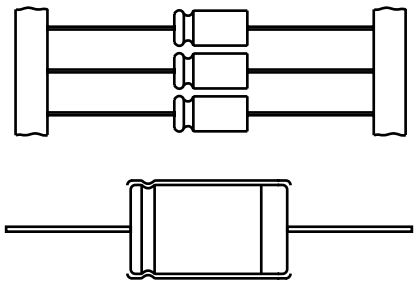
Aluminum Capacitors
Axial Capacitor Style



Component outlines

FEATURES

- Polarized aluminum electrolytic capacitors
- High ripple current capability
- Very long lifetime
- Charge/discharge proof
- Temperature range 105 °C

Pb-free
RoHS COMPLIANT

APPLICATIONS

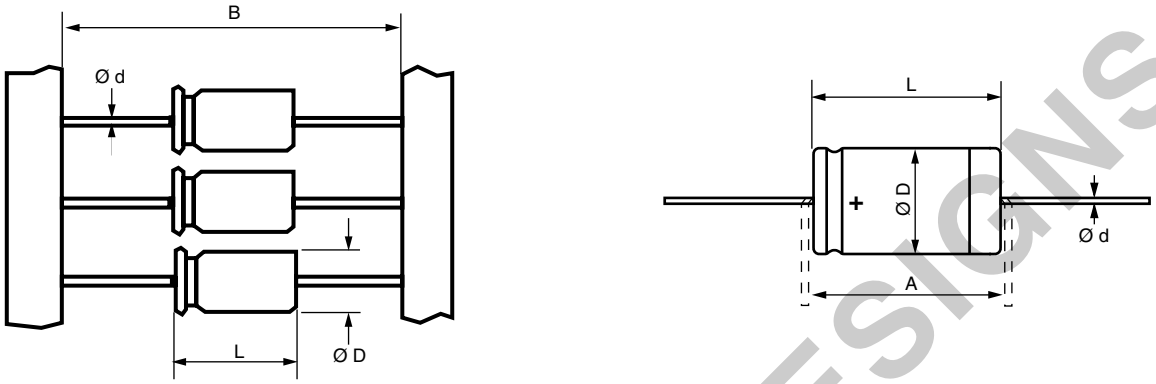
- Industrial and automotive electronics, audio/video, telecommunication systems, power supply units
- Coupling, smoothing, filtering, buffering and timing

QUICK REFERENCE DATA			
DESCRIPTION	**UNIT**	**LOW VOLTAGE**	**HIGH VOLTAGE**
Nominal case size (Ø D x L)	mm	6.5 x 18 to 10 x 25	6.5 x 18 to 10 x 25
Rated capacitance range C_R	µF	4.7 to 470	1.0 to 22
Capacitance tolerance	%	- 10/+ 50	
Rated voltage range	V	16 to 100	160 to 350
Category temperature range	°C	- 40 to + 105	
Endurance test at upper category temp.	h	2000	
Useful life at 105 °C and I_R applied	h	3000	3000
Useful life at 85 °C and I_R applied	h	11 000	11 000
Useful life at 40 °C and I_R applied	h	330 000	330 000
Shelf life (0 V, 105 °C)	h	100	
Failure rate	10^{-9}/h	≤ 14	≤ 14
Based on sectional specification		IEC 60384-4, EN130300	
Based on detailed specifications		CECC 30301-003, CECC 30301-801 DIN 45910 Part 123, without quality assessment	
Climatic category IEC 60068 DIN 40040		40/105/56 GMF	

SELECTION CHART FOR C_R, U_R AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)

C_R (µF)	U_R (V)							
	16	**25**	**40**	**63**	**100**	**160**	**250**	**350**
1.0	→	→	→	→	→	→	→	6.5 x 18
2.2	→	→	→	→	→	6.5 x 18	8 x 18	8 x 18
4.7	→	→	→	→	→	→	→	10 x 18
47	6.5 x 18	8 x 18	8 x 18	10 x 18	10 x 25	12 x 30	-	-
100	8 x 18	10 x 18	10 x 18	12 x 25	12 x 30	-	-	-
220	10 x 18	10 x 25	12 x 25	12 x 30	-	-	-	-
470	10 x 25	-	-	-	-	-	-	-

