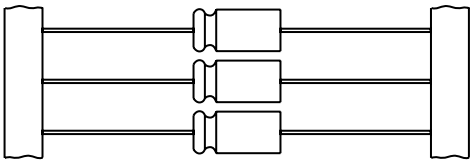
Aluminum Capacitors
Axial Non-Polar Capacitor Styles



Component outlines

FEATURES

- Non-polarized aluminum electrolytic capacitors
- EBU with small dimensions
- EBT with low ESR values over a large frequency range
- Compliant to RoHS directive 2002/95/EC

Pb-free RoHS COMPLIANT

APPLICATIONS

- EBU for circuits with changing or unknown polarity
- EBT for audio frequency networks

QUICK REFERENCE DATA

DESCRIPTION	UNIT	EBU	EBT
Nominal case size (Ø D x L)	mm	8 x 18 to 10 x 25	
Rated capacitance range C_R	µF	10 to 220	2.2 to 22
Capacitance tolerance	%	- 10 to + 50	- 15 to + 15
Rated voltage range, direct voltage alternating voltage	Vdc Vac	6.3 to 63	40 to 100 15 to 35
Category temperature range	°C	- 40 to + 85	
Endurance test at 85 °Cand rated direct voltage	h	1000	
Useful life at 85 °C, rated direct voltage and I_R, or voltages from audio frequency mixture	h	3000	5000
Useful life at 40 °C, rated direct voltage and I_R, or voltages from audio frequency mixture	h	70 000	110 000
Failure rate (0.8 U_R, 40 °C)	10^{-9}/h	≤ 90	≤ 50
Based on sectional specification		IEC 60384-4/EN 130300	
Climatic category IEC 60068 DIN 40040		40/085/56 GPF	

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

EBU STYLE			
C_R (µF)	U_R (Vdc)		
	16	40	63
10	→	8 x 18	8 x 18
22	→	8 x 18	10 x 18
47	8 x 18	10 x 18	10 x 25
100	10 x 18	10 x 25	-
220	10 x 25	-	-

EBT STYLE			
C_R (µF)	U_R (Vdc/Vac)		
	40/15	63/23	100/35
2.2	8 x 18	8 x 18	8 x 18
3.3	8 x 18	8 x 18	10 x 18
4.7	8 x 18	10 x 18	10 x 25
6.8	10 x 18	10 x 25	-
10	10 x 18	10 x 25	-
15	10 x 25	-	-
22	10 x 25	-	-

EBU/EBT

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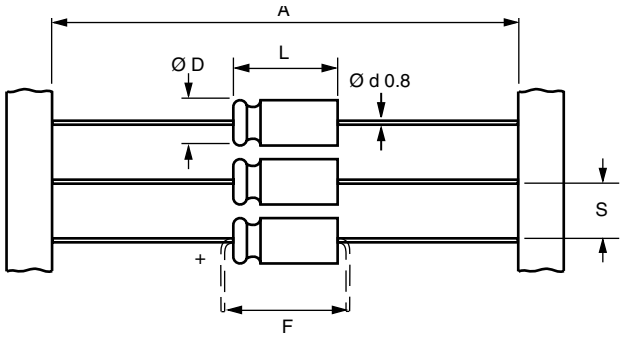
DIMENSIONS in millimeters AND AVAILABLE FORMS



DIMENSIONS in millimeters AND PACKAGING QUANTITIES

CASE SIZE D x L	MAXIMUM SIZE $D_{max.}$ x $L_{max.}$	A	S	F min.	PACKAGING QUANTITIES ENDING OF ORDERING CODE			
					TAPED AMMO		TAPED ON REEL	
					CODE	PCS.	CODE	PCS.
8 x 18	8.5 x 18.5	73.5 ± 1.6	10 ± 0.4	25	...B0W	500	...A0W	500
10 x 18	10.5 x 18.5	73.5 ± 1.6	15 ± 0.75	25	...B0W	500	...A0W	500
10 x 25	10.5 x 25	73.5 ± 1.6	15 ± 0.75	30	...B0W	500	...A0W	500

ELECTRICAL DATA - EBU STYLE

SYMBOL	DESCRIPTION
U_R	rated voltage
C_R	rated capacitance at 100 Hz
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	impedance at 10 kHz
I_R	rated alternating current (rms) at 100 Hz and T_{UC}
T_{UC}	upper category temperature
T_a	ambient temperature

Note
Unless otherwise specified, all electrical values apply at T_a = 20 °C, P = 80 kPa to 120 kPa, RH = 45 % to 75 %.

ORDERING EXAMPLE

EBU 10 µF/40 V, - 10 %/+ 50 %, Size: 8 mm x 18 mm

Taped ammopack:
Ordering code: MALAEB020FL210GB0W

Taped on reel:
Ordering code: MALAEB020FL210GA0W

Capacitors are sleeve-insulated.

