

## Aluminum Capacitors Power Miniaturized General Purpose Snap-In

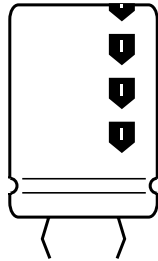
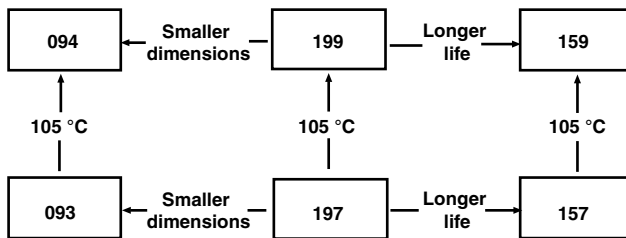


Fig.1 Component outlines



QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case size ( $\varnothing$ D x L in mm)	22 x 25 to 35 x 50
Rated capacitance range, $C_R$	68 $\mu$ F to 2200 $\mu$ F
Tolerance on $C_R$	$\pm 20\%$
Rated voltage range, $U_R$	200 V to 450 V
Category temperature range	- 25 °C to + 85 °C
Useful life at 85 °C	2000 hours
Useful life at 40 °C and 1.4 x $I_R$ applied	36 000 hours
Shelf life at 0 V, 85 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300/W of JISC5141

SELECTION CHART FOR $C_R$ , $U_R$ AND RELEVANT NOMINAL CASE SIZES ( $\varnothing$ D x L in mm)					
$C_R$ ( $\mu$ F)	$U_R$ (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

### FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, miniaturized dimensions, cylindrical aluminum case insulated with a blue sleeve
- Useful life: 2000 hours at 85 °C


**RoHS  
COMPLIANT**

### APPLICATIONS

- Consumer electronics
- Whitegood motor control
- Electronic drives
- Smps/ups

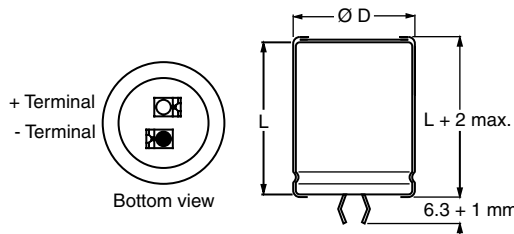
### MARKING

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

- Rated capacitance (in  $\mu$ F)
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (M for  $\pm 20\%$ )
- 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

<b>SELECTION CHART FOR C<sub>R</sub>, U<sub>R</sub> AND RELEVANT NOMINAL CASE SIZES (∅ D x L in mm)</b>					
C <sub>R</sub> (μF)	U <sub>R</sub> (V)				
	200	250	400	420	450
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
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

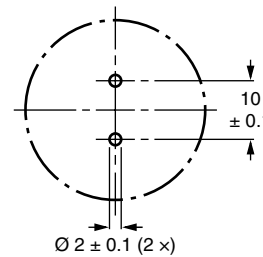


Fig.3 Mounting hole diagram

Table 1

<b>DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES</b>					
NOMINAL CASE SIZE ∅ D x L	∅ D <sub>max.</sub>	L <sub>max.</sub>	MASS (g)	PACKAGING QUANTITIES	CARDBOARD BOX DIMENSIONS L x W x H
22 x 25	22.5	25.5	≈ 12	216	280 x 240 x 140
22 x 30	22.5	30.5	≈ 16	216	280 x 240 x 140
22 x 35	22.5	35.5	≈ 20	144	280 x 240 x 105
22 x 40	22.5	40.5	≈ 23	144	280 x 240 x 105
22 x 45	22.5	45.5	≈ 26	144	280 x 240 x 140
22 x 50	22.5	50.5	≈ 29	72	280 x 240 x 105
25 x 25	25.5	25.5	≈ 20	216	280 x 240 x 140
25 x 30	25.5	32.0	≈ 22	216	280 x 240 x 140
25 x 35	25.5	35.5	≈ 24	144	280 x 240 x 105
25 x 40	25.5	40.5	≈ 27	144	280 x 240 x 105
25 x 45	25.5	45.5	≈ 32	144	280 x 240 x 140
25 x 50	25.5	50.5	≈ 38	144	280 x 240 x 140
30 x 25	30.5	27.5	≈ 25	168	280 x 240 x 140
30 x 30	30.5	32.5	≈ 30	168	280 x 240 x 140
30 x 35	30.5	37.5	≈ 35	112	280 x 240 x 105
30 x 40	30.5	41.5	≈ 40	112	280 x 240 x 105
30 x 45	30.5	46.5	≈ 45	112	280 x 240 x 140
30 x 50	30.5	51.5	≈ 50	112	280 x 240 x 140
35 x 25	35.5	25.5	≈ 33	126	280 x 240 x 140
35 x 30	35.5	32.5	≈ 40	126	280 x 240 x 140
35 x 35	35.5	35.5	≈ 48	84	280 x 240 x 105
35 x 40	35.5	41.5	≈ 55	84	280 x 240 x 105
35 x 45	35.5	46.5	≈ 63	84	280 x 240 x 140
35 x 50	35.5	51.5	≈ 72	84	280 x 240 x 140



