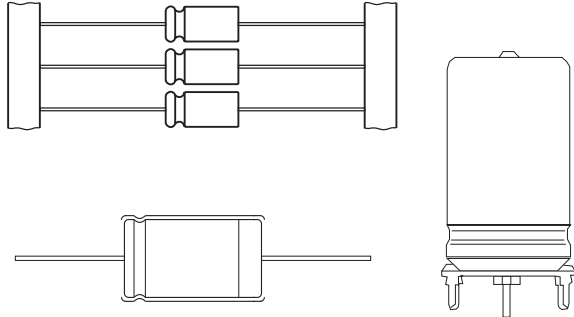


# Aluminum Capacitors

## Axial and Mounting Ring Capacitor Style



Component outlines.

**FEATURES**

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


 Available  
**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 (∅D × L)	mm	3.3 × 8 to 3.3 × 11	4.5 × 11	6 × 10 to 10 × 25	12 × 25 to 30 × 50	6.5 × 18 to 10 × 25	12 × 25 to 30 × 50
Rated capacitance range C <sub>R</sub>	μF	0.47 to 10	0.47 to 47	4.7 to 1000	100 to 33000	1 to 22	10 to 680
Capacitance tolerance	%	- 10 to + 50					
Rated voltage range	V	6.3 to 63	10 to 100	6.3 to 100		160 to 385	160 to 500
Category temperature range	°C	- 40 to + 85			- 40 to + 105		- 40 to + 85
Endurance test at upper category temp.	h	1000					2000
Useful life at 105 °C and I <sub>R</sub> applied	h	-	(750)	(1000)	2000	-	
Useful life at 85 °C and I <sub>R</sub> applied	h	1500	3000		7000	5000	
Useful life at 40 °C and I <sub>R</sub> applied	h	40000	85000		200000	130000	
Failure rate (0.8 U <sub>R</sub> , 40 °C)	10 <sup>-9</sup> /h	≤ 550	≤ 105		≤ 45	≤ 70	
Based on sectional specifications		IEC 384-4, CECC 30300					
Based on detailed specifications		similar to CECC 30301-044					
Climatic category IEC 60 068 DIN 40040		40/085/56 GPF			40/105/56 GMF	40/085/56 GPF	

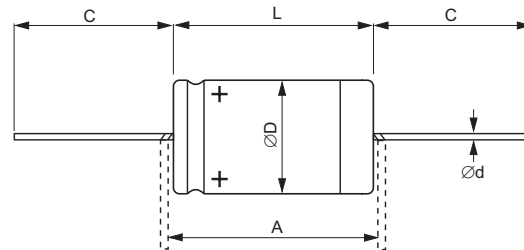
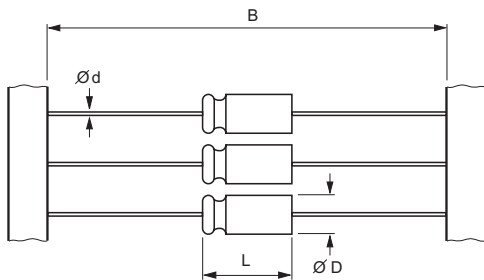
**SELECTION CHART FOR C<sub>R</sub>, U<sub>R</sub> AND RELEVANT NOMINAL CASE SIZES (∅D × L in mm)**

C <sub>R</sub> (μF)	U <sub>R</sub> (V) ≤ 100 V								U <sub>R</sub> (V) > 100 V							
	6.3	10	16	25	40	50	63	100	160	250	350	385	400	450	500	
0.47	-	-	-	-	-	-	3.3 × 8 3.3 × 11	4.5 × 10	-	-	-	-	-	-	-	
1	-	<b>EL</b>	-	-	3.3 × 11	-	3.3 × 8 4.5 × 10	4.5 × 10	-	-	-	6.5 × 18	-	<b>EB</b>	-	
2.2	-	-	-	-	3.3 × 8 3.3 × 11	-	3.3 × 11 4.5 × 10	4.5 × 10	-	6.5 × 18	-	8 × 18	-	-	-	
4.7	-	-	3.3 × 8 3.3 × 11	-	3.3 × 11	-	4.5 × 10	-	6.5 × 18	8 × 18	10 × 18	10 × 25	-	-	-	
10	3.3 × 8 3.3 × 11	-	3.3 × 11	4.5 × 10	4.5 × 10	-	-	-	8 × 18	10 × 25	12 × 25	12 × 25	-	12 × 25	12 × 30	
15	-	-	-	-	-	-	-	-	-	-	12 × 25	12 × 25	12 × 25	12 × 30	16 × 30	
22	-	4.5 × 10	-	4.5 × 10	-	-	<b>EB</b>	-	10 × 25	12 × 25	12 × 30	12 × 30	16 × 30	16 × 30	16 × 40	
33	-	-	-	-	-	-	-	-	12 × 25	12 × 25	16 × 30	16 × 30	16 × 30	18 × 30	18 × 40	
47	-	4.5 × 10	-	-	-	-	-	-	12 × 25	16 × 30	18 × 30	16 × 40	16 × 40	18 × 40	21 × 40	

