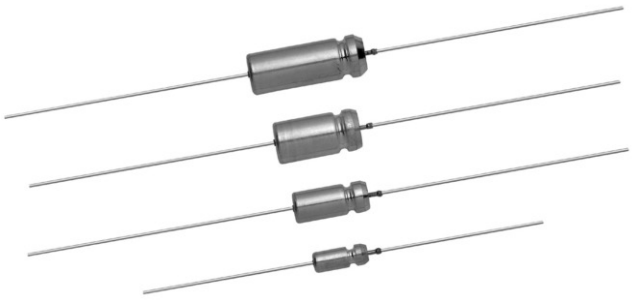
Wet Tantalum Capacitors Sintered Anode TANTALEX® Capacitors Hermetically-Sealed with True Glass-to-Tantalum Seal



FEATURES

- Terminations: standard tin/lead (SnPb), 100 % tin (RoHS compliant) available
- Improved reliability through the use of a glass-to-tantalum true hermetic anode seal is the prime feature of the Type 138D sintered anode TANTALEX® capacitor. This construction offers outstanding resistance to thermal shock.
- 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.

Pb-free Available

RoHS* COMPLIANT

PERFORMANCE CHARACTERISTICS

Operating Temperature: - 55 °C to + 85 °C and with voltage derating to two-thirds the + 85 °C rating at + 125 °C. Use of Type 138D capacitors for high temperature applications is recommended.

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:

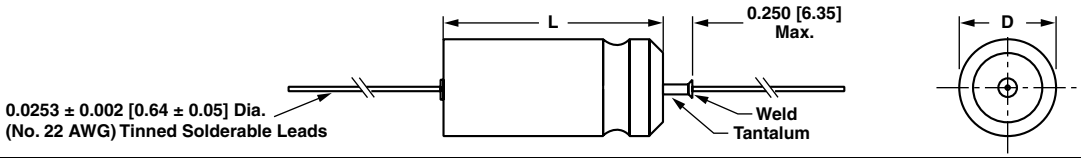
1. DCL shall not exceed 125 % of the original requirement.
2. The ESR shall not exceed 200 % of the initial requirement.
3. Change in capacitance value shall not exceed the percentages below.
   a) 6 WVDC Units: + 10 % to - 25 % of initial measurement.
   b) 8 WVDC and 10 WVDC Units: + 10 % to - 20 % of initial measurement.
   c) 15 WVDC Units: + 10 % to - 15 % of initial measurement.
   d) 20 WVDC 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	TERMINATION	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	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 recommended due to the unit weight.

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]

