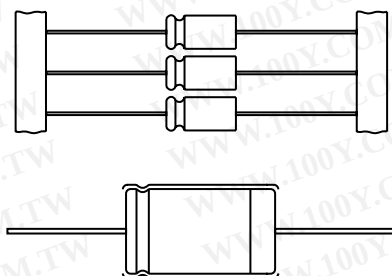


Aluminum Capacitors Axial Capacitor Style



Component outlines

FEATURES

- Polarized aluminum electrolytic capacitors
- Standard dimensions
- Long lifetime
- Charge/discharge proof
- High ripple current capability



RoHS
COMPLIANT

APPLICATIONS

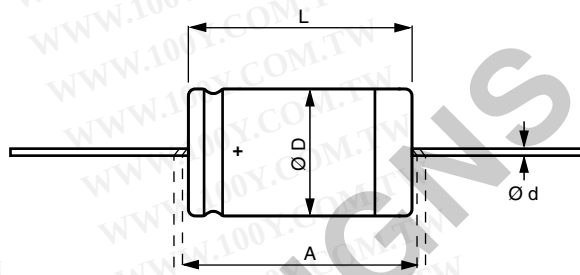
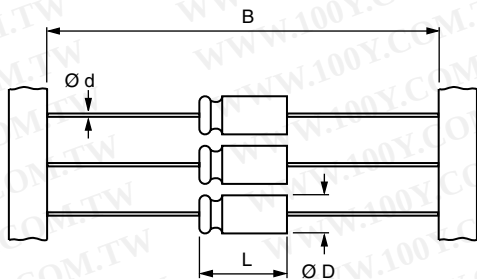
- General purpose, industrial and automotive electronics, audio/video systems
- Coupling, smoothing, filtering, buffering and timing
- Portable and mobile units
- Vibration and shock resistant

QUICK REFERENCE DATA

DESCRIPTION	UNIT	LOW VOLTAGE			HIGH VOLTAGE
Nominal case size (Ø D x L)	mm	3.3 x 8 to 3.3 x 11	4.5 x 11	6 x 10 to 10 x 25	6.5 x 18 to 10 x 25
Rated capacitance range C _R	µF	0.47 to 10	0.47 to 47	4.7 to 1000	1 to 22
Capacitance tolerance	%	- 10 to + 50			
Rated voltage range	V	6.3 to 63	10 to 100	6.3 to 100	160 to 385
Category temperature range	°C	- 40 to + 85			- 40 to + 85
Endurance test at upper category temp.	h	1000			2000
Useful life at 105 °C and I _R applied	h	-	(750)	(1000)	-
Useful life at 85 °C and I _R applied	h	1500	3000		5000
Useful life at 40 °C and I _R applied	h	40 000	85 000		130 000
Failure rate (0.8 U _R , 40 °C)	10 ⁻⁹ /h	≤ 550	≤ 105		≤ 70
Based on sectional specifications		IEC 384-4, CECC 30300			
Based on detailed specifications		similar to CECC 30301-044			
Climatic category IEC 60068 DIN 40040		40/085/56 GPF			40/085/56 GPF

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

C _R (µF)	U _R (V) ≤ 100 V								U _R (V) > 100 V			
	6.3	10	16	25	40	50	63	100	160	250	350	385
0.47	→	→	→	→	→	→	3.3 x 8 3.3 x 11	4.5 x 10	-	-	-	-
1.0	→	EL	→	→	3.3 x 11	→	3.3 x 8 4.5 x 10	4.5 x 10	→	→	→	6.5 x 18
2.2	→	→	→	→	3.3 x 8 3.3 x 11	→	3.3 x 11 4.5 x 10	4.5 x 10	→	6.5 x 18	→	8 x 18
4.7	→	→	3.3 x 8 3.3 x 11	→	3.3 x 11	→	4.5 x 10	→	6.5 x 18	8 x 18	10 x 18	10 x 25
10	3.3 x 8 3.3 x 11	→	3.3 x 11	4.5 x 10	4.5 x 10	→	→	→	8 x 18	10 x 25	-	-
22	→	4.5 x 10	-	4.5 x 10	-	-	EB	-	10 x 25	-	-	-
47	→	4.5 x 10	-	-	-	-	-	-	-	-	-	-
100	→	6 x 10	→	6.5 x 18	8 x 18	10 x 18	10 x 25	-	-	-	-	-
220	EB	6.5 x 18	8 x 18	10 x 18	10 x 18	-	-	-	-	-	-	-
470	8 x 18	10 x 18	10 x 18	10 x 25	-	-	-	-	-	-	-	-
1000	10 x 25	10 x 25	10 x 25	-	-	-	-	-	-	-	-	-

