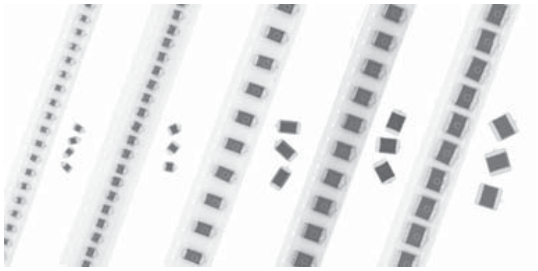
Solid Tantalum Chip Capacitors
TANTAMOUNT®, Low Profile, Low ESR, Conformal Coated, Maximum CV



FEATURES
- New case size offerings.
- 1.2mm to 2mm height
- Terminations: Tin (2) standard.
- Very low ESR
- 8mm, 12mm tape and reel packaging available per EIA-481-1 and reeling per IEC 286-3. 7" [178mm] standard. 13" [330mm] available.
- Footprint compatible with EIA 535BAAC and CECC 30801 molded chips.

PERFORMANCE CHARACTERISTICS

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

Capacitance Range: 1μF to 1000μF

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

Voltage Rating: 4WVDC to 10WVDC, (16WVDC, 20WVDC, and 25WVDC under development)

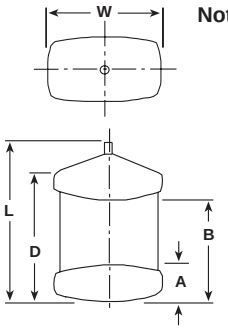
ORDERING INFORMATION

591D	477	X0	6R3	W	2	T
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING @ + 85°C	CASE CODE	TERMINATION	REEL SIZE AND PACKAGING
	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	**X0 = ± 20%** X9 = ± 10%	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 volts).	See Ratings and Case Codes Table.	2 = Solderable Coating.	**T = Tape and Reel 7" [178mm] Reel** W = 13" [330mm] Reel

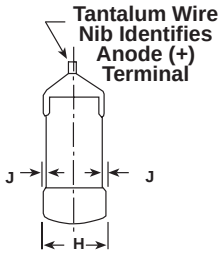
Note: Preferred Tolerance and reel sizes are in bold.

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]



Note: U, V and W are similar to C, D and R footprint (592D) with a 2mm height



CASE CODE	L (MAX.)	W	H	A	B	D (REF.)	J (MAX.)
A	0.146 [3.7]	0.072 ± 0.010 [1.8 ± 0.3]	0.047 ± 0.008 [1.2 ± 0.3]	0.031 ± 0.012 [0.80 ± 0.30]	0.085 ± 0.015 [2.2 ± 0.4]	0.115 [2.9]	0.004 [0.1]
B	0.158 [4.0]	0.110 + 0.012 - 0.016 [2.8 + 0.3 - 0.4]	0.047 ± 0.008 [1.2 ± 0.3]	0.031 ± 0.012 [0.80 ± 0.30]	0.097 ± 0.015 [2.5 ± 0.4]	0.127 [3.2]	0.004 [0.1]
C	0.281 [7.1]	0.126 ± 0.010 [3.2 ± 0.3]	0.047 ± 0.008 [1.2 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.180 ± 0.025 [4.6 ± 0.6]	0.236 [6.0]	0.004 [0.1]
D	0.293 [7.5]	0.170 ± 0.010 [4.3 ± 0.3]	0.047 ± 0.008 [1.2 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.180 ± 0.025 [4.6 ± 0.6]	0.253 [6.4]	0.004 [0.1]
R	0.285 [7.2]	0.235 ± 0.012 [6.0 ± 0.3]	0.047 ± 0.008 [1.2 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.180 ± 0.025 [4.6 ± 0.6]	0.243 [6.2]	0.004 [0.1]
U	0.281 [7.1]	0.126 ± 0.010 [3.2 ± 0.3]	0.079 [2.0] Max.	0.051 ± 0.012 [1.3 ± 0.3]	0.180 ± 0.025 [4.6 ± 0.6]	0.236 [6.0]	0.004 [0.1]
V	0.293 [7.5]	0.170 ± 0.010 [4.3 ± 0.3]	0.079 [2.0] Max.	0.051 ± 0.012 [1.3 ± 0.3]	0.180 ± 0.025 [4.6 ± 0.6]	0.253 [6.4]	0.004 [0.1]
W	0.285 [7.2]	0.235 ± 0.010 [6.0 ± 0.3]	0.079 [2.0] Max.	0.051 ± 0.012 [1.3 ± 0.3]	0.180 ± 0.025 [4.6 ± 0.6]	0.243 [6.2]	0.004 [0.1]

Note: The anode termination (D less B) will be a minimum of .010" [0.3mm].

