MIL 39006/22

MIL Qualified - CLR79

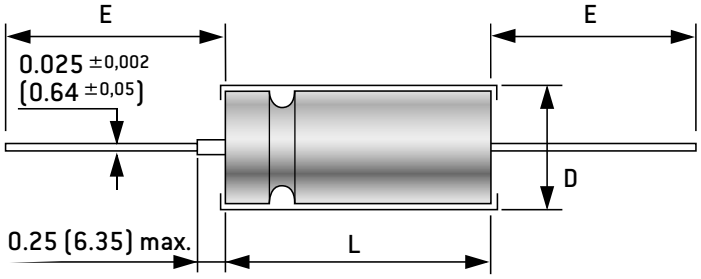
Wet tantalum capacitors
Hermetically sealed tantalum cases
High ripple current
Axial leads
Polarized

ELECTRICAL AND CLIMATIC CHARACTERISTICS

	MIL 39006/22
Detail specification	MIL-PRF-39006/22 Failure rate level M, level P, level R
Operating temperature	−55°C +125°C
Capacitance range	1,7µF ⇨ 1200µF
Tolerance	±10% - ±20%
Voltage range	6V ⇨ 125V
Max. capacitance change −55°C	see table
Max. capacitance change +85°C	see table
Max. capacitance change +125°C	see table
Maximum DF at +25°C	see table
Max. impedance at 120Hz −55°C	see table
Max. leakage current at +25°C	see table
Max. leakage current at +85°C / +125°C	see table
Max. ripple current at 40kHz +85°C	see table
Max. Reverse voltage at +85°C	3 volts
Max. Reverse voltage at +125°C	2 volts
Max. surge voltage at +85°C	1,15 x U_R

DIMENSIONS (mm)

Case code	Without insulating sleeve		With insulating sleeve	Lead length
	D ±0,41	L +0,79 −0,41	D max.	E ±6,35
T1	4,78	11,51	5,56	38,10
T2	7,14	16,28	7,92	57,15
T3	9,52	19,46	10,31	57,15
T4	9,52	26,97	10,31	57,15



PACKAGING, CONSTRUCTION:
see general characteristics

HOW TO ORDER

EXXELIA PN	Model code	Dash Number	Vibration and shock (optional)
	M39006/22	-0220	H

