Aluminum Capacitors
Power Ultra Miniature Snap-In

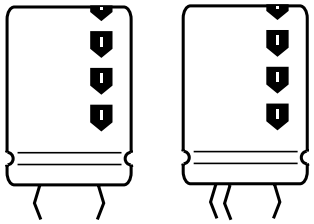
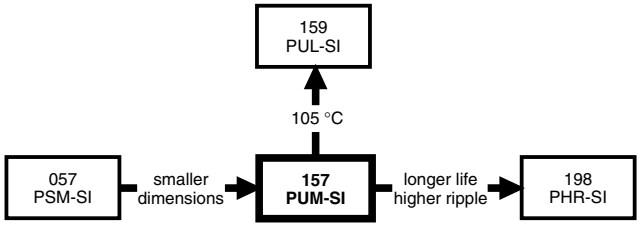


Fig.1 Component outlines



FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, very small dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Useful life: 5000 hours at 85 °C
- Keyed polarity version available

Pb-free
RoHS COMPLIANT

APPLICATIONS

- General purpose, industrial and audio/video systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems

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 (YYMM)
- Name of manufacturer
- Code for factory of origin
- '-' sign to identify the negative terminal, visible from the top and side of the capacitor
- Code number, all 12 or last 8 digits (2222) 157 xxxxx
- Climatic category in accordance with IEC 60068

QUICK REFERENCE DATA		
DESCRIPTION	**VALUE**	
Nominal case sizes (Ø D x L in mm)	22 x 25 to 35 x 60	
Rated capacitance range (E6/E12 series), C_R	56 µF to 2200 µF	
Tolerance on C_R	± 20 %	
Rated voltage range, U_R	200 V, 250 V	400 V, 450 V
Category temperature range	- 25 to + 85 °C	
Endurance test at 85 °C	3000 hours	
Load life at 85 °C	3000 hours	
Useful life at 85 °C	5000 hours	
Useful life at 40 °C, 1.4 x I_R applied	90 000 hours	
Shelf life at 0 V, 85 °C	1000 hours	
Based on sectional specification	IEC 60384-4/EN130300	
Climatic category IEC 60038	25/085/56	

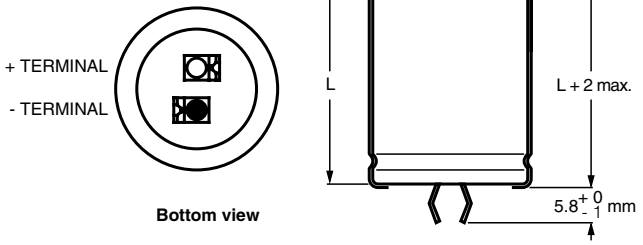
SELECTION CHART FOR C_R, U_R AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)

C_R (µF)	U_R (V)			
	200	**250**	**400**	**450**
56	-	-	-	22 x 25
68	-	-	22 x 25	22 x 30
82	-	-	22 x 25	22 x 30
	-	-	-	25 x 25
100	-	-	22 x 30	22 x 35
	-	-	-	25 x 30
120	-	-	22 x 30	22 x 40
	-	-	-	25 x 30
	-	-	-	30 x 25

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**	**450**
150	-	-	22 x 35	25 x 35
	-	-	25 x 30	25 x 40
	-	-	-	30 x 30
180	-	-	22 x 40	25 x 40
	-	-	25 x 35	30 x 35
	-	-	-	35 x 25
220	-	22 x 30	25 x 40	25 x 50
	-	-	30 x 30	30 x 40
	-	-	35 x 25	35 x 30
270	22 x 25	22 x 30	25 x 45	30 x 45
	-	25 x 25	30 x 35	35 x 35
	-	-	35 x 30	-
330	22 x 30	22 x 35	30 x 40	30 x 50
	-	25 x 30	35 x 30	35 x 40
390	22 x 30	22 x 40	30 x 45	35 x 45
	-	30 x 25	35 x 35	-
470	22 x 35	25 x 35	30 x 50	35 x 50
	25 x 30	30 x 30	35 x 40	-
560	22 x 40	25 x 40	35 x 45	-
	25 x 35	30 x 30	-	-
	30 x 25	35 x 25	-	-
680	25 x 40	25 x 45	35 x 50	35 x 60
	30 x 30	30 x 35	-	-
	35 x 25	35 x 30	-	-
820	25 x 45	30 x 40	35 x 60	-
	30 x 35	35 x 35	-	-
	35 x 30	-	-	-
1000	30 x 40	30 x 45	-	-
	35 x 30	35 x 40	-	-
1200	30 x 45	35 x 45	-	-
	35 x 35	-	-	-
1500	30 x 50	35 x 50	-	-
	35 x 40	-	-	-
1800	35 x 45	-	-	-
2200	35 x 50	-	-	-

DIMENSIONS in millimeters **AND AVAILABLE FORMS**

TWO TERMINAL SNAP-IN



The minus terminal can be marked with a black dot or with an imprinted '–' sign.

