

## Aluminum Capacitors Power Long Life Printed Wiring

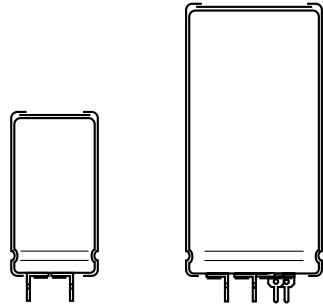
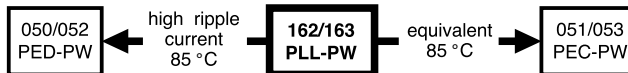


Fig.1 Component outlines


**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  $\mu\text{F}$ )
- 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**

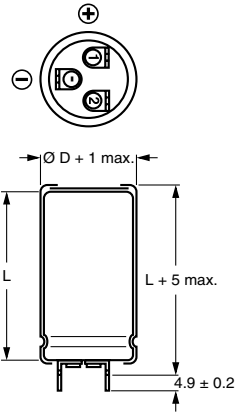
| DESCRIPTION                                    | VALUE                        |                          |
|--|------------------------------|--------------------------|
|  | 162                          | 163                      |
| Nominal case size ( $\varnothing$ D x L in mm) | 25 x 30 to 40 x 100          |                          |
| Rated capacitance range (E6 series), $C_R$     | 470 to 150 000 $\mu\text{F}$ | 68 to 3300 $\mu\text{F}$ |
| 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 | 150 000 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 x L in mm)**

| $C_R$<br>( $\mu\text{F}$ ) | $U_R$ (V) |          |          |          |          |          |
|----------------------------|-----------|----------|----------|----------|----------|----------|
|                            | 10        | 16       | 25       | 40       | 63       | 100      |
| 470                        | -         | -        | -        | -        | -        | 25 x 30  |
| 680                        | -         | -        | -        | -        | -        | 25 x 40  |
| 1000                       | -         | -        | -        | -        | 25 x 30  | 30 x 40  |
| 1500                       | -         | -        | -        | -        | 25 x 40  | 35 x 40  |
| 2200                       | -         | -        | -        | 25 x 30  | 30 x 40  | 35 x 50  |
| 3300                       | -         | -        | -        | 25 x 40  | 35 x 40  | 40 x 40  |
| 4700                       | -         | -        | 25 x 30  | 30 x 40  | 35 x 50  | 40 x 70  |
| 6800                       | -         | 25 x 30  | 25 x 40  | 35 x 40  | 40 x 50  | 40 x 100 |
| 10 000                     | 25 x 30   | 25 x 40  | 30 x 40  | 35 x 50  | 40 x 70  | -        |
| 15 000                     | 25 x 40   | 30 x 40  | 35 x 40  | 40 x 50  | 40 x 100 | -        |
| 22 000                     | 30 x 40   | 35 x 40  | 35 x 50  | 40 x 70  | -        | -        |
| 33 000                     | 35 x 40   | 35 x 50  | 40 x 50  | 40 x 100 | -        | -        |
| 47 000                     | 35 x 50   | 40 x 50  | 40 x 70  | -        | -        | -        |
| 68 000                     | 40 x 50   | 40 x 70  | 40 x 100 | -        | -        | -        |
| 100 000                    | 40 x 70   | 40 x 100 | -        | -        | -        | -        |
| 150 000                    | 40 x 100  | -        | -        | -        | -        | -        |