- = Without
H = With

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STANDARD RATINGS - ELECTRICAL CHARACTERISTICS

Capacitance 120Hz +25°C (µF)	Case (code)	Dash Number Failure Rate Level M			Dash Number Failure Rate Level P			Dash Number Failure Rate Level R			Capacitance maximum change			Max. DF +25°C (%)	Max. Impedance 120Hz −55°C (Ω)	Max. I leak		Irms Max. 40kHz +85°C (mA)	Max. ESR 120Hz +25°C (Ω)
		±5%	±10%	±20%	±5%	±10%	±20%	±5%	±10%	±20%	−55°C (%)	+85°C (%)	+125°C (%)			+25°C (µA)	+85°C +125°C (µA)		
Rated voltage (+85°C) 6 V - Derated voltage (+125°C) 4 V																			
30	T1	0003	0002	0001	0223	0222	0221	0443	0442	0441	−40	+10.5	+12	9	100	1	2	820	3.98
68	T1	0006	0005	0004	0226	0225	0224	0446	0445	0444	−40	+14	+16	15	60	1	2	960	3.16
140	T2	0009	0008	0007	0229	0228	0227	0449	0448	0447	−40	+14	+16	21	40	1	3	1200	1.99
270	T2	0012	0011	0010	0232	0231	0230	0452	0451	0450	−44	+17.5	+20	45	25	1	6.5	1375	2.21
330	T3	0015	0014	0013	0235	0234	0233	0455	0454	0453	−44	+14	+16	36	20	2	7.9	1800	1.45
560	T3	0018	0017	0016	0238	0237	0236	0458	0457	0456	−64	+17.5	+20	55	25	2	13	1900	1.30
1200	T4	–	0020	0019	–	0240	0239	–	0460	0459	−80	+25	+25	90	20	3	14	2265	1.00
Rated voltage (+85°C) 8 V - Derated voltage (+125°C) 5 V																			
25	T1	0023	0022	0021	0243	0242	0241	0463	0462	0461	−40	+10.5	+12	7.5	100	1	2	820	3.98
56	T1	0026	0025	0024	0246	0245	0244	0466	0465	0464	−40	+14	+16	14	59	1	2	900	3.32
120	T2	0029	0028	0027	0249	0248	0247	0469	0468	0467	−44	+17.5	+20	20	50	1	2	1220	2.21
220	T2	0032	0031	0030	0252	0251	0250	0472	0471	0470	−44	+17.5	+20	37	30	1	7	1370	2.23
290	T3	0035	0034	0033	0255	0254	0253	0475	0474	0473	−64	+17.5	+20	34	25	2	6	1770	1.56
430	T3	0038	0037	0036	0258	0257	0256	0478	0477	0476	−64	+17.5	+20	46	25	2	14	1825	1.42
850	T4	–	0040	0039	–	0260	0259	–	0480	0479	−80	+25	+25	60	22	4	16	2330	0.94
Rated voltage (+85°C) 10 V - Derated voltage (+125°C) 7 V																			
20	T1	0043	0042	0041	0263	0262	0261	0483	0482	0481	−32	+10.5	+12	6	175	1	2	820	3.98
47	T1	0046	0045	0044	0266	0265	0264	0486	0485	0484	−36	+14	+16	13	100	1	2	855	3.67
100	T2	0049	0048	0047	0269	0268	0267	0489	0488	0487	−36	+14	+16	15	60	1	4	1200	1.99
180	T2	0052	0051	0050	0272	0271	0270	0492	0491	0490	−36	+14	+16	30	40	1	7	1365	2.21
250	T3	0055	0054	0053	0275	0274	0273	0495	0494	0493	−40	+14	+16	30	30	2	10	1720	1.59
390	T3	0058	0057	0056	0278	0277	0276	0498	0497	0496	−64	+17.5	+20	44	25	2	16	1800	1.50
750	T4	–	0060	0059	–	0280	0279	–	0500	0499	−80	+25	+25	50	23	4	16	2360	0.88
Rated voltage (+85°C) 15 V - Derated voltage (+125°C) 10 V																			
15	T1	0063	0062	0061	0283	0282	0281	0503	0502	0501	−24	+10.5	+12	5	155	1	2	780	4.42
33	T1	0066	0065	0064	0286	0285	0284	0506	0505	0504	−28	+14	+16	10	90	1	2	820	4.02
70	T2	0069	0068	0067	0289	0288	0287	0509	0508	0507	−28	+14	+16	13	75	1	4	1150	2.46
120	T2	0072	0071	0070	0292	0291	0290	0512	0511	0510	−28	+17.5	+20	18	50	1	7	1450	1.99
170	T3	0075	0074	0073	0295	0294	0293	0515	0514	0513	−32	+14	+16	25	35	2	10	1480	1.95
270	T3	0078	0077	0076	0298	0297	0296	0518	0517	0516	−56	+17.5	+20	32	30	2	16	1740	1.57
540	T4	–	0080	0079	–	0300	0299	–	0520	0519	−80	+25	+25	40	23	6	24	2330	0.98
Rated voltage (+85°C) 25 V - Derated voltage (+125°C) 15 V																			
10	T1	0083	0082	0081	0303	0302	0301	0523	0522	0521	−16	+8	+9	4	220	1	2	715	5.31
22	T1	0086	0085	0084	0306	0305	0304	0526	0525	0524	−20	+10.5	+12	6.6	140	1	2	825	3.98
50	T2	0089	0088	0087	0309	0308	0307	0529	0528	0527	−28	+13	+15	11	70	1	2	1130	2.92
100	T2	0092	0091	0090	0312	0311	0310	0532	0531	0530	−28	+13	+15	15	50	1	10	1435	1.99
120	T3	0095	0094	0093	0315	0314	0313	0535	0534	0533	−32	+13	+15	21	38	2	6	1450	2.32
180	T3	0098	0097	0096	0318	0317	0316	0538	0537	0536	−48	+13	+15	26	32	2	18	1525	1.92
350	T4	–	0100	0099	–	0320	0319	–	0540	0539	−70	+25	+25	35	24	7	28	1970	1.33
Rated voltage (+85°C) 30 V - Derated voltage (+125°C) 20 V																			
8	T1	0103	0102	0101	0323	0322	0321	0543	0542	0541	−16	+8	+12	4	275	1	2	640	6.64
15	T1	0106	0105	0104	0326	0325	0324	0546	0545	0544	−20	+10.5	+12	5	175	1	2	780	4.42
40	T2	0109	0108	0107	0329	0328	0327	0549	0548	0547	−24	+10.5	+12	10	65	1	5	1120	3.32
68	T2	0112	0111	0110	0332	0331	0330	0552	0551	0550	−24	+13	+15	13	60	1	8	1285	2.54
100	T3	0115	0114	0113	0335	0334	0333	0555	0554	0553	−28	+10.5	+12	17	40	2	12	1450	2.26
150	T3	0118	0117	0116	0338	0337	0336	0558	0557	0556	−48	+13	+15	23	35	2	18	1525	2.03
300	T4	–	0120	0119	–	0340	0339	–	0560	0559	−60	+25	+25	31	25	8	32	1950	1.37