Fig.2 Two terminal snap-in

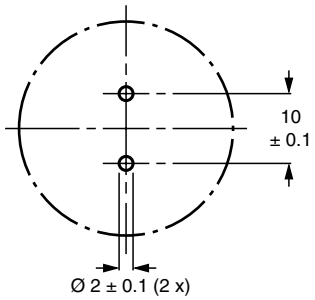
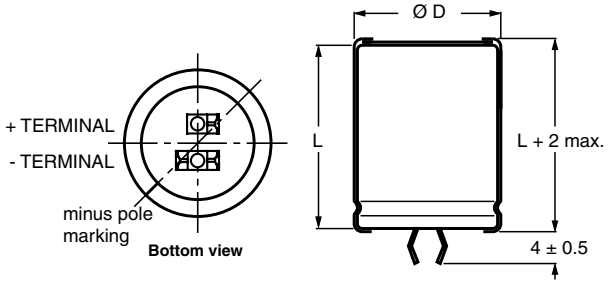


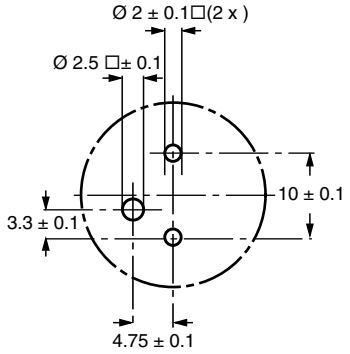
Fig.3 Mounting hole diagram

THREE TERMINAL SNAP-IN



The negative terminal has **TWO** pins which are **BOTH** electrically connected.

Fig.4 Three terminal snap-in



The 10 mm spacing of the 2 pin snap-in is used as the base layout and a third hole is added.
The third hole is closer to the negative primary hole so that polarization is always maintained, together with added mechanical stability.

Fig.5 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 (units per box)**
22 x 25	23	27	≈ 12	100
22 x 30	23	32	≈ 16	100
22 x 35	23	37	≈ 20	100
22 x 40	23	42	≈ 23	100
25 x 25	26	27	≈ 20	100
25 x 30	26	32	≈ 22	100
25 x 35	26	37	≈ 24	100
25 x 40	26	42	≈ 27	100
25 x 45	26	47	≈ 32	100
25 x 50	26	52	≈ 38	100
30 x 25	31	27	≈ 25	100
30 x 30	31	32	≈ 30	100
30 x 35	31	37	≈ 35	100
30 x 40	31	42	≈ 40	100
30 x 45	31	47	≈ 45	100
30 x 50	31	52	≈ 50	100
35 x 25	36	27	≈ 33	50
35 x 30	36	32	≈ 40	50
35 x 35	36	37	≈ 48	50
35 x 40	36	42	≈ 55	50
35 x 45	36	47	≈ 63	50
35 x 50	36	52	≈ 72	50
35 x 60	36	62	≈ 82	50

ELECTRICAL DATA	
SYMBOL	**DESCRIPTION**
C_R	rated capacitance at 100/120 Hz
I_R	rated RMS ripple current at 120 Hz, 85 °C
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	typ./max. equivalent series resistance at 100 Hz (1)
Z	typ./max. impedance at 10 kHz

Notes

(1) ESR at 120 Hz is approximately 0.95 x ESR 100 Hz

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

ORDERING EXAMPLE

Electrolytic capacitor 157 series
1000 µF/200 V; ± 20 %
Nominal case size: Ø 30 x 40 mm