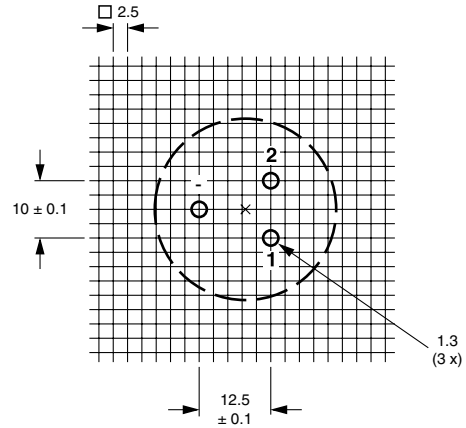
| C <sub>R</sub><br>(μF) | U <sub>R</sub> (V) |          |          |          |
|------------------------|--------------------|----------|----------|----------|
|                        | 200                | 250      | 385      | 400      |
| 68                     | -                  | -        | 25 x 30  | 25 x 30  |
| 100                    | -                  | 25 x 30  | 25 x 40  | 25 x 40  |
| 150                    | 25 x 30            | 25 x 40  | 30 x 40  | 30 x 40  |
| 220                    | 25 x 40            | 30 x 40  | 35 x 40  | 35 x 40  |
| 330                    | 30 x 40            | 35 x 40  | 35 x 50  | 35 x 50  |
|                        | -                  | -        | 40 x 40  | 40 x 40  |
| 470                    | 35 x 40            | 35 x 50  | 40 x 50  | 40 x 50  |
|                        | -                  | 40 x 40  | -        | -        |
| 680                    | 35 x 50            | 40 x 50  | 40 x 70  | 40 x 70  |
|                        | 40 x 50            | -        | -        | -        |
| 1000                   | 40 x 50            | 40 x 70  | 40 x 100 | 40 x 100 |
| 1500                   | 40 x 70            | 40 x 100 | -        | -        |
| 2200                   | 40 x 100           | -        | -        | -        |

