

Aluminum Electrolytic Capacitors

Power High Ripple Current Miniaturized Snap-In

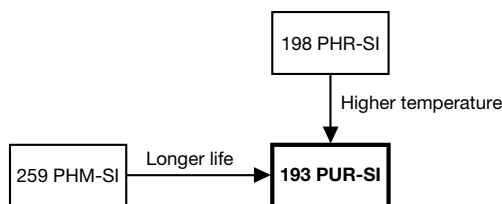


Fig. 1


RoHS
COMPLIANT

FEATURES

- Compact design
- Useful life: 5000 h at 105 °C
- > 25 years 24/7 application life at 60 °C
- Available up to 500 V
- 10 % to 30 % higher ripple current than similar sized standard products
- Keyed polarity snap-in version available
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- Solar PV inverters
- Motor controls / small drives
- Standard and switched mode power supplies
- Industrial air conditioning
- Industrial lamp driver
- Welding / cutting / melting
- Uninterruptable power supply (UPS)

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 $\pm 20\%$)
- Rated voltage (in V)
- Date code (YYMM or in 2 digits according to IEC 60062)
- 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, at least last 8 digits 193 xxxxx
- Climatic category in accordance with IEC 60068

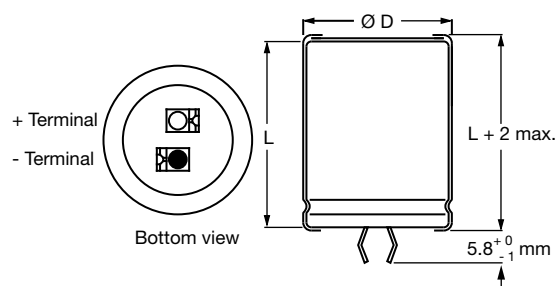
QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case size ($\varnothing$ D x L in mm)	22 x 25 to 35 x 60
Rated capacitance range, C_R	47 μF to 820 μF
Tolerance on C_R	$\pm 20\%$
Rated voltage range, U_R	400 V to 450 V 500 V
Category temperature range	-40 °C to 105 °C -25 °C to 105 °C
Endurance test at 105 °C	2000 h
Useful life at 105 °C	5000 h
Shelf life at 0 V, 105 °C	1000 h
Based on sectional specification	IEC 60384-4 / EN 130300
Climatic category IEC 60068	40 / 105 / 56 25 / 105 / 56

SELECTION CHART FOR C_R , U_R , AND RELEVANT NOMINAL CASE SIZES ($\varnothing$ D x L in mm)			
C_R (μF)	U_R (V)		
	400	450	500
47	-	-	22 x 25
56	-	-	25 x 25
68	22 x 25	22 x 25	22 x 30
82	-	22 x 30 25 x 25	22 x 35 25 x 30
100	22 x 30 25 x 25	-	22 x 40
120	-	22 x 35 25 x 30 30 x 25	25 x 35 30 x 30 35 x 25
150	22 x 35 25 x 30 30 x 25	22 x 40 25 x 35	25 x 45

SELECTION CHART FOR C_R, U_R, AND RELEVANT NOMINAL CASE SIZES ($\varnothing D \times L$ in mm)			
C_R (μF)	U_R (V)		
	400	450	500
180	22 x 45 25 x 35	25 x 40 30 x 30 35 x 25	30 x 35 35 x 30
220	25 x 40 30 x 30	25 x 50 30 x 35 35 x 30	30 x 40
270	25 x 50 30 x 35	30 x 40	30 x 50 35 x 35
330	30 x 40 35 x 30	35 x 35	35 x 45
390	30 x 45	35 x 40	35 x 50
470	30 x 50 35 x 40	35 x 50	35 x 55
560	35 x 45	35 x 55	-
680	35 x 50	-	-
820	35 x 60	-	-

