

Solid Tantalum Surface Mount Capacitors

TANTAMOUNT[®], Molded Case, Low ESR



Effective September 2005, new capacitor ratings will not be added to the 593D series. All new ratings are available in the TR3 series. The TR3 series offers state-of-the-art low ESR for switch mode power supplies and DC/DC converters.

FEATURES

- Terminations: 100 % matte tin, standard, tin/lead available
- Compliant terminations
- Molded case available in five case codes
- Compatible with "High Volume" automatic pick and place equipment
- High ripple current carrying capability
- Low ESR
- Meets IEC specification QC300801/US0001 and EIA535BAAC mechanical and performance requirements
- Compliant to RoHS Directive 2002/95/EC
- Moisture sensitivity level 1



Note

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

PERFORMANCE CHARACTERISTICS

www.vishay.com/doc?40088

Operating Temperature: - 55 °C to + 125 °C
(above + 85 °C voltage derating is required)

Capacitance Range: 0.47 µF to 680 µF
Capacitance Tolerance: ± 5 %, ± 10 %, ± 20 %
100 % Surge Current Tested (C, D and E Case Sizes)
Voltage Rating: 4 V_{DC} to 50 V_{DC}

ORDERING INFORMATION					
593D	107	X9	010	D	2WE3
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	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 V)	See Ratings and Case Codes table	2TE3: Matte tin, 7" (178 mm) reel 2WE3: Matte tin, 13" (330 mm) reel 8T: Tin/lead, 7" (178 mm) reel 8W: Tin/lead, 13" (330 mm) reel

Notes

- 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. Effective July 15, 2008, part numbers with solderable termination codes 2T and 2W may have either matte or tin/lead terminations. Codes 2TE3 and 2WE3 specify only matte tin terminations. Codes 8T and 8W specify only tin/lead terminations.
- Dry pack is available per request, contact regional marketing.

DIMENSIONS in inches [millimeters]							
CASE CODE	EIA SIZE	L	W	H	P	T _W	T _H (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]	0.169 ± 0.012 [4.3 ± 0.30]	0.110 ± 0.012 [2.8 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]
E	7343-43	0.287 ± 0.012 [7.3 ± 0.30]	0.169 ± 0.012 [4.3 ± 0.30]	0.157 ± 0.012 [4.0 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]

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	D/E
6.8			A	A	B	C	C/D	D/E
10		A	A	A/B/C	B/C	C	C/D	D/E
15	A	A	A/B	B/C	B/C	C/D	D/E	
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							

MARKING																			
<p>Capacitance Code, pF</p> <p>Indicates Lead (Pb)-free</p> <p>Polarity Band</p> <p>Voltage Code</p> <p>A Case</p>	“A” CASE VOLTAGE CODE																		
	<table border="1"> <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>	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																		
<p>Marking</p> <p>Capacitor marking includes an anode (+) polarity band, capacitance in microfarads and the voltage rating. “A” Case capacitors use a letter code for the voltage and EIA capacitance code.</p> <p>The Vishay Sprague® trademark is included if space permits. Capacitors rated at 6.3 V are marked 6 V.</p> <p>A manufacturing date code is marked on all capacitors.</p> <p>Capacitors might bear a slightly different marking than the one shown above. For example, rating 22 μF 10 V could be marked either as 22-10L or 22R10.</p> <p>Call the factory for further explanation.</p>																			