For technical questions, contact tantalum@vishay.com

RATINGS AND CASE CODES

µF	4 V		6.3 V		10 V		16 V		20 V		25 V		35 V	
	STD	EXT	STD	EXT	STD	EXT	STD	EXT	STD	EXT	STD	EXT	STD	EXT
1													B	A
2.2											B	A	C	B
3.3											C	B	D	C
4.7								A	B	A	C		R	
6.8							B	A	C	B	D	C	R	D
10					B	A	C	B	D	B	R	D		R
15			B	A			D	B	R	C	U*	R	V*	
22	B	A		B	C	B	D	C	R/V*	D	V*		V*	
33			C	B	D	C	R	C/D	V*	R	V*			
47	C	B	D	C	R	D	U	R						
68	D	C	R	D	R/U	C/D	V*	U*						
100	R	D	R	C	U	D	V							
150		C/R	U	D/R	V	U	W							
220	U		V	R/U		V/W								
330	V	U	W	U/V		W								
470	W	U/V		V/W										
680		V/W		W										
1000		W												

STANDARD / EXTENDED RATINGS

CAPACITANCE (µF)	CASE CODE	PART NUMBER*	Max. DCL @ + 25°C (µA)	Max. DF @ + 25°C 120 Hz (%)	Max. ESR @ + 25°C 100kHz (Ohms)	Max. RIPPLE 100kHz Irms (Amps)
4 WVDC @ + 85°C, SURGE = 5.2 V . . . 2.7 WVDC @ + 125°C, SURGE = 3.4 V						
22	**A**	**591D226X_004A2T**	**0.9**	**6**	**1.200**	**0.22**
22	B	591D226X_004B2T	0.9	6	0.800	0.32
47	**B**	**591D476X_004B2T**	**1.9**	**6**	**0.800**	**0.33**
47	C	591D476X_004C2T	1.9	6	0.200	0.74
68	**C**	**591D686X_004C2T**	**2.7**	**6**	**0.180**	**0.78**
68	D	591 D686X_004D2T	2.7	6	0.140	1.04
100	**D**	**591D107X_004D2T**	**4.0**	**8**	**0.130**	**1.07**
100	R	591D107X_004R2T	4.0	8	0.110	1.22
150	**C**	**591D157X_004C2T**	**6.0**	**8**	**0.150**	**0.86**
150	**R**	**591D157X_004R2T**	**6.0**	**8**	**0.100**	**1.28**
220	U	591D227X_004U2T	8.8	8	0.075	1.21
330	V	591D337X_004V2T	13.2	8	0.060	1.53
330	**U**	**591D337X_004U2T**	**13.2**	**8**	**0.070**	**1.25**
470	W	591D477X_004W2T	18.8	8	0.045	1.97
470	**U**	**591D477X_004U2T**	**18.8**	**10**	**0.07**	**1.25**
470	**V**	**591D477X_004V2T**	**18.8**	**10**	**0.060**	**1.52**
680	**V**	**591D687X_004V2T**	**27.2**	**12**	**0.085**	**1.28**
680	**W**	**591D687X_004W2T**	**27.2**	**12**	**0.045**	**1.97**
1000	**W**	**591D108X_004W2T**	**40.0**	**14**	**0.050**	**1.67**
6.3 WVDC @ + 85°C, SURGE = 8 V . . . 4 WVDC @ + 125°C, SURGE = 5 V						
15	**A**	**591D156X_6R3A2T**	**0.9**	**6**	**1.300**	**0.24**
15	B	591D156X_6R3B2T	0.9	6	0.800	0.32
22	**B**	**591D226X_6R3B2T**	**1.4**	**6**	**0.800**	**0.32**
33	**B**	**591D336X_6R3B2T**	**2.1**	**6**	**0.800**	**0.32**
33	C	591D336X_6R3C2T	2.1	6	0.200	0.74
47	**C**	**591D476X_6R3C2T**	**3.0**	**6**	**0.200**	**0.74**
47	D	591D476X_6R3D2T	3.0	6	0.140	1.04
68	**D**	**591D686X_6R3D2T**	**4.0**	**6**	**0.130**	**1.07**
68	R	591D686X_6R3R2T	4.0	6	0.110	1.22
100	**C**	**591D107X_6R3C2T**	**6.0**	**8**	**0.19**	**0.76**
100	R	591D107X_6R3R2T	6.0	8	0.100	1.28
150	**D**	**591D157X_6D3U2T**	**9.5**	**8**	**0.19**	**0.88**
150	**R**	**591D157X_6R3U2T**	**9.5**	**8**	**0.14**	**1.08**
150	U	591D157X_6R3U2T	9.5	8	0.080	1.17
220	**R**	**591D227X_6R3R2T**	**13.9**	**8**	**0.15**	**1.05**
220	V	591D227X_6R3V2T	13.9	8	0.065	1.47
220	**U**	**591D227X_6R3U2T**	**13.9**	**8**	**0.075**	**1.21**
330	W	591D337X_6R3W2T	20.8	8	0.045	1.97
330	**V**	**591D337X_6R3V2T**	**20.8**	**8**	**0.060**	**1.52**
330	**U**	**591D337X_6R3U2T**	**20.8**	**8**	**0.07**	**1.25**
470	**W**	**591D477X_6R3W2T**	**29.6**	**10**	**0.045**	**1.97**
470	**V**	**591D477X_6R3V2T**	**29.6**	**10**	**0.085**	**1.28**
680	**W**	**591D687X_6R3W2T**	**42.8**	**10**	**0.060**	**1.87**