**DIMENSIONS** in millimeters **AND AVAILABLE FORMS**



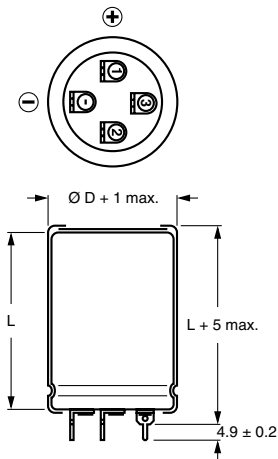
Case Ø D = 25 mm

Fig.2 Printed wiring pin version



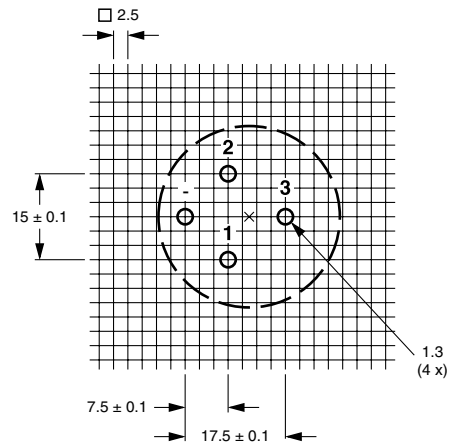
Case Ø D = 25 mm

Fig.3 Mounting hole diagram viewed from component side



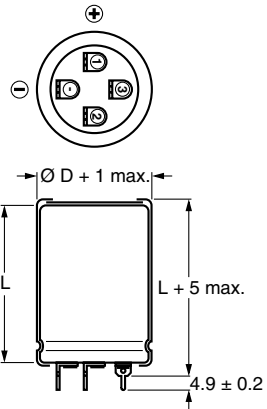
Case Ø D = 30 mm

Fig.4 Printed wiring pin version



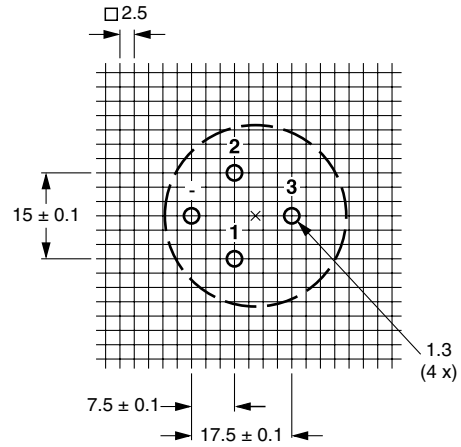
Case Ø D = 30 mm

Fig.5 Mounting hole diagram viewed from component side



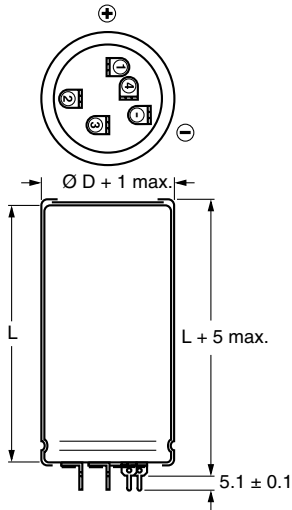
Case  $\varnothing D = 35 \text{ mm}$

Fig.6 Printed wiring pin version



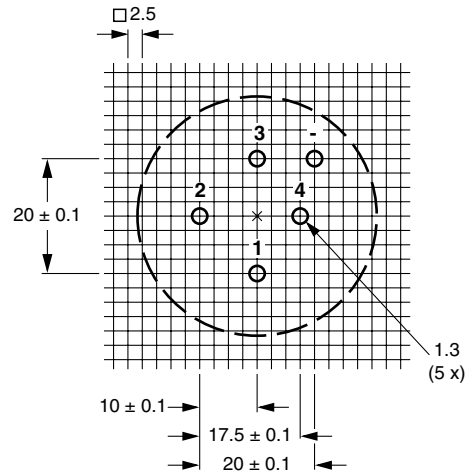
Case  $\varnothing D = 35 \text{ mm}$

Fig.7 Mounting hole diagram viewed from component side



Case  $\varnothing D = 40 \text{ mm}$

Fig.8 Printed wiring pin version



Case  $\varnothing D = 40 \text{ mm}$

Fig.9 Mounting hole diagram viewed from component side

Table 1

| DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES PW versions |                               |                   |             |   |   |
|--|-------------------------------|-------------------|-------------|---|---|
| NOMINAL CASE SIZE<br>$\varnothing D \times L$                        | $\varnothing D_{\text{max.}}$ | $L_{\text{max.}}$ | MASS<br>(g) | PACKAGING QUANTITIES<br>(units per box) | CARDBOARD BOX DIMENSIONS<br>$L \times W \times H$ |
| 25 x 30  | 26                            | 35                | ≈ 24        | 100                                     | 290 x 280 x 50                                    |
| 25 x 40  | 26                            | 45                | ≈ 28        | 100                                     | 290 x 280 x 60                                    |
| 30 x 40  | 31                            | 45                | ≈ 38        | 100                                     | 340 x 330 x 60                                    |
| 35 x 40  | 36                            | 45                | ≈ 51        | 50                                      | 390 x 198 x 60                                    |
| 35 x 50  | 36                            | 55                | ≈ 66        | 50                                      | 390 x 198 x 70                                    |
| 40 x 40  | 41                            | 45                | ≈ 78        | 50                                      | 440 x 223 x 60                                    |
| 40 x 50  | 41                            | 55                | ≈ 82        | 50                                      | 440 x 223 x 70                                    |
| 40 x 70  | 41                            | 75                | ≈ 110       | 25                                      | 230 x 230 x 90                                    |
| 40 x 100   | 41                            | 105               | ≈ 176       | 25                                      | 230 x 230 x 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  
 10 000  $\mu$ F/25 V;  $\pm$  20 %  
 Nominal case size:  $\varnothing$  30 x 40 mm  
 Ordering code: MAL2 16256103E3  
 Former 12NC: 2222 16256103