STANDARD RATINGS						
CAPACITANCE (μ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C (μ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (Ω)	MAX. RIPPLE 100 kHz I_{RMS} (A)
4 V_{DC} AT + 85 °C; 2.7 V_{DC} AT + 125 °C						
15	A	593D156(1)004A(2)	0.6	6	1.500	0.22
22	A	593D226(1)004A(2)	0.9	6	1.500	0.22
33	A	593D336(1)004A(2)	1.3	6	1.500	0.22
33	B	593D336(1)004B(2)	1.3	6	0.500	0.41
47	A	593D476(1)004A(2)	1.9	14	0.800	0.31
47	B	593D476(1)004B(2)	1.9	6	0.500	0.41
68	B	593D686(1)004B(2)	2.7	6	0.500	0.41
68	C	593D686(1)004C(2)	2.7	6	0.275	0.63
100	B	593D107(1)004B(2)	4.0	8	0.450	0.43
100	C	593D107(1)004C(2)	4.0	6	0.225	0.66
150	B	593D157(1)004B(2)	6.0	14	0.500	0.41
150	C	593D157(1)004C(2)	6.0	12	0.250	0.66
150	D	593D157(1)004D(2)	6.0	8	0.150	1.00
220	C	593D227(1)004C(2)	8.8	8	0.200	0.74
220	D	593D227(1)004D(2)	8.8	8	0.150	1.00
330	D	593D337(1)004D(2)	13.2	8	0.150	1.00
470	D	593D477(1)004D(2)	18.8	10	0.125	1.10
470	E	593D477(1)004E(2)	18.8	10	0.100	1.28
680	E	593D687(1)004E(2)	27.2	12	0.100	1.28
6.3 V_{DC} AT + 85 °C; 4 V_{DC} AT 125 °C						
10	A	593D106(1)6R3A(2)	0.6	6	2.000	0.19
15	A	593D156(1)6R3A(2)	0.9	6	2.000	0.19
22	A	593D226(1)6R3A(2)	1.3	6	2.000	0.19
22	B	593D226(1)6R3B(2)	1.3	6	0.600	0.38
33	A	593D336(1)6R3A(2)	2.0	14	0.800	0.31
33	B	593D336(1)6R3B(2)	2.0	6	0.600	0.38
47	B	593D476(1)6R3B(2)	2.8	6	0.550	0.39
47	C	593D476(1)6R3C(2)	2.8	6	0.300	0.61
68	B	593D686(1)6R3B(2)	4.1	6	0.550	0.39
68	C	593D686(1)6R3C(2)	4.1	6	0.275	0.63
100	B	593D107(1)6R3B(2)	6.0	15	0.500	0.41
100	C	593D107(1)6R3C(2)	6.0	6	0.250	0.66
100	D	593D107(1)6R3D(2)	6.0	6	0.140	1.04
150	C	593D157(1)6R3C(2)	9.0	8	0.200	0.74
150	D	593D157(1)6R3D(2)	9.0	8	0.125	1.10
150	E	593D157(1)6R3E(2)	9.0	8	0.100	1.28
220	D	593D227(1)6R3D(2)	13.2	8	0.100	1.22
220	E	593D227(1)6R3E(2)	13.2	8	0.100	1.28
330	D	593D337(1)6R3D(2)	19.8	8	0.125	1.10
330	E	593D337(1)6R3E(2)	19.8	8	0.100	1.28
470	E	593D477(1)6R3E(2)	28.2	10	0.100	1.28
10 V_{DC} AT + 85 °C; 7 V_{DC} AT 125 °C						
4.7	A	593D475(1)010A(2)	0.5	6	3.000	0.16
6.8	A	593D685(1)010A(2)	0.7	6	3.000	0.16
10	A	593D106(1)010A(2)	1.0	6	2.000	0.19
15	A	593D156(1)010A(2)	1.5	6	2.000	0.19
15	B	593D156(1)010B(2)	1.5	6	0.700	0.35
22	A	593D226(1)010A(2)	2.2	8	1.500	0.22
22	B	593D226(1)010B(2)	2.2	6	0.700	0.35
22	C	593D226(1)010C(2)	2.2	6	0.345	0.56

Note

- Part number definitions:
 - Tolerance: X0, X9, X5
 - Terminations and packaging: 2TE3, 2WE3, 8T, 8W



