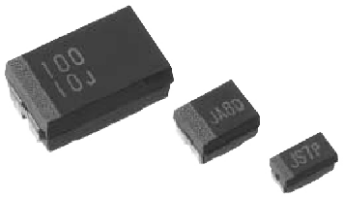
Solid Tantalum Surface Mount Chip Capacitors, Molded Case, Extended Range



FEATURES

- Small size, suitable for high density packaging
- Terminations: 100 % matte tin
- Qualified to EIA-717
- MSL level: 1
- Compatible with “high volume” automatic pick and place equipment
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

HALOGEN FREE Available

GREEN (5-2008) Available

PERFORMANCE / ELECTRICAL CHARACTERISTICS

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

Capacitance Range: 0.47 µF to 470 µF

Capacitance Tolerance: ± 10 %, ± 20 %

Voltage Rating: 2.5 V_{DC} to 35 V_{DC}

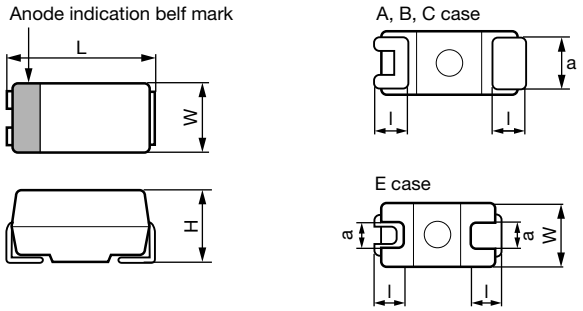
APPLICATIONS

- Industrial
- AV equipment
- General purpose

ORDERING INFORMATION

TMCM	A	0J	106	M	TR	(2)	F
TYPE	CASE CODE	DC VOLTAGE RATING AT +85 °C	CAPACITANCE (µF)	CAPACITANCE TOLERANCE	PACKAGING POLARITY	(OPTIONAL)	TERMINAL CODE
	See Ratings and Case Codes table	0E = 2.5 V 0G = 4.0 V 0J = 6.3 V (7 V) 1A = 10 V 1C = 16 V 1D = 20 V 1E = 25 V 1V = 35 V	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	K = ± 10 % M = ± 20 %	TR = 7" reel, cathodes close to perforation side	Halogen-free (special order), not applicable for E case	F = lead (Pb)-free terminations

DIMENSIONS in inches [millimeters]



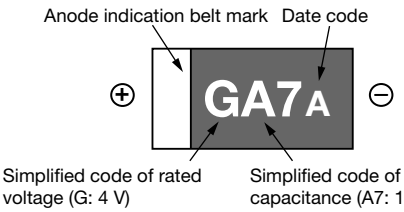
CASE CODE	EIA SIZE	L	W	H	l	a
A	3216-18	0.126 ± 0.008 [3.2 ± 0.2]	0.063 ± 0.008 [1.6 ± 0.2]	0.063 ± 0.008 [1.6 ± 0.2]	0.028 ± 0.012 [0.7 ± 0.3]	0.047 ± 0.008 [1.2 ± 0.2]
B	3528-21	0.138 ± 0.008 [3.5 ± 0.2]	0.110 ± 0.008 [2.8 ± 0.2]	0.075 ± 0.008 [1.9 ± 0.2]	0.030 ± 0.012 [0.8 ± 0.3]	0.087 ± 0.008 [2.2 ± 0.2]
C	5832-27	0.228 ± 0.008 [5.8 ± 0.2]	0.126 ± 0.008 [3.2 ± 0.2]	0.100 ± 0.008 [2.5 ± 0.2]	0.051 ± 0.012 [1.3 ± 0.3]	0.087 ± 0.008 [2.2 ± 0.2]
E	7343-30	0.287 ± 0.008 [7.3 ± 0.2]	0.169 ± 0.012 [4.3 ± 0.3]	0.112 ± 0.008 [2.8 ± 0.2]	0.051 ± 0.012 [1.3 ± 0.3]	0.094 ± 0.008 [2.4 ± 0.2]

RATINGS AND CASE CODES

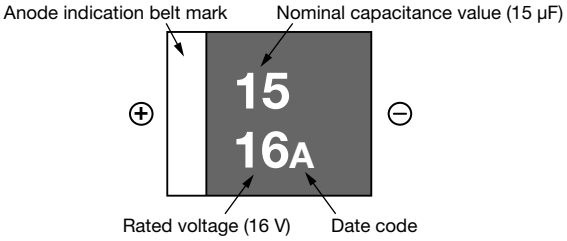
µF	2.5 V	4.0 V	6.3 V (7 V)	10 V	16 V	20 V	25 V	35 V
0.47								A
0.68							A	A
1.0						A	A	A
1.5					A	A	A	A / B
2.2				A	A	A	A / B	A / B
3.3			A	A	A	A / B	A / B	B
4.7		A	A	A	A / B	A / B	A / B	C
6.8	A	A	A	A / B	A / B	B	B / C	C
10	A	A	A / B	A / B	A / B	B / C	B / C	C / E
15	A	A / B	A / B	A / B	A / B / C	B / C	C / E	E
22	A / B	A / B	A / B	A / B / C	A / B / C	B / C / E	C / E	E
33	A / B	A / B	A / B / C	A / B / C	B / C / E	C / E	E	
47	A / B	A / B / C	A / B / C	A / B / C / E	B / C / E	E	E	
68	A / B / C	A / B / C	A / B / C / E	B / C / E	C / E	E		
100	A / B / C	A / B / C / E	A / B / C / E	B / C / E	C / E			
150	A / B / C / E	A / B / C / E	B / C / E	C / E				
220	A / B / C / E	A / B / C / E	B / C / E	E				
330	B / C / E	B / C / E	C / E	E				
470	B / C / E	E	E					

MARKING

A, B Case



C, E Case



SIMPLIFIED VOLTAGE CODES, CASES A, B

VOLTAGE CODE V	CODE	VOLTAGE CODE V	CODE
2.5	e	16	C
4.0	G	20	D
6.3 (7)	J	25	E
10	A	35	V

SIMPLIFIED CAP CODES, CASES A, B

CAPACITANCE CODE µF	CODE	CAPACITANCE CODE µF	CODE
0.47	S5	22	J7
0.68	W5	33	N7
1.0	A6	47	S7
1.5	E6	68	W7
2.2	J6	100	A8
3.3	N6	150	E8
4.7	S6	220	J8
6.8	W6	330	N8
10	A7	470	S8
15	E7		