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

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		
					+ 25 °C	+ 85 °C + 125 °C	- 55 °C	+ 85 °C	+ 125 °C
6 WVDC at + 85 °C . . . 4 WVDC at + 125 °C									
30	C	138D306X0006C2	4	100	1	2	- 40	+ 10.5	+ 12
68	C	138D686X0006C2	4	60	1	2	- 40	+ 14	+ 16
140	F	138D147X0006F2	2	40	1	3	- 40	+ 14	+ 16
270	F	138D277X0006F2	4	25	1	6.5	- 44	+ 17.5	+ 20
330	T	138D337X0006T2	2	20	2	7.9	- 44	+ 14	+ 16
560	T	138D567X0006T2	3	25	2	13	- 64	+ 17.5	+ 20
1200	K	138D128X0006K2	1.6	20	3	14	- 80	+ 25	+ 25
8 WVDC at + 85 °C . . . 5 WVDC at + 125 °C									
25	C	138D256X0008C2	4	100	1	2	- 40	+ 10.5	+ 12
56	C	138D566X0008C2	4	59	1	2	- 40	+ 14	+ 16
220	F	138D227X0008F2	4	30	1	7	- 44	+ 17.5	+ 20
430	T	138D437X0008T2	3	25	2	14	- 64	+ 17.5	+ 20
850	K	138D857X0008K2	1	22	4	16	- 80	+ 25	+ 25
10 WVDC at + 85 °C . . . 7 WVDC at + 125 °C									
20	C	138D206X0010C2	4	175	1	2	- 32	+ 10.5	+ 12
47	C	138D476X0010C2	5	100	1	2	- 36	+ 14	+ 16
100	F	138D107X0010F2	2	60	1	4	- 36	+ 14	+ 16
180	F	138D187X0010F2	4	40	1	7	- 36	+ 14	+ 16
250	T	138D257X0010T2	2	30	2	10	- 40	+ 14	+ 16
390	T	138D397X0010T2	3	25	2	16	- 64	+ 17.5	+ 20
750	K	138D757X0010K2	1	23	4	16	- 80	+ 25	+ 25
15 WVDC at + 85 °C . . . 10 WVDC at + 125 °C									
15	C	138D156X0015C2	5	155	1	2	- 24	+ 10.5	+ 12
33	C	138D336X0015C2	5	90	1	2	- 28	+ 14	+ 16
70	F	138D706X0015F2	4	75	1	4	- 28	+ 14	+ 16
120	F	138D127X0015F2	4	50	1	7	- 28	+ 17.5	+ 20
170	T	138D177X0015T2	2	35	2	10	- 32	+ 14	+ 16
270	T	138D277X0015T2	3	30	2	16	- 56	+ 17.5	+ 20
540	K	138D547X0015K2	1.0	23	6	24	- 80	+ 25	+ 25
20 WVDC at + 85 °C . . . 13 WVDC at + 125 °C									
27	C	138D276X0020C2	5	100	1	2	- 20	+ 11	+ 14
220	T	138D227X0020T2	4	30	2	16	- 48	+ 13	+ 15
25 WVDC at + 85 °C . . . 15 WVDC at + 125 °C									
10	C	138D106X0025C2	6	220	1	2	- 16	+ 8	+ 9
22	C	138D226X0025C2	5	140	1	2	- 20	+ 10.5	+ 12
27	C	138D276X0025C2	4.3	110	2	9	- 35	+ 12	+ 15
50	F	138D506X0025F2	4	70	1	5	- 28	+ 13	+ 15
100	F	138D107X0025F2	4	50	1	10	- 28	+ 13	+ 15
180	T	138D187X0025T2	4	32	2	18	- 48	+ 13	+ 15
350	K	138D357X0025K2	1.3	24	7	28	- 70	+ 25	+ 25
30 WVDC at + 85 °C . . . 20 WVDC at + 125 °C									
8.0	C	138D805X0030C2	7.5	275	1	2	- 16	+ 8	+ 12
15	C	138D156X0030C2	8	175	1	2	- 20	+ 10.5	+ 12
40	F	138D406X0030F2	4	65	1	5	- 24	+ 10.5	+ 12
100	T	138D107X0030T2	6	40	2	12	- 28	+ 10.5	+ 12
150	T	138D157X0030T2	2.5	35	2	16	- 48	+ 13	+ 15
300	K	138D307X0030K2	1.6	25	8	32	- 60	+ 25	+ 25

Note

(1) Part Numbers listed are for units with outer plastic-film insulation and a capacitance tolerance of ± 20 %. For bare case units, substitute “0” for “2” at the end of the Part Number. For capacitors with ± 10 % tolerance, change the digit following the letter “X” to “9”. For RoHS compliant add “E3“.

Wet Tantalum Capacitors Sintered Anode TANTALEX® Capacitors Hermetically-Sealed with True Glass-to-Tantalum Seal

