Aluminum Electrolytic Capacitors
Power High Ripple Current Miniaturized Snap-In



LINKS TO ADDITIONAL RESOURCES

3D Models

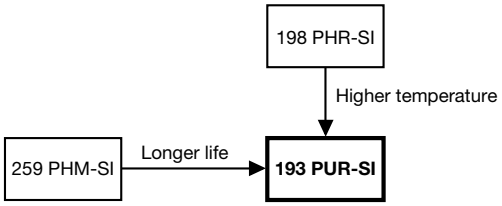


Fig. 1

QUICK REFERENCE DATA

DESCRIPTION	VALUE	
Nominal case size (Ø 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	± 20 %	
Rated voltage range, U_R	400 V to 450 V	500 V to 600 V
Temperature range	-40 °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 (1)

Note

(1) Capacitors can be operated in temperature range of -40 °C to +105 °C, but impedance at -40 °C must be taken into consideration with regards to IEC 60068

FEATURES

Pb-free

RoHS COMPLIANT

- Compact design
- Long useful life: > 5000 h at 105 °C
- > 25 years 24/7 application life at 60 °C
- **Rated voltages up to 600 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
- Uninterruptible 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 ± 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

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

C_R (µF)	U_R (V)				
	400	450	500	550	600
47	-	-	22 x 25	22 x 25	22 x 30
56	-	-	25 x 25	22 x 30	22 x 35
68	22 x 25	22 x 25	22 x 30	22 x 35	22 x 40
82	-	22 x 30 25 x 25	22 x 35 25 x 30	22 x 40	22 x 45
100	22 x 30 25 x 25	-	22 x 40	22 x 45 30 x 30	25 x 45 30 x 30

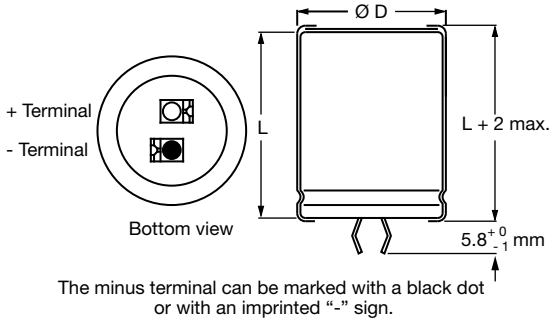
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SELECTION CHART FOR C_R, U_R, AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)					
C_R (µF)	U_R (V)				
	400	450	500	550	600
120	-	22 x 35 25 x 30 30 x 25	25 x 35 30 x 30 35 x 25	22 x 50 30 x 30	25 x 50 30 x 35
150	22 x 35 25 x 30 30 x 25	22 x 40 25 x 35	25 x 45	25 x 45 30 x 35	30 x 40 35 x 35
180	22 x 45 25 x 35	25 x 40 30 x 30 35 x 25	30 x 35 35 x 30	25 x 50 30 x 40	30 x 45 35 x 35
220	25 x 40 30 x 30	25 x 50 30 x 35 35 x 30	30 x 40	30 x 45	35 x 40
270	25 x 50 30 x 35	30 x 40	30 x 50 35 x 35	30 x 50 35 x 40	35 x 50
330	30 x 40 35 x 30	35 x 35	35 x 45	35 x 45	35 x 55
390	30 x 45	35 x 40	35 x 50	35 x 50	-
470	30 x 50 35 x 40	35 x 50	35 x 55	35 x 60	-
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

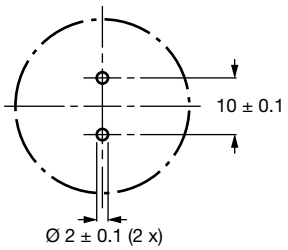
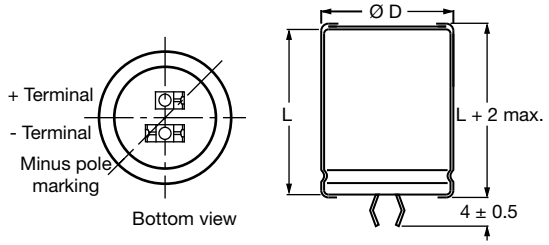


