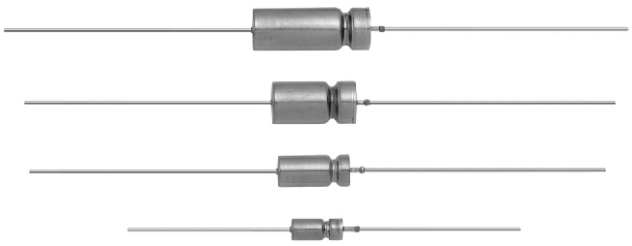
Wet Tantalum Capacitors Silver Case TANTALEX® Capacitors Hermetically-Sealed



FEATURES

- Terminations: axial, standard tin / lead (SnPb), 100 % tin (RoHS-compliant) available
- Model 138D is the commercial equivalents of Tansitor styles WT, UWT, Mallory-NACC styles TLX, TXX and military styles CL66, CL67, CLR65, and CLR69, designed to meet the performance requirements of military specification MIL-PRF-39006/09/21.
  Capacitors in accordance with military specifications should be ordered by their military part numbers.
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free Available

RoHS* Available

HALOGEN FREE GREEN (5-2008) Available

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.

PERFORMANCE CHARACTERISTICS

Operating Temperature: -55 °C to +85 °C
(to +125 °C with voltage derating)

Capacitance Tolerance: at 120 Hz, +25 °C. ± 20 % standard. ± 10 %, ± 5 % available as special.

DC Leakage Current (DCL Max.): at +25 °C, +85 °C and +125 °C: leakage current shall not exceed the values listed in the Standard Ratings tables.

Life Test: capacitors are capable of withstanding a 2000 h life test at a temperature of +85 °C or +125 °C at the applicable rated DC working voltage.

Following the life test:

1. DCL shall not exceed 125 % of the original requirement.
2. The ESR shall not exceed 200 % of the initial requirement.
3. Change in capacitance value shall not exceed the percentages below.
   a) 6 V_{DC} units: +10 % to -25 % of initial measurement.
   b) 8 V_{DC} and 10 V_{DC} units: +10 % to -20 % of initial measurement.
   c) 15 V_{DC} units: +10 % to -15 % of initial measurement.
   d) 20 V_{DC} and above: ± 10 % of initial measurement.

ORDERING INFORMATION

138D	306	X0	006	C	2	E3
MODEL	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT +85 °C	CASE CODE	STYLE NUMBER	RoHS-COMPLIANT
	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	0 = no outer sleeve 2 = outer plastic film insulation 6 = high temperature film insulation	E3 = 100 % tin termination (RoHS-compliant) Blank = SnPb termination (standard design)

Note

- Packaging: the use of formed plastic trays for packaging these axial lead components is standard. Tape and reel is not available due to the unit weight.

For technical questions, contact: tantalum@vishay.com

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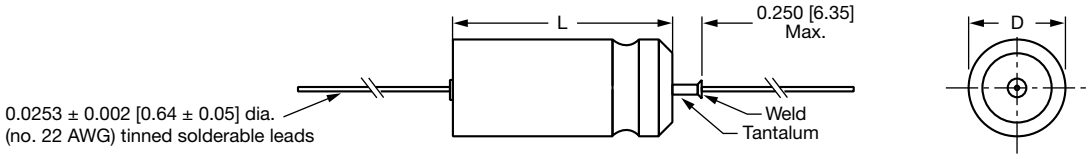
DIMENSIONS in inches [millimeters]



CASE CODE	BARE TUBE		WITH OUTER PLASTIC - FILM INSULATION		LEAD LENGTH	MAX. WEIGHT (oz. / g)
	D	L	D (MAX.)	L (MAX.)		
C	0.188 ± 0.016 [4.78 ± 0.41]	0.453 + 0.031 / - 0.016 [11.51 + 0.79 / - 0.41]	0.219 [5.56]	0.608 [15.45]	1.500 ± 0.250 [38.10 ± 6.35]	0.07 [2.0]
F	0.281 ± 0.016 [7.14 ± 0.41]	0.641 + 0.031 / - 0.016 [16.28 + 0.79 / - 0.41]	0.312 [7.92]	0.796 [20.22]	2.250 ± 0.250 [57.15 ± 6.35]	0.18 [5.1]
T	0.375 ± 0.016 [9.53 ± 0.41]	0.766 + 0.031 / - 0.016 [19.46 + 0.79 / - 0.41]	0.406 [10.31]	0.921 [23.40]	2.250 ± 0.250 [57.15 ± 6.35]	0.36 [10.2]
K	0.375 ± 0.016 [9.53 ± 0.41]	1.062 + 0.031 / - 0.023 [26.97 + 0.79 / - 0.58]	0.406 [10.31]	1.127 [30.91]	2.250 ± 0.250 [57.15 ± 6.35]	0.49 [13.9]

