



## Aluminum Capacitors Power General Purpose Snap-In



RoHS  
COMPLIANT

### FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, very small dimensions, cylindrical aluminum case insulated with a blue sleeve
- Useful life: 3000 h at 85 °C
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

### APPLICATIONS

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

### MARKING

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

- Rated capacitance (in  $\mu\text{F}$ )
- 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

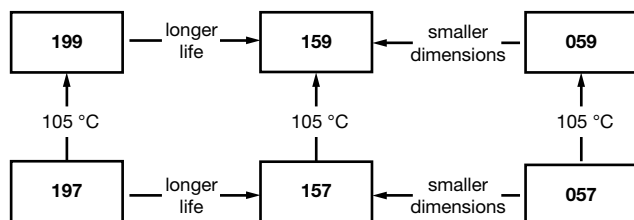


Fig. 1

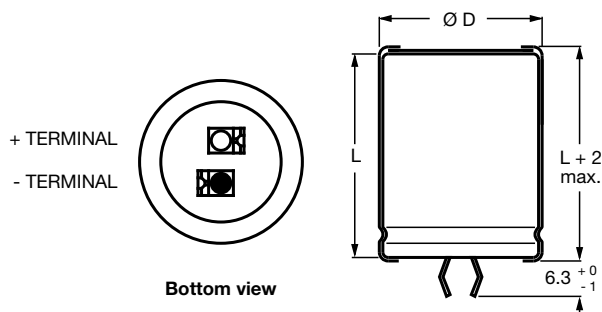
QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case size ( $\varnothing$ D x L in mm)	22 x 25 to 35 x 50
Rated capacitance range (E6/E12 series), $C_R$	56 $\mu\text{F}$ to 2200 $\mu\text{F}$
Tolerance on $C_R$	$\pm 20\%$
Rated voltage range, $U_R$	160 V, 200 V, 250 V, 400 V, 450 V
Category temperature range	-25 °C to +85 °C
Useful life at 85 °C	3000 h
Useful life at 40 °C and 1.4 x $I_R$ applied	90 000 h
Shelf life at 0 V, 85 °C	1000 h
Based on sectional specification	IEC 60384-4 / EN 130300/W of JISC5141

SELECTION CHART FOR $C_R$ , $U_R$ , AND RELEVANT NOMINAL CASE SIZES ( $\varnothing$ D x L in mm)					
$C_R$ ( $\mu\text{F}$ )	$U_R$ (V)				
	160	200	250	400	450
56	-	-	-	-	22 x 25
68	-	-	-	22 x 25	22 x 25
82	-	-	-	22 x 25	22 x 30
	-	-	-	-	25 x 25
100	-	-	-	22 x 30	22 x 35
	-	-	-	25 x 25	25 x 30
120	-	-	-	-	22 x 40
	-	-	-	22 x 35	25 x 30
	-	-	-	25 x 35	30 x 25
150	22 x 25	22 x 25	22 x 25	22 x 35	-
	-	-	-	25 x 30	25 x 35
	-	-	-	30 x 25	30 x 30



SELECTION CHART FOR $C_R$ , $U_R$ , AND RELEVANT NOMINAL CASE SIZES ( $\varnothing D \times L$ in mm)					
$C_R$ ( $\mu F$ )	$U_R$ (V)				
	160	200	250	400	450
180	22 x 25	22 x 25	22 x 25	22 x 40	-
	-	-	-	25 x 35	25 x 40
	-	-	-	30 x 25	30 x 30
	-	-	-	-	35 x 30
220	22 x 25	22 x 25	22 x 30	-	-
	-	-	25 x 25	25 x 40	30 x 35
	-	-	-	30 x 30	35 x 30
	-	-	-	-	-
270	22 x 25	22 x 25	22 x 30	-	30 x 40
	-	-	25 x 25	30 x 35	35 x 35
	-	-	-	35 x 30	-
	-	-	-	-	-
330	22 x 25	22 x 30	22 x 35	25 x 50	30 x 50
	-	25 x 25	25 x 30	30 x 40	35 x 40
	-	-	30 x 25	35 x 30	-
390	22 x 30	22 x 30	22 x 40	30 x 45	30 x 50
	-	25 x 25	25 x 35	35 x 35	35 x 50
	-	-	30 x 25	-	-
470	22 x 30	22 x 35	-	30 x 50	35 x 50
	25 x 25	25 x 30	25 x 40	35 x 40	-
	-	30 x 25	30 x 30	-	-
560	25 x 25	22 x 40	25 x 40	35 x 45	-
	30 x 25	25 x 35	-	-	-
	-	30 x 25	30 x 35	-	-
680	25 x 30	25 x 40	25 x 50	35 x 50	-
	30 x 25	30 x 30	30 x 40	-	-
	-	-	35 x 30	-	-
820	25 x 35	-	30 x 45	-	-
	-	30 x 35	35 x 35	-	-
	-	35 x 30	-	-	-
1000	25 x 40	30 x 40	30 x 50	-	-
	30 x 30	35 x 35	35 x 40	-	-
1200	30 x 35	30 x 45	35 x 50	-	-
	35 x 30	35 x 35	-	-	-
1500	35 x 35	35 x 50	35 x 50	-	-
1800	30 x 50	-	-	-	-
	35 x 40	-	-	-	-
2200	35 x 50	35 x 50	-	-	-

