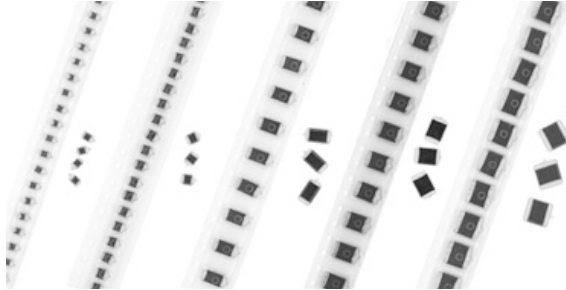


Solid Tantalum Chip Capacitors

TANTAMOUNT[®], Low Profile, Conformal Coated, Maximum CV



FEATURES

- New robust 6.3 V ratings for battery operated wireless applications.
- New extended range offerings.
- 1.0 mm to 2.5 mm height.
- Terminations: Lead (Pb)-free (2) standard.
- Low Impedance
- 8 mm, 12 mm tape and reel packaging available per EIA-481-1 and reeling per IEC 286-3. 7" [178 mm] standard. 13" [330 mm] available.
- Case code 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: 1.0 µF to 3300 µF

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

Voltage Rating: 4 WVDC to 35 WVDC

ORDERING INFORMATION							
592D	106	X0	010	B	2	T	15H
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	TERMINATION	REEL SIZE AND PACKAGING	SUFFIX
	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 = 100 % Tin 4 = Gold Plated 8 = Solder Plated 60/40 Special Order	T = Tape and Reel 7" [178 mm] Reel W = 13" [330 mm] Reel	Maximum Height (mm) See Dimensions
<p>Note: Preferred Tolerance and reel sizes are in bold.</p> <p>We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size.</p> <p>Voltage substitutions will be marked with the higher voltage rating.</p>							

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DIMENSIONS in inches [millimeters]								
CASE CODE	SUFFIX	H	L (Max.)	W	A	B	D (Ref.)	J (Max.)
A	15H	0.047 ± 0.012 [1.2 ± 0.3]	0.146 [3.7]	0.072 ± 0.012 [1.8 ± 0.3]	0.031 ± 0.012 [0.80 ± 0.3]	0.087 ± 0.016 [2.2 ± 0.4]	0.115 [2.9]	0.004 [0.1]
B	15H	0.047 ± 0.012 [1.2 ± 0.3]	0.158 [4.0]	0.110 ± 0.012 [2.8 ± 0.3]	0.031 ± 0.012 [0.80 ± 0.3]	0.097 ± 0.016 [2.5 ± 0.4]	0.139 [3.5]	0.004 [0.1]
B	20H	0.079 [2.0] Max						
C	15H	0.047 ± 0.012 [1.2 ± 0.3]	0.281 [7.1]	0.126 ± 0.012 [3.2 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.180 ± 0.024 [4.4 ± 0.6]	0.238 [6.0]	0.004 [0.1]
C	20H	0.079 [2.0] Max						
D	15H	0.047 ± 0.012 [1.2 ± 0.3]	0.298 [7.5]	0.170 ± 0.012 [4.3 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.180 ± 0.024 [4.6 ± 0.6]	0.254 [6.4]	0.004 [0.1]
D	20H	0.079 [2.0] Max						
R	15H	0.047 ± 0.012 [1.2 ± 0.3]	0.285 [7.2]	0.235 ± 0.012 [6.0 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.180 ± 0.024 [4.6 ± 0.6]	0.246 [6.2]	0.004 [0.1]
R	20H	0.079 [2.0] Max						
S	13H	0.040 ± 0.012 [1.0 ± 0.3]	0.126 ± 0.012 [3.2 ± 0.3]	0.063 ± 0.012 [1.6 ± 0.3]	0.031 ± 0.012 [0.8 ± 0.3]	0.079 ± 0.012 [2.0 ± 0.3]	0.087 [2.2]	0.004 [0.1]
X	20H	0.079 [2.0] Max	0.575 [14.5]	0.290 ± 0.010 [7.37 ± 0.25]	0.051 ± 0.016 [1.3 ± 0.4]	0.470 ± 0.024 [11.9 ± 0.6]	0.524 [13.2]	0.004 [0.1]
X	25H	0.098 [2.5] Max						

Note: The anode termination (D less B) will be a minimum of 0.012" [0.3 mm].

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
1.0													B	A
1.5													B	
2.2											B	A	C	B*
3.3											C	B	D	C
4.7								A	B	C			R	
6.8							B	A	C	B	D	C	R	D
10					B	A	C	B	D	B	R	B*/D		R
15			B	A			D	B*	R	C	C*	R		
22	B	A		A/B	C	B	D/B	C	R/C*/B	D	C*/D*			
33		B	B/C	A/S	D/B*	C	R/B	C/D	D*	R				
47	C	B*	C/D	A/B	R/B	D	C	R/B*						
68	D	B/C	D/B/R	C	D/R/C*	C/B	D	C						
100	R/B	C/D	D/R	C/B	D/C	B/R	D	C*						
150	D/R	C/B	D/C	R	D*	C	R*							
220	C/D	R	D	D/R/C	D	C/D		D						
330	D	R/C	R	R/C/D	D	R								
470	R	C/D		C/D/R										
680		D/R		R										
1000		R		X/R										
1500		X		X										
2200		X		X/X(25H)*										
3300				X										