STANDARD RATINGS						
CAPACITANCE (μ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C (μ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (Ω)	MAX. RIPPLE 100 kHz I_{RMS} (A)
10 V_{DC} AT + 85 °C; 7 V_{DC} AT 125 °C						
33	B	593D336(1)010B(2)	3.3	6	0.600	0.38
33	C	593D336(1)010C(2)	3.3	6	0.300	0.61
47	B	593D476(1)010B(2)	4.7	6	0.600	0.38
47	C	593D476(1)010C(2)	4.7	6	0.300	0.61
47	D	593D476(1)010D(2)	4.7	6	0.200	0.87
68	C	593D686(1)010C(2)	6.8	6	0.275	0.63
68	D	593D686(1)010D(2)	6.8	6	0.150	1.00
100	C	593D107(1)010C(2)	10.0	8	0.200	0.74
100	D	593D107(1)010D(2)	10.0	6	0.100	1.22
150	D	593D157(1)010D(2)	15.0	8	0.100	1.22
150	E	593D157(1)010E(2)	15.0	8	0.100	1.28
220	D	593D227(1)010D(2)	22.0	8	0.125	1.10
220	E	593D227(1)010E(2)	22.0	8	0.100	1.28
330	E	593D337(1)010E(2)	33.0	10	0.100	1.28
16 V_{DC} AT + 85 °C; 10 V_{DC} AT + 125 °C						
3.3	A	593D335(1)016A(2)	0.5	6	3.500	0.15
4.7	A	593D475(1)016A(2)	0.8	6	2.500	0.17
4.7	B	593D475(1)016B(2)	0.8	6	1.500	0.24
6.8	A	593D685(1)016A(2)	1.1	6	3.000	0.16
10	A	593D106(1)016A(2)	1.6	6	1.700	0.21
10	B	593D106(1)016B(2)	1.6	6	0.800	0.33
10	C	593D106(1)016C(2)	1.6	6	0.450	0.49
15	B	593D156(1)016B(2)	2.4	6	0.800	0.33
15	C	593D156(1)016C(2)	2.4	6	0.400	0.52
22	B	593D226(1)016B(2)	3.5	6	0.700	0.35
22	C	593D226(1)016C(2)	3.5	6	0.350	0.56
33	B	593D336(1)016B(2)	5.3	6	0.700	0.35
33	C	593D336(1)016C(2)	5.3	6	0.300	0.61
33	D	593D336(1)016D(2)	4.2	4	0.225	0.82
47	C	593D476(1)016C(2)	7.5	6	0.300	0.61
47	D	593D476(1)016D(2)	7.5	6	0.150	1.00
68	D	593D686(1)016D(2)	10.9	6	0.150	1.00
100	D	593D107(1)016D(2)	16.0	8	0.125	1.10
100	E	593D107(1)016E(2)	16.0	8	0.100	1.28
150	E	593D157(1)016E(2)	24.0	8	0.100	1.28
20 V_{DC} AT + 85 °C; 13 V_{DC} AT + 125 °C						
1.0	A	593D105(1)020A(2)	0.5	4	5.500	0.12
2.2	A	593D225(1)020A(2)	0.5	6	4.000	0.14
3.3	A	593D335(1)020A(2)	0.7	6	4.000	0.14
4.7	A	593D475(1)020A(2)	0.9	6	3.500	0.15
4.7	B	593D475(1)020B(2)	0.9	6	1.000	0.29
6.8	B	593D685(1)020B(2)	1.4	6	1.000	0.29
10	B	593D106(1)020B(2)	2.0	6	1.000	0.29
10	C	593D106(1)020C(2)	2.0	6	0.450	0.49
15	B	593D156(1)020B(2)	3.0	6	1.000	0.29
15	C	593D156(1)020C(2)	3.0	6	0.400	0.52
22	C	593D226(1)020C(2)	4.4	6	0.375	0.54
22	D	593D226(1)020D(2)	3.5	4	0.225	0.82
33	C	593D336(1)020C(2)	6.6	6	0.350	0.56
33	D	593D336(1)020D(2)	6.6	6	0.200	0.87
47	D	593D476(1)020D(2)	9.4	6	0.200	0.87
47	E	593D476(1)020E(2)	7.5	4	0.150	1.05
68	D	593D686(1)020D(2)	13.6	6	0.175	0.93
68	E	593D686(1)020E(2)	13.6	6	0.150	1.05
100	E	593D107(1)020E(2)	20.0	8	0.150	1.05

Note

- Part number definitions:
 - (1) Tolerance: X0, X9, X5
 - (2) Terminations and packaging: 2TE3, 2WE3, 8T, 8W



