Aluminum Electrolytic Capacitors
Power Miniaturized General Purpose Snap-In



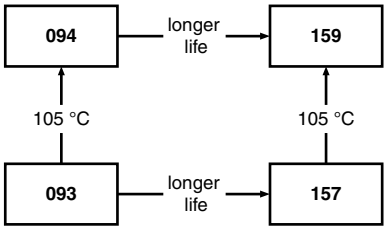


Fig. 1

FEATURES

- Useful life: 2000 h at 85 °C
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, miniaturized dimensions, cylindrical aluminum case insulated with a blue sleeve
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

APPLICATIONS

- Consumer electronics
- Whitegood motor control
- Electronic drives
- SMPS / UPS

MARKING

The capacitors are marked (where possible) with the following information:

- Rated capacitance (in µF)
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (M for ± 20 %)
- Rated voltage (in V)
- Date code
- Name of manufacturer
- "-" sign to identify the negative terminal, visible from the top and side of the capacitor
- Code number (last 8 digits)
- Maximum operating temperature

QUICK REFERENCE DATA	
DESCRIPTION	**VALUE**
Nominal case size (Ø D x L in mm)	22 x 25 to 35 x 50
Rated capacitance range, C_R	68 µF to 2200 µF
Tolerance on C_R	± 20 %
Rated voltage range, U_R	200 V to 450 V
Category temperature range	-25 °C to +85 °C
Endurance test at 85 °C	2000 h
Useful life at 85 °C	2000 h
Useful life at 40 °C and 1.4 x I_R applied	36 000 h
Shelf life at 0 V, 85 °C	500 h
Max. RMS value of ripple voltage	12 V
Based on sectional specification	IEC 60384-4 / EN 130300/W of JISC5141

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

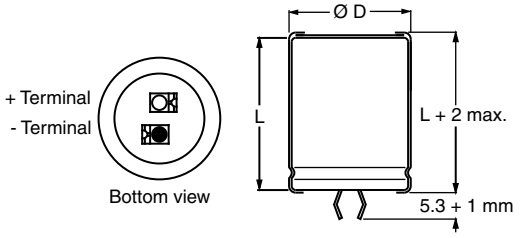
C_R (µF)	U_R (V)				
	200	**250**	**400**	**420**	**450**
68	-	-	22 x 25	-	-
82	-	-	-	-	22 x 25
100	-	-	22 x 25	22 x 25	22 x 30
120	-	-	-	-	22 x 30 25 x 25
150	-	-	22 x 30 25 x 25	-	22 x 35
180	-	-	22 x 35 25 x 30	22 x 35 25 x 30	22 x 40 25 x 30 30 x 25
220	-	22 x 25	22 x 40 25 x 30 30 x 25	25 x 35 30 x 25	22 x 50 25 x 35
270	22 x 25	22 x 30	22 x 50	22 x 50 30 x 30	30 x 30 35 x 25
330	-	22 x 35	25 x 40 30 x 30 35 x 25	25 x 50 30 x 35	25 x 50 35 x 30

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SELECTION CHART FOR C_R, U_R, AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)					
C_R (µF)	U_R (V)				
	200	250	400	420	450
390	22 x 30 25 x 25	22 x 35 25 x 30	25 x 50 30 x 35 35 x 30	35 x 30	30 x 40 35 x 35
470	22 x 35	25 x 35	30 x 40 35 x 30	35 x 35	35 x 40
560	25 x 30	25 x 40	30 x 45 35 x 35	30 x 50 35 x 40	35 x 45
680	25 x 35	30 x 30	35 x 40	35 x 45	35 x 50
820	25 x 40	30 x 35	35 x 50	-	-
1000	30 x 35	30 x 40	-	-	-
1200	30 x 40	35 x 40	-	-	-
1500	30 x 45	35 x 45	-	-	-
1800	30 x 50 35 x 40	35 x 50	-	-	-
2200	35 x 45	-	-	-	-

