

## Aluminum Electrolytic Capacitors Power Ultra Long Life Snap-In



Fig. 1

| QUICK REFERENCE DATA                                      |                        |
|---|------------------------|
| DESCRIPTION   | VALUE                  |
| Nominal case size (Ø D x L in mm)                         | 22 x 25 to 35 x 60     |
| Rated capacitance range (E6 / E12 series), C <sub>R</sub> | 56 µF to 1800 µF       |
| Tolerance on C <sub>R</sub>                               | ± 20 %                 |
| Rated voltage range, U <sub>R</sub>                       | 200 V to 450 V   500 V |
| Category temperature range                                | -25 °C to +105 °C      |
| Endurance test at 105 °C                                  | 2000 h                 |
| Load life at 105 °C                                       | 2000 h                 |
| Useful life at 105 °C                                     | 5000 h                 |
| Useful life at 40 °C and 1.6 x I <sub>R</sub> applied     | 500 000 h              |
| Shelf life at 0 V, 105 °C                                 | 1000 h                 |
| Based on sectional specification                          | IEC 60384-4 / EN130300 |
| Climatic category IEC 60068                               | 25 / 105 / 56          |

### FEATURES

- Useful life: 5000 h at 105 °C
- Available up to 500 V
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, very small dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Low ESR, high ripple current capability
- Keyed polarity snap-in version available
- High reliability
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### APPLICATIONS

- Solar PV inverters
- General purpose, industrial and audio / video systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems

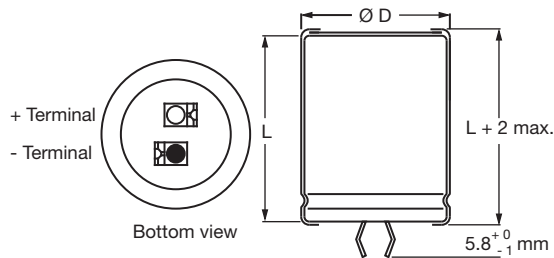
### MARKING

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

- Rated capacitance (in µF)
- Tolerance code on rated capacitance, code letter in accordance with IEC 60062 (M for ± 20 %)
- Rated voltage (in V)
- Date code (YYMM or in 2 digits according to 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, last 8 digits 159 xxxxx
- Climatic category in accordance with IEC 60068

| SELECTION CHART FOR C <sub>R</sub> , U <sub>R</sub> , AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm) |                    |         |         |         |         |         |
|---|--------------------|---------|---------|---------|---------|---------|
| C <sub>R</sub><br>(µF)  | U <sub>R</sub> (V) |         |         |         |         |         |
|   | 200                | 250     | 400     | 450     | 500     |         |
| 56  | -                  | -       | -       | 22 x 25 | 22 x 30 | 22 x 30 |
| 68  | -                  | -       | 22 x 25 | 22 x 30 | 22 x 35 | 22 x 35 |
|   | -                  | -       | -       | 25 x 25 | 25 x 30 | 25 x 30 |
| 82  | -                  | -       | 22 x 30 | 22 x 35 | 22 x 35 | 22 x 35 |
|   | -                  | -       | 25 x 25 | -       | 25 x 30 | 25 x 30 |
| 100   | -                  | -       | 22 x 35 | 22 x 40 | 22 x 40 | 22 x 40 |
|   | -                  | -       | 25 x 30 | 25 x 30 | 25 x 35 | 25 x 35 |
|   | -                  | -       | -       | 30 x 25 | -       | -       |
| 120   | -                  | -       | 22 x 35 | -       | 25 x 40 | 25 x 40 |
|   | -                  | -       | 25 x 30 | 25 x 35 | 30 x 30 | 30 x 30 |
|   | -                  | -       | 30 x 25 | -       | -       | -       |
| 150   | -                  | -       | 22 x 40 | 25 x 40 | 25 x 45 | 25 x 45 |
|   | -                  | -       | 25 x 35 | 30 x 30 | 30 x 35 | 30 x 35 |
|   | -                  | -       | 30 x 30 | 35 x 25 | -       | -       |
| 180   | -                  | -       | 25 x 40 | 25 x 45 | 25 x 50 | 25 x 50 |
|   | -                  | -       | 30 x 30 | 30 x 35 | 30 x 40 | 30 x 40 |
|   | -                  | -       | 35 x 25 | -       | 35 x 30 | 35 x 30 |
| 220   | -                  | 22 x 30 | 25 x 45 | 30 x 40 | 30 x 45 | 30 x 45 |
|   | -                  | 25 x 25 | 30 x 35 | 35 x 30 | 35 x 35 | 35 x 35 |
|   | -                  | -       | 35 x 30 | -       | -       | -       |