STANDARD RATINGS

CAPACITANCE (µF)	CASE CODE	PART NUMBER [1]	MAX. ESR AT +25 °C 120 Hz (Ω)	MAX. IMP. AT -55 °C 120 Hz (Ω)	MAX. DCL (µA) AT		MAX. CAPACITANCE CHANGE (%) AT			MAX. RMS RIPPLE CURRENT 120 Hz (mA)
					+25 °C	+85 °C +125 °C	-55 °C	+85 °C	+125 °C	
6 V_{DC} AT +85 °C; 4 V_{DC} AT +125 °C										
30	C	138D306X0006C2	4	100	1	2	-40	+10.5	+12	140
68	C	138D686X0006C2	4	60	1	2	-40	+14	+16	160
140	F	138D147X0006F2	2	40	1	3	-40	+14	+16	330
270	F	138D277X0006F2	4	25	1	6.5	-44	+17.5	+20	330
330	T	138D337X0006T2	2	20	2	7.9	-44	+14	+16	410
560	T	138D567X0006T2	3	25	2	13	-64	+17.5	+20	410
1200	K	138D128X0006K2	1.6	20	3	14	-80	+25	+25	530
8 V_{DC} AT +85 °C; 5 V_{DC} AT +125 °C										
25	C	138D256X0008C2	4	100	1	2	-40	+10.5	+12	140
56	C	138D566X0008C2	4	59	1	2	-40	+14	+16	160
220	F	138D227X0008F2	4	30	1	7	-44	+17.5	+20	270
430	T	138D437X0008T2	3	25	2	14	-64	+17.5	+20	410
850	K	138D857X0008K2	1	22	4	16	-80	+25	+25	670
10 V_{DC} AT +85 °C; 7 V_{DC} AT +125 °C										
20	C	138D206X0010C2	4	175	1	2	-32	+10.5	+12	140
47	C	138D476X0010C2	5	100	1	2	-36	+14	+16	160
100	F	138D107X0010F2	2	60	1	4	-36	+14	+16	270
180	F	138D187X0010F2	4	40	1	7	-36	+14	+16	270
250	T	138D257X0010T2	2	30	2	10	-40	+14	+16	410
390	T	138D397X0010T2	3	25	2	16	-64	+17.5	+20	410
750	K	138D757X0010K2	1	23	4	16	-80	+25	+25	670
15 V_{DC} AT +85 °C; 10 V_{DC} AT +125 °C										
15	C	138D156X0015C2	5	155	1	2	-24	+10.5	+12	130
33	C	138D336X0015C2	5	90	1	2	-28	+14	+16	160
70	F	138D706X0015F2	4	75	1	4	-28	+14	+16	270
120	F	138D127X0015F2	4	50	1	7	-28	+17.5	+20	270
170	T	138D177X0015T2	2	35	2	10	-32	+14	+16	410
270	T	138D277X0015T2	3	30	2	16	-56	+17.5	+20	410
540	K	138D547X0015K2	1.0	23	6	24	-80	+25	+25	610
20 V_{DC} AT +85 °C; 13 V_{DC} AT +125 °C										
27	C	138D276X0020C2	5	100	1	2	-20	+11	+14	160
220	T	138D227X0020T2	4	30	2	16	-48	+13	+15	410

Note

[1] Part numbers listed are for units with ± 20 % capacitance tolerance insulated capacitors. For ± 10 % tolerance capacitors, change the digit following the letter "X" from "0" to "9"; for ± 5 %, change the digit following the letter "X" from "0" to "5". For capacitors without outer polyester-film insulation, change the last digit in the part number from "2" to "0". For capacitors with a high temperature insulating sleeve, change the last digit in the part number from "2" to "6". For RoHS-compliant add "E3".