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

STANDARD / EXTENDED RATINGS

CAPACITANCE (μF)	CASE CODE	PART NUMBER**	Max. DCL @ + 25°C (μA)	Max. DF @ + 25°C 120 Hz (%)	Max. ESR @ + 25°C 100kHz (Ohms)	Max. RIPPLE 100kHz Irms (Amps)
10 WVDC @ + 85°C, SURGE = 13 V . . . 7 WVDC @ + 125°C, SURGE = 8 V						
10	**A**	**591D106X_010A2T**	**1.0**	**6**	**1.300**	**0.24**
10	B	591D106X_010B2T	1.0	6	0.850	0.31
22	**B**	**591D226X_010B2T**	**2.2**	**6**	**0.800**	**0.32**
22	C	591D226X_010C2T	2.2	6	0.200	0.74
33	**C**	**591D336X_010C2T**	**3.3**	**6**	**0.200**	**0.74**
33	D	591D336X_010D2T	3.3	6	0.140	1.04
47	**D**	**591D476X_010D2T**	**4.7**	**6**	**0.140**	**1.04**
47	R	591D476X_010R2T	4.7	6	0.120	1.17
68	**C**	**591D686X_010C2T**	**6.8**	**6**	**0.190**	**0.76**
68	**D**	**591D686X_010D2T**	**6.8**	**6**	**0.130**	**1.15**
68	R	591D686X_010R2T	6.8	6	0.110	1.22
68	U	591D686X_010U2T	6.8	6	0.100	1.04
100	**D**	**591D107X_010D2T**	**10.0**	**8**	**0.130**	**1.07**
100	U	591D107X_010U2T	10.0	8	0.085	1.13
150	V	591D157X_010V2T	15.0	8	0.075	1.37
150	**U**	**591D157X_010U2T**	**15.0**	**8**	**0.080**	**1.17**
220	**W**	**591D227X_010W2T**	**22.0**	**8**	**0.055**	**1.78**
220	**V**	**591D227X_010V2T**	**22.0**	**8**	**0.065**	**1.47**
330	**W**	**591D337X_010W2T**	**33.0**	**8**	**0.050**	**1.87**
16 WVDC @ + 85°C, SURGE = 20 V . . . 10 WVDC @ + 125°C, SURGE = 12 V						
4.7	**A**	**591D475X_016A2T**	**0.8**	**6**	**1.750**	**0.19**
6.8	**A**	**591D685X_016A2T**	**1.1**	**6**	**1.750**	**0.19**
6.8	B	591D685X_016B2T	1.1	6	0.900	0.30
10	**B**	**591D106X_016B2T**	**1.6**	**6**	**0.800**	**0.32**
10	C	5910106X_016C2T	1.6	6	0.500	0.45
15	**B**	**591D156X_016B2T**	**2.4**	**6**	**0.700**	**0.34**
15	D	591D156X_016D2T	2.4	6	0.250	0.77
22	**C**	**591D226X_016C2T**	**3.5**	**6**	**0.240**	**0.67**
22	D	591D226X_016D2T	3.5	6	0.180	0.91
33	**C**	**591D336X_016C2T**	**5.3**	**6**	**0.250**	**0.66**
33	**D**	**591D336X_016D2T**	**5.3**	**6**	**0.170**	**0.94**
33	R	591D336X_016R2T	5.3	6	0.140	1.08
47	**R**	**591D476X_016R2T**	**7.5**	**6**	**0.130**	**1.12**
47*	U*	591D476X_016U2T*	7.5*	6*	0.180*	0.78*
68	V	591D686X_016V2T	10.9	6	0.080	1.32
68	**U**	**591D686X_016U2T**	**10.9**	**6**	**0.100**	**1.05**
100	V	591D107X_016V2T	16.0	8	0.075	1.37
150	W	591D157X_016W2T	24.0	8	0.060	1.71
20 WVDC @ + 85°C, SURGE = 26 V . . . 13 WVDC @ + 125°C, SURGE = 16 V						
4.7	**A**	**591D475X_020A2T**	**0.9**	**6**	**1.900**	**0.18**
4.7	B	591D475X_020B2T	0.9	6	1.600	0.22
6.8	**B**	**591D685X_020B2T**	**1.4**	**6**	**1.600**	**0.22**
6.8	C	591D685X_020C2T	1.4	6	0.400	0.52
10	**B**	**591D106X_020B2T**	**2.0**	**6**	**1.500**	**0.23**
10	D	591D106X_020D2T	2.0	6	0.270	0.75
15	**C**	**591D156X_020C2T**	**3.0**	**6**	**0.300**	**0.60**
15	R	591D156X_020R2T	3.0	6	0.180	0.91
22	**D**	**591D226X_020D2T**	**4.4**	**6**	**0.200**	**0.87**
22	R	5910226X_020R2T	4.4	6	0.140	1.09
22	U	5910226X_020U2T	4.4	6	0.375	0.54
33	**R**	**591D336X_020R2T**	**6.6**	**6**	**0.140**	**1.08**
33	V	591D336X_020V2T	6.6	6	0.200	0.73