\*Pb containing terminations are not RoHS compliant, exemptions may apply

<b>SELECTION CHART FOR C<sub>R</sub>, U<sub>R</sub> AND RELEVANT NOMINAL CASE SIZES (∅D × L in mm)</b>															
C <sub>R</sub> (μF)	U <sub>R</sub> (V) ≤ 100 V								U <sub>R</sub> (V) > 100 V						
	6.3	10	16	25	40	50	63	100	160	250	350	385	400	450	500
68	-	-	-	-	-	-	-	-	12 × 30	18 × 30	18 × 40	18 × 40	18 × 40	21 × 40	25 × 40
100	-	6 × 10	-	6.5 × 18	8 × 18	10 × 18	10 × 25	12 × 25	18 × 30	18 × 40	21 × 40	21 × 40	21 × 40	25 × 40	25 × 45
150	-	-	-	-	-	-	-	12 × 25	18 × 40	21 × 40	25 × 40	25 × 45	25 × 40	30 × 40	30 × 45
220	<b>EB</b>	6.5 × 18	8 × 18	10 × 18	10 × 18	12 × 25	12 × 25	-	21 × 40	25 × 40	30 × 40	30 × 40	30 × 40	30 × 50	-
330	-	-	-	-	-	12 × 25	12 × 30	-	25 × 40	25 × 50	30 × 50	-	-	-	-
470	8 × 18	10 × 18	10 × 18	10 × 25	12 × 25	12 × 30	-	-	25 × 45	30 × 45	-	-	-	-	-
680	-	-	-	12 × 25	12 × 30	-	-	-	30 × 45	-	-	-	-	-	-
1000	10 × 25	10 × 25	10 × 25	12 × 30	16 × 30	16 × 40	18 × 40	25 × 40	-	-	-	-	-	-	-
1500	12 × 25	12 × 25	10 × 30	16 × 30	16 × 40	18 × 40	21 × 40	25 × 50	-	-	-	-	-	-	-
2200	12 × 25	12 × 30	16 × 30	16 × 40	18 × 40	21 × 40	25 × 40	30 × 50	-	-	-	-	-	-	-
3300	12 × 30	16 × 40	16 × 40	18 × 40	21 × 40	25 × 40	25 × 50 30 × 45	-	-	-	-	-	-	-	-
4700	16 × 40	16 × 40	18 × 40	21 × 40	25 × 40	25 × 50 30 × 45	30 × 50	-	-	<b>EG</b>	-	-	-	-	-
6800	18 × 40	21 × 40	21 × 40	25 × 40	25 × 50 30 × 40	30 × 50	-	-	-	-	-	-	-	-	-
10000	21 × 40	25 × 40	25 × 40	25 × 50 30 × 40	30 × 50	-	-	-	-	-	-	-	-	-	-
15000	25 × 40	25 × 45	30 × 40	30 × 50	-	-	-	-	-	-	-	-	-	-	-
22000	25 × 50	30 × 45	30 × 50	-	-	-	-	-	-	-	-	-	-	-	-
33000	30 × 50	-	-	-	-	-	-	-	-	-	-	-	-	-	-

**DIMENSIONS in millimeters AND AVAILABLE FORMS**



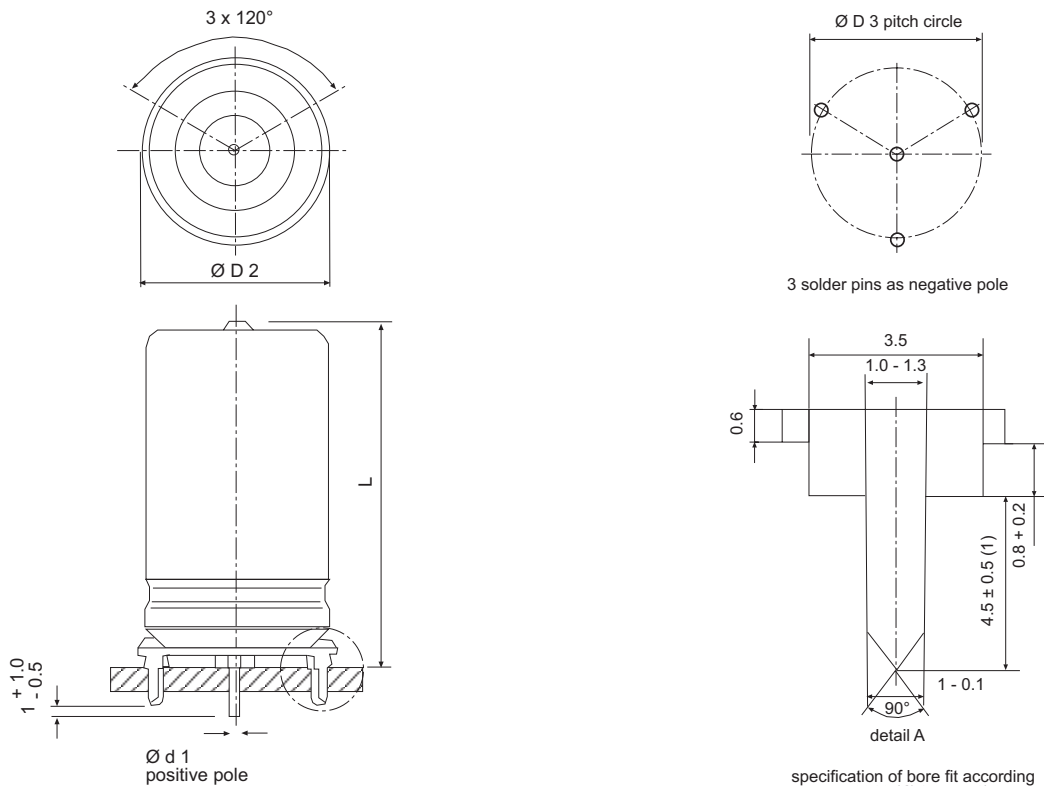
<b>AXIAL STYLE: DIMENSIONS in millimeters, MASS, PACKAGING QUANTITIES AND ORDERING CODE</b>													
NOMINAL CASE SIZE ∅D × L	∅d	C	∅D MAX.	L MAX.	A MIN.	B	MASS APPROX. g	PACKAGING, ENDING OF ORDERING CODE, QUANTITIES					
								BULK IN BOX		TAPED ON REEL		TAPED AMMO	
								CODE	PCS.	CODE	PCS.	CODE	PCS.
3.3 × 8	0.6	-	3.5	9.0	12.5	63.5 ± 1.5	0.3	-	-	..A0V	4000	..B0V	1000
3.3 × 11	0.6	-	3.5	12.0	15	63.5 ± 1.5	0.35	-	-	..A0V	3000	..B0V	1000
4.5 × 10	0.6	-	5.0	10.5	15	63.5 ± 1.5	0.5	-	-	..A0V	3000	..B0V	1000
6 × 10	0.6	-	6.3	10.5	15	63.5 ± 1.5	0.7	-	-	..A0V	1000	..B0V	1000
6.5 × 18	0.8	-	6.9	18.5	25	73.0 ± 1.6	1.3	-	-	..A0V	1000	..B0V	1000
8 × 18	0.8	-	8.5	18.5	25	73.0 ± 1.6	1.7	-	-	..A0V	500	..B0V	500
10 × 18	0.8	-	10.5	18.5	25	73.0 ± 1.6	2.5	-	-	..A0V	500	..B0V	500
10 × 25	0.8	-	10.5	25.0	30	73.0 ± 1.6	3.3	-	-	..A0V	500	..B0V	500
12 × 25	0.8	40 .5	12.5	26.5	30	73.0 ± 1.6	4	..00B	800	..A0B	450	..B0B	700
12 × 30	0.8	40 .5	12.5	31.5	35	73.0 ± 1.6	6	..00B	800	..A0B	450	..B0B	700