DATE CODE

YEAR	MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12
2013	A	B	C	D	E	F	G	H	J	K	L	M
2014	N	P	Q	R	S	T	U	V	W	X	Y	Z
2015	a	b	c	d	e	f	g	h	j	k	l	m
2016	n	p	q	r	s	t	u	v	w	x	y	z

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)
2.5 V_{DC} AT +85 °C, 1.6 V_{DC} AT +125 °C						
6.8	A	TMCMA0E685(1)TRF	0.5	6	4.0	0.140
10	A	TMCMA0E106(1)TRF	0.5	8	2.0	0.197
15	A	TMCMA0E156(1)TRF	0.5	8	2.9	0.164
22	A	TMCMA0E226(1)TRF	0.6	8	2.0	0.197
22	B	TMCMB0E226(1)TRF	0.6	8	1.1	0.295
33	A	TMCMA0E336(1)TRF	0.8	8	2.0	0.197
33	B	TMCMB0E336(1)TRF	0.8	8	1.1	0.295
47	A	TMCMA0E476(1)TRF	1.2	12	2.0	0.197
47	B	TMCMB0E476(1)TRF	1.2	8	1.1	0.295
68	A	TMCMA0E686(1)TRF	1.7	18	2.0	0.197
68	B	TMCMB0E686(1)TRF	1.7	8	1.1	0.295
68	C	TMCMC0E686(1)TRF	1.7	8	1.1	0.302
100	A	TMCMA0E107(1)TRF	5.0	18	1.1	0.266
100	B	TMCMB0E107(1)TRF	2.5	12	1.1	0.295
100	C	TMCMC0E107(1)TRF	2.5	8	1.1	0.302
150	A	TMCMA0E157(1)TRF	7.5	30	1.8	0.208
150	B	TMCMB0E157(1)TRF	3.8	18	1.1	0.295
150	C	TMCMC0E157(1)TRF	3.8	8	1.1	0.302
150	E	TMCME0E157(1)TRF	3.8	8	0.3	0.632
220	A	TMCMA0E227(1)TRF	27.5	30	1.8	0.208
220	B	TMCMB0E227(1)TRF	5.5	18	1.1	0.295
220	C	TMCMC0E227(1)TRF	5.5	8	1.1	0.302
220	E	TMCME0E227(1)TRF	5.5	8	0.3	0.632
330	B	TMCMB0E337(1)TRF	16.5	30	1.1	0.295
330	C	TMCMC0E337(1)TRF	8.3	18	1.1	0.302
330	E	TMCME0E337(1)TRF	8.3	10	0.3	0.632
470	B	TMCMB0E477MTRF	58.8	30	1.1	0.295
470	C	TMCMC0E477(1)TRF	11.8	18	1.1	0.302
470	E	TMCME0E477(1)TRF	11.8	10	0.2	0.775
4 V_{DC} AT + 85 °C, 2.5 V_{DC} AT +125 °C						
4.7	A	TMCMA0G475(1)TRF	0.5	6	4.0	0.140
6.8	A	TMCMA0G685(1)TRF	0.5	6	4.0	0.140
10	A	TMCMA0G106(1)TRF	0.5	8	2.0	0.197
15	A	TMCMA0G156(1)TRF	0.6	8	2.9	0.164
15	B	TMCMB0G156(1)TRF	0.6	8	1.7	0.238
22	A	TMCMA0G226(1)TRF	0.9	8	1.8	0.208
22	B	TMCMB0G226(1)TRF	0.9	8	1.1	0.295
33	A	TMCMA0G336(1)TRF	1.3	8	2.0	0.197
33	B	TMCMB0G336(1)TRF	1.3	8	1.1	0.295
47	A	TMCMA0G476(1)TRF	1.9	12	2.0	0.197
47	B	TMCMB0G476(1)TRF	1.9	8	1.1	0.295
47	C	TMCMC0G476(1)TRF	1.9	8	1.1	0.302
68	A	TMCMA0G686(1)TRF	5.4	12	2.0	0.197
68	B	TMCMB0G686(1)TRF	2.7	8	1.1	0.295
68	C	TMCMC0G686(1)TRF	2.7	8	1.1	0.302
100	A	TMCMA0G107(1)TRF	8.0	30	1.1	0.266
100	B	TMCMB0G107(1)TRF	4.0	12	1.1	0.295
100	C	TMCMC0G107(1)TRF	4.0	8	1.1	0.302
100	E	TMCME0G107(1)TRF	4.0	8	0.6	0.447
150	A	TMCMA0G157(1)TRF	60.0	30	1.8	0.208
150	B	TMCMB0G157(1)TRF	6.0	18	1.1	0.295
150	C	TMCMC0G157(1)TRF	6.0	8	1.1	0.302
150	E	TMCME0G157(1)TRF	6.0	8	0.3	0.632

Note

- Part number definition:
  (1) Tolerance: For 10 % tolerance, specify “K”; for 20 % tolerance, change to “M”