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

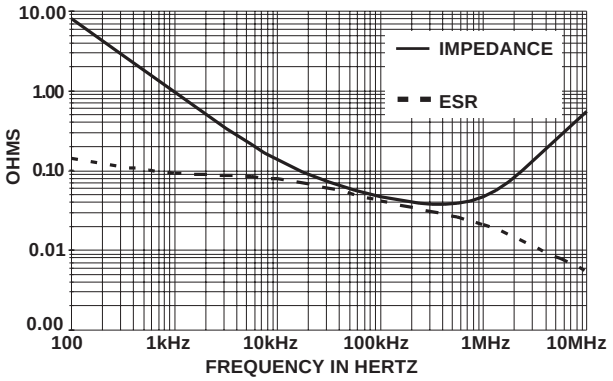
STANDARD / EXTENDED RATINGS

CAPACITANCE (μF)	CASE CODE	PART NUMBER**	Max. DCL @ + 25°C (μA)	Max. DF @ + 25°C 120 Hz (%)	Max. ESR @ + 25°C 100kHz (Ohms)	Max. RIPPLE 100kHz Irms (Amps)
25 WVDC @ + 85°C, SURGE = 33 V . . . 17 WVDC @ + 125°C, SURGE = 20 V						
2.2	**A**	**591D225X_025A2T**	**0.6**	**6**	**5.000**	**0.11**
2.2	B	591D225X_025B2T	0.6	6	3.800	0.15
3.3	**B**	**591D335X_025B2T**	**0.8**	**6**	**3.700**	**0.15**
3.3	C	591D335X_025C2T	0.8	6	1.000	0.32
4.7	C	591 D475X_025C2T	1.2	6	0.800	0.37
6.8	**C**	**591D685X_025C2T**	**1.7**	**6**	**0.750**	**0.38**
6.8	D	591D685X_025D2T	1.7	6	0.650	0.48
10	**D**	**591D106X_025D2T**	**2.5**	**6**	**0.600**	**0.50**
10	R	591D106X_025R2T	2.5	6	0.240	0.83
15	**R**	**591D156X_025R2T**	**3.8**	**6**	**0.200**	**0.91**
15*	U*	591D156X_025U2T*	3.8*	6*	0.250*	0.66*
22*	V*	591D226X_025V2T*	5.5*	6*	0.200*	0.84*
33*	V*	591D336X_025V2T*	6.0*	6*	0.200*	0.84*
35 WVDC @ + 85°C, SURGE = 46 V . . . 23 WVDC @ + 125°C, SURGE = 28 V						
1	**A**	**591D105X_035A2T**	**0.5**	**4**	**5.000**	**0.11**
1	B	591D105X_035B2T	0.5	4	4.400	0.13
2.2	**B**	**591D225X_035B2T**	**0.8**	**6**	**4.000**	**0.14**
2.2	C	591D225X_035C2T	0.8	6	2.000	0.22
3.3	**B**	**591D335X_035B2T**	**1.2**	**6**	**3.500**	**0.15**
3.3	**C**	**591D335X_035C2T**	**1.2**	**6**	**1.900**	**0.23**
3.3	D	591D335X_035D2T	1.2	6	1.500	0.32
4.7	R	591 D475X_035R2T	1.6	6	0.750	0.47
6.8	**D**	**591D685X_035D2T**	**2.4**	**6**	**0.950**	**0.40**
6.8	R	591D685X_035R2T	2.4	6	0.750	0.47
10	**R**	**591D106X_035R2T**	**3.5**	**6**	**0.600**	**0.52**

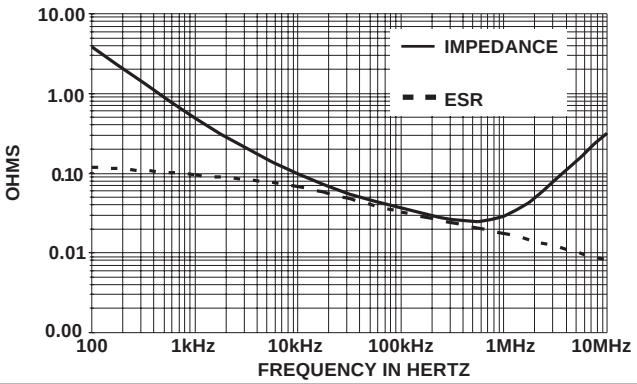
* Preliminary values contact factory for availability. For 10% tolerance, specify "9"; for 20% tolerance, change to "0". **Extended ratings are in bold print.**

TYPICAL CURVES OF ESR - AS A FUNCTION OF FREQUENCY

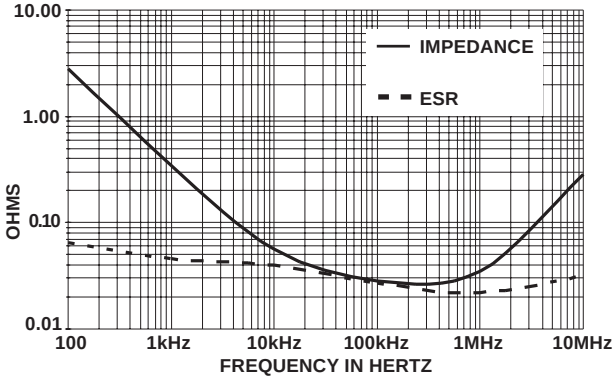
591D 150 - 10V U CASE ESR/IMPEDANCE VS FREQUENCY