| SELECTION CHART FOR $C_R$ , $U_R$ , AND RELEVANT NOMINAL CASE SIZES ( $\varnothing D \times L$ in mm) |           |         |         |         |         |
|---|-----------|---------|---------|---------|---------|
| $C_R$<br>( $\mu F$ )  | $U_R$ (V) |         |         |         |         |
|   | 200       | 250     | 400     | 450     | 500     |
| 270   | -         | 22 x 35 | 25 x 50 | 30 x 45 | 30 x 50 |
|   | -         | 25 x 30 | 30 x 40 | 35 x 35 | 35 x 40 |
|   | -         | 30 x 25 | 35 x 30 | -       | -       |
| 330   | 22 x 30   | 22 x 40 | 30 x 45 | 30 x 50 | 35 x 45 |
|   | -         | 25 x 30 | 35 x 35 | 35 x 40 | -       |
|   | -         | 30 x 25 | -       | -       | -       |
| 390   | 22 x 35   | 25 x 35 | 30 x 50 | 35 x 45 | 35 x 55 |
|   | 25 x 30   | 30 x 30 | 35 x 40 | -       | -       |
| 470   | 22 x 40   | 25 x 40 | 35 x 45 | 35 x 50 | 35 x 60 |
|   | 30 x 25   | 30 x 30 | -       | 35 x 40 | -       |
| 560   | -         | 35 x 25 | -       | -       | -       |
|   | -         | 25 x 45 | -       | 35 x 60 | -       |
|   | 25 x 35   | 30 x 35 | -       | -       | -       |
| 680   | 30 x 30   | 35 x 30 | -       | -       | -       |
|   | 25 x 45   | 30 x 40 | 35 x 60 | -       | -       |
|   | 30 x 30   | 35 x 35 | -       | -       | -       |
| 820   | 35 x 25   | -       | -       | -       | -       |
|   | 25 x 50   | 30 x 45 | -       | -       | -       |
|   | 30 x 35   | 35 x 35 | -       | -       | -       |
| 1000  | 35 x 30   | 35 x 40 | -       | -       | -       |
|   | 30 x 45   | 35 x 40 | -       | -       | -       |
| 1200  | 35 x 35   | 35 x 45 | -       | -       | -       |
|   | 30 x 50   | 35 x 45 | -       | -       | -       |
| 1500  | 35 x 35   | 35 x 50 | -       | -       | -       |
| 1800  | 35 x 45   | -       | -       | -       | -       |
| 1800  | 35 x 50   | -       | -       | -       | -       |

**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

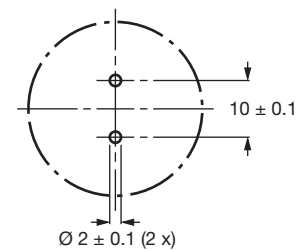
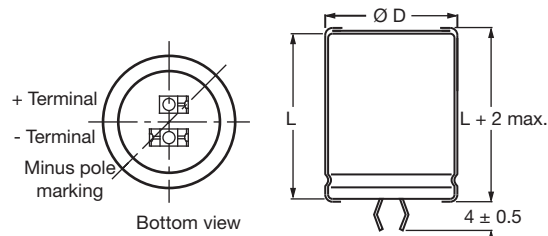
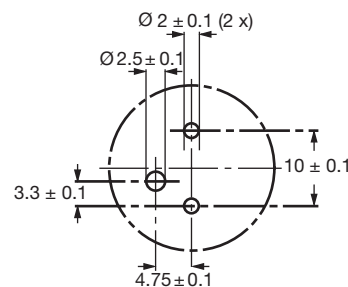