#### 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 |                               |  |                                  |                           |                           |                                |                              |                               |
|---|-------------------------------|--|----------------------------------|---------------------------|---------------------------|--------------------------------|------------------------------|-------------------------------|
| $U_R$<br>(V)  | $C_R$<br>100 Hz<br>( $\mu$ F) | NOMINAL<br>CASE SIZE<br>$\varnothing$ D x L (mm) | $I_R$<br>100 Hz<br>105 °C<br>(A) | $I_{L1}$<br>1 min<br>(mA) | $I_{L5}$<br>5 min<br>(mA) | ESR<br>100 Hz<br>(m $\Omega$ ) | Z<br>10 kHz<br>(m $\Omega$ ) | ORDERING CODE<br>MAL2162..... |
| 10  | 10 000                        | 25 x 30  | 3.17                             | 0.60                      | 0.20                      | 48                             | 37                           | 54103E3                       |
|   | 15 000                        | 25 x 40  | 4.21                             | 0.90                      | 0.30                      | 34                             | 27                           | 54153E3                       |
|   | 22 000                        | 30 x 40  | 5.05                             | 1.32                      | 0.44                      | 29                             | 23                           | 54223E3                       |
|   | 33 000                        | 35 x 40  | 5.63                             | 1.98                      | 0.66                      | 27                             | 22                           | 54333E3                       |
|   | 47 000                        | 35 x 50  | 6.19                             | 2.82                      | 0.94                      | 26                             | 21                           | 54473E3                       |
|   | 47 000                        | 40 x 40  | 6.19                             | 2.82                      | 0.94                      | 26                             | 21                           | 44473E3                       |
|   | 68 000                        | 40 x 50  | 7.64                             | 4.08                      | 1.36                      | 21                             | 18                           | 54683E3                       |
|   | 100 000                       | 40 x 70  | 10.0                             | 6.00                      | 2.00                      | 16                             | 15                           | 54104E3                       |
|   | 150 000                       | 40 x 100   | 12.9                             | 9.00                      | 3.00                      | 13                             | 12                           | 54154E3                       |
| 16  | 6800                          | 25 x 30  | 3.11                             | 0.65                      | 0.22                      | 50                             | 37                           | 55682E3                       |
|   | 10 000                        | 25 x 40  | 4.09                             | 0.96                      | 0.32                      | 36                             | 27                           | 55103E3                       |
|   | 15 000                        | 30 x 40  | 4.97                             | 1.44                      | 0.48                      | 30                             | 23                           | 55153E3                       |
|   | 22 000                        | 35 x 40  | 5.53                             | 2.12                      | 0.71                      | 29                             | 22                           | 55223E3                       |
|   | 33 000                        | 35 x 50  | 6.08                             | 3.17                      | 1.06                      | 28                             | 21                           | 55333E3                       |
|   | 33 000                        | 40 x 40  | 6.08                             | 3.17                      | 1.06                      | 28                             | 21                           | 45333E3                       |
|   | 47 000                        | 40 x 50  | 7.46                             | 4.52                      | 1.51                      | 22                             | 18                           | 55473E3                       |
|   | 68 000                        | 40 x 70  | 9.70                             | 6.53                      | 2.18                      | 17                             | 15                           | 55683E3                       |
|   | 100 000                       | 40 x 100   | 12.90                            | 9.60                      | 3.20                      | 13                             | 12                           | 55104E3                       |
| 25  | 4700                          | 25 x 30  | 2.94                             | 0.71                      | 0.24                      | 56                             | 37                           | 56472E3                       |
|   | 6800                          | 25 x 40  | 3.93                             | 1.02                      | 0.34                      | 39                             | 27                           | 56682E3                       |
|   | 10 000                        | 30 x 40  | 4.81                             | 1.50                      | 0.50                      | 32                             | 23                           | 56103E3                       |
|   | 15 000                        | 35 x 40  | 5.43                             | 2.25                      | 0.75                      | 30                             | 22                           | 56153E3                       |
|   | 22 000                        | 35 x 50  | 5.98                             | 3.30                      | 1.10                      | 29                             | 21                           | 56223E3                       |
|   | 22 000                        | 40 x 40  | 5.98                             | 3.30                      | 1.10                      | 29                             | 21                           | 46223E3                       |
|   | 33 000                        | 40 x 40  | 5.98                             | 3.30                      | 1.10                      | 29                             | 21                           | 56533E3                       |