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STANDARD RATINGS - ELECTRICAL CHARACTERISTICS

Capacitance 120Hz +25°C (µF)	Case (code)	Dash Number Failure Rate Level M			Dash Number Failure Rate Level P			Dash Number Failure Rate Level R			Capacitance maximum change			Max. DF +25°C (%)	Max. Impedance 120Hz −55°C (Ω)	Max. I leak		Irms Max. 40kHz +85°C (mA)	Max. ESR 120Hz +25°C (Ω)
		±5%	±10%	±20%	±5%	±10%	±20%	±5%	±10%	±20%	−55°C (%)	+85°C (%)	+125°C (%)			+25°C (µA)	+85°C +125°C (µA)		
Rated voltage (+85°C) 50 V - Derated voltage (+125°C) 30 V																			
5	T1	0123	0122	0121	0343	0342	0341	0563	0562	0561	−16	+5	+6	3	400	1	2	580	7.96
10	T1	0126	0125	0124	0346	0345	0344	0566	0565	0564	−24	+8	+9	4	250	1	2	715	5.31
25	T2	0129	0128	0127	0349	0348	0347	0569	0568	0567	−20	+10.5	+12	8	95	1	5	1005	4.25
47	T2	0132	0131	0130	0352	0351	0350	0572	0571	0570	−28	+13	+15	11	70	1	9	1155	3.11
60	T3	0135	0134	0133	0355	0354	0353	0575	0574	0573	−16	+10.5	+12	12	45	2	12	1335	2.65
82	T3	0138	0137	0136	0358	0357	0356	0578	0577	0576	−32	+13	+15	15	45	2	16	1400	2.43
160	T4	–	0140	0139	–	0360	0359	–	0580	0579	−50	+25	+25	17	27	8	32	1900	1.41
Rated voltage (+85°C) 60 V - Derated voltage (+125°C) 40 V																			
4	T1	0143	0142	0141	0363	0362	0361	0583	0582	0581	−16	+5	+6	2.8	550	1	2	525	9.29
8.2	T1	0146	0145	0144	0366	0365	0364	0586	0585	0584	−24	+8	+9	4	275	1	2	625	6.47
20	T2	0149	0148	0147	0369	0368	0367	0589	0588	0587	−16	+10.5	+12	7	105	1	5	930	4.64
39	T2	0152	0151	0150	0372	0371	0370	0592	0591	0590	−28	+10.5	+12	10	90	1	9	1110	3.40
50	T3	0155	0154	0153	0375	0374	0373	0595	0594	0593	−16	+10.5	+12	10	50	2	12	1330	2.65
68	T3	0158	0157	0156	0378	0377	0376	0598	0597	0596	−32	+10.5	+12	13	50	2	16	1365	2.54
140	T4	–	0160	0159	–	0380	0379	–	0600	0599	−40	+20	+20	16	28	8	32	1850	1.52
Rated voltage (+85°C) 75 V - Derated voltage (+125°C) 50 V																			
3.5	T1	0163	0162	0161	0383	0382	0381	0603	0602	0601	−16	+5	+6	2.5	650	1	2	525	9.48
6.8	T1	0166	0165	0164	0386	0385	0384	0606	0605	0604	−20	+8	+9	3.5	300	1	2	610	6.83
15	T2	0169	0168	0167	0389	0388	0387	0609	0608	0607	−16	+8	+9	6	150	1	5	890	5.31
33	T2	0172	0171	0170	0392	0391	0390	0612	0611	0610	−24	+10.5	+15	10	90	1	10	1000	4.02
40	T3	0175	0174	0173	0395	0394	0393	0615	0614	0613	−16	+10.5	+12	9	60	2	12	1250	2.99
56	T3	0178	0177	0176	0398	0397	0396	0618	0617	0616	−28	+10.5	+15	11	60	2	17	1335	2.61
110	T4	–	0180	0179	–	0400	0399	–	0620	0619	−35	+20	+20	12	29	9	36	1850	1.45
Rated voltage (+85°C) 100 V - Derated voltage (+125°C) 65 V																			
2.5	T1	0183	0182	0181	0403	0402	0401	0623	0622	0621	−16	+7	+8	2	950	1	2	505	10.62
4.7	T1	0186	0185	0184	0406	0405	0404	0626	0625	0624	−16	+7	+8	3	500	1	2	565	8.47
11	T2	0189	0188	0187	0409	0408	0407	0629	0628	0627	−16	+8	+8	5	200	1	4	835	6.03
22	T2	0192	0191	0190	0412	0411	0410	0632	0631	0630	−16	+8	+8	7.5	100	1	9	965	4.52
30	T3	0195	0194	0193	0415	0414	0413	0635	0634	0633	−16	+8	+8	7	80	2	12	1240	3.10
43	T3	0198	0197	0196	0418	0417	0416	0638	0637	0636	−20	+8	+8	8.5	70	2	17	1335	2.62
86	T4	–	0200	0199	–	0420	0419	–	0640	0639	−25	+15	+15	10	30	9	36	1800	1.54
Rated voltage (+85°C) 125 V - Derated voltage (+125°C) 85 V																			
1.7	T1	0203	0202	0201	0423	0422	0421	0643	0642	0641	−16	+7	+8	2	1250	1	2	415	15.61
3.6	T1	0206	0205	0204	0426	0425	0424	0646	0645	0644	−16	+7	+8	2.7	600	1	2	520	9.95
9	T2	0209	0208	0207	0429	0428	0427	0649	0648	0647	−16	+7	+8	5	240	1	5	755	7.37
14	T2	0212	0211	0210	0432	0431	0430	0652	0651	0650	−16	+7	+8	6	167	1	7	860	5.69
18	T3	0215	0214	0213	0435	0434	0433	0655	0654	0653	−16	+7	+8	5	129	2	9	1130	3.69
25	T3	0218	0217	0216	0438	0437	0436	0658	0657	0656	−16	+7	+8	6	93	2	13	1200	3.18
56	T4	–	0220	0219	–	0440	0439	–	0660	0659	−25	+15	+15	6.5	32	10	40	1800	1.54

Electrical characteristics

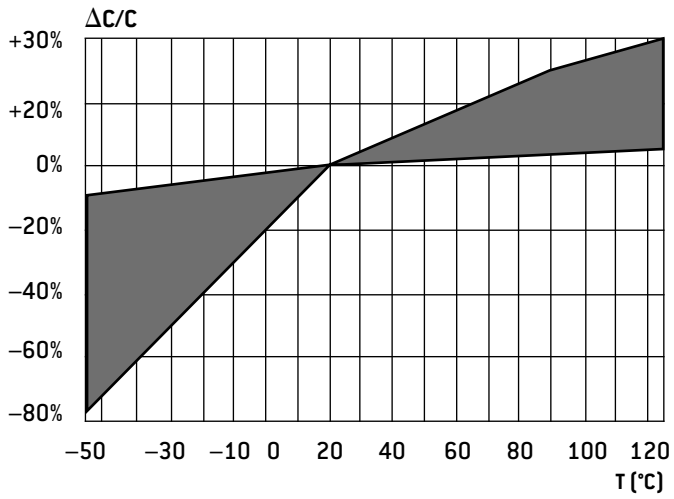
CAPACITANCE

The capacitance is defined by a rated value (C_R, indicated on the capacitor) and a tolerance (generally ±20%).

The capacitance is measured at a 100Hz or at a 120Hz frequency under a 0,1 to 1 V_{AC} voltage and a 2,1 to 2,5 V bias (or 9 to 10 V for $U_R \geq 100$ V).
At room temperature, it must be in the range defined by the rated value and the tolerance.