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STANDARD RATINGS

CAPACITANCE (µF)	CASE CODE	PART NUMBER [1]	MAX. ESR AT +25 °C 120 Hz (Ω)	MAX. IMP. AT -55 °C 120 Hz (Ω)	MAX. DCL (µA) AT		MAX. CAPACITANCE CHANGE (%) AT			MAX. RMS RIPPLE CURRENT 120 Hz (mA)
					+25 °C	+85 °C +125 °C	-55 °C	+85 °C	+125 °C	
25 V_{DC} AT +85 °C; 15 V_{DC} AT +125 °C										
10	C	138D106X0025C2	6	220	1	2	-16	+8	+9	130
22	C	138D226X0025C2	5	140	1	2	-20	+10.5	+12	160
27	C	138D276X0025C2	4.3	110	2	9	-35	+12	+15	160
50	F	138D506X0025F2	4	70	1	5	-28	+13	+15	270
100	F	138D107X0025F2	4	50	1	10	-28	+13	+15	270
180	T	138D187X0025T2	4	32	2	18	-48	+13	+15	340
350	K	138D357X0025K2	1.3	24	7	28	-70	+25	+25	580
30 V_{DC} AT +85 °C; 20 V_{DC} AT +125 °C										
8.0	C	138D805X0030C2	7.5	275	1	2	-16	+8	+12	130
15	C	138D156X0030C2	8	175	1	2	-20	+10.5	+12	160
40	F	138D406X0030F2	4	65	1	5	-24	+10.5	+12	270
100	T	138D107X0030T2	6	40	2	12	-28	+10.5	+12	410
150	T	138D157X0030T2	2.5	35	2	16	-48	+13	+15	340
300	K	138D307X0030K2	1.6	25	8	32	-60	+25	+25	550
35 V_{DC} AT +85 °C; 22 V_{DC} AT +125 °C										
68	F	138D686X0035F2	6	60	1	8	-24	+12	+15	270
27	C	138D276X0035C2	4	140	2	9	-28	+10	+12	140
120	T	138D127X0035T2	4	38	2	16	-30	+13	+15	410
270	K	138D277X0035K2	2.2	23	8	32	-45	+20	+25	500
50 V_{DC} C AT +85 °C; 30 V_{DC} AT +125 °C										
5.0	C	138D505X0050C2	9	400	1	2	-16	+5	+6	130
10	C	138D106X0050C2	8	250	1	2	-24	+8	+9	160
25	F	138D256X0050F2	6	95	1	5	-20	+10.5	+12	270
47	F	138D476X0050F2	6	70	1	9	-28	+10.5	+15	270
60	T	138D606X0050T2	3	45	2	12	-16	+10.5	+12	410
82	T	138D826X0050T2	4	45	2	16	-32	+13	+15	410