Aluminum Capacitors  
Axial and Mounting Ring Capacitor Style

Vishay Roederstein

<b>AXIAL STYLE: DIMENSIONS</b> in millimeters, <b>MASS, PACKAGING QUANTITIES AND ORDERING CODE</b>													
NOMINAL CASE SIZE $\varnothing D \times L$	$\varnothing d$	C	$\varnothing D$ MAX.	L MAX.	A MIN.	B	MASS APPROX. g	PACKAGING, ENDING OF ORDERING CODE, QUANTITIES					
								BULK IN BOX		TAPED ON REEL		TAPED AMMO	
								CODE	PCS.	CODE	PCS.	CODE	PCS.
16 × 30	0.8	40 <sub>-5</sub>	16.5	30.0	35	73.0 ± 1.6	8	..00B	150	..A0B	250	..B0B	400
16 × 40	0.8	40 <sub>-5</sub>	16.5	40.0	45	-	11	..00B	150	-	-	-	-
18 × 30	0.8	40 <sub>-5</sub>	18.5	30.5	35	-	10	..00B	150	-	-	-	-
18 × 40	0.8	40 <sub>-5</sub>	18.5	40.5	45	-	15	..00B	100	-	-	-	-
21 × 40	0.8	40 <sub>-5</sub>	21.5	41.0	45	-	21	..00B	100	-	-	-	-
25 × 40	0.8	40 <sub>-5</sub>	25.5	41.0	45	-	31	..00B	60	-	-	-	-
25 × 45	0.8	40 <sub>-5</sub>	25.5	47.0	51	-	38	..00B	60	-	-	-	-
25 × 50	0.8	40 <sub>-5</sub>	25.5	51.0	55	-	44	..00B	50	-	-	-	-
30 × 40	1.0	40 <sub>-5</sub>	30.5	41.0	45	-	46	..00B	40	-	-	-	-
30 × 45	1.0	40 <sub>-5</sub>	30.5	47.0	51	-	54	..00B	30	-	-	-	-
30 × 50	1.0	40 <sub>-5</sub>	30.5	51.0	55	-	64	..00B	30	-	-	-	-

Axial style capacitors are insulated



**EG 03..**

Cases of mounting ring style capacitors are not insulated.  
Insulation on request.

<b>MOUNTING RING: DIMENSIONS</b> in millimeters, <b>MASS, PACKAGING AND ORDERING CODE</b>							
CASE SIZE Ø D × L	Ø D 1	Ø D 2 MAX.	Ø D 3 ± 0.2	L <sub>max.</sub>	MASS APPROX. g	START OF ORDERING CODE	PACKAGING QUANTITY pcs
16 × 30	1.0	17.2	16.5	32	12	EG 03..	504
16 × 40	1.0	17.2	16.5	42	13	EG 03..	336
18 × 30	1.0	19.2	18.5	32	13	EG 03..	429
18 × 40	1.0	19.2	18.5	42	19	EG 03..	286
21 × 40	1.0	22.2	21.5	42	24	EG 03..	220
25 × 40	1.0	26.2	25.5	42	28	EG 03..	144
25 × 45	1.0	26.2	25.5	48	33	EG 03..	144
25 × 50	1.0	26.2	25.5	53	40	EG 03..	144
30 × 40	1.0	31.2	30.5	42	42	EG 03..	112
30 × 45	1.0	31.2	30.5	48	46	EG 03..	112
30 × 50	1.0	31.2	30.5	53	50	EG 03..	112

<b>ELECTRICAL DATA</b>	
SYMBOL	DESCRIPTION
C <sub>R</sub>	rated capacitance at 100 Hz
U <sub>R</sub>	rated voltage
Tan δ	max. dissipation factor at 100 Hz
R <sub>ESR</sub>	equivalent series resistance at 100 Hz, (calculated from Tan δ max and C <sub>R</sub> )
Z	max. impedance at 10 kHz
I <sub>R</sub>	rated alternating current (rms) at 100 Hz and upper category temperature
T <sub>a</sub>	ambient temperature
T <sub>uc</sub>	upper category temperature
RH	relative humidity
P	ambient pressure

**Note**

- Unless otherwise specified, all electrical values apply at T<sub>a</sub> = 20 °C, P = 86 to 106 kPa, RH = 45 to 75 %.