Capacitance change vs temperature: see typical curves below. Maximum changes are given, for each type, on the data sheets.

CAPACITANCE CHANGE VS TEMPERATURE

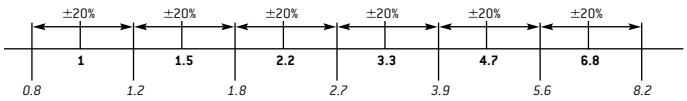


TOLERANCE (ON RATED CAPACITANCE)

It defines, with the rated capacitance, the range in which the capacitance value must be at room temperature.

e.g.: Rated capacitance: 100µF
Tolerance: 20%
The measured capacitance must be between:
100 - (20% of 100) = 80µF and 100 + (20% of 100) = 120µF

The standard tolerance for tantalum capacitors is 20%.

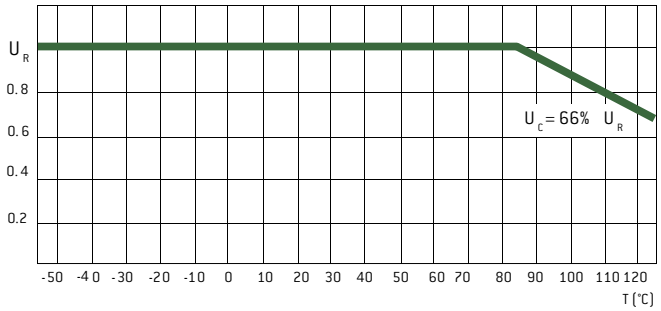


Electrical characteristics

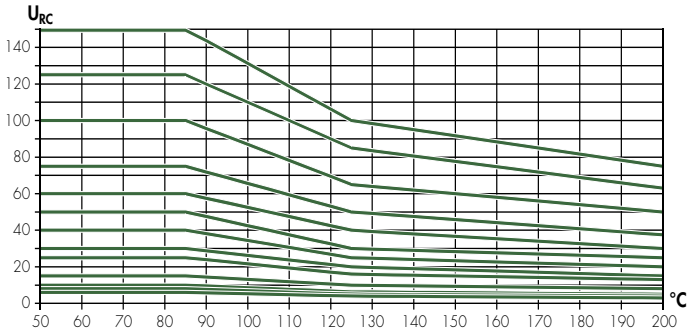
DIRECT DC VOLTAGE

The rated voltage (U_R), indicated on the capacitor, is the maximum DC voltage which can be applied continuously between –55°C and +85°C.

For the types which can be used up to 125°C, the voltage must be derated between +85°C and +125°C according to the following curve.



For the types which can be used up to 200°C, the voltage must be derated between +85°C and +200°C according to the following curve.



The category voltage (U_C) is consequently the maximum DC voltage which can be applied continuously at +125°C.

The surge voltage is the maximum voltage which can be applied for short periods.

It is given for each type in the data sheet and is generally equal to 1,15 times U_R between –55°C and +85°C and 1,15 times U_C at +125°C.

Tests are performed with charging periods of 30 seconds, through a 1000 Ω resistor, and discharging periods of 5 min 30s. 1000 cycles are done.

REVERSE VOLTAGE

Capacitors in silver cases (CT4, CT4E, CT9, CT9E) and some in tantalum cases (WT83, WS83) cannot withstand any reverse voltage: it would cause damage, more or less rapidly depending upon the voltage value.

It is therefore necessary to be sure that the bias voltage is high enough to avoid that the AC voltage creates a reverse voltage (negative peak).

Other capacitors in tantalum cases (CT79, CT79E, ST79, DSCC 93026, M39006/22 and M39006/25) can withstand a reverse voltage as specified in the individual datasheet.

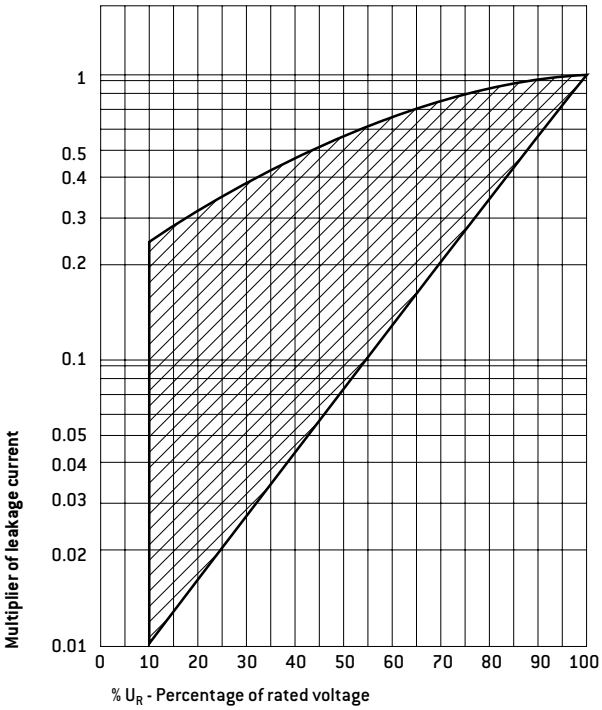
LEAKAGE CURRENT

Leakage current is the residual current which flows through the capacitor after the charging time, under rated voltage. It is measured after a time not exceeding 5 minutes and is given in μA.

It is equivalent to the insulation resistance of the capacitor and it must be as low as possible.

Maximum leakage current is a function of capacitance and rated voltage values and is given, for each type, in the data sheets.

LEAKAGE CURRENT CHANGE VS APPLIED VOLTAGE



Electrical characteristics

DISSIPATION FACTOR

Dissipation factor is generally measured at the same time as the capacitance, with the same conditions. It is a function of the series resistance of the capacitor and the capacitance at low frequency.