591D 330 - 6.3V V CASE ESR/IMPEDANCE VS FREQUENCY

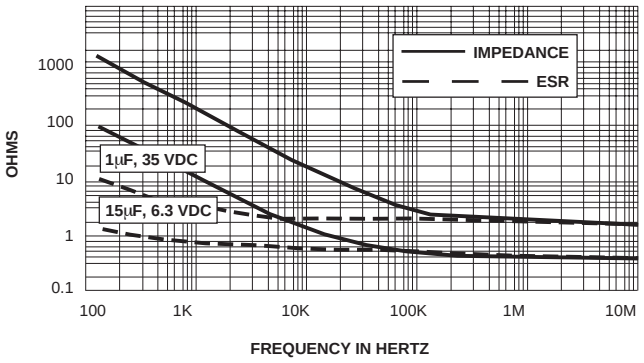


591D 470 - 6.3V W CASE ESR/IMPEDANCE VS FREQUENCY

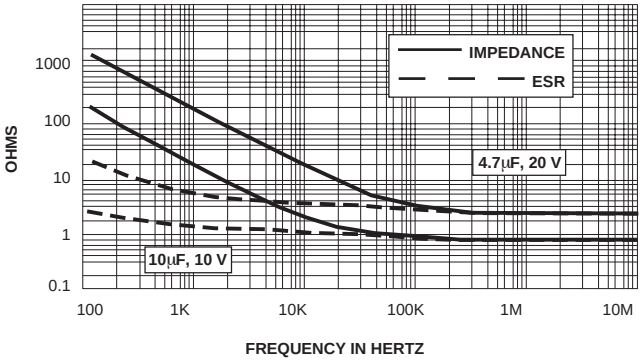


TYPICAL CURVES @ + 25°C, IMPEDANCE AND ESR VS FREQUENCY

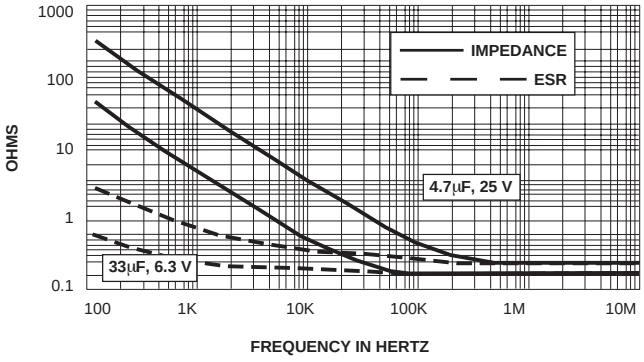
"A" Case



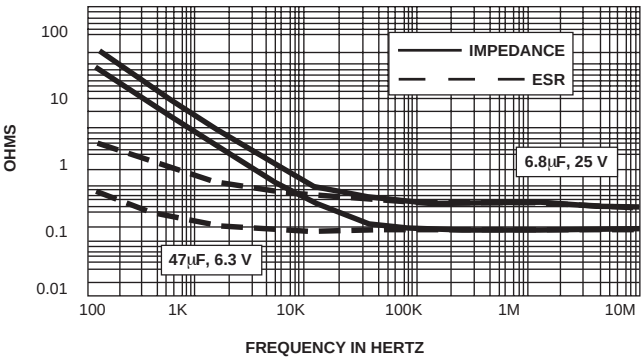
"B" Case



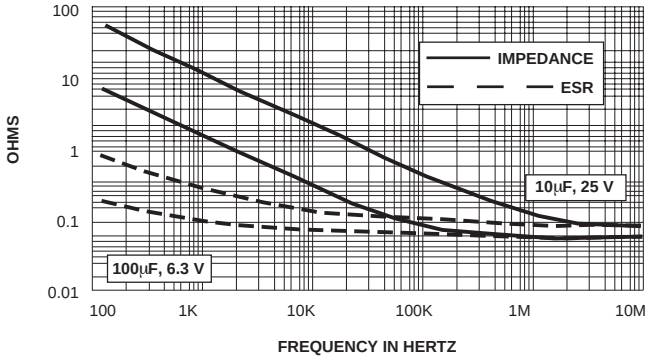
"C" Case



"D" Case



"R" Case



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	2.7	3.4
6.3	8	4	5
10	13	7	8
16	20	10	12
20	26	13	16
25	32	17	20

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 ± 10%.

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%

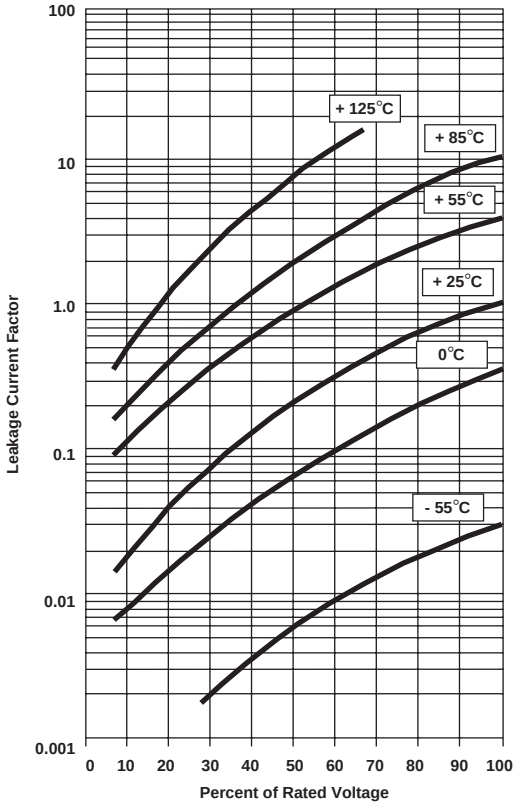
6. **Dissipatior Factor:** The dissipatior factor, determined from the expression 2πRC, shall not exceed values listed in the Standard Ratings Table.

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

7. **Leakage Current:** Capacitors shall be stabilized at the rated temperature for 30 minutes. Rated voltage shall be 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 not 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,** the leakage current shall not exceed the value listed in the Standard Ratings Table.