Aluminum Capacitors  
Power Miniaturized General Purpose Snap-In

Vishay BCcomponents

ELECTRICAL DATA	
SYMBOL	DESCRIPTION
C <sub>R</sub>	rated capacitance at 120 Hz
I <sub>R</sub>	rated RMS ripple current at 120 Hz, 85 °C
I <sub>L5</sub>	max. leakage current after 5 minutes at U <sub>R</sub>
ESR	max. equivalent series resistance at 120 Hz <sup>(1)</sup>

**ORDERING EXAMPLE**

Electrolytic capacitor 093 series  
330 µF/400 V; ± 20 %  
Nominal case size: Ø 25 x 40 mm  
2-terminal snap-in:  
Ordering code: MAL209346331 E3  
Former 12NC: 222209346331

**Notes**

- ESR at 100 Hz is approximately 1.05 x ESR 120 Hz
- Unless otherwise specified, all electrical values in table 2 apply at  
T<sub>amb</sub> = 20 °C, P = 86 to 106 kPa, RH = 45 to 75 °C

Table 2

ELECTRICAL DATA AND ORDERING INFORMATION							
U <sub>R</sub> (V)	C <sub>R</sub> 120 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I <sub>R</sub> 120 Hz (A)	I <sub>L5</sub> (mA)	MAX. ESR <sup>(1)</sup> 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
250	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
	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
400	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
	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	



ELECTRICAL DATA AND ORDERING INFORMATION							
$U_R$ (V)	$C_R$ 120 Hz ( $\mu$ F)	NOMINAL CASE SIZE $\varnothing$ D x L (mm)	$I_R$ 120 Hz (A)	$I_{L5}$ (mA)	MAX. ESR <sup>(1)</sup> 120 Hz ( $\Omega$ )	MAX. Z 10 kHz ( $\Omega$ )	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

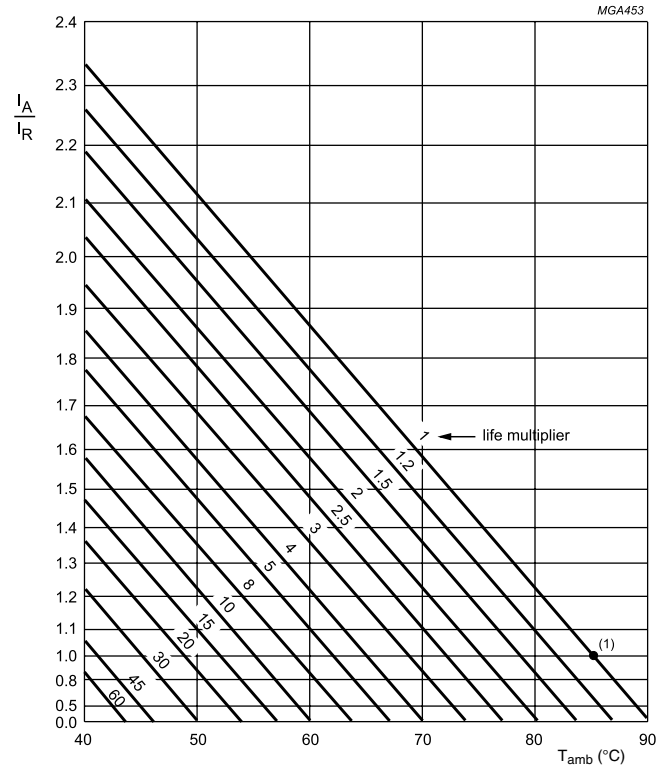
**Note**<sup>(1)</sup> ESR at 100 Hz is approximately 1.05 x ESR 120 Hz

ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
<b>Voltage</b>		
Surge voltage	$\geq 200$ V versions	$U_S = 1.1 \times U_R$
Reverse voltage	$\leq 1$ V	-
<b>Current</b>		
Leakage current	After 5 minutes at $U_R$	$I_{L5} \leq 0.02 C_R \times U_R$ or 1.5 mA, whichever is smaller
<b>Inductance</b>		
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) <sup>(1)</sup>
		200 to 450
Impedance ratio	Z (-25 °C)/Z (+20 °C)	4

**Note**<sup>(1)</sup> Impedance ratio shall not exceed the given values

**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 hours

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
	<b>400 and 450 V</b>
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	$T_{amb} = 85\text{ °C}$ ; $U_R$ and $I_R$ applied; 2000 hours	$\Delta C/C: \pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4/EN130300 subclause 4.17	$T_{amb} = 85\text{ °C}$ ; no voltage applied; 500 hours After test: $U_R$ to be applied for 30 minutes, 24 hours to 48 hours before measurement	$\Delta C/C: \pm 20\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 1 \times \text{spec. limit}$



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