DIMENSIONS in millimeters AND AVAILABLE FORMS



AXIAL: DIMENSIONS in millimeters, MASS, PACKAGING AND ORDERING CODE

CASE SIZE Ø D x L	LEAD Ø d	Ø $D_{max.}$	$L_{max.}$	$A_{min.}$	B	WEIGHT APPROX. g	PACKAGING, ENDING OF ORDERING CODE, QUANTITIES			
							TAPED ON REEL		TAPED AMMO	
							code	pieces	code	pieces
6.5 x 18	0.8	6.9	18.5	25	73.0 ± 1.6	1.3	..A0W	1000	..B0W	1000
8 x 18	0.8	8.5	18.5	25	73.0 ± 1.6	1.7	..A0W	500	..B0W	500
10 x 18	0.8	10.5	18.5	25	73.0 ± 1.6	2.5	..A0W	500	..B0W	500
10 x 25	0.8	10.5	25.5	30	73.0 ± 1.6	3.3	..A0W	500	..B0W	500

Axial style capacitors are insulated.

ELECTRICAL DATA

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz
U_R	rated voltage
tan δ	max. dissipation factor at 100 Hz
R_{ESR}	equivalent series resistance at 100 Hz, (calculated from tan $\delta_{max.}$ and C_R)
Z	max. impedance at 10 kHz
I_R	rated alternating current (rms) at 100 Hz and upper category temperature
T_a	ambient temperature
T_{uc}	upper category temperature
RH	relative humidity
P	ambient pressure

Note

Unless otherwise specified, all electrical values apply at T_a = 20 °C, P = 80 to 106 kPa, RH = 45 to 75 %.

ORDERING EXAMPLE

The following table gives the ordering number.

The 16th place of ordering code refers to packaging for axial lead capacitors:

MALAEBC00FL210J...	EBC 1000 µF 63 V 8 x 18
MALAEBC00FL210JA0W	A = taped on reel
MALAEBC00FL210JB0W	B = taped ammo

Please see table “Axial Styles” for available versions.

ELECTRICAL DATA AND ORDERING INFORMATION

U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	tan δ 100 Hz max.	R_{ESR} 100 Hz (Ω)	Z 10 kHz max. (Ω)	I_R 100 Hz T_{UC} (A)	CATALOG NUMBER MALA...
16	47	6.5 x 18	0.14	4.7	2.6	0.095	EBC00DL247DA0W
	100	8 x 18	0.14	2.2	1.2	0.15	EBC00FL310DA0W
	220	10 x 18	0.14	1.0	0.55	0.25	EBC00GL322DA0W
	470	10 x 25	0.14	0.47	0.26	0.45	EBC00GD347DA0W
25	22	6.5 x 18	0.11	8.0	4.1	0.060	EBC00DL222EA0W
	47	8 x 18	0.11	3.7	1.9	0.11	EBC00FL247EA0W
	100	10 x 18	0.11	1.8	0.90	0.18	EBC00GL310EA0W
	220	10 x 25	0.11	0.80	0.40	0.34	EBC00GD322EA0W
40	10	6.5 x 18	0.10	16	7.5	0.046	EBC00DL210GA0W
	22	8 x 18	0.10	7.2	3.4	0.080	EBC00FL222GA0W
	47	8 x 18	0.09	3.0	1.6	0.12	EBC00FL247GA0W
	100	10 x 18	0.09	1.4	0.75	0.21	EBC00GL310GA0W
63	4.7	6.5 x 18	0.07	24	12	0.038	EBC00DL147JA0W
	10	8 x 18	0.07	11	5.5	0.064	EBC00FL210JA0W
	22	8 x 18	0.07	5.1	2.5	0.10	EBC00FL222JA0W
	47	10 x 18	0.07	2.4	1.2	0.17	EBC00GL247JA0W
100	4.7	6.5 x 18	0.06	20	9.6	0.048	EBC00DL147LA0W
	10	8 x 18	0.06	9.5	4.5	0.073	EBC00FL210LA0W
	22	10 x 18	0.06	4.3	2.0	0.13	EBC00GL222LA0W
	47	10 x 25	0.06	2.0	1.0	0.22	EBC00GD247LA0W
160	2.2	6.5 x 18	0.10	72	55	0.022	EBC00DL122MA0W
	4.7	8 x 18	0.10	34	26	0.037	EBC00FL147MA0W
	10	10 x 18	0.10	16	12	0.061	EBC00GL210MA0W
	22	10 x 25	0.10	7.2	5.5	0.12	EBC00GD222MA0W
250	2.2	8 x 18	0.10	72	50	0.025	EBC00FL122NA0W
	4.7	10 x 18	0.10	34	23	0.037	EBC00GL147NA0W
	10	10 x 25	0.10	16	11	0.066	EBC00GD210NA0W
350	1.0	6.5 x 18	0.10	159	100	0.015	EBC00DL110OA0W
	2.2	8 x 18	0.10	72	45	0.025	EBC00FL122OA0W
	4.7	10 x 18	0.10	34	21	0.043	EBC00GL147OA0W

