

Aluminum Capacitors Power General Purpose Screw Terminals

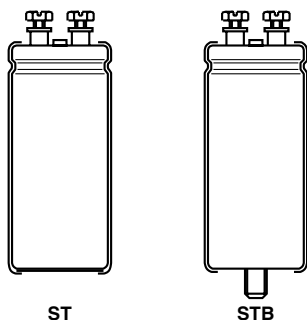


Fig.1 Component outline

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief in the sealing disc
- Efficient design


RoHS
COMPLIANT

APPLICATIONS

- UPS
- Energy storage in medical or industrial pulse systems

MARKING

The capacitors are marked with the following information:

- Rated capacitance (in μF)
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (M for $\pm 20\%$)
- Rated voltage (in V)
- Date code
- Name of manufacturer
- Code for factory of origin
- Code number

QUICK REFERENCE DATA

| DESCRIPTION | VALUE |
|--|---------------------------------|
| | 500 |
| Nominal case size (\varnothing D x L in mm) | 50 x 80 to 90 x 220 |
| Rated capacitance range, C_R | 1000 to 15 000 μF |
| Tolerance on C_R | $\pm 20\%$ |
| Rated voltage range, U_R | 400 to 450 V |
| Category temperature range | - 40 to + 85 $^{\circ}\text{C}$ |
| Endurance test at 85 $^{\circ}\text{C}$ | 2000 hours |
| Useful life at 85 $^{\circ}\text{C}$ | 2000 hours |
| Shelf life at 0 V, 85 $^{\circ}\text{C}$ | 500 hours |
| Based on sectional specification | IEC 60384-4/EN 130300 |
| Climatic category IEC 60068 | 40/085/56 |

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 | 420 | 450 |
| 1000 | 50 x 80 | 50 x 80 | 50 x 80 |
| 1200 | 50 x 80 | 50 x 80 | 50 x 80 |
| 1500 | 50 x 105 | 50 x 105 | 50 x 105 |
| 1800 | 50 x 105 | 50 x 105 | 50 x 105 |
| 2200 | 50 x 105 65 x 105 | 65 x 105 | 65 x 105 |
| 2700 | 65 x 105 | 65 x 105 | 65 x 105 |
| 3300 | 65 x 105 | 65 x 105 | 76 x 105 |
| 3900 | 65 x 105 | 76 x 105 | 76 x 105 |
| 4700 | 76 x 105 | 76 x 114 | 76 x 114 |
| 5600 | 76 x 114 | 76 x 130 | 76 x 146 |
| 6800 | 76 x 146 | 76 x 146 | 90 x 146 |
| 8200 | 90 x 146 | 90 x 146 | 76 x 220 |
| 10 000 | 76 x 220 90 x 146 | 76 x 220 | 76 x 220 |
| 12 000 | 76 x 220 | - | 90 x 220 |
| 15 000 | 90 x 220 | 90 x 220 | - |

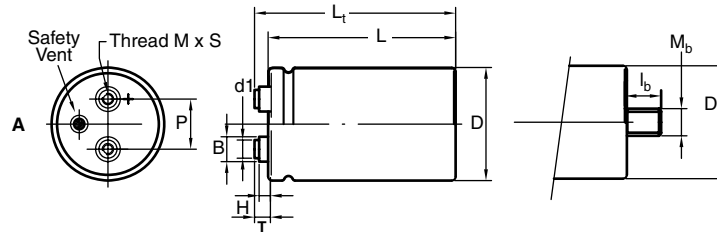
DIMENSIONS in millimeters AND AVAILABLE FORMS


Fig. 2A: Standard M5 disc: screw terminal (ST) and screw terminal bolt nut (STB)