DIMENSIONS in millimeters **AND AVAILABLE FORMS****AXIAL STYLE: DIMENSIONS** in millimeters, **MASS, PACKAGING QUANTITIES AND ORDERING CODE**

NOMINAL CASE SIZE Ø D x L	Ø d	Ø D _{max.}	L _{max.}	A _{min.}	B	MASS APPROX. g	PACKAGING, ENDING OF ORDERING CODE, QUANTITIES			
							TAPED ON REEL		TAPED AMMO	
							CODE	PCS.	CODE	PCS.
3.3 x 8	0.6	3.5	9.0	12.5	63.5 ± 1.5	0.3	..A0W	4000	..B0W	1000
3.3 x 11	0.6	3.5	12.0	15	63.5 ± 1.5	0.35	..A0W	3000	..B0W	1000
4.5 x 10	0.6	5.0	10.5	15	63.5 ± 1.5	0.5	..A0W	3000	..B0W	1000
6 x 10	0.6	6.3	10.5	15	63.5 ± 1.5	0.7	..A0W	1000	..B0W	1000
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	25.0	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 δ _{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 = 86 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:

MALAE000GD410C...

EB 1000 µF 10 V 10 x 25

MALAE000GD410CA0W

A = taped on reel

MALAE000GD410CB0W

B = taped ammo

Aluminum Capacitors
Axial Capacitor Style

Vishay Roederstein

ELECTRICAL DATA AND ORDERING INFORMATION

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$\tan \delta$ 100 Hz MAX.	R_{ESR} 100 Hz (Ω)	Z 10 kHz MAX. (Ω)	I_R 100 Hz T_{UC} (A)	CATALOG NUMBER MALA...
6.3	10	3.3 x 8	0.30	47.7	20.0	0.011	EL000AN210BA0W
	10	3.3 x 11	0.30	47.7	20.0	0.015	EL000AA210BA0W
	470	8 x 18	0.25	0.847	0.430	0.33	EB000FL347BA0W
	1000	10 x 25	0.25	0.398	0.200	0.56	EB000GD410BA0W
10	22	4.5 x 11	0.20	14.5	7.30	0.045	EL000BA222CA0W
	47	4.5 x 11	0.20	6.78	3.40	0.070	EL000BA247CA0W
	100	6 x 10	0.20	3.19	1.60	0.11	EB000CK310CA0W
	220	6.5 x 18	0.20	1.45	0.730	0.21	EB000DL322CA0W
	470	10 x 18	0.20	0.680	0.340	0.41	EB000GL347CA0W
	1000	10 x 25	0.20	0.320	0.160	0.56	EB000GD410C00V
16	4.7	3.3 x 8	0.20	68.0	26.0	0.009	EL000AN147DA0W
	4.7	3.3 x 11	0.20	67.8	26.0	0.015	EL000AA147DA0W
	10	3.3 x 11	0.20	32.0	12.0	0.016	EL000AA210DA0W
	220	8 x 18	0.16	1.16	0.550	0.27	EB000FL322DA0W
	470	10 x 18	0.16	0.540	0.280	0.41	EB000GL347DA0W
	1000	10 x 25	0.16	0.260	0.130	0.55	EB000GD410DA0W
25	10	4.5 x 11	0.14	22.300	9.000	0.05	EL000BA210EA0W
	22	4.5 x 11	0.14	10.200	4.100	0.06	EL000BA222EA0W
	47	6 x 10	0.14	4.800	1.900	0.10	EB000CK247EA0W
	100	6.5 x 18	0.14	2.200	0.900	0.16	EB000DL310EA0W
	220	10 x 18	0.14	1.000	0.410	0.35	EB000GL322EA0W
	470	10 x 25	0.14	0.470	0.190	0.50	EB000GD347EA0W
40	1.0	3.3 x 11	0.16	239	75.0	0.008	EL000AA110GA0W
	2.2	3.3 x 8	0.16	120	32.0	0.007	EL000AN122GA0W
	2.2	3.3 x 11	0.16	109	32.0	0.012	EL000AA122GA0W
	4.7	3.3 x 11	0.16	54.000	15.000	0.013	EL000AA147GA0W
