

Aluminum Capacitors

Power Long Life Printed Wiring

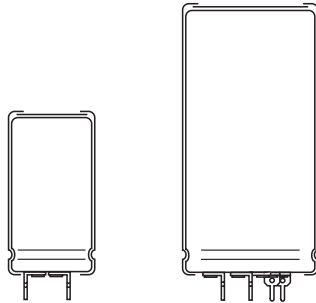
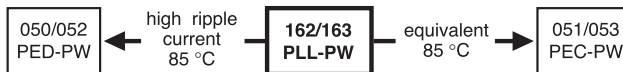


Fig. 1 Component outlines.


FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Provided with keyed polarity
- Very long useful life: 5000 hours at 105 °C
- Low ESR, high ripple current capability
- Temperature range up to 105 °C
- High resistance to shock and vibration.


RoHS*
COMPLIANT

APPLICATIONS

- Computer, telecommunication and industrial systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems.

MARKING

The capacitors are marked (where possible) 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 (YYMM).
- Name of manufacturer.
- Code for factory of origin.
- Polarity of the terminals and '-' sign to indicate the negative terminal, visible from the top and/or side of the capacitor.
- Code number.
- Climatic category in accordance with IEC 60068.

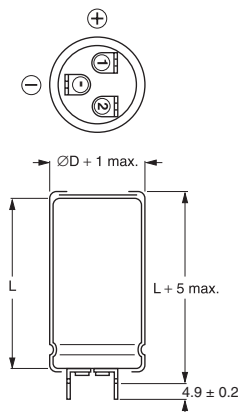
| QUICK REFERENCE DATA | | |
|---|-----------------------------|--------------------------|
| DESCRIPTION | VALUE | |
| | 162 | 163 |
| Nominal case size ($\varnothing D \times L$ in mm) | 25 × 30 to 40 × 100 | |
| Rated capacitance range (E6 series), C_R | 470 to 150000 μF | 68 to 3300 μF |
| Tolerance on C_R | $\pm 20\%$ | |
| Rated voltage range, U_R | 10 to 100 V | 200 to 400 V |
| Category temperature range | -40 to +105 °C | |
| Endurance test at 105 °C | 2000 hours | |
| Useful life at 105 °C | 5000 hours | |
| Useful life at 40 °C, $1.9 \times I_R$ applied | 150000 hours | |
| Shelf life at 0 V, 105 °C | 500 hours | |
| Based on sectional specification | IEC 60384-4/EN130300 | |
| Climatic category IEC 60068 | 40/105/56 | |

| SELECTION CHART FOR C_R , U_R AND RELEVANT NOMINAL CASE SIZES FOR 162 SERIES ($\varnothing D \times L$ in mm) | | | | | | |
|--|-----------|----------|----------|----------|----------|----------|
| C_R (μF) | U_R (V) | | | | | |
| | 10 | 16 | 25 | 40 | 63 | 100 |
| 470 | - | - | - | - | - | 25 × 30 |
| 680 | - | - | - | - | - | 25 × 40 |
| 1000 | - | - | - | - | 25 × 30 | 30 × 40 |
| 1500 | - | - | - | - | 25 × 40 | 35 × 40 |
| 2200 | - | - | - | 25 × 30 | 30 × 40 | 35 × 50 |
| | | | | | | 40 × 40 |
| 3300 | - | - | - | 25 × 40 | 35 × 40 | 40 × 50 |
| 4700 | - | - | 25 × 30 | 30 × 40 | 35 × 50 | 40 × 70 |
| | | | | | 40 × 40 | |
| 6800 | - | 25 × 30 | 25 × 40 | 35 × 40 | 40 × 50 | 40 × 100 |
| 10000 | 25 × 30 | 25 × 40 | 30 × 40 | 35 × 50 | 40 × 70 | - |
| | | | | 40 × 40 | | |
| 15000 | 25 × 40 | 30 × 40 | 35 × 40 | 40 × 50 | 40 × 100 | - |
| 22000 | 30 × 40 | 35 × 40 | 35 × 50 | 40 × 70 | - | - |
| | | | 40 × 40 | | | |
| 33000 | 35 × 40 | 35 × 50 | 40 × 50 | 40 × 100 | - | - |
| | | 40 × 40 | | | | |
| 47000 | 35 × 50 | 40 × 50 | 40 × 70 | - | - | - |
| | 40 × 40 | | | | | |
| 68000 | 40 × 50 | 40 × 70 | 40 × 100 | - | - | - |
| 100000 | 40 × 70 | 40 × 100 | - | - | - | - |
| 150000 | 40 × 100 | - | - | - | - | - |