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, 2.5 V_{DC} AT +125 °C						
220	A	TMCMA0G227MTRF	88.0	30	1.8	0.208
220	B	TMCMB0G227(1)TRF	17.6	18	1.1	0.295
220	C	TMCMC0G227(1)TRF	8.8	12	1.1	0.302
220	E	TMCME0G227(1)TRF	8.8	8	0.3	0.632
330	B	TMCMB0G337MTRF	26.4	30	1.1	0.295
330	C	TMCMC0G337(1)TRF	13.2	18	1.1	0.302
330	E	TMCME0G337(1)TRF	13.2	10	0.3	0.632
470	E	TMCME0G477(1)TRF	18.8	16	0.2	0.775
6.3 V_{DC} (7 V_{DC}) AT + 85 °C, 4 V_{DC} AT +125 °C						
3.3	A	TMCMA0J335(1)TRF	0.5	6	4.0	0.140
4.7	A	TMCMA0J475(1)TRF	0.5	6	4.0	0.140
6.8	A	TMCMA0J685(1)TRF	0.5	6	4.0	0.140
10	A	TMCMA0J106(1)TRF	0.7	8	2.9	0.164
10	B	TMCMB0J106(1)TRF	0.7	8	1.7	0.238
15	A	TMCMA0J156(1)TRF	1.1	8	4.0	0.140
15	B	TMCMB0J156(1)TRF	1.1	8	1.7	0.238
22	A	TMCMA0J226(1)TRF	1.5	8	1.8	0.208
22	B	TMCMB0J226(1)TRF	1.5	8	1.1	0.295
33	A	TMCMA0J336(1)TRF	2.3	10	2.0	0.197
33	B	TMCMB0J336(1)TRF	2.3	8	1.1	0.295
33	C	TMCMC0J336(1)TRF	2.3	8	1.1	0.302
47	A	TMCMA0J476(1)TRF	5.9	12	1.8	0.208
47	B	TMCMB0J476(1)TRF	3.3	8	1.1	0.295
47	C	TMCMC0J476(1)TRF	3.3	8	1.1	0.302
68	A	TMCMA0J686(1)TRF	8.6	20	2.0	0.197
68	B	TMCMB0J686(1)TRF	4.8	10	1.1	0.295
68	C	TMCMC0J686(1)TRF	4.8	8	1.1	0.302
68	E	TMCME0J686(1)TRF	4.8	8	0.6	0.447
100	A	TMCMA0J107MTRF	31.5	30	1.8	0.208
100	B	TMCMB0J107(1)TRF	7.0	12	1.1	0.295
100	C	TMCMC0J107(1)TRF	7.0	8	1.1	0.302
100	E	TMCME0J107(1)TRF	7.0	8	0.6	0.447
150	B	TMCMB0J157(1)TRF	18.9	20	1.1	0.295
150	C	TMCMC0J157(1)TRF	10.5	10	1.1	0.302
150	E	TMCME0J157(1)TRF	10.5	8	0.3	0.632
220	B	TMCMB0J227MTRF	27.7	30	1.1	0.295
220	C	TMCMC0J227(1)TRF	15.4	18	1.1	0.302
220	E	TMCME0J227(1)TRF	15.4	10	0.3	0.632
330	C	TMCMC0J337MTRF	23.1	30	1.1	0.302
330	E	TMCME0J337(1)TRF	23.1	16	0.2	0.775
470	E	TMCME0J477(1)TRF	32.9	20	0.3	0.632
10 V_{DC} AT + 85 °C, 6.3 V_{DC} AT +125 °C						
2.2	A	TMCMA1A225(1)TRF	0.5	6	4.4	0.133
3.3	A	TMCMA1A335(1)TRF	0.5	6	4.0	0.140
4.7	A	TMCMA1A475(1)TRF	0.5	6	4.0	0.140
6.8	A	TMCMA1A685(1)TRF	0.7	6	4.0	0.140
6.8	B	TMCMB1A685(1)TRF	0.7	6	2.8	0.185
10	A	TMCMA1A106(1)TRF	1.0	8	2.9	0.164
10	B	TMCMB1A106(1)TRF	1.0	8	1.7	0.238
15	A	TMCMA1A156(1)TRF	1.5	8	2.9	0.164
15	B	TMCMB1A156(1)TRF	1.5	8	1.7	0.238
22	A	TMCMA1A226(1)TRF	4.4	12	2.4	0.180
22	B	TMCMB1A226(1)TRF	2.2	8	1.1	0.295
22	C	TMCMC1A226(1)TRF	2.2	8	1.7	0.243

Note

- Part number definition:
  (1) Tolerance: For 10 % tolerance, specify “K”; for 20 % tolerance, change to “M”

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)
10 V_{DC} AT + 85 °C, 6.3 V_{DC} AT +125 °C						
33	A	TMCMA1A336(1)TRF	6.6	18	2.0	0.197
33	B	TMCMB1A336(1)TRF	3.3	8	1.1	0.295
33	C	TMCMC1A336(1)TRF	3.3	8	1.1	0.302
47	A	TMCMA1A476MTRF	9.4	20	2.6	0.173
47	B	TMCMB1A476(1)TRF	4.7	10	1.1	0.295
47	C	TMCMC1A476(1)TRF	4.7	8	1.1	0.302
47	E	TMCME1A476(1)TRF	4.7	8	0.9	0.365
68	B	TMCMB1A686(1)TRF	6.8	18	1.1	0.295
68	C	TMCMC1A686(1)TRF	6.8	8	1.1	0.302
68	E	TMCME1A686(1)TRF	6.8	8	0.6	0.447
100	B	TMCMB1A107MTRF	20.0	30	1.7	0.238
100	C	TMCMC1A107(1)TRF	10.0	10	1.1	0.302
100	E	TMCME1A107(1)TRF	10.0	8	0.6	0.447
150	C	TMCMC1A157MTRF	15.0	18	1.1	0.302
150	E	TMCME1A157(1)TRF	15.0	8	0.3	0.632
220	E	TMCME1A227(1)TRF	22.0	12	0.2	0.775
330	E	TMCME1A337(1)TRF	33.0	30	0.3	0.632
16 V_{DC} AT + 85 °C, 10 V_{DC} AT +125 °C						
1.5	A	TMCMA1C155(1)TRF	0.5	6	6.6	0.109
2.2	A	TMCMA1C225(1)TRF	0.5	6	6.6	0.109
3.3	A	TMCMA1C335(1)TRF	0.5	6	4.0	0.140
4.7	A	TMCMA1C475(1)TRF	0.8	6	4.0	0.140
4.7	B	TMCMB1C475(1)TRF	0.8	6	2.8	0.185
6.8	A	TMCMA1C685(1)TRF	1.1	6	4.0	0.140
6.8	B	TMCMB1C685(1)TRF	1.1	6	2.8	0.185
10	A	TMCMA1C106(1)TRF	1.6	8	2.9	0.164
10	B	TMCMB1C106(1)TRF	1.6	8	1.7	0.238
15	A	TMCMA1C156(1)TRF	2.4	12	2.9	0.164
15	B	TMCMB1C156(1)TRF	2.4	8	1.7	0.238
15	C	TMCMC1C156(1)TRF	2.4	8	1.7	0.243
22	A	TMCMA1C226MTRF	7.0	16	2.9	0.164
22	B	TMCMB1C226(1)TRF	3.5	8	1.7	0.238
22	C	TMCMC1C226(1)TRF	3.5	8	1.1	0.302
33	B	TMCMB1C336(1)TRF	5.3	12	1.1	0.295
33	C	TMCMC1C336(1)TRF	5.3	8	1.1	0.302
33	E	TMCME1C336(1)TRF	5.3	8	0.9	0.365
47	B	TMCMB1C476MTRF	7.5	20	1.7	0.238
47	C	TMCMC1C476(1)TRF	7.5	8	2.2	0.213
47	E	TMCME1C476(1)TRF	7.5	8	0.9	0.365
68	C	TMCMC1C686(1)TRF	10.9	20	1.1	0.302
68	E	TMCME1C686(1)TRF	10.9	8	0.6	0.447
100	C	TMCMC1C107MTRF	16.0	20	1.7	0.243
100	E	TMCME1C107(1)TRF	16.0	8	0.6	0.447
20 V_{DC} AT + 85 °C, 13 V_{DC} AT +125 °C						
1.0	A	TMCMA1D105(1)TRF	0.5	4	6.6	0.109
1.5	A	TMCMA1D155(1)TRF	0.5	6	4.4	0.133
2.2	A	TMCMA1D225(1)TRF	0.5	6	4.4	0.133
3.3	A	TMCMA1D335(1)TRF	0.7	6	4.0	0.140
3.3	B	TMCMB1D335(1)TRF	0.7	6	3.9	0.157
4.7	A	TMCMA1D475(1)TRF	0.9	6	4.0	0.140
4.7	B	TMCMB1D475(1)TRF	0.9	6	2.8	0.185
6.8	B	TMCMB1D685(1)TRF	1.4	6	2.2	0.209
10	B	TMCMB1D106(1)TRF	2.0	8	2.2	0.209
10	C	TMCMC1D106(1)TRF	2.0	8	1.7	0.243

