

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_R	220 μ F to 560 μ F
Tolerance on C_R	$\pm 20\%$
Rated voltage, U_R	500 V 570 V
Rated temperature range	-40 °C to +50 °C -40 °C to +60 °C
Endurance at U_R , 50 °C, no ripple applied	5000 h -
Endurance at U_R , 60 °C, no ripple applied	- 5000 h
Category voltage, U_C	450 V 475 V
Category temperature range	-40 °C to +105 °C
Useful life at U_C , 105 °C, I_R applied	6000 h
Operation up to 600 V, 60 °C, no ripple applied ⁽¹⁾	- > 200 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

Note

⁽¹⁾ Single operation max. 5 min, 600 V, 60 °C, no ripple current; afterwards min. 1 hour within specified U_R or U_C conditions

SELECTION CHART FOR C_R , U_R , AND RELEVANT NOMINAL CASE SIZES (\varnothing D x L in mm)					
C_R (μ F)	U_R (V)				
	35 x 30	35 x 40	35 x 45	35 x 50	35 x 60
220	-	-	-	-	-
330	-	-	-	-	-
390	-	-	-	-	-
470	-	-	-	-	-
560	-	-	-	-	-

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



APPLICATIONS

- Solar PV inverters
- Industrial motor control
- Power supply

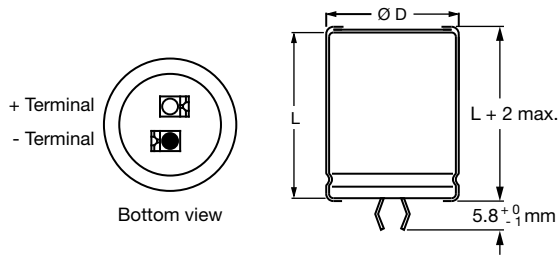
MARKING

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

- Rated capacitance (in μ F)
- Tolerance code on rated capacitance, code letter in accordance with IEC 60062 ($\pm 20\%$)
- 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

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

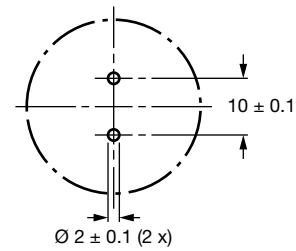
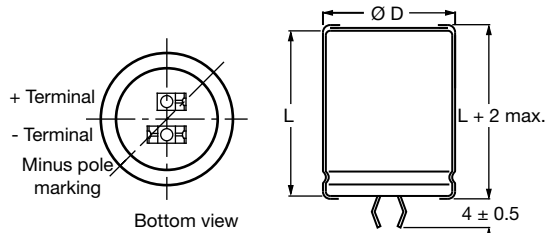


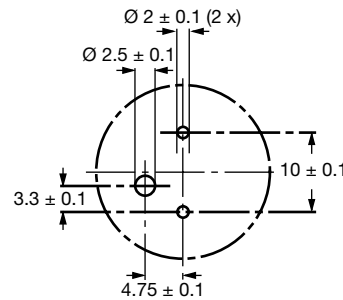
Fig. 3 - Mounting hole diagram

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 _{max.}	L _{max.}	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_{L1}	Max. leakage current after 1 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 kPa , $RH = 45\%$ to 75%

Table 2

ELECTRICAL DATA AND ORDERING INFORMATION									
U_R (V)	U_C (V)	C_R (μF)	CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 105 °C (A) ⁽¹⁾	I_L 1 min (mA)	ESR 100 Hz MAX. (m Ω)	Z 10 kHz MAX. (m Ω)	ORDERING CODE MAL2193.....	
								2-TERM.	3-TERM.
500	450	220	35 x 30	1.35	0.6	900	600	MAL219390101E3	MAL219390111E3
		330	35 x 40	1.74	0.9	600	400	MAL219390102E3	MAL219390112E3
		390	35 x 45	1.94	1.1	500	350	MAL219390103E3	MAL219390113E3
		470	35 x 50	2.18	1.3	450	300	MAL219390104E3	MAL219390114E3
		560	35 x 60	2.52	1.5	350	250	MAL219390105E3	MAL219390115E3
570	475	220	35 x 30	1.32	0.7	600	450	MAL219390121E3	MAL219390131E3
		330	35 x 40	1.70	1.0	400	300	MAL219390122E3	MAL219390132E3
		390	35 x 45	1.90	1.2	350	250	MAL219390123E3	MAL219390133E3
		470	35 x 50	2.14	1.4	300	200	MAL219390124E3	MAL219390134E3
		560	35 x 60	2.46	1.6	250	150	MAL219390125E3	MAL219390135E3