7.2 **At + 85°C,** the leakage current shall not exceed 10 times the value listed in the Standard Ratings Table.

7.3 **At + 125°C,** the leakage current shall not exceed 12 times the value listed in the Standard Ratings Table.

8. **Equivalent Series Resistance:** Measurements shall be made by the bridge method at, or referred to, a frequency of 100 KHz and a temperature of + 25°C.

8.1 The Equivalent Series Resistance shall not exceed the value listed in the Standard Ratings Table.

9. **Life Test:** Capacitors shall withstand rated DC voltage applied at + 85°C for 2000 hours or derated DC voltage applied at + 125°C for 1000 hours.

9.1 Following the life test, the dissipation factor and leakage shall meet the initial requirement; the capacitance change shall not exceed ± 10% of the initial value.

10 **Humidity Test:** Capacitors shall withstand 1000 hours at + 40°C, 90% to 95% relative humidity, with no voltage applied

10.1 Following the humidity test, capacitance change shall not exceed ± 10% of the initial value, dissipation factor shall not exceed 150% of the initial requirement; leakage currrent shall not exceed 200% of the initial requirement at + 25°C

11. **Solderability:** Capacitors will meet the solderability requirements of ANSI/J-STD-002, test B category 1.

12. **Resistance to Soldering Heat:** Capacitors mounted on a substrate will withstand + 260°C for 5 seconds.

12.1 Following the resistance to soldering heat test, capacitance, dissipation factor and DC leakage current shall meet the initial requirement.

13. **Marking:** The small body area of these capacitors does not allow elaborate marking schemes. All required information is present on the carton or package in which the parts are shipped; in addition, part number, quantity and data code are indicated on the reels.

14. **Terminal Strength:** Per IEC-384-3, minimum of 5N shear force.

15. **Environmental:** Mercury, CFC and ODS materials are not used in the manufacture of these capacitors.

16. **Flammability:** Encapsulant materials meet UL94 V0

17. **Capacitor Failure Mode:** The predominant failure mode for solid tantalum capacitors is increased leakage current resulting in a shorted circuit. Capacitor failure may result from excess forward or reverse DC voltage, surge current, ripple current, thermal shock or excessive temperature.

The increase in leakage is caused by a breakdown of the Ta_2O_5 dielectric. For additional information on leakage failure of solid tantalum chip capacitors, refer to Vishay Sprague Technical Paper, “Leakage Failure Mode in Solid Tantalum Chip Capacitors.”

GUIDE TO APPLICATION

1.0 **Recommended rated working voltage guidelines:** (-55°C to + 85°C)

Application Voltage (V)	Recommended Capacitor Voltage Rating (V)
2.5	4
4	6.3
5	8
6	10
10	16
12	20
18	25

2. **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 6.0 (Power Dissipation)

R_{ESR} = The capacitor Equivalent Series Resistance at the specified frequency.

3. **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:

where, $$V_{rms} = I_{rms} \times Z$$

P = Power Dissipation in Watts @ + 25°C as given in the table in Paragraph Number 6.0 (Power Dissipation).

R_{ESR} = The capacitor Equivalent Series Resistance at the specified frequency.

GUIDE TO APPLICATION

4.0 Reverse Voltage: These capacitors are capable of withstanding peak voltages in the reverse direction equal to 10% of the DC rating or 1 volt maximum at + 25°C and 5% of the DC voltage rating or 0.5 volt maximum at + 85°C.

5.0 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:

Temperature	Derating Factor
+ 25°C	1.0
+ 85°C	0.9
+ 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 *Irms* 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	0.075
B	0.085
C	0.110
D	0.150
R	0.165
U	0.110
V	0.140
W	0.175

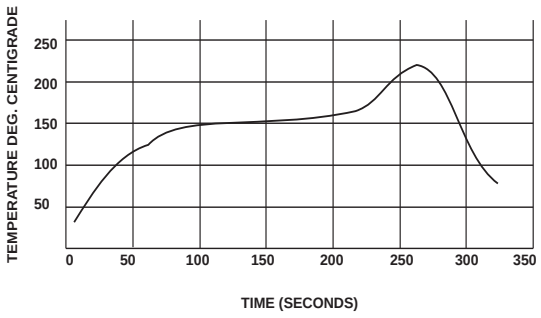
6. Printed Circuit Board Materials: The capacitors are compatible with most commonly used printed circuit board materials (alumina substrates, FR4, FR5, G10, PTFE-fluorocarbon and porcelanized steel). If your desired board material is not shown there please contact the Tantalum Marketing Department for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

7. Attachment:

7.1 Solder Paste: The recommended thickness of the solder paste after application is 0.007" ± 0.001" [0.178mm ± 0.025mm]. 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.

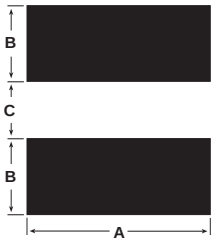
7.2 Soldering: Capacitors can be attached by conventional soldering techniques - convection, infrared reflow, wave soldering and hot plate methods. The Soldering Profile chart shows typical recomended time/temperature conditions for soldering. Attachment with a soldering iron is not recommended due to the difficulty of controlling temperature and time at temperature. The soldering iron must never come in contact with the capacitor.