* Contact factory for availability



STANDARD / EXTENDED RATINGS						
CAPACITANCE (μ F)	CASE CODE	PART NUMBER	Max. DCL at + 25 °C (μ A)	Max. DF at + 25 °C 120 Hz (%)	Max. ESR at + 25 °C 100 kHz (Ohms)	Max. RIPPLE 100 kHz IRMS (Amps)
4 WVDC @ + 85 °C, SURGE = 5.2 V . . . 2.7 WVDC @ + 125 °C, SURGE = 3.4 V						
22	A	592D226X_004A2_15H	0.9	6	2.40	0.16
22	B	592D226X_004B2_15H	0.9	6	1.60	0.22
33	B	592D336X_004B2_15H	1.3	6	1.60	0.22
47*	B*	592D476X_004B2_15H*	1.9*	6*	1.5*	0.23*
47	C	592D476X_004C2_15H	1.9	6	0.40	0.50
68	B	592D686X_004B2_15H	2.7	6	1.40	0.24
68	C	592D686X_004C2_15H	2.7	6	0.35	0.53
68	D	592D686X_004D2_15H	2.7	6	0.27	0.68
100	B	592D107X_004B2_20H	4.0	8	0.20	0.87
100	C	592D107X_004C2_15H	4.0	8	0.45	0.42
100	D	592D107X_004D2_15H	4.0	8	0.35	0.53
100	R	592D107X_004R2_15H	4.0	8	0.26	0.69
100	B	592D107X_004B2_20H	4.0	8	0.45	0.42
150	B	592D157X_004B2_20H	6.0	8	0.20	0.87
150	C	592D157X_004C2_15H	6.0	8	0.45	0.42
150	D	592D157X_004D2_15H	6.0	8	0.36	0.52
150	R	592D157X_004R2_15H	6.0	8	0.25	0.71
150	B	592D157X_004B2_20H	6.0	8	0.45	0.42
220	C	592D227X_004C2_20H	8.3	8	0.20	0.87
220	D	592D227X_004D2_20H	8.3	8	0.20	0.78
220	R	592D227X_004R2_15H	8.3	8	0.19	0.76
330	C	592D337X_004C2_15H	13.2	8	0.12	1.08
330	D	592D337X_004D2_15H	13.2	8	0.18	0.91
330	R	592D337X_004R2_15H	13.2	8	0.15	0.86
470	D	592D477X_004D2_15H	18.8	8	0.14	0.94
470	C	592D477X_004C2_20H	18.8	8	0.10	1.05
470	D	592D477X_004D2_20H	18.8	8	0.10	1.18
470	R	592D477X_004R2_20H	18.8	10	0.10	1.32
680	D	592D687X_004D2_20H	27.2	12	0.10	1.32
680	R	592D687X_004R2_20H	27.2	12	0.10	1.18
1000	R	592D108X_004R2_20H	40	14	0.20	0.94
1500	X	592D158X_004X2_20H	60	20	0.04	2.10
2200	X	592D228X_004X2_25H	88	25	0.04	2.30
2200	X	592D228X_004X2_20H	88	25	0.55	2.30
6.3 WVDC @ + 85 °C, SURGE = 8 V . . . 4 WVDC @ + 125 °C, SURGE = 5 V						
15	A	592D156X_6R3A2_15H	0.9	6	2.50	0.15
15	B	592D156X_6R3B2_15H	0.9	6	1.70	0.22
22	B	592D226X_6R3B2_15H	1.4	6	1.50	0.23
22	A	592D226X_6R3A2_13H	1.4	6	1.50	0.20
22	B	592D226X_6R3B2_15H	1.4	6	1.50	0.20
33	A	592D336X_6R3A2_15H	2.1	6	1.70	0.32
33	B	592D336X_6R3B2_15H	2.1	6	1.40	0.24
33	C	592D336X_6R3C2_15H	2.1	6	0.40	0.50
33	S	592D336X_6R3S2_12H	2.1	10	2.00	0.17
33	S	592D336X_6R3S2_13H	2.1	8	1.30	0.24
47	A	592D476X_6R3A2_15H	9.0	8	1.40	0.21
47	B	592D476X_6R3B2_15H	3.0	8	1.40	0.24