STANDARD RATINGS						
CAPACITANCE (μ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C (μ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (Ω)	MAX. RIPPLE 100 kHz I_{RMS} (A)
25 V_{DC} AT + 85 °C; 17 V_{DC} AT + 125 °C						
1.0	A	593D105(1)025A(2)	0.5	4	4.000	0.14
1.5	A	593D155(1)025A(2)	0.5	6	4.000	0.14
2.2	A	593D225(1)025A(2)	0.6	6	4.000	0.14
2.2	B	593D225(1)025B(2)	0.6	6	1.500	0.24
3.3	B	593D335(1)025B(2)	0.8	6	1.500	0.24
4.7	B	593D475(1)025B(2)	1.2	6	1.500	0.24
4.7	C	593D475(1)025C(2)	1.2	6	0.525	0.46
6.8	C	593D685(1)025C(2)	1.7	6	0.500	0.47
10	C	593D106(1)025C(2)	2.5	6	0.450	0.49
15	C	593D156(1)025C(2)	3.8	6	0.425	0.51
15	D	593D156(1)025D(2)	3.8	6	0.250	0.77
22	D	593D226(1)025D(2)	5.5	6	0.200	0.87
33	D	593D336(1)025D(2)	8.3	6	0.200	0.87
33	E	593D336(1)025E(2)	8.3	6	0.200	0.91
47	E	593D476(1)025E(2)	11.8	6	0.200	0.91
35 V_{DC} AT + 85 °C; 23 V_{DC} AT + 125 °C						
0.47	A	593D474(1)035A(2)	0.5	4	4.000	0.14
0.68	A	593D684(1)035A(2)	0.5	4	4.000	0.14
1.0	A	593D105(1)035A(2)	0.5	4	4.000	0.14
1.0	B	593D105(1)035B(2)	0.5	4	2.000	0.21
1.5	B	593D155(1)035B(2)	0.5	6	2.000	0.21
1.5	C	593D155(1)035C(2)	0.5	6	0.900	0.35
2.2	B	593D225(1)035B(2)	0.8	6	2.000	0.21
2.2	C	593D225(1)035C(2)	0.8	6	0.900	0.40
3.3	C	593D335(1)035C(2)	1.2	6	0.700	0.45
4.7	C	593D475(1)035C(2)	1.6	6	0.500	0.47
6.8	C	593D685(1)035C(2)	2.4	6	0.475	0.48
6.8	D	593D685(1)035D(2)	2.4	6	0.300	0.71
10	C	593D106(1)035C(2)	3.5	6	0.450	0.49
10	D	593D106(1)035D(2)	3.5	6	0.300	0.71
15	D	593D156(1)035D(2)	5.3	6	0.300	0.71
15	E	593D156(1)035E(2)	5.3	6	0.300	0.74
22	D	593D226(1)035D(2)	7.7	6	0.300	0.71
22	E	593D226(1)035E(2)	7.7	6	0.275	0.77
50 V_{DC} AT + 85 °C; 33 V_{DC} AT + 125 °C						
1.0	B	593D105(1)050B(2)	0.5	4	2.000	0.21
1.0	C	593D105(1)050C(2)	0.5	4	1.600	0.26
1.5	B	593D155(1)050B(2)	0.8	6	2.000	0.21
1.5	C	593D155(1)050C(2)	0.8	6	1.500	0.27
2.2	C	593D225(1)050C(2)	1.1	6	1.500	0.27
2.2	D	593D225(1)050D(2)	1.1	6	0.800	0.43
3.3	C	593D335(1)050C(2)	1.7	6	1.500	0.27
3.3	D	593D335(1)050D(2)	1.7	6	0.800	0.43
4.7	D	593D475(1)050D(2)	2.4	6	0.600	0.50
4.7	E	593D475(1)050E(2)	1.9	6	0.600	0.50
6.8	D	593D685(1)050D(2)	3.4	6	0.600	0.50
6.8	E	593D685(1)050E(2)	3.4	6	0.550	0.55
10	D	593D106(1)050D(2)	5.0	6	0.550	0.52
10	E	593D106(1)050E(2)	5.0	6	0.550	0.55

Note

- Part number definitions:
 - (1) Tolerance: X0, X9, X5
 - (2) Terminations and packaging: 2TE3, 2WE3, 8T, 8W



RECOMMENDED VOLTAGE DERATING GUIDELINES (for temperatures below + 85 °C)	
STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
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	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24

POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
A	0.075
B	0.085
C	0.110
D	0.150
E	0.165

STANDARD PACKAGING QUANTITY		
CASE CODE	UNITS PER REEL	
	7" REEL	13" REEL
A	2000	9000
B	2000	8000
C	500	3000
D	500	2500
E	400	1500

PRODUCT INFORMATION	
Guide for Molded Tantalum Capacitors	www.vishay.com/doc?40074
Pad Dimensions	
Packaging Dimensions	
Moisture Sensitivity	www.vishay.com/doc?40135
SELECTOR GUIDES	
Solid Tantalum Selector Guide	www.vishay.com/doc?49053
Solid Tantalum Chip Capacitors	www.vishay.com/doc?40091
FAQ	
Frequently Asked Questions	www.vishay.com/doc?40110



Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk and agree to fully indemnify and hold Vishay and its distributors harmless from and against any and all claims, liabilities, expenses and damages arising or resulting in connection with such use or sale, including attorneys fees, even if such claim alleges that Vishay or its distributor was negligent regarding the design or manufacture of the part. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.