DIMENSIONS in millimeters AND AVAILABLE FORMS



The minus and/or plus terminal can be marked with an imprinted sign

Fig. 2 - Two terminal snap-in

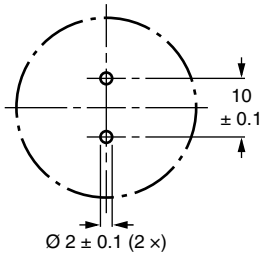


Fig. 3 - Mounting hole diagram

Table 1

DIMENSIONS in millimeters, MASS, AND PACKAGING QUANTITIES					
NOMINAL CASE SIZE Ø D x L	Ø $D_{max.}$	$L_{max.}$	MASS (g)	PACKAGING QUANTITIES	CARDBOARD BOX DIMENSIONS L x W x H
22 x 25	23.0	27	≈ 12	100	260 x 250 x 39
22 x 30	23.0	32	≈ 16	100	260 x 250 x 44
22 x 35	23.0	37	≈ 20	100	260 x 250 x 49
22 x 40	23.0	42	≈ 23	100	260 x 250 x 54
22 x 45	23.0	47	≈ 26	100	260 x 250 x 59
22 x 50	23.0	52	≈ 29	100	260 x 250 x 64
25 x 25	26.0	27	≈ 20	100	290 x 280 x 39
25 x 30	26.0	32	≈ 22	100	290 x 280 x 44
25 x 35	26.0	37	≈ 24	100	290 x 280 x 49
25 x 40	26.0	42	≈ 27	100	290 x 280 x 54
25 x 45	26.0	47	≈ 32	100	290 x 280 x 59
25 x 50	26.0	52	≈ 38	100	290 x 280 x 64
30 x 25	31.0	27	≈ 25	100	340 x 330 x 39
30 x 30	31.0	32	≈ 30	100	340 x 330 x 44
30 x 35	31.0	37	≈ 35	100	340 x 330 x 49
30 x 40	31.0	42	≈ 40	100	340 x 330 x 54
30 x 45	31.0	47	≈ 45	100	340 x 330 x 59
30 x 50	31.0	52	≈ 50	100	340 x 330 x 64
35 x 25	36.0	27	≈ 33	50	390 x 198 x 39
35 x 30	36.0	32	≈ 40	50	390 x 198 x 44
35 x 35	36.0	37	≈ 48	50	390 x 198 x 49
35 x 40	36.0	42	≈ 55	50	390 x 198 x 54
35 x 45	36.0	47	≈ 63	50	390 x 198 x 59
35 x 50	36.0	52	≈ 72	50	390 x 198 x 64

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ELECTRICAL DATA	
SYMBOL	DESCRIPTION
C_R	Rated capacitance at 120 Hz
I_R	Rated RMS ripple current at 120 Hz, 85 °C
I_{L5}	Max. leakage current after 5 min at U_R
ESR	Max. equivalent series resistance at 120 Hz (1)

Notes
- Unless otherwise specified, all electrical values in Table 2 apply at T_{amb} = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %

(1) ESR at 100 Hz is approximately 1.05 x ESR 120 Hz

ORDERING EXAMPLE

Electrolytic capacitor 093 series

330 µF / 400 V; ± 20 %

Nominal case size: Ø 25 mm x 40 mm

2-terminal snap-in:

Ordering code: MAL2 09346331E3
Former 12 NC: 2222 09346331

Table 2

ELECTRICAL DATA AND ORDERING INFORMATION							
U_R (V)	C_R 120 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I_R 120 Hz (A)	I_{L5} (mA)	MAX. ESR (1) 120 Hz (Ω)	MAX. Z 10 kHz (Ω)	ORDERING CODE MAL2093.....
200	270	22 x 25	1.26	1.08	0.47	0.31	52271E3
	390	22 x 30	1.55	1.50	0.33	0.22	52391E3
	390	25 x 25	1.46	1.50	0.36	0.25	42391E3
	470	22 x 35	1.78	1.50	0.27	0.18	52471E3
	560	25 x 30	1.83	1.50	0.25	0.17	42561E3
	680	25 x 35	2.06	1.50	0.21	0.15	42681E3
	820	25 x 40	2.36	1.50	0.18	0.12	42821E3
	1000	30 x 35	2.35	1.50	0.18	0.13	32102E3
	1200	30 x 40	2.69	1.50	0.15	0.11	32122E3
	1500	30 x 45	3.00	1.50	0.12	0.09	32152E3
	1800	30 x 50	3.36	1.50	0.11	0.08	32182E3
	1800	35 x 40	2.91	1.50	0.14	0.10	22182E3
	2200	35 x 45	3.23	1.50	0.12	0.09	22222E3
250	220	22 x 25	1.18	1.10	0.50	0.32	53221E3
	270	22 x 30	1.37	1.35	0.40	0.25	53271E3
	330	22 x 35	1.58	1.50	0.32	0.20	53331E3
	390	22 x 35	1.67	1.50	0.29	0.18	53391E3
	390	25 x 30	1.64	1.50	0.29	0.19	43391E3
	470	25 x 35	1.85	1.50	0.25	0.16	43471E3
	560	25 x 40	2.11	1.50	0.21	0.14	43561E3
	680	30 x 30	2.01	1.50	0.22	0.15	33681E3
	820	30 x 35	2.23	1.50	0.19	0.13	33821E3
	1000	30 x 40	2.56	1.50	0.15	0.11	33102E3
	1200	35 x 40	3.82	1.50	0.15	0.11	23122E3
	1500	35 x 45	3.08	1.50	0.13	0.09	23152E3
	1800	35 x 50	3.35	1.50	0.11	0.08	23182E3
400	68	22 x 25	0.80	0.54	2.06	1.49	56689E3
	100	22 x 25	0.98	0.80	1.48	1.09	56101E3
	150	22 x 30	1.11	1.20	1.00	0.74	56151E3
	150	25 x 25	1.10	1.20	1.03	0.77	46151E3
	180	22 x 35	1.26	1.44	0.83	0.61	56181E3
	180	25 x 30	1.27	1.44	0.81	0.59	46181E3
	220	22 x 40	1.46	1.50	0.68	0.50	56221E3
	220	25 x 30	1.38	1.50	0.70	0.52	46221E3
	220	30 x 25	1.43	1.50	0.71	0.53	36221E3
	270	22 x 50	1.58	1.50	0.53	0.39	56271E3
	330	25 x 40	1.82	1.50	0.49	0.37	46331E3
	330	30 x 30	1.77	1.50	0.50	0.39	36331E3
	330	35 x 25	1.77	1.50	0.58	0.46	26331E3
	390	25 x 50	2.21	1.50	0.40	0.30	46391E3
	390	30 x 35	1.98	1.50	0.43	0.33	36391E3
	390	35 x 30	2.10	1.50	0.44	0.34	26391E3
	470	30 x 40	2.20	1.50	0.37	0.28	36471E3
	470	35 x 30	2.14	1.50	0.40	0.32	26471E3
	560	30 x 45	2.48	1.50	0.30	0.23	36561E3
	560	35 x 35	2.35	1.50	0.34	0.27	26561E3
	680	35 x 40	2.68	1.50	0.28	0.22	26681E3
	820	35 x 50	3.18	1.50	0.22	0.17	26821E3