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



Solid Tantalum Chip Capacitors
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STANDARD / EXTENDED RATINGS						
CAPACITANCE (μ F)	CASE CODE	PART NUMBER	Max. DCL at + 25 °C (μ A)	Max. DF at + 25 °C 120 Hz (%)	Max. ESR at + 25 °C 100 kHz (Ohms)	Max. RIPPLE 100 KHZ IRMS (Amps)
6.3 WVDC @ + 85 °C, SURGE = 8 V . . . 4 WVDC @ + 125 °C, SURGE = 5 V						
47	C	592D476X_6R3C2_15H	3.0	6	0.40	0.50
47	D	592D476X_6R3D2_15H	3.0	6	0.30	0.65
68	B	592D686X_6R3B2_20H	4.3	6	0.50	0.40
68	B	592D686X_6R3B2_13H	4.3	8	0.60	0.36
68	C	592D686X_6R3C2_15H	4.3	6	0.38	0.51
68	D	592D686X_6R3D2_15H	4.3	6	0.27	0.68
68	R	592D686X_6R3R2_15H	4.3	6	0.20	0.87
100	B	592D107X_6R3B2_15H	4.3	6	0.50	0.40
100	B	592D107X_6R3B2_20H	6.3	8	0.45	0.42
100	C	592D107X_6R3C2_15H	6.3	8	0.38	0.51
100	C	592D107X_6W3C2_15H	6.3	8	0.38	0.51
100	D	592D107X_6R3D2_15H	6.3	8	0.26	0.69
100	R	592D107X_6R3R2_15H	6.3	8	0.20	0.87
100	R	592D107X_6W3R2_15H	6.3	8	0.20	0.87
150	C	592D157X_6R3C2_20H	9.5	8	0.19	0.76
150	D	592D157X_6R3D2_15H	9.5	8	0.25	0.71
150	R	592D157X_6W3R2_15H	9.5	8	0.20	0.87
150	R	592D157X_6R3R2_15H	9.5	8	0.20	0.87
220	C	592D227X_6R3C2_20H	13.9	8	0.15	0.86
220	C	592D227X_6W3C2_20H	13.9	8	0.15	0.86
220	D	592D227X_6R3D2_15H	13.9	8	0.22	0.75
220	D	592D227X_6R3D2_20H	13.9	8	0.12	1.08
220	R	592D227X_6R3R2_15H	13.9	8	0.18	0.91
330	C	592D337X_6R3C2_20H	20.8	8	0.10	1.05
330	D	592D337X_6R3D2_16H	20.8	8	0.10	1.18
330	D	592D337X_6R3D2_20H	20.8	8	0.10	1.18
330	D	592D337X_6W3D2_20H	20.8	8	0.10	1.18
330	R	592D337X_6R3R2_15H	20.8	8	0.18	0.91
330	R	592D337X_6R3R2_20H	20.8	8	0.10	1.32
470	C	592D477X_6R3C2_20H	29.6	14	0.10	1.05
470	D	592D477X_6R3D2_20H	29.6	10	0.10	1.18
470	R	592D477X_6R3R2_20H	29.6	10	0.10	1.32
470	R	592D477X_6W3R2_20H	29.6	10	0.10	1.32
470	R	592D477X_6R3R2_16H	29.6	10	0.10	1.32
680	R	592D687X_6R3R2_20H	42.8	10	0.10	1.87
680	R	592D687X_6R3R2_16H	42.8	10	0.10	1.87
1000	R	592D108X_6R3R2_20H	63	20	0.20	0.94
1000	X	592D108X_6R3X2_20H	63	16	0.04	2.10
1500	X	592D158X_6R3X2_25H	95	20	0.035	2.30
1500	X	592D158X_6W3X2_25H	95	20	0.035	2.30
1500	X	592D158X_6R3X2_20H	95	25	0.045	1.97
2200*	X*	592D228X_6R3X2_25H*	139*	35*	0.055*	1.80*
2200	X	592D228X_6R3X2_20H	139	35	0.055	1.80
3300	X	592D338X_6R3X2_25H	208	35	0.055	1.80

* 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 (μ F)	CASE CODE	PART NUMBER	Max. DCL at + 25 °C (μ A)	Max. DF at + 25 °C 120 Hz (%)	Max. ESR at + 25 °C 100 kHz (Ohms)	Max. RIPPLE 100 kHz IRMS (Amps)
10 WVDC @ + 85 °C, SURGE = 13 V . . . 7 WVDC @ + 125 °C, SURGE = 8 V						
10	A	592D106X_010A2_15H	1.0	6	2.60	0.15
10	B	592D106X_010B2_15H	1.0	6	1.70	0.22
22	B	592D226X_010B2_15H	2.2	6	1.50	0.23
22	C	592D226X_010C2_15H	2.2	6	0.40	0.50
33	C	592D336X_010C2_15H	3.3	6	0.40	0.50
33	D	592D336X_010D2_15H	3.3	6	0.30	0.65
33*	B*	592D336X_010B2_20H*	3.3*	6*	0.50*	0.40*
47	B	592D476X_010B2_20H	4.7	6	0.50	0.68
47	D	592D476X_010D2_15H	4.7	6	0.27	0.87
47	R	592D476X_010R2_15H	4.7	6	0.20	0.40
68	B	592D686X_010B2_20H	6.8	6	0.45	0.84
68	C	592D686X_010C2_15H	6.8	6	0.24	0.68
68*	C*	592D686X_010C2_20H*	6.8*	6*	0.25*	0.66*
68	D	592D686X_010D2_15H	6.8	6	0.27	0.87
68	R	592D686X_010R2_15H	6.8	6	0.20	0.42
100	B	592D107X_010B2T20H	10	12	0.40	0.45
100	C	592D107X_010C2_20H	10	8	0.19	1.11
100	D	592D107X_010D2_15H	10	8	0.10	0.76
100	R	592D107X_010R2_15H	10	6	0.22	0.83
150	C	592D157X_010C2_20H	15	8	0.17	0.80
150	D	592D157X_010D2_20H	15	8	0.14	1.00
220	D	592D227X_010D2_20H	22	8	0.12	1.08
220	R	592D227X_010R2_20H	22	8	0.10	1.32
330	D	592D337X_010D2_20H*	33	8	0.10	1.18
330	R	592D337X_010R2_20H	33	8	0.10	1.32
16 WVDC @ + 85 °C, SURGE = 20 V . . . 10 WVDC @ + 125 °C, SURGE = 12 V						
4.7	A	592D475X_016A2_15H	0.8	6	3.50	0.13
6.8	A	592D685X_016A2_15H	1.1	6	3.30	0.13
6.8	B	592D685X_016B2_15H	1.1	6	1.80	0.21
10	B	592D106X_016B2_15H	1.6	6	1.60	0.22
10	C	592D106X_016C2_15H	1.6	6	1.00	0.32
15*	B*	592D156X_016B2_15H*	2.4*	6*	1.40*	0.24*
15	D	592D156X_016D2_15H	2.4	6	0.50	0.50
22	B	592D226X_016B2_20H	3.5	6	0.60	0.36
22	C	592D226X_016C2_15H	3.5	6	30	0.46
22	D	592D226X_016D2_15H	3.5	6	0.40	0.60
33	B	592D336X_016B2_20H	5.3	6	0.60	0.36
33	C	592D336X_016C2_15H	5.3	6	0.25	0.66
33	D	592D336X_016D2_15H	5.3	6	0.30	0.62
33	R	592D336X_016R2_15H	5.3	6	0.27	0.75
47*	B*	592D476X_016B2_20H*	7.5*	6*	0.45*	0.42*
47	C	592D476X_016C2_20H	7.5	6	0.25	0.66
47	R	592D476X_016R2_15H	7.5	6	0.25	0.77
68*	C*	592D686X_016C2_15H*	10.9*	6*	0.50*	1.20*
68	C	592D686X_016C2_20H	10.9	6	0.25	0.66
68	D	592D686X_016D2_20H	10.9	6	0.17	0.91
100*	C*	592D107X_016C2_15H*	16*	8*	0.30*	1.80*
100	D	592D107X_016D2_15H	16	8	0.15	0.97

