

Solid Tantalum Surface Mount Chip 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.

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}

FEATURES

- Low ESR
- Molded case available in five case codes
- Terminations: 100 % matte tin, standard, tin/lead available
- High ripple current carrying capability
- Compatible with “High Volume” automatic pick and place equipment
- Moisture sensitivity level 1
- Compliant terminations
- Meets IEC specification QC300801/US0001 and EIA535BAAC mechanical and performance requirements
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912



Note

* This datasheet provides information about parts that are RoHS-compliant and/or parts that are non-RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information/tables in this datasheet for details.

APPLICATIONS

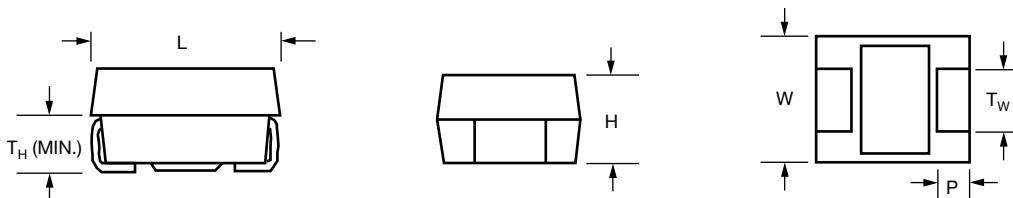
- Industrial
- Telecom infrastructure
- General purpose

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.
Low ESR solid tantalum chip capacitors allow delta ESR of 1.25 times the datasheet limits after mounting.
- Dry pack is available per request, contact regional marketing.

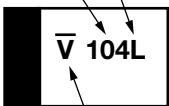
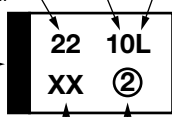
DIMENSIONS in inches [millimeters]


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	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

Capacitance Code, pF Indicates Lead (Pb)-free  Polarity Band Voltage Code A Case	"A" CASE VOLTAGE CODE		Capacitance μF Voltage Indicates Lead (Pb)-free  Polarity Band Data Code Vishay Sprague Logo B, C, D, E Cases
	VOLTS	CODE	
	4.0	G	
	6.3	J	
	10	A	
	16	C	
	20	D	
	25	E	
	35	V	
	50	T	

Marking

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.

The Vishay Sprague® trademark is included if space permits. Capacitors rated at 6.3 V are marked 6 V.

A manufacturing date code is marked on all capacitors.

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.

Call the factory for further explanation.

STANDARD RATINGS

CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C (μA)	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

Note

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



STANDARD RATINGS						
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (Ω)	MAX. RIPPLE 100 kHz I_{RMS} (A)
6.3 V _{DC} AT + 85 °C; 4 V _{DC} AT 125 °C						
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
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

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. DCL 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)
16 V _{DC} AT + 85 °C; 10 V _{DC} AT + 125 °C						
1.0	A	593D105(1)016A(2)	0.5	4	5.500	0.12
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 (μF)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C (μA)	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	
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