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		
					+ 25 °C	+ 85 °C + 125 °C	- 55 °C	+ 85 °C	+ 125 °C
35 WVDC at + 85 °C . . . 22 WVDC at + 125 °C									
68	F	138D686X0035F2	6	60	1	8	- 24	+ 12	+ 15
120	T	138D127X0035T2	4	38	2	16	- 30	+ 13	+ 15
270	K	138D277X0035K2	2.2	23	8	32	- 45	+ 20	+ 25
50 WVDC at + 85 °C . . . 30 WVDC at + 125 °C									
5.0	C	138D505X0050C2	9	400	1	2	- 16	+ 5	+ 6
10	C	138D106X0050C2	8	250	1	2	- 24	+ 8	+ 9
25	F	138D256X0050F2	6	95	1	5	- 20	+ 10.5	+ 12
47	F	138D476X0050F2	6	70	1	9	- 28	+ 10.5	+ 15
60	T	138D606X0050T2	3	45	2	12	- 16	+ 10.5	+ 12
82	T	138D826X0050T2	4	45	2	16	- 32	+ 13	+ 15
160	K	138D167X0050K2	2.2	27	8	32	- 50	+ 25	+ 25
60 WVDC at + 85 °C . . . 40 WVDC at + 125 °C									
4.0	C	138D405X0060C2	10	550	1	2	- 16	+ 5	+ 6
8.2	C	138D825X0060C2	8	275	1	2	- 24	+ 8	+ 9
20	F	138D206X0060F2	5	105	1	5	- 16	+ 10.5	+ 12
39	F	138D396X0060F2	7	90	1	9	- 28	+ 10.5	+ 12
50	T	138D506X0060T2	4	50	2	12	- 16	+ 10.5	+ 12
68	T	138D686X0060T2	6	50	2	16	- 32	+ 10.5	+ 12
140	K	138D147X0060K2	2.4	28	8	32	- 40	+ 20	+ 20
75 WVDC at + 85 °C . . . 50 WVDC at + 125 °C									
3.5	C	138D355X0075C2	10	650	1	2	- 16	+ 5	+ 6
6.8	C	138D685X0075C2	8	300	1	2	- 20	+ 8	+ 9
15	F	138D156X0075F2	6.5	150	1	5	- 16	+ 8	+ 9
33	F	138D336X0075F2	7	90	1	10	- 24	+ 10.5	+ 15
40	T	138D406X0075T2	5	60	2	12	- 16	+ 10.5	+ 12
56	T	138D566X0075T2	6	60	2	17	- 28	+ 10.5	+ 15
110	K	138D117X0075K2	3.1	29	9	36	- 35	+ 20	+ 20
100 WVDC at + 85 °C . . . 65 WVDC at + 125 °C									
2.5	C	138D255X0100C2	26.5	950	1	2	- 16	+ 7	+ 8
4.7	C	138D475X0100C2	10	500	1	2	- 16	+ 7	+ 8
11	F	138D116X0100F2	6	200	1	4	- 16	+ 7	+ 8
22	F	138D226X0100F2	7	100	1	9	- 16	+ 7	+ 8
30	T	138D306X0100T2	4	80	2	12	- 16	+ 7	+ 8
43	T	138D436X0100T2	6	70	2	17	- 20	+ 7	+ 8
86	K	138D866X0100K2	3.1	30	9	36	- 25	+ 15	+ 15
125 WVDC at + 85 °C . . . 85 WVDC at + 125 °C									
1.7	C	138D175X0125C2	54.6	1250	1	2	- 16	+ 7	+ 8
3.6	C	138D365X0125C2	15	600	1	2	- 16	+ 7	+ 8
9.0	F	138D905X0125F2	15	240	1	5	- 16	+ 7	+ 8
14	F	138D146X0125F2	12	167	1	7	- 16	+ 7	+ 8
18	T	138D186X0125T2	11	129	2	9	- 16	+ 7	+ 8
25	T	138D256X0125T2	10	93	2	13	- 16	+ 7	+ 8
56	K	138D566X0125K2	4.1	32	10	40	- 25	+ 15	+ 15

Note

(1) Part Numbers listed are for units with outer plastic-film insulation and a capacitance tolerance of ± 20 %. For bare case units, substitute “0” for “2” at the end of the Part Number. For capacitors with ± 10 % tolerance, change the digit following the letter “X” to “9”. For RoHS compliant add “E3“.

