Aluminum Capacitors
Power Ultra Long Life Snap-In

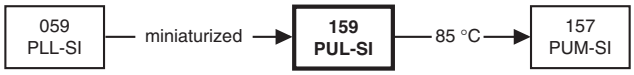


Fig. 1

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, very small dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Low ESR, high ripple current capability
- Useful life: 5000 h at 105 °C
- Keyed polarity snap-in version available
- Compliant to RoHS Directive 2002/95/EC

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 code 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) 159 xxxxx
- Climatic category in accordance with IEC 60068

QUICK REFERENCE DATA

DESCRIPTION	VALUE	
Nominal case size (Ø D x L in mm)	22 x 25 to 35 x 60	
Rated capacitance range (E6/E12 series), C_R	56 µF to 1800 µF	
Tolerance on C_R	± 20 %	
Rated voltage range, U_R	200 V, 250 V	400 V, 450 V
Category temperature range	- 25 °C to + 105 °C	
Endurance test at 105 °C	2000 h	
Load life at 105 °C	2000 h	
Useful life at 105 °C	5000 h	
Useful life at 40 °C and 1.6 x I_R applied	500 000 h	
Shelf life at 0 V, 105 °C	1000 h	
Based on sectional specification	IEC 60384-4/EN130300	
Climatic category IEC 60068	25/105/56	

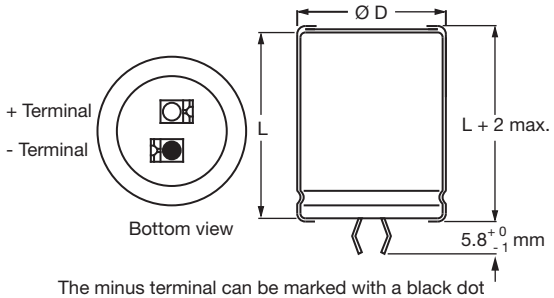
SELECTION CHART FOR C_R, U_R, AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)

C_R (µF)	U_R (V)			
	200	250	400	450
56	-	-	-	22 x 25
68	-	-	22 x 25	22 x 30
	-	-	-	25 x 25
82	-	-	22 x 30	22 x 35
	-	-	25 x 25	-
100	-	-	22 x 35	22 x 40
	-	-	25 x 30	25 x 30
	-	-	-	30 x 25
120	-	-	22 x 35	-
	-	-	25 x 30	25 x 35
	-	-	30 x 25	-
150	-	-	22 x 40	25 x 40
	-	-	25 x 35	30 x 30
	-	-	30 x 30	35 x 25
180	-	-	25 x 40	25 x 45
	-	-	30 x 30	30 x 35
	-	-	35 x 25	-
220	-	22 x 30	25 x 45	30 x 40
	-	25 x 25	30 x 35	35 x 30
	-	-	35 x 30	-

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
270	-	22 x 35	25 x 50	30x 45
	-	25 x 30	30 x 40	35 x 35
	-	30 x 25	35 x 30	-
330	22 x 30	22 x 40	30 x 45	30 x 50
	-	25 x 30	35 x 35	35 x 40
	-	30 x 25	-	-
390	22 x 35	25 x 35	30 x 50	35 x 45
	25 x 30	30 x 30	35 x 40	-
470	22 x 40	25 x 40	35 x 45	35 x 50
	30 x 25	30 x 30	-	35 x 40
	-	35 x 25	-	-
560	-	25 x 45	-	35 x 60
	25 x 35	30 x 35	-	-
	30 x 30	35 x 30	-	-
680	25 x 45	30 x 40	35 x 60	-
	30 x 30	35 x 35	-	-
	35 x 25	-	-	-
820	25 x 50	30 x 45	-	-
	30 x 35	35 x 35	-	-
	35 x 30	35 x 40	-	-
1000	30 x 45	35 x 40	-	-
	35 x 35	35 x 45	-	-
1200	30 x 50	35 x 45	-	-
	35 x 35	35 x 50	-	-
1500	35 x 45	-	-	-
1800	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