**DIMENSIONS** in millimeters **AND AVAILABLE FORMS**



The minus terminal can be marked with an imprinted sign.

Fig. 2 - Two terminal snap-in

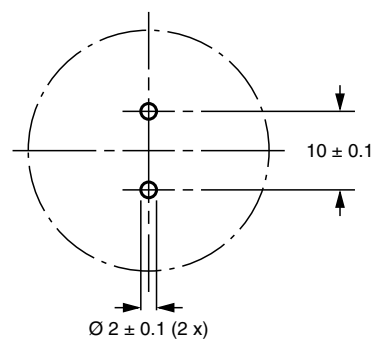


Fig. 3 - Mounting hole diagram



Table 1

<b>DIMENSIONS</b> in millimeters, <b>MASS AND PACKAGING QUANTITIES</b>					
<b>NOMINAL CASE SIZE</b> $\varnothing D \times L$	$\varnothing D_{MAX.}$	$L_{MAX.}$	<b>MASS</b> (g)	<b>PACKAGING</b> <b>QUANTITIES</b>	<b>CARDBOARD BOX DIMENSIONS</b> 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

<b>ELECTRICAL DATA</b>	
<b>SYMBOL</b>	<b>DESCRIPTION</b>
$C_R$	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 <sup>(1)</sup>

**Notes**

- <sup>(1)</sup> ESR at 100 Hz is approximately 1.05 x ESR 120 Hz
- Unless otherwise specified, all electrical values in table 2 apply at  $T_{amb} = 20\text{ °C}$ ,  $P = 86\text{ kPa}$  to  $106\text{ kPa}$ ,  $RH = 45\%$  to  $75\%$

**ORDERING EXAMPLE**

Electrolytic capacitor 197 series

1000  $\mu\text{F}$ /200 V;  $\pm 20\%$ Nominal case size:  $\varnothing 30\text{ mm} \times 40\text{ mm}$ 