	10	4.5 x 11	0.11	17.600	7.000	0.05	EL000BA210GA0W
	22	6 x 10	0.11	8.000	3.200	0.075	EB000CK222GA0W
	47	6.5 x 18	0.11	3.800	1.500	0.15	EB000DL247GA0W
	100	8 x 18	0.11	1.750	0.700	0.22	EB000FL310GA0W
	220	10 x 18	0.12	0.870	0.340	0.36	EB000GL322GA0W
50	100	10 x 18	0.10	1.60	0.650	0.25	EB000GL310HA0W
63	0.47	3.3 x 8	0.10	340	120	0.004	EL000AN047JA0W
	0.47	3.3 x 11	0.10	339	117	0.008	EL000AA047JA0W
	1.0	3.3 x 8	0.12	190.000	55.000	0.006	EL000AN110JA0W
	1.0	4.5 x 11	0.09	143.000	55.000	0.013	EL000BA110JA0W
	2.2	3.3 x 11	0.14	87.000	25.000	0.011	EL000AA122JA0W
	2.2	4.5 x 11	0.09	66.000	25.000	0.025	EL000BA122JA0W
	4.7	4.5 x 11	0.09	31.000	12.000	0.040	EL000BA147JA0W
	10	6 x 10	0.08	12.800	5.500	0.070	EB000CK210JA0W
	22	6.5 x 18	0.08	5.800	2.500	0.11	EB000DL222JA0W
	47	8 x 18	0.08	2.700	1.200	0.19	EB000FL247JA0W
	100	10 x 25	0.08	1.270	0.550	0.30	EB000GD310JA0W

ELECTRICAL DATA AND ORDERING INFORMATION

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$\tan \delta$ 100 Hz MAX.	R_{ESR} 100 Hz (Ω)	Z 10 kHz MAX. (Ω)	I_R 100 Hz T_{UC} (A)	CATALOG NUMBER MALA...
100	0.47	4.5 x 11	0.08	271	96.0	0.009	EL000BA047LA0W
	1.0	4.5 x 11	0.08	128	45.0	0.020	EL000BA110LA0W
	2.2	4.5 x 11	0.08	57.9	21.0	0.030	EL000BA122LA0W
	4.7	6 x 10	0.07	23.7	9.60	0.050	EB000CK147LA0W
	10	6.5 x 18	0.07	11.2	4.50	0.090	EB000DL210LA0W
	22	8 x 18	0.07	5.07	2.10	0.12	EB000FL222LA0W
	47	10 x 18	0.07	2.37	0.900	0.15	EB000GL247LA0W
160	4.7	6.5 x 18	0.15	51.0	26.0	0.050	EB000DL147MA0W
	10	8 x 18	0.15	24.0	12.0	0.070	EB000FL210MA0W
	22	10 x 25	0.15	11.0	5.50	0.19	EB000GD222MA0W
250	2.2	6.5 x 18	0.10	72.0	50.0	0.035	EB000DL122NA0W
	4.7	8 x 18	0.10	34.0	23.0	0.055	EB000FL147NA0W
	10	10 x 25	0.10	16.0	11.0	0.090	EB000GD210NA0W
350	4.7	10 x 18	0.10	34.0	22.0	0.060	EB000GL147OA0W
385	1.0	6.5 x 18	0.10	160	100	0.020	EB000DL110RA0W
	2.2	8 x 18	0.10	72.0	45.0	0.040	EB000FL122RA0W
	4.7	10 x 25	0.10	34.0	22.0	0.070	EB000GD147RA0W

ADDITIONAL ELECTRICAL DATA

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

LOW TEMPERATURE BEHAVIOUR

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

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

T_a ($^{\circ}$ C)	RATED VOLTAGE (V)											
	6.3	10	16	25	40	50	63	100	160	250	350	385
- 25	1300	1000	860	440	330	270	200	160	1000	940	860	1800
- 40	4800	3500	2400	1200	990	800	550	500	5000	4600	4200	6000

In practical operation the lower limit of the series resistance and impedance is given 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 .