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



Solid Tantalum Chip Capacitors
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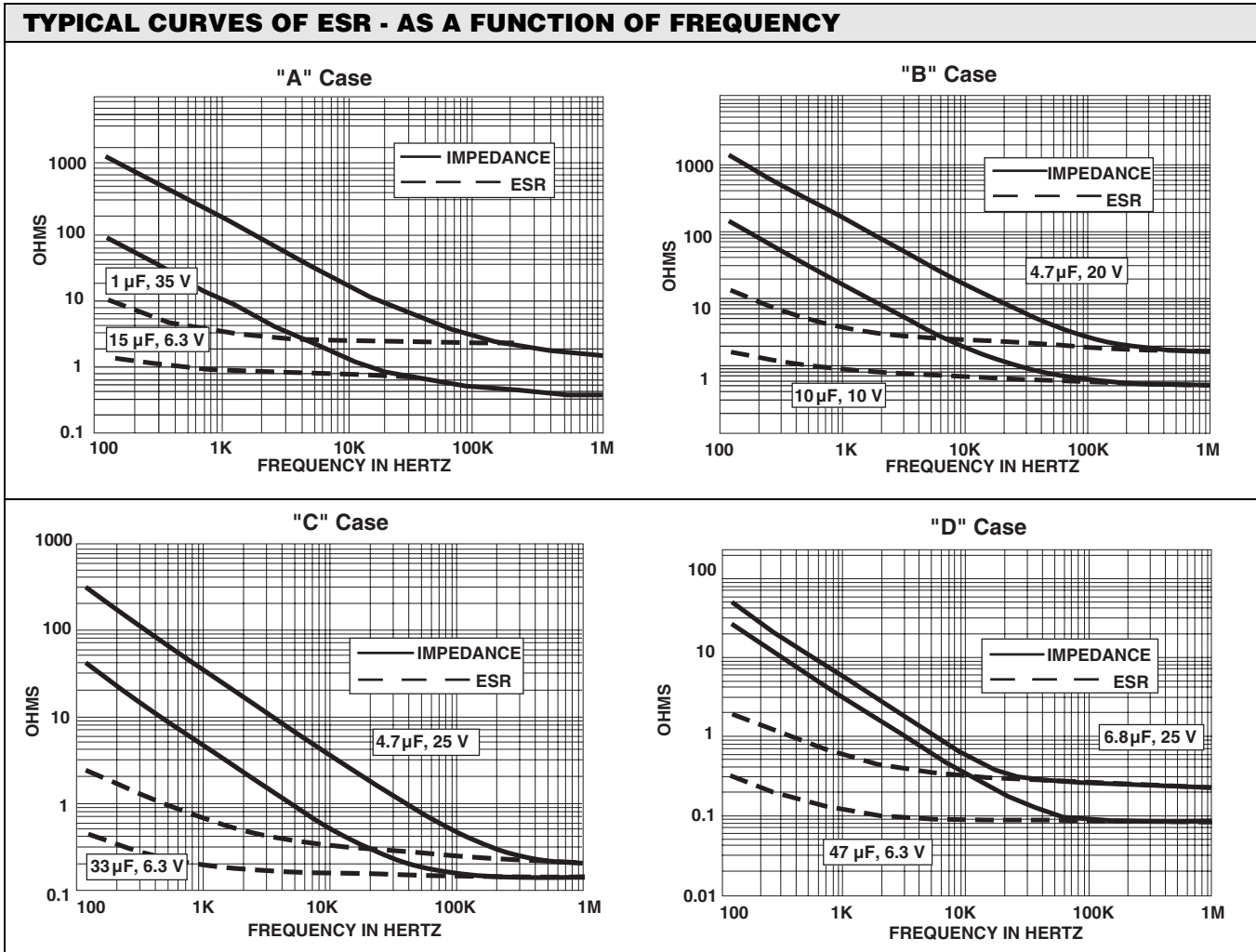
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STANDARD / EXTENDED RATINGS						
CAPACITANCE (μ F)	CASE CODE	PART NUMBER	Max. DCL at + 25 °C (μ A)	Max. DF at + 25 °C 120 Hz (%)	Max. ESR at + 25 °C 100 kHz (Ohms)	Max. RIPPLE 100 kHz IRMS (Amps)
16 WVDC @ + 85 °C, SURGE = 20 V . . . 10 WVDC @ + 125 °C, SURGE = 12 V						
100	D	592D107X_016C2_20H	16	8	0.15	0.97
100	D	592D107X_016D2_20H	16	8	0.15	0.97
150*	R*	592D157X_016R2_20H*	24*	8*	0.10*	1.32*
220	D	592D227X_016D2_15H	35.2	9	0.12	1.30
20 WVDC @ + 85 °C, SURGE = 26 V . . . 13 WVDC @ + 125 °C, SURGE = 16 V						
4.7	A	592D475X_020A2_15H	0.9	6	3.80	0.13
4.7	B	592D475X_020B2_15H	0.9	6	3.20	0.16
6.8*	B*	592D685X_020B2_15H*	1.4*	6*	3.10*	0.16*
6.8	C	592D685X_020C2_15H	1.4	6	1.10	0.30
10	B	592D106X_020B2_15H	2.0	6	3.00	0.16
10	D	592D106X_020D2_15H	2.0	6	0.50	0.48
15	C	592D156X_020C2_15H	3.0	6	0.60	0.42
15	R	592D156X_020R2_15H	3.0	6	0.40	0.65
22	B	592D226X_020B2_20H	4.4	6	0.60	0.37
22*	C*	592D226X_020C2_20H*	4.4*	6*	0.30*	0.61*
22	D	592D226X_020D2_15H	4.4	6	0.40	0.56
22	R	592D226X_020R2_15H	4.4	6	0.28	0.73