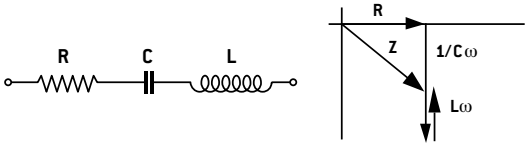
$$DF = ESR \times C \times 2\pi f$$

At low frequency, the series resistance is the sum of an ohmic part (leads, contacts, MnO_2) and the dielectric losses.

Dissipation factor is given in % and maximum limits are given for each type in the data sheets.

EQUIVALENT SERIES RESISTANCE OR IMPEDANCE

Equivalent circuit of a capacitor



- **R:** equivalent series resistance of the capacitor (leads,contacts, MnO_2, dielectric losses)
- **L:** inductance mainly due to the leads
- **C:** capacitance

Impedance

It is specified at 100Hz and –55°C and the formula for impedance is:

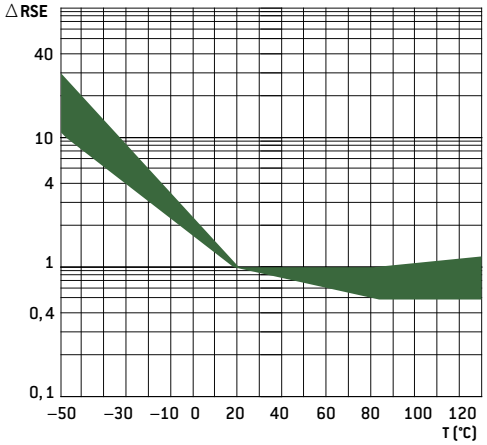
$$Z = \sqrt{R^2 + (L\omega - 1/C\omega)^2}$$

It can be seen that:

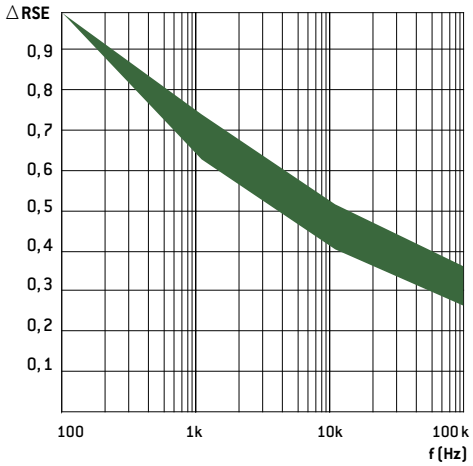
- at low frequencies, impedance is a function of capacitance
- at high frequencies, impedance is a function of inductance
- at medium frequencies, it is a function of the ESR

Maximum impedance: see data sheets.

ESR CHANGE VS TEMPERATURE



ESR CHANGE VS FREQUENCY



Electrical characteristics

MAXIMUM RIPPLE CURRENT

CT79/79E (SMD) - CT79/79E HT200 - ST79 (SMD) - ST79 HT200 - WT83 - WS83

Maximum ripple currents which are indicated in the data sheets are given for the following conditions:

Temperature: +85°C (+70°C only WT82)
Frequency: 40kHz
Applied voltage: 0,66
If conditions are different, use the multipliers given in the table below to calculate the new maximum current.

Frequency		100Hz				1kHz				10kHz				40kHz				100kHz			
Temperature		+55°C	+85°C	+105°C	+125°C	+55°C	+85°C	+105°C	+125°C	+55°C	+85°C	+105°C	+125°C	+55°C	+85°C	+105°C	+125°C	+55°C	+85°C	+105°C	+125°C
Peak voltage in % of U_R	66%	0,6	0,6	0,46	0,27	0,72	0,72	0,55	0,32	0,88	0,88	0,68	0,4	1	1	0,77	0,45	1,1	1,1	0,85	0,5
	70%	0,6	0,58	0,44	–	0,72	0,7	0,52	–	0,88	0,85	0,64	–	1	0,97	0,73	–	1,1	1,07	0,8	–
	80%	0,6	0,52	0,35	–	0,72	0,62	0,42	–	0,88	0,76	0,52	–	1	0,87	0,59	–	1,1	0,96	0,65	–
	90%	0,6	0,46	–	–	0,72	0,55	–	–	0,88	0,67	–	–	1	0,77	–	–	1,1	0,85	–	–
	100%	0,6	0,39	–	–	0,72	0,45	–	–	0,88	0,55	–	–	1	0,63	–	–	1,1	0,69	–	–

CT4 - CT4E - CT9 - CT9E TYPES

Maximum ripple currents which are indicated in the data sheets are given for the following conditions:

- frequency from 100Hz to 100kHz and more
- temperature from –55°C to +85°C

Correction vs temperature

If the temperature is higher than 85°C, decrease linearly the maximum value from 100% at +85°C to 80% at +125°C.

Correction vs frequency

If frequency is lower than 100Hz, apply the following multipliers to the maximum ripple currents:

75Hz: 0,79 **60Hz:** 0,65 **50Hz:** 0,55 **25Hz:** 0,55

OTHERS RULES (FOR ALL TYPES)

- the sum of the positive peak AC voltage and the DC bias voltage must be lower than the rated voltage.
- the negative peak must not create any Reverse voltage (or maximum 3 volts for CT79 and CT79E types).
- because of the increase of the series resistance at low temperature, it is better to not apply directly the maximum ripple current but to increase this one gradually to raise the capacitor temperature.

CLIMATIC CHARACTERISTICS

1- CLIMATIC CATEGORY

Climatic category defines the temperature range over which the capacitor can be used continuously, and also the number of days for the damp heat test (this test is performed periodically at 40°C with a 93% moisture rate).

