

# Operational life time section

## LIFE TIME CALCULATION OF RIFA ELECTROLYTIC CAPACITORS

$$P_{\text{LOSS}} = I_{\text{RMS}}^2 \times \text{ESR}$$

$$P_{\text{LOSS}} = \text{Power losses in the capacitor}$$

$$I_{\text{RMS}} = \text{Ripple current}$$

$$\text{ESR} = \text{Equivalent serie resistance}$$

$$T_h = T_a + P_{\text{LOSS}} \times R_{\text{th}}$$

$$T_h = \text{Hot spot temperature}$$

$$T_a = \text{Ambient temperature}$$

$$R_{\text{th}} = \text{Thermal resistance}$$

$$A = \text{Expected life time at } 85^\circ\text{C hotspot temperature}$$

$$L_{\text{OP}} = \text{Expected life time} = A \times 2^{\frac{85-T_h}{C}} \text{ hours}$$

Capacitor	Diameter	A	C
PEG124	10	36000	11
	13	43000	11
	16	65000	11
	20	97000	11
PEG 126	16	64000	12
	20	85000	12
PEH 124	18	65000	11
PEH 532	22-40	6500	12
PEH 534	22-40	13000	12
PEH 536	22-40	19500	12
PEH 506	22-40	6000	12
PEH 526	25-35	63000*	12
PEH 169	35	29000	12
	50	35000	12
	65	44000	12
	75	58000	12
	90	78000	12
PEH 200	35	20000	12
	50	24000	12
	65	30000	12
	75	40000	12
	90	60000	12

\* =  $L_{\text{OP}}$  (125°C) limited to 4000h

Capacitor		Max $T_a$	Max $T_h$ at Max $T_a$
PEG 124	125°C	125°C	129°C
	105°C	105°C	108°C
PEG 126	150°C	150°C	151°C
PEH 124	125°C	125°C	129°C
PEH 532	105°C	105°C	110°C
PEH 534	105°C	105°C	110°C
PEH 536	105°C	105°C	110°C
PEH 506	85°C	85°C	97°C
PEH 526	125°C	125°C	129°C
PEH 169	85°C	85°C	100°C ( $U_R \leq 420$ VCD)
	85°C	85°C	95°C ( $U_R = 450$ VDC)
	105°C	105°C	112°C
PEH 200	85°C	85°C	100°C
	105°C	105°C	110°C

CALCULATION EXAMPLE

**Article No:** PEH2000O427AMB2

**Input:** Ambient temperature = 70°C  
 Ripple current = 30A (10kHz)  
 ESR (85°C, 10 kHz) = 5.8 mΩ  
 Thermal resistance  $R_{th} = 2.6^\circ\text{C/W}$

**Calculation:**  $P_{LOSS} = I_{RMS}^2 \times ESR = 30^2 \times 5.8 \times 10^{-3} = 5.3 \text{ W}$   
 Hot spot temp.  $T_h = T_a + R_{th} \times P_{LOSS} = 70 + 2.6 \times 5.3 = 84^\circ\text{C}$   
 The assumption of hot-spot temp  $85^\circ\text{C}$  when we get ESR was OK!

**Output:** Expected Life time  $L_{OP} = 30000 \times 2^{\frac{85-84}{12}} = 31\text{k hours}$

**Remark!** ESR ( $T_h, f$ ) values, of a given article number, is available upon request. Please contact customer support.

Equivalent series resistance factor k as a function of frequency and winding hot-spot temperature.

$k = \text{ESR}(T_{hs}, f) / \text{ESR}(20^\circ\text{C}, 100\text{Hz})$        $\text{ESR}(20^\circ\text{C}, 100\text{Hz}) = 26 \text{ m}\Omega$  (Maximum value)  
 18 mΩ (Typical value)

Freq. f kHz	Hot-spot temperature $T_h$ (°C)													
	-40	-30	-20	-10	0	10	20	30	40	50	60	70	85	100
0.050	13.0	7.9	4.9	3.1	2.2	1.7	1.5	1.5	1.5	1.5	1.5	1.5	1.6	1.7
0.100	12.5	7.4	4.4	2.6	1.7	1.2	1.0	0.93	0.89	0.88	0.88	0.88	0.91	0.95
0.200	12.2	7.2	4.1	2.4	1.4	0.96	0.75	0.66	0.61	0.58	0.56	0.56	0.56	0.58
0.300	12.2	7.1	4.0	2.3	1.3	0.88	0.66	0.57	0.52	0.48	0.46	0.45	0.45	0.45
0.400	12.1	7.1	4.0	2.2	1.3	0.84	0.62	0.52	0.47	0.43	0.41	0.39	0.39	0.39
0.500	12.1	7.0	4.0	2.2	1.3	0.81	0.60	0.50	0.44	0.40	0.38	0.36	0.35	0.36
0.600	12.1	7.0	3.9	2.2	1.3	0.80	0.58	0.48	0.42	0.38	0.35	0.34	0.33	0.33
0.800	12.1	7.0	3.9	2.2	1.2	0.78	0.56	0.46	0.40	0.36	0.33	0.31	0.30	0.30
1.000	12.0	7.0	3.9	2.2	1.2	0.76	0.55	0.44	0.39	0.34	0.31	0.29	0.28	0.28
2.000	12.0	7.0	3.9	2.1	1.2	0.74	0.52	0.42	0.36	0.31	0.28	0.26	0.25	0.24
5.000	12.0	6.9	3.9	2.1	1.2	0.72	0.51	0.40	0.34	0.30	0.26	0.24	0.23	0.22
10.000	12.0	6.9	3.9	2.1	1.2	0.72	0.50	0.40	0.34	0.29	0.26	0.23	0.22	0.21
20.000	12.0	6.9	3.9	2.1	1.2	0.71	0.50	0.39	0.33	0.29	0.25	0.23	0.22	0.21
50.000	12.0	6.9	3.9	2.1	1.2	0.71	0.50	0.39	0.33	0.29	0.25	0.23	0.21	0.21
100.000	12.0	6.9	3.9	2.1	1.2	0.71	0.50	0.39	0.33	0.29	0.25	0.23	0.21	0.21