**ORDERING EXAMPLE**

The following table gives the ordering number for standard version = axial leads, in bulk.

\* The 3rd place of the catalog number is always a blank sign which is essential for ordering code

The 5<sup>th</sup> place of ordering code refers to termination style:  
 EG 00..                    0 = axial leads  
 EG 03..                    3 = mounting ring with solder pins

The 12<sup>th</sup> place of ordering code refers to packaging for axial lead capacitors:

EB 00HD415C...                    = EB 1500 µF 10 V 12 x 25  
 EB 00HD415C00B                    0 = in bulk (box)  
 EB 00HD415CA0B                    A = taped on reel  
 EB 00HD415CB0B                    B = taped ammo

Please see tables “Axial Styles” and “Mounting Ring Styles” for available versions.

<b>ELECTRICAL DATA AND ORDERING INFORMATION</b>							
U <sub>R</sub> (V)	C <sub>R</sub> 100 Hz (µF)	NOMINAL CASE SIZE Ø D × L (mm)	Tan δ 100 Hz MAX.	R <sub>ESR</sub> 100 Hz (Ω)	Z 10 kHz MAX. (Ω)	I <sub>R</sub> 100 Hz T <sub>uc</sub> (A)	CATALOG NUMBER*
6.3	10	3.3 × 8	0.30	47.7	20.0	0.011	EL 00AN210B00V
	10	3.3 × 11	0.30	47.7	20.0	0.015	EL 00AA210B00V
	470	8 × 18	0.25	0.847	0.430	0.33	EB 00FL347B00V
	1000	10 × 25	0.25	0.398	0.200	0.56	EB 00GD410B00V
	1500	12 × 25	0.26	0.276	0.170	0.54	EB 00HD415B00B
	2200	12 × 25	0.24	0.200	0.100	1.0	EB 00HD422B00B
	3300	12 × 30	0.26	0.150	0.070	1.6	EB 00HE433B00B
	4700	16 × 40	0.28	0.110	0.050	1.8	EG 00KG447B00B
	6800	18 × 40	0.30	0.066	< 0.050	2.1	EG 00LG468B00B
	10000	21 × 40	0.34	0.055	< 0.050	2.4	EG 00MG510B00B
	15000	25 × 40	0.45	0.050	< 0.050	2.5	EG 00NG515B00B
	22000	25 × 50	0.50	< 0.050	< 0.050	3.0	EG 00NJ522B00B
	33000	30 × 50	0.80	< 0.050	< 0.050	3.0	EG 00PJ533B00B



Aluminum Capacitors  
Axial and Mounting Ring Capacitor Style

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ELECTRICAL DATA AND ORDERING INFORMATION							
U <sub>R</sub> (V)	C <sub>R</sub> 100 Hz (μF)	NOMINAL CASE SIZE ØD × L (mm)	Tan δ 100 Hz MAX.	R <sub>ESR</sub> 100 Hz (Ω)	Z 10 kHz MAX. (Ω)	I <sub>R</sub> 100 Hz T <sub>UC</sub> (A)	CATALOG NUMBER*
10	22	4.5 × 10	0.20	14.5	7.30	0.045	EL 00BA222C00V
	47	4.5 × 10	0.20	6.78	3.40	0.070	EL 00BA247C00V
	100	6 × 10	0.20	3.19	1.60	0.11	EB 00CK310C00V
	220	6.5 × 18	0.20	1.45	0.730	0.21	EB 00DL322C00V
	470	10 × 18	0.20	0.680	0.340	0.41	EB 00GL347C00V
	1000	10 × 25	0.20	0.320	0.160	0.56	EB 00GD410C00V
	1500	12 × 25	0.21	0.220	0.110	1.0	EB 00HD415C00B
	2200	12 × 30	0.22	0.160	0.080	1.3	EB 00HE422C00B
	3300	16 × 40	0.25	0.120	0.050	1.9	EG 00KG433C00B
	4700	16 × 40	0.26	0.090	< 0.050	2.2	EG 00KG447C00B
	6800	21 × 40	0.32	0.070	< 0.050	2.6	EG 00MG468C00B
	10000	25 × 40	0.36	0.060	< 0.050	2.7	EG 00NG510C00B
	15000	25 × 45	0.48	0.050	< 0.050	2.9	EG 00NH515C00B
	22000	30 × 45	0.62	< 0.050	< 0.050	2.9	EG 00PH522C00B
16	4.7	3.3 × 8	0.20	68.0	26.0	0.009	EL 00AN147D00V
	4.7	3.3 × 11	0.20	67.8	26.0	0.015	EL 00AA147D00V
	10	3.3 × 11	0.20	32.0	12.0	0.016	EL 00AA210D00V
	220	8 × 18	0.16	1.16	0.550	0.27	EB 00FL322D00V
	470	10 × 18	0.16	0.540	0.280	0.41	EB 00GL347D00V
	1000	10 × 25	0.16	0.260	0.130	0.55	EB 00G0410D00V
	1500	12 × 30	0.17	0.180	0.090	1.2	EB 00HE415D00B
	2200	16 × 30	0.18	0.130	0.060	1.6	EG 00KE422D00B
	3300	16 × 40	0.21	0.100	< 0.050	2.1	EG 00KG433D00B
	4700	18 × 40	0.24	0.080	< 0.050	2.4	EG 00LG447D00B
	6800	21 × 40	0.28	0.070	< 0.050	2.5	EG 00MG468D00B
	10000	25 × 40	0.34	0.050	< 0.050	2.6	EG 00NG510D00B
	15000	30 × 40	0.44	< 0.050	< 0.050	2.5	EG 00PG515D00B
	22000	30 × 50	0.58	< 0.050	< 0.050	3.0	EG 00PJ522D00B
25	10	4.5 × 10	0.14	22.300	9.000	0.05	EL 00BA210E00V
	22	4.5 × 10	0.14	10.200	4.100	0.06	EL 00BA222E00V
	47	6 × 10	0.14	4.800	1.900	0.10	EB 00CK247E00V
	100	6.5 × 18	0.14	2.200	0.900	0.16	EB 00DL310E00V
	220	10 × 18	0.14	1.000	0.410	0.35	EB 00GL322E00V
	470	10 × 25	0.14	0.470	0.190	0.50	EB 00G0347E00V
	680	12 × 25	0.14	0.320	0.130	0.87	EB 00H0368E00B
	1000	12 × 30	0.14	0.220	0.090	1.1	EB 00HE410E00B
	1500	16 × 30	0.15	0.160	0.060	1.5	EG 00KE415E00B
	2200	16 × 40	0.16	0.120	< 0.050	1.9	EG 00KG422E00B
	3300	18 × 40	0.19	0.090	< 0.050	2.2	EG 00LG433E00B
	4700	21 × 40	0.21	0.070	< 0.050	2.4	EG 00MG447E00B
	6800	25 × 40	0.26	0.060	< 0.050	2.5	EG 00NG468E00B
	10000	25 × 40	0.32	0.050	< 0.050	2.9	EG 00NG510E00B
	10000	30 × 40	0.32	0.050	< 0.050	2.8	EG 00PG510E00B
	15000	30 × 50	0.36	< 0.050	< 0.050	3.0	EG 00PJ515E00B