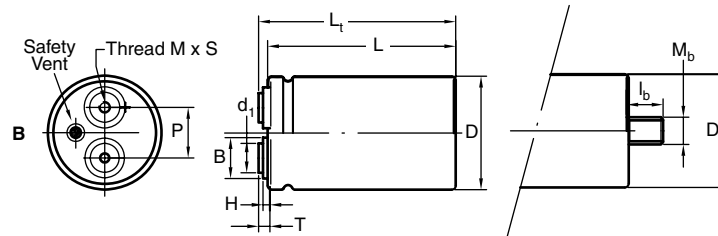


Fig. 2B: High current M6 disc: screw terminal (ST) and screw terminal bolt nut (STB)

Maximum permissible torque which may be applied to the termination screws: 2 Nm for M5; 2.5 Nm for M6
 For accessories refer to datasheet "Mounting Accessories".
 The capacitors are delivered with screws and washers.

Table 1

DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES

| DESIGN | DRAWING | L ± 1 | L _t ± 1 | D ± 1 | P ± 0.3 | T ± 0.2 | H ± 0.3 | B ± 0.3 | d ₁ ± 0.1 | M | S - 0 | M _b | l _b ± 0.1 | MASS (g) | PACKING QTY |
|-------------|---------|-------|--------------------|-------|---------|---------|---------|---------|----------------------|----|-------|----------------|----------------------|----------|-------------|
| 50 x 80 | 2A | 82.8 | 88.8 | 51.0 | 22.2 | 7.1 | 4.8 | 11.0 | 7.9 | M5 | 9.5 | M12 | 16.0 | 200 | 25 |
| 50 x 105 | 2A | 104.8 | 110.8 | 51.0 | 22.2 | 7.1 | 4.8 | 11.0 | 7.9 | M5 | 9.5 | M12 | 16.0 | 300 | 25 |
| 65 x 105 | 2A | 104.8 | 110.7 | 65.0 | 28.5 | 7.0 | 4.6 | 11.9 | 7.9 | M5 | 9.5 | M12 | 16.0 | 480 | 16 |
| 65 x 105 HC | 2B | 104.8 | 109.2 | 65.0 | 28.5 | 5.5 | 3.5 | 18.0 | 13.0 | M6 | 8.5 | M12 | 16.0 | 480 | 16 |
| 76 x 105 | 2A | 105.8 | 111.7 | 76.4 | 31.8 | 7.0 | 4.6 | 11.7 | 7.9 | M5 | 9.5 | M12 | 16.0 | 700 | 12 |
| 76 x 105 HC | 2B | 105.8 | 110.2 | 76.4 | 31.8 | 5.5 | 3.5 | 18.3 | 13.0 | M6 | 8.5 | M12 | 16.0 | 700 | 12 |
| 76 x 114 | 2A | 115.8 | 121.7 | 76.4 | 31.8 | 7.0 | 4.6 | 11.7 | 7.9 | M5 | 9.5 | M12 | 16.0 | 800 | 12 |
| 76 x 114 HC | 2B | 115.8 | 120.2 | 76.4 | 31.8 | 5.5 | 3.5 | 18.3 | 13.0 | M6 | 8.5 | M12 | 16.0 | 800 | 12 |
| 76 x 146 | 2A | 145.8 | 151.7 | 76.4 | 31.8 | 7.0 | 4.6 | 11.7 | 7.9 | M5 | 9.5 | M12 | 16.0 | 1000 | 12 |
| 76 x 146 HC | 2B | 145.8 | 150.2 | 76.4 | 31.8 | 5.5 | 3.5 | 18.3 | 13.0 | M6 | 8.5 | M12 | 16.0 | 1000 | 12 |
| 76 x 220 | 2A | 219.8 | 225.7 | 76.4 | 31.8 | 7.0 | 4.6 | 11.7 | 7.9 | M5 | 9.5 | M12 | 16.0 | 1500 | 10 |
| 76 x 220 HC | 2B | 219.8 | 224.2 | 76.4 | 31.8 | 5.5 | 3.5 | 18.3 | 13.0 | M6 | 8.5 | M12 | 16.0 | 1500 | 10 |
| 90 x 146 HC | 2B | 150.1 | 155.4 | 89.4 | 31.8 | 7.9 | 0.0 | 13.0 | 13.0 | M6 | 10.0 | M12 | 16.0 | 1300 | 10 |
| 90 x 220 HC | 2B | 218.1 | 223.4 | 89.4 | 31.8 | 7.9 | 0.0 | 13.0 | 13.0 | M6 | 10.0 | M12 | 16.0 | 2000 | 10 |