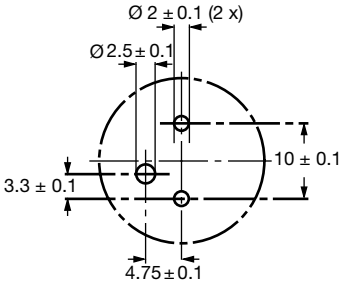
Fig. 3 - Mounting hole diagram

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

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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 and 105 °C
I_{L5}	Max. leakage current after 5 min at U_R
tan δ	Max. dissipation factor at 100 Hz
ESR	Max. equivalent series resistance at 100 Hz
Z	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

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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 5 min (mA)	tan δ 100 Hz	MAX. ESR 100 Hz (mΩ)	MAX. Z 10 kHz (mΩ)	ORDERING CODE MAL2193.....	
								2-TERM.	3-TERM.
400	68	22 x 25	0.69	0.27	0.15	1150	640	56689E3	16689E3
	100	22 x 30	0.87	0.40	0.15	790	440	56101E3	16101E3
	100	25 x 25	0.87	0.40	0.15	800	460	66101E3	26101E3
	150	22 x 35	1.11	0.60	0.15	530	300	66151E3	26151E3
	150	25 x 30	1.1	0.60	0.15	540	310	56151E3	16151E3
	150	30 x 25	1.13	0.60	0.15	570	330	76151E3	36151E3
	180	22 x 45	1.32	0.72	0.15	440	250	56181E3	16181E3
	180	25 x 35	1.26	0.72	0.15	450	250	66181E3	26181E3
	220	25 x 40	1.45	0.88	0.15	370	210	66221E3	26221E3
	220	30 x 30	1.41	0.88	0.15	390	230	76221E3	36221E3
	270	25 x 50	1.78	1.08	0.15	300	170	56271E3	16271E3
	270	30 x 35	1.62	1.08	0.15	320	190	66271E3	26271E3
	330	30 x 40	1.84	1.32	0.15	260	155	56331E3	16331E3
	330	35 x 30	1.78	1.32	0.15	300	190	66331E3	26331E3
	390	30 x 45	2.08	1.56	0.15	220	130	56391E3	16391E3
	390	35 x 35	2.02	1.56	0.15	240	150	66391E3	26391E3
	470	30 x 50	2.36	1.88	0.15	190	110	56471E3	16471E3
	470	35 x 40	2.26	1.88	0.15	210	130	66471E3	26471E3
	560	35 x 45	2.52	2.24	0.15	170	110	56561E3	16561E3
	680	35 x 50	2.82	2.72	0.15	150	90	56681E3	16681E3
	820	35 x 60	3.27	3.28	0.15	120	80	56821E3	16821E3
450	68	22 x 25	0.7	0.31	0.20	1080	590	57689E3	17689E3
	82	22 x 30	0.8	0.37	0.20	890	490	67829E3	27829E3
	82	25 x 25	0.8	0.37	0.20	910	500	57829E3	17829E3
	120	22 x 35	1.01	0.54	0.20	610	340	57121E3	17121E3
	120	25 x 30	1.01	0.54	0.20	630	350	67121E3	27121E3
	120	30 x 25	1.04	0.54	0.20	650	370	77121E3	37121E3
	150	22 x 40	1.18	0.68	0.20	490	270	57151E3	17151E3
	150	25 x 35	1.17	0.68	0.20	500	280	67151E3	27151E3
	180	25 x 40	1.34	0.81	0.20	420	230	57181E3	17181E3
	180	30 x 30	1.31	0.81	0.20	440	250	67181E3	27181E3
	180	35 x 25	1.36	0.81	0.20	480	290	77181E3	37181E3
	220	25 x 50	1.63	0.99	0.20	350	190	57221E3	17221E3
	220	30 x 35	1.5	0.99	0.20	370	210	67221E3	27221E3
	220	35 x 30	1.58	0.99	0.20	390	230	77221E3	37221E3
	270	30 x 40	1.71	1.22	0.20	300	180	57271E3	17271E3
	330	35 x 35	1.91	1.49	0.20	270	160	57331E3	17331E3
	390	35 x 40	2.13	1.76	0.20	230	140	57391E3	17391E3
	470	35 x 50	2.53	2.12	0.20	180	110	57471E3	17471E3
	560	35 x 55	2.78	2.52	0.20	160	100	57561E3	17561E3
500	47	22 x 25	0.57	0.24	0.20	3220	2370	59479E3	19479E3
	56	25 x 25	0.65	0.28	0.20	2710	2000	59569E3	19569E3
	68	22 x 30	0.71	0.34	0.20	2230	1640	59689E3	19689E3
	82	22 x 35	0.82	0.41	0.20	1840	1360	59829E3	19829E3
	82	25 x 30	0.82	0.41	0.20	1850	1370	69829E3	29829E3
	100	22 x 40	0.94	0.50	0.20	1520	1120	59101E3	19101E3
	120	25 x 35	1.03	0.60	0.20	1280	940	59121E3	19121E3
	120	30 x 30	1.07	0.60	0.20	1290	950	69121E3	29121E3
	120	35 x 25	1.14	0.60	0.20	1320	1000	79121E3	39121E3
	150	25 x 45	1.26	0.75	0.20	1020	750	59151E3	19151E3
	180	30 x 35	1.34	0.90	0.20	870	650	59181E3	19181E3
	180	35 x 30	1.42	0.90	0.20	890	670	69181E3	29181E3
	220	30 x 40	1.53	1.10	0.20	710	540	59221E3	19221E3
	270	30 x 50	1.85	1.35	0.20	580	440	59271E3	19271E3
	270	35 x 35	1.74	1.35	0.20	610	460	69271E3	29271E3
	330	35 x 45	2.06	1.65	0.20	490	370	59331E3	19331E3
	390	35 x 50	2.3	1.95	0.20	410	310	59391E3	19391E3
	470	35 x 55	2.55	2.35	0.20	360	260	59471E3	19471E3