33*	D*	592D336X_020D2_20H*	6.6*	6*	0.26*	0.73*
33	R	592D336X_020R2_15H	6.6	6	0.28	0.73
25 WVDC @ + 85 °C, SURGE = 33 V . . . 17 WVDC @ + 125 °C, SURGE = 20 V						
2.2	A	592D225X_025A2_15H	0.6	6	8.00	0.09
2.2	B	592D225X_025B2_15H	0.6	6	6.00	0.12
3.3	B	592D335X_025B2_15H	0.8	6	530	0.12
3.3	C	592D335X_025C2_15H	0.8	6	2.00	0.22
4.7	C	592D475X_025C2_15H	1.2	6	1.60	0.25
6.8	C	592D685X_025C2_15H	1.7	6	130	0.26
6.8	D	592D685X_025D2_15H	1.7	6	1.30	0.31
10*	B*	592D106X_025B2_15H*	2.5*	6*	6.00*	0.12*
10	D	592D106X_025D2_15H	2.5	6	1.20	0.32
10	R	592D106X_025R2_15H	2.5	6	0.48	0.56
15	R	592D156X_025R2_15H	3.8	6	0.40	0.61
15*	C*	592D156X_025C2_20H*	3.8*	6*	0.40*	0.52*
22*	C*	592D226X_025C2_20H*	5.5*	6*	0.30*	0.68*
22*	D*	592D226X_025D2_20H*	5.5*	6*	0.30*	0.68*
35 WVDC @ + 85 °C, SURGE = 46 V . . . 23 WVDC @ + 125 °C, SURGE = 28 V						
1.0	A	592D105X_035A2_15H	0.5	4	10.0	0.08
1.0	B	592D105X_035B2_15H	0.5	4	6.50	0.11
1.5	B	592D155X_035B2_15H	0.5	4	4.2	0.14
2.2*	B*	592D225X_035B2_15H*	0.8*	6*	6.00*	0.12*
2.2	C	592D225X_035C2_15H	0.8	6	3.50	0.17
3.3	C	592D335X_035C2_15H	1.2	6	3.20	0.18
3.3	D	592D335X_035D2_15H	1.2	6	2.10	0.24
4.7	R	592 D475X_035R2_15H	1.6	6	1.30	0.34
6.8	D	592 D685X_035D2_15H	2.4	6	1.30	0.31
6.8	R	592D685X_035R2_15H	2.4	6	1.20	0.35
10	R	592D106X_035R2_15H	3.5	6	1.20	0.35

