Aluminum Capacitors
Power Miniaturized General Purpose Snap-In

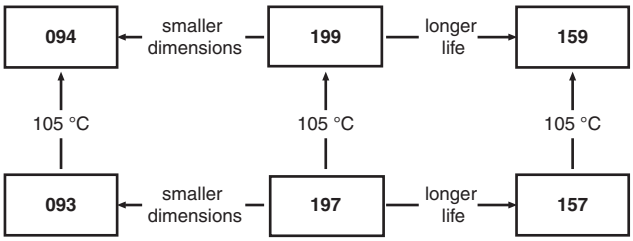


Fig. 1

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, miniaturized dimensions, cylindrical aluminum case insulated with a blue sleeve
- Useful life: 2000 h at 85 °C
- Compliant to RoHS Directive 2002/95/EC

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
Tolerence on C_R	± 20 %
Rated voltage range, U_R	200 V to 450 V
Category temperature range	- 25 °C to + 85 °C
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
Based on sectional specification	IEC 60384-4/EN130300/W of JISC5141

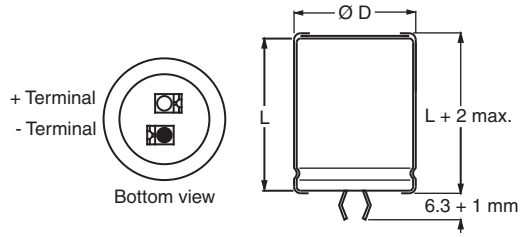
SELECTION CHART FOR C_R, U_R AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)

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 30 x 25
270	22 x 25	22 x 30	22 x 50 30 x 25	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
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

For technical questions, contact: aluminumcaps2@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

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
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

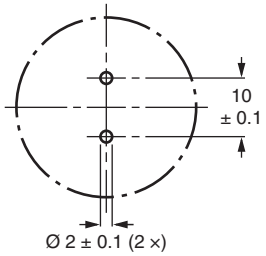


Fig. 3 - Mounting hole diagram

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	22.5	26.5	≈ 12	216	280 x 240 x 140
22 x 30	22.5	31.5	≈ 16	216	280 x 240 x 140
22 x 35	22.5	36.5	≈ 20	144	280 x 240 x 105
22 x 40	22.5	41.5	≈ 23	144	280 x 240 x 105
22 x 45	22.5	46.5	≈ 26	144	280 x 240 x 140
22 x 50	22.5	51.5	≈ 29	72	280 x 240 x 105
25 x 25	25.5	26.5	≈ 20	216	280 x 240 x 140
25 x 30	25.5	33.5	≈ 22	216	280 x 240 x 140
25 x 35	25.5	36.5	≈ 24	144	280 x 240 x 105
25 x 40	25.5	41.5	≈ 27	144	280 x 240 x 105
25 x 45	25.5	46.5	≈ 32	144	280 x 240 x 140
25 x 50	25.5	51.5	≈ 38	144	280 x 240 x 140
30 x 25	30.5	28.5	≈ 25	168	280 x 240 x 140
30 x 30	30.5	33.5	≈ 30	168	280 x 240 x 140
30 x 35	30.5	38.5	≈ 35	112	280 x 240 x 105
30 x 40	30.5	42.5	≈ 40	112	280 x 240 x 105
30 x 45	30.5	47.5	≈ 45	112	280 x 240 x 140
30 x 50	30.5	52.5	≈ 50	112	280 x 240 x 140
35 x 25	35.5	26.5	≈ 33	126	280 x 240 x 140
35 x 30	35.5	33.5	≈ 40	126	280 x 240 x 140
35 x 35	35.5	36.5	≈ 48	84	280 x 240 x 105
35 x 40	35.5	42.5	≈ 55	84	280 x 240 x 105
35 x 45	35.5	47.5	≈ 63	84	280 x 240 x 140
35 x 50	35.5	52.5	≈ 72	84	280 x 240 x 140

For technical questions, contact: aluminumcaps2@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

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
	270	30 x 25	1.53	1.50	0.63	0.48	36271E3
	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

For technical questions, contact: aluminumcaps2@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

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
	220	30 x 25	1.42	1.50	0.76	0.59	37221E3
	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.

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

For technical questions, contact: aluminumcaps2@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

RIPPLE CURRENT AND USEFUL LIFE

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

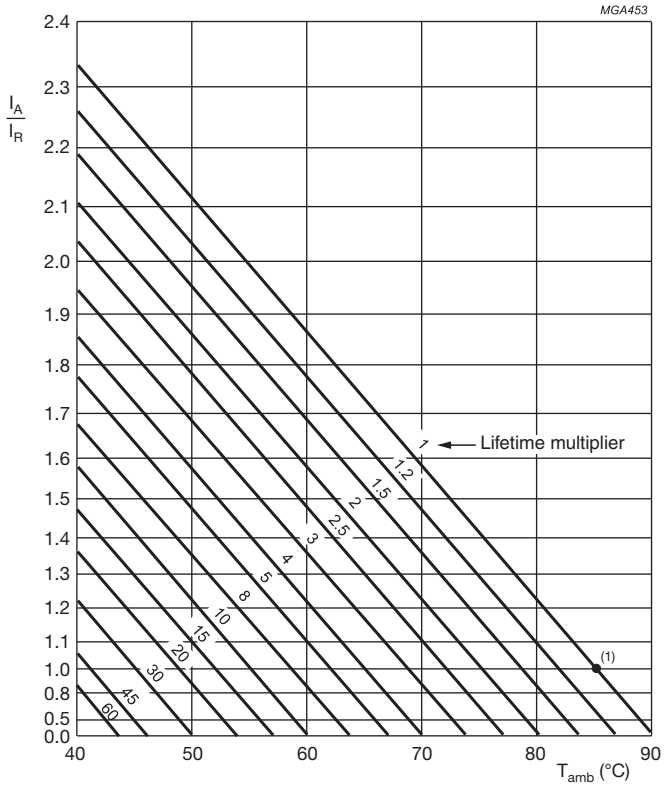


Fig. 4 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 4

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY	
FREQUENCY (Hz)	I_R MULTIPLIER 400 V AND 450 V
60	0.90
100	0.95
120	1.00
500	1.20
1000	1.30
≥ 10 000	1.40

Table 5

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
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

For technical questions, contact: aluminumcaps2@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

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.