ADDITIONAL ELECTRICAL DATA

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	$U_R \leq 100$ V	$U_s = 1.15 \times U_R$
	$U_R \geq 160$ V	$U_s = 1.10 \times U_R$
Reverse voltage	-	$U_{rev} \leq 1$ V
Current		
Leakage current	$U_R \leq 100$ V U_R, 300 s $U_R \geq 160$ V U_R, 300 s	$I_L/\mu A \leq 0.0015 \times C_R/\mu F \times U_R/V + 3$ $I_L/\mu A \leq 0.0150 \times C_R/\mu F \times U_R/V + 10$

LOW TEMPERATURE BEHAVIOUR

Table for the calculation of the maximum 10 kHz impedance at low temperatures:

$$Z\,(10\,kHz)\,[\Omega] = \frac{Tabular\,value}{C_R\,[\mu F]}$$

T_a (°C)	RATED VOLTAGE (V)							
	16	**25**	**40**	**63**	**100**	**160**	**250**	**350**
- 25	2250	1500	850	600	450	1000	940	860
- 40	5400	3600	2040	1440	1080	5000	4600	4200

The lower limit of the series resistance and impedance is determined by the ohmic part of the contact points and the foil resistance values. Therefore it will not always be possible to achieve calculated values below 0.05 Ω.