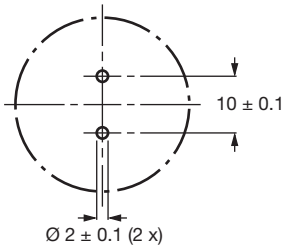
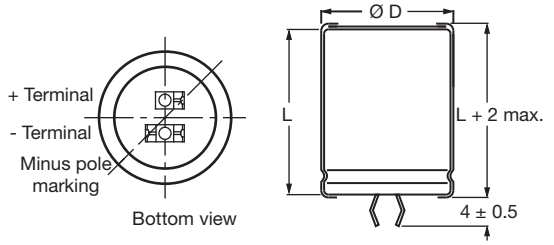


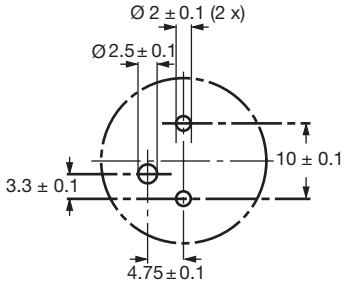
Fig. 3 - Mounting hole diagram

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)	CARDBOARD BOX DIMENSIONS L x W x H
22 x 25	23	27	≈ 12	100	260 x 250 x 39
22 x 30	23	32	≈ 16	100	260 x 250 x 44
22 x 35	23	37	≈ 20	100	260 x 250 x 49
22 x 40	23	42	≈ 23	100	260 x 250 x 54
25 x 25	26	27	≈ 20	100	290 x 280 x 39
25 x 30	26	32	≈ 22	100	290 x 280 x 44
25 x 35	26	37	≈ 24	100	290 x 280 x 49
25 x 40	26	42	≈ 27	100	290 x 280 x 54
25 x 45	26	47	≈ 32	100	290 x 280 x 59
25 x 50	26	52	≈ 38	100	290 x 280 x 64
30 x 25	31	27	≈ 25	100	340 x 330 x 39
30 x 30	31	32	≈ 30	100	340 x 330 x 44
30 x 35	31	37	≈ 35	100	340 x 330 x 49
30 x 40	31	42	≈ 40	100	340 x 330 x 54
30 x 45	31	47	≈ 45	100	340 x 330 x 59
30 x 50	31	52	≈ 50	100	340 x 330 x 64
35 x 25	36	27	≈ 33	50	390 x 198 x 39
35 x 30	36	32	≈ 40	50	390 x 198 x 44
35 x 35	36	37	≈ 48	50	390 x 198 x 49
35 x 40	36	42	≈ 55	50	390 x 198 x 54
35 x 45	36	47	≈ 63	50	390 x 198 x 59
35 x 50	36	52	≈ 72	50	390 x 198 x 64
35 x 60	36	62	≈ 84	50	390 x 198 x 74

ELECTRICAL DATA	
SYMBOL	DESCRIPTION
C_R	Rated capacitance at 100 Hz
I_R	Rated RMS ripple current at 120 Hz, 105 °C
I_{L5}	Max. leakage current after 5 min at U_R
ESR	Typ./max. equivalent series resistance at 100 Hz (1)
Z	Typ./max. impedance at 10 kHz

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 120 Hz is approximately 0.95 x ESR 100 Hz

ORDERING EXAMPLE

Electrolytic capacitor 159 series

1000 µF/200 V; ± 20 %

Nominal case size: Ø 30 mm x 45 mm

2-terminal snap-in:

Ordering code: MAL2 15942102E3
Former 12NC: 2222 15942102

3-terminal snap-in:

Ordering code: MAL2 15922102E3
Former 12NC: 2222 15922102

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 105 °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 MAL2159.....	
									2-TERM.	3-TERM.
200	330	22 x 30	1.08	0.66	450	730	300	500	52331E3	72331E3
	390	22 x 35	1.23	0.78	380	610	280	470	42391E3	22391E3
	390	25 x 30	1.23	0.78	380	610	280	470	52391E3	72391E3
	470	22 x 40	1.37	0.94	300	505	240	400	32471E3	12471E3
	470	30 x 25	1.27	0.94	300	505	240	400	52471E3	72471E3
	560	25 x 35	1.50	1.12	260	425	235	390	42561E3	22561E3
	560	30 x 30	1.52	1.12	260	425	235	390	52561E3	72561E3
	680	25 x 45	1.82	1.36	210	350	205	340	42681E3	22681E3
	680	30 x 30	1.59	1.36	210	350	205	340	52681E3	72681E3
	680	35 x 25	1.44	1.36	210	350	205	340	62681E3	82681E3
	820	25 x 50	2.04	1.64	180	290	145	240	32821E3	12821E3
	820	30 x 35	1.83	1.64	180	290	145	240	42821E3	22821E3
	820	35 x 30	1.77	1.64	180	290	145	240	52821E3	72821E3
	1000	30 x 45	2.23	2.00	150	235	135	225	42102E3	22102E3
	1000	35 x 35	2.04	2.00	150	235	135	225	52102E3	72102E3
	1200	30 x 50	2.47	2.40	130	210	115	190	42122E3	22122E3
	1200	35 x 35	2.07	2.40	130	210	115	190	52122E3	72122E3
	1500	35 x 45	2.56	3.00	100	170	95	155	52152E3	72152E3
	1800	35 x 50	2.80	3.60	90	150	80	130	52182E3	72182E3
250	220	22 x 30	1.00	0.55	540	1080	420	700	43221E3	23221E3
	220	25 x 25	1.00	0.55	540	1080	420	700	53221E3	73221E3
	270	22 x 35	1.07	0.67	440	880	335	560	43271E3	23271E3
	270	25 x 30	1.08	0.67	440	880	335	560	53271E3	73271E3
	270	30 x 25	1.08	0.67	440	880	335	560	63271E3	83271E3
	330	22 x 40	1.20	0.82	360	720	255	430	33331E3	13331E3
	330	25 x 30	1.21	0.82	360	720	255	430	43331E3	23331E3
	330	30 x 25	1.19	0.82	360	720	255	430	53331E3	73331E3
	390	25 x 35	1.39	0.97	330	610	245	410	43391E3	23391E3
	390	30 x 30	1.41	0.97	330	610	245	410	53391E3	73391E3
	470	25 x 40	1.58	1.17	270	505	240	400	33471E3	13471E3
	470	30 x 30	1.57	1.17	270	505	240	400	43471E3	23471E3
	470	35 x 25	1.37	1.17	270	505	240	400	53471E3	73471E3
	560	25 x 45	1.78	1.40	230	425	185	310	43561E3	23561E3
	560	30 x 35	1.71	1.40	230	425	185	310	53561E3	73561E3
	560	35 x 30	1.67	1.40	230	425	185	310	63561E3	83561E3
	680	30 x 40	1.93	1.70	210	350	155	260	43681E3	23681E3
	680	35 x 35	1.92	1.70	210	350	155	260	53681E3	73681E3
	820	30 x 45	2.16	2.05	180	290	125	210	43821E3	23821E3
	820	35 x 35	1.97	2.05	180	290	125	210	53821E3	73821E3
	820	35 x 40	2.16	2.05	180	290	125	210	63821E3	83821E3
	1000	35 x 40	2.22	2.50	140	235	105	180	53102E3	73102E3
	1000	35 x 45	2.41	2.50	140	235	105	180	63102E3	83102E3
	1200	35 x 45	2.46	3.00	130	200	95	160	43122E3	23122E3
	1200	35 x 50	2.65	3.00	130	200	95	160	53122E3	73122E3

