

## Solid Tantalum Chip Capacitors TANTAMOUNT® Commercial, Surface Mount for Switch Mode Power Supplies and Converters



Effective September 2005, new capacitor ratings will not be added to the 593D series. All new ratings are available in the new TR3 series. The TR3 series offers state-of-the-art Low ESR for switch Mode Power Supplies and DC/DC Converters.

### PERFORMANCE/ELECTRICAL CHARACTERISTICS

**Operating Temperature:** - 55 °C to + 85 °C

(To + 125 °C with voltage derating)

**Note:** Refer to Doc. 40088

### FEATURES

- Terminations: 100 % Tin, Standard. SnPb available
- Molded case available in five case codes
- Compatible with "High Volume" automatic pick and place equipment
- High Ripple Current carrying capability
- Low ESR
- Meets EIA 535BAAE and IEC Specification QC300801/US0001



**RoHS\***  
COMPLIANT

**Capacitance Range:** 0.47 μF to 680 μF

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

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

**Compliant Terminations**

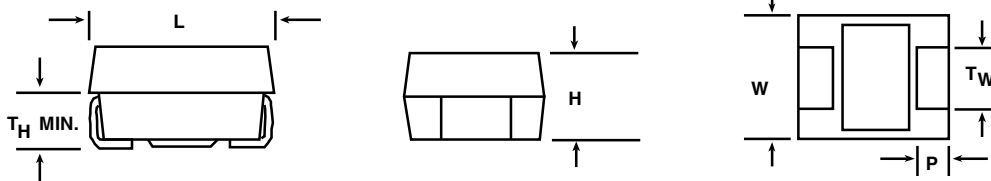
**100 % Surge Current Tested (B, C, D & E Case Sizes)**

### ORDERING INFORMATION

593D TYPE	107 CAPACITANCE	X9 CAPACITANCE TOLERANCE	010 DC VOLTAGE RATING AT + 85 °C	D CASE CODE	2WE3 TERMINATION 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 % X5 = ± 5 % (Special Order)	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.	2TE3: 100 % tin terminations, 7" (178 mm) reel 2WE3: 100 % tin terminations, 13" (330 mm) reel 8T: 90/10 SnPb Solder Plate terminations, 7" (178 mm) reel 8W: 90/10 SnPb Solder Plate terminations, 13" (330 mm) reel 2T: Solderable coating, non-preferred 2W: Solderable coating, non-preferred	

**Note:** 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	EIA SIZE	L	W	H	P	T <sub>w</sub>	T <sub>H</sub> (MIN.)
A	3216-18	0.126 ± 0.008 [3.2 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.047 ± 0.004 [1.2 ± 0.10]	0.028 [0.70]
B	3528-21	0.138 ± 0.008 [3.5 ± 0.20]	0.110 ± 0.008 [2.8 ± 0.20]	0.075 ± 0.008 [1.9 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.028 [0.70]
C	6032-28	0.236 ± 0.012 [6.0 ± 0.30]	0.126 ± 0.012 [3.2 ± 0.30]	0.098 ± 0.012 [2.5 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.039 [1.0]
D	7343-31	0.287 ± 0.012 [7.3 ± 0.30]	0.170 ± 0.012 [4.3 ± 0.30]	0.110 ± 0.012 [2.8 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.095 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]
E	7343-43	0.287 ± 0.012 [7.3 ± 0.30]	0.170 ± 0.012 [4.3 ± 0.30]	0.158 ± 0.012 [4.0 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.095 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]