|   | 47 000                        | 40 x 70  | 9.43                             | 7.05                      | 2.35                      | 18                             | 15                           | 56473E3                       |
|   | 68 000                        | 40 x 100   | 12.44                            | 10.20                     | 3.40                      | 14                             | 12                           | 56683E3                       |
| 40  | 2200                          | 25 x 30  | 2.36                             | 0.53                      | 0.18                      | 87                             | 54                           | 57222E3                       |
|   | 3300                          | 25 x 40  | 3.17                             | 0.79                      | 0.27                      | 60                             | 38                           | 57332E3                       |
|   | 4700                          | 30 x 40  | 3.93                             | 1.13                      | 0.38                      | 48                             | 33                           | 57472E3                       |
|   | 6800                          | 35 x 40  | 4.59                             | 1.63                      | 0.55                      | 42                             | 31                           | 57682E3                       |
|   | 10 000                        | 35 x 50  | 5.03                             | 2.40                      | 0.80                      | 41                             | 29                           | 57103E3                       |
|   | 10 000                        | 40 x 40  | 5.03                             | 2.40                      | 0.80                      | 41                             | 29                           | 47103E3                       |
|   | 15 000                        | 40 x 50  | 6.09                             | 3.60                      | 1.20                      | 33                             | 24                           | 57153E3                       |
|   | 22 000                        | 40 x 70  | 8.34                             | 5.28                      | 1.76                      | 23                             | 18                           | 57223E3                       |
|   | 33 000                        | 40 x 100   | 10.97                            | 7.92                      | 2.64                      | 18                             | 15                           | 57333E3                       |
| 63  | 1000                          | 25 x 30  | 1.55                             | 0.38                      | 0.13                      | 202                            | 155                          | 58102E3                       |
|   | 1500                          | 25 x 40  | 2.10                             | 0.57                      | 0.19                      | 137                            | 109                          | 58152E3                       |
|   | 2200                          | 30 x 40  | 2.72                             | 0.83                      | 0.28                      | 100                            | 79                           | 58222E3                       |
|   | 3300                          | 35 x 40  | 3.44                             | 1.25                      | 0.42                      | 75                             | 61                           | 58332E3                       |
|   | 4700                          | 35 x 50  | 4.09                             | 1.78                      | 0.60                      | 62                             | 53                           | 58472E3                       |
|   | 4700                          | 40 x 40  | 4.09                             | 1.78                      | 0.60                      | 62                             | 53                           | 48472E3                       |
|   | 6800                          | 40 x 50  | 5.10                             | 2.57                      | 0.86                      | 47                             | 40                           | 58682E3                       |
|   | 10 000                        | 40 x 70  | 6.86                             | 3.78                      | 1.26                      | 34                             | 29                           | 58103E3                       |
|   | 15 000                        | 40 x 100   | 9.31                             | 5.67                      | 1.89                      | 25                             | 21                           | 58153E3                       |
| 100   | 470                           | 25 x 30  | 1.42                             | 0.28                      | 0.10                      | 240                            | 155                          | 59471E3                       |
|   | 680                           | 25 x 40  | 1.90                             | 0.41                      | 0.14                      | 167                            | 109                          | 59681E3                       |
|   | 1000                          | 30 x 40  | 2.48                             | 0.60                      | 0.20                      | 120                            | 79                           | 59102E3                       |
|   | 1500                          | 35 x 40  | 3.17                             | 0.90                      | 0.30                      | 88                             | 61                           | 59152E3                       |
|   | 2200                          | 35 x 50  | 3.79                             | 1.32                      | 0.44                      | 72                             | 53                           | 59222E3                       |
|   | 2200                          | 40 x 40  | 3.79                             | 1.32                      | 0.44                      | 72                             | 53                           | 49222E3                       |
|   | 3300                          | 40 x 50  | 4.81                             | 1.98                      | 0.66                      | 53                             | 40                           | 59332E3                       |
|   | 4700                          | 40 x 70  | 6.49                             | 2.82                      | 0.94                      | 38                             | 29                           | 59472E3                       |
|   | 6800                          | 40 x 100   | 8.80                             | 4.08                      | 1.36                      | 28                             | 21                           | 59682E3                       |