160	K	138D167X0050K2	2.2	27	8	32	-50	+25	+25	460
60 V_{DC} AT +85 °C; 40 V_{DC} AT +125 °C										
4.0	C	138D405X0060C2	10	550	1	2	-16	+5	+6	110
8.2	C	138D825X0060C2	8	275	1	2	-24	+8	+9	140
20	F	138D206X0060F2	5	105	1	5	-16	+10.5	+12	270
39	F	138D396X0060F2	7	90	1	9	-28	+10.5	+12	330
50	T	138D506X0060T2	4	50	2	12	-16	+10.5	+12	410
68	T	138D686X0060T2	6	50	2	16	-32	+10.5	+12	410
140	K	138D147X0060K2	2.4	28	8	32	-40	+20	+20	430
75 V_{DC} AT +85 °C; 50 V_{DC} AT +125 °C										
3.5	C	138D355X0075C2	10	650	1	2	-16	+5	+6	110
6.8	C	138D685X0075C2	8	300	1	2	-20	+8	+9	140
15	F	138D156X0075F2	6.5	150	1	5	-16	+8	+9	270
33	F	138D336X0075F2	7	90	1	10	-24	+10.5	+15	270
40	T	138D406X0075T2	5	60	2	12	-16	+10.5	+12	410
56	T	138D566X0075T2	6	60	2	17	-28	+10.5	+15	410
110	K	138D117X0075K2	3.1	29	9	36	-35	+20	+20	110
100 V_{DC} AT +85 °C; 65 V_{DC} AT +125 °C										
2.5	C	138D255X0100C2	26.5	950	1	2	-16	+7	+8	100
4.7	C	138D475X0100C2	10	500	1	2	-16	+7	+8	130
11	F	138D116X0100F2	6	200	1	4	-16	+7	+8	230
22	F	138D226X0100F2	7	100	1	9	-16	+7	+8	230
30	T	138D306X0100T2	4	80	2	12	-16	+7	+8	340
43	T	138D436X0100T2	6	70	2	17	-20	+7	+8	340
86	K	138D866X0100K2	3.1	30	9	36	-25	+15	+15	400
125 V_{DC} AT +85 °C; 85 V_{DC} AT +125 °C										
1.7	C	138D175X0125C2	54.6	1250	1	2	-16	+7	+8	100
3.6	C	138D365X0125C2	15	600	1	2	-16	+7	+8	110
9.0	F	138D905X0125F2	15	240	1	5	-16	+7	+8	210
14	F	138D146X0125F2	12	167	1	7	-16	+7	+8	210
18	T	138D186X0125T2	11	129	2	9	-16	+7	+8	340
25	T	138D256X0125T2	10	93	2	13	-16	+7	+8	340
56	K	138D566X0125K2	4.1	32	10	40	-25	+15	+15	400