ELECTRICAL DATA AND ORDERING INFORMATION - EBU

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}, 125 °C (mA)	WEIGHT (g)	ORDERING NUMBER MALA...
16	47	8 x 18	0.20	6.78	2.77	0.11	2.0	EB020FL247DB0W
	100	10 x 18	0.16	2.55	1.30	0.18	3.0	EB020GL310DB0W
	220	10 x 25	0.16	1.16	0.59	0.27	3.5	EB020GD322DB0W
40	10	8 x 18	0.12	19.10	7.50	0.05	2.0	EB020FL210GB0W
	22	8 x 18	0.12	8.69	3.41	0.09	2.0	EB020FL222GB0W
	47	10 x 18	0.12	4.07	1.60	0.15	3.0	EB020GL247GB0W
	100	10 x 25	0.12	1.91	0.75	0.21	3.5	EB020GD310GB0W
63	10	8 x 18	0.10	15.90	5.50	0.07	2.0	EB020FL210JB0W
	22	10 x 18	0.08	5.79	2.50	0.11	3.0	EB020GL222JB0W
	47	10 x 25	0.08	2.71	1.17	0.19	3.5	EB020GD247JB0W

For technical questions, contact: aluminumcaps1@vishay.com
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LIFETIME TABLE - EBU Style

INTERRELATION BETWEEN ALTERNATING CURRENT, AMBIENT TEMPERATURE AND LIFETIME																
I/I_R (FREQUENCY DEPENDENT)						**SURFACE TEMPERATURE RISE**	**LIFETIME MULTIPLIER L (depending on I/I_R and T_a)**									
FREQUENCY [Hz]							**AMBIENT TEMPERATURE T_a [°C]**									
50	**100**	**250**	**500**	**1000**	**> 2500**	**ΔT_o [°C]**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**
0.19	0.20	0.21	0.22	0.22	0.23	0.1	37	26	19	13	9.3	6.6	4.7	3.3	2.33	1.65
0.37	0.40	0.42	0.43	0.45	0.47	0.5	35	25	18	12	8.8	6.2	4.4	3.1	2.19	1.55
0.56	0.60	0.63	0.65	0.67	0.70	1.2	32	22	16	11	7.9	5.6	3.9	2.8	1.97	1.39
0.75	0.80	0.84	0.86	0.89	0.93	2.1	27	19	14	9.6	6.8	4.8	3.4	2.4	1.71	1.21
0.93	1.00	1.05	1.08	1.11	1.16	3.3	23	16	11	8.0	5.7	4.0	2.8	2.0	1.41	1.00
1.12	1.20	1.26	1.29	1.34	1.40	4.8	18	13	9.0	6.4	4.5	3.2	2.3	1.6		
1.31	1.40	1.47	1.51	1.56	1.63	6.5	14	9.7	6.9	4.9	3.4	2.4	1.7			
1.49	1.60	1.68	1.73	1.78	1.86	8.4	10	7.1	5.0	3.6	2.5	1.8		**combination**		
1.68	1.80	1.89	1.94	2.00	2.09	11	7.1	5.0	3.5	2.5				**not**		
1.86	2.00	2.10	2.16	2.23	2.33	13	4.8	3.4						**permitted**		
2.05	2.20	2.31	2.37	2.45	2.56	16	3.1									

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

I User current [A]

T_a Ambient temperature of capacitor [°C]

ΔT_o Surface temperature rise of capacitor caused by AC load [°C]

L Lifetime multiplier

ADDITIONAL ELECTRICAL DATA - EBU AND EBT		
PARAMETER	**CONDITIONS**	**VALUE**
Current		
Leakage current (Test conditions: U_R, 20 °C)	After 5 minutes at U_R	$I_{L5} \leq 0.015 \times C_R \times U_R + 10\ \mu A$
Resistance		
Equivalent series resistance (ESR)	Calculated from tan $\delta_{max.}$	ESR = tan $\delta/2\ \pi f\ C_R$

EBU/EBT

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Aluminum Capacitors
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ELECTRICAL DATA - EBT STYLE

SYMBOL	DESCRIPTION
U_R	rated direct voltage
C_R	rated capacitance at 1 kHz
U_{EFF}	rated alternating voltage
tan δ	max. dissipation factor at 1 kHz
R_{ESR}	equivalent series resistance at 1 kHz, calculated from Tan $\delta_{max.}$ and C_R
Z	impedance at 10 kHz
T_a	ambient temperature

Note

Unless otherwise specified, all electrical values apply at T_a = 20 °C, P = 80 kPa to 120 kPa, RH = 45 % to 75 %.