* Pb containing terminations are not RoHS compliant, exemptions may apply

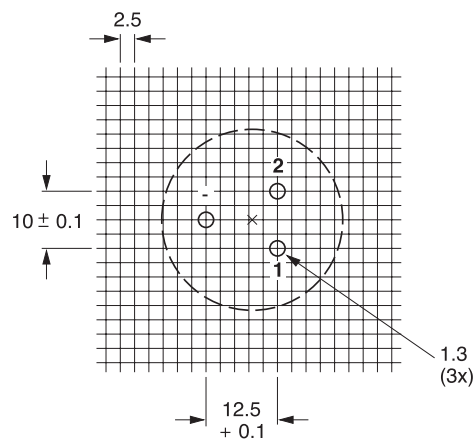
| C _R (μF) | U _R (V) | | | |
|------------------------|--------------------|----------|----------|----------|
| | 200 | 250 | 385 | 400 |
| 68 | – | – | 25 × 30 | 25 × 30 |
| 100 | – | 25 × 30 | 25 × 40 | 25 × 40 |
| 150 | 25 × 30 | 25 × 40 | 30 × 40 | 30 × 40 |
| 220 | 25 × 40 | 30 × 40 | 35 × 40 | 35 × 40 |
| 330 | 30 × 40 | 35 × 40 | 35 × 50 | 35 × 50 |
| | – | – | 40 × 40 | 40 × 40 |
| 470 | 35 × 40 | 35 × 50 | 40 × 50 | 40 × 50 |
| | – | 40 × 40 | – | – |
| 680 | 35 × 50 | 40 × 50 | 40 × 70 | 40 × 70 |
| | 40 × 50 | – | – | – |
| 1000 | 40 × 50 | 40 × 70 | 40 × 100 | 40 × 100 |
| 1500 | 40 × 70 | 40 × 100 | – | – |
| 2200 | 40 × 100 | – | – | – |

DIMENSIONS in millimeters AND AVAILABLE FORMS



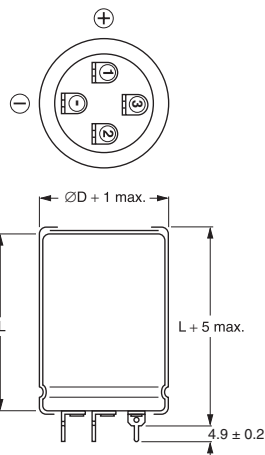
Case ØD = 25 mm.

Fig.2 Printed wiring pin version.



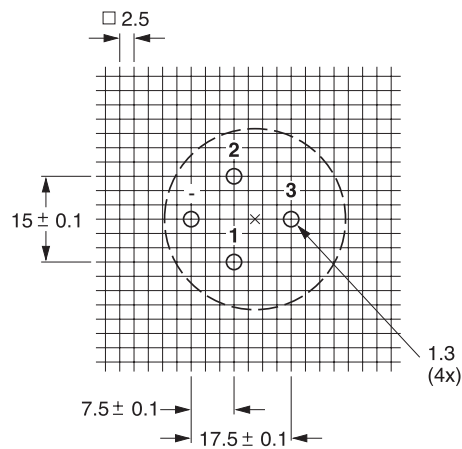
Case ØD = 25 mm.

Fig.3 Mounting hole diagram viewed from component side.



Case ØD = 30 mm.

Fig.4 Printed wiring pin version.



Case ØD = 30 mm.

Fig.5 Mounting hole diagram viewed from component side.

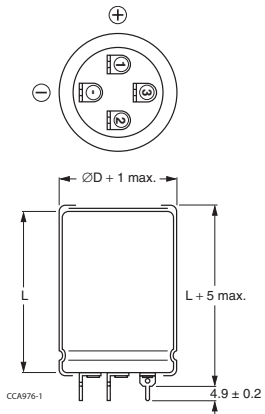

 Case $\varnothing D = 35$ mm.

Fig.6 Printed wiring pin version.

