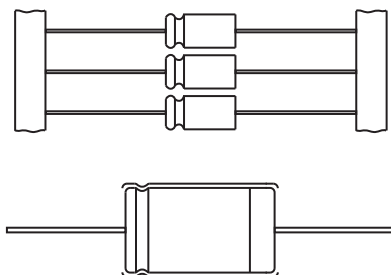


Aluminum Capacitors Axial Capacitors Style



FEATURES

- Polarized aluminum electrolytic capacitors
- Standard dimensions
- Charge/discharge proof
- High ripple current capability
- Material categorization:
For definitions of compliance please see www.vishay.com/doc?99912



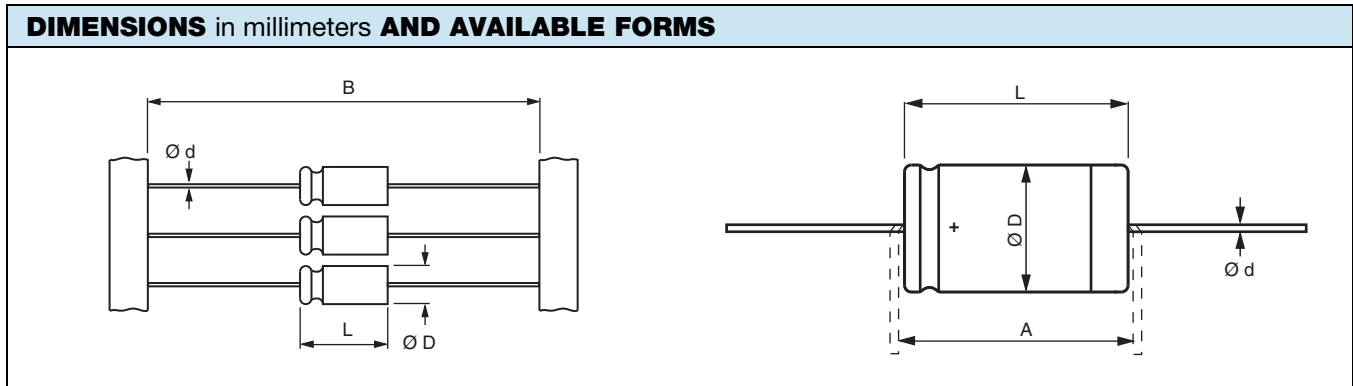
RoHS
COMPLIANT

APPLICATIONS

- General purpose, industrial electronics and 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 (∅ 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		40/085/56			40/085/56
IEC 60068		GPF			GPF
DIN 40040					

SELECTION CHART FOR C _R , U _R AND RELEVANT NOMINAL CASE SIZES (∅ 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 11	-	-	-	-
1.0	→	EL	→	→	3.3 x 11	→	3.3 x 8 4.5 x 11	4.5 x 11	→	→	→	6.5 x 18
2.2	→	→	→	→	3.3 x 8 3.3 x 11	→	3.3 x 11 4.5 x 11	4.5 x 11	→	6.5 x 18	→	8 x 18
4.7	→	→	3.3 x 8 3.3 x 11	→	3.3 x 11	→	4.5 x 11	→	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 11	4.5 x 11	→	→	→	8 x 18	10 x 25	-	-
22	→	4.5 x 11	→	4.5 x 11	→	→	EB	→	10 x 25	-	-	-
47	→	4.5 x 11	-	-	-	-	-	-	-	-	-	-
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	-	-	-	-	-	-	-	-	-



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 11	0.6	5.0	11.5	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

Note

- 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 kPa 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:

MALAEB000GD410C...	EB 1000 µF 10 V 10 x 25
MALAEB000GD410CA0W	<u>A</u> = taped on reel
MALAEB000GD410CB0W	<u>B</u> = taped ammo