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		
					+ 25 °C	+ 85 °C + 125 °C	- 55 °C	+ 85 °C	+ 125 °C
6 WVDC at + 85 °C . . . 4 WVDC at + 125 °C									
560	F	138D567X0006F2	2.5	20	3	14	- 80	+ 16	+ 20
820	F	138D827X0006F2	2.5	18	3	14	- 88	+ 16	+ 20
1500	T	138D158X0006T2	1.5	18	5	20	- 90	+ 20	+ 25
2200	K	138D228X0006K2	1	13	6	24	- 90	+ 25	+ 30
8 WVDC at + 85 °C . . . 5 WVDC at + 125 °C									
180	C	138D187X0008C2	3	45	2	9	- 60	+ 13	+ 16
470	F	138D477X0008F2	2.5	25	3	14	- 75	+ 16	+ 20
680	F	138D687X0008F2	2.5	22	3	14	- 83	+ 16	+ 20
1800	K	138D188X0008K2	1	14	7	25	- 90	+ 20	+ 30
10 WVDC at + 85 °C . . . 7 WVDC at + 125 °C									
100	C	138D107X0010C2	3	60	2	9	- 50	+ 13	+ 16
150	C	138D157X0010C2	3	54	2	9	- 55	+ 13	+ 16
390	F	138D397X0010F2	2.5	30	3	16	- 70	+ 16	+ 20
560	F	138D567X0010F2	2.5	27	3	16	- 77	+ 16	+ 20
1200	T	138D128X0010T2	1.5	18	5	20	- 88	+ 20	+ 25
1500	K	138D158X0010K2	1	15	7	25	- 88	+ 25	+ 30
15 WVDC at + 85 °C . . . 10 WVDC at + 125 °C									
68	C	138D686X0015C2	4	80	2	9	- 40	+ 13	+ 16
100	C	138D107X0015C2	4	72	2	9	- 44	+ 13	+ 16
270	F	138D277X0015F2	2.5	35	3	16	- 60	+ 16	+ 20
390	F	138D397X0015F2	2.5	31	3	16	- 16	+ 16	+ 20
540	T	138D547X0015T2	1.8	25	6	24	- 70	+ 20	+ 25
820	T	138D827X0015T2	1.8	22	6	24	- 77	+ 20	+ 25
1000	K	138D108X0015K2	1.2	17	8	32	- 77	+ 25	+ 30
20 WVDC at + 85 °C . . . 13 WVDC at + 125 °C									
56	C	138D566X0020C2	4.3	90	2	9	- 38	+ 13	+ 16
82	C	138D826X0020C2	4.3	81	2	9	- 43	+ 13	+ 16
220	F	138D227X0020F2	2.7	35	3	16	- 60	+ 16	+ 20
330	F	138D337X0020F2	2.7	31	3	16	- 66	+ 16	+ 20
25 WVDC at + 85 °C . . . 15 WVDC at + 125 °C									
47	C	138D476X0025C2	4.3	100	2	9	- 35	+ 12	+ 15
68	C	138D686X0025C2	4.3	90	2	9	- 40	+ 12	+ 15
180	F	138D187X0025F2	2.7	37	3	16	- 55	+ 13	+ 16
270	F	138D277X0025F2	2.7	33	3	16	- 62	+ 13	+ 16
350	T	138D357X0025T2	1.8	27	7	28	- 60	+ 20	+ 25
30 WVDC at + 85 °C . . . 20 WVDC at + 125 °C									
39	C	138D396X0030C2	5.2	110	2	9	- 32	+ 12	+ 15
56	C	138D566X0030C2	5.2	100	2	9	- 38	+ 12	+ 15
150	F	138D157X0030F2	2.5	40	3	16	- 50	+ 13	+ 16
220	F	138D227X0030F2	2.5	36	3	16	- 60	+ 13	+ 16
330	T	138D337X0030T2	1.8	28	8	32	- 50	+ 20	+ 25
470	T	138D477X0030T2	1.8	25	8	32	- 65	+ 20	+ 25
560	K	138D567X0030K2	1.3	20	9	36	- 65	+ 25	+ 30

Note

(1) Part Numbers listed are for units with outer plastic-film insulation and a capacitance tolerance of ± 20 %. For bare case units, substitute “0” for “2” at the end of the Part Number. For capacitors with ± 10 % tolerance, change the digit following the letter “X” to “9”. For RoHS compliant add “E3“.