Fig. 3 - Mounting hole diagram

**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<br>Ø D x L                             | Ø D <sub>max.</sub> | L <sub>max.</sub> | MASS<br>(g) | PACKAGING QUANTITIES<br>(units per box) | CARDBOARD BOX DIMENSIONS<br>L x W x H |
| 22 x 25  | 23                  | 27                | ≈ 12        | 100                                     | 260 x 250 x 39                        |
| 22 x 30  | 23                  | 32                | ≈ 16        | 100                                     | 260 x 250 x 44                        |
| 22 x 35  | 23                  | 37                | ≈ 20        | 100                                     | 260 x 250 x 49                        |
| 22 x 40  | 23                  | 42                | ≈ 23        | 100                                     | 260 x 250 x 54                        |
| 25 x 25  | 26                  | 27                | ≈ 20        | 100                                     | 290 x 280 x 39                        |
| 25 x 30  | 26                  | 32                | ≈ 22        | 100                                     | 290 x 280 x 44                        |
| 25 x 35  | 26                  | 37                | ≈ 24        | 100                                     | 290 x 280 x 49                        |
| 25 x 40  | 26                  | 42                | ≈ 27        | 100                                     | 290 x 280 x 54                        |
| 25 x 45  | 26                  | 47                | ≈ 32        | 100                                     | 290 x 280 x 59                        |
| 25 x 50  | 26                  | 52                | ≈ 38        | 100                                     | 290 x 280 x 64                        |
| 30 x 25  | 31                  | 27                | ≈ 25        | 100                                     | 340 x 330 x 39                        |
| 30 x 30  | 31                  | 32                | ≈ 30        | 100                                     | 340 x 330 x 44                        |
| 30 x 35  | 31                  | 37                | ≈ 35        | 100                                     | 340 x 330 x 49                        |
| 30 x 40  | 31                  | 42                | ≈ 40        | 100                                     | 340 x 330 x 54                        |
| 30 x 45  | 31                  | 47                | ≈ 45        | 100                                     | 340 x 330 x 59                        |
| 30 x 50  | 31                  | 52                | ≈ 50        | 100                                     | 340 x 330 x 64                        |
| 35 x 25  | 36                  | 27                | ≈ 33        | 50                                      | 390 x 198 x 39                        |
| 35 x 30  | 36                  | 32                | ≈ 40        | 50                                      | 390 x 198 x 44                        |
| 35 x 35  | 36                  | 37                | ≈ 48        | 50                                      | 390 x 198 x 49                        |
| 35 x 40  | 36                  | 42                | ≈ 55        | 50                                      | 390 x 198 x 54                        |
| 35 x 45  | 36                  | 47                | ≈ 63        | 50                                      | 390 x 198 x 59                        |
| 35 x 50  | 36                  | 52                | ≈ 72        | 50                                      | 390 x 198 x 64                        |
| 35 x 55  | 36                  | 57                | ≈ 80        | 50                                      | 390 x 198 x 69                        |
| 35 x 60  | 36                  | 62                | ≈ 84        | 50                                      | 390 x 198 x 74                        |

| ELECTRICAL DATA |   |
|-----------------|---|
| SYMBOL          | DESCRIPTION   |
| C <sub>R</sub>  | Rated capacitance at 100 Hz                                       |
| I <sub>R</sub>  | Rated RMS ripple current at 120 Hz, 105 °C                        |
| I <sub>L5</sub> | Max. leakage current after 5 min at U <sub>R</sub>                |
| ESR             | Typ. / max. equivalent series resistance at 100 Hz <sup>(1)</sup> |
| Z               | Typ. / max. impedance at 10 kHz                                   |

**Notes**

- Unless otherwise specified, all electrical values in Table 2 apply at T<sub>amb</sub> = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %
- <sup>(1)</sup> ESR at 120 Hz is approximately 0.95 x ESR 100 Hz