\* Pb containing terminations are not RoHS compliant, exemptions may apply



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Vishay Sprague

RATINGS AND CASE CODES								
μF	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V
0.47							A	
0.68							A	
1.0					A	A	A/B	B/C
1.5						A	B/C	B/C
2.2					A	A/B	B/C	C/D
3.3				A	A	B	C	C/D
4.7			A	A/B	A/B	B/C	C	E/D
6.8			A	A	B	C	C/D	D/E
10		A	A	A/B/C	B/C	C	C/D	E
15	A	A	A/B	B/C	B/C	C/D	D	
22	A	A/B	A/B/C	B/C	C/D	D	D/E	
33	A/B	A/B	B/C	B/C/D	C/D	D/E		
47	A/B	B/C	B/C/D	C/D	D/E	E		
68	B/C	B/C	C/D	D	D/E			
100	B/C	B/C/D	C/D	D/E	E			
150	B/C/D	C/D/E	D/E	E				
220	C/D	D/E	D/E					
330	D	D/E	E					
470	D/E	E						
680	E							

CONSTRUCTION AND MARKING																			
<p><b>CONSTRUCTION</b></p>	<p><b>MARKING</b></p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Capacitance Code, pF</p> <p>Indicates Lead (Pb)-free</p> <p>Polarity Band</p> <p>Voltage Code</p> <p>A Case</p> </div> <div style="text-align: center;"> <p>Capacitance μF</p> <p>Voltage</p> <p>Indicates Lead (Pb)-free</p> <p>Polarity Band</p> <p>Data Code</p> <p>Vishay Sprague Logo</p> <p>B, C, D, E Case</p> </div> </div> <table border="1" style="margin-top: 10px;"> <thead> <tr> <th>Volts</th> <th>Code</th> </tr> </thead> <tbody> <tr><td>4.0</td><td>G</td></tr> <tr><td>6.3</td><td>J</td></tr> <tr><td>10</td><td>A</td></tr> <tr><td>16</td><td>C</td></tr> <tr><td>20</td><td>D</td></tr> <tr><td>25</td><td>E</td></tr> <tr><td>35</td><td>V</td></tr> <tr><td>50</td><td>T</td></tr> </tbody> </table> <p><b>Marking:</b>            Capacitor marking includes an anode (+) polarity band, capacitance in microfarads and the voltage rating of + 85 °C. 'A' Case capacitors use a letter code for the voltage and EIA capacitance code.            The Vishay Sprague® trademark will be included if space permits. Capacitors keep rated at 6.3 V shall be marked 6 V.            A manufacturing date code is marked on all capacitors.            Call the factory for further explanation.</p>	Volts	Code	4.0	G	6.3	J	10	A	16	C	20	D	25	E	35	V	50	T
Volts	Code																		
4.0	G																		
6.3	J																		
10	A																		
16	C																		
20	D																		
25	E																		
35	V																		
50	T																		