Note

[1] Part numbers listed are for units with ± 20 % capacitance tolerance insulated capacitors. For ± 10 % tolerance capacitors, change the digit following the letter "X" from "0" to "9"; for ± 5 %, change the digit following the letter "X" from "0" to "5". For capacitors without outer polyester-film insulation, change the last digit in the part number from "2" to "0". For capacitors with a high temperature insulating sleeve, change the last digit in the part number from "2" to "6". For RoHS-compliant add "E3".

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EXTENDED RATINGS

CAPACITANCE (µF)	CASE CODE	PART NUMBER [1]	MAX. ESR AT +25 °C 120 Hz (Ω)	MAX. IMP. AT -55 °C 120 Hz (Ω)	MAX. DCL (µA) AT		MAX. CAPACITANCE CHANGE (%) AT			MAX. RMS RIPPLE CURRENT 120 Hz (mA)
					+25 °C	+85 °C +125 °C	-55 °C	+85 °C	+125 °C	
6 V_{DC} AT +85 °C; 4 V_{DC} AT +125 °C										
560	F	138D567X0006F2	2.5	20	3	14	-80	+16	+20	300
820	F	138D827X0006F2	2.5	18	3	14	-88	+16	+20	300
1500	T	138D158X0006T2	1.5	18	5	20	-90	+20	+25	480
2200	K	138D228X0006K2	1	13	6	24	-90	+25	+30	670
8 V_{DC} AT +85 °C; 5 V_{DC} AT +125 °C										
180	C	138D187X0008C2	3	45	2	9	-60	+13	+16	180
470	F	138D477X0008F2	2.5	25	3	14	-75	+16	+20	300
680	F	138D687X0008F2	2.5	22	3	14	-83	+16	+20	300
1800	K	138D188X0008K2	1	14	7	25	-90	+20	+30	670
10 V_{DC} AT +85 °C; 7 V_{DC} AT +125 °C										
100	C	138D107X0010C2	3	60	2	9	-50	+13	+16	160
150	C	138D157X0010C2	3	54	2	9	-55	+13	+16	180
390	F	138D397X0010F2	2.5	30	3	16	-70	+16	+20	300
560	F	138D567X0010F2	2.5	27	3	16	-77	+16	+20	300
1200	T	138D128X0010T2	1.5	18	5	20	-88	+20	+25	480
1500	K	138D158X0010K2	1	15	7	25	-88	+25	+30	670
15 V_{DC} AT +85 °C; 10 V_{DC} AT +125 °C										
68	C	138D686X0015C2	4	80	2	9	-40	+13	+16	140
100	C	138D107X0015C2	4	72	2	9	-44	+13	+16	160
270	F	138D277X0015F2	2.5	35	3	16	-60	+16	+20	300
390	F	138D397X0015F2	2.5	31	3	16	-16	+16	+20	300
540	T	138D547X0015T2	1.8	25	6	24	-70	+20	+25	440
820	T	138D827X0015T2	1.8	22	6	24	-77	+20	+25	440
1000	K	138D108X0015K2	1.2	17	8	32	-77	+25	+30	610
20 V_{DC} AT +85 °C; 13 V_{DC} AT +125 °C										
56	C	138D566X0020C2	4.3	90	2	9	-38	+13	+16	140
82	C	138D826X0020C2	4.3	81	2	9	-43	+13	+16	160
220	F	138D227X0020F2	2.7	35	3	16	-60	+16	+20	300
330	F	138D337X0020F2	2.7	31	3	16	-66	+16	+20	300
25 V_{DC} AT +85 °C; 15 V_{DC} AT +125 °C										
47	C	138D476X0025C2	4.3	100	2	9	-35	+12	+15	140
68	C	138D686X0025C2	4.3	90	2	9	-40	+12	+15	160
180	F	138D187X0025F2	2.7	37	3	16	-55	+13	+16	300
270	F	138D277X0025F2	2.7	33	3	16	-62	+13	+16	300
350	T	138D357X0025T2	1.8	27	7	28	-60	+20	+25	440
30 V_{DC} AT +85 °C; 20 V_{DC} AT +125 °C										
39	C	138D396X0030C2	5.2	110	2	9	-32	+12	+15	140
56	C	138D566X0030C2	5.2	100	2	9	-38	+12	+15	140
150	F	138D157X0030F2	2.5	40	3	16	-50	+13	+16	300
220	F	138D227X0030F2	2.5	36	3	16	-60	+13	+16	300
330	T	138D337X0030T2	1.8	28	8	32	-50	+20	+25	440
470	T	138D477X0030T2	1.8	25	8	32	-65	+20	+25	440
560	K	138D567X0030K2	1.3	20	9	36	-65	+25	+30	590

Note

[1] Part numbers listed are for units with ± 20 % capacitance tolerance insulated capacitors. For ± 10 % tolerance capacitors, change the digit following the letter “X” from “0” to “9”; for ± 5 %, change the digit following the letter “X” from “0” to “5”. For capacitors without outer polyester-film insulation, change the last digit in the part number from “2” to “0”. For capacitors with a high temperature insulating sleeve, change the last digit in the part number from “2” to “6”. For RoHS-compliant add “E3”.

