.015 [3.81 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
C	0.050 ± 0.015 [1.27 ± 0.38]	0.200 ± 0.015 [5.08 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
D	0.100 ± 0.015 [2.54 ± 0.38]	0.150 ± 0.015 [3.81 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
E	0.100 ± 0.015 [2.54 ± 0.38]	0.200 ± 0.015 [5.08 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
F	0.135 ± 0.015 [3.43 ± 0.38]	0.220 ± 0.015 [5.59 ± 0.38]	0.070 ± 0.015 [1.78 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
G	0.110 ± 0.015 [2.79 ± 0.38]	0.265 ± 0.015 [6.73 ± 0.38]	0.110 ± 0.015 [2.79 ± 0.38]	0.050 ± 0.005 [1.27 ± 0.13]	0.005 [0.13]	0.015 [0.38]
H	0.150 ± 0.015 [3.81 ± 0.38]	0.285 ± 0.015 [7.24 ± 0.38]	0.110 ± 0.015 [2.79 ± 0.38]	.050 ± 0.005 [1.27 ± 0.13]	0.005 [0.13]	0.015 [0.38]

**Note:** When solder coated terminations are required, add 0.015" [0.381] to termination dimension tolerances.



194D / CTC1 RATINGS AND CASE CODES																
μF	4 V		6 V / 6.3 V**		10 V		15 V / 16 V**		20 V		25 V		35 V / 40 V**		50 V	
	Std.	Ext.	Std.	Ext.	Std.	Ext.	Std.	Ext.	Std.	Ext.	Std.	Ext.	Std.	Ext.	Std.	Ext.
0.10														A		A*
0.15														A		A
0.22														A		B*
0.33												A		B		B
0.47									A		B	A		B		C
0.68							A		B	A	B			C		D
1.0					A		B	A	B	A	C			D		E
1.5			A		B	A	B	A	C	B	D			E		F*
2.2	A		B	A	B	A	C	B	D	C	E			F		F
3.3	B	A	B	A	C	B	D	C	E	D	F			F		G
4.7	B		C	B	D	C	E	D	F	E	F			G	F	H
6.8	C	B	D	C	E	D	F	E	F		G*	F	H	G		H
10	D	C	E	D	F	E	F	E	G	F	G	F		H		
15	E	D	F	E	F	E	G	F	G		H			H		
22	F	E	F		G	F	G	F	H			H				
33	F		G	F	G	F	H	G		H						
47	G	F	G	F	H	G		H								
68	G	F	H	G		H		H								
100	H			H		H										
120		H		H		H										
150		H		H												

\* only available in 194D

\*\* CECC voltages are 6.3 volts, 16 volts and 40 volts. 20 volts range only available in 194D. .

Extended range values not available in CECC styles

STANDARD / EXTENDED RATINGS						
CAPACITANCE (μF)	CASE CODE	PART NUMBER*	Max. DCL @ + 25°C (μA)	Max. DF @ + 25°C 120 Hz (%)		
4 WVDC @ + 85°C, SURGE = 5 V . . . 2.7 WVDC @ + 125°C, SURGE = 3.4 V						
2.2	A	194D225X_004A2	0.5	6		
<b>3.3</b>	<b>A</b>	<b>194D335X_004A2</b>	<b>0.5</b>	<b>6</b>		
3.3	B	194D335X_004B2	0.5	6		
4.7	B	194D475X_004B2	0.5	6		
<b>6.8</b>	<b>B</b>	<b>194D685X_004B2</b>	<b>0.5</b>	<b>6</b>		
6.8	C	194D685X_004C2	0.5	6		
<b>10</b>	<b>C</b>	<b>194D106X_004C2</b>	<b>0.5</b>	<b>6</b>		
10	D	194D106X_004D2	0.5	6		
<b>15</b>	<b>D</b>	<b>194D156X_004D2</b>	<b>0.6</b>	<b>6</b>		
15	E	194D156X_004E2	0.6	6		
<b>22</b>	<b>E</b>	<b>194D226X_004E2</b>	<b>0.9</b>	<b>6</b>		
22	F	194D226X_004F2	0.9	6		
33	F	194D336X_004F2	1.3	6		
<b>47</b>	<b>F</b>	<b>194D476X_004F2</b>	<b>1.9</b>	<b>6</b>		
47	G	194D476X_004G2	1.9	6		
<b>68</b>	<b>F</b>	<b>194D686X_004F2</b>	<b>2.7</b>	<b>6</b>		
68	G	194D686X_004G2	2.7	6		
100	H	194D107X_004H2	4.0	8		
<b>120</b>	<b>H</b>	<b>194D127X_004H2</b>	<b>4.8</b>	<b>8</b>		
<b>150</b>	<b>H</b>	<b>194D157X_004H2</b>	<b>6.0</b>	<b>8</b>		