<b>STANDARD/EXTENDED RATINGS</b>						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (Ohms)	MAX. RIPPLE 100 kHz I <sub>rms</sub> (Amps)
<b>4 WVDC AT + 85 °C, SURGE = 5.2 V . . . 2.7 WVDC AT + 125 °C, SURGE = 3.4 V</b>						
15	A	593D156X_004A2_E3	0.6	6	1.500	0.22
22	A	593D226X_004A2_E3	0.9	6	1.500	0.22
33	A	593D336X_004A2_E3	1.3	6	1.500	0.22
33	B	593D336X_004B2_E3	1.3	6	0.500	0.41
47	A	593D476X_004A2_E3	1.9	14	0.800	0.31
47	B	593D476X_004B2_E3	1.9	6	0.500	0.41
68	B	593D686X_004B2_E3	2.7	6	0.500	0.41
68	C	593D686X_004C2_E3	2.7	6	0.275	0.63
100	B	593D107X_004B2_E3	4.0	6	0.450	0.43
100	C	593D107X_004C2_E3	4.0	6	0.225	0.66
150	B	593D157X_004B2_E3	6.0	14	0.500	0.41
150	C	593D157X_004C2_E3	6.0	8	0.250	0.66
150	D	593D157X_004D2_E3	6.0	8	0.150	1.00
220	C	593D227X_004C2_E3	8.8	8	0.200	0.74
220	D	593D227X_004D2_E3	8.8	8	0.150	1.00
330	D	593D337X_004D2_E3	13.2	8	0.150	1.00
470	D	593D477X_004D2_E3	18.8	10	0.125	1.10
470	E	593D477X_004E2_E3	18.8	10	0.100	1.28
680	E	593D687X_004E2_E3	27.2	12	0.100	1.28
<b>6.3 WVDC AT + 85 °C, SURGE = 8 V . . . 4 WVDC AT 125 °C, SURGE = 5 V</b>						
10	A	593D106X_6R3A2_E3	0.6	6	2.000	0.19
15	A	593D156X_6R3A2_E3	0.9	6	2.000	0.19
22	A	593D226X_6R3A2_E3	1.3	6	2.000	0.19
22	B	593D226X_6R3B2_E3	1.3	6	0.600	0.38
33	A	593D336X_6R3A2_E3	2.0	14	0.800	0.31
33	B	593D336X_6R3B2_E3	2.0	6	0.600	0.38
47	B	593D476X_6R3B2_E3	2.8	6	0.550	0.39
47	C	593D476X_6R3C2_E3	2.8	6	0.300	0.61
68	B	593D686X_6R3B2_E3	4.1	6	0.550	0.39
68	C	593D686X_6R3C2_E3	4.1	6	0.275	0.63
100	B	593D107X_6R3B2_E3	6.0	15	0.500	0.41
100	C	593D107X_6R3C2_E3	6.0	6	0.250	0.66
100	D	593D107X_6R3D2_E3	6.0	6	0.140	1.04
150	C	593D157X_6R3C2_E3	9.0	8	0.200	0.74
150	D	593D157X_6R3D2_E3	9.0	8	0.125	1.10
150	E	593D157X_6R3E2_E3	9.0	8	0.100	1.28
220	D	593D227X_6R3D2_E3	13.2	8	0.100	1.22
220	E	593D227X_6R3E2_E3	13.2	8	0.100	1.28
330	D	593D337X_6R3D2_E3	19.8	8	0.125	1.10
330	E	593D337X_6R3E2_E3	19.8	8	0.100	1.28
470	E	593D477X_6R3E2_E3	28.2	10	0.100	1.28
<b>10 WVDC AT + 85 °C, SURGE = 13 V . . . 7 WVDC AT 125 °C, SURGE = 8 V</b>						
4.7	A	593D475X_010A2_E3	0.5	6	3.000	0.16
6.8	A	593D685X_010A2_E3	0.7	6	3.000	0.16
10	A	593D106X_010A2_E3	1.0	6	2.000	0.19
15	A	593D156X_010A2_E3	1.5	6	2.000	0.19
15	B	593D156X_010B2_E3	1.5	6	0.700	0.35
22	A	593D226X_010A2_E3	2.2	8	1.500	0.22
22	B	593D226X_010B2_E3	2.2	6	0.700	0.35
22	C	593D226X_010C2_E3	2.2	6	0.345	0.56
33	B	593D336X_010B2_E3	3.3	6	0.600	0.38
33	C	593D336X_010C2_E3	3.3	6	0.300	0.61

For 10 % tolerance, specify "9"; for 20 % tolerance, change to "0".