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

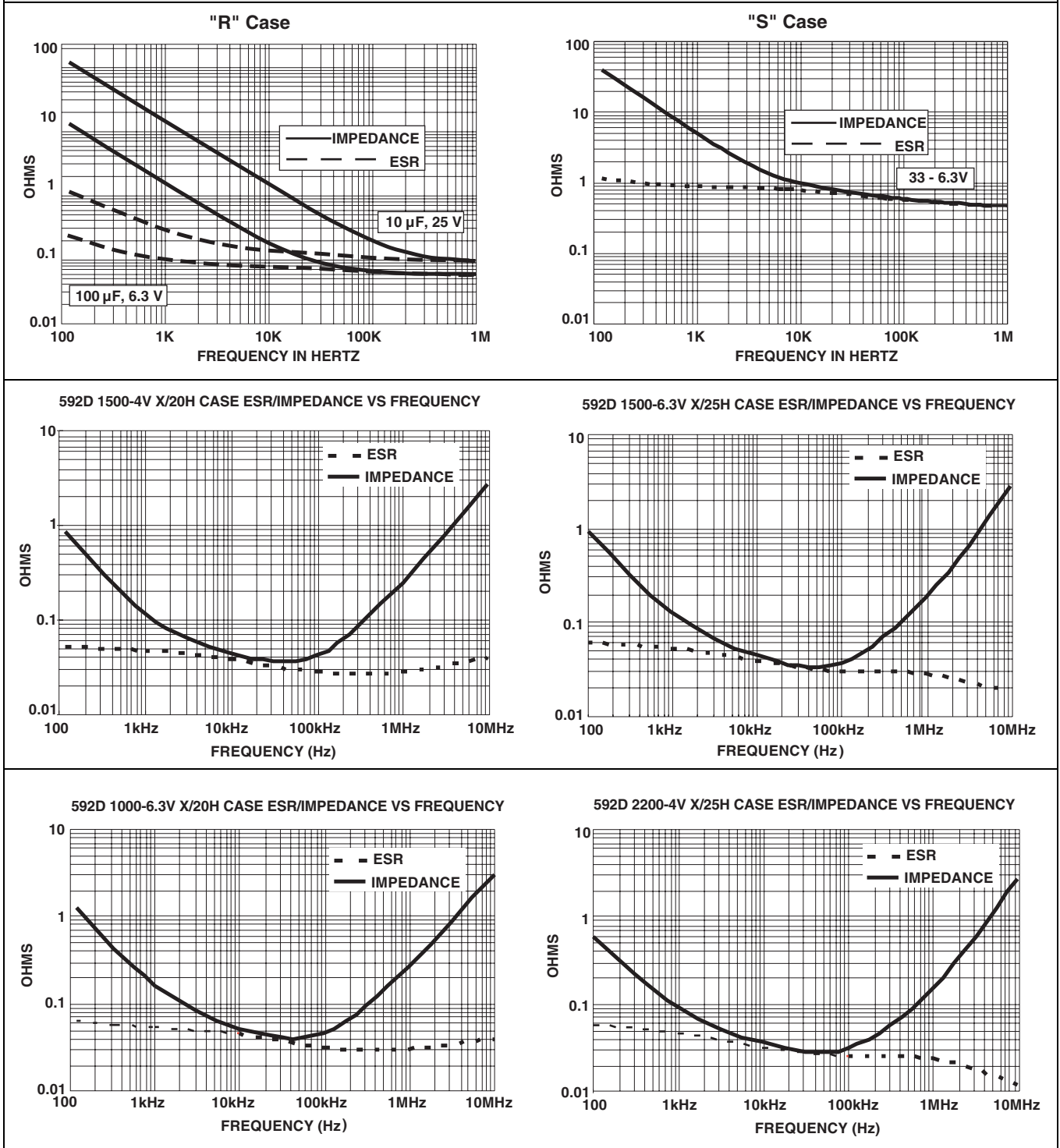


CASE CODE/PART NUMBER X-REF	
OLD	NEW
A2_	A2_15H
B2_	B2_15H
C2_	C2_15H
D2_	D2_15H
R2_	R2_15H
S2_	S2_13H
T2_	B2_20H
U2_	C2_20H
V2_	D2_20H
W2_	R2_20H
X2_	X2_20H
Y2_	X2_25H





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





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.

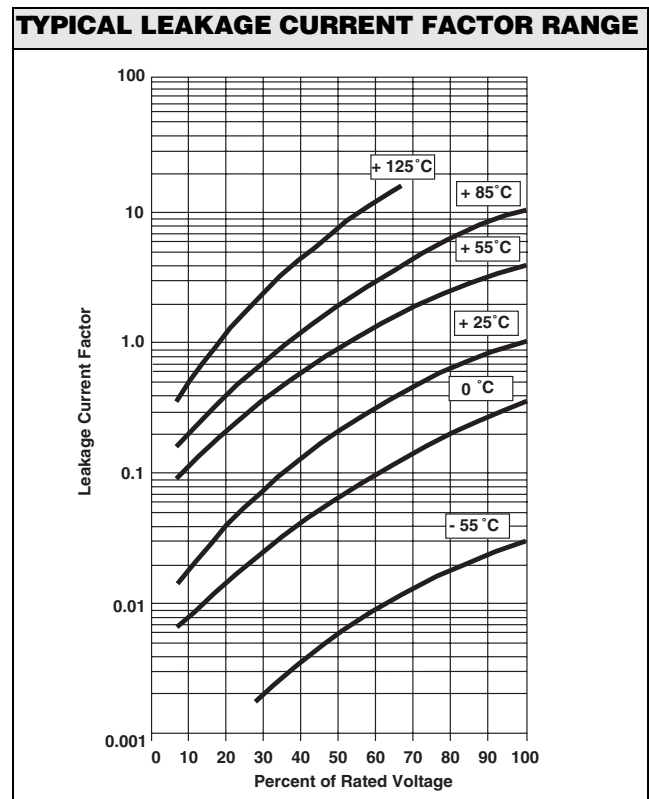
+ 85 °C RATING		+ 125 °C RATING	
Working Voltage (V)	Surge Voltage (V)	Working Voltage (V)	Surge Voltage (V)
4.0	5.2	2.7	3.4
6.3	8.0	4.0	5.0
10	13	7.0	8.0
16	20	10	12
20	26	13	16
25	32	17	20
35	46	23	28

- 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. 592D228X_6R3X2T and 592D338X_6R3V2T, not surge voltage tested.
- 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. **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.



- 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.



Solid Tantalum Chip Capacitors
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Vishay Sprague

PERFORMANCE CHARACTERISTICS (Continued)

- 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; the leakage current shall not exceed 125 % of the initial requirement
- 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 current 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 3.
- 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 Ta₂O₅ 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. **Recommended rated working voltage guidelines:**
(-55 °C to + 85 °C)

Standard Conditions, for example; output filters

Capacitor Voltage Rating (V)	Operating Voltage (V)
4.0	2.5
6.3*	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28

Severe Conditions, for example; input filters

Capacitor Voltage Rating (V)	Operating Voltage (V)
4.0	2.5
6.3*	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24

*For typical wireless applications, Vishay offers 6.3 V Rated Voltage capacitors with 4.5 V Operating Voltage capability. Part number indicator is a "W" in place of "R" within the DC Voltage Rating identifier.

Example; 592D107X_6W3C2_15H.

Contact factory for availability

- 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 at + 25 °C as given in the table in Paragraph Number 5 (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:

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

where,

P = Power Dissipation in Watts at + 25 °C as given in the table in Paragraph Number 5 (Power Dissipation).

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

Z = The capacitor impedance at the specified frequency.

