

## Aluminum Electrolytic Capacitors Power Ultra High Ripple Current Snap-In for Solar



### LINKS TO ADDITIONAL RESOURCES

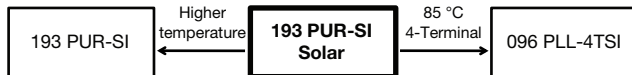


Fig. 1

QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case size (D x L in mm)	35 x 30 to 35 x 60
Rated capacitance range, C <sub>R</sub>	220 μF to 560 μF
Tolerance on C <sub>R</sub>	± 20 %
Rated voltage, U <sub>R</sub>	500 V   570 V
Rated temperature range	-40 °C to +60 °C
Endurance at U <sub>R</sub> , 60 °C, no ripple applied	6000 h
Category voltage, U <sub>C</sub>	450 V   475 V
Category temperature range	-40 °C to +105 °C
Useful life at U <sub>C</sub> , 105 °C, I <sub>R</sub> applied	6000 h
Operation up to 600 V, 60 °C, no ripple applied	-   1000 h
Shelf life at 0 V, 105 °C	1000 h
Based on sectional specification	IEC 60384-4 / EN130300
Climatic category IEC 60068	40 / 105 / 56

### FEATURES

- Tailored design for solar PV inverters
- Specified for higher voltage, up to 600 V at specific operation conditions
- Long useful life: 6000 h at +105 °C
- > 25 years 24/7 application life at 60 °C
- High ripple current capability
- High reliability
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### APPLICATIONS

- Solar PV inverters
- Industrial motor control
- Power supply

### MARKING

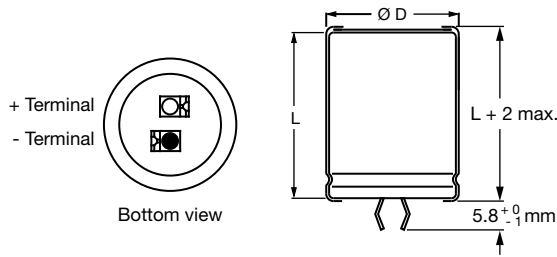
The capacitors are marked (where possible) with the following information:

- Rated capacitance (in μF)
- Tolerance code on rated capacitance, code letter in accordance with IEC 60062 (± 20 %)
- Rated voltage (in V)
- Two digit date code, in accordance with 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
- Climatic category in accordance with IEC 60068
- “LL” for long life grade

SELECTION CHART FOR C <sub>R</sub> , U <sub>R</sub> , AND RELEVANT NOMINAL CASE SIZES (∅ D x L in mm)					
C <sub>R</sub> (μF)	U <sub>R</sub> (V)				
	35 x 30	35 x 40	35 x 45	35 x 50	35 x 60
220	35 x 30	-	-	-	-
330	-	35 x 40	-	-	-
390	-	-	35 x 45	-	-
470	-	-	-	35 x 50	-
560	-	-	-	-	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

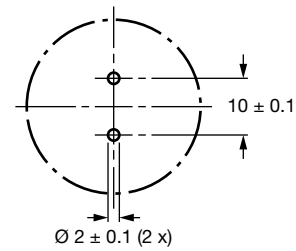
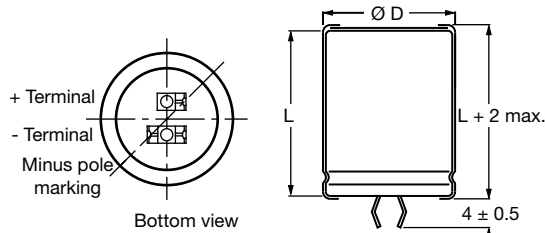