Note

- Part number definition:
  (1) Tolerance: For 10 % tolerance, specify “K”; for 20 % tolerance, change to “M”

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)
20 V_{DC} AT + 85 °C, 13 V_{DC} AT +125 °C						
15	B	TMCMB1D156(1)TRF	3.0	8	1.1	0.295
15	C	TMCMC1D156(1)TRF	3.0	8	1.7	0.243
22	B	TMCMB1D226(1)TRF	4.4	8	1.7	0.238
22	C	TMCMC1D226(1)TRF	4.4	8	1.7	0.243
22	E	TMCME1D226(1)TRF	4.4	8	0.9	0.365
33	C	TMCMC1D336(1)TRF	6.6	8	1.0	0.316
33	E	TMCME1D336(1)TRF	6.6	8	0.9	0.365
47	E	TMCME1D476(1)TRF	9.4	8	0.9	0.365
68	E	TMCME1D686(1)TRF	13.6	8	0.5	0.490
25 V_{DC} AT + 85 °C, 16 V_{DC} AT +125 °C						
0.68	A	TMCMA1E684(1)TRF	0.5	4	9.7	0.090
1.0	A	TMCMA1E105(1)TRF	0.5	4	6.6	0.109
1.5	A	TMCMA1E155(1)TRF	0.5	6	4.4	0.133
2.2	A	TMCMA1E225(1)TRF	0.6	6	4.4	0.133
2.2	B	TMCMB1E225(1)TRF	0.6	6	3.9	0.157
3.3	A	TMCMA1E335(1)TRF	0.8	6	2.8	0.167
3.3	B	TMCMB1E335(1)TRF	0.8	6	3.9	0.157
4.7	A	TMCMA1E475MTRF	1.2	6	6.6	0.109
4.7	B	TMCMB1E475(1)TRF	1.2	6	2.8	0.185
6.8	B	TMCMB1E685(1)TRF	1.7	8	2.8	0.185
6.8	C	TMCMC1E685(1)TRF	1.7	8	1.7	0.243
10	B	TMCMB1E106(1)TRF	2.5	8	2.2	0.209
10	C	TMCMC1E106(1)TRF	2.5	8	1.7	0.243
15	C	TMCMC1E156(1)TRF	3.8	8	1.7	0.243
15	E	TMCME1E156(1)TRF	3.8	8	0.9	0.365
22	C	TMCMC1E226(1)TRF	5.5	8	1.1	0.302
22	E	TMCME1E226(1)TRF	5.5	8	0.9	0.365
33	E	TMCME1E336(1)TRF	8.3	8	0.9	0.365
47	E	TMCME1E476(1)TRF	11.8	8	0.9	0.365
35 V_{DC} AT + 85 °C, 22 V_{DC} AT +125 °C						
0.47	A	TMCMA1V474(1)TRF	0.5	4	16.5	0.069
0.68	A	TMCMA1V684(1)TRF	0.5	4	9.7	0.090
1.0	A	TMCMA1V105(1)TRF	0.5	4	6.6	0.109
1.5	A	TMCMA1V155(1)TRF	0.5	6	4.4	0.133
1.5	B	TMCMB1V155(1)TRF	0.5	6	3.9	0.157
2.2	A	TMCMA1V225MTRF	0.8	8	4.4	0.133
2.2	B	TMCMB1V225(1)TRF	0.8	6	5.5	0.132
3.3	B	TMCMB1V335(1)TRF	1.2	6	3.9	0.157
4.7	C	TMCMC1V475(1)TRF	1.6	6	2.8	0.189
6.8	C	TMCMC1V685(1)TRF	2.4	6	1.7	0.243
10	C	TMCMC1V106(1)TRF	3.5	8	1.7	0.243
10	E	TMCME1V106(1)TRF	3.5	8	1.1	0.330
15	E	TMCME1V156(1)TRF	5.3	8	0.9	0.365
22	E	TMCME1V226(1)TRF	7.7	8	0.9	0.365

Note

- Part number definition:
  (1) Tolerance: For 10 % tolerance, specify “K”; for 20 % tolerance, change to “M”

RECOMMENDED VOLTAGE DERATING GUIDELINES (for temperature below +85 °C)

CAPACITOR VOLTAGE RATING	OPERATING VOLTAGE
2.5	1.2
4.0	2.0
6.3 (7.0)	3.1 (3.5)
10	5.0
16	8.0
20	10.0
25	12.5
35	17.5

POWER DISSIPATION

CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT +25 °C (W) IN FREE AIR
A	0.078
B	0.096
C	0.100
E	0.120