Ordering code: MAL2 197 22102 E3

Former 12NC: 2222 197 22102



Table 2

<b>ELECTRICAL DATA AND ORDERING INFORMATION</b>						
<b>U<sub>R</sub></b> <b>(V)</b>	<b>C<sub>R</sub></b> <b>120 Hz</b> <b>(µF)</b>	<b>NOMINAL</b> <b>CASE SIZE</b> <b>Ø D x L (mm)</b>	<b>I<sub>R</sub></b> <b>120 Hz</b> <b>85 °C (A)</b>	<b>I<sub>L5</sub></b> <b>5 min</b> <b>(mA)</b>	<b>MAX. ESR</b> <b>120 <sup>(1)</sup></b> <b>(Ω)</b>	<b>ORDERING CODE</b> <b>MAL2197.....</b>
160	150	22 x 25	0.92	0.48	1.11	11151E3
	180	22 x 25	0.99	0.58	0.92	11181E3
	220	22 x 25	1.08	0.70	0.75	11221E3
	270	22 x 25	1.16	0.86	0.61	11271E3
	330	22 x 25	1.24	1.06	0.50	11331E3
	390	22 x 30	1.45	1.25	0.43	11391E3
	470	22 x 30	1.53	1.50	0.35	11471E3
	470	25 x 25	1.45	1.50	0.35	21471E3
	560	30 x 25	1.67	1.50	0.30	31561E3
	680	25 x 30	1.82	1.50	0.24	21681E3
	680	30 x 25	1.70	1.50	0.24	31681E3
	820	25 x 35	2.04	1.50	0.20	21821E3
	1000	30 x 30	2.07	1.50	0.17	31102E3
	1000	35 x 30	2.24	1.50	0.17	41102E3
	1200	30 x 35	2.28	1.50	0.17	21122E3
	1200	35 x 30	2.22	1.50	0.17	31122E3
	1500	35 x 35	2.42	1.50	0.15	21152E3
	1500	35 x 40	2.72	1.50	0.13	31152E3
1800	30 x 50	3.08	1.50	0.11	11182E3	
1800	35 x 40	2.66	1.50	0.13	21182E3	
2200	35 x 50	3.25	1.50	0.10	41222E3	
200	150	22 x 25	1.06	0.60	1.11	12151E3
	180	22 x 25	1.15	0.72	0.92	12181E3
	220	22 x 25	1.24	0.88	0.75	12221E3
	270	22 x 25	1.34	1.08	0.61	12271E3
	330	22 x 30	1.58	1.32	0.50	12331E3
	330	25 x 25	1.53	1.32	0.50	22331E3
	390	25 x 25	1.59	1.50	0.45	22391E3
	470	22 x 35	1.92	1.50	0.35	12471E3
	470	25 x 30	1.92	1.50	0.35	22471E3
	470	30 x 25	1.86	1.50	0.38	32471E3
	560	25 x 35	2.16	1.50	0.30	22561E3
	560	30 x 25	1.90	1.50	0.34	32561E3
	680	25 x 40	2.44	1.50	0.24	22681E3
	680	30 x 30	2.28	1.50	0.27	32681E3
	820	30 x 35	2.55	1.50	0.24	32821E3
	820	35 x 30	2.52	1.50	0.26	42821E3
	1000	30 x 40	2.84	1.50	0.20	22102E3
	1000	35 x 35	2.79	1.50	0.22	32102E3
1200	30 x 45	3.16	1.50	0.17	12122E3	
1200	35 x 35	2.77	1.50	0.21	22122E3	
1500	35 x 50	3.72	1.50	0.15	22152E3	
2200	35 x 50	3.70	1.50	0.11	12222E3	
250	150	22 x 25	1.07	0.75	1.11	13151E3
	180	22 x 25	1.16	0.90	0.92	13181E3
	220	22 x 30	1.36	1.10	0.75	13221E3
	220	25 x 25	1.34	1.10	0.75	23221E3
	270	22 x 30	1.47	1.35	0.61	13271E3
	270	25 x 25	1.42	1.35	0.61	23271E3
	330	22 x 35	1.70	1.50	0.50	13331E3
	330	25 x 30	1.71	1.50	0.50	23331E3
	330	30 x 25	1.68	1.50	0.50	33331E3
	390	22 x 40	1.92	1.50	0.43	13391E3
	390	25 x 35	1.92	1.50	0.43	23391E3
	390	30 x 25	1.74	1.50	0.43	33391E3
	470	25 x 40	2.17	1.50	0.35	23471E3
	470	30 x 30	2.07	1.50	0.35	33471E3
	560	25 x 40	2.28	1.50	0.27	53561E3
	560	30 x 35	2.32	1.50	0.30	33561E3
	680	25 x 50	2.73	1.50	0.24	13681E3
	680	30 x 40	2.60	1.50	0.24	23681E3
680	35 x 30	2.36	1.50	0.27	33681E3	
820	30 x 45	2.90	1.50	0.20	13821E3	
820	35 x 35	2.61	1.50	0.24	23821E3	
1000	30 x 50	3.21	1.50	0.17	13102E3	
1000	35 x 40	2.89	1.50	0.21	23102E3	
1200	35 x 50	3.49	1.50	0.19	13122E3	
1500	35 x 50	3.56	1.50	0.19	13152E3	