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EXTENDED RATINGS

CAPACITANCE (µF)	CASE CODE	PART NUMBER [1]	MAX. ESR AT +25 °C 120 Hz (Ω)	MAX. IMP. AT -55 °C 120 Hz (Ω)	MAX. DCL (µA) AT		MAX. CAPACITANCE CHANGE (%) AT			MAX. RMS RIPPLE CURRENT 120 Hz (mA)
					+25 °C	+85 °C +125 °C	-55 °C	+85 °C	+125 °C	
35 V_{DC} AT +85 °C; 22 V_{DC} AT +125 °C										
33	C	138D336X0035C2	5.2	130	2	9	-30	+10	+12	140
47	C	138D476X0035C2	5.2	115	2	9	-35	+10	+12	140
100	T	138D107X0035T2	2.0	40	2	12	-28	+10.5	+12	410
120	F	138D127X0035F2	2.5	45	3	16	-45	+13	+16	300
220	T	138D227X0035T2	1.8	30	8	32	-45	+20	+25	440
390	T	138D397X0035T2	1.8	27	8	32	-58	+20	+25	440
470	K	138D477X0035K2	1.3	21	9	36	-58	+25	+30	590
50 V_{DC} AT +85 °C; 30 V_{DC} AT +125 °C										
22	C	138D226X0050C2	5	150	2	9	-24	+10	+12	140
33	C	138D336X0050C2	5	135	2	9	-29	+10	+12	140
82	F	138D826X0050F2	2.5	55	4	24	-35	+10	+15	300
120	F	138D127X0050F2	2.5	49	4	24	-42	+12	+15	300
160	T	138D167X0050T2	1.8	32	6	32	-35	+20	+25	420
270	T	138D277X0050T2	1.8	29	8	32	-46	+20	+25	440
330	K	138D337X0050K2	1.5	22	9	36	-46	+25	+30	550
60 V_{DC} AT +85 °C; 40 V_{DC} AT +125 °C										
18	C	138D186X0060C2	5	160	3	12	-20	+10	+12	140
27	C	138D276X0060C2	5	144	3	12	-24	+10	+12	140
68	F	138D686X0060F2	3	60	4	20	-30	+12	+15	270
100	F	138D107X0060F2	2.5	54	4	20	-36	+12	+15	300
140	T	138D147X0060T2	2	32	8	32	-30	+16	+20	420
220	T	138D227X0060T2	1.8	29	8	32	-40	+16	+20	440
270	K	138D277X0060K2	1.5	23	9	36	-45	+20	+25	550
75 V_{DC} AT +85 °C; 50 V_{DC} AT +125 °C										
15	C	138D156X0075C2	5	175	3	12	-16	+10	+12	140
22	C	138D226X0075C2	5	157	3	12	-19	+10	+12	140
56	F	138D566X0075F2	3	70	4	24	-25	+12	+15	270
82	F	138D826X0075F2	2.5	63	4	24	-30	+12	+15	300
110	T	138D117X0075T2	2	33	9	36	-25	+16	+20	420
180	T	138D187X0075T2	1.8	30	9	36	-35	+16	+20	440
220	K	138D227X0075K2	2.2	24	10	40	-40	+20	+25	450
100 V_{DC} AT +85 °C; 65 V_{DC} AT +125 °C										
8.2	C	138D825X0100C2	6	250	3	12	-12	+10	+12	130
10	C	138D106X0100C2	6	200	3	12	-17	+10	+12	130
33	F	138D336X0100F2	3.5	85	5	24	-18	+12	+15	250
39	F	138D396X0100F2	3.5	80	5	24	-20	+12	+15	250
68	T	138D686X0100T2	2.2	40	10	40	-30	+14	+16	400
120	K	138D127X0100K2	2.8	30	12	48	-35	+15	+17	440
125 V_{DC} AT +85 °C; 85 V_{DC} AT +125 °C										
6.8	C	138D685X0125C2	11.7	300	3	12	-14	+10	+12	130
27	F	138D276X0125F2	3.5	90	5	24	-18	+12	+15	250
39	T	138D396X0125T2	2.2	60	10	40	-16	+14	+16	400
47	T	138D476X0125T2	2.2	50	10	40	-26	+14	+16	400
82	K	138D826X0125K2	2.8	32	12	48	-30	+15	+17	440

Note

[1] Part numbers listed are for units with ± 20 % capacitance tolerance insulated capacitors. For ± 10 % tolerance capacitors, change the digit following the letter "X" from "0" to "9"; for ± 5 %, change the digit following the letter "X" from "0" to "5". For capacitors without outer polyester-film insulation, change the last digit in the part number from "2" to "0". For capacitors with a high temperature insulating sleeve, change the last digit in the part number from "2" to "6". For RoHS-compliant add "E3".