STANDARD PACKAGING QUANTITY

CASE CODE	UNITS PER 7" REEL
A	2000
B	2000
C	500
E	500

PERFORMANCE CHARACTERISTICS

ITEM	CONDITION	POST TEST PERFORMANCE				
Temperature characteristics	Measure the specified characteristics in each stage		Specified initial value	-55 °C	+85 °C	+125 °C
		Capacitance change	-	-10 % to 0 %	0 % to +10 %	0 % to +12 %
		Dissipation factor (%)	4	9	7	9
			6	10	8	10
			8	12	10	12
			10	14	12	14
			12	16	14	16
			16	20	18	20
			18	34	20	22
			20	36	22	24
			30	60	30	40
		Leakage current	Refer to Standard Ratings table	-	1000 % specified initial value or less	1250 % specified initial value or less
Solder heat resistance	Solder dip: 260 °C ± 5 °C A, B case: 10 s ± 1 s C, E case: 5 s ± 0.5 s Reflow 260 °C, 10 s ± 1 s	Capacitance change		Within ± 5 % of initial value		
		Dissipation factor		Shall not exceed initial specified value		
		Leakage current		Shall not exceed initial specified value		
Moisture resistance no load	Leave at 40 °C and 90 % to 95 % RH for 500 h	Capacitance change		Within ± 10 % of initial value		
		Dissipation factor		Shall not exceed initial specified value		
		Leakage current		Shall not exceed initial specified value		
High temperature load	85 °C. The rated voltage is applied for 2000 h	Capacitance change		Within ± 10 % of initial value		
		Dissipation factor		Shall not exceed initial specified value		
		Leakage current		Shall not exceed 125 % of initial specified value		
Thermal shock	Leave at -55 °C, normal temperature, 125 °C, and normal temperature for 30 min, 3 min, 30 min, and 3 min. Repeat this operation 5 times running	Capacitance change		Within ± 10 % of initial value		
		Dissipation factor		Shall not exceed initial specified value		
		Leakage current		Shall not exceed initial specified value		
Moisture resistance load	Leave at 40 °C and 90 % to 95 % RH. The rated voltage applied for 500 h	Capacitance change		Within ± 10 % of initial value		
		Dissipation factor		Shall not exceed 150 % of initial specified value		
		Leakage current		Shall not exceed 200 % of initial specified value		
Failure rate	85 °C. The rated voltage is applied through a protective resistor of 1 Ω/V	1 %/1000 h				

Note

- Test conditions per JIS C5101-1

Guide for Tantalum and Niobium Solid Electrolyte Chip Capacitors

INTRODUCTION

Tantalum electrolytic capacitors are the preferred choice in applications where volumetric efficiency, stable electrical parameters, high reliability, and long service life are primary considerations. The stability and resistance to elevated temperatures of the tantalum / tantalum oxide / manganese dioxide system make solid tantalum capacitors an appropriate choice for today's surface mount assembly technology.

Vishay Sprague has been a pioneer and leader in this field, producing a large variety of tantalum capacitor types for consumer, industrial, automotive, military, and aerospace electronic applications.

Tantalum is not found in its pure state. Rather, it is commonly found in a number of oxide minerals, often in combination with Columbium ore. This combination is known as “tantalite” when its contents are more than one-half tantalum. Important sources of tantalite include Australia, Brazil, Canada, China, and several African countries. Synthetic tantalite concentrates produced from tin slags in Thailand, Malaysia, and Brazil are also a significant raw material for tantalum production.

Electronic applications, and particularly capacitors, consume the largest share of world tantalum production. Other important applications for tantalum include cutting tools (tantalum carbide), high temperature super alloys, chemical processing equipment, medical implants, and military ordnance.

Vishay Sprague is a major user of tantalum materials in the form of powder and wire for capacitor elements and rod and sheet for high temperature vacuum processing.

THE BASICS OF TANTALUM CAPACITORS

Most metals form crystalline oxides which are non-protecting, such as rust on iron or black oxide on copper. A few metals form dense, stable, tightly adhering, electrically insulating oxides. These are the so-called “valve” metals and include titanium, zirconium, niobium, tantalum, hafnium, and aluminum. Only a few of these permit the accurate control of oxide thickness by electrochemical means. Of these, the most valuable for the electronics industry are aluminum and tantalum.

Capacitors are basic to all kinds of electrical equipment, from radios and television sets to missile controls and automobile ignitions. Their function is to store an electrical charge for later use.

Capacitors consist of two conducting surfaces, usually metal plates, whose function is to conduct electricity. They are separated by an insulating material or dielectric. The dielectric used in all tantalum electrolytic capacitors is tantalum pentoxide.

Tantalum pentoxide compound possesses high-dielectric strength and a high-dielectric constant. As capacitors are being manufactured, a film of tantalum pentoxide is applied to their electrodes by means of an electrolytic process. The film is applied in various thicknesses and at various voltages and although transparent to begin with, it takes on different colors as light refracts through it. This coloring occurs on the tantalum electrodes of all types of tantalum capacitors.

Rating for rating, tantalum capacitors tend to have as much as three times better capacitance / volume efficiency than aluminum electrolytic capacitors. An approximation of the capacitance / volume efficiency of other types of capacitors may be inferred from the following table, which shows the dielectric constant ranges of the various materials used in each type. Note that tantalum pentoxide has a dielectric constant of 26, some three times greater than that of aluminum oxide. This, in addition to the fact that extremely thin films can be deposited during the electrolytic process mentioned earlier, makes the tantalum capacitor extremely efficient with respect to the number of microfarads available per unit volume. The capacitance of any capacitor is determined by the surface area of the two conducting plates, the distance between the plates, and the dielectric constant of the insulating material between the plates.

COMPARISON OF CAPACITOR DIELECTRIC CONSTANTS

DIELECTRIC	e DIELECTRIC CONSTANT
Air or vacuum	1.0
Paper	2.0 to 6.0
Plastic	2.1 to 6.0
Mineral oil	2.2 to 2.3
Silicone oil	2.7 to 2.8
Quartz	3.8 to 4.4
Glass	4.8 to 8.0
Porcelain	5.1 to 5.9
Mica	5.4 to 8.7
Aluminum oxide	8.4
Tantalum pentoxide	**26**
Ceramic	12 to 400K

In the tantalum electrolytic capacitor, the distance between the plates is very small since it is only the thickness of the tantalum pentoxide film. As the dielectric constant of the tantalum pentoxide is high, the capacitance of a tantalum capacitor is high if the area of the plates is large:

$$C = \frac{eA}{t}$$

where

C = capacitance

e = dielectric constant

A = surface area of the dielectric

t = thickness of the dielectric

Tantalum capacitors contain either liquid or solid electrolytes. In solid electrolyte capacitors, a dry material (manganese dioxide) forms the cathode plate. A tantalum lead is embedded in or welded to the pellet, which is in turn connected to a termination or lead wire. The drawings show the construction details of the surface mount types of tantalum capacitors shown in this catalog.