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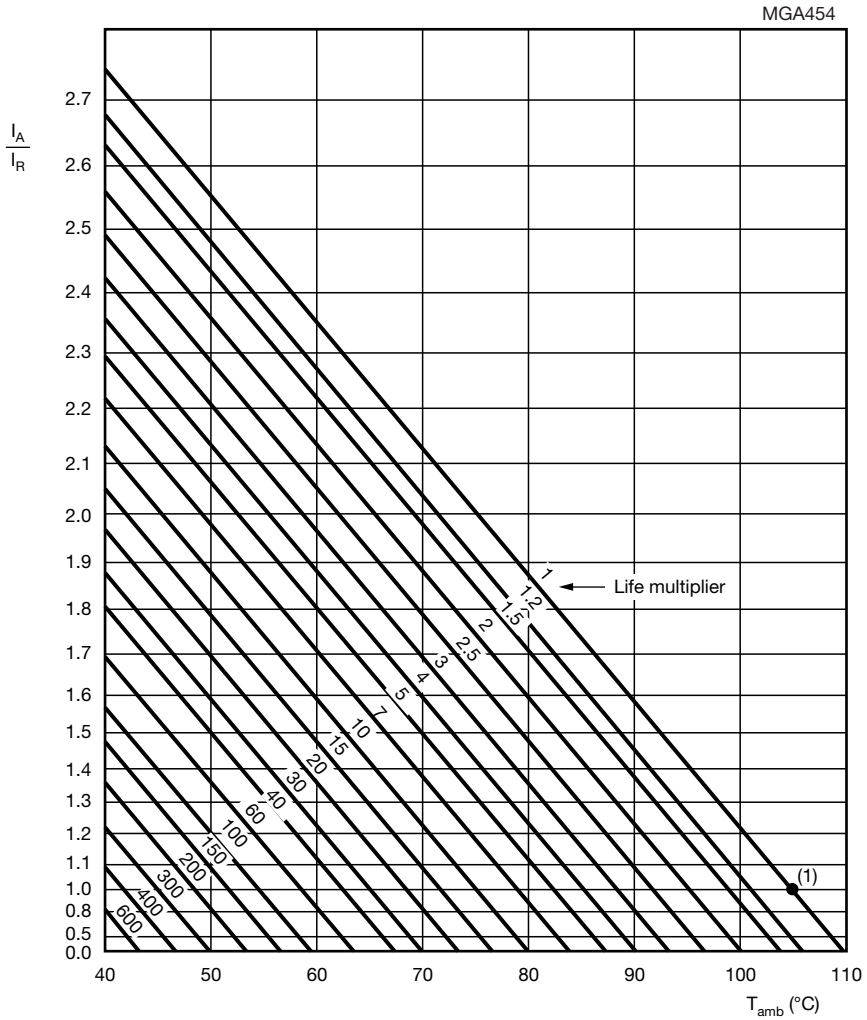
U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I_R 100 Hz 105 °C (A)	I_L 5 min (mA)	tan δ 100 Hz	MAX. ESR 100 Hz (mΩ)	MAX. Z 10 kHz (mΩ)	ORDERING CODE MAL2193.....	
								2-TERM.	3-TERM.
550	47	22 x 25	0.58	0.26	0.20	2950	2190	50479E3	10479E3
	56	22 x 30	0.66	0.31	0.20	2455	1825	50569E3	10569E3
	68	22 x 35	0.76	0.37	0.20	2020	1500	50689E3	10689E3
	82	22 x 40	0.87	0.45	0.20	1680	1245	50829E3	10829E3
	100	22 x 45	1.00	0.55	0.20	1380	1025	50101E3	10101E3
	100	30 x 30	1.19	0.55	0.20	1255	840	60101E3	20101E3
	120	22 x 50	1.13	0.66	0.20	1160	860	50121E3	10121E3
	120	30 x 30	1.30	0.66	0.20	1025	680	60121E3	20121E3
	150	25 x 45	1.26	0.83	0.20	980	730	50151E3	10151E3
	150	30 x 35	1.50	0.83	0.20	680	415	60151E3	20151E3
	180	25 x 50	1.45	0.99	0.20	830	625	50181E3	10181E3
	180	30 x 40	1.70	0.99	0.20	570	350	60181E3	20181E3
	220	30 x 45	1.68	1.21	0.20	645	465	50221E3	10221E3
	270	30 x 50	1.93	1.49	0.20	545	400	50271E3	10271E3
	270	35 x 40	2.26	1.49	0.20	400	250	60271E3	20271E3
	330	35 x 45	2.26	1.82	0.20	440	290	50331E3	10331E3
	390	35 x 50	2.37	2.15	0.20	415	270	50391E3	10391E3
	470	35 x 60	2.74	2.59	0.20	335	220	50471E3	10471E3
600	47	22 x 30	0.63	0.28	0.20	3365	2700	51479E3	11479E3
	56	22 x 35	0.73	0.34	0.20	2755	2210	51569E3	11569E3
	68	22 x 40	0.84	0.41	0.20	2270	1825	51689E3	11689E3
	82	22 x 45	0.96	0.49	0.20	1885	1515	51829E3	11829E3
	100	25 x 45	1.16	0.60	0.20	1420	1145	51101E3	11101E3