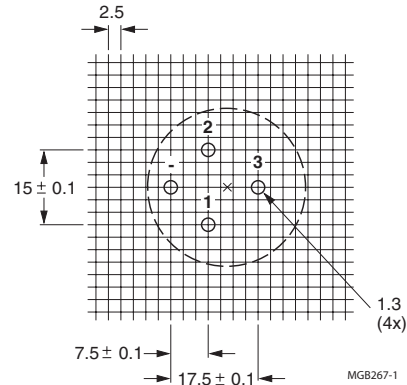

 Case $\varnothing D = 35$ mm.

Fig.7 Mounting hole diagram viewed from component side.

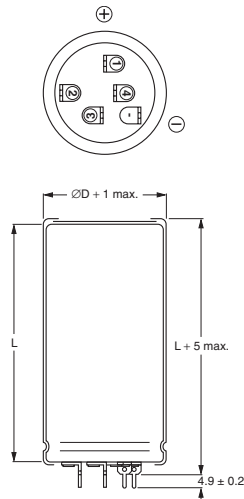

 Case $\varnothing D = 40$ mm.

Fig.8 Printed wiring pin version.

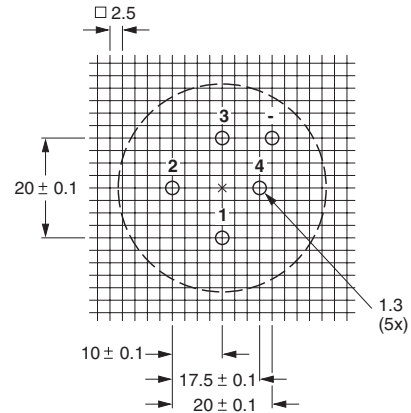

 Case $\varnothing D = 40$ mm.

Fig.9 Mounting hole diagram viewed from component side.

Table 1

| DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES PW versions | | | | | |
|--|-----------------------|-----------|-------------|---|---|
| NOMINAL CASE SIZE $\varnothing D \times L$ | $\varnothing D_{MAX}$ | L_{MAX} | MASS (g) | PACKAGING QUANTITIES (units per box) | CARDBOARD BOX DIMENSIONS $L \times W \times H$ |
| 25 × 30 | 26 | 35 | ≈24 | 100 | 290 × 280 × 50 |
| 25 × 40 | 26 | 45 | ≈28 | 100 | 290 × 280 × 60 |
| 30 × 40 | 31 | 45 | ≈38 | 100 | 340 × 330 × 60 |
| 35 × 40 | 36 | 45 | ≈51 | 50 | 390 × 198 × 60 |
| 35 × 50 | 36 | 55 | ≈66 | 50 | 390 × 198 × 70 |
| 40 × 40 | 41 | 45 | ≈78 | 50 | 440 × 223 × 60 |
| 40 × 50 | 41 | 55 | ≈82 | 50 | 440 × 223 × 70 |
| 40 × 70 | 41 | 75 | ≈110 | 25 | 230 × 230 × 90 |
| 40 × 100 | 41 | 105 | ≈176 | 25 | 230 × 230 × 120 |

MOUNTING

When a number of capacitors are connected in a bank, they must not be closer together than 15 mm, when no derating of ripple current and/or temperature is applied.

Pin numbers 2, 3 and 4 (if present) must be free from the electrical circuit.

| 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 minute at U _R |
| 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 |

ORDERING EXAMPLE*

Electrolytic capacitor 162 series

10000 µF/25 V; ± 20 %

Nominal case size: Ø30 × 40 mm

Catalog number: 2222 162 56103.

* Note: To ensure delivery of lead (Pb)-free parts during the transition period, please contact your Vishay sales agent.

Note

1. 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%.