SOLID ELECTROLYTE TANTALUM CAPACITORS

Solid electrolyte capacitors contain manganese dioxide, which is formed on the tantalum pentoxide dielectric layer by impregnating the pellet with a solution of manganous nitrate. The pellet is then heated in an oven, and the manganous nitrate is converted to manganese dioxide.

The pellet is next coated with graphite, followed by a layer of metallic silver, which provides a conductive surface between the pellet and the leadframe.

Molded chip tantalum capacitor encases the element in plastic resins, such as epoxy materials. After assembly, the capacitors are tested and inspected to assure long life and reliability. It offers excellent reliability and high stability for consumer and commercial electronics with the added feature of low cost.

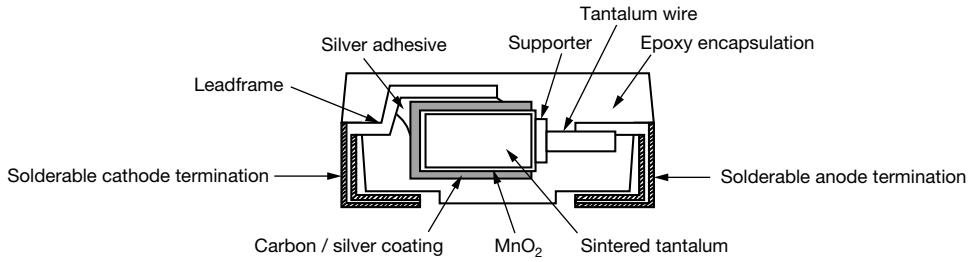
Surface mount designs of “Solid Tantalum” capacitors use lead frames as shown in the accompanying drawings.

TANTALUM CAPACITORS FOR ALL DESIGN CONSIDERATIONS

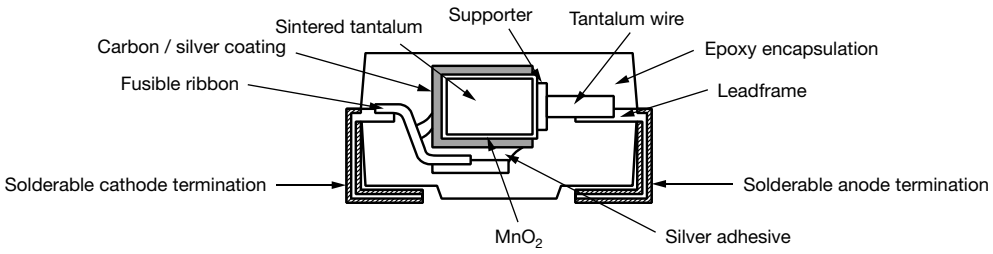
Solid electrolyte designs are the least expensive for a given rating and are used in many applications where their very small size for a given unit of capacitance is of importance. Also important are their good low temperature performance characteristics and freedom from corrosive electrolytes.

Datasheets covering the various types and styles of capacitors for consumer and entertainment electronics and industry applications are available where detailed performance characteristics must be specified.

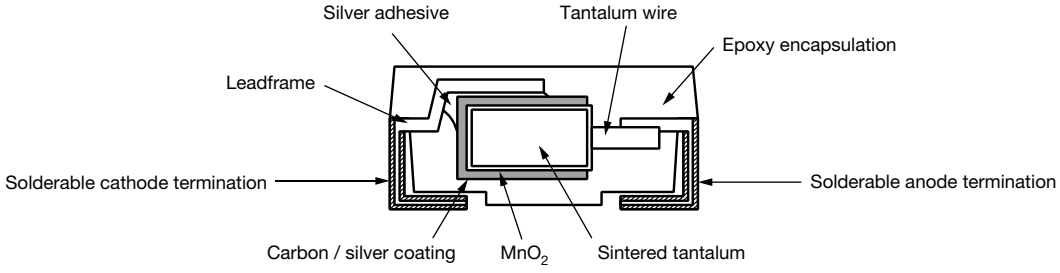
MOLDED CHIP CAPACITOR, ALL TYPES EXCEPT TMCTX / TMCJ / NMC



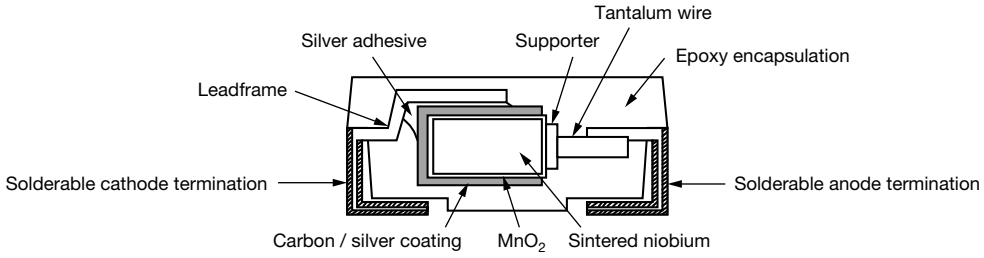
MOLDED CHIP CAPACITOR WITH BUILT-IN FUSE, TYPE TMCTX



MOLDED CHIP CAPACITOR 0603 SIZE, TYPE TMCJ



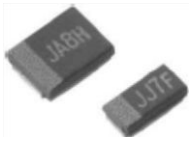
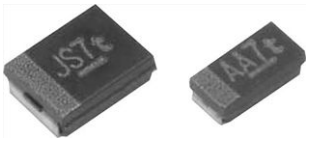
MOLDED CHIP CAPACITOR NIOBIUM, TYPE NMC