Note

(1) ESR at 100 Hz is approximately 1.05 x ESR 120 Hz

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ELECTRICAL DATA AND ORDERING INFORMATION

U_R (V)	C_R 120 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I_R 120 Hz (A)	I_{L5} (mA)	MAX. ESR [1] 120 Hz (Ω)	MAX. Z 10 kHz (Ω)	ORDERING CODE MAL2093.....
420	100	22 x 25	0.89	0.84	1.44	1.05	54101E3
	180	22 x 35	1.29	1.50	0.81	0.59	54181E3
	180	25 x 30	1.29	1.50	0.78	0.57	44181E3
	220	25 x 35	1.47	1.50	0.67	0.50	44221E3
	220	30 x 25	1.44	1.50	0.69	0.52	34221E3
	270	22 x 50	1.61	1.50	0.54	0.39	54271E3
	270	30 x 30	1.67	1.50	0.56	0.41	34271E3
	330	25 x 50	1.47	1.50	0.43	0.31	44331E3
	330	30 x 35	1.88	1.50	0.46	0.35	34331E3
	390	35 x 30	2.05	1.50	0.47	0.37	24391E3
	470	35 x 35	2.27	1.50	0.37	0.28	24471E3
	560	30 x 50	2.66	1.50	0.31	0.25	34561E3
	560	35 x 40	2.57	1.50	0.34	0.27	24561E3
	680	35 x 45	2.87	1.50	0.28	0.23	24681E3
450	82	22 x 25	0.80	0.74	1.77	1.31	57829E3
	100	22 x 30	0.95	0.90	1.45	1.07	57101E3
	120	22 x 30	1.00	1.08	1.26	0.95	57121E3
	120	25 x 25	1.00	1.08	1.29	0.97	47121E3
	150	22 x 35	1.17	1.35	1.01	0.76	57151E3
	180	22 x 40	1.34	1.50	0.85	0.63	57181E3
	180	25 x 30	1.27	1.50	0.86	0.65	47181E3
	180	30 x 25	1.32	1.50	0.86	0.65	37181E3
	220	22 x 50	1.45	1.50	0.66	0.49	57221E3
	220	25 x 35	1.45	1.50	0.73	0.56	47221E3
	270	30 x 30	1.64	1.50	0.61	0.47	37271E3
	270	35 x 25	1.66	1.50	0.68	0.54	27271E3
	330	25 x 50	2.07	1.50	0.46	0.35	47331E3
	330	35 x 30	1.98	1.50	0.50	0.39	27331E3
	390	30 x 40	2.11	1.50	0.42	0.32	37391E3
	390	35 x 35	2.18	1.50	0.43	0.33	27391E3
	470	35 x 40	2.47	1.50	0.35	0.27	27471E3
	560	35 x 45	2.74	1.50	0.30	0.23	27561E3
	680	35 x 50	3.07	1.50	0.25	0.20	27681E3

Note
[1] ESR at 100 Hz is approximately 1.05 x ESR 120 Hz

ADDITIONAL ELECTRICAL DATA

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≥ 200 V versions	$U_S = 1.1 \times U_R$
Reverse voltage	≤ 1 V	-
Current		
Leakage current	After 5 min at U_R	$I_{L5} \leq 0.02\ C_R \times U_R$ or 1.5 mA, whichever is smaller
Inductance		
Equivalent series inductance (ESL)	All case sizes	19 nH typical / 25 nH max.