Note

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

ELECTRICAL DATA AND ORDERING INFORMATION

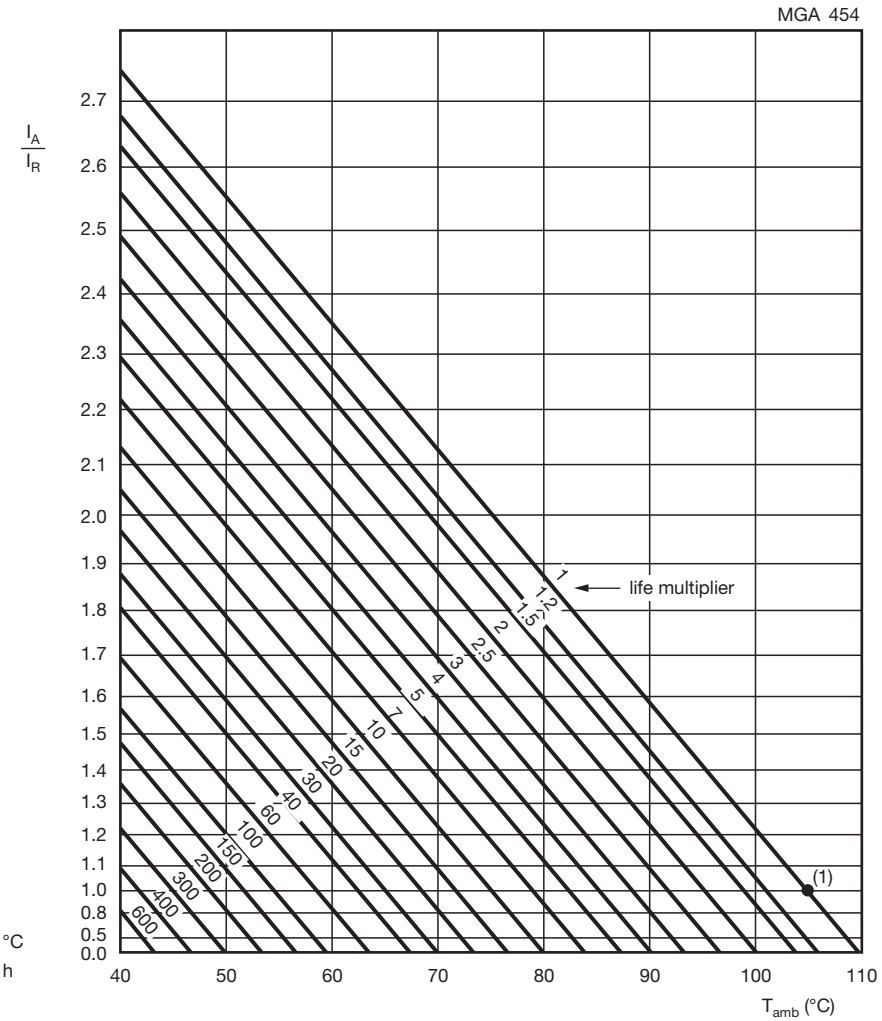
U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I_R 120 Hz 105 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 100 Hz [1] (mΩ)	MAX. ESR 100 Hz [1] (mΩ)	TYP. Z 10 kHz (mΩ)	MAX. Z 10 kHz (mΩ)	ORDERING CODE MAL2159.....	
									2-TERM.	3-TERM.
400	68	22 x 25	0.51	0.27	1600	3200	1170	1950	56689E3	76689E3
	82	22 x 30	0.60	0.33	1200	2400	910	1520	46829E3	26829E3
	82	25 x 25	0.60	0.33	1200	2400	910	1520	56829E3	76829E3
	100	22 x 35	0.69	0.40	990	1980	740	1240	46101E3	26101E3
	100	25 x 30	0.70	0.40	990	1980	740	1240	56101E3	76101E3
	120	22 x 35	0.76	0.48	800	1600	660	1100	46121E3	26121E3
	120	25 x 30	0.76	0.48	800	1600	660	1100	56121E3	76121E3
	120	30 x 25	0.77	0.48	800	1600	660	1100	66121E3	86121E3
	150	22 x 40	0.86	0.60	700	1400	510	860	36151E3	16151E3
	150	25 x 35	0.89	0.60	700	1400	510	860	46151E3	26151E3
	150	30 x 30	0.92	0.60	700	1400	510	860	56151E3	76151E3
	180	25 x 40	1.01	0.72	590	1170	420	700	36181E3	16181E3
	180	30 x 30	0.99	0.72	590	1170	420	700	46181E3	26181E3
	180	35 x 25	0.96	0.72	590	1170	420	700	56181E3	76181E3
	220	25 x 45	1.15	0.88	470	940	350	590	46221E3	26221E3
	220	30 x 35	1.15	0.88	470	940	350	590	56221E3	76221E3
	220	35 x 30	1.14	0.88	470	940	350	590	66221E3	86221E3
	270	25 x 50	1.31	1.08	380	760	330	550	46271E3	26271E3
	270	30 x 40	1.30	1.08	380	760	330	550	56271E3	76271E3
	270	35 x 30	1.21	1.08	380	760	330	550	66271E3	86271E3
	330	30 x 45	1.47	1.32	320	640	270	450	56331E3	76331E3
	330	35 x 35	1.40	1.32	320	640	270	450	66331E3	86331E3
	390	30 x 50	1.63	1.56	270	540	240	410	46391E3	26391E3
	390	35 x 40	1.57	1.56	270	540	240	410	56391E3	76391E3
	470	35 x 45	1.72	1.88	230	450	200	330	56471E3	76471E3
	560	35 x 50	1.84	2.24	210	420	170	280	56561E3	76561E3
	680	35 x 60	2.24	2.72	180	350	130	230	56681E3	76681E3
450	56	22 x 25	0.48	0.25	1600	3200	1120	1880	57569E3	77569E3
	68	22 x 30	0.56	0.30	1200	2400	910	1530	47689E3	27689E3