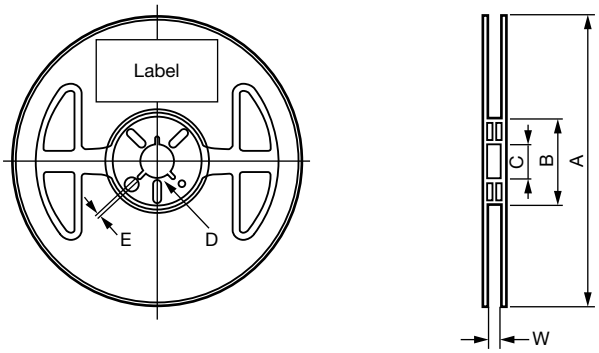
SOLID TANTALUM CAPACITORS - MOLDED CASE

SERIES	TMCS	TMCM	TMCR	TMCU	TMCP	TMCJ
PRODUCT IMAGE						
TYPE	Solid tantalum surface mount chip capacitors, molded case					
FEATURES	Standard industrial grade	Standard industrial grade extended range	Low ESR	Low profile	0805 size	0603 size
TEMPERATURE RANGE	-55 °C to +125 °C					
CAPACITANCE RANGE	0.1 µF to 68 µF	0.47 µF to 470 µF	10 µF to 330 µF	0.1 µF to 220 µF	0.1 µF to 47 µF	0.68 µF to 22 µF
VOLTAGE RANGE	4 V to 35 V	2.5 V to 35 V	7 V to 35 V	2.5 V to 35 V	2.5 V to 25 V	2.5 V to 20 V
CAPACITANCE TOLERANCE	± 10 %, ± 20 %					± 20 %
LEAKAGE CURRENT	0.01 CV or 0.5 µA, whichever is greater					
DISSIPATION FACTOR	4 % to 6 %	4 % to 30 %	6 % to 30 %	4 % to 30 %	6 % to 30 %	20 %
CASE SIZES	A, B, C, E	A, B, C, E	B, C, E	UA, UB	P	J
TERMINATION FINISH	100 % tin			Case UA: 100 % tin Case UB: Ni / Pd / Au	100 % tin	

SOLID TANTALUM CAPACITORS - MOLDED CASE			
SERIES	**TMCTX**	**TMCH**	**THC**
PRODUCT IMAGE			
TYPE	Solid tantalum surface mount chip capacitors, molded case		
FEATURES	Built-in fuse	High reliability	High reliability, high temperature +150 °C
TEMPERATURE RANGE	-55 °C to +125 °C		-55 °C to +150 °C
CAPACITANCE RANGE	1.0 µF to 68 µF	0.1 µF to 100 µF	0.33 µF to 47 µF
VOLTAGE RANGE	10 V to 35 V	4 V to 35 V	10 V to 35 V
CAPACITANCE TOLERANCE	± 10 %, ± 20 %		
LEAKAGE CURRENT	0.01 CV or 0.5 µA, whichever is greater	0.005 CV or 0.25 µA, whichever is greater	
DISSIPATION FACTOR	4 % to 6 %	4 % to 8 %	4 % to 6 %
CASE SIZES	B, C, E, F	A, B, C, E, P	A, B, C, E
TERMINATION FINISH	100 % tin		

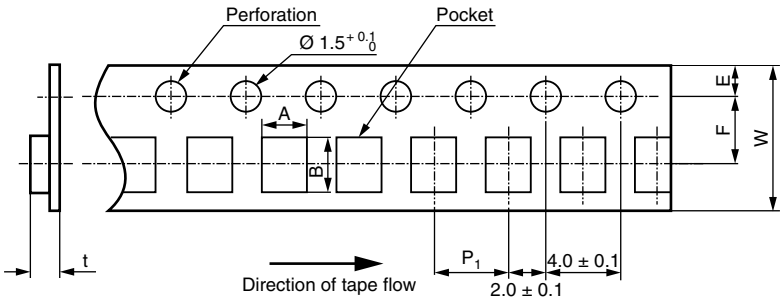
SOLID NIOBIUM CAPACITORS - MOLDED CASE		
SERIES	**NMC**	**NMCU**
PRODUCT IMAGE		
TYPE	Solid niobium surface mount chip capacitors, molded case	
FEATURES	Flame retardant	Flame retardant, low profile
TEMPERATURE RANGE	-55 °C to +105 °C	
CAPACITANCE RANGE	10 µF to 470 µF	4.7 µF to 47 µF
VOLTAGE RANGE	2.5 V to 10 V	
CAPACITANCE TOLERANCE	± 20 %	
LEAKAGE CURRENT	0.02 CV or less	
DISSIPATION FACTOR	8 % to 30 %	30 %
CASE SIZES	A, B, C, E	UA, UB
TERMINATION FINISH	100 % tin	Case UA: 100 % tin Case UB: Ni / Pd / Au

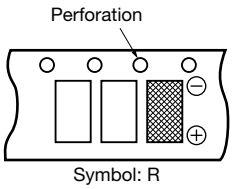
PLASTIC TAPE AND REEL PACKAGING DIMENSIONS in millimeters

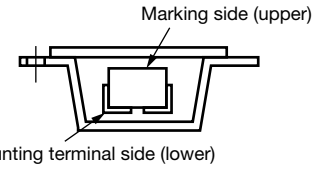


CASE CODE	J, P, A, UA, B, UB	C, E, F
TAPE WIDTH	8	12
A + 0 / - 3	Ø 180	
B + 1 / 0	Ø 60	
C ± 0.2	Ø 13	
D ± 0.5	Ø 21	
E ± 0.5	2.0	
W ± 0.3	9.0	13.0

TAPE SIZE in millimeters



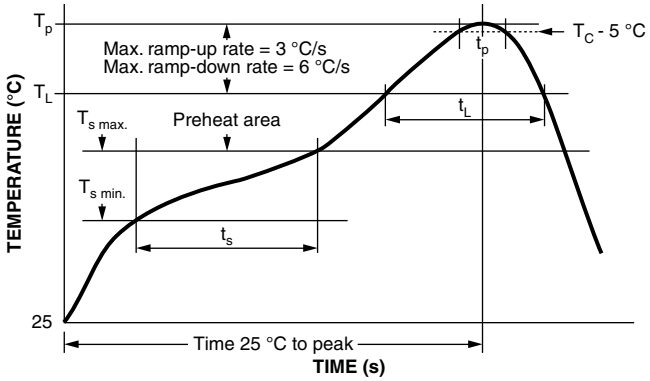




CASE CODE	A ± 0.2	B ± 0.2	W ± 0.3	F ± 0.1	E ± 0.1	P_1 ± 0.1	$t_{max.}$
J	1.0	1.8	8.0	3.5	1.75	4.0	1.3
P	1.4	2.2	8.0	3.5	1.75	4.0	1.6
A	1.9	3.5	8.0	3.5	1.75	4.0	2.5
UA	1.9	3.5	8.0	3.5	1.75	4.0	1.7
B	3.1	3.8	8.0	3.5	1.75	4.0	2.5
UB	3.1	3.8	8.0	3.5	1.75	4.0	1.7
C	3.7	6.3	12.0	5.5	1.75	8.0	3.1
E	4.8	7.7	12.0	5.5	1.75	8.0	3.4
F	6.2	7.5	12.0	5.5	1.75	8.0	4.1