Notes

- For bolt version holds:
- 1. L = L standard - 0.5 mm
- 2. L_t = L_t standard - 0.5 mm

ELECTRICAL DATA

| SYMBOL | DESCRIPTION |
|-----------------|--|
| C _R | rated capacitance at 100 Hz, tolerance ± 20 % |
| I _R | rated RMS ripple current at 100 Hz, 85 °C |
| I _{L5} | max. leakage current after 5 minutes 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 Tables 2 and 3 apply at T_{amb} = 20 °C, P = 86 to 106 kPa, RH = 45 to 75 %

ORDERING EXAMPLE

Electrolytic capacitor 500 series
 4700 µF/400 V; ± 20 %
 Nominal case size: Ø 76 x 105 mm;
 STB version; high post M5 disc
 Ordering code: MAL250056472 E3
 Former 12NC: 222250056472

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 120 Hz 85 °C (A) | I _R 120 Hz 40 °C (A) | I _{L5} 5 min (mA) | ESR max. 120 Hz (mΩ) | Z max. 10 kHz (mΩ) | HIGH POST M5 DISC | | HIGH CURRENT M6 DISC | |
| | | | | | | | | ORDERING CODE ST MAL2500..... | ORDERING CODE STB MAL2500..... | ORDERING CODE ST MAL2500..... | ORDERING CODE STB MAL2500..... |
| 400 | 1000 | 50 x 80 | 4.2 | 11.2 | 0.80 | 125 | 98 | 26102E3 | 66102E3 | - | - |
| | 1200 | 50 x 80 | 4.5 | 12.0 | 0.96 | 107 | 85 | 16122E3 | 56122E3 | - | - |
| | 1500 | 50 x 105 | 5.1 | 14.1 | 1.20 | 86 | 68 | 16152E3 | 56152E3 | - | - |
| | 1800 | 50 x 105 | 5.6 | 15.1 | 1.44 | 73 | 59 | 16182E3 | 56182E3 | - | - |
| | 2200 | 50 x 105 | 6.3 | 17.1 | 1.76 | 58 | 46 | 16222E3 | 56222E3 | - | - |
| | 2200 | 65 x 105 | 7.4 | 19.9 | 1.76 | 58 | 46 | 26222E3 | 66222E3 | 46222E3 | 86222E3 |
| | 2700 | 65 x 105 | 7.9 | 21.5 | 2.16 | 49 | 39 | 16272E3 | 56272E3 | 36272E3 | 76272E3 |
| | 3300 | 65 x 105 | 8.9 | 24.0 | 2.64 | 39 | 31 | 16332E3 | 56332E3 | 36332E3 | 76332E3 |
| | 3900 | 65 x 105 | 9.4 | 25.5 | 3.12 | 34 | 28 | 16392E3 | 56392E3 | 36392E3 | 76392E3 |
| | 4700 | 76 x 105 | 11.1 | 30.0 | 3.76 | 30 | 25 | 16472E3 | 56472E3 | 36472E3 | 76472E3 |
| | 5600 | 76 x 114 | 12.1 | 32.6 | 4.48 | 26 | 21 | 16562E3 | 56562E3 | 36562E3 | 76562E3 |
| | 6800 | 76 x 146 | 13.6 | 36.6 | 5.44 | 21 | 18 | 16682E3 | 56682E3 | 36682E3 | 76682E3 |
| | 8200 | 90 x 146 | 17.7 | 47.7 | 6.56 | 16 | 13 | - | - | 36822E3 | 76822E3 |
| | 10 000 | 76 x 220 | 17.0 | 45.8 | 8.00 | 15 | 12 | 16103E3 | 56103E3 | 36103E3 | 76103E3 |
| | 10 000 | 90 x 146 | 19.3 | 52.2 | 8.00 | 13 | 11 | - | - | 46103E3 | 86103E3 |
| 12 000 | 76 x 220 | 17.8 | 48.1 | 9.60 | 13 | 11 | 16123E3 | 56123E3 | 36123E3 | 76123E3 | |
| 15 000 | 90 x 220 | 23.6 | 63.7 | 12.00 | 9 | 8 | - | - | 36153E3 | 76153E3 | |