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

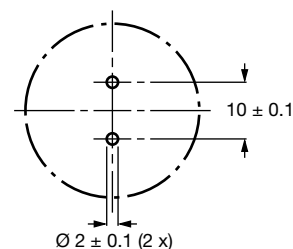
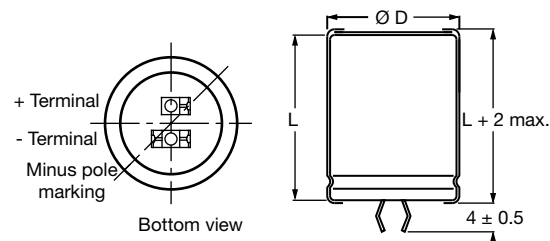


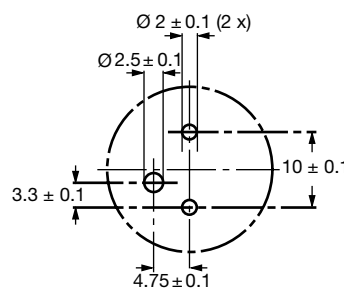
Fig. 3 - Mounting hole diagram

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
22 x 45	23	47	≈ 26	100	260 x 250 x 59
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 55	36	57	≈ 80	50	390 x 198 x 69
35 x 60	36	62	≈ 82	50	390 x 198 x 74

ELECTRICAL DATA	
SYMBOL	DESCRIPTION
C _R	Rated capacitance at 100 Hz
I _R	Rated RMS ripple current at 100 Hz, 105 °C
I _{L5}	Max. leakage current after 5 min at U _R
ESR	Typ. / max. equivalent series resistance at 100 Hz
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 %

ORDERING EXAMPLE

Electrolytic capacitor 193 series

330 µF / 450 V; ± 20 %

Nominal case size: Ø 35 mm x 35 mm

2-terminal snap-in:

Ordering code: MAL219357331E3

3-terminal snap-in:

Ordering code: MAL219317331E3



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 100 Hz 105 °C (A)	I _L 1 min (mA)	MAX. ESR 100 Hz (mΩ)	MAX. Z 10 kHz (mΩ)	ORDERING CODE MAL2193.....	
							2-TERM.	3-TERM.
400	68	22 x 25	0.69	0.167	1150	640	56689E3	16689E3
	100	22 x 30	0.87	0.244	790	440	56101E3	16101E3
	100	25 x 25	0.87	0.244	800	460	66101E3	26101E3
	150	22 x 35	1.11	0.364	530	300	66151E3	26151E3
	150	25 x 30	1.1	0.364	540	310	56151E3	16151E3
	150	30 x 25	1.13	0.364	570	330	76151E3	36151E3
	180	22 x 45	1.32	0.436	440	250	56181E3	16181E3
	180	25 x 35	1.26	0.436	450	250	66181E3	26181E3
	220	25 x 40	1.45	0.532	370	210	66221E3	26221E3
	220	30 x 30	1.41	0.532	390	230	76221E3	36221E3
	270	25 x 50	1.78	0.652	300	170	56271E3	16271E3
	270	30 x 35	1.62	0.652	320	190	66271E3	26271E3
	330	30 x 40	1.84	0.796	260	155	56331E3	16331E3
	330	35 x 30	1.78	0.796	300	190	66331E3	26331E3
	390	30 x 45	2.08	0.94	220	130	56391E3	16391E3
	390	35 x 35	2.02	0.94	240	150	66391E3	26391E3
	470	30 x 50	2.36	1.132	190	110	56471E3	16471E3
	470	35 x 40	2.26	1.132	210	130	66471E3	26471E3
	560	35 x 45	2.52	1.348	170	110	56561E3	16561E3
	680	35 x 50	2.82	1.636	150	90	56681E3	16681E3
	820	35 x 60	3.27	1.972	120	80	56821E3	16821E3
450	68	22 x 25	0.7	0.188	1080	590	57689E3	17689E3
	82	22 x 30	0.8	0.225	890	490	67829E3	27829E3
	82	25 x 25	0.8	0.225	910	500	57829E3	17829E3
	120	22 x 35	1.01	0.328	610	340	57121E3	17121E3
	120	25 x 30	1.01	0.328	630	350	67121E3	27121E3
	120	30 x 25	1.04	0.328	650	370	77121E3	37121E3
	150	22 x 40	1.18	0.409	490	270	57151E3	17151E3
	150	25 x 35	1.17	0.409	500	280	67151E3	27151E3
	180	25 x 40	1.34	0.49	420	230	57181E3	17181E3
	180	30 x 30	1.31	0.49	440	250	67181E3	27181E3
	180	35 x 25	1.36	0.49	480	290	77181E3	37181E3
	220	25 x 50	1.63	0.598	350	190	57221E3	17221E3
	220	30 x 35	1.5	0.598	370	210	67221E3	27221E3
	220	35 x 30	1.58	0.598	390	230	77221E3	37221E3
	270	30 x 40	1.71	0.733	300	180	57271E3	17271E3
	330	35 x 35	1.91	0.895	270	160	57331E3	17331E3
	390	35 x 40	2.13	1.057	230	140	57391E3	17391E3
	470	35 x 50	2.53	1.273	180	110	57471E3	17471E3
	560	35 x 55	2.78	1.516	160	100	57561E3	17561E3
500	47	22 x 25	0.57	0.145	2800	2060	59479E3	19479E3
	56	25 x 25	0.65	0.172	2360	1740	59569E3	19569E3
	68	22 x 30	0.71	0.208	1940	1430	59689E3	19689E3
	82	22 x 35	0.82	0.25	1600	1180	59829E3	19829E3
	82	25 x 30	0.82	0.25	1610	1190	69829E3	29829E3
	100	22 x 40	0.94	0.304	1320	970	59101E3	19101E3
	120	25 x 35	1.03	0.364	1110	820	59121E3	19121E3
	120	30 x 30	1.07	0.364	1120	830	69121E3	29121E3
	120	35 x 25	1.14	0.364	1150	870	79121E3	39121E3
	150	25 x 45	1.26	0.454	890	650	59151E3	19151E3
	180	30 x 35	1.34	0.544	760	560	59181E3	19181E3
	180	35 x 30	1.42	0.544	770	580	69181E3	29181E3
	220	30 x 40	1.53	0.664	620	470	59221E3	19221E3
	270	30 x 50	1.85	0.814	500	380	59271E3	19271E3
	270	35 x 35	1.74	0.814	530	400	69271E3	29271E3
	330	35 x 45	2.06	0.994	430	320	59331E3	19331E3
	390	35 x 50	2.3	1.174	360	270	59391E3	19391E3
	470	35 x 55	2.55	1.414	310	230	59471E3	19471E3

ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≥ 400 V versions	$U_S = 1.1 \times U_R$
Reverse voltage	≤ 1 V	-
Current		
Leakage current	After 5 min at U_R	$I_{L5} \leq 0.01 C_R \times U_R$
Inductance		
Equivalent series inductance (ESL)	All case sizes	Typ. 19 nH
		Max. 25 nH