ELECTRICAL DATA AND ORDERING INFORMATION							
$U_R$ (V)	$C_R$ 100 Hz ( $\mu$ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$\tan \delta$ 100 Hz MAX.	$R_{ESR}$ 100 Hz ( $\Omega$ )	$Z$ 10 kHz MAX. ( $\Omega$ )	$I_R$ 100 Hz $T_{UC}$ (A)	CATALOG NUMBER*
40	1	3.3 × 11	0.16	239	75.0	0.008	EL 00AA110G00V
	2.2	3.3 × 8	0.16	120	32.0	0.007	EL 00AA122G00V
	2.2	3.3 × 11	0.16	109	32.0	0.012	EL 00AA122G00V
	4.7	3.3 × 11	0.16	54.000	15.000	0.013	EL 00AA147G00V
	10	4.5 × 10	0.11	17.600	7.000	0.05	EL 00BA210G00V
	22	6 × 10	0.11	8.000	3.200	0.075	EB 00CK222G00V
	47	6.5 × 18	0.11	3.800	1.500	0.15	EB 00DL247G00V
	100	8 × 18	0.11	1.750	0.700	0.22	EB 00FL310G00V
	220	10 × 18	0.12	0.870	0.340	0.36	EB 00GL322G00V
	470	12 × 25	0.10	0.410	0.150	0.75	EB 00H0347G00B
	680	12 × 30	0.10	0.280	0.120	0.94	EB 00HE368G00B
	1000	16 × 30	0.10	0.190	0.080	1.3	EG 00KE410G00B
	1500	16 × 40	0.13	0.140	0.060	1.6	EG 00KG415G00B
	2200	18 × 40	0.14	0.100	< 0.050	2.0	EG 00LG422G00B
	3300	21 × 40	0.17	0.080	< 0.050	2.2	EG 00MG433G00B
	4700	25 × 40	0.18	0.070	< 0.050	2.4	EG 00NG447G00B
	6800	25 × 50	0.24	0.060	< 0.050	2.8	EG 00NJ468G00B
6800	30 × 40	0.24	0.060	< 0.050	2.4	EG 00PG468G00B	
10000	30 × 50	0.32	< 0.050	< 0.050	2.9	EG 00PJ510G00B	
50	100	10 × 18	0.10	1.60	0.650	0.25	EB 00GL310H00V
	220	12 × 25	0.10	0.720	0.300	0.31	EB 00HD322H00B
	330	12 × 25	0.10	0.480	0.200	0.63	EB 00HD333H00B
	470	12 × 30	0.10	0.340	0.140	0.78	EB 00HE347H00B
	680	16 × 30	0.10	0.240	0.100	1.1	EG 00KE368H00B
	1000	16 × 40	0.10	0.160	0.070	1.4	EG 00KG410H00B
	1500	18 × 40	0.11	0.120	0.050	1.7	EG 00LG415H00B
	2200	21 × 40	0.12	0.090	< 0.050	2.1	EG 00MG422H00B
	3300	25 × 40	0.15	0.070	< 0.050	2.3	EG 00NG433H00B
	4700	25 × 50	0.18	0.060	< 0.050	2.8	EG 00NJ447H00B
	4700	30 × 45	0.18	0.060	< 0.050	2.8	EG 00PH447H00B
6800	30 × 50	0.22	0.050	< 0.050	3.0	EG 00PJ468H00B	
63	0.47	3.3 × 8	0.10	340	120	0.004	EL 00AN047J00V
	0.47	3.3 × 11	0.10	339	117	0.008	EL 00AA047J00V
	1	3.3 × 8	0.12	190.000	55.000	0.006	EL 00AN110J00V
	1	4.5 × 10	0.09	143.000	55.000	0.013	EL 00BA110J00V
	2.2	3.3 × 11	0.14	87.000	25.000	0.011	EL 00AA122J00V
	2.2	4.5 × 10	0.09	66.000	25.000	0.025	EL 00BA122J00V
	4.7	4.5 × 10	0.09	31.000	12.000	0.040	EL 00BA147J00V
	10	6 × 10	0.08	12.800	5.500	0.070	EB 00CK210J00V
	22	6.5 × 18	0.08	5.800	2.500	0.11	EB 00DL222J00V
	47	8 × 18	0.08	2.700	1.200	0.19	EB 00FL247J00V
	100	10 × 25	0.08	1.270	0.550	0.30	EB 00GD310J00V
	220	12 × 25	0.08	0.580	0.250	0.52	EB 00HD322J00B
	330	12 × 30	0.08	0.380	0.170	0.67	EB 00HE333J00B
	470	16 × 30	0.08	0.270	0.120	0.92	EG 00KE347J00B
	680	16 × 40	0.08	0.200	0.090	1.2	EG 00KG368J00B
	1000	18 × 40	0.08	0.130	0.060	1.5	EG 00LG410J00B
	1500	21 × 40	0.09	0.100	0.050	1.9	EG 00MG415J00B
	2200	25 × 40	0.10	0.070	< 0.050	2.2	EG 00NG422J00B
	3300	25 × 50	0.13	0.060	< 0.050	2.6	EG 00NJ433J00B
3300	30 × 45	0.13	0.060	< 0.050	2.6	EG 00PH433J00B	
4700	30 × 50	0.15	0.050	< 0.050	2.8	EG 00PJ447J00B	