| 420 | 1000 | 50 x 80 | 4.3 | 11.5 | 0.84 | 105 | 74 | 14102E3 | 54102E3 | - | - |
| | 1200 | 50 x 80 | 4.6 | 12.4 | 1.01 | 90 | 65 | 14122E3 | 54122E3 | - | - |
| | 1500 | 50 x 105 | 5.3 | 14.4 | 1.26 | 72 | 52 | 14152E3 | 54152E3 | - | - |
| | 1800 | 50 x 105 | 5.7 | 15.3 | 1.52 | 62 | 46 | 14182E3 | 54182E3 | - | - |
| | 2200 | 65 x 105 | 7.5 | 20.4 | 1.85 | 49 | 35 | 14222E3 | 54222E3 | 34222E3 | 74222E3 |
| | 2700 | 65 x 105 | 8.1 | 21.9 | 2.27 | 42 | 31 | 14272E3 | 54272E3 | 34272E3 | 74272E3 |
| | 3300 | 65 x 105 | 9.1 | 24.6 | 2.78 | 33 | 24 | 14332E3 | 54332E3 | 34332E3 | 74332E3 |
| | 3900 | 76 x 105 | 10.7 | 28.8 | 3.28 | 29 | 22 | 14392E3 | 54392E3 | 34392E3 | 74392E3 |
| | 4700 | 76 x 114 | 11.7 | 31.5 | 3.95 | 25 | 19 | 14472E3 | 54472E3 | 34472E3 | 74472E3 |
| | 5600 | 76 x 130 | 12.8 | 34.6 | 4.71 | 21 | 16 | 14562E3 | 54562E3 | 34562E3 | 74562E3 |
| | 6800 | 76 x 146 | 13.8 | 37.2 | 5.72 | 18 | 14 | 14682E3 | 54682E3 | 34682E3 | 74682E3 |
| | 8200 | 90 x 146 | 17.6 | 47.6 | 6.89 | 14 | 10 | - | - | 34822E3 | 74822E3 |
| | 10 000 | 76 x 220 | 17.3 | 46.6 | 8.40 | 13 | 10 | 14103E3 | 54103E3 | 34103E3 | 74103E3 |
| 15 000 | 90 x 220 | 24.1 | 65.0 | 12.60 | 8 | 6 | - | - | 34153E3 | 74153E3 | |
| 450 | 1000 | 50 x 80 | 4.2 | 11.3 | 0.90 | 126 | 88 | 17102E3 | 57102E3 | - | - |
| | 1200 | 50 x 80 | 4.5 | 12.1 | 1.08 | 100 | 76 | 17122E3 | 57122E3 | - | - |
| | 1500 | 50 x 105 | 5.3 | 14.2 | 1.35 | 79 | 61 | 17152E3 | 57152E3 | - | - |
| | 1800 | 50 x 105 | 5.9 | 15.9 | 1.62 | 64 | 48 | 17182E3 | 57182E3 | - | - |
| | 2200 | 65 x 105 | 7.4 | 20.0 | 1.98 | 54 | 41 | 17222E3 | 57222E3 | 37222E3 | 77222E3 |
| | 2700 | 65 x 105 | 8.3 | 22.5 | 2.43 | 43 | 33 | 17272E3 | 57272E3 | 37272E3 | 77272E3 |
| | 3300 | 76 x 105 | 9.9 | 26.8 | 2.97 | 37 | 28 | 17332E3 | 57332E3 | 37332E3 | 77332E3 |
| | 3900 | 76 x 105 | 10.5 | 28.4 | 3.51 | 32 | 25 | 17392E3 | 57392E3 | 37392E3 | 77392E3 |
| | 4700 | 76 x 114 | 11.5 | 31.0 | 4.23 | 28 | 22 | 17472E3 | 57472E3 | 37472E3 | 77472E3 |
| | 5600 | 76 x 146 | 12.8 | 34.6 | 5.04 | 23 | 18 | 17562E3 | 57562E3 | 37562E3 | 77562E3 |
| | 6800 | 90 x 146 | 16.6 | 44.8 | 6.12 | 17 | 13 | - | - | 37682E3 | 77682E3 |
| | 8200 | 76 x 220 | 16.0 | 43.3 | 7.38 | 16 | 13 | 17822E3 | 57822E3 | 37822E3 | 77822E3 |
| | 10 000 | 76 x 220 | 17.0 | 45.8 | 9.00 | 14 | 11 | 17103E3 | 57103E3 | 37103E3 | 77103E3 |
| | 12 000 | 90 x 220 | 22.1 | 59.5 | 10.80 | 10 | 8 | - | - | 37123E3 | 77123E3 |