LIFETIME TABLE $U_R \leq 100$ V

INTERRELATION BETWEEN ALTERNATING CURRENT, AMBIENT TEMPERATURE AND LIFETIME																				
I/I_R (FREQUENCY DEPENDENT)							LIFETIME MULTIPLIER L (depending on I/I_R and T_a)													
FREQUENCY [Hz]							AMBIENT TEMPERATURE T_a [°C]													
50	**100**	**250**	**500**	**1000**	**> 2500**	**10 K**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**	**105**
0	0	0	0	0	0	0	200	127	81	53	35	23	16	11	7.4	5.1	3.6	2.6	1.84	1.33
0.18	0.20	0.22	0.23	0.24	0.25	0.26	195	123	79	52	34	23	15	10	7.2	5.0	3.5	2.5	1.81	1.31
0.36	0.40	0.44	0.46	0.48	0.50	0.52	179	115	74	48	32	21	14	9.9	6.9	4.8	3.4	2.4	1.73	1.26
0.54	0.60	0.66	0.69	0.72	0.75	0.78	158	102	66	44	29	20	13	9.1	6.3	4.5	3.2	2.3	1.63	1.19
0.72	0.80	0.88	0.92	0.96	1.00	1.04	135	87	57	38	26	17	12	8.3	5.8	4.1	2.9	2.1	1.51	1.10
0.90	1.00	1.10	1.15	1.20	1.25	1.30	112	73	49	33	22	15	10	7.3	5.1	3.6	2.6	1.9	1.37	1.00
1.08	1.20	1.32	1.38	1.44	1.50	1.56	90	60	40	27	19	13	9.0	6.3	4.5	3.2	2.3	1.7	1.21	
1.26	1.40	1.54	1.61	1.68	1.75	1.82	70	47	32	22	15	11	7.5	5.3	3.8	2.7	2.0	1.4	1.06	
1.44	1.60	1.76	1.84	1.92	2.00	2.08	54	37	25	18	12	8.8	6.2	4.4	3.2	2.3	1.7	1.2		
1.62	1.80	1.98	2.07	2.16	2.25	2.34	40	28	20	14	9.9	7.0	5.0	3.6	2.6	1.9	1.4	1.0		
1.80	2.00	2.20	2.30	2.40	2.50	2.60	30	21	15	11	7.7	5.6	4.0	2.9	2.2	1.6	1.2			
1.98	2.20	2.42	2.53	2.64	2.75	2.86	22	16	11	8.2	6.0	4.3	3.2	2.3	1.7	1.3				
2.16	2.40	2.64	2.76	2.88	3.00	3.12	16	11	8.4	6.1	4.5	3.3	2.5	1.8	1.4	1.0				
2.34	2.60	2.86	2.99	3.12	3.25	3.38	11	8.3	6.1	4.6	3.4	2.5	1.9	1.4	1.1					
2.52	2.80	3.08	3.22	3.36	3.50	3.64	7.9	5.9	4.5	3.4	2.5	1.9	1.5	1.1						
2.70	3.00	3.30	3.45	3.60	3.75	3.90	5.5	4.2	3.2	2.5	1.9	1.4	1.1							
2.88	3.20	3.52	3.68	3.84	4.00	4.16	3.9	3.0	2.3	1.8	1.4	1.1								
3.06	3.40	3.74	3.91	4.08	4.25	4.42	2.7	2.1	1.6	1.3	1.0									
3.24	3.60	3.96	4.14	4.32	4.50	4.68	1.8	1.5	1.2											
3.42	3.80	4.18	4.37	4.56	4.75	4.94	1.3	1.0												

combination not permitted

I_R 100 Hz alternating current [A] at upper category temperature T_{UC} taken from data sheet

I User current [A]

T_a Ambient temperature of capacitor [°C]

L Lifetime multiplier

Regard L as a function of ambient temperature (x-axis) and of current (y-axis); use the current-axis according to the frequency