\* Preliminary values, contact factory for availability. For 10% tolerance, specify "9"; for 20% tolerance, change to "0". **Extended Ratings in bold print.**



<b>STANDARD / EXTENDED RATINGS</b>				
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER*	Max. DCL @ + 25°C ( $\mu$ A)	Max. DF @ + 25°C 120 Hz (%)
<b>6 WVDC @ + 85°C, SURGE = 8 V . . . 4 WVDC @ + 125°C, SURGE = 5 V</b>				
1.5	A	194D155X_006A2	0.5	6
<b>2.2</b>	<b>A</b>	<b>194D225X_006A2</b>	<b>0.5</b>	<b>6</b>
2.2	B	194D225X_006B2	0.5	6
<b>3.3</b>	<b>A</b>	<b>194D335X_006A2</b>	<b>0.5</b>	<b>6</b>
3.3	B	194D335X_006B2	0.5	6
<b>4.7</b>	<b>B</b>	<b>194D475X_006B2</b>	<b>0.5</b>	<b>6</b>
4.7	C	194D475X_006C2	0.5	6
<b>6.8</b>	<b>C</b>	<b>194D685X_006C2</b>	<b>0.5</b>	<b>6</b>
6.8	D	194D685X_006D2	0.5	6
<b>10</b>	<b>D</b>	<b>194D106X_006D2</b>	<b>0.6</b>	<b>6</b>
10	E	194D106X_006E2	0.6	6
<b>6 WVDC @ + 85°C, SURGE = 8 V . . . 4 WVDC @ + 125°C, SURGE = 5 V</b>				
<b>15</b>	<b>E</b>	<b>194D156X_006E2</b>	<b>1.0</b>	<b>6</b>
15	F	194D156X_006F2	1.0	6
22	F	194D226X_006F2	1.4	6
<b>33</b>	<b>F</b>	<b>194D336X_006F2</b>	<b>2.1</b>	<b>6</b>
33	G	194D336X_006G2	2.1	6
<b>47</b>	<b>F</b>	<b>194D476X_006F2</b>	<b>3.0</b>	<b>6</b>
47	G	194D476X_006G2	3.0	6
<b>68</b>	<b>G</b>	<b>194D686X_006G2</b>	<b>4.3</b>	<b>6</b>
68	H	194D686X_006H2	4.3	6
<b>100</b>	<b>H</b>	<b>194D107X_006H2</b>	<b>6.0</b>	<b>8</b>
<b>120</b>	<b>H</b>	<b>194D127X_006H2</b>	<b>7.2</b>	<b>8</b>
<b>150</b>	<b>H</b>	<b>194D157X_006H2</b>	<b>9.0</b>	<b>8</b>
<b>10 WVDC @ + 85°C, SURGE = 13 V . . . 7 WVDC @ + 125°C, SURGE = 9 V</b>				
1.0	A	194D105X_010A2	0.5	4
<b>1.5</b>	<b>A</b>	<b>194D155X_010A2</b>	<b>0.5</b>	<b>6</b>
1.5	B	194D155X_010B2	0.5	6
<b>2.2</b>	<b>A</b>	<b>194D225X_010A2</b>	<b>0.5</b>	<b>6</b>
2.2	B	194D225X_010B2	0.5	6
<b>3.3</b>	<b>B</b>	<b>194D335X_010B2</b>	<b>0.5</b>	<b>6</b>
3.3	C	194D335X_010C2	0.5	6
<b>4.7</b>	<b>C</b>	<b>194D475X_010C2</b>	<b>0.5</b>	<b>6</b>
4.7	D	194D475X_010D2	0.5	6
<b>6.8</b>	<b>D</b>	<b>194D685X_010D2</b>	<b>0.7</b>	<b>6</b>
6.8	E	194D685X_010E2	0.7	6
<b>10</b>	<b>E</b>	<b>194D106X_010E2</b>	<b>1.0</b>	<b>6</b>
10	F	194D106X_010F2	1.0	6
<b>15</b>	<b>E</b>	<b>194D156X_010E2</b>	<b>1.5</b>	<b>6</b>
15	F	194D156X_010F2	1.5	6
<b>22</b>	<b>F</b>	<b>194D226X_010F2</b>	<b>2.2</b>	<b>6</b>
22	G	194D226X_010G2	2.2	6
<b>33</b>	<b>F</b>	<b>194D336X_010F2</b>	<b>3.3</b>	<b>6</b>
33	G	194D336X_010G2	3.3	6
<b>47</b>	<b>G</b>	<b>194D476X_010G2</b>	<b>4.7</b>	<b>6</b>
47	H	194D476X_010H2	4.7	6
<b>68</b>	<b>H</b>	<b>194D686X_010H2</b>	<b>6.8</b>	<b>6</b>
<b>100</b>	<b>H</b>	<b>194D107X_010H2</b>	<b>10.0</b>	<b>8</b>
<b>120</b>	<b>H</b>	<b>194D127X_010H2</b>	<b>12.0</b>	<b>8</b>