Table 2

| ELECTRICAL DATA AND ORDERING INFORMATION FOR 162 SERIES | | | | | | | | |
|---|----------------------------------|--|---|----------------------------------|----------------------------------|-----------------------|---------------------|----------------------------------|
| U _R (V) | C _R 100 Hz (µF) | NOMINAL CASE SIZE ØD × L (mm) | I _R 100 Hz 105 °C (A) | I _{L1} 1 min (mA) | I _{L5} 5 min (mA) | ESR 100 Hz (mΩ) | Z 10 kHz (mΩ) | CATALOG NUMBER 2222 |
| 10 | 10000 | 25 × 30 | 3.17 | 0.60 | 0.20 | 48 | 37 | 162 54103 |
| | 15000 | 25 × 40 | 4.21 | 0.90 | 0.30 | 34 | 27 | 162 54153 |
| | 22000 | 30 × 40 | 5.05 | 1.32 | 0.44 | 29 | 23 | 162 54223 |
| | 33000 | 35 × 40 | 5.63 | 1.98 | 0.66 | 27 | 22 | 162 54333 |
| | 47000 | 35 × 50 | 6.19 | 2.82 | 0.94 | 26 | 21 | 162 54473 |
| | 47000 | 40 × 40 | 6.19 | 2.82 | 0.94 | 26 | 21 | 162 44473 |
| | 68000 | 40 × 50 | 7.64 | 4.08 | 1.36 | 21 | 18 | 162 54683 |
| | 100000 | 40 × 70 | 10.0 | 6.00 | 2.00 | 16 | 15 | 162 54104 |
| 150000 | 40 × 100 | 12.9 | 9.00 | 3.00 | 13 | 12 | 162 54154 | |
| 16 | 6800 | 25 × 30 | 3.11 | 0.65 | 0.22 | 50 | 37 | 162 55682 |
| | 10000 | 25 × 40 | 4.09 | 0.96 | 0.32 | 36 | 27 | 162 55103 |
| | 15000 | 30 × 40 | 4.97 | 1.44 | 0.48 | 30 | 23 | 162 55153 |
| | 22000 | 35 × 40 | 5.53 | 2.12 | 0.71 | 29 | 22 | 162 55223 |
| | 33000 | 35 × 50 | 6.08 | 3.17 | 1.06 | 28 | 21 | 162 55333 |
| | 33000 | 40 × 40 | 6.08 | 3.17 | 1.06 | 28 | 21 | 162 45333 |
| | 47000 | 40 × 50 | 7.46 | 4.52 | 1.51 | 22 | 18 | 162 55473 |
| | 68000 | 40 × 70 | 9.70 | 6.53 | 2.18 | 17 | 15 | 162 55683 |
| 100000 | 40 × 100 | 12.90 | 9.60 | 3.20 | 13 | 12 | 162 55104 | |
| 25 | 4700 | 25 × 30 | 2.94 | 0.71 | 0.24 | 56 | 37 | 162 56472 |
| | 6800 | 25 × 40 | 3.93 | 1.02 | 0.34 | 39 | 27 | 162 56682 |
| | 10000 | 30 × 40 | 4.81 | 1.50 | 0.50 | 32 | 23 | 162 56103 |
| | 15000 | 35 × 40 | 5.43 | 2.25 | 0.75 | 30 | 22 | 162 56153 |
| | 22000 | 35 × 50 | 5.98 | 3.30 | 1.10 | 29 | 21 | 162 56223 |
| | 22000 | 40 × 40 | 5.98 | 3.30 | 1.10 | 29 | 21 | 162 46223 |
| | 33000 | 40 × 50 | 7.30 | 4.95 | 1.65 | 23 | 18 | 162 56333 |
| | 47000 | 40 × 70 | 9.43 | 7.05 | 2.35 | 18 | 15 | 162 56473 |
| 68000 | 40 × 100 | 12.44 | 10.20 | 3.40 | 14 | 12 | 162 56683 | |
| 40 | 2200 | 25 × 30 | 2.36 | 0.53 | 0.18 | 87 | 54 | 162 57222 |
| | 3300 | 25 × 40 | 3.17 | 0.79 | 0.27 | 60 | 38 | 162 57332 |
| | 4700 | 30 × 40 | 3.93 | 1.13 | 0.38 | 48 | 33 | 162 57472 |
| | 6800 | 35 × 40 | 4.59 | 1.63 | 0.55 | 42 | 31 | 162 57682 |
| | 10000 | 35 × 50 | 5.03 | 2.40 | 0.80 | 41 | 29 | 162 57103 |
| | 10000 | 40 × 40 | 5.03 | 2.40 | 0.80 | 41 | 29 | 162 47103 |
| | 15000 | 40 × 50 | 6.09 | 3.60 | 1.20 | 33 | 24 | 162 57153 |
| | 22000 | 40 × 70 | 8.34 | 5.28 | 1.76 | 23 | 18 | 162 57223 |
| 33000 | 40 × 100 | 10.97 | 7.92 | 2.64 | 18 | 15 | 162 57333 | |
| 63 | 1000 | 25 × 30 | 1.55 | 0.38 | 0.13 | 202 | 155 | 162 58102 |
| | 1500 | 25 × 40 | 2.10 | 0.57 | 0.19 | 137 | 109 | 162 58152 |
| | 2200 | 30 × 40 | 2.72 | 0.83 | 0.28 | 100 | 79 | 162 58222 |
| | 3300 | 35 × 40 | 3.44 | 1.25 | 0.42 | 75 | 61 | 162 58332 |
| | 4700 | 35 × 50 | 4.09 | 1.78 | 0.60 | 62 | 53 | 162 58472 |
| | 4700 | 40 × 40 | 4.09 | 1.78 | 0.60 | 62 | 53 | 162 48472 |
| | 6800 | 40 × 50 | 5.10 | 2.57 | 0.86 | 47 | 40 | 162 58682 |
| | 10000 | 40 × 70 | 6.86 | 3.78 | 1.26 | 34 | 29 | 162 58103 |
| 15000 | 40 × 100 | 9.31 | 5.67 | 1.89 | 25 | 21 | 162 58153 | |
| 100 | 470 | 25 × 30 | 1.42 | 0.28 | 0.10 | 240 | 155 | 162 59471 |
| | 680 | 25 × 40 | 1.90 | 0.41 | 0.14 | 167 | 109 | 162 59681 |
| | 1000 | 30 × 40 | 2.48 | 0.60 | 0.20 | 120 | 79 | 162 59102 |
| | 1500 | 35 × 40 | 3.17 | 0.90 | 0.30 | 88 | 61 | 162 59152 |
| | 2200 | 35 × 50 | 3.79 | 1.32 | 0.44 | 72 | 53 | 162 59222 |
| | 2200 | 40 × 40 | 3.79 | 1.32 | 0.44 | 72 | 53 | 162 49222 |
| | 3300 | 40 × 50 | 4.81 | 1.98 | 0.66 | 53 | 40 | 162 59332 |
| | 4700 | 40 × 70 | 6.49 | 2.82 | 0.94 | 38 | 29 | 162 59472 |
| 6800 | 40 × 100 | 8.80 | 4.08 | 1.36 | 28 | 21 | 162 59682 | |