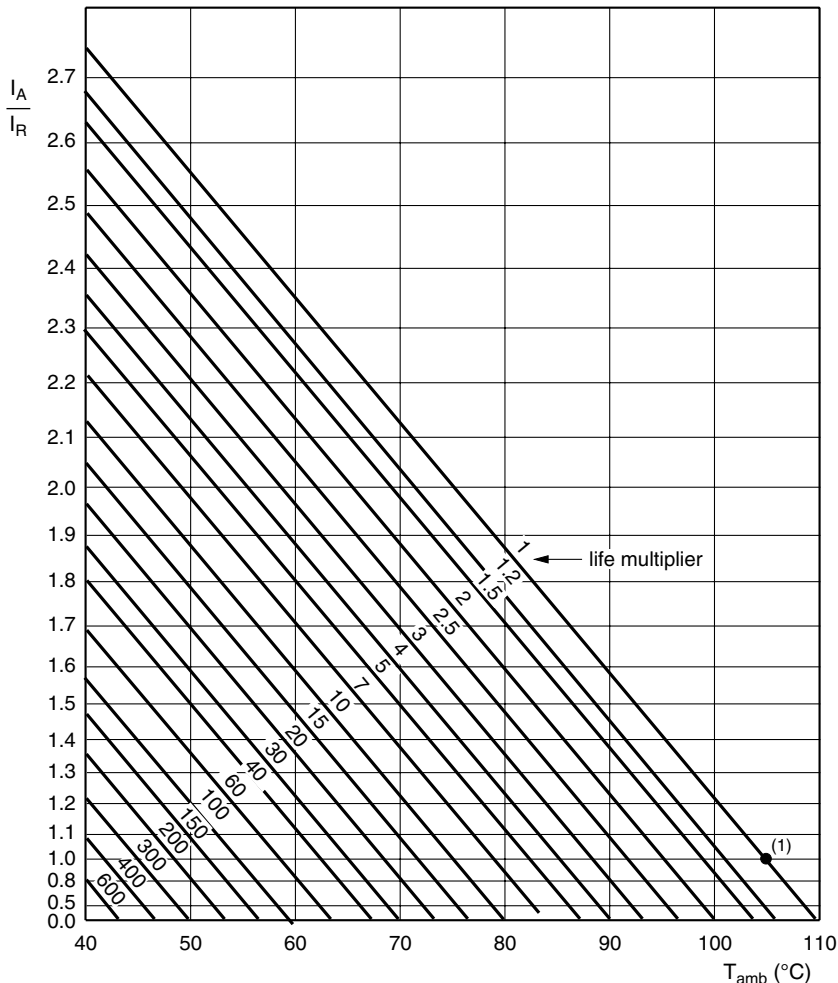
Table 3

| ELECTRICAL DATA AND ORDERING INFORMATION FOR 163 SERIES |                                  |                                      |   |                                  |                                  |                       |                     |                               |
|---|----------------------------------|--------------------------------------|---|----------------------------------|----------------------------------|-----------------------|---------------------|-------------------------------|
| U <sub>R</sub><br>(V)                                   | C <sub>R</sub><br>100 Hz<br>(µF) | NOMINAL<br>CASE SIZE<br>Ø D x L (mm) | I <sub>R</sub><br>100 Hz<br>105 °C<br>(A) | I <sub>L1</sub><br>1 min<br>(mA) | I <sub>L5</sub><br>5 min<br>(mA) | ESR<br>100 Hz<br>(mΩ) | Z<br>10 kHz<br>(mΩ) | ORDERING CODE<br>MAL2163..... |
| 200   | 150                              | 25 x 30                              | 0.72                                      | 0.18                             | 0.06                             | 950                   | 710                 | 52151E3                       |
|   | 220                              | 25 x 40                              | 0.96                                      | 0.26                             | 0.09                             | 650                   | 485                 | 52221E3                       |
|   | 330                              | 30 x 40                              | 1.29                                      | 0.40                             | 0.14                             | 442                   | 330                 | 52331E3                       |
|   | 470                              | 35 x 40                              | 1.66                                      | 0.57                             | 0.19                             | 321                   | 240                 | 52471E3                       |
|   | 680                              | 35 x 50                              | 2.09                                      | 0.82                             | 0.28                             | 237                   | 185                 | 52681E3                       |
|   | 680                              | 40 x 40                              | 2.09                                      | 0.82                             | 0.28                             | 237                   | 185                 | 42681E3                       |
|   | 1000                             | 40 x 50                              | 2.71                                      | 1.20                             | 0.40                             | 167                   | 133                 | 52102E3                       |
|   | 1500                             | 40 x 70                              | 3.75                                      | 1.80                             | 0.60                             | 114                   | 90                  | 52152E3                       |
| 2200  | 40 x 100                         | 5.24                                 | 2.64                                      | 0.88                             | 79                               | 62                    | 52222E3             |                               |
| 250   | 100                              | 25 x 30                              | 0.67                                      | 0.15                             | 0.05                             | 1060                  | 710                 | 53101E3                       |
|   | 150                              | 25 x 40                              | 0.92                                      | 0.22                             | 0.08                             | 710                   | 485                 | 53151E3                       |
|   | 220                              | 30 x 40                              | 1.28                                      | 0.33                             | 0.11                             | 492                   | 330                 | 53221E3                       |
|   | 330                              | 35 x 40                              | 1.65                                      | 0.49                             | 0.17                             | 325                   | 240                 | 53331E3                       |
|   | 470                              | 35 x 50                              | 2.01                                      | 0.70                             | 0.24                             | 256                   | 185                 | 53471E3                       |
|   | 470                              | 40 x 40                              | 2.01                                      | 0.70                             | 0.24                             | 256                   | 185                 | 43471E3                       |
|   | 680                              | 40 x 50                              | 2.59                                      | 1.02                             | 0.34                             | 182                   | 133                 | 53681E3                       |