Aluminum Capacitors
Axial Capacitor Style

Vishay Roederstein

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	10K	40	45	50	55	60	65	70	75	80	85	90	95	100	105
0	0	0	0	0	0	0	56	35	23	15	9.7	6.4	4.3	3.0	2.0	1.42	1.00	0.71	0.51	0.37
0.18	0.20	0.22	0.23	0.24	0.25	0.26	54	34	22	14	9.4	6.3	4.2	2.9	2.0	1.40	0.98	0.70	0.50	0.36
0.36	0.40	0.44	0.46	0.48	0.50	0.52	49	31	20	13	8.8	5.9	4.0	2.7	1.9	1.33	0.94	0.67	0.48	0.35
0.54	0.60	0.66	0.69	0.72	0.75	0.78	43	28	18	12	8.0	5.4	3.7	2.5	1.8	1.24	0.88	0.63	0.45	0.33
0.72	0.80	0.88	0.92	0.96	1.00	1.04	36	24	16	10	7.0	4.8	3.3	2.3	1.6	1.13	0.80	0.58	0.42	0.31
0.90	1.00	1.10	1.15	1.20	1.25	1.30	29	19	13	8.8	6.0	4.1	2.9	2.0	1.4	1.00	0.72	0.52	0.38	0.28
1.08	1.20	1.32	1.38	1.44	1.50	1.56	23	16	11	7.3	5.0	3.5	2.4	1.7	1.2	0.88	0.63	0.46	0.34	
1.26	1.40	1.54	1.61	1.68	1.75	1.82	18	12	8.5	5.9	4.1	2.9	2.0	1.5	1.0	0.75	0.55	0.40	0.29	
1.44	1.60	1.76	1.84	1.92	2.00	2.08	13	9.4	6.6	4.7	3.3	2.3	1.7	1.2	0.87	0.64	0.47	0.34		
1.62	1.80	1.98	2.07	2.16	2.25	2.34	10	7.1	5.1	3.6	2.6	1.9	1.4	1.0	0.72	0.53	0.39	0.29		
1.80	2.00	2.20	2.30	2.40	2.50	2.60	7.3	5.3	3.8	2.8	2.0	1.5	1.1	0.80	0.59	0.43	0.32			
1.98	2.20	2.42	2.53	2.64	2.75	2.86	5.3	3.9	2.9	2.1	1.6	1.2	0.85	0.63	0.47	0.35				
2.16	2.40	2.64	2.76	2.88	3.00	3.12	3.8	2.8	2.1	1.6	1.2	0.89	0.66	0.50	0.37	0.28				
2.34	2.60	2.86	2.99	3.12	3.25	3.38	2.7	2.1	1.6	1.2	0.89	0.67	0.51	0.39	0.29					
2.52	2.80	3.08	3.22	3.36	3.50	3.64	1.9	1.5	1.1	0.87	0.67	0.51	0.39	0.30						
2.70	3.00	3.30	3.45	3.60	3.75	3.90	1.4	1.1	0.82	0.64	0.49	0.38	0.30							
2.88	3.20	3.52	3.68	3.84	4.00	4.16	0.95	0.75	0.59	0.46	0.36	0.28								
3.06	3.40	3.74	3.91	4.08	4.25	4.42	0.66	0.53	0.42	0.34										
3.24	3.60	3.96	4.14	4.32	4.50	4.68	0.46	0.37												
3.42	3.80	4.18	4.37	4.56	4.75	4.94	0.32													