RECOMMENDED REFLOW SOLDERING PROFILE



7.1 Recommended Mounting Pad Geometries: 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]

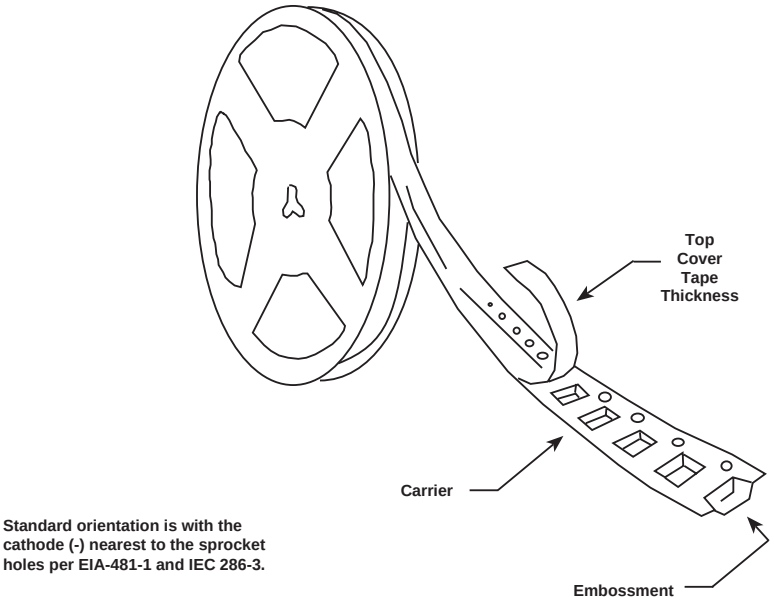


CASE CODE	WIDTH (A)	PAD METALIZATION	SEPARATION (C)
A	0.083 [2.1]	0.067 [1.7]	0.050 [1.3]
B	0.138 [3.5]	0.067 [1.7]	0 .067 [1.7]
C	0.138 [3.5]	0.090 [2.3]	0.127 [3.1]
D	0.180 [4.6]	0.090 [2.3]	0.145 [3.7]
R	0.322 [8.1]	0.090 [2.3]	0.145 [3.7]
U	0.138 [3.5]	0.090 [2.3]	0.122 [3.1]
V	0.180 [4.6]	0.090 [2.3]	0.145 [3.7]
W	0.327 [8.3]	0.090 [2.3]	0.145 [3.7]

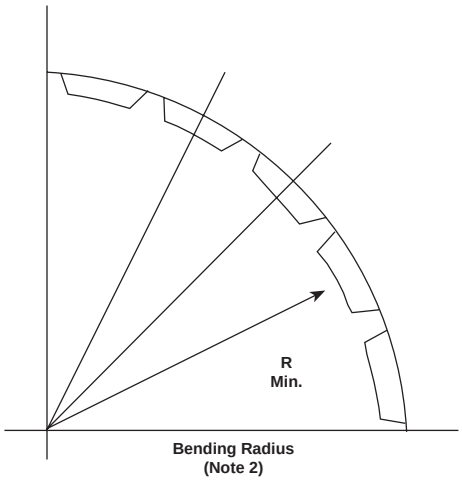
* Pads for B, C and D case codes are otherwise pad compatible with
* Type 293D, B, C and D case codes respectively.

8. Cleaning (Flux Removal) After Soldering: The capacitors are compatible with all commonly used solvents such as TES, TMS, Prelete, Chlorethane, Terpene and aqueous cleaning media. Solvents containing methylene chloride or other epoxy solvents should be avoided since these will attack the epoxy encapsulation material.

TAPE AND REEL PACKAGING



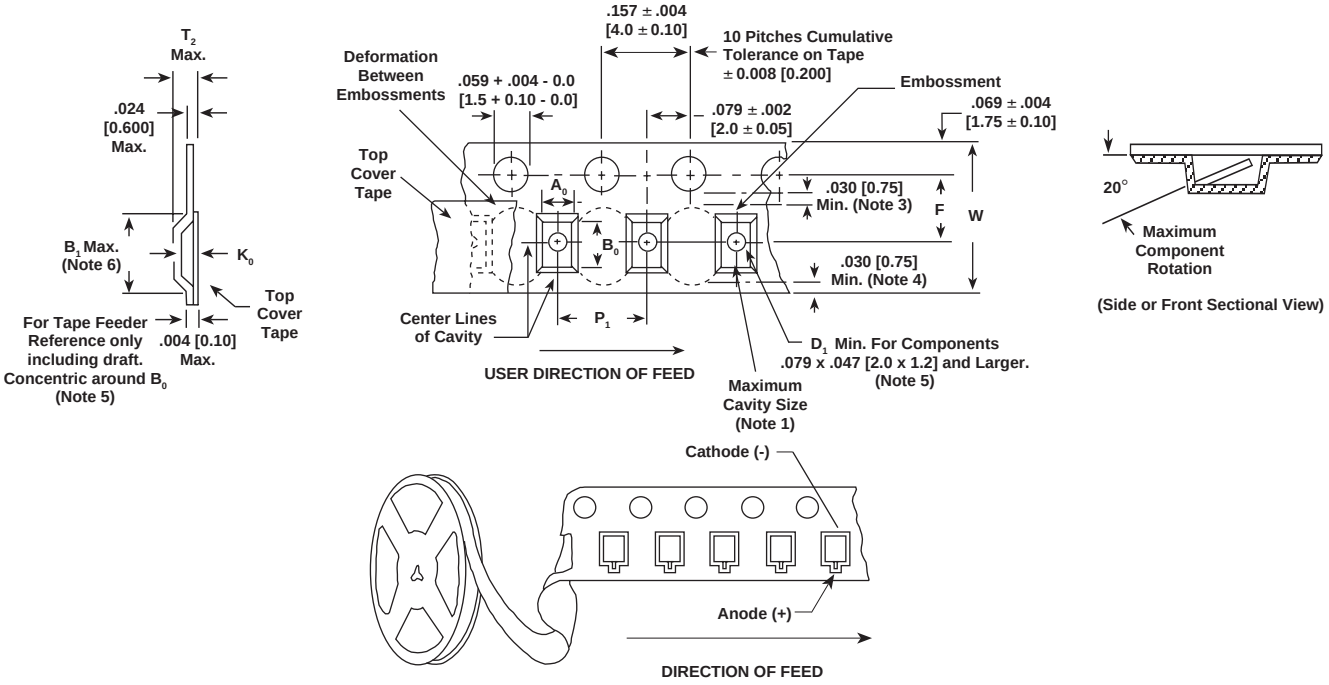
Standard orientation is with the cathode (-) nearest to the sprocket holes per EIA-481-1 and IEC 286-3.