|   | 1000                             | 40 x 70                              | 3.58                                      | 1.50                             | 0.50                             | 125                   | 90                  | 53102E3                       |
| 1500  | 40 x 100                         | 5.05                                 | 2.25                                      | 0.75                             | 85                               | 62                    | 53152E3             |                               |
| 385   | 68                               | 25 x 30                              | 0.61                                      | 0.16                             | 0.06                             | 1650                  | 1260                | 58689E3                       |
|   | 100                              | 25 x 40                              | 0.82                                      | 0.23                             | 0.08                             | 1120                  | 855                 | 58101E3                       |
|   | 150                              | 30 x 40                              | 1.10                                      | 0.35                             | 0.12                             | 755                   | 580                 | 58151E3                       |
|   | 220                              | 35 x 40                              | 1.44                                      | 0.51                             | 0.17                             | 525                   | 405                 | 58221E3                       |
|   | 330                              | 35 x 50                              | 1.84                                      | 0.77                             | 0.26                             | 360                   | 280                 | 58331E3                       |
|   | 330                              | 40 x 40                              | 1.84                                      | 0.77                             | 0.26                             | 360                   | 280                 | 48331E3                       |
|   | 470                              | 40 x 50                              | 2.37                                      | 1.09                             | 0.36                             | 260                   | 205                 | 58471E3                       |
|   | 680                              | 40 x 70                              | 3.24                                      | 1.58                             | 0.53                             | 180                   | 140                 | 58681E3                       |
| 1000  | 40 x 100                         | 4.54                                 | 2.31                                      | 0.78                             | 125                              | 100                   | 58102E3             |                               |
| 400   | 68                               | 25 x 30                              | 0.39                                      | 0.16                             | 0.06                             | 3200                  | 2660                | 56689E3                       |
|   | 100                              | 25 x 40                              | 0.53                                      | 0.24                             | 0.08                             | 2180                  | 1810                | 56101E3                       |
|   | 150                              | 30 x 40                              | 0.72                                      | 0.36                             | 0.12                             | 1460                  | 1210                | 56151E3                       |
|   | 220                              | 35 x 40                              | 0.94                                      | 0.52                             | 0.17                             | 1010                  | 830                 | 56221E3                       |
|   | 330                              | 35 x 50                              | 1.24                                      | 0.79                             | 0.26                             | 680                   | 570                 | 56331E3                       |
|   | 330                              | 40 x 40                              | 1.24                                      | 0.79                             | 0.26                             | 680                   | 570                 | 46331E3                       |
|   | 470                              | 40 x 50                              | 1.59                                      | 1.12                             | 0.37                             | 485                   | 407                 | 56471E3                       |
|   | 680                              | 40 x 70                              | 2.18                                      | 1.63                             | 0.54                             | 336                   | 282                 | 56681E3                       |
| 1000  | 40 x 100                         | 3.07                                 | 2.40                                      | 0.80                             | 230                              | 193                   | 56102E3             |                               |

