

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 +60 °C |
| Endurance at U_R , 60 °C, no ripple applied | 6000 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 | - 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



APPLICATIONS

- Solar PV inverters
- Industrial motor control
- Power supply

MARKING

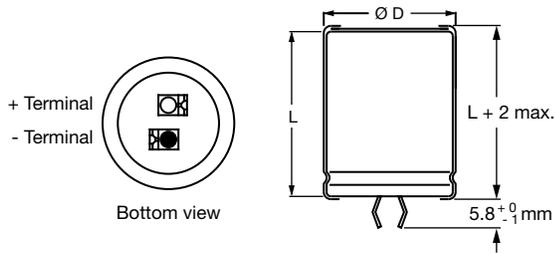
The capacitors are marked (where possible) with the following information:

- 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

| 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 | 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

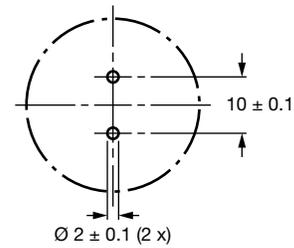
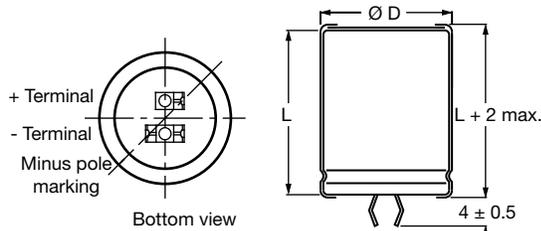


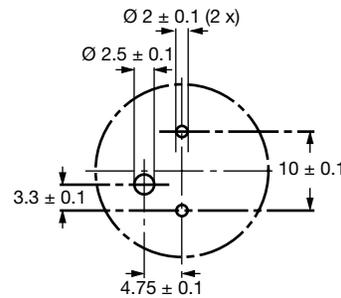
Fig. 3 - Mounting hole diagram

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 _{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_{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 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 5 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 | 0.99 | 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
- ⁽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 5 min at U_C | $I_{L5} \leq 0.01 C_R \times U_C$ |
| 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 , 60 °C, no I_R applied | 6000 h |
| Useful life | U_C , 105 °C, I_R applied | |

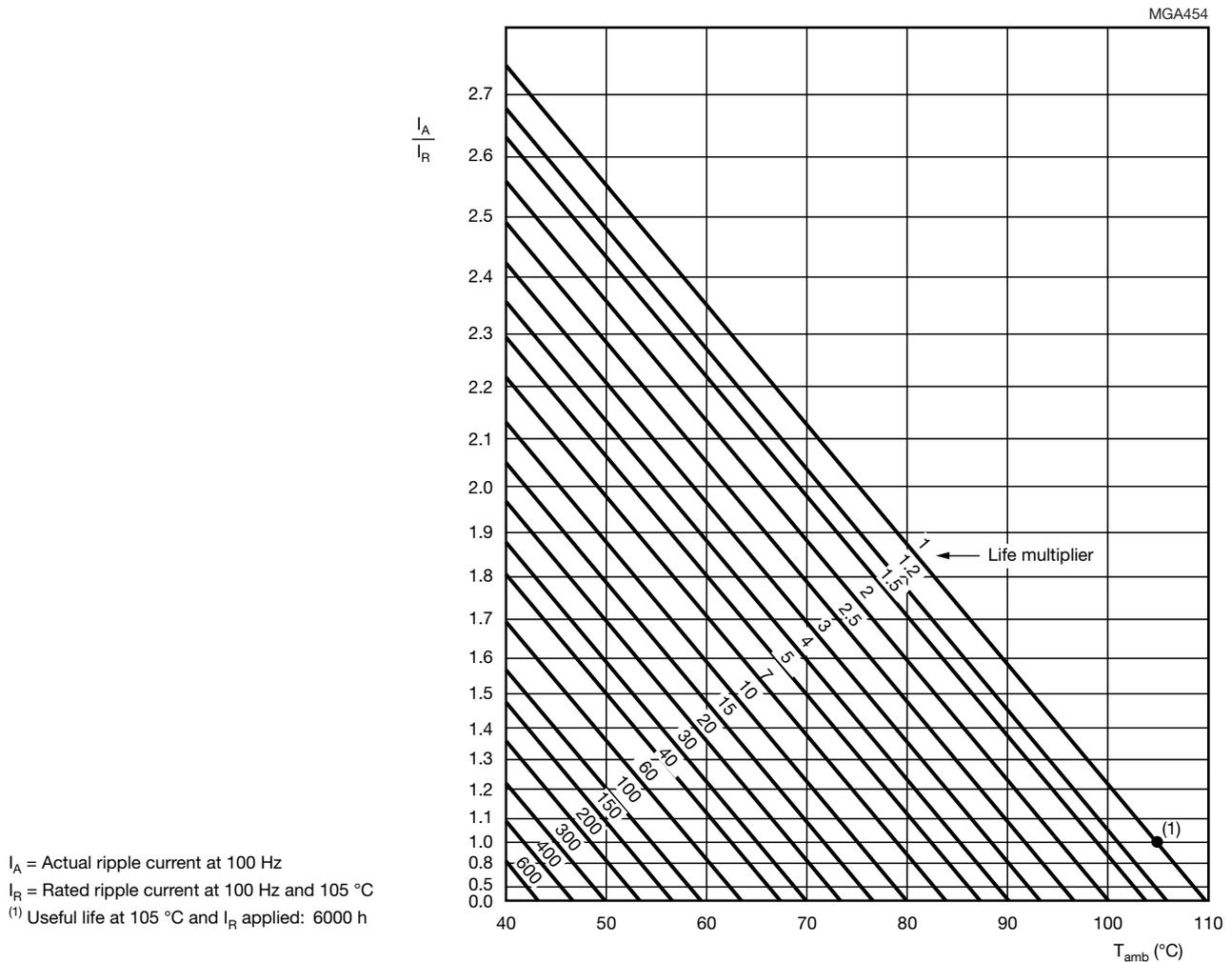


Fig. 6 - Multiplier of useful life as a function of ambient temperature and ripple current load

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 | $T_{amb} = 60\text{ }^{\circ}\text{C}$; 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 | $T_{amb} = 105\text{ }^{\circ}\text{C}$; 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 | $\Delta C/C: \pm 15\%$ $ESR \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$ |

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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