GUIDE TO APPLICATION (Continued)

- 3.1 The sum of the peak AC voltage plus the applied DC voltage shall not exceed the DC voltage rating of the capacitor.
- 3.2 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.
4. **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. **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

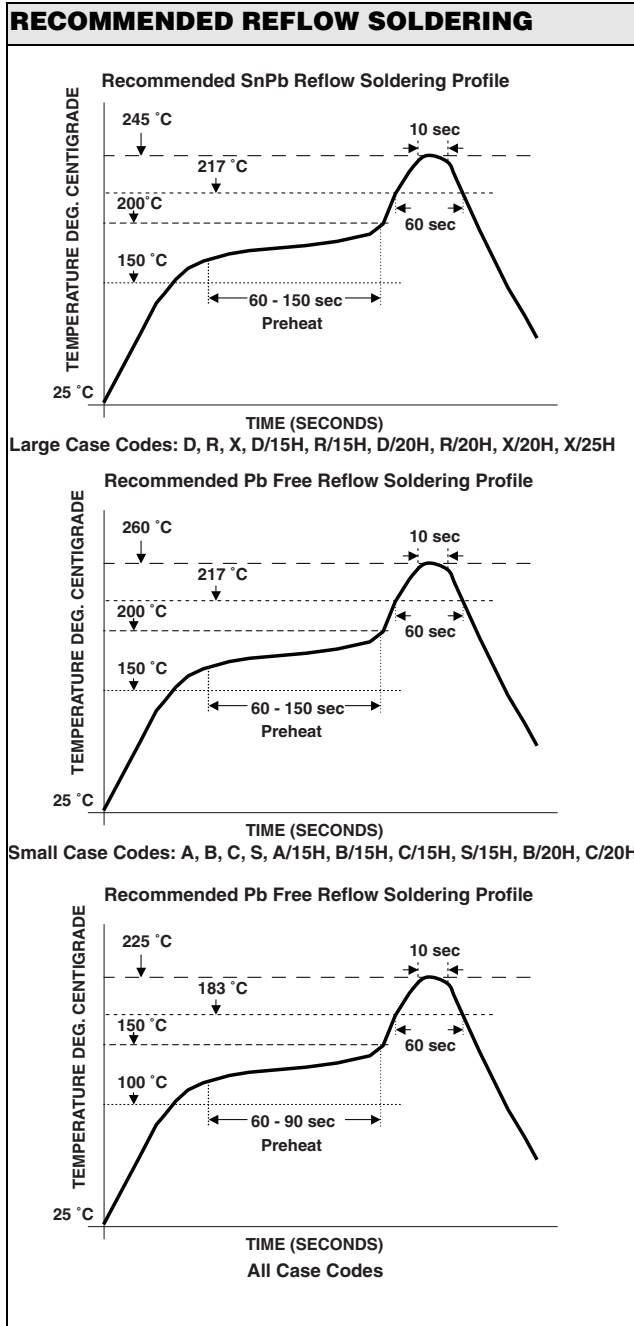
6. **Power Dissipation:** Power dissipation will be affected by the heat sinking capability of the mounting surface. Non-sinusoidal ripple current may produce heating effects which differ from those shown. It is important that the equivalent *I_{rms}* value be established when calculating permissible operating levels. (Power dissipation calculated using + 25 °C temperature rise.)

Case Code/Suffix	Maximum Permissible Power Dissipation at + 25 °C (Watts) in Free Air
A/15H	0.06
B/15H	0.08
C/15H	0.10
D/15H	0.125
R/15H	0.15
B/20H	0.08
C/20H	0.11
D/20H	0.14
R/20H	0.175
X/20H	0.175
X/25H	0.180

7. **Printed Circuit Board Materials:** The capacitors are 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.
8. **Attachment:**
- 8.1 **Solder Paste:** The recommended thickness of the solder paste after application is 0.007" ± 0.001" [0.178 mm ± 0.025 mm]. 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.
- 8.2 **Soldering:** Capacitors can be attached by conventional soldering techniques, vapor phase, convection, infrared reflow wave soldering and hot plate methods. The Soldering Profile charts show typical recommended time/temperature conditions for soldering. Preheating is recommended. The recommended maximum ramp rate is 2 °C per second. 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.

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GUIDE TO APPLICATION (Continued)


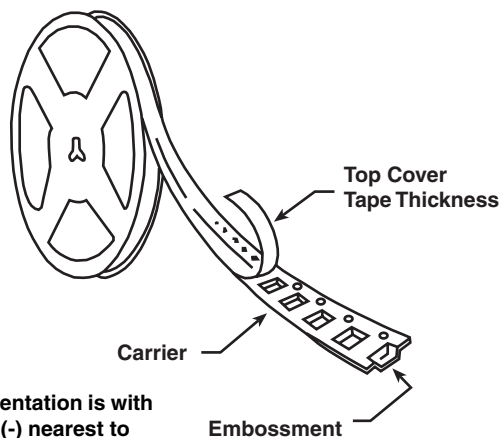
9. **Recommended Mounting Pad Geometries:** The nib must have sufficient clearance to avoid electrical contact with other components. The width dimension indicated is the same as the maximum width of the capacitor. This is to minimize lateral movement.
10. **Cleaning (Flux Removal) After Soldering:** The capacitors are compatible with all commonly used solvents such as TES, TMS, Prelete, Chlorothane, Terpene and aqueous cleaning media. Solvents containing methylene chloride or other epoxy solvents should be avoided since these will attack the epoxy encapsulation material.