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 85 °C (A)	$I_{L5}$ 5 min (mA)	MAX. ESR 120 <sup>(1)</sup> ( $\Omega$ )	ORDERING CODE MAL2197.....
400	68	22 x 25	0.57	0.55	3.66	16689E3
	82	22 x 25	0.62	0.66	3.03	16829E3
	100	22 x 30	0.73	0.80	2.49	16101E3
	100	25 x 25	0.73	0.80	2.49	26101E3
	120	22 x 35	0.84	0.96	2.07	16121E3
	120	25 x 35	0.89	0.96	2.07	26121E3
	150	22 x 35	0.93	1.20	1.66	16151E3
	150	25 x 30	0.94	1.20	1.66	26151E3
	150	30 x 25	0.96	1.20	1.66	36151E3
	180	25 x 35	1.07	1.44	1.38	26181E3
	180	30 x 25	1.03	1.44	1.38	36181E3
	220	25 x 40	1.23	1.50	1.13	26221E3
	220	30 x 30	1.21	1.50	1.13	36221E3
	270	30 x 35	1.38	1.50	0.92	26271E3
	270	35 x 30	1.41	1.50	0.92	36271E3
	330	30 x 40	1.57	1.50	0.75	26331E3
	330	35 x 30	1.49	1.50	0.78	36331E3
	390	30 x 45	1.75	1.50	0.64	16391E3
	390	35 x 35	1.67	1.50	0.66	26391E3
	470	30 x 50	1.96	1.50	0.53	16471E3
470	35 x 40	1.87	1.50	0.56	26471E3	
560	35 x 45	2.08	1.50	0.47	16561E3	
680	35 x 50	2.31	1.50	0.39	16681E3	
450	56	22 x 25	0.53	0.28	4.44	17569E3
	68	22 x 25	0.58	0.34	3.66	17689E3
	82	22 x 30	0.68	0.41	3.03	17829E3
	82	25 x 25	0.68	0.41	3.03	27829E3
	100	22 x 35	0.78	0.50	2.49	17101E3
	100	25 x 30	0.80	0.50	2.49	27101E3
	120	22 x 40	0.89	0.60	2.07	17121E3
	120	25 x 30	0.86	0.60	2.07	27121E3
	120	30 x 25	0.89	0.60	2.07	37121E3
	150	25 x 35	1.00	0.75	1.66	27151E3
	150	30 x 30	1.05	0.75	1.66	37151E3
	180	25 x 40	1.14	0.90	1.38	27181E3
	180	30 x 30	1.13	0.90	1.38	37181E3
	180	35 x 30	1.22	0.90	1.38	47181E3
	220	30 x 35	1.29	1.10	1.13	27221E3
	220	35 x 30	1.32	1.10	1.13	37221E3
	270	30 x 40	1.47	1.35	0.92	17271E3
	330	30 x 50	1.74	1.50	0.75	17331E3
	330	35 x 40	1.69	1.50	0.75	27331E3
	390	35 x 50	1.97	1.50	0.64	27391E3
470	35 x 50	2.10	1.50	0.53	17471E3	

**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	$\geq 400$ V versions	$U_S = 1.1 \times U_R$
	$\leq 250$ V versions	$U_S = 1.15 \times U_R$
Reverse voltage	$\leq 1$ V	-
<b>Current</b>		
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



Table 3

LOW TEMPERATURE CHARACTERISTIC (at 120 Hz)						
DESCRIPTION		$U_R$ (V) <sup>(1)</sup>				
		160	200	250	400	450
Impedance ratio	Z(- 25 °C)/Z(+ 20 °C)	4	4	4	4	4

**Note**

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

Table 4

DISSIPATION FACTOR (tan δ at 120 Hz, 20 °C)						
DESCRIPTION		$U_R$ (V)				
		160	200	250	400	450
tan δ (max.)		0.10 <sup>(1)</sup>	0.10 <sup>(1)</sup>	0.10 <sup>(1)</sup>	0.15	0.15