\* Preliminary values, contact factory for availability. For 10% tolerance, specify "9"; for 20% tolerance, change to "0". **Extended Ratings in bold print.**



<b>STANDARD / EXTENDED RATINGS</b>				
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER*	Max. DCL @ + 25°C ( $\mu$ A)	Max. DF @ + 25°C 120 Hz (%)
<b>15 WVDC @ + 85°C, SURGE = 20 V . . . 10 WVDC @ + 125°C, SURGE = 12 V</b>				
0.68	A	194D684X_015A2	.5	4
<b>1.0</b>	<b>A</b>	<b>194D105X_015A2</b>	<b>.5</b>	<b>4</b>
1.0	B	194D105X_015B2	.5	4
<b>1.5</b>	<b>A</b>	<b>194D155X_015A2</b>	<b>.5</b>	<b>6</b>
1.5	B	194D155X_015B2	.5	6
<b>2.2</b>	<b>B</b>	<b>194D225X_015B2</b>	<b>.5</b>	<b>6</b>
2.2	C	194D225X_015C2	.5	6
<b>3.3</b>	<b>C</b>	<b>194D335X_015C2</b>	<b>.5</b>	<b>6</b>
3.3	D	194D335X_015D2	.5	6
<b>4.7</b>	<b>D</b>	<b>194D475X_015D2</b>	<b>.7</b>	<b>6</b>
4.7	E	194D475X_015E2	.7	6
<b>6.8</b>	<b>E</b>	<b>194D685X_015E2</b>	<b>1.1</b>	<b>6</b>
6.8	F	194D685X_015F2	1.1	6
<b>10</b>	<b>E</b>	<b>194D106X_015E2</b>	<b>1.6</b>	<b>6</b>
10	F	194D106X_015F2	1.6	6
<b>15</b>	<b>F</b>	<b>194D156X_015F2</b>	<b>2.4</b>	<b>6</b>
15	G	194D156X_015G2	2.4	6
<b>22</b>	<b>F</b>	<b>194D226X_015F2</b>	<b>3.5</b>	<b>6</b>
22	G	194D226X_015G2	3.5	6
<b>33</b>	<b>G</b>	<b>194D336X_015G2</b>	<b>5.3</b>	<b>6</b>
33	H	194D336X_015H2	5.3	6
<b>47</b>	<b>H</b>	<b>194D476X_015H2</b>	<b>7.0</b>	<b>6</b>
<b>68</b>	<b>H</b>	<b>194D686X_015H2</b>	<b>10.0</b>	<b>6</b>
<b>20 WVDC @ + 85°C, SURGE = 26 V . . . 13 WVDC @ + 125°C, SURGE = 16 V</b>				
0.47	A	194D474X_020A2	.5	4
<b>0.68</b>	<b>A</b>	<b>194D684X_020A2</b>	<b>.5</b>	<b>4</b>
0.68	B	194D684X_020B2	.5	4
<b>1.0</b>	<b>A</b>	<b>194D105X_020A2</b>	<b>.5</b>	<b>4</b>
1.0	B	194D105X_020B2	.5	4
<b>1.5</b>	<b>B</b>	<b>194D155X_020B2</b>	<b>.5</b>	<b>6</b>
1.5	C	194D155X_020C2	.5	6
<b>2.2</b>	<b>C</b>	<b>194D225X_020C2</b>	<b>.5</b>	<b>6</b>
2.2	D	194D225X_020D2	.5	6
<b>3.3</b>	<b>D</b>	<b>194D335X_020D2</b>	<b>.7</b>	<b>6</b>
3.3	E	194D335X_020E2	.7	6
<b>4.7</b>	<b>E</b>	<b>194D475X_020E2</b>	<b>.9</b>	<b>6</b>
4.7	F	194D475X_020F2	.9	6
6.8	F	194D685X_020F2	1.4	6
<b>10</b>	<b>F</b>	<b>194D106X_020F2</b>	<b>2.0</b>	<b>6</b>
10	G	194D106X_020G2	2.0	6
15	G	194D156X_020G2	3.0	6
22	H	194D226X_020H2	4.4	6
<b>33</b>	<b>H</b>	<b>194D336X_020H2</b>	<b>6.6</b>	<b>6</b>