2-terminal snap-in:
Ordering code: MAL2 157 52102 E3
Former 12NC: 2222 157 52102

3-terminal snap-in:
Ordering code: MAL2 157 72102 E3
Former 12NC: 2222 157 72102

Table 2

ELECTRICAL DATA AND ORDERING INFORMATION

U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 100 Hz (1) (MΩ)	MAX. ESR 100 Hz (1) (MΩ)	TYP. Z 10 kHz (MΩ)	MAX. Z 10 kHz (MΩ)	ORDERING CODE MAL2157.....	
									2-TERM.	3-TERM.
200	270	22 x 25	1.15	0.54	550	880	420	700	52271E3	72271E3
	330	22 x 30	1.36	0.66	430	720	300	500	52331E3	72331E3
	390	22 x 30	1.46	0.78	390	650	295	490	52391E3	72391E3
	470	22 x 35	1.68	0.94	350	580	240	400	32471E3	12471E3
	470	25 x 30	1.67	0.94	350	580	240	400	52471E3	72471E3
	560	22 x 40	1.91	1.12	255	425	235	390	42561E3	22561E3
	560	25 x 35	1.91	1.12	255	425	235	390	32561E3	12561E3
	560	30 x 25	1.89	1.12	255	425	235	390	52561E3	72561E3
	680	25 x 40	2.18	1.36	210	350	205	340	42681E3	22681E3
	680	30 x 30	2.04	1.36	210	350	205	340	52681E3	72681E3
	680	35 x 25	2.06	1.36	210	350	205	340	62681E3	82681E3
	820	25 x 45	2.46	1.64	170	290	145	240	62821E3	82821E3
	820	30 x 35	2.35	1.64	170	290	145	240	32821E3	12821E3
	820	35 x 30	2.29	1.64	170	290	145	240	52821E3	72821E3
	1000	30 x 40	2.66	2.00	140	235	135	225	52102E3	72102E3
	1000	35 x 30	2.33	2.00	140	235	135	225	62102E3	82102E3
	1200	30 x 45	2.98	2.40	120	200	110	190	32122E3	12122E3
	1200	35 x 35	2.69	2.40	120	200	110	190	62122E3	82122E3
	1500	30 x 50	3.31	3.00	110	180	95	155	42152E3	22152E3
	1500	35 x 40	3.04	3.00	110	180	95	155	52152E3	72152E3
	1800	35 x 45	3.36	3.60	100	160	80	130	42182E3	22182E3
	2200	35 x 50	3.68	4.40	90	150	65	105	52222E3	72222E3
250	220	22 x 30	1.23	0.55	600	1080	420	700	53221E3	73221E3
	270	22 x 30	1.32	0.67	490	880	335	560	43271E3	23271E3
	270	25 x 25	1.23	0.67	490	880	335	560	53271E3	73271E3
	330	22 x 35	1.53	0.82	400	720	255	430	33331E3	13331E3
	330	25 x 30	1.56	0.82	400	720	255	430	53331E3	73331E3