Aluminum Capacitors  
Axial and Mounting Ring Capacitor Style

Vishay Roederstein

ELECTRICAL DATA AND ORDERING INFORMATION							
U <sub>R</sub> (V)	C <sub>R</sub> 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	Tan δ 100 Hz MAX.	R <sub>ESR</sub> 100 Hz (Ω)	Z 10 kHz MAX. (Ω)	I <sub>R</sub> 100 Hz T <sub>UC</sub> (A)	CATALOG NUMBER*
100	0.47	4.5 × 10	0.08	271	96.0	0.009	EL 00BA047L00V
	1	4.5 × 10	0.08	128	45.0	0.020	EL 00BA110L00V
	2.2	4.5 × 10	0.08	57.9	21.0	0.030	EL 00BA122L00V
	4.7	6 × 10	0.07	23.7	9.60	0.050	EB 00CK147L00V
	10	6.5 × 18	0.07	11.2	4.50	0.090	EB 00DL210L00V
	22	8 × 18	0.07	5.07	2.10	0.12	EB 00FL222L00V
	47	10 × 18	0.07	2.37	0.900	0.15	EB 00GL247L00V
	100	12 × 25	0.07	1.11	0.500	0.31	EB 00HD310L00B
	150	12 × 25	0.07	0.740	0.330	0.37	EB 00HD315L00B
	220	16 × 30	0.07	0.510	0.200	0.54	EG 00KE322L00B
	330	16 × 40	0.07	0.340	0.130	0.70	EG 00KG333L00B
	470	18 × 40	0.07	0.240	0.090	0.90	EG 00LG347L00B
	680	21 × 40	0.07	0.160	0.070	1.2	EG 00MG368L00B
	1000	25 × 40	0.07	0.110	0.050	1.5	EG 00NG410L00B
1500	25 × 50	0.08	0.090	< 0.050	1.9	EG 00NJ415L00B	
2200	30 × 50	0.10	0.070	< 0.050	2.3	EG 00PJ422L00B	
160	4.7	6.5 × 18	0.15	51.0	26.0	0.050	EB 00DL147M00V
	10	8 × 18	0.15	24.0	12.0	0.070	EB 00FL210M00V
	22	10 × 25	0.15	11.0	5.50	0.19	EB 00GD222M00V
	33	12 × 25	0.07	3.38	1.04	0.23	EB 00HD233M00B
	47	12 × 25	0.07	2.37	0.730	0.29	EB 00HD247M00B
	68	12 × 30	0.07	1.64	0.505	0.37	EB 00HE268M00B
	100	18 × 30	0.07	1.12	0.350	0.56	EG 00LE310M00B
	150	18 × 40	0.07	0.745	0.235	0.73	EG 00LG315M00B
	220	21 × 40	0.07	0.505	0.165	0.97	EG 00MG322M00B
	330	25 × 40	0.07	0.340	0.115	1.3	EG 00NG333M00B
470	25 × 45	0.07	0.235	0.085	1.6	EG 00NH347M00B	
680	30 × 45	0.07	0.165	0.065	2.0	EG 00PH368M00B	
250	2.2	6.5 × 18	0.10	72.0	50.0	0.035	EB 00DL122N00V
	4.7	8 × 18	0.10	34.0	23.0	0.055	EB 00FL147N00V
	10	10 × 25	0.10	16.0	11.0	0.090	EB 00GD210N00V
	22	12 × 25	0.07	5.07	1.84	0.20	EB 00HD222N00B
	33	12 × 25	0.07	3.38	1.23	0.26	EB 00HD233N00B
	47	16 × 30	0.07	2.37	0.865	0.38	EG 00KE247N00B
	68	18 × 30	0.07	1.64	0.600	0.49	EG 00LE268N00B
	100	18 × 40	0.07	1.12	0.410	0.63	EG 00LG310N00B
	150	21 × 40	0.07	0.745	0.280	0.86	EG 00MG315N00B
	220	25 × 40	0.07	0.505	0.195	1.1	EG 00NG322N00B
330	25 × 50	0.07	0.340	0.135	1.5	EG 00NJ333N00B	
470	30 × 45	0.07	0.235	0.105	1.8	EG 00PH347N00B	
350	4.7	10 × 18	0.10	34.0	22.0	0.060	EB 00GL147O00V
	10	12 × 25	0.09	12.5	7.56	0.13	EB 00HD210O00B
	15	12 × 25	0.09	8.32	5.04	0.16	EB 00HD215O00B
	22	12 × 30	0.09	5.68	3.44	0.21	EB 00HE222O00B
	33	16 × 30	0.09	3.79	2.30	0.31	EG 00KE233O00B
	47	18 × 30	0.09	2.67	1.62	0.41	EG 00LE247O00B
	68	18 × 40	0.09	1.85	1.12	0.52	EG 00LG268O00B
	100	21 × 40	0.09	1.26	0.765	0.69	EG 00MG310O00B
	150	25 × 40	0.09	0.850	0.520	0.95	EG 00NG315O00B
	220	30 × 40	0.09	0.595	0.370	1.3	EG 00PG322O00B
330	30 × 50	0.09	0.400	0.250	1.6	EG 00PJ333O00B	