ORDERING EXAMPLE

EBT 3.3 µF/40 V, - 10 %/+ 50 %, Size: 8 mm x18 mm

Taped ammopack:
Ordering code: MALAEBT20FL133GB0W

Taped on reel:
Ordering code: MALAEBT20FL133GA0W

Capacitors are sleeve-insulated.

ELECTRICAL DATA AND ORDERING INFORMATION - EBT

U_R (V)	C_R 1 KHz (µF)	U_{eff} (V)	NOMINAL CASE SIZE Ø D x L (mm)	tan δ 1 kHz max.	R_{ESR} 1 kHz (Ω)	Z 10 kHz max. (Ω)	WEIGHT (g)	ORDERING NUMBER MALA...
40	2.2	15	8 x 18	0.095	6.90	11.00	2.0	EBT20FL122GB0W
	3.3	15	8 x 18	0.095	4.60	7.60	2.0	EBT20FL133GB0W
	4.7	15	8 x 18	0.095	3.20	5.30	2.0	EBT20FL147GB0W
	6.8	15	10 x 18	0.095	2.20	3.70	3.0	EBT20GL168GB0W
	10.0	15	10 x 18	0.095	1.50	2.50	3.0	EBT20GL210GB0W
	15.0	15	10 x 25	0.080	0.85	1.70	3.5	EBT20GD215GB0W
63	2.2	23	8 x 18	0.090	6.50	11.00	2.0	EBT20FL122JB0W
	3.3	23	8 x 18	0.090	4.30	7.30	2.0	EBT20FL133JB0W
	4.7	23	10 x 18	0.090	3.00	5.10	3.0	EBT20GL147JB0W
	6.8	23	10 x 25	0.090	2.10	3.50	3.5	EBT20GD168JB0W
	10.0	23	10 x 25	0.090	1.40	2.40	3.5	EBT20GD210JB0W
100	2.2	35	8 x 18	0.085	6.10	10.00	2.0	EBT20FL122LB0W
	3.3	35	10 x 18	0.085	4.10	7.00	3.0	EBT20GL133LB0W
	4.7	35	10 x 25	0.085	2.90	4.90	3.5	EBT20GD147LB0W

LOW TEMPERATURE BEHAVIOUR - EBT

Table for the calculation of the maximum impedance Z(f) [Ω] at low temperatures:

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

U_R (V)	U_{eff} (V)	T_a (°C)	FREQUENCY (f) [kHz]										
			0.05	0.1	0.2	0.5	1	2	5	10	20	50	100
40	15	- 25	4000	2300	1100	520	310	170	95	80	58	51	50
		- 40	4400	2500	1300	590	400	330	300	290	230	210	190
63	23	- 25	4000	2300	1100	520	300	150	80	70	50	49	46
		- 40	4400	2500	1300	590	380	300	260	240	190	170	155
100	35	- 25	4000	2300	1100	520	290	130	70	60	44	42	42
		- 40	4400	2500	1300	590	380	270	220	200	150	140	130

For technical questions, contact: aluminumcaps1@vishay.com

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MAXIMUM DISSIPATION FACTOR tan δ VS. FREQUENCY f - EBT

U_R (V)	C_R 1 kHz (µF)	U_{eff} (V)	FREQUENCY f (kHz)								
			0.05	0.1	0.2	0.5	1	2	5	10	20
40	2.2	15	0.070	0.080	0.085	0.090	0.095	0.14	0.27	0.40	0.72
	3.3	15	0.070	0.080	0.085	0.090	0.095	0.14	0.27	0.40	0.72
	4.7	15	0.070	0.080	0.085	0.090	0.095	0.14	0.27	0.40	0.72
	6.8	15	0.070	0.080	0.085	0.090	0.095	0.14	0.27	0.40	0.72
	10.0	15	0.070	0.080	0.085	0.090	0.095	0.14	0.27	0.40	0.72
	15.0	15	0.050	0.060	0.065	0.070	0.080	0.13	0.24	0.40	0.72
63	2.2	23	0.065	0.075	0.080	0.085	0.090	0.13	0.24	0.35	0.64
	3.3	23	0.065	0.075	0.080	0.085	0.090	0.13	0.24	0.35	0.64
	4.7	23	0.065	0.075	0.080	0.085	0.090	0.13	0.24	0.35	0.64
	6.8	23	0.065	0.075	0.080	0.085	0.090	0.13	0.24	0.35	0.64
	10.0	23	0.065	0.075	0.080	0.085	0.090	0.13	0.24	0.35	0.64
100	2.2	35	0.060	0.070	0.075	0.080	0.085	0.12	0.23	0.32	0.56
	3.3	35	0.060	0.070	0.075	0.080	0.085	0.12	0.23	0.32	0.56
	4.7	35	0.060	0.070	0.075	0.080	0.085	0.12	0.23	0.32	0.56