ELECTRICAL DATA AND ORDERING INFORMATION

U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 100 Hz (1) (MΩ)	MAX. ESR 100 Hz (1) (MΩ)	TYP. Z 10 kHz (MΩ)	MAX. Z 10 kHz (MΩ)	ORDERING CODE MAL2157.....	
									2-TERM.	3-TERM.
250	390	22 x 40	1.74	0.97	330	610	250	425	43391E3	23391E3
	390	30 x 25	1.58	0.97	330	610	250	425	53391E3	73391E3
	470	25 x 35	1.87	1.17	280	505	190	320	33471E3	13471E3
	470	30 x 30	1.89	1.17	280	505	190	320	53471E3	73471E3
	560	25 x 40	2.12	1.40	240	425	185	310	43561E3	23561E3
	560	30 x 30	1.97	1.40	240	425	185	310	53561E3	73561E3
	560	35 x 25	1.80	1.40	240	425	185	310	63561E3	83561E3
	680	25 x 45	2.29	1.70	200	350	155	260	63681E3	83681E3
	680	30 x 35	2.28	1.70	200	350	155	260	33681E3	13681E3
	680	35 x 30	2.20	1.70	200	350	155	260	53681E3	73681E3
	820	30 x 40	2.57	2.05	160	290	125	210	53821E3	73821E3
	820	35 x 35	2.54	2.05	160	290	125	210	63821E3	83821E3
	1000	30 x 45	2.88	2.50	140	235	105	180	33102E3	13102E3
	1000	35 x 40	2.86	2.50	140	235	105	180	53102E3	73102E3
	1200	35 x 45	3.17	3.00	120	200	95	160	43122E3	23122E3
	1500	35 x 50	3.49	3.75	90	160	85	140	53152E3	73152E3
400	68	22 x 25	0.71	0.27	1400	2800	1170	1950	56689E3	76689E3
	82	22 x 25	0.77	0.33	1250	2500	970	1620	56829E3	76829E3
	100	22 x 30	0.94	0.40	1125	2250	750	1220	56101E3	76101E3
	120	22 x 30	0.97	0.48	990	1980	700	1140	56121E3	76121E3
	150	22 x 35	1.13	0.60	750	1500	540	900	36151E3	16151E3
	150	25 x 30	1.16	0.60	750	1500	540	900	56151E3	76151E3
	180	22 x 40	1.29	0.72	630	1260	435	725	46181E3	26181E3
	180	25 x 35	1.35	0.72	630	1260	435	725	36181E3	16181E3
	220	25 x 40	1.54	0.88	520	1040	355	590	46221E3	26221E3
	220	30 x 30	1.50	0.88	520	1040	355	590	56221E3	76221E3
	220	35 x 25	1.42	0.88	520	1040	355	590	66221E3	86221E3
	270	25 x 45	1.72	1.08	430	860	335	560	66271E3	86271E3
	270	30 x 35	1.74	1.08	430	860	335	560	36271E3	16271E3
	270	35 x 30	1.71	1.08	430	860	335	560	56271E3	76271E3
	330	30 x 40	1.97	1.32	350	700	315	525	56331E3	76331E3
	330	35 x 30	1.76	1.32	350	700	315	525	66331E3	86331E3
	390	30 x 45	2.19	1.56	300	610	250	420	56391E3	76391E3
	390	35 x 35	2.04	1.56	300	610	250	420	36391E3	16391E3
	470	30 x 50	2.40	1.88	250	505	210	350	46471E3	26471E3
	470	35 x 40	2.30	1.88	250	505	210	350	56471E3	76471E3
	560	35 x 45	2.55	2.24	210	425	180	305	46561E3	26561E3
	680	35 x 50	2.79	2.72	190	380	160	265	56681E3	76681E3
	820	35 x 60	3.33	3.28	155	315	115	215	56821E3	76821E3

ELECTRICAL DATA AND ORDERING INFORMATION

U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 100 Hz [1] (MΩ)	MAX. ESR 100 Hz [1] (MΩ)	TYP. Z 10 kHz (MΩ)	MAX. Z 10 kHz (MΩ)	ORDERING CODE MAL2157.....	
									2-TERM.	3-TERM.
	56	22 x 25	0.68	0.25	1650	3300	1120	1880	57569E3	77569E3
	68	22 x 30	0.80	0.30	1400	2800	920	1530	57689E3	77689E3
	82	22 x 30	0.87	0.36	1200	2400	780	1290	47829E3	27829E3
	82	25 x 25	0.85	0.36	1200	2400	780	1290	57829E3	77829E3
	100	22 x 35	1.00	0.45	1000	2000	630	1050	37101E3	17101E3
	100	25 x 30	1.02	0.45	1000	2000	630	1050	57101E3	77101E3
	120	22 x 40	1.15	0.54	800	1600	530	885	47121E3	27121E3
	120	25 x 30	1.09	0.54	800	1600	530	885	57121E3	77121E3
	120	30 x 25	1.10	0.54	800	1600	530	885	67121E3	87121E3
	150	25 x 40	1.35	0.67	650	1300	420	705	47151E3	27151E3
	150	25 x 35	1.27	0.67	650	1300	420	705	67151E3	87151E3
	150	30 x 30	1.32	0.67	650	1300	420	705	57151E3	77151E3
450	180	25 x 40	1.45	0.81	570	1150	360	605	47181E3	27181E3
	180	30 x 35	1.49	0.81	570	1150	360	605	57181E3	77181E3
	180	35 x 25	1.35	0.81	570	1150	360	605	67181E3	87181E3
	220	25 x 50	1.73	0.99	450	900	315	525	47221E3	27221E3
	220	30 x 40	1.72	0.99	450	900	315	525	57221E3	77221E3
	220	35 x 30	1.61	0.99	450	900	315	525	67221E3	87221E3
	270	30 x 45	1.95	1.21	380	770	270	450	37271E3	17271E3
	270	35 x 35	1.86	1.21	380	770	270	450	67271E3	87271E3
	330	30 x 50	2.19	1.48	300	600	230	390	47331E3	27331E3
	330	35 x 40	2.10	1.48	300	600	230	390	57331E3	77331E3
	390	35 x 45	2.34	1.75	250	500	190	340	47391E3	27391E3
	470	35 x 50	2.60	2.11	210	420	170	290	57471E3	77471E3
	680	35 x 60	3.15	3.06	150	300	110	200	57681E3	77681E3