RECOMMENDED REFLOW PROFILES

Capacitors should withstand reflow profile as per J-STD-020 standard

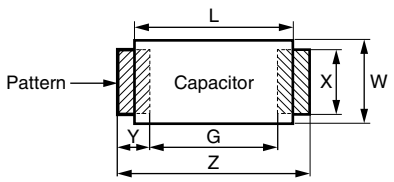


PROFILE FEATURE	LEAD (Pb)-FREE ASSEMBLY
Preheat / soak	
Temperature min. ($T_{s\ min.}$)	130 °C
Temperature max. ($T_{s\ max.}$)	160 °C
Time (t_s) from ($T_{s\ min.}$ to $T_{s\ max.}$)	60 s to 120 s
Ramp-up	
Ramp-up rate (T_L to T_p)	3 °C/s max.
Liquidus temperature (T_L)	200 °C
Time (t_L) maintained above T_L	50 s max.
Peak package body temperature (T_p) max.	Depends on case size - see table below
Time (t_p) within 5 °C of the peak maximum temperature	10 s max.
Ramp-down rate (T_p to T_L)	6 °C/s max.
Time from 25 °C to peak temperature	8 min max.

PEAK PACKAGE BODY TEMPERATURE (T_p)

CASE CODE	PEAK PACKAGE BODY TEMPERATURE (T_p)
	LEAD (Pb)-FREE PROCESS
J, P, UA, A, UB, B, C	260 °C
E, F	250 °C

PAD DIMENSIONS in millimeters



CASE / DIMENSIONS	CAPACITOR SIZE		PAD DIMENSIONS			
	L	W	G (max.)	Z (min.)	X (min.)	Y (Ref.)
J	1.6	0.8	0.7	2.5	1.0	0.9
P	2.0	1.25	0.5	2.6	1.2	1.05
UA, A	3.2	1.6	1.1	3.8	1.5	1.35
UB, B	3.5	2.8	1.4	4.1	2.7	1.35
C	5.8	3.2	2.9	6.9	2.7	2.0
E	7.3	4.3	4.1	8.2	2.9	2.05
F	7.3	5.8	4.1	8.2	4.0	2.05

GUIDE TO APPLICATION

1. **AC 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 W at +25 °C as given in the tables in the product datasheets.

R_{ESR} = the capacitor equivalent series resistance at the specified frequency.

2. **AC 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:

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

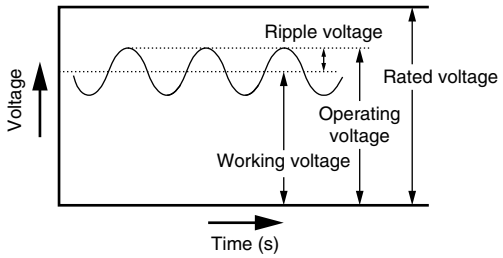
where,

P = power dissipation in W at +25 °C as given in the tables in the product datasheets.

R_{ESR} = The capacitor equivalent series resistance at the specified frequency.

Z = The capacitor impedance at the specified frequency.

2.1 The tantalum capacitors must be used in such a condition that the sum of the working voltage and ripple voltage peak values does not exceed the rated voltage as shown in figure below.



3. **Temperature Derating:** power dissipation is affected by the heat sinking capability of the mounting surface. If these capacitors are to be operated at temperatures above +25 °C, the permissible ripple current (or voltage) shall be calculated using the derating coefficient as shown in the table below:

MAXIMUM RIPPLE CURRENT TEMPERATURE DERATING FACTOR		
TEMPERATURE	**TMC**	**NMC**
≤ 25 °C	1.0	1.0
85 °C	0.9	0.9
105 °C	0.65	0.4
125 °C	0.4	-

4. **Reverse Voltage:** the capacitors are not intended for use with reverse voltage applied. If the application of an reverse voltage is unavoidable, it must not exceed the following values:

At 25 °C: 10 % of the rated voltage or 1 V, whichever is smaller.

At 85 °C: 5 % of the rated voltage or 0.5 V, whichever is smaller.

5. **Mounting Precautions:**

5.1 **Limit Pressure on Capacitor Installation with Mounter:** pressure must not exceed 4.9 N with a tool end diameter of 1.5 mm when applied to the capacitors using an absorber, centering tweezers, or similar (maximum permitted pressurization time: 5 s). An excessively low absorber setting position would result in not only the application of undue force to the capacitors but capacitor and other component scattering, circuit board wiring breakage, and / or cracking as well, particularly when the capacitors are mounted together with other chips having a height of 1 mm or less.

5.2 **Flux Selection**

5.2.1 Select a flux that contains a minimum of chlorine and amine.

5.2.2 After flux use, the chlorine and amine in the flux remain must be removed.

5.3 **Cleaning After Mounting:** the following solvents are usable when cleaning the capacitors after mounting. Never use a highly active solvent.

- Halogen organic solvent (HCFC225, etc.)
- Alcoholic solvent (IPA, ethanol, etc.)
- Petroleum solvent, alkali saponifying agent, water, etc.

Circuit board cleaning must be conducted at a temperature of not higher than 50 °C and for an immersion time of not longer than 30 minutes. When an ultrasonic cleaning method is used, cleaning must be conducted at a frequency of 48 kHz or lower, at an vibrator output of 0.02 W/cm^3, at a temperature of not higher than 40 °C, and for a time of 5 minutes or shorter.

Notes

- Care must be exercised in cleaning process so that the mounted capacitor will not come into contact with any cleaned object or the like or will not get rubbed by a stiff brush or similar. If such precautions are not taken particularly when the ultrasonic cleaning method is employed, terminal breakage may occur.
- When performing ultrasonic cleaning under conditions other than stated above, conduct adequate advance checkout.

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