\* Preliminary values, contact factory for availability. For 10% tolerance, specify "9"; for 20% tolerance, change to "0". **Extended Ratings in bold print.**



<b>STANDARD / EXTENDED RATINGS</b>				
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER*	Max. DCL @ + 25°C ( $\mu$ A)	Max. DF @ + 25°C 120 Hz (%)
<b>25 WVDC @ + 85°C, SURGE = 32 V . . . 17 WVDC @ + 125°C, SURGE = 20 V</b>				
0.33	A	194D334X_025A2	.5	4
<b>0.47</b>	<b>A</b>	<b>194D474X_025A2</b>	<b>.5</b>	<b>4</b>
0.47	B	194D474X_025B2	.5	4
0.68	B	194D684X_025B2	.5	4
1.0	C	194D105X_025C2	.5	4
1.5	D	194D155X_025D2	.5	6
2.2	E	194D225X_025E2	.6	6
3.3	F	194D335X_025F2	.8	6
4.7	F	194D475X_025F2	1.2	6
<b>6.8</b>	<b>F</b>	<b>194D685X_025F2</b>	<b>1.7</b>	<b>6</b>
6.8	G	194D685X_025G2	1.7	6
<b>10</b>	<b>F</b>	<b>194D106X_025F2</b>	<b>2.5</b>	<b>6</b>
10	G	194D106X_025G2	2.5	6
15	H	194D156X_025H2	3.8	6
<b>22</b>	<b>H</b>	<b>194D226X_025H2</b>	<b>5.5</b>	<b>6</b>
<b>35 WVDC @ + 85°C, SURGE = 46 V . . . 23 WVDC @ + 125°C, SURGE = 28 V</b>				
0.10	A	194D104X_035A2	.5	4
0.15	A	194D154X_035A2	.5	4
0.22	A	194D224X_035A2	.5	4
0.33	B	194D334X_035B2	.5	4
0.47	B	194D474X_035B2	.5	4
0.68	C	194D684X_035C2	.5	4
1.0	D	194D105X_035D2	.5	4
1.5	E	194D155X_035E2	.5	6
2.2	F	194D225X_035F2	.8	6
3.3	F	194D335X_035F2	1.2	6
<b>4.7</b>	<b>F</b>	<b>194D475X_035F2</b>	<b>1.6</b>	<b>6</b>
4.7	G	194D475X_035G2	1.6	6
<b>6.8</b>	<b>G</b>	<b>194D685X_035G2</b>	<b>2.4</b>	<b>6</b>
6.8	H	194D685X_035H2	2.4	6
<b>10</b>	<b>H</b>	<b>194D106X_035H2</b>	<b>3.5</b>	<b>6</b>
<b>15</b>	<b>H</b>	<b>194D156X_035H2</b>	<b>5.3</b>	<b>6</b>
<b>50 WVDC @ + 85°C, SURGE = 65 V . . . 33 WVDC @ + 125°C, SURGE = 38 V</b>				
0.10	A	194D104X_050A2	.5	4
0.15	A	194D154X_050A2	.5	4
0.22	B	194D224X_050B2	.5	4
0.33	B	194D334X_050B2	.5	4
0.47	C	194D474X_050C2	.5	4
0.68	D	194D684X_050D2	.5	4
1.0	E	194D105X_050E2	.5	4
1.5	F	194D155X_050F2	.8	6
2.2	F	194D225X_050F2	1.1	6
3.3	G	194D335X_050G2	1.7	6
4.7	H	194D475X_050H2	2.4	6
<b>6.8</b>	<b>H</b>	<b>194D685X_050H2</b>	<b>3.4</b>	<b>6</b>