Wet Tantalum Capacitors Sintered Anode TANTALEX® Capacitors Hermetically-Sealed with True Glass-to-Tantalum Seal

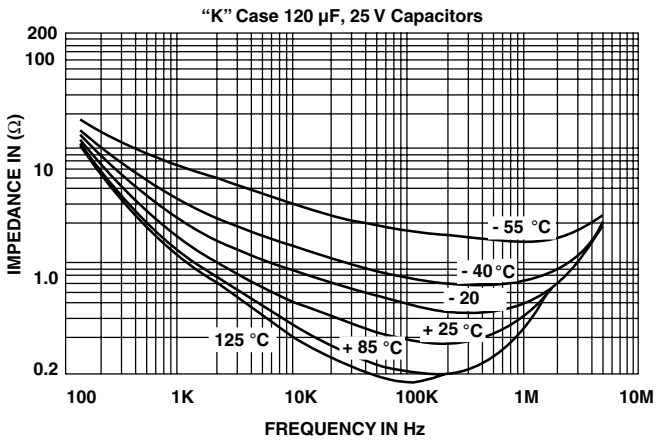
EXTENDED RATINGS

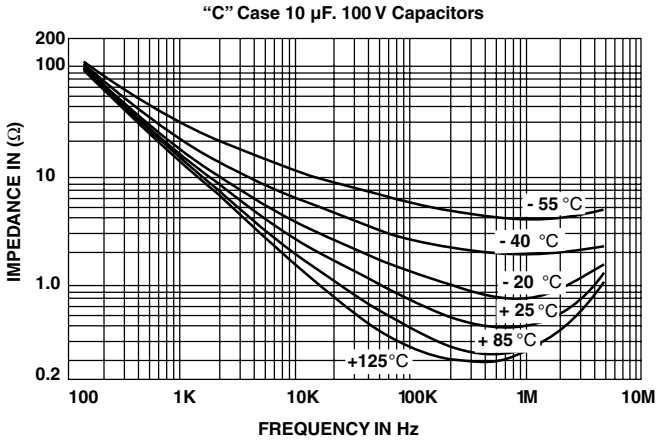
35 WVDC at + 85 °C . . . 22 WVDC at + 125 °C									
33	C	138D336X0035C2	5.2	130	2	9	- 30	+ 10	+ 12
47	C	138D476X0035C2	5.2	115	2	9	- 35	+ 10	+ 12
120	F	138D127X0035F2	2.5	45	3	16	- 45	+ 13	+ 16
220	T	138D227X0035T2	1.8	30	8	32	- 45	+ 20	+ 25
390	T	138D397X0035T2	1.8	27	8	32	- 58	+ 20	+ 25
470	K	138D477X0035K2	1.3	21	9	36	- 58	+ 25	+ 30
50 WVDC at + 85 °C . . . 30 WVDC at + 125 °C									
22	C	138D226X0050C2	5	150	2	9	- 24	+ 10	+ 12
33	C	138D336X0050C2	5	135	2	9	- 29	+ 10	+ 12
82	F	138D826X0050F2	2.5	55	4	24	- 35	+ 10	+ 15
120	F	138D127X0050F2	2.5	49	4	24	- 42	+ 12	+ 15
160	T	138D167X0050T2	1.8	32	6	32	- 35	+ 20	+ 25
270	T	138D277X0050T2	1.8	29	8	32	- 46	+ 20	+ 25
330	K	138D337X0050K2	1.5	22	9	36	- 46	+ 25	+ 30
60 WVDC at + 85 °C . . . 40 WVDC at + 125 °C									
18	C	138D186X0060C2	5	160	3	12	- 20	+ 10	+ 12
27	C	138D276X0060C2	5	144	3	12	- 24	+ 10	+ 12
68	F	138D686X0060F2	3	60	4	20	- 30	+ 12	+ 15
100	F	138D107X0060F2	2.5	54	4	20	- 36	+ 12	+ 15
140	T	138D147X0060T2	2	32	8	32	- 30	+ 16	+ 20
220	T	138D227X0060T2	1.8	29	8	32	- 40	+ 16	+ 20
270	K	138D277X0060K2	1.5	23	9	36	- 45	+ 20	+ 25
75 WVDC at + 85 °C . . . 50 WVDC at + 125 °C									
15	C	138D156X0075C2	5	175	3	12	- 16	+ 10	+ 12
22	C	138D226X0075C2	5	157	3	12	- 19	+ 10	+ 12
56	F	138D566X0075F2	3	70	4	24	- 25	+ 12	+ 15
82	F	138D826X0075F2	2.5	63	4	24	- 30	+ 12	+ 15
110	T	138D117X0075T2	2	33	9	36	- 25	+ 16	+ 20
180	T	138D187X0075T2	1.8	30	9	36	- 35	+ 16	+ 20
220	K	138D227X0075K2	2.2	24	10	40	- 40	+ 20	+ 25
100 WVDC at + 85 °C . . . 65 WVDC at + 125 °C									
8.2	C	138D825X0100C2	6	250	3	12	- 12	+ 10	+ 12
10	C	138D106X0100C2	6	200	3	12	- 17	+ 10	+ 12
33	F	138D336X0100F2	3.5	85	5	24	- 18	+ 12	+ 15
39	F	138D396X0100F2	3.5	80	5	24	- 20	+ 12	+ 15
68	T	138D686X0100T2	2.2	40	10	40	- 30	+ 14	+ 16
120	K	138D127X0100K2	2.8	30	12	48	- 35	+ 15	+ 17
125 WVDC at + 85 °C . . . 85 WVDC at + 125 °C									
6.8	C	138D685X0125C2	11.7	300	3	12	- 14	+ 10	+ 12
27	F	138D276X0125F2	3.5	90	5	24	- 18	+ 12	+ 15
39	T	138D396X0125T2	2.2	60	10	40	- 16	+ 14	+ 16
47	T	138D476X0125T2	2.2	50	10	40	- 26	+ 14	+ 16
82	K	138D826X0125K2	2.8	32	12	48	- 30	+ 15	+ 17