Table 3

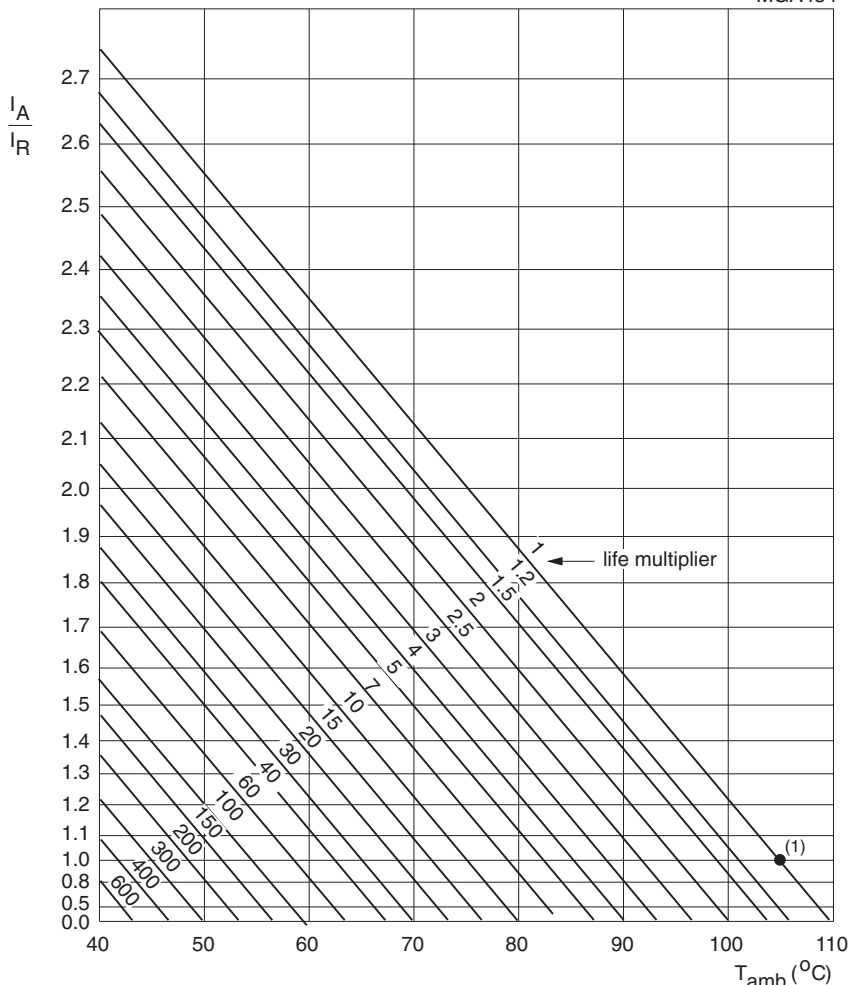
| ELECTRICAL DATA AND ORDERING INFORMATION FOR 163 SERIES | | | | | | | | |
|---|----------------------------------|--|---|----------------------------------|----------------------------------|-----------------------|---------------------|----------------------------------|
| U _R (V) | C _R 100 Hz (MF) | NOMINAL CASE SIZE ØD × L (mm) | I _R 100 Hz 105 °C (A) | I _{L1} 1 min (mA) | I _{L5} 5 min (mA) | ESR 100 Hz (mΩ) | Z 10 kHz (mΩ) | CATALOG NUMBER 2222 |
| 200 | 150 | 25 × 30 | 0.72 | 0.18 | 0.06 | 950 | 710 | 163 52151 |
| | 220 | 25 × 40 | 0.96 | 0.26 | 0.09 | 650 | 485 | 163 52221 |
| | 330 | 30 × 40 | 1.29 | 0.40 | 0.14 | 442 | 330 | 163 52331 |
| | 470 | 35 × 40 | 1.66 | 0.57 | 0.19 | 321 | 240 | 163 52471 |
| | 680 | 35 × 50 | 2.09 | 0.82 | 0.28 | 237 | 185 | 163 52681 |
| | 680 | 40 × 40 | 2.09 | 0.82 | 0.28 | 237 | 185 | 163 42681 |
| | 1000 | 40 × 50 | 2.71 | 1.20 | 0.40 | 167 | 133 | 163 52102 |
| | 1500 | 40 × 70 | 3.75 | 1.80 | 0.60 | 114 | 90 | 163 52152 |
| 250 | 2200 | 40 × 100 | 5.24 | 2.64 | 0.88 | 79 | 62 | 163 52222 |
| | 100 | 25 × 30 | 0.67 | 0.15 | 0.05 | 1060 | 710 | 163 53101 |
| | 150 | 25 × 40 | 0.92 | 0.22 | 0.08 | 710 | 485 | 163 53151 |
| | 220 | 30 × 40 | 1.28 | 0.33 | 0.11 | 492 | 330 | 163 53221 |
| | 330 | 35 × 40 | 1.65 | 0.49 | 0.17 | 325 | 240 | 163 53331 |
| | 470 | 35 × 50 | 2.01 | 0.70 | 0.24 | 256 | 185 | 163 53471 |