\* Preliminary values, contact factory for availability. For 10% tolerance, specify "9"; for 20% tolerance, change to "0". **Extended Ratings in bold print.**



**PERFORMANCE CHARACTERISTICS**

1. **Operating Temperature:** Capacitors are designed to operate over the temperature range - 55°C to + 85°C.

1.1 Capacitors may be operated to + 125°C with voltage derating to two-thirds the + 85°C rating.

+ 85°C Rating		+ 125°C Rating	
Working Voltage (V)	Surge Voltage (V)	Working Voltage (V)	Surge Voltage (V)
4	5	2.7	3.4
6.3	8	4	5
10	13	7	8
15	20	10	12
20	26	13	16
25	32	17	20
35	46	23	28
50	65	33	38

2. **DC Working Voltage:** The DC working voltage is the maximum operating voltage for continuous duty at the rated temperature.

3. **Surge Voltage:** The surge DC rating is the maximum voltage to which the capacitors may be subjected under any conditions, including transients and peak ripple at the highest line voltage.

3.1 **Surge Voltage Test:** Capacitors shall withstand the surge voltage applied in series with a 33 ohm ± 5% resistor at the rate of one-half minute on, one-half minute off, at + 85°C, for 1000 successive test cycles.

3.2 Following the surge voltage test, the dissipation factor and the leakage current shall meet the initial requirements; the capacitance shall not have changed more than ± 5%; the leakage current shall meet the initial requirements at + 25°C.

3.3 Not more than 1 failure for any of the above reasons shall be allowed for any 6 capacitors tested.

4. **Capacitance Tolerance:** The capacitance of all capacitors shall be within the specified tolerance limits of the normal rating.

4.1 Capacitance measurements shall be made by means of polarized capacitance bridge. The polarizing voltage shall be of such magnitude that there shall be no reversal of polarity due to the AC component. The maximum voltage applied to capacitors during measurement shall be 2 volts rms at 120 Hz at +25°C. If the AC voltage applied is less than one-half volt rms, no DC bias is required. Accuracy of the bridge shall be within ± 2%.

5. **Capacitance Change With Temperature:** The capacitance change with temperature shall not exceed the following percentage of the capacitance measured at + 25°C:

- 55°C	+ 85°C	+ 125°C
- 10%	+ 10%	+ 12%

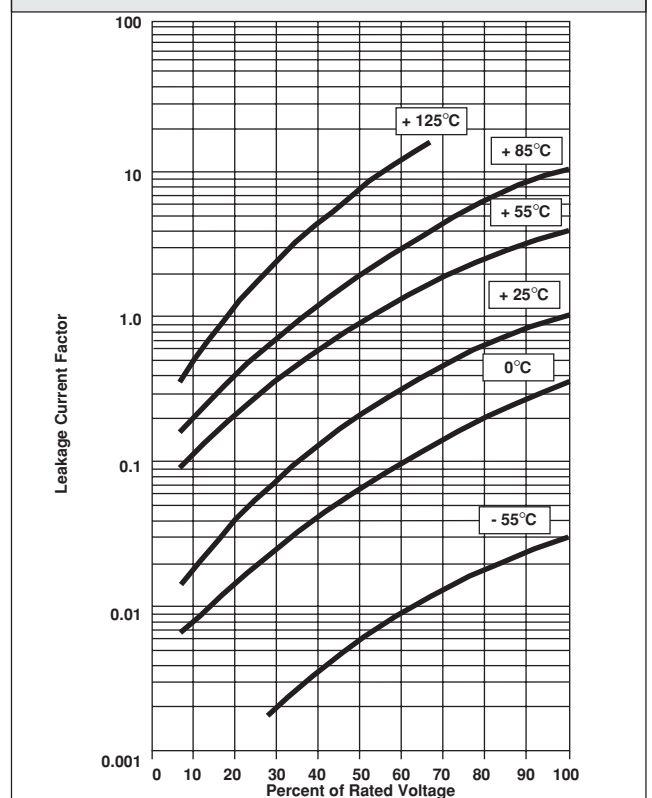
6. **Dissipation Factor:** The dissipation factor, determined from the expression  $2\pi fRC$ , shall not exceed values listed in the Standard Ratings Table.