ELECTRICAL DATA AND ORDERING INFORMATION							
$U_R$ (V)	$C_R$ 100 Hz ( $\mu$ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$\tan \delta$ 100 Hz MAX.	$R_{ESR}$ 100 Hz ( $\Omega$ )	$Z$ 10 kHz MAX. ( $\Omega$ )	$I_R$ 100 Hz $T_{UC}$ (A)	CATALOG NUMBER*
385	1	6.5 × 18	0.10	160	100	0.020	EB 00DL110R00V
	2.2	8 × 18	0.10	72.0	45.0	0.040	EB 00FL122R00V
	4.7	10 × 25	0.10	34.0	22.0	0.070	EB 00GD147R00V
	10	12 × 25	0.10	16.0	6.85	0.13	EB 00HD210R00B
	15	12 × 25	0.10	11.0	4.57	0.16	EB 00HD215R00B
	22	12 × 30	0.10	7.24	3.12	0.21	EB 00HE222R00B
	33	16 × 30	0.10	4.83	2.09	0.31	EG 00KE233R00B
	47	16 × 40	0.10	3.39	1.73	0.39	EG 00KG247R00B
	68	18 × 40	0.10	2.34	1.02	0.52	EG 00LG268R00B
	100	21 × 40	0.10	1.59	0.825	0.70	EG 00MG310R00B
	150	25 × 45	0.10	1.06	0.520	0.96	EG 00NH315R00B
220	30 × 40	0.10	0.725	0.340	1.3	EG 00PG322R00B	
400	15	12 × 25	0.06	5.64	3.13	0.18	EB 00HD215X00B
	22	16 × 30	0.06	3.74	2.08	0.28	EB 00KE222X00B
	33	16 × 30	0.06	2.51	1.39	0.35	EG 00KE233X00B
	47	16 × 40	0.06	1.76	0.975	0.45	EG 00KG247X00B
	68	18 × 40	0.06	1.22	0.680	0.59	EG 00LG268X00B
	100	21 × 40	0.06	0.840	0.470	0.78	EG 00MG310X00B
	150	25 × 40	0.06	0.575	0.325	1.0	EG 00NG315X00B
220	30 × 40	0.06	0.410	0.235	1.4	EG 00PG322X00B	
450	10	12 × 25	0.15	24.0	6.21	0.13	EB 00HD210P00B
	15	12 × 30	0.15	16.0	4.14	0.17	EB 00HE215P00B
	22	16 × 30	0.15	11.0	2.83	0.24	EG 00KE222P00B
	33	18 × 30	0.15	7.24	1.89	0.33	EG 00LE233P00B
	47	18 × 40	0.15	5.08	1.33	0.42	EG 00LG247P00B
	68	21 × 40	0.15	3.52	0.920	0.56	EG 00MG268P00B
	100	25 × 40	0.15	2.39	0.635	0.76	EG 00NG310P00B
	150	30 × 40	0.15	1.59	0.435	1.0	EG 00PG315P00B
220	30 × 45	0.15	1.09	0.300	1.3	EG 00PH322P00B	
500	6.8	12 × 25	0.08	15.9	9.78	0.12	EB 00HD168Y00B
	10	12 × 30	0.08	10.8	6.65	0.15	EB 00HE210Y00B
	15	16 × 30	0.08	7.04	4.32	0.23	EG 00KE215Y00B
	22	16 × 40	0.08	4.80	2.95	0.30	EG 00KG222Y00B
	33	18 × 40	0.08	3.21	1.97	0.40	EG 00LG233Y00B
	47	21 × 40	0.08	2.26	1.39	0.52	EG 00MG247Y00B
	68	25 × 40	0.08	1.57	0.970	0.70	EG 00NG268Y00B
	100	25 × 45	0.08	1.08	0.665	0.88	EG 00NH310Y00B
	150	30 × 45	0.08	0.730	0.455	1.2	EG 00PH315Y00B

ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
<b>Voltage</b>		
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
<b>Current</b>		
Leakage current	$U_R \leq 100$ V;	$I_L/\mu A \leq 0.0015 \times C_R/\mu F \times U_R/V + 3$
	$U_R \geq 160$ V;	$I_L/\mu A \leq 0.0150 \times C_R/\mu F \times U_R/V + 10$



## Aluminum Capacitors Axial and Mounting Ring Capacitor Style

Vishay Roederstein

### 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 <sub>a</sub> (°C)	RATED VOLTAGE (V)														
	6.3	10	16	25	40	50	63	100	160	250	350	385	400	450	500
- 25	1300	1000	860	440	330	270	200	160	1000	940	860	1800	1800	5000	5000
- 40	4800	3500	2400	1200	990	800	550	500	5000	4600	4200	6000	6000	10000	10000

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<sub>R</sub> ≤ 100 V and Ø ≤ 10 mm

<b>INTERRELATION BETWEEN ALTERNATING CURRENT, AMBIENT TEMPERATURE AND LIFETIME</b>																				
I/I <sub>R</sub> (FREQUENCY DEPENDENT)							LIFETIME MULTIPLIER L (depending on I/I <sub>R</sub> and T <sub>a</sub> )													
FREQUENCY [Hz]							AMBIENT TEMPERATURE T <sub>a</sub> [°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	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													

**combination not permitted**

I<sub>R</sub> Rated ripple current (100 Hz, rms) [A] at upper category temperature T<sub>UC</sub> taken from data sheet.