| | 470 | 40 × 40 | 2.01 | 0.70 | 0.24 | 256 | 185 | 163 43471 |
| | 680 | 40 × 50 | 2.59 | 1.02 | 0.34 | 182 | 133 | 163 53681 |
| 385 | 1000 | 40 × 70 | 3.58 | 1.50 | 0.50 | 125 | 90 | 163 53102 |
| | 1500 | 40 × 100 | 5.05 | 2.25 | 0.75 | 85 | 62 | 163 53152 |
| | 68 | 25 × 30 | 0.61 | 0.16 | 0.06 | 1650 | 1260 | 163 58689 |
| | 100 | 25 × 40 | 0.82 | 0.23 | 0.08 | 1120 | 855 | 163 58101 |
| | 150 | 30 × 40 | 1.10 | 0.35 | 0.12 | 755 | 580 | 163 58151 |
| | 220 | 35 × 40 | 1.44 | 0.51 | 0.17 | 525 | 405 | 163 58221 |
| | 330 | 35 × 50 | 1.84 | 0.77 | 0.26 | 360 | 280 | 163 58331 |
| | 330 | 40 × 40 | 1.84 | 0.77 | 0.26 | 360 | 280 | 163 48331 |
| 400 | 470 | 40 × 50 | 2.37 | 1.09 | 0.36 | 260 | 205 | 163 58471 |
| | 680 | 40 × 70 | 3.24 | 1.58 | 0.53 | 180 | 140 | 163 58681 |
| | 1000 | 40 × 100 | 4.54 | 2.31 | 0.78 | 125 | 100 | 163 58102 |
| | 68 | 25 × 30 | 0.39 | 0.16 | 0.06 | 3200 | 2660 | 163 56689 |
| | 100 | 25 × 40 | 0.53 | 0.24 | 0.08 | 2180 | 1810 | 163 56101 |
| | 150 | 30 × 40 | 0.72 | 0.36 | 0.12 | 1460 | 1210 | 163 56151 |
| | 220 | 35 × 40 | 0.94 | 0.52 | 0.17 | 1010 | 830 | 163 56221 |
| | 330 | 35 × 50 | 1.24 | 0.79 | 0.26 | 680 | 570 | 163 56331 |
| 400 | 330 | 40 × 40 | 1.24 | 0.79 | 0.26 | 680 | 570 | 163 46331 |
| | 470 | 40 × 50 | 1.59 | 1.12 | 0.37 | 485 | 407 | 163 56471 |
| | 680 | 40 × 70 | 2.18 | 1.63 | 0.54 | 336 | 282 | 163 56681 |
| | 1000 | 40 × 100 | 3.07 | 2.40 | 0.80 | 230 | 193 | 163 56102 |