Notes

- Other case sizes, terminations and capacitance values available on request

⁽¹⁾ At $U_{max.} \leq U_C$

ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s = 1.1 \times U_C$
Reverse voltage		$U_{rev} \leq 1\text{ V}$
Current		
Leakage current	After 1 min at U_R	$I_{L1} \leq 0.006 C_R \times U_C$
	After 5 min at U_R	$I_{L5} \leq 0.002 C_R \times U_C$
Inductance		
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	$U_R = 500 \text{ V}$, $50 \text{ }^\circ\text{C}$, no ripple applied	5000 h
	$U_R = 570 \text{ V}$, $60 \text{ }^\circ\text{C}$, no ripple applied	
Useful life	$U_C = 450 \text{ V}$; $105 \text{ }^\circ\text{C}$, I_R applied	6000 h
	$U_C = 475 \text{ V}$; $105 \text{ }^\circ\text{C}$, I_R applied	

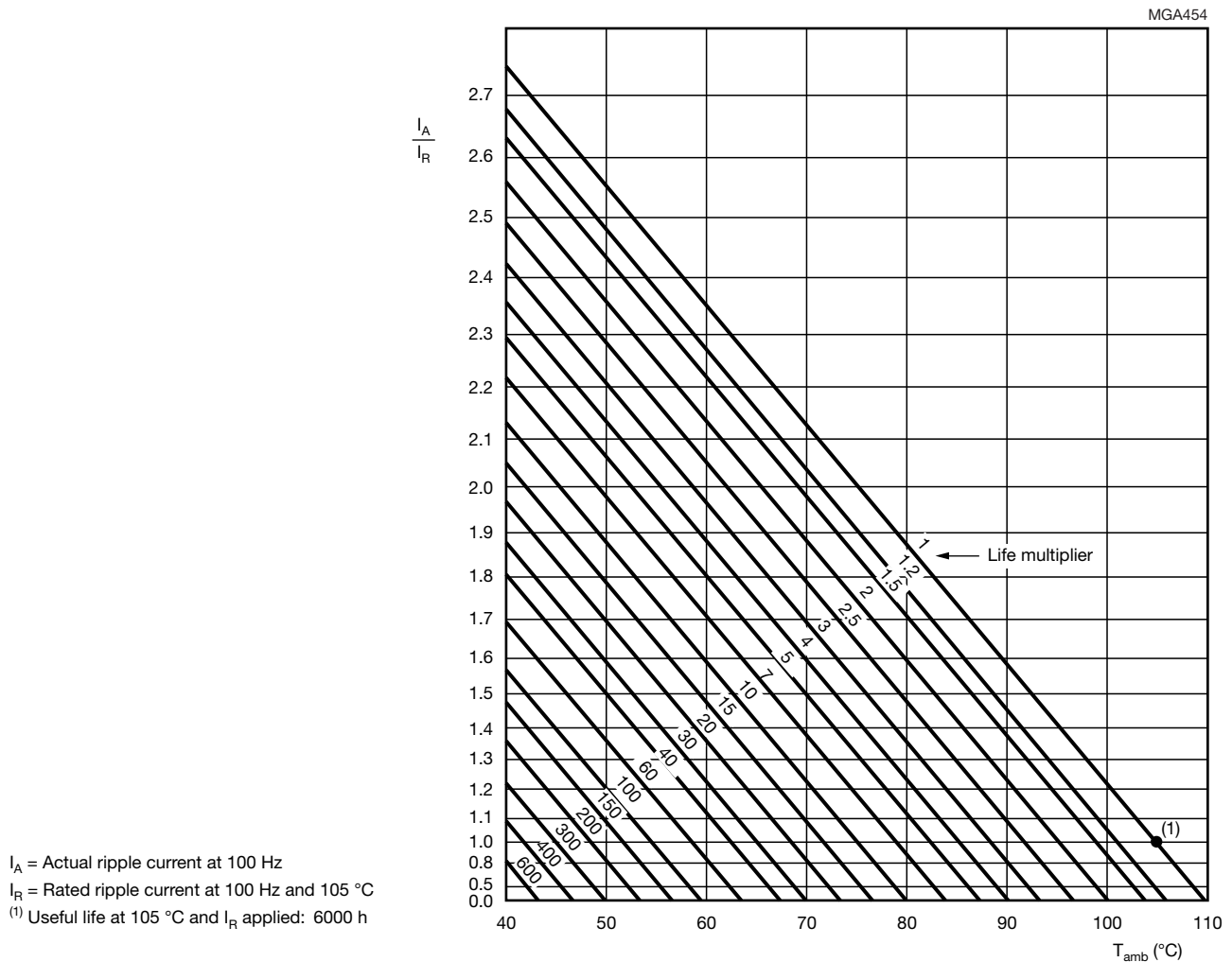


Fig. 6 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 4

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY					
FREQUENCY (Hz)					
50	100	120	200	1000	$\geq 10\ 000$
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	$T_{amb} = 50\text{ }^{\circ}\text{C}$; $U_R = 500\text{ V}$ applied; $T_{amb} = 60\text{ }^{\circ}\text{C}$; $U_R = 570\text{ V}$ applied; 5000 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	$T_{amb} = 105\text{ }^{\circ}\text{C}$; 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	$T_{amb} = 105\text{ }^{\circ}\text{C}$; no voltage applied; 1000 h After test: U_C to be applied for 30 min, 24 h to 48 h before measurement	$\Delta C/C: \pm 15\%$ $ESR \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

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