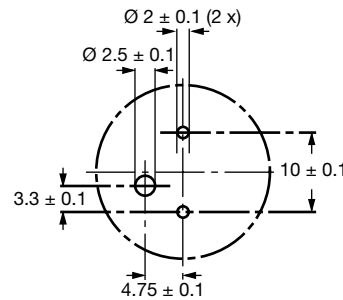
Fig. 3 - Mounting hole diagram

### 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 <sub>max.</sub>	L <sub>max.</sub>	MASS (g)	PACKAGING QUANTITIES (unit per box)	CARDBOARD BOX DIMENSIONS L x W x H
35 x 30	36	32	40	50	390 x 198 x 44
35 x 40	36	42	56	50	390 x 198 x 54
35 x 45	36	47	64	50	390 x 198 x 59
35 x 50	36	52	72	50	390 x 198 x 64
35 x 60	36	62	88	50	377 x 375 x 88



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 $U_R$
ESR	Max. equivalent series resistance at 100 Hz
Z	Max. impedance at 10 kHz

**Note**

- 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  $75\%$

Table 2

ELECTRICAL DATA AND ORDERING INFORMATION									
$U_R$ (V)	$U_C$ (V)	$C_R$ ( $\mu\text{F}$ )	CASE SIZE $\varnothing D \times L$ (mm)	$I_R$ 100 Hz 105 °C (A) <sup>(1)</sup>	$I_L$ 5 min (mA)	ESR 100 Hz MAX. (m $\Omega$ )	Z 10 kHz MAX. (m $\Omega$ )	ORDERING CODE MAL2193.....	
								2-TERM.	3-TERM.
500	450	220	35 x 30	1.35	0.99	900	600	MAL219390101E3	MAL219390111E3
		330	35 x 40	1.74	1.49	600	400	MAL219390102E3	MAL219390112E3
		390	35 x 45	1.94	1.76	500	350	MAL219390103E3	MAL219390113E3
		470	35 x 50	2.18	2.12	450	300	MAL219390104E3	MAL219390114E3
		560	35 x 60	2.52	2.52	350	250	MAL219390105E3	MAL219390115E3
570	475	220	35 x 30	1.32	1.05	600	450	MAL219390121E3	MAL219390131E3
		330	35 x 40	1.70	1.57	400	300	MAL219390122E3	MAL219390132E3
		390	35 x 45	1.90	1.85	350	250	MAL219390123E3	MAL219390133E3
		470	35 x 50	2.14	2.23	300	200	MAL219390124E3	MAL219390134E3
		560	35 x 60	2.46	2.66	250	150	MAL219390125E3	MAL219390135E3

**Notes**

- Other case sizes, terminations and capacitance values available on request
- <sup>(1)</sup> At  $U_{max.} \leq U_C$

ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
<b>Voltage</b>		
Surge voltage		$U_s = 1.1 \times U_C$
Reverse voltage		$U_{rev} \leq 1\text{ V}$
<b>Current</b>		
Leakage current	After 5 min at $U_C$	$I_{L5} \leq 0.01 C_R \times U_C$
<b>Inductance</b>		
Equivalent series inductance (ESL)	All case sizes	ca. 20 nH

## RIPPLE CURRENT AND USEFUL LIFE

Table 3

ENDURANCE TEST DURATION AND USEFUL LIFE		
PARAMETER	CONDITIONS	VALUE
Endurance	$U_R$ , 60 °C, no $I_R$ applied	6000 h
Useful life	$U_C$ , 105 °C, $I_R$ applied	