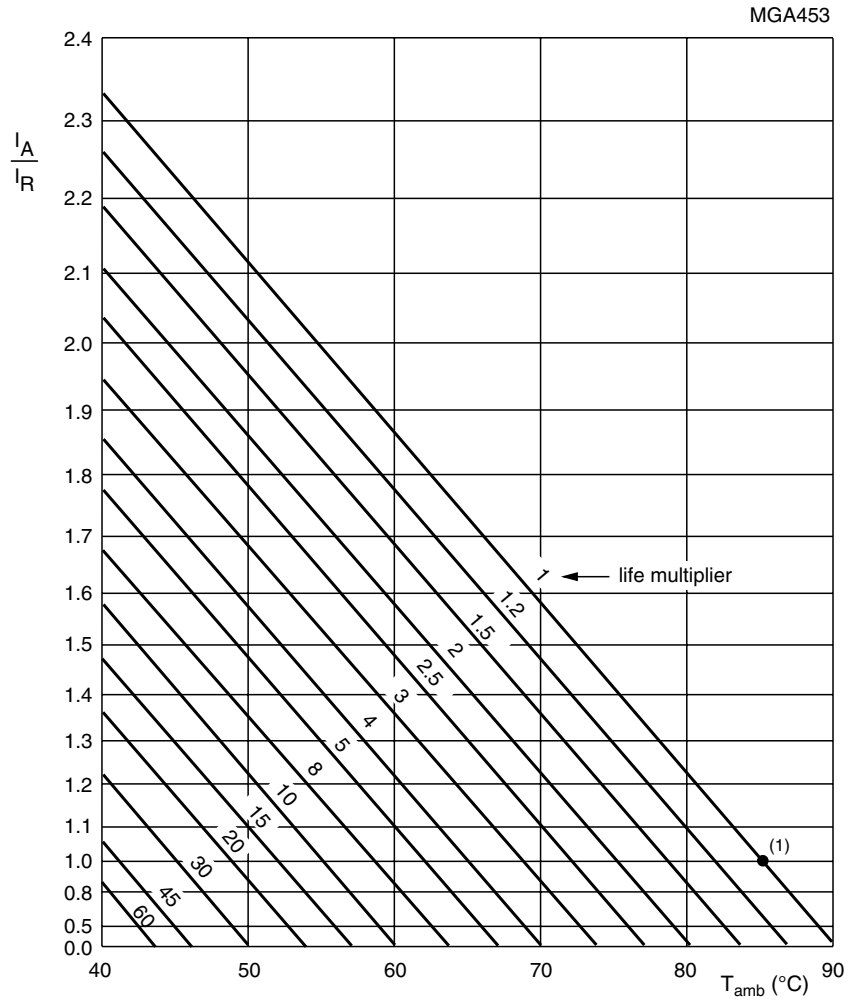
Note

[1] ESR at 120 Hz is approximately 0.95 x ESR 100 Hz

ADDITIONAL ELECTRICAL DATA

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≥ 400 V versions	$U_s = 1.1 \times U_R$
	≤ 250 V versions	$U_s = 1.15 \times U_R$
Reverse voltage		≤ 1 V
Current		
Leakage current	After 5 minutes at U_R	$I_{L5} \leq 0.01\ C_R \times U_R$
Inductance		
Equivalent series inductance (ESL)	All case sizes	typ. 19 nH
		max. 25 nH

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: 5000 hours

Fig.6 Multiplier of useful life as a function of ambient temperature and ripple current load

Table 3

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY	
FREQUENCY (Hz)	**I_R MULTIPLIER**
50	0.90
100	0.95
120	1.00
200	1.15
1000	1.30
≥ 10 000	1.40

Table 4

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; 3000 hours	ΔC/C: ± 10 % ESR ≤ 2 x spec. limit I_{L5} ≤ spec. limit
Load life		T_{amb} = 85 °C; U_R and I_R applied; 3000 hours	ΔC/C: ± 20 % 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; 5000 hours	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; 1000 hours After test: U_R to be applied for 30 minutes, 24 hours to 48 hours before measurement	ΔC/C: ± 15 % ESR ≤ 1.5 x spec. limit I_{L5} ≤ 1 x spec. limit

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