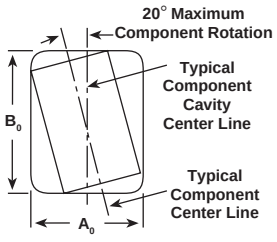


Case Code	Tape Width	Component Pitch	Units Per Reel	
			7" [178] Reel	13" [330] Reel
A	8mm	4mm	2500	10,000
B	12mm	4mm	2000	8000
C	12mm	8mm	1000	4000
D	12mm	8mm	1000	4000
R	12mm	8mm	1000	4000
U	12mm	8mm	1000	4000
V	12mm	8mm	1000	4000
W	12mm	8mm	1000	2500

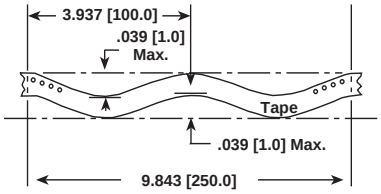
TAPE AND REEL PACKAGING in inches [millimeters]

Please Note: Metric dimensions will govern. Dimensions in inches are rounded and for reference only.





(Top View)



Camber
(Top View)
Allowable Camber to be .039/3.937 [1/100]
Non-Cumulative Over 9.843 [250.0]

Tape and Reel Specifications: All case sizes are available on plastic embossed tape per EIA-481-1. Tape reeling per IEC 286-3 is also available. Standard reel diameter is 7" [178mm]. 13" [330mm] reels are available and recommended as the most cost effective packaging method.

The most efficient packaging quantities are full reel increments on a given reel diameter. The quantities shown allow for the sealed empty pockets required to be in conformance with EIA-481-1. Reel size and packaging orientation must be specified in the Vishay Sprague part number.

TAPE SIZE	B_1 (Max.) (Note 6)	D_1 (Min.) (Note 5)	F	P_1	R (Min.) (Note 2)	T_2 (Max.)	W	$A_0 B_0 K_0$
8mm	0.179 [4.55]	0.039 [1.0]	0.138 ± 0.002 [3.5 ± 0.05]	0.157 ± 0.004 [4.0 ± 0.10]	0.984 [25.0]	0.098 [2.5]	0.315 + 0.012 - 0.004 [8.0 + 0.3 - 0.1]	(Note 1)
12mm	0.323 [8.2]	0.059 [1.5]	0.217 ± 0.002 [5.5 ± 0.05]	0.157 ± 0.004 [4.0 ± 0.10]	1.181 [30.0]	0.256 [6.5]	0.472 ± 0.012 [12.0 ± 0.30]	
12mm Double Pitch	0.323 [8.2]	0.059 [1.5]	0.453 ± 0.004 [11.5 ± 0.03]	0.315 ± 0.004 [8.0 ± 0.10]	1.181 [30.0]	0.256 [6.5]	0.945 ± 0.012 [24.0 ± 0.03]	

Notes:

1. $A_0 B_0 K_0$ are determined by the maximum dimensions to the ends of the terminals extending from the component body and/or the body dimensions of the component. The clearance between the ends of the terminals or body of the component to the sides and depth of the cavity ($A_0 B_0 K_0$) must be within .002" [0.05mm] minimum and .020" [0.50mm] maximum. The clearance allowed must also prevent rotation of the component within the cavity of not more than 20 degrees.
2. Tape with components shall pass around radius "R" without damage. The minimum trailer length may require additional length to provide R minimum for 12mm embossed tape for reels with hub diameters approaching N minimum.
3. This dimension is the flat area from the edge of the sprocket hole to either the outward deformation of the carrier tape between the embossed cavities or to the edge of the cavity whichever is less.
4. This dimension is the flat area from the edge of the carrier tape opposite the sprocket holes to either the outward deformation of the carrier tape between the embossed cavity or to the edge of the cavity whichever is less.
5. The embossment hole location shall be measured from the sprocket hole controlling the location of the embossment. Dimensions of embossment location and hole location shall be applied independent of each other.
6. B_1 dimension is a reference dimension for tape feeder clearance only.