| ADDITIONAL ELECTRICAL DATA | | |
|------------------------------------|--------------------------|--|
| PARAMETER | CONDITIONS | VALUE |
| Voltage | | |
| Surge voltage | ≥ 400 V versions | $U_s = 1.1 \times U_R$ |
| Reverse voltage | | $U_{rev} \leq 1 \text{ V}$ |
| Current | | |
| Leakage current | After 1 minute at U_R | $I_{L1} \leq 0.006 C_R \times U_R + 4 \mu\text{A}$ |
| | After 5 minutes at U_R | $I_{L5} \leq 0.002 C_R \times U_R + 4 \mu\text{A}$ |
| Inductance | | |
| Equivalent series inductance (ESL) | Case Ø D = 50 mm | typ. 16 nH |
| | Case Ø D = 65 mm | typ. 19 nH |
| | Case Ø D = 76 mm | typ. 20 nH |
| | Case Ø D = 90 mm | typ. 20 nH |

Table 3

| MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY | |
|---|------------------|
| FREQUENCY (Hz) | I_R MULTIPLIER |
| | 500 |
| 60 | 0.70 |
| 100 | 0.95 |
| 120 | 1.00 |
| 500 | 1.20 |
| 1000 | 1.30 |
| ≥ 10 000 | 1.40 |

Table 4

| MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF TEMPERATURE | |
|---|------------------|
| TEMPERATURE (°C) | I_R MULTIPLIER |
| 40 | 2.7 |
| 60 | 2.0 |
| 70 | 1.7 |
| 85 | 1.0 |

Table 5

| TEST PROCEDURES AND REQUIREMENTS | | | |
|--|--|--|--|
| TEST | | PROCEDURE (quick reference) | REQUIREMENTS |
| NAME OF TEST | REFERENCE | | |
| Endurance | IEC 60384-4/ EN130300 subclause 4.13 | $T_{amb} = 85 \text{ °C}$; U_R applied; 2000 hours | $\Delta C/C: \pm 10 \%$ $ESR \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ |
| Useful life | CECC 30301 subclause 1.8.1 | $T_{amb} = 85 \text{ °C}$; U_R and I_R applied; 2000 hours | $\Delta C/C: \pm 30 \%$ $ESR \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $\leq 3 \%$ |
| Shelf life (storage at high temperature) | IEC 60384-4/ EN130300 subclause 4.17 | $T_{amb} = 85 \text{ °C}$; no voltage applied; 500 hours After test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement | $\Delta C/C: \pm 10 \%$ $ESR \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$ |



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