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...
6.3	10	3.3 x 8	0.30	47.7	20.0	0.011	EL000AN210BB0W
	10	3.3 x 11	0.30	47.7	20.0	0.015	EL000AA210BB0W
	470	8 x 18	0.25	0.847	0.430	0.33	EB000FL347BB0W
	1000	10 x 25	0.25	0.398	0.200	0.56	EB000GD410BB0W
10	22	4.5 x 11	0.20	14.5	7.30	0.045	EL000BA222CB0W
	47	4.5 x 11	0.20	6.78	3.40	0.070	EL000BA247CB0W
	100	6 x 10	0.20	3.19	1.60	0.11	EB000CK310CB0W
	220	6.5 x 18	0.20	1.45	0.730	0.21	EB000DL322CB0W
	470	10 x 18	0.20	0.680	0.340	0.41	EB000GL347CB0W
	1000	10 x 25	0.20	0.320	0.160	0.56	EB000GD410CB0W
16	4.7	3.3 x 8	0.20	68.0	26.0	0.009	EL000AN147DB0W
	4.7	3.3 x 11	0.20	67.8	26.0	0.015	EL000AA147DB0W
	10	3.3 x 11	0.20	32.0	12.0	0.016	EL000AA210DB0W
	220	8 x 18	0.16	1.16	0.550	0.27	EB000FL322DB0W
	470	10 x 18	0.16	0.540	0.280	0.41	EB000GL347DB0W
	1000	10 x 25	0.16	0.260	0.130	0.55	EB000GD410DB0W
25	10	4.5 x 11	0.14	22.300	9.000	0.05	EL000BA210EB0W
	22	4.5 x 11	0.14	10.200	4.100	0.06	EL000BA222EB0W
	100	6.5 x 18	0.14	2.200	0.900	0.16	EB000DL310EB0W
	220	10 x 18	0.14	1.000	0.410	0.35	EB000GL322EB0W
	470	10 x 25	0.14	0.470	0.190	0.50	EB000GD347EB0W
40	1.0	3.3 x 11	0.16	239	75.0	0.008	EL000AA110GB0W
	2.2	3.3 x 8	0.16	120	32.0	0.007	EL000AN122Gb0W
	2.2	3.3 x 11	0.16	109	32.0	0.012	EL000AA122GB0W
	4.7	3.3 x 11	0.16	54.000	15.000	0.013	EL000AA147GB0W
	10	4.5 x 11	0.11	17.600	7.000	0.05	EL000BA210GB0W
	100	8 x 18	0.11	1.750	0.700	0.22	EB000FL310GB0W
	220	10 x 18	0.12	0.870	0.340	0.36	EB000GL322GB0W
50	100	10 x 18	0.10	1.60	0.650	0.25	EB000GL310HB0W
63	0.47	3.3 x 8	0.10	340	120	0.004	EL000AN047JB0W
	0.47	3.3 x 11	0.10	339	117	0.008	EL000AA047JB0W
	1.0	3.3 x 8	0.12	190.000	55.000	0.006	EL000AN110JB0W
	1.0	4.5 x 11	0.09	143.000	55.000	0.013	EL000BA110JB0W
	2.2	3.3 x 11	0.14	87.000	25.000	0.011	EL000AA122JB0W
	2.2	4.5 x 11	0.09	66.000	25.000	0.025	EL000BA122JB0W
	4.7	4.5 x 11	0.09	31.000	12.000	0.040	EL000BA147JB0W
	100	10 x 25	0.08	1.270	0.550	0.30	EB000GD310JB0W
100	0.47	4.5 x 11	0.08	271	96.0	0.009	EL000BA047LB0W
	1.0	4.5 x 11	0.08	128	45.0	0.020	EL000BA110LB0W
	2.2	4.5 x 11	0.08	57.9	21.0	0.030	EL000BA122LB0W



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...
160	4.7	6.5 x 18	0.15	51.0	26.0	0.050	EB000DL147MB0W
	10	8 x 18	0.15	24.0	12.0	0.070	EB000FL210MB0W
	22	10 x 25	0.15	11.0	5.50	0.19	EB000GD222MB0W
250	2.2	6.5 x 18	0.10	72.0	50.0	0.035	EB000DL122NB0W
	4.7	8 x 18	0.10	34.0	23.0	0.055	EB000FL147NB0W
	10	10 x 25	0.10	16.0	11.0	0.090	EB000GD210NB0W
350	4.7	10 x 18	0.10	34.0	22.0	0.060	EB000GL147OB0W
385	1.0	6.5 x 18	0.10	160	100	0.020	EB000DL110RB0W
	2.2	8 x 18	0.10	72.0	45.0	0.040	EB000FL122RB0W
	4.7	10 x 25	0.10	34.0	22.0	0.070	EB000GD147RB0W

ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	U _R ≤ 100 V	U _s = 1.15 x U _R
	U _R ≥ 160 V	U _s = 1.10 x U _R
Reverse voltage	-	U _{rev} ≤ 1 V
Current		
Leakage current	U _R ≤ 100 V U _R ≥ 160 V	U _R , 300 s U _R , 300 s
		I _L /μA ≤ 0.0015 x C _R /μF x U _R /V + 3 I _L /μA ≤ 0.0150 x C _R /μF x U _R /V + 10

LOW TEMPERATURE BEHAVIOUR

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

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

T _A (°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

Note

- 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.



LIFETIME TABLE $U_R \leq 100\text{ V}$

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													

Note

I_R Rated ripple current (100 Hz, RMS) [A] at upper category temperature T_{UC} taken from datasheet

I User ripple 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 $U_R > 100\text{ V}$

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													

Note

I_R Rated ripple current (100 Hz, RMS) [A] at upper category temperature T_{UC} taken from datasheet

I User ripple 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 1300300, subclause 4.13	T_A = Upper cat. temp.; U_R applied $6.3\text{ V} \leq U_R \leq 100\text{ V}$: 1000 h $T_A = 85\text{ °C}$; U_R applied $160\text{ V} \leq U_R \leq 500\text{ V}$: 2000 h	$U_R = 6.3\text{ V}$: $-40\% \leq \Delta C/C \leq 25\%$ $U_R = 6.3\text{ V}$: $-30\% \leq \Delta C/C \leq 30\%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_L (300\text{ s}) \leq \text{spec. limit}$
Useful life	CECC 30301, subclause 1.8.1	$T_A = 105\text{ °C}$; 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	$U_R = 6.3\text{ V}$: $-50\% \leq \Delta C/C \leq 45\%$ $U_R = 6.3\text{ V}$: $-45\% \leq \Delta C/C \leq 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_L (300\text{ s}) \leq \text{spec. limit}$ No short or open circuit Total failure percentage: $\leq 1\%$
		$T_A = 85\text{ °C}$; U_R and I_R applied $160\text{ V} \leq U_R \leq 400\text{ V}$: 5000 h	
Shelf life (storage at high temperature)	IEC 60348-4/ 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 min 24 h to 48 h 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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Material Category Policy

Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.

Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.

Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.