Note: it is necessary to derate the voltage for temperatures higher than 85°C (see page 15).

2- THERMAL SHOCKS - RAPID CHANGES OF TEMPERATURE

This test is performed to check that the capacitors can withstand sudden temperature changes. The method which is used is the one with two chambers, one at –55°C, the other one at +125°C. Five cycles are performed, with 30min at low temperature and 30min at high temperature, during the periodical tests (30 cycles for CT79 type). Electrical characteristics are measured after this test.

3 - DAMP HEAT TEST

This test is performed during the periodical test, with the following conditions:

Temperature: 40°C
Humidity: 90 to 95%
DC voltage: without
Time: 21 or 56 days

Electrical characteristics are measured after this test.

MECHANICAL CHARACTERISTICS

1 - VIBRATIONS

This test is performed during the periodical test, with the following conditions:

CT9 - CT9E types

- Frequency: 10 to 2000Hz
- Amplitude: 1,5mm or 196m/s² - 20g
- Time: 6 hours

CT79/79E (SMD) - CT79/79E HT200 - ST79 (SMD) - ST79 HT200 - WT83 - WS83

- Frequency: 10 to 2000Hz
- Amplitude: 3,5mm or 490m/s² - 50g
- Time: 6 hours

2 - SHOCKS

This test is performed just after the vibrations test, with the following conditions for all types:

- Acceleration: 981 m/s² - 100g
- Pulse width: 6 ms
- Shape: 1/2 sinewave
- Number of shocks: 18 (3 in each direction, positive and negative)

Electrical characteristics

RELIABILITY

Reliability of a component can be defined as its probability to work without any failure, in defined conditions and during a fixed time.

Reliability is not therefore only a function of the component quality, but also of the application and environmental conditions.

The parameter which is the most commonly used for the reliability is the failure rate in time, generally expressed in % per 1000 hours.

CALCULATION OF A COMPONENT FAILURE RATE USED IN AN EQUIPMENT

The calculation method on the next page uses parmeters which are given by the CNET (Centre National d'Étude des Télécommunications) in its Reliability Data Book (RDF 1993).

The failure rate is calculated with parameters which are function of the capacitor (capacitance, case type, approvals, high surge current test) and others ones which are representative of application conditions (voltage, temperature, resistance in serie, environmental conditions).

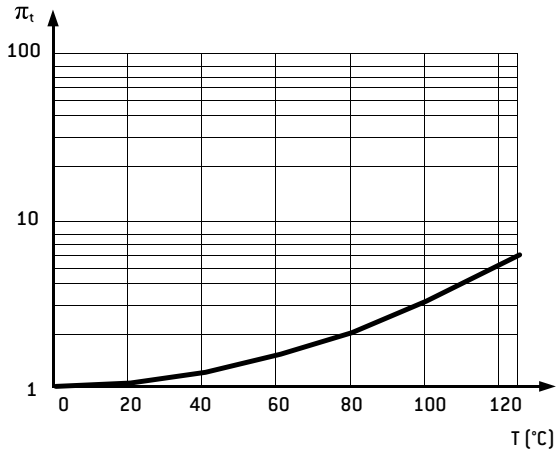
Example:

CT79E 2200µF - 6,3 V used under 3 volts, at 40°C, in a satellite in orbit:

$\pi_t = 1,2$ $\pi_V = 1,38$
$\pi_C = 1,4$ $\pi_E = 0,5$ $\pi_q = 1$

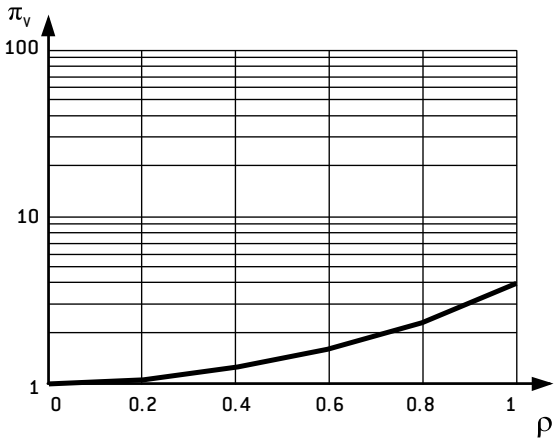
$\lambda = 3 \times 1,2 \times 1,38 \times 1,4 \times 0,5 \times 1.10^{-9}/h = 3,5.10^{-9}/h = 0,00035$ % defects/1000 hours

π_t = TEMPERATURE INFLUENCE



Formula: $\pi_t = \exp\{1,8.(t / tm)^2\}$
with: t = using temperature
tm = maximum temperature
Curve for tm = 125°C

π_V = INFLUENCE OF APPLIED VOLTAGE VS RATED VOLTAGE



Formula: $\pi_v = \exp\{(\rho / 0,85)^2\}$

$$\rho = \frac{\text{peak voltage}}{\text{rated voltage}}$$

Curve $\pi_v = f(\rho)$

π_C = INFLUENCE OF CAPACITANCE

3,3µF	$\pi_C = 0,9$
20µF	$\pi_C = 1,0$
1000µF	$\pi_C = 1,3$
2200µF	$\pi_C = 1,4$

π_E = INFLUENCE OF APPLICATION

Satellite in orbit	$\pi_E = 0,5$
Ground; stationary; protected	$\pi_E = 1$
Ground; stationary; non protected	$\pi_E = 2,5$
Ground; mobile; soft conditions	$\pi_E = 6$
Aircraft; soft conditions	$\pi_E = 6$
Ship; soft conditions	$\pi_E = 6$
Ground; mobile; hard conditions	$\pi_E = 8$
Ship; hard conditions	$\pi_E = 10$
Aircraft; hard conditions	$\pi_E = 15$
Satellite; launching	$\pi_E = 20$

π_q = INFLUENCE OF QUALIFICATION

Products approved to CECC	$\pi_q = 1,0$
Others products	$\pi_q = 2,0$

Electrical characteristics

PRODUCT SAFETY INFORMATION SHEET

This should read in conjunction with the Product Data Sheet/Specification.