**Note**

<sup>(1)</sup> 0.15 for Ø D = 35 mm

**RIPPLE CURRENT AND USEFUL LIFE**

Table 5

ENDURANCE TEST DURATION AND USEFUL LIFE	
ENDURANCE AT 85 °C (h)	USEFUL LIFE AT 85 °C (h)
-	3000

**Note**

- Multiplier of useful life code: MGA453

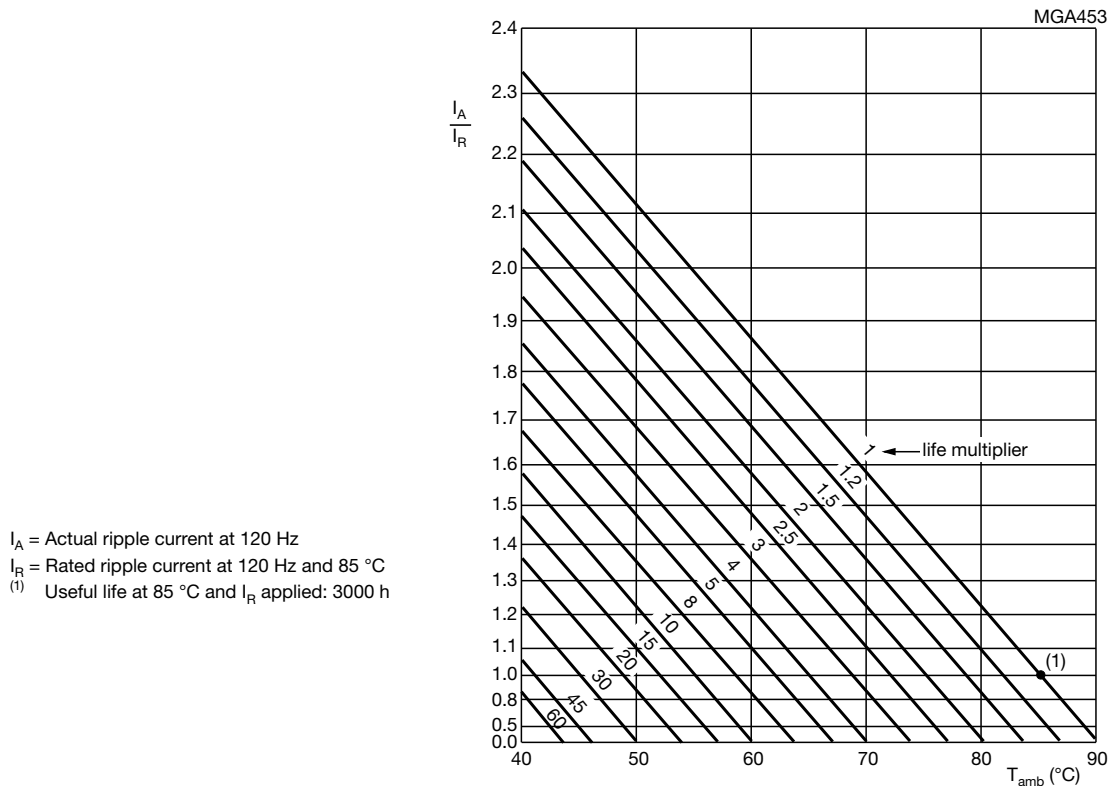


Fig. 4 - Multiplier of useful life as a function of ambient temperature and ripple current load



Table 6

MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY						
$U_R$ (V)	FREQUENCY (Hz)					
	60	100	120	500	1000	$\geq 10\ 000$
$I_R$ MULTIPLIER						
160	0.81	0.97	1.00	1.32	1.45	1.50
200	0.81	0.97	1.00	1.32	1.45	1.50
250	0.81	0.97	1.00	1.32	1.45	1.50
400	0.90	0.95	1.00	1.20	1.30	1.40
450	0.90	0.95	1.00	1.20	1.30	1.40

Table 7

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\ ^\circ\text{C}$ ; $U_R$ and $I_R$ applied: 3000 h	$\Delta C/C: \pm 30\ \%$ ESR $\leq 3 \times$ spec. limit $I_{L5} \leq$ 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	$T_{amb} = 85\ ^\circ\text{C}$ ; no voltage applied; 1000 h After test: $U_R$ to be applied for 30 min, 24 h to 48 h before measurement	$\Delta C/C: \pm 20\ \%$ ESR $\leq 2 \times$ spec. limit $I_{L5} \leq 1 \times$ 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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