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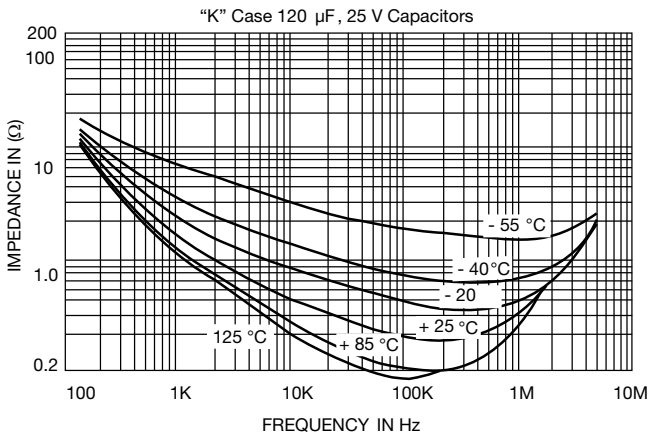
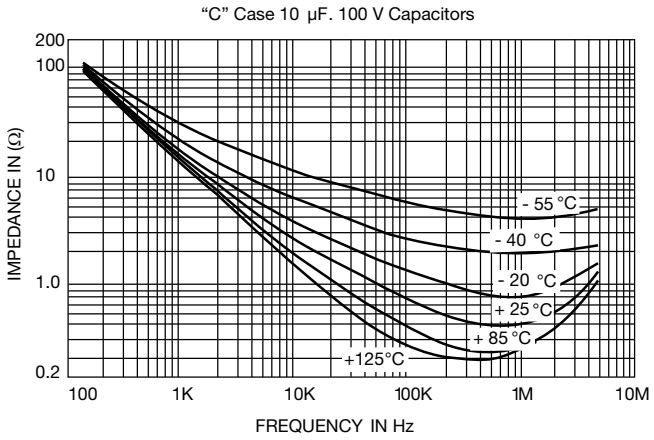
TYPICAL CURVES OF IMPEDANCE AS A FUNCTION OF FREQUENCY AT VARIOUS TEMPERATURES





PERFORMANCE CHARACTERISTICS

1. **Operating Temperature:** capacitors are designed to operate over the temperature range of -55 °C to +125 °C.

UP TO +85 °C WORKING VOLTAGE (V)	AT +125 °C WORKING VOLTAGE (V)	UP TO +85 °C WORKING VOLTAGE (V)	AT +125 °C WORKING VOLTAGE (V)
6	4	35	22
8	5	50	30
10	7	60	40
15	10	75	50
20	13	100	70
25	15	125	85
30	20	150	100

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 should be subjected under any conditions. This includes transients and peak ripple at the highest line voltage. The surge voltage of capacitors rated below 150 V is 115 % of the rated DC working voltage. The surge voltage of capacitors rated at 150 V_{DC} is 165 V.

3.1 **Surge Voltage Test:** capacitors shall withstand the surge voltage test applied through a 1000 Ω ± 10 % resistor in series with the capacitor and voltage source at the rate of one-half min on, four and one-half min. off, for 1000 successive test cycles at +85 °C or +125 °C.

4. **Capacitance Tolerance:** the capacitance of all capacitors shall be within the specified tolerance limits of the nominal rating.

4.1 Capacitance measurements shall be made by the bridge method at or referred to, a frequency of 120 Hz at a temperature of +25 °C. A polarizing voltage shall be used of such magnitude that there shall be no reversal of polarity due to the AC component. The maximum AC voltage will be 1 V_{RMS} applied during measurement.

5. **Capacitance Change With Temperature:** the capacitance change with temperature shall not exceed the limits given in the Standard and Extended Ratings table for each capacitor.
6. **Equivalent Series Resistance:** measurements shall be made by the bridge method at or referred to, a frequency of 120 Hz at a temperature of +25 °C. A polarizing voltage shall be used of such magnitude that there shall be no reversal of polarity due to the AC component. The maximum AC voltage will be 1 V_{RMS} applied during measurement.

6.1 The equivalent series resistance shall not exceed the maximum value in ohms listed in the Standard and Extended Ratings table for each capacitor.

6.2 The dissipation factor may be calculated from the equivalent series resistance and capacitance values as shown:

$$DF = \frac{2\pi fRC}{10^4}$$

where:

DF = dissipation factor in %

R = ESR in Ω

C = capacitance in µF

f = frequency in Hz

At 120 Hz, the above equation becomes:

$$DF = \frac{R \times C}{13.26}$$

For example, percent dissipation factor of a 30 µF, 6 V capacitor, which has a maximum ESR of 3.4 Ω at +25 °C and 120 Hz, would be calculated as shown:

$$DF = \frac{2\pi \times 120 \times 3.4 \times 30}{10^4} = \frac{3.4 \times 30}{13.26} = 7.7\ \%$$

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PERFORMANCE CHARACTERISTICS (CONTINUED)