REFLOW SOLDER PADS*

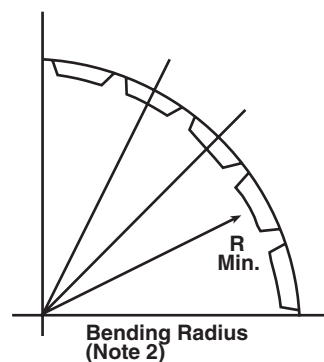
in inches [millimeters]

FOOTPRINT	Width (A)	Pad Metalization (B)	Separation (C)
A	0.082 [2.1]	0.085 [1.7]	0.050 [1.3]
B	0.120 [3.5]	0.065 [1.7]	0.065 [1.7]
C	0.130 [3.5]	0.080 [2.3]	0.120 [3.1]
D	0.180 [4.6]	0.080 [2.3]	0.145 [3.7]
R	2.45 [8.3]	0.090 [2.3]	0.145 [3.7]
S	0.067 [1.7]	0.032 [0.8]	0.043 [1.1]
X	0.310	0.120	0.360

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

TAPE AND REEL PACKAGING


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



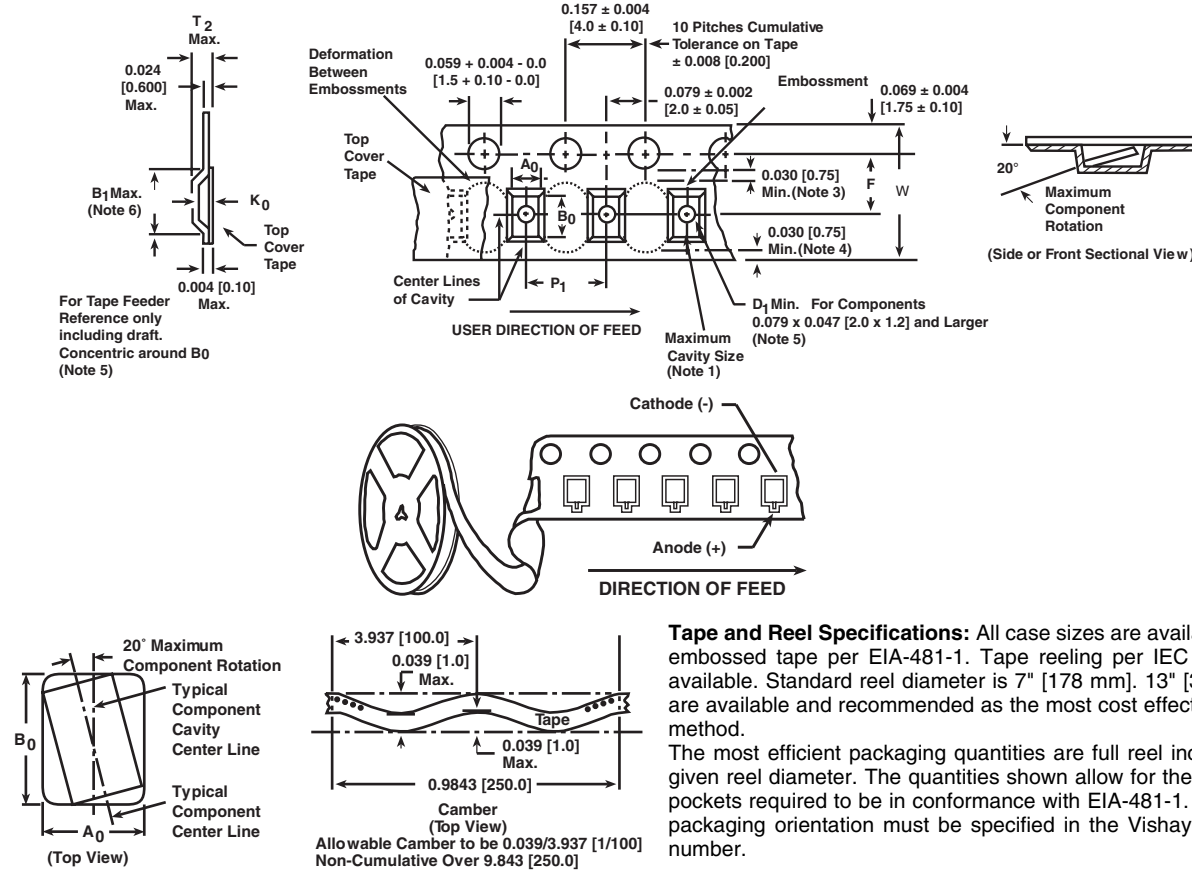
Case Code	Tape Width	Component Pitch	Units Per Reel	
			7" [178] Reel	13" [330] Reel
A	8 mm	4 mm	2500	10000
B	12 mm	4 mm	2000	8000
C	12 mm	8 mm	1000	4000
D	12 mm	8 mm	1000	4000
R	12 mm	8 mm	1000	4000
S	8 mm	4 mm	2500	10000
X	24 mm	12 mm	500	

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TAPE AND REEL PACKAGING in inches [millimeters]

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



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
8 mm	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 + .012 - 0.004 [8.0 + 0.3 - 0.1]	(Note 1)
12 mm	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]	
12 mm Double Pitch	0.323 [8.2]	0.059 [1.5]	0.217 ± 0.002 [5.5 ± 0.05]	0.315 ± 0.004 [8.0 ± 0.10]	1.181 [30.0]	0.256 [6.5]	0.472 ± 0.012 [12.0 ± 0.30]	
24 mm	0.791 [20.1]	0.059 [1.5]	0.453 ± 0.04 [11.5 ± 0.03]	0.472 ± 0.004 [12.0 ± 0.10]	1.181 [30.0]	0.103 [2.6]	0.945 ± 0.012 [24.0 ± 0.03]	

Notes:

- A₀B₀K₀ 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 (A₀B₀K₀) must be within 0.002" [0.05 mm] minimum and 0.020" [0.50 mm] maximum. The clearance allowed must also prevent rotation of the component within the cavity of not more than 20 degrees.
- Tape with components shall pass around radius "R" without damage. The minimum trailer length may require additional length to provide R minimum for 12 mm embossed tape for reels with hub diameters approaching N minimum.
- 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.
- 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.
- 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.
- B₁ dimension is a reference dimension for tape feeder clearance only.