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Table 3

LOW TEMPERATURE CHARACTERISTIC (at 120 Hz)		
DESCRIPTION		U_R (V) (1)
		200 TO 450
Impedance ratio	Z (-25 °C) / Z (+20 °C)	4

Note

(1) Impedance ratio shall not exceed the given values

RIPPLE CURRENT AND USEFUL LIFE

Table 4

ENDURANCE TEST DURATION AND USEFUL LIFE	
ENDURANCE AT 85 °C (h)	USEFUL LIFE AT 85 °C (h)
2000	2000

Note

- Multiplier of useful life code: MGA453

I_A = Actual ripple current at 120 Hz
I_R = Rated ripple current at 120 Hz and 85 °C
(1) Useful life at 85 °C and I_R applied: 2000 h

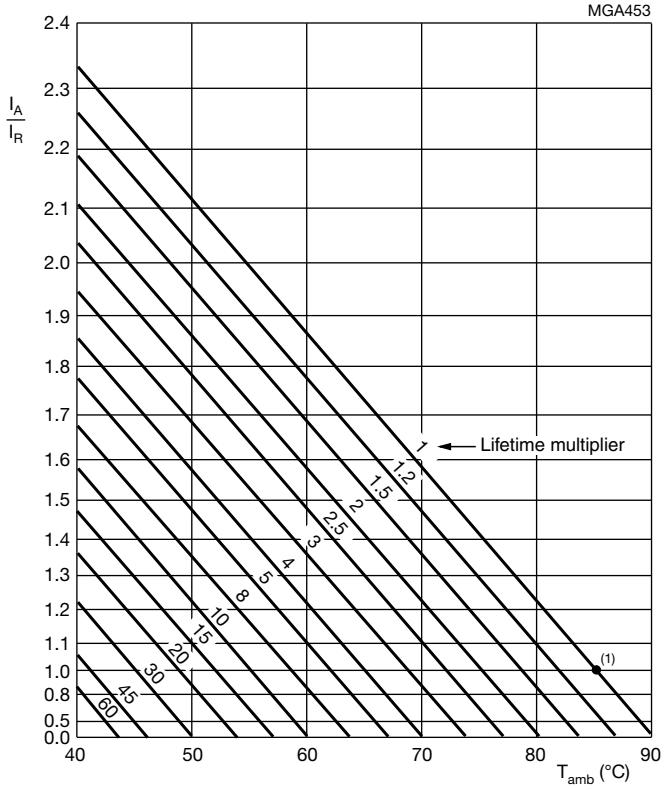


Fig. 4 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 5

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY					
FREQUENCY (Hz)					
60	100	120	500	1000	≥ 10 000
I_R MULTIPLIER					
0.90	0.95	1.00	1.20	1.30	1.40

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Table 6

TEST PROCEDURES AND REQUIREMENTS			
TEST		**PROCEDURE (quick reference)**	**REQUIREMENTS**
NAME OF TEST	**REFERENCE**		
Endurance	IEC 60384-4 / EN130300 subclause 4.13	T_{amb} = 85 °C; U_R applied; 2000 h	ΔC/C: ± 10 % ESR ≤ 2 x spec. limit I_{L5} ≤ spec. limit
Useful life	CECC 30301 subclause 1.8.1	T_{amb} = 85 °C; U_R and I_R applied: 2000 h	ΔC/C: ± 30 % ESR ≤ 3 x spec. limit I_{L5} ≤ spec. limit no short or open circuit, no visible damage total failure percentage: ≤ 3 %
Shelf life (storage at high temperature)	IEC 60384-4 / EN130300 subclause 4.17	T_{amb} = 85 °C; no voltage applied; 500 h After test: U_R to be applied for 30 min, 24 h to 48 h before measurement	ΔC/C: ± 20 % ESR ≤ 2 x spec. limit I_{L5} ≤ 1 x spec. limit

Statements about product lifetime are based on calculations and internal testing. They should only be interpreted as estimations. Also due to external factors, the lifetime in the field application may deviate from the calculated lifetime. In general, nothing stated herein shall be construed as a guarantee of durability.

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