I User ripple current [A].

T<sub>a</sub> 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**  $U_R \leq 100\text{ V}$  and  $\varnothing \geq 12\text{ mm}$

<b>INTERRELATION BETWEEN ALTERNATING CURRENT, AMBIENT TEMPERATURE AND LIFETIME</b>																				
$I/I_R$ (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	194	123	79	51	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	176	113	73	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	155	100	65	43	29	19	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	129	85	56	37	25	17	12	8.2	5.7	4.1	2.9	2.1	1.50	1.10
0.90	1.00	1.10	1.15	1.20	1.25	1.30	105	70	47	32	22	15	10	7.2	5.1	3.6	2.6	1.9	1.36	1.00
1.08	1.20	1.32	1.38	1.44	1.50	1.56	83	56	38	26	18	13	8.8	6.2	4.4	3.2	2.3	1.7	1.21	
1.26	1.40	1.54	1.61	1.68	1.75	1.82	64	44	30	21	15	10	7.3	5.2	3.8	2.7	2.0	1.4	1.06	
1.44	1.60	1.76	1.84	1.92	2.00	2.08	49	34	24	17	12	8.4	6.0	4.3	3.1	2.3	1.7	1.2		
1.62	1.80	1.98	2.07	2.16	2.25	2.34	36	26	18	13	9.4	6.8	4.9	3.6	2.6	1.9	1.4	1.0		
1.80	2.00	2.20	2.30	2.40	2.50	2.60	26	19	14	10	7.3	5.3	3.9	2.9	2.1	1.6	1.2			
1.98	2.20	2.42	2.53	2.64	2.75	2.86	19	14	10	7.6	5.6	4.1	3.1	2.3	1.7	1.3				
2.16	2.40	2.64	2.76	2.88	3.00	3.12	14	10	7.6	5.7	4.3	3.2	2.4	1.8	1.3	1.0				
2.34	2.60	2.86	2.99	3.12	3.25	3.38	9.7	7.4	5.6	4.2	3.2	2.4	1.8	1.4	1.1					
2.52	2.80	3.08	3.22	3.36	3.50	3.64	6.9	5.3	4.1	3.1	2.4	1.8	1.4	1.1						
2.70	3.00	3.30	3.45	3.60	3.75	3.90	4.9	3.8	3.0	2.3	1.8	1.4	1.1							
2.88	3.20	3.52	3.68	3.84	4.00	4.16	3.4	2.7	2.1	1.7	1.3	1.0								
3.06	3.40	3.74	3.91	4.08	4.25	4.42	2.4	1.9	1.5	1.2										
3.24	3.60	3.96	4.14	4.32	4.50	4.68	1.7	1.3	1.1											
3.42	3.80	4.18	4.37	4.56	4.75	4.94	1.2													

combination not permitted

$I_R$  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 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**  $U_R > 100\text{ V}$

<b>INTERRELATION BETWEEN ALTERNATING CURRENT, AMBIENT TEMPERATURE AND LIFETIME</b>																	
$I/I_R$ (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	
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										

combination not permitted

$I_R$  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 multiplier.

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



Aluminum Capacitors  
Axial and Mounting Ring Capacitor Style

Vishay Roederstein

<b>TEST PROCEDURES AND REQUIREMENTS</b>			
<b>TEST</b>		<b>PROCEDURE (quick reference)</b>	<b>REQUIREMENTS</b>
<b>NAME OF TEST</b>	<b>REFERENCE</b>		
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  $T_A = 85\text{ }^\circ\text{C}$ ; $U_R$ applied; $160\text{ V} \leq U_R \leq 500\text{ V}$ : 2000 hours	$U_R = 6.3\text{ V}$ : - 40 % $\leq DC/C \leq 25\%$ $U_R = 6.3\text{ V}$ : - 30 % $\leq DC/C \leq 30\%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_L(300\text{ s}) \leq \text{spec. limit}$
Useful life	CECC 30301, subclause 1.8.1	$T_A = 105\text{ }^\circ\text{C}$ ; $U_R$ and $I_R$ applied; $6.3\text{ V} \leq U_R \leq 100\text{ V}$  case $4.5 \times 11$ : 750 h cases $6 \times 10$ to $10 \times 25$ : 1000 cases $6 \times 10$ to $10 \times 25$ : 1000 h	$U_R = 6.3\text{ V}$ : - 50 % $\leq DC/C \leq 45\%$ $U_R = 6.3\text{ V}$ : - 45 % $\leq DC/C \leq 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_L(300\text{ s}) \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
		$T_A = 85\text{ }^\circ\text{C}$ ; $U_R$ and $I_R$ applied; $160\text{ V} \leq U_R \leq 500\text{ V}$ : 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 $3.3 \times 8$ to $10 \times 25$ : 500 h cases $12 \times 25$ to $30 \times 50$ : 100 h After test: $U_R$ to be applied for 30 minutes, 24 to 48 hours before measurement	$U_R = 6.3\text{ V}$ : - 40 % $\leq DC/C \leq 25\%$ $U_R = 6.3\text{ V}$ : - 30 % $\leq DC/C \leq 30\%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_L(300\text{ s}) \leq 2 \times \text{spec. limit}$



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