| ADDITIONAL ELECTRICAL DATA | | |
|------------------------------------|-----------------------------------|--|
| PARAMETER | CONDITIONS | VALUE |
| Voltage | | |
| Surge voltage | ≤ 200 V versions | U _s = 1.15 × U _R |
| | ≥ 385 V versions | U _s = 1.1 × U _R |
| Reverse voltage | | U _{rev} ≤ 1 V |
| Current | | |
| Leakage current | after 1 minute at U _R | I _{L1} ≤ 0.006 C _R × U _R + 4 μA |
| | after 5 minutes at U _R | I _{L5} ≤ 0.002 C _R × U _R + 4 μA |
| Inductance | | |
| Equivalent series inductance (ESL) | case ØD = 25 mm | max. 25 nH |
| | case ØD = 30 and 35 mm | max. 30 nH |
| | case ØD = 40 mm | max. 35 nH |



RIPPLE CURRENT AND USEFUL LIFE

MGA454



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 hours.

Fig.10 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) | I_R MULTIPLIER | | |
| | $U_R = 10 \text{ to } 25 \text{ V}$ | $U_R = 40 \text{ to } 100 \text{ V}$ | $U_R = 200 \text{ to } 400 \text{ V}$ |
| 50 | 0.93 | 0.91 | 0.86 |
| 100 | 1.00 | 1.00 | 1.00 |
| 200 | 1.04 | 1.05 | 1.13 |
| 400 | 1.07 | 1.09 | 1.21 |
| 1000 | 1.11 | 1.13 | 1.29 |
| 2000 | 1.13 | 1.15 | 1.32 |
| 4000 | 1.15 | 1.18 | 1.35 |
| ≥ 10000 | 1.18 | 1.22 | 1.40 |



Table 5

| TEST PROCEDURES AND REQUIREMENT | | | |
|--|--|--|---|
| TEST | | PROCEDURE (quick reference) | REQUIREMENTS |
| NAME OF TEST | REFERENCE | | |
| Endurance | IEC 60384-4/ EN130300 subclause 4.13 | $T_{amb} = 105\text{ °C}$; U_R applied; 2000 hours | $U_R \leq 100\text{ V}$; $\Delta C/C$: $\pm 15\%$ $U_R > 100\text{ V}$; $\Delta C/C$: $\pm 10\%$ $ESR \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ |
| Useful life | CECC 30301 subclause 1.8.1 | $T_{amb} = 105\text{ °C}$; U_R and I_R applied; 5000 hours | $U_R \leq 100\text{ V}$; $\Delta C/C$: $\pm 45\%$ $U_R > 100\text{ V}$; $\Delta C/C$: $\pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $U_R \leq 100\text{ V}$: $\leq 1\%$; $U_R > 100\text{ V}$: $\leq 3\%$ |
| Shelf life (storage at high temperature) | IEC 60384-4/ EN130300 subclause 4.17 | $T_{amb} = 105\text{ °C}$; 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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