6.1 Measurements shall be made by the bridge method at, or referred to, a frequency of 120 Hz and a temperature of + 25°C.

7. **Leakage Current:** Capacitors shall be stabilized at the rated temperature for 30 minutes. Rated voltage shall be applied to capacitors for 5 minutes using a steady source of power (such as a regulated power supply) with 1000 ohm resistor connected in series with the capacitor under test to limit the charging current. Leakage current shall then be measured.

*Note that the leakage current varies with temperature and applied voltage. See graph below for the appropriate adjustment factor.*

**TYPICAL LEAKAGE CURRENT FACTOR RANGE**





### PERFORMANCE CHARACTERISTICS (Continued)

- 7.1 At + 25°C ± 5°C**, the leakage current for any capacitor shall not exceed the maximum value listed in the Standard Ratings Table.
- 7.2 At + 85°C**, when measured at + 85°C ± 5°C, the leakage current for any capacitor shall not exceed 10 times the maximum value listed in the Standard Ratings Table.
- 7.3 At + 125°C**, when measured at + 125°C ± 5°C, the leakage current for any capacitor shall not exceed 12 times the maximum value listed in the Standard Ratings Table.
- 8. Life Test:** Capacitors shall be capable of withstanding a 2000 hour life test at the +85°C rated DC working voltage or a 1000 hour life test at the + 125°C derated working voltage.
- 8.1** Following the life test, the capacitors shall meet the following requirements; the capacitance at + 25°C shall not have changed by more than ± 10% from the initial value; the dissipation factor shall meet the initial requirements; the leakage current shall not be more than the original requirements.
- 9. Reflow Soldering:** It is recommended that these capacitors be reflow soldered at a temperature of not greater than + 250°C for a period of not more than 30 seconds.
- 10: Marking:** The small body area of these capacitors does not permit elaborate marking schemes. Required information will be distinctly marked on the carton or packages in which the units are shipped. Capacitors may be ordered with color coding at additional cost. Color coding shall be as mutually agreed upon by Vishay Sprague and the customer.
- 10.1 Polarity:** The anode terminal of each capacitor is identified by the weld and dimple projection on the anode cap (see Dimensions).

### GUIDE TO APPLICATION

- 1. A-C 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 Watts @ + 25°C as given in the table in Paragraph Number 5 (Power Dissipation).

R<sub>ESR</sub> = The capacitor Equivalent Series Resistance at the specified frequency.

- 2. A-C 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 Watts @ + 25°C as given in the table in Paragraph Number 5 (Power Dissipation).

R<sub>ESR</sub> = The capacitor Equivalent Series Resistance at the specified frequency.

Z = The capacitor Impedance at the specified frequency.

- 2.1** The sum of the peak AC voltage plus the DC voltage shall not exceed the DC voltage rating of the capacitor.
- 2.2** The sum of the negative peak AC voltage plus the applied DC voltage shall not allow a voltage reversal exceeding 10% of the DC working voltage at + 25°C.
- 3. Reverse Voltage:** These capacitors are capable of withstanding peak voltages in the reverse direction equal to 10% of the DC rating at + 25°C and 5% of the DC rating at + 85°C and 1% of the DC rating at +125°C.
- 4. 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 derating factors as shown:

**GUIDE TO APPLICATION** (Continued)

Temperature	Derating Factor
+ 25°C	1.0
+ 55°C	0.9
+ 85°C	0.8
+ 125°C	0.4

5. **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.)

Case Code	Maximum Permissible Power Dissipation @ + 25°C (Watts) in free air
A	0.060
B	0.075
C	0.075
D	0.085
E	0.095
F	0.110
G	0.120
H	0.150

6. **Printed Circuit Board Materials:** The 194D is compatible with most commonly used printed circuit board materials (alumina substrates, FR4, FR5, G10, PTFE-fluorocarbon and porcelainized steel). If your desired board material is not shown there, please contact the Tantalum Marketing Department for assistance in determining compatibility.