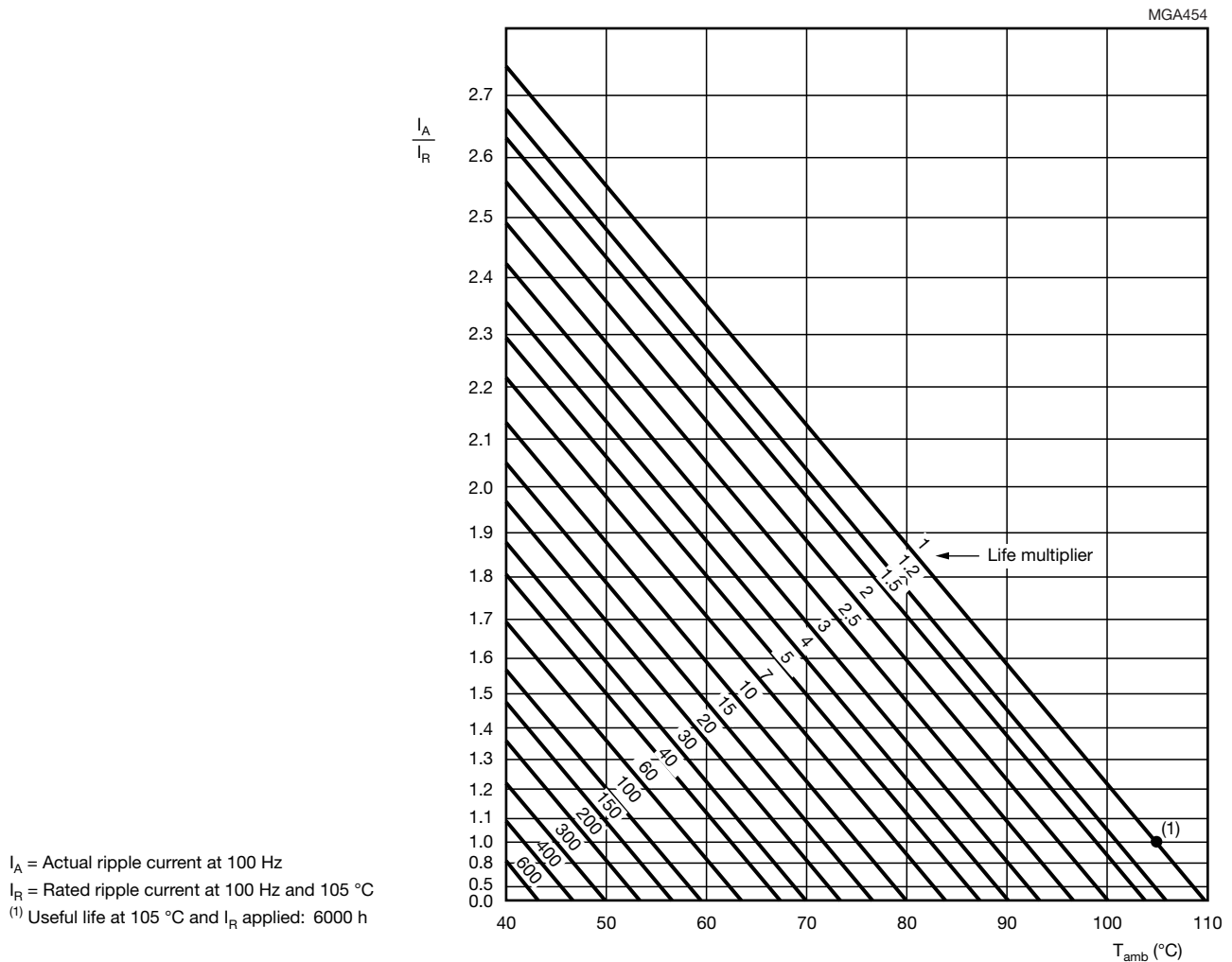


Fig. 6 - Multiplier of useful life as a function of ambient temperature and ripple current load

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					
0.90	1.00	1.05	1.15	1.30	1.40



Table 5

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4 / EN130301 subclause 4.13	$T_{amb} = 60\text{ °C}$ ; $U_R$ applied; 6000 h	$\Delta C/C: \pm 15\%$ $ESR \leq 1.5 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	EN130301 subclause 1.8.1	$T_{amb} = 105\text{ °C}$ ; $U_C$ and $I_R$ applied; 6000 h	$\Delta C/C: \pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit no visible damage total failure percentage $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4 / EN130300 subclause 4.17	$T_{amb} = 105\text{ °C}$ ; no voltage applied; 1000 h After test: $U_C$ to be applied for 30 min, 24 h to 48 h before measurement	$\Delta C/C: \pm 15\%$ $ESR \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

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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