 I_R Rated ripple current (100 Hz, rms) [A] at upper category temperature T_{UC} taken from data sheet I User ripple current [A] T_a Ambient temperature of capacitor [°C] L Lifetime multiplierRegard 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	10K	40	45	50	55	60	65	70	75	80	85	
0	0	0	0	0	0	0	66	42	27	17	11	8	5.1	3.5	2.42	1.69	
0.17	0.20	0.23	0.25	0.26	0.27	0.28	63	40	26	17	11	7	5.0	3.4	2.35	1.64	
0.34	0.40	0.46	0.50	0.52	0.54	0.56	54	35	23	15	10	6.7	4.6	3.1	2.18	1.53	
0.51	0.60	0.70	0.74	0.78	0.80	0.84	44	29	19	13	8.7	5.9	4.0	2.8	1.95	1.37	
0.68	0.80	0.93	0.99	1.04	1.07	1.12	35	23	16	11	7.2	4.9	3.4	2.4	1.68	1.19	
0.85	1.00	1.16	1.24	1.30	1.34	1.40	26	17	12	8.3	5.7	4.0	2.8	2.0	1.40	1.00	
1.02	1.20	1.39	1.49	1.56	1.61	1.68	18	13	9.0	6.3	4.4	3.1	2.2	1.6	1.14		
1.19	1.40	1.62	1.74	1.82	1.88	1.96	13	9.2	6.5	4.7	3.3	2.4	1.7	1.2			
1.36	1.60	1.86	1.98	2.08	2.14	2.24	8.8	6.4	4.7	3.4	2.5	1.8	1.3				
1.53	1.80	2.09	2.23	2.34	2.41	2.52	5.9	4.4	3.2	2.4	1.8	1.3					
1.70	2.00	2.32	2.48	2.60	2.68	2.80	3.9	3.0	2.2	1.7	1.2						
1.87	2.20	2.55	2.73	2.86	2.95	3.08	2.6	2.0	1.5	1.1							
2.04	2.40	2.78	2.98	3.12	3.22	3.36	1.7	1.3	1.0								
2.21	2.60	3.02	3.22	3.38	3.48	3.64	1.1										

 I_R Rated ripple current (100 Hz, rms) [A] at upper category temperature T_{UC} taken from data sheet I User ripple current [A] T_a Ambient temperature of capacitor [°C] L Lifetime multiplierRegard 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 1300300, subclause 4.13	T_A = upper cat. temp.; U_R applied $6.3 \text{ V} \leq U_R \leq 100 \text{ V}$: 1000 hours $T_A = 85^\circ\text{C}$; U_R applied $160 \text{ V} \leq U_R \leq 500 \text{ V}$: 2000 hours	$U_R = 6.3 \text{ V}$: $-40\% \leq \Delta C/C \leq 25\%$ $U_R = 6.3 \text{ V}$: $-30\% \leq \Delta C/C \leq 30\%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_L(300 \text{ s}) \leq \text{spec. limit}$
Useful life	CECC 30301, subclause 1.8.1	$T_A = 105^\circ\text{C}$; U_R and I_R applied $6.3 \text{ V} \leq U_R \leq 100 \text{ V}$ Case 4.5 x 11: 750 h Cases 6 x 10 to 10 x 25: 1000 h Cases 6 x 10 to 10 x 25: 1000 h	$U_R = 6.3 \text{ V}$: $-50\% \leq \Delta C/C \leq 45\%$ $U_R = 6.3 \text{ V}$: $-45\% \leq \Delta C/C \leq 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_L(300 \text{ s}) \leq \text{spec. limit}$
		$T_A = 85^\circ\text{C}$; U_R and I_R applied $160 \text{ V} \leq U_R \leq 400 \text{ V}$: 5000 h	No short or open circuit Total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN 1300300, subclause 4.17	T_A = upper cat. temp.; no voltage applied $6.3 \text{ V} \leq U_R \leq 100 \text{ V}$ Cases 3.3 x 8 to 10 x 25: 500 h After test: U_R to be applied for 30 minutes 24 to 48 hours before measurement	$U_R = 6.3 \text{ V}$: $-40\% \leq \Delta C/C \leq 25\%$ $U_R = 6.3 \text{ V}$: $-30\% \leq \Delta C/C \leq 30\%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_L(300 \text{ s}) \leq 2 \times \text{spec. limit}$



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