7. **Attachment:**

7.1 **Solder Paste:** The recommended thickness of the solder paste after application is .007" ± .001" [1.78mm ± .025mm]. Care should be exercised in selecting the solder paste. The metal purity should be as high as practical. The flux (in the paste) must be active enough to remove the oxides formed on the metallization prior to the exposure to soldering heat. In practice this can be aided by extending the solder preheat time at temperatures below the liquidous state of the solder.

7.2 **Soldering:** Capacitors can be attached by conventional soldering techniques - convection, infrared reflow, wave soldering and hot plate methods. The Solder Temperature/Soldering Time chart shows maximum recommended time/temperature conditions for soldering. Attachment with a soldering iron is not recommended due to the difficulty of controlling time at temperature.

8. **Cleaning (Flux Removal) After Soldering:** The 695D is compatible with all commonly used solvents such as TES, TMS, Prelete, Chlorethane. Solvents containing methylene chloride or other epoxy solvents should be avoided since these will attack the epoxy encapsulation material.

9. **Recommended Mounting Pad Geometries:** The area under the tantalum wire nib should not be metallized on the PC board. The nib must have sufficient clearance to avoid electrical contact with other components. The width dimension indicated is the same as the maximum width of the capacitor. This is to minimize lateral movement.

**REFLOW SOLDER PADS\***

in inches [millimeters]

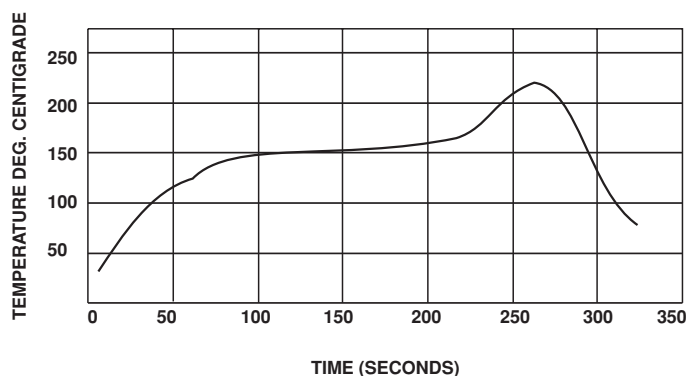
\* Pads for B, C and D case codes are otherwise pad compatible with Type 293D, B, C and D case codes respectively.

CASE CODE	WIDTH (A)	PAD METALLIZATION (B)	SEPARATION (C)
A	0.065 [1.6]	0.050 [1.3]	0.040 [1.0]
B	0.065 [1.6]	0.070 [1.8]	0.055 [1.4]
C	0.066 [1.6]	0.070 [1.8]	0.120 [3.0]
D	0.115 [2.9]	0.070 [1.8]	0.070 [1.8]
E	0.115 [2.8]	0.070 [1.8]	0.120 [3.6]
F	0.150 [3.8]	0.070 [1.8]	0.140 [3.6]
G	0.125 [3.2]	0.070 [1.8]	0.170 [4.3]
H	0.165 [4.2]	0.080 [2.3]	0.170 [4.3]





**RECOMMENDED REFLOW SOLDERING PROFILE**



**TAPE AND REEL PACKAGING**

Case Code	Tape Width	Unit Pitch Ctr/Ctr P	Quantity per Full 7" [178] Reel	Minimum Quantity Per Reel
A	8mm	4mm	2500	1250
B	12mm	4mm	2500	1250
C	12mm	4mm	2500	1250
D	12mm	4mm	2500	1250
E	12mm	4mm	2500	1250
F	12mm	8mm	1000	500
G	16mm	8mm	600	300
H	16mm	8mm	600	300

**Tape and Reel Specifications:** 194D capacitors are available in tape and reel packaging to facilitate the use of automatic placement equipment. Tape and Reel is per EIA (Electronic Industries Association) specification RS-481. Capacitor orientation within the tape pockets is negative terminal toward sprocket holes and mounting side down. Quantities less than minimum reel will be shipped in 'Blister-Pack' trays.