Note

(1) Part Numbers listed are for units with outer plastic-film insulation and a capacitance tolerance of ± 20 %. For bare case units, substitute “0” for “2” at the end of the Part Number. For capacitors with ± 10 % tolerance, change the digit following the letter “X” to “9”. For RoHS compliant add “E3“.

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 volts.

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 minute on, four and one-half minutes 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 volt 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 ohms
C = Capacitance in µF
f = frequency in Hz

At 120 Hz, the above equation becomes:

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

PERFORMANCE CHARACTERISTICS (Continued)

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:

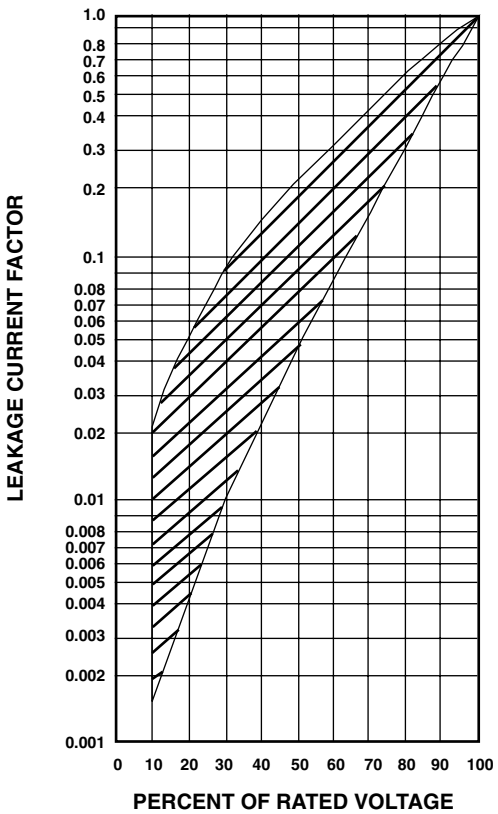
$$DF = \frac{2\pi \times 120 \times 3.4 \times 30}{10^4} = \frac{3.4 \times 30}{13.26} = 7.7\ \%$$

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 minutes 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 HERTZ			
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.

Disclaimer

All product specifications and data are subject to change without notice.

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 herein or in any other disclosure relating to any product.

Vishay disclaims any and all liability arising out of the use or application of any product described herein or of any information provided herein to the maximum extent permitted by law. The product specifications do not expand or otherwise modify Vishay’s terms and conditions of purchase, including but not limited to the warranty expressed therein, which apply to these products.

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.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications unless otherwise expressly indicated. Customers using or selling Vishay products not expressly indicated for use in such applications do so entirely at their own risk and agree to fully indemnify Vishay for any damages arising or resulting from such use or sale. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

Product names and markings noted herein may be trademarks of their respective owners.