	68	25 x 25	0.56	0.30	1200	2400	910	1530	57689E3	77689E3
	82	22 x 35	0.64	0.36	1100	2200	770	1290	57829E3	77829E3
	100	22 x 40	0.74	0.45	900	1800	630	1050	37101E3	17101E3
	100	25 x 30	0.71	0.45	900	1800	630	1050	47101E3	27101E3
	100	30 x 25	0.73	0.45	900	1800	630	1050	57101E3	77101E3
	120	25 x 35	0.82	0.54	750	1500	530	885	57121E3	77121E3
	150	25 x 40	0.95	0.67	600	1200	420	705	47151E3	27151E3
	150	30 x 30	0.93	0.67	600	1200	420	705	57151E3	77151E3
	150	35 x 25	0.91	0.67	600	1200	420	705	67151E3	87151E3
	180	25 x 45	1.07	0.81	500	1000	360	605	47181E3	27181E3
	180	30 x 35	1.06	0.81	500	1000	360	605	57181E3	77181E3
	220	30 x 40	1.21	0.99	370	740	310	525	47221E3	27221E3
	220	35 x 30	1.14	0.99	370	740	310	525	57221E3	77221E3
	270	30 x 45	1.37	1.21	350	700	270	450	47271E3	27271E3
	270	35 x 35	1.32	1.21	350	700	270	450	57271E3	77271E3
	330	30 x 50	1.54	1.48	300	600	230	390	47331E3	27331E3
	330	35 x 40	1.49	1.48	300	600	230	390	57331E3	77331E3
	390	35 x 45	1.61	1.75	250	500	200	340	57391E3	77391E3
	470	35 x 40	1.90	1.50	210	300	115	190	90103E3D	-
	470	35 x 50	1.72	2.11	210	420	170	290	57471E3	77471E3
	560	35 x 60	2.11	2.52	190	380	140	240	57561E3	77561E3

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 min 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 105 °C

(1) Useful life at 105 °C and I_R applied: 5000 h

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} = 105 °C; U_R applied; 2000 h	ΔC/C: ± 15 % ESR ≤ 1.3 x spec. limit I_{L5} ≤ spec. limit
Load life		T_{amb} = 105 °C; U_R and I_R applied; 2000 h	ΔC/C: ± 20 % ESR ≤ 2 x spec. limit I_{L5} ≤ spec. limit
Useful life	CECC 30301 subclause 1.8.1	T_{amb} = 105 °C; U_R and I_R applied; 5000 h	ΔC/C: ± 30 % ESR ≤ 3 x spec. limit I_{L5} ≤ spec. limit total failure percentage: ≤ 3 %
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	T_{amb} = 105 °C; no voltage applied; 1000 h after test: U_R to be applied for 30 min, 24 h to 48 h before measurement	ΔC/C: ± 15 % ESR ≤ 1.5 x spec. limit I_{L5} ≤ spec. limit

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