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<b>STANDARD/EXTENDED RATINGS</b>						
CAPACITANCE (µF)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C (µA)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (Ohms)	MAX. RIPPLE 100 kHz I <sub>rms</sub> (Amps)
<b>10 WVDC AT + 85 °C, SURGE = 13 V . . . 7 WVDC AT 125 °C, SURGE = 8 V</b>						
47	B	593D476X_010B2_E3	4.7	6	0.600	0.38
47	C	593D476X_010C2_E3	4.7	6	0.300	0.61
47	D	593D476X_010D2_E3	4.7	6	0.200	0.87
68	C	593D686X_010C2_E3	6.8	6	0.275	0.63
68	D	593D686X_010D2_E3	6.8	6	0.150	1.00
100	C	593D107X_010C2_E3	10.0	8	0.200	0.74
100	D	593D107X_010D2_E3	10.0	6	0.100	1.22
150	D	593D157X_010D2_E3	15.0	8	0.100	1.22
150	E	593D157X_010E2_E3	15.0	8	0.100	1.28
220	D	593D227X_010D2_E3	22.0	8	0.125	1.10
220	E	593D227X_010E2_E3	22.0	8	0.100	1.28
330	E	593D337X_010E2_E3	33.0	10	0.100	1.28
<b>16 WVDC AT + 85 °C, SURGE = 20 V . . . 10 WVDC AT + 125 °C, SURGE = 12 V</b>						
3.3	A	593D335X_016A2_E3	0.5	6	3.500	0.15
4.7	A	593D475X_016A2_E3	0.8	6	2.500	0.17
4.7	B	593D475X_016B2_E3	0.8	6	1.500	0.24
6.8	A	593D685X_016A2_E3	1.1	6	3.000	0.16
10	A	593D106X_016A2_E3	1.6	6	1.700	0.21
10	B	593D106X_016B2_E3	1.6	6	0.800	0.33
10	C	593D106X_016C2_E3	1.6	6	0.450	0.49
15	B	593D156X_016B2_E3	2.4	6	0.800	0.33
15	C	593D156X_016C2_E3	2.4	6	0.400	0.52
22	B	593D226X_016B2_E3	3.5	6	0.700	0.35
22	C	593D226X_016C2_E3	3.5	6	0.350	0.56
33	B	593D336X0016B2_E3	5.3	6	0.700	0.35
33	C	593D336X_016C2_E3	5.3	6	0.300	0.61
33	D	593D336X_016D2_E3	4.2	4	0.225	0.82
47	C	593D476X_016C2_E3	7.5	6	0.300	0.61
47	D	593D476X_016D2_E3	7.5	6	0.150	1.00
68	D	593D686X_016D2_E3	10.9	6	0.150	1.00
100	D	593D107X_016D2_E3	16.0	8	0.125	1.10
100	E	593D107X_016E2_E3	16.0	8	0.100	1.28
150	E	593D157X_016E2_E3	24.0	8	0.100	1.28
<b>20 WVDC AT + 85 °C, SURGE = 26 V . . . 13 WVDC AT + 125 °C, SURGE = 16 V</b>						
1.0	A	593D105X_020A2_E3	0.5	4	5.500	0.12
2.2	A	593D225X_020A2_E3	0.5	6	4.000	0.14
3.3	A	593D335X_020A2_E3	0.7	6	4.000	0.14
4.7	A	593D475X_020A2_E3	0.9	6	3.500	0.15
4.7	B	593D475X_020B2_E3	0.9	6	1.000	0.29
6.8	B	593D685X_020B2_E3	1.4	6	1.000	0.29
10	B	593D106X_020B2_E3	2.0	6	1.000	0.29
10	C	593D106X_020C2_E3	2.0	6	0.450	0.49
15	B	593D156X_020B2_E3	3.0	6	1.000	0.29
15	C	593D156X_020C2_E3	3.0	6	0.400	0.52
22	C	593D226X_020C2_E3	4.4	6	0.375	0.54
22	D	593D226X_020D2_E3	3.5	4	0.225	0.82
33	C	593D336X_020C2_E3	6.6	6	0.350	0.56
33	D	593D336X_020D2_E3	6.6	6	0.200	0.87
47	D	593D476X_020D2_E3	9.4	6	0.200	0.87
47	E	593D476X_020E2_E3	7.5	4	0.150	1.05
68	D	593D686X_020D2_E3	13.6	6	0.175	0.93
68	E	593D686X_020E2_E3	13.6	6	0.150	1.05
100	E	593D107X_020E2_E3	20.0	8	0.150	1.05

For 10 % tolerance, specify "9"; for 20 % tolerance, change to "0".