RIPPLE CURRENT AND USEFUL LIFE

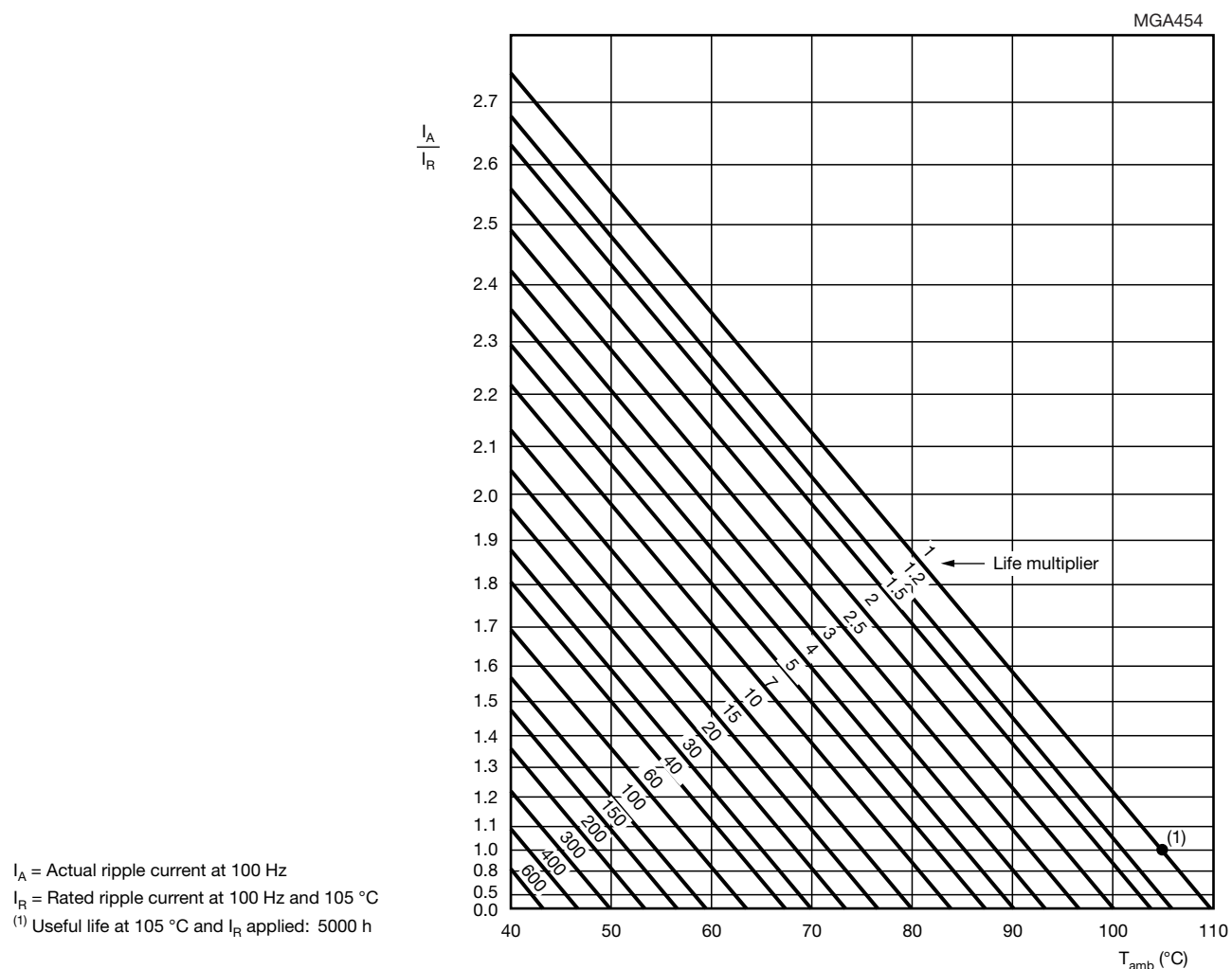


Fig. 6 - Multiplier of useful life as a function of ambient temperature and ripple current load



Table 3

ENDURANCE TEST DURATION AND USEFUL LIFE	
ENDURANCE AT 105 °C (h)	USEFUL LIFE AT 105 °C (h)
2000	5000

Note

- Multiplier of useful life code: MGA454

Table 4

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY					
FREQUENCY (Hz)					
50	100	120	200	1000	$\geq 10\,000$
I_R MULTIPLIER					
0.8	1.0	1.05	1.2	1.4	1.5

Table 5

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4 / EN 130300 subclause 4.13	$T_{amb} = 105\,^{\circ}\text{C}$; U_R applied; 2000 h	$\Delta C/C: \pm 15\,\%$ $ESR \leq 1.3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\,^{\circ}\text{C}$; U_R and I_R applied; 5000 h	$\Delta C/C: \pm 30\,\%$ $ESR \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ total failure percentage: $\leq 3\,\%$
Shelf life (storage at high temperature)	IEC 60384-4 / EN 130300 subclause 4.17	$T_{amb} = 105\,^{\circ}\text{C}$; no voltage applied; 1000 h after test: U_R to be applied for 30 min, 24 h to 48 h before measurement	$\Delta C/C: \pm 15\,\%$ $ESR \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$

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