LIFETIME TABLE U_R > 100 V

INTERRELATION BETWEEN ALTERNATING CURRENT, AMBIENT TEMPERATURE AND LIFETIME																				
I/I_R (FREQUENCY DEPENDENT)							LIFETIME MULTIPLIER L (depending on I/I_R and T_a)													
FREQUENCY [Hz]							AMBIENT TEMPERATURE T_a [°C]													
50	100	250	500	1000	> 2500	10 K	40	45	50	55	60	65	70	75	80	85	90	95	100	105
0	0	0	0	0	0	0	200	127	81	53	35	23	16	11	7.4	5.1	3.6	2.6	1.84	1.33
0.17	0.20	0.23	0.25	0.26	0.27	0.28	194	123	79	52	34	23	15	10	7.2	5.0	3.5	2.5	1.81	1.31
0.34	0.40	0.46	0.50	0.52	0.54	0.56	178	114	74	48	32	21	14	9.9	6.9	4.8	3.4	2.4	1.73	1.26
0.51	0.60	0.70	0.74	0.78	0.80	0.84	158	102	66	44	29	20	13	9.1	6.3	4.5	3.2	2.3	1.63	1.19
0.68	0.80	0.93	0.99	1.04	1.07	1.12	133	87	57	38	26	17	12	8.3	5.8	4.1	2.9	2.1	1.51	1.10
0.85	1.00	1.16	1.24	1.30	1.34	1.40	110	73	49	33	22	15	11	7.3	5.1	3.6	2.6	1.9	1.37	1.00
1.02	1.20	1.39	1.49	1.56	1.61	1.68	88	59	40	27	19	13	9.0	6.3	4.5	3.2	2.3	1.7	1.21	
1.19	1.40	1.62	1.74	1.82	1.88	1.96	69	47	32	22	15	11	7.6	5.4	3.8	2.7	2.00	1.4	1.06	
1.36	1.60	1.86	1.98	2.08	2.14	2.24	53	37	26	18	12	8.8	6.2	4.5	3.2	2.3	1.7	1.2		
1.53	1.80	2.09	2.23	2.34	2.41	2.52	40	28	20	14	9.9	7.1	5.1	3.7	2.7	1.9	1.4	1.0		
1.70	2.00	2.32	2.48	2.60	2.68	2.80	30	21	15	11	7.8	5.6	4.1	3	2.2	1.6	1.2			
1.87	2.20	2.55	2.73	2.86	2.95	3.08	22	16	11	8.3	6.0	4.4	3.2	2.4	1.7	1.3				
2.04	2.40	2.78	2.98	3.12	3.22	3.36	16	12	8.5	6.2	4.6	3.4	2.5	1.9	1.4	1.0				
2.21	2.60	3.02	3.22	3.38	3.48	3.64	11	8.4	6.2	4.6	3.5	2.6	1.9	1.4	1.1					
2.38	2.80	3.25	3.47	3.64	3.75	3.92	8.0	6.0	4.5	3.4	2.6	1.9	1.5	1.1						
2.55	3.00	3.48	3.72	3.90	4.02	4.20	5.6	4.3	3.3	2.5	1.9	1.4	1.1							
2.72	3.20	3.71	3.97	4.16	4.29	4.48	3.9	3.0	2.3	1.8	1.4	1.1								
2.89	3.40	3.94	4.22	4.42	4.56	4.76	2.7	2.1	1.7	1.3	1.0									
3.06	3.60	4.18	4.46	4.68	4.82	5.04	1.9	1.5	1.2											
3.23	3.80	4.41	4.71	4.94	5.09	5.32	1.3	1.0												

combination not permitted

I_R 100 Hz alternating current [A] at upper category temperature T_{UC} taken from data sheet

I User current [A]

T_a Ambient temperature of capacitor [°C]

L Lifetime multiplier

Regard L as a function of ambient temperature (x-axis) and of current (y-axis); use the current-axis according to the frequency

TEST PROCEDURES AND REQUIREMENTS

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN 130300 subclause 4.13	T_A = 105 °C; U_R applied 2000 h	- 15 % ≤ ΔC/C ≤ 15 % tan δ ≤ 1.3 x spec. limit Z ≤ 2 x spec. limit I_L(300 s) ≤ spec. limit
Useful life	CECC 30301 subclause 1.8.1	T_A = 105 °C; U_R and I_R applied 16 V ≤ U_R ≤ 100 V Cases 6.5 x 8 to 10 x 25: 3000 h 160 V ≤ U_R ≤ 400 V Cases 6.5 x 8 to 10 x 25: 3000 h	- 45 % ≤ ΔC/C ≤ 45 % tan δ ≤ 3 x spec. limit Z ≤ 3 x spec. limit I_L(300s) ≤ spec. limit No short or open circuit Total failure percentage: ≤ 1 %
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	T_A = 105 °C; no voltage applied 100 h After test: U_R to be applied for 30 minutes 24 to 48 h before measurement	- 15 % ≤ ΔC/C ≤ 15 % tan δ ≤ 1.3 x spec. limit Z ≤ 2 x spec. limit I_L(300 s) ≤ 2 x spec. limit

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