Failure to observe the ratings, and the information on this sheet may result in a safety hazard.

1. MATERIAL CONTENT

Wet tantalum capacitors contain hazardous materials:

- Liquid electrolyte - gelled diluted sulphuric acid
- Solid tantalum anode

The device consists of solder coated terminal wires and the materials listed below:

- Silver case or tantalum case
- Rubber "o" rings
- PTFE spacers
- Filled epoxy resin end cap on silver case products

2. PHYSICAL FORM

These Capacitors are physically small and are cylindrical with axial leads.

3. INTRINSIC PROPERTIES

3.1 Operating

Wet tantalum capacitors will operate satisfactorily providing that the sum of the applied d.c. and the peak a.c. ripple voltage does not exceed the rated d.c. voltage.

There must be no reversal of polarity.

The maximum ripple currents and voltages and d.c. polarising voltages are specified in the data sheets.

Some tantalum cased devices will stand up to 3 V_{DC} Reverse for short periods of time.

A Reverse application of the rated voltage will result in loss of capacitance, early short circuit failure and may result in fire or explosion.

It may also cause consequential failure of other associated components in circuit, e.g. diodes, transformers, etc.

3.2 Non-Operating

Wet Tantalum capacitors contain electrolyte which is a conducting material.

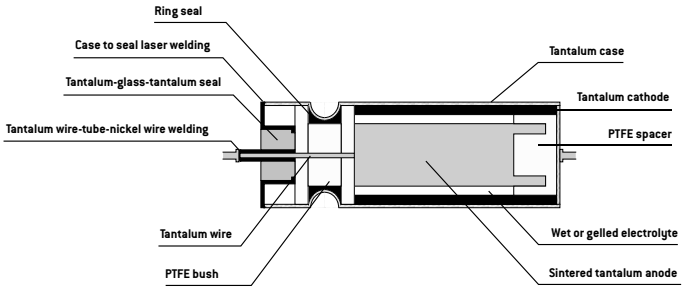
If electrolyte leaks onto a printed circuit board or similar insulated support, short circuits can be caused.

All electrolytes are corrosive to some extent.

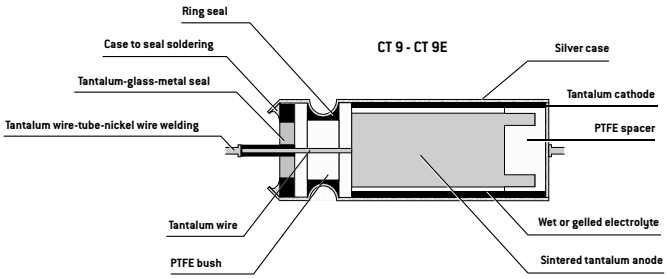
No electrolyte should be allowed to come in contact with the skin, eyes, etc., and if they do appropriate medical treatment should be applied.

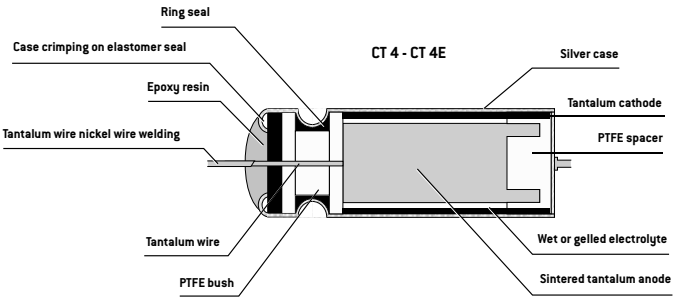
CONSTRUCTION

CT79/79E (SMD) - CT79/79E HT200 - ST79 (SMD) - ST79 HT200 - WT83 - WS83

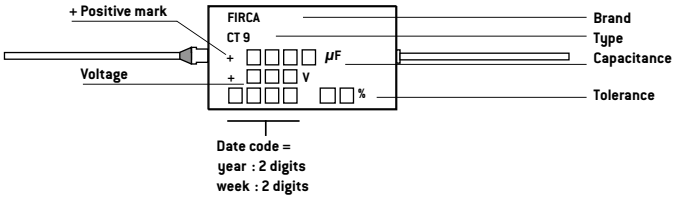


Glass metal seal: CT9 - CT9E
Epoxy sealing: CT4 - CT4E





MARKING (except DSCC 93026, M39006/22, M39006/25)



PACKAGING

In cardboard boxes

General information

Tantalum capacitors are, with ceramic, aluminum and film capacitors, one of the most used family.

The manufacturing technology and the constant improvements in tantalum powders allow it to be the capacitor with the highest CV (product capacitance x voltage) per volume, very long life and high reliability.

It has also the following advantages:

- Wide range of capacitance (less than 1μF to more than 10 000μF)
- Wide operating temperature range (–55°C to +200°C)
- Electrical characteristics stable with temperature
- Low leakage current
- Very low ESR for some types
- Stability after long periods of storage , without any reforming

All these characteristics allow tantalum capacitors to be commonly used either in large volume markets like mobile phones or computers, or in specific High-Rel applications such as space, aerospace and military.

Its main uses are found in the following functions:

- Filtering
- Bypass
- Coupling
- RC time constant
- Energy storage

Tantalum capacitors can be divided into two main families and several subfamilies:

Solid tantalum capacitors:

- Solid MnO_2
  - Metal cases
  - Molded cases
  - SMD
- Solid Polymer
  - SMD

Wet tantalum capacitors:

- Silver cases
- Tantalum cases

HOW TO USE THE SELECTION GUIDE

1 - The **Technical Selection Guide** can be used to select a product according to the main technical requirements.