| ADDITIONAL ELECTRICAL DATA         |                                   |  |
|------------------------------------|-----------------------------------|--|
| PARAMETER                          | CONDITIONS                        | VALUE  |
| <b>Voltage</b>                     |                                   |  |
| Surge voltage                      | ≤ 200 V versions                  | U <sub>s</sub> = 1.15 x U <sub>R</sub>                         |
|                                    | ≥ 385 V versions                  | U <sub>s</sub> = 1.1 x U <sub>R</sub>                          |
| Reverse voltage                    |                                   | U <sub>rev</sub> ≤ 1 V   |
| <b>Current</b>                     |                                   |  |
| Leakage current                    | After 1 minute at U <sub>R</sub>  | I <sub>L1</sub> ≤ 0.006 C <sub>R</sub> x U <sub>R</sub> + 4 µA |
|                                    | After 5 minutes at U <sub>R</sub> | I <sub>L5</sub> ≤ 0.002 C <sub>R</sub> x U <sub>R</sub> + 4 µA |
| <b>Inductance</b>                  |                                   |  |
| Equivalent series inductance (ESL) | Case Ø D = 25 mm                  | max. 25 nH   |
|                                    | Case Ø D = 30 and 35 mm           | max. 30 nH   |
|                                    | Case Ø D = 40 mm                  | max. 35 nH   |



**RIPPLE CURRENT AND USEFUL LIFE**



$I_A$  = 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   |                     |                      |
|   | $U_R = 10$ to 25 V | $U_R = 40$ to 100 V | $U_R = 200$ to 400 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                 |
| ≥ 10 000  | 1.18               | 1.22                | 1.40                 |



Table 5

| <b>TEST PROCEDURES AND REQUIREMENT</b>         |  |  |   |
|--|--|--|---|
| <b>TEST</b>                                    |  | <b>PROCEDURE<br/>(quick reference)</b>   | <b>REQUIREMENTS</b>   |
| <b>NAME OF TEST</b>                            | <b>REFERENCE</b>                           |  |   |
| Endurance                                      | IEC 60384-4/<br>EN130300<br>subclause 4.13 | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; $U_R$ applied;<br>2000 hours   | $U_R \leq 100\text{ V}$ ; $\Delta C/C: \pm 15\%$<br>$U_R > 100\text{ V}$ ; $\Delta C/C: \pm 10\%$<br>$ESR \leq 1.3 \times \text{spec. limit}$<br>$Z \leq 2 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$   |
| Useful life                                    | CECC 30301<br>subclause 1.8.1              | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied;<br>5000 hours   | $U_R \leq 100\text{ V}$ ; $\Delta C/C: \pm 45\%$<br>$U_R > 100\text{ V}$ ; $\Delta C/C: \pm 30\%$<br>$ESR \leq 3 \times \text{spec. limit}$<br>$Z \leq 3 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$<br>no short or open circuit,<br>no visible damage<br>total failure percentage:<br>$U_R \leq 100\text{ V}: \leq 1\%$ ;<br>$U_R > 100\text{ V}: \leq 3\%$ |
| Shelf life<br>(storage at<br>high temperature) | IEC 60384-4/<br>EN130300<br>subclause 4.17 | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; no voltage applied;<br>500 hours<br><br>After test: $U_R$ to be applied for 30 minutes,<br>24 to 48 hours before measurement | $\Delta C/C: \pm 10\%$<br>$ESR \leq 1.2 \times \text{spec. limit}$<br>$I_{L5} \leq 2 \times \text{spec. limit}$   |



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