MAXIMUM EQUIVALENT SERIES RESISTANCE R_{ESR} (Ω) VERSUS FREQUENCY f - EBT

U_R (V)	C_R 1 kHz (µF)	U_{eff} (V)	FREQUENCY f (kHz)								
			0.05	0.1	0.2	0.5	1	2	5	10	20
40	2.2	15	101.0	58.00	31.00	13.00	6.90	5.00	4.10	3.20	2.70
	3.3	15	68.0	38.00	21.00	8.80	4.60	3.30	2.70	2.10	1.80
	4.7	15	47.0	27.00	15.00	6.20	3.20	2.30	1.90	1.50	1.30
	6.8	15	33.0	19.00	10.00	4.30	2.20	1.60	1.30	1.00	0.90
	10.0	15	22.0	13.00	6.80	2.90	1.50	1.10	0.90	0.70	0.60
	15.0	15	10.6	6.40	3.50	1.50	0.85	0.67	0.53	0.47	0.40
63	2.2	23	94.0	54.00	29.00	12.00	6.40	4.50	3.60	2.70	2.30
	3.3	23	63.0	36.00	19.00	8.20	4.20	3.00	2.40	1.80	1.50
	4.7	23	44.0	25.00	14.00	5.70	3.00	2.10	1.70	1.30	1.10
	6.8	23	30.0	18.00	9.40	4.00	2.10	1.50	1.20	0.88	0.73
	10.0	23	21.0	12.00	6.40	2.70	1.40	1.00	0.80	0.60	0.50
100	2.2	35	87.0	50.00	27.00	12.00	6.40	4.50	3.60	2.70	2.30
	3.3	35	58.0	34.00	18.00	7.90	4.20	3.00	2.40	1.80	1.50
	4.7	35	41.0	24.00	13.00	5.50	3.00	2.10	1.70	1.30	1.10

MAXIMUM ALTERNATING CURRENT $I_R(f)$ (mA) AT UPPER CATEGORY TEMPERATURE - EBT											
U_R (V)	C_R 1 kHz (µF)	U_{eff} (V)	FREQUENCY f (kHz)								
			0.05	0.1	0.2	0.5	1	2	5	10	20
40	2.2	15	10	20	39	59	82	95	110	130	130
	3.3	15	15	29	47	73	100	120	130	150	160
	4.7	15	21	41	56	87	120	140	160	180	190
	6.8	15	30	52	71	110	150	180	200	230	250
	10.0	15	44	68	93	140	200	230	260	300	320
	15.0	15	67	100	140	220	290	320	370	410	430
63	2.2	23	15	29	40	61	84	99	110	130	140
	3.3	23	23	37	51	79	110	130	150	170	180
	4.7	23	33	48	66	100	140	160	190	220	230
	6.8	23	48	63	86	130	180	210	250	290	310
	10.0	23	66	86	120	180	250	290	340	400	420
100	2.2	35	24	32	43	66	91	110	120	150	160
	3.3	35	32	42	57	87	120	140	160	200	210
	4.7	35	41	54	74	110	160	190	210	250	270

Notes

1. The alternating voltage must never exceed the rated alternating voltage value, not even as a ripple component.
2. The sum voltage resulting from a direct voltage and the crest value of a ripple voltage, must not exceed the rated DC voltage value.
3. When applying such voltages take care not to exceed neither the permissible frequency-dependent AC values nor the rated surface temperatures of the electrolytic capacitors.

LIFETIME TABLE - EBT Style

INTERRELATION BETWEEN ALTERNATING CURRENT, AMBIENT TEMPERATURE AND LIFETIME											
I/I_R (f)	SURFACE TEMPERATURE RISE ΔT_o [°C]	LIFETIME MULTIPLIER L (depending on I/I_R and T_a)									
		AMBIENT TEMPERATURE T_a [°C]									
		40	45	50	55	60	65	70	75	80	85
0.20	0.1	37	26	19	13	9.3	6.6	4.7	3.3	2.33	1.65
0.40	0.5	35	25	18	12	8.8	6.2	4.4	3.1	2.19	1.55
0.60	1.2	32	22	16	11	7.9	5.6	3.9	2.8	1.97	1.39
0.80	2.1	27	19	14	9.6	6.8	4.8	3.4	2.4	1.71	1.21
1.00	3.3	23	16	11	8.0	5.7	4.0	2.8	2.0	1.41	1.00
1.20	4.8	18	13	9.0	6.4	4.5	3.2	2.3	1.6		
1.40	6.5	14	9.7	6.9	4.9	3.4	2.4	1.7			
1.60	8.4	10	7.1	5.0	3.6	2.5	1.8				
1.80	11	7.1	5.0	3.5	2.5						
2.00	13	4.8	3.4								
2.20	16	3.1									

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]

ΔT_o Surface temperature rise of capacitor caused by AC load [°C]

L Lifetime multiplier

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