2 - The **Classification according to specification** makes the link between all major standard specifications and the products.

3 - The **Selection Guide** by family has the same classification as in the catalogue. You will find for each type the main features, the approvals and the page number of the technical data sheet.

MANUFACTURING

ANODE AND INSULATOR

Tantalum capacitors are the capacitors which have the highest ratio of capacitance per volume. This is mainly due to the high dielectric coefficient of its insulator and to its large cross-section.

The basic raw material is a high purity (greater than 99,99%) tantalum powder with a very fine granulation, compressed to form a cylinder or a parallelipiped constituting the anode of the capacitor (positive plate).

The pellet is then sintered at high temperature (1200°C to 2200°C), under high vacuum (10^{-6} Torr), firstly to purify the powder and secondly to obtain a strong mechanical structure by a welding of the particles.

The insulating part is obtained by anodization to a depth of the tantalum surface which forms a tantalum pentoxide film (Ta_2O_5) with a thickness of about 16 angstroms per anodization volt. The dielectric coefficient is between 21 and 27 depending upon the anodization conditions.

WET ELECTROLYTE: CATHODE AND ENCAPSULATION

In this case, the cathode is formed by a sulphuric acid solution. The anodized tantalum pellet is impregnated with this solution and then placed in a silver or tantalum case, into which some equivalent gelled solution have been previously deposited.

The case is then crimped on the internal PTFE gasket to make the sealing. The final steps are welding (CT79), soldering (CT9) or elastomer seal (CT4) depending on the capacitors.

SOLID ELECTROLYTE: CATHODE AND ENCAPSULATION

In this case, the cathode is formed either by managanous dioxide which is a grey semi conductor or by polymer solution.

Solid MnO_2 cathode is obtained by dipping the pellets into a manganous nitrate water solution which impregnates the internal structure; this solution is then decomposed in a high temperature oven to obtain manganous dioxide. This operation is repeated several times. The nature and quality of this semiconductor are important to some of the electrical parameters (especially the serial resistance).

To finish the negative plate, a graphite coating and then a silver coating are deposited on the outside surface of the manganous dioxide or conducting polymer.

The positive nickel lead is welded on the tantalum wire and the negative lead is either soldered for the products with axial leads or glued with a silver epoxy for the SMD range.

BURN-IN - SORTING - INSPECTION

All the products are submitted to a final burn-in, with differing severities depending upon the characteristics of each type (temperature, voltage, duration).

Then follows the sorting, marking and inspection operations. It can be noted that the procedures for these operations are the same for approved and non approved parts (except the periodical tests).

General information

TYPE IDENTIFICATION - ORDERING INFORMATION

THE COMPLETE IDENTIFICATION OF A PRODUCT IS MADE OF

- The type (or model)
- The case size
- The rated capacitance
- The tolerance
- The rated voltage
- If applicable the CECC specification number

THE TYPE

It can be expressed with the commercial description (CTC21E C 33μF 10% 40V) or the **EXXELIA** part number (TS22EC336K040F).
When applicable the CECC specification number should be indicated.

THE CASE SIZE

It is indicated on the technical data sheets in front of each capacitance-voltage value and is generally identified by a letter code . It is important to give this information because there can be, for the same type, a standard range and an extended range in which the same value will be available in two different sizes.

THE RATED CAPACITANCE

It can be expressed:

- Directly in μF (eg: 47μF)
- Coded according to MIL specification, with:
  - 2 digits number for the value
  - A multiplying factor to obtain the capacitance in pF (power of 10)

Eg: 567 = 56.10^7 pF = 560μF

THE TOLERANCE

It can be expressed directly in % or identified by a code letter:

M = ±20%
K = ±10%
J = ±5%

N.B.: the standard tolerance for tantalum capacitors is 20%; if no tolerance is specified, it would be considered as 20%.

A 20% tolerance means in fact –20% to +20%.

THE RATED VOLTAGE

It is expressed directly in volts (V)

N.B.: 6,3V rated voltage can be coded as 6V.

CECC SPECIFICATIONS

Some of the products which are described in this catalogue are made to a CECC specification; these documents give in detail the following information for each type:

- The climatic, electrical and mechanical characteristics
- The test and inspection procedures
- The sampling methods and levels
- The tests periods

The reference specifications concerning the tantalum capacitors are the following:

CECC 30 000 (NFC 83-100)

Generic specification: fixed capacitors

- Terminology
- Quality Assessment Procedures
- Test and inspection methods

CECC 30 200 (NFC 83-112)

Sectional specification: tantalum capacitors

- Prefered characteristics
- Quality Assessment Procedures
- Test and inspection methods

CECC 30 201 XXX

Detail specifications solid tantalum capacitors

- Detailed characteristics for each type

CECC 30 202 XXX

Detail specifications wet tantalum capacitors

- Detailed characteristics for each type

CECC 30 800 (NFC 83-113)

Sectional specification: tantalum chip capacitors

- Prefered characteristics
- Quality Assessment Procedures
- Test and inspection methods

CECC 30 801 XXX

Detail specifications tantalum chip capacitors

- Detailed characteristics for each type
- The list of all the detail specifications is given in the selection guide, with the corresponding type.

NB: Some of the products refer to specifications which are no longer published.

OTHER SPECIFICATIONS

In addition to CECC approvals, some of the products are qualified to MIL standard M39006/22, M39006/25, DSCC DWG No. 93026 and some others are listed in ESA (European Space Agency) Preferred Parts Lists ESCC EPPL I or II.