	100	30 x 30	1.15	0.60	0.20	1380	1060	61101E3	21101E3
	120	25 x 50	1.27	0.72	0.20	1300	1045	51121E3	11121E3
	120	30 x 35	1.33	0.72	0.20	1095	765	61121E3	21121E3
	150	30 x 40	1.41	0.90	0.20	1065	865	51151E3	11151E3
	150	35 x 35	1.64	0.90	0.20	880	620	61151E3	21151E3
	180	30 x 45	1.52	1.08	0.20	990	780	51181E3	11181E3
	180	35 x 35	1.78	1.08	0.20	755	540	61181E3	21181E3
	220	35 x 40	1.75	1.32	0.20	825	655	51221E3	11221E3
	270	35 x 50	2.10	1.62	0.20	640	505	51271E3	11271E3
	330	35 x 55	2.35	1.98	0.20	540	430	51331E3	11331E3

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

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RIPPLE CURRENT AND USEFUL LIFE



I_A = Actual ripple current at 100 Hz

I_R = Rated ripple current at 100 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

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

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Table 4

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY					
FREQUENCY (Hz)					
50	100	120	200	1000	≥ 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 °C; U_R applied; 2000 h	ΔC/C: ± 15 % ESR ≤ 1.3 x spec. limit I_{L5} ≤ spec. limit
Useful life		T_{amb} = 105 °C; U_R and I_R applied; > 5000 h	ΔC/C: ± 20 % tan δ ≤ 2 x initial spec. limit I_{L5} ≤ spec. limit
Shelf life (storage at high temperature)	IEC 60384-4 / EN 130300 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

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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