<b>STANDARD/EXTENDED RATINGS</b>						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (Ohms)	MAX. RIPPLE 100 kHz Irms (Amps)
<b>25 WVDC AT + 85 °C, SURGE = 32 V . . . 17 WVDC AT + 125 °C, SURGE = 20 V</b>						
1.0	A	593D105X_025A2_E3	0.5	4	4.000	0.14
1.5	A	593D155X_025A2_E3	0.5	6	4.000	0.14
2.2	A	593D225X_025A2_E3	0.5	6	4.000	0.14
2.2	B	593D225X_025B2_E3	0.6	6	1.500	0.24
3.3	B	593D335X_025B2_E3	0.8	6	1.500	0.24
4.7	B	593D475X_025B2_E3	1.2	6	1.500	0.24
4.7	C	593D475X_025C2_E3	1.2	6	0.525	0.46
6.8	C	593D685X_025C2_E3	1.7	6	0.500	0.47
10	C	593D106X_025C2_E3	2.5	6	0.450	0.49
15	C	593D156X_025C2_E3	3.8	6	0.425	0.51
15	D	593D156X_025D2_E3	3.8	6	0.250	0.77
22	D	593D226X_025D2_E3	5.5	6	0.200	0.87
33	D	593D336X_025D2_E3	8.3	6	0.200	0.87
33	E	593D336X_025E2_E3	8.3	6	0.200	0.91
47	E	593D476X_025E2_E3	11.8	6	0.200	0.91
<b>35 WVDC AT + 85 °C, SURGE = 46 V . . . 23 WVDC AT + 125 °C, SURGE = 28 V</b>						
0.47	A	593D474X_035A2_E3	0.5	4	4.000	0.14
0.68	A	593D684X_035A2_E3	0.5	4	4.000	0.14
1.0	A	593D105X_035A2_E3	0.5	4	4.000	0.14
1.0	B	593D105X_035B2_E3	0.5	4	2.000	0.21
1.5	B	593D155X_035B2_E3	0.5	6	2.000	0.21
1.5	C	593D155X_035C2_E3	0.5	6	0.900	0.35
2.2	B	593D225X_035B2_E3	0.8	6	2.000	0.21
2.2	C	593D225X_035C2_E3	0.8	6	0.900	0.40
3.3	C	593D335X_035C2_E3	1.2	6	0.700	0.45
4.7	C	593D475X_035C2_E3	1.6	6	0.500	0.47
6.8	C	593D685X_035C2_E3	2.4	6	0.475	0.48
6.8	D	593D685X_035D2_E3	2.4	6	0.300	0.71
10	C	593D106X_035C2_E3	3.5	6	0.450	0.49
10	D	593D106X_035D2_E3	3.5	6	0.300	0.71
15	D	593D156X_035D2_E3	5.3	6	0.300	0.71
22	D	593D226X_035D2_E3	7.7	6	0.300	0.71
22	E	593D226X_035E2_E3	7.7	6	0.275	0.77
<b>50 WVDC AT + 85 °C, SURGE = 65 V . . . 33 WVDC AT + 125 °C, SURGE = 40 V</b>						
1.0	B	593D105X_050B2_E3	0.5	4	2.000	0.21
1.0	C	593D105X_050C2_E3	0.5	4	1.600	0.26
1.5	B	593D155X_050B2_E3	0.8	6	2.000	0.21
1.5	C	593D155X_050C2_E3	0.8	6	1.500	0.27
2.2	C	593D225X_050C2_E3	1.1	6	1.500	0.27
2.2	D	593D225X_050D2_E3	1.1	6	0.800	0.43
3.3	C	593D335X_050C2_E3	1.7	6	1.500	0.27
3.3	D	593D335X_050D2_E3	1.7	6	0.800	0.43
4.7	D	593D475X_050D2_E3	2.4	6	0.600	0.50
4.7	E	593D475X_050E2_E3	1.9	6	0.600	0.50
6.8	D	593D685X_050D2_E3	3.4	6	0.600	0.50
6.8	E	593D685X_050E2_E3	3.4	6	0.550	0.55
10	E	593D106X_050E2_E3	5.0	6	0.550	0.55

For 10 % tolerance, specify "9"; for 20 % tolerance, change to "0".



### Notice

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