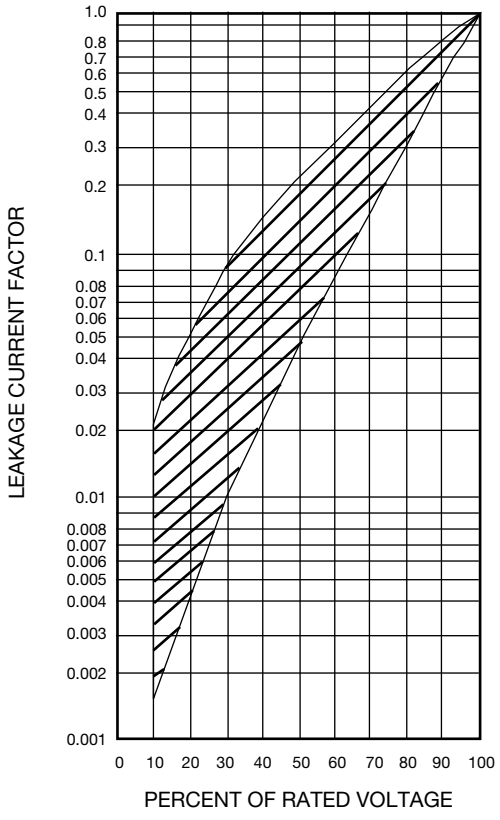
7. **Leakage Current:** measurements shall be made at the applicable rated working voltage at +25 °C ± 5 °C through application of a steady source of power, such as a regulated power supply. The total resistance in series with each capacitor shall be between 1000 Ω and 10 000 Ω. The voltage shall be applied to the capacitor for 5 min before making the leakage current measurement.

7.1 The maximum leakage current for any capacitor shall not exceed the value in microamperes listed in the Standard and Extended Ratings Table for each capacitor.

Note

- Leakage current varies with applied voltage. See graph below for the appropriate adjustment factor.

LEAKAGE AS A FUNCTION OF VOLTAGE AND TEMPERATURE



8. **Low Temperature Impedance:** the impedance of any capacitor at -55 °C at 120 Hz, shall not exceed the values given in the Standard and Extended Ratings tables.

9. **Life Test:** capacitors are capable of withstanding a 2000 h life test at a temperature of +85 °C or +125 °C at the applicable rated DC working voltage

10. **High Frequency Vibration:** capacitors shall with stand vibration from 10 Hz to 2000 Hz at 20 *g* when tested.

11. **Lead Pull Test:** capacitors shall withstand a lead tensile stress of 3 pounds (13.2 N) for 30 s, applied axially

12. **Marking:** capacitors shall be marked with Sprague® and / or the Sprague trademark 2, the Sprague type (138D); rated capacitance and tolerance (the tolerance shall be coded, using the list shown in How to Order); rated DC working voltage at +85 °C; the standard EIA date code of manufacture.

GUIDE TO APPLICATION

1. **Ripple Current:** all capacitors will withstand rms ripple currents as listed for each capacitor.

1.1 The RMS ripple current rating is independent of temperature or frequency within the following limitations:

1.1.1 At frequencies of less than 120 Hz, the rated RMS ripple current must be multiplied by the factors shown:

FREQUENCY IN Hz			
25	50	60	100
0.36	0.59	0.65	0.88

1.1.2 The sum of the peak AC voltage plus the DC voltage shall not exceed the DC working voltage of the capacitor.

1.1.3 The sum of the negative peak AC voltage, plus the applied DC voltage shall not allow a voltage reversal.

2. Cleaning wiring boards with type 138D capacitors: customary cleaning solvents used in the electronics industry at present will not affect Type 138D capacitors. However, the use of ultrasonic cleaning techniques is not recommended under any circumstances.

3. **Apparent Capacitance:** note that in timing circuit applications, the circuit designer must take into account two important variables which affect any electrolytic capacitor. These are the internal leakage resistance of the capacitor and its dielectric absorption, which will depend on the elapsed time since the capacitor was last energized. In applications where electrolytic capacitors are subjected to DC energy, or in effect, extremely low frequencies, the value of the apparent capacitance will be somewhat higher than that which is measured at 120 Hz.

4. **No Reverse Voltage:** the application of reverse voltage to these capacitors will cause internal damage. The resulting damage will lead to immediate or delayed failure of the unit. This will take the form of a catastrophic short circuit with possible expulsion of the electrolyte.

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