**ORDERING EXAMPLE**

Electrolytic capacitor 159 series

1000 µF / 200 V; ± 20 %

Nominal case size: Ø 30 mm x 45 mm

**2-terminal snap-in:**

Ordering code: MAL215942102E3

Former 12NC: 222215942102

**3-terminal snap-in:**

Ordering code: MAL215922102E3

Former 12NC: 222215922102



Table 2

| ELECTRICAL DATA AND ORDERING INFORMATION |                                  |   |   |                                  |   |   |                          |                          |                               |         |
|--|----------------------------------|---|---|----------------------------------|---|---|--------------------------|--------------------------|-------------------------------|---------|
| U <sub>R</sub><br>(V)                    | C <sub>R</sub><br>100 Hz<br>(μF) | NOMINAL<br>CASE SIZE<br>Ø D x L<br>(mm) | I <sub>R</sub><br>120 Hz<br>105 °C<br>(A) | I <sub>L5</sub><br>5 min<br>(mA) | TYP. ESR<br>100 Hz <sup>(1)</sup><br>(mΩ) | MAX. ESR<br>100 Hz <sup>(1)</sup><br>(mΩ) | TYP. Z<br>10 kHz<br>(mΩ) | MAX. Z<br>10 kHz<br>(mΩ) | ORDERING CODE<br>MAL2159..... |         |
|  |                                  |   |   |                                  |   |   |                          |                          | 2-TERM.                       | 3-TERM. |
| 200                                      | 330                              | 22 x 30                                 | 1.08                                      | 0.66                             | 450                                       | 730                                       | 300                      | 500                      | 52331E3                       | 72331E3 |
|  | 390                              | 22 x 35                                 | 1.23                                      | 0.78                             | 380                                       | 610                                       | 280                      | 470                      | 42391E3                       | 22391E3 |
|  | 390                              | 25 x 30                                 | 1.23                                      | 0.78                             | 380                                       | 610                                       | 280                      | 470                      | 52391E3                       | 72391E3 |
|  | 470                              | 22 x 40                                 | 1.37                                      | 0.94                             | 300                                       | 505                                       | 240                      | 400                      | 32471E3                       | 12471E3 |
|  | 470                              | 30 x 25                                 | 1.27                                      | 0.94                             | 300                                       | 505                                       | 240                      | 400                      | 52471E3                       | 72471E3 |
|  | 560                              | 25 x 35                                 | 1.50                                      | 1.12                             | 260                                       | 425                                       | 235                      | 390                      | 42561E3                       | 22561E3 |
|  | 560                              | 30 x 30                                 | 1.52                                      | 1.12                             | 260                                       | 425                                       | 235                      | 390                      | 52561E3                       | 72561E3 |
|  | 680                              | 25 x 45                                 | 1.82                                      | 1.36                             | 210                                       | 350                                       | 205                      | 340                      | 42681E3                       | 22681E3 |
|  | 680                              | 30 x 30                                 | 1.59                                      | 1.36                             | 210                                       | 350                                       | 205                      | 340                      | 52681E3                       | 72681E3 |
|  | 680                              | 35 x 25                                 | 1.44                                      | 1.36                             | 210                                       | 350                                       | 205                      | 340                      | 62681E3                       | 82681E3 |
|  | 820                              | 25 x 50                                 | 2.04                                      | 1.64                             | 180                                       | 290                                       | 145                      | 240                      | 32821E3                       | 12821E3 |
|  | 820                              | 30 x 35                                 | 1.83                                      | 1.64                             | 180                                       | 290                                       | 145                      | 240                      | 42821E3                       | 22821E3 |
|  | 820                              | 35 x 30                                 | 1.77                                      | 1.64                             | 180                                       | 290                                       | 145                      | 240                      | 52821E3                       | 72821E3 |
|  | 1000                             | 30 x 45                                 | 2.23                                      | 2.00                             | 150                                       | 235                                       | 135                      | 225                      | 42102E3                       | 22102E3 |
|  | 1000                             | 35 x 35                                 | 2.04                                      | 2.00                             | 150                                       | 235                                       | 135                      | 225                      | 52102E3                       | 72102E3 |
|  | 1200                             | 30 x 50                                 | 2.47                                      | 2.40                             | 130                                       | 210                                       | 115                      | 190                      | 42122E3                       | 22122E3 |
| 1200                                     | 35 x 35                          | 2.07                                    | 2.40                                      | 130                              | 210                                       | 115                                       | 190                      | 52122E3                  | 72122E3                       |         |
| 1500                                     | 35 x 45                          | 2.56                                    | 3.00                                      | 100                              | 170                                       | 95  | 155                      | 52152E3                  | 72152E3                       |         |
| 1800                                     | 35 x 50                          | 2.80                                    | 3.60                                      | 90                               | 150                                       | 80  | 130                      | 52182E3                  | 72182E3                       |         |
| 250                                      | 220                              | 22 x 30                                 | 1.00                                      | 0.55                             | 540                                       | 1080                                      | 420                      | 700                      | 43221E3                       | 23221E3 |
|  | 220                              | 25 x 25                                 | 1.00                                      | 0.55                             | 540                                       | 1080                                      | 420                      | 700                      | 53221E3                       | 73221E3 |
|  | 270                              | 22 x 35                                 | 1.07                                      | 0.67                             | 440                                       | 880                                       | 335                      | 560                      | 43271E3                       | 23271E3 |
|  | 270                              | 25 x 30                                 | 1.08                                      | 0.67                             | 440                                       | 880                                       | 335                      | 560                      | 53271E3                       | 73271E3 |
|  | 270                              | 30 x 25                                 | 1.08                                      | 0.67                             | 440                                       | 880                                       | 335                      | 560                      | 63271E3                       | 83271E3 |
|  | 330                              | 22 x 40                                 | 1.20                                      | 0.82                             | 360                                       | 720                                       | 255                      | 430                      | 33331E3                       | 13331E3 |
|  | 330                              | 25 x 30                                 | 1.21                                      | 0.82                             | 360                                       | 720                                       | 255                      | 430                      | 43331E3                       | 23331E3 |
|  | 330                              | 30 x 25                                 | 1.19                                      | 0.82                             | 360                                       | 720                                       | 255                      | 430                      | 53331E3                       | 73331E3 |
|  | 390                              | 25 x 35                                 | 1.39                                      | 0.97                             | 330                                       | 610                                       | 245                      | 410                      | 43391E3                       | 23391E3 |
|  | 390                              | 30 x 30                                 | 1.41                                      | 0.97                             | 330                                       | 610                                       | 245                      | 410                      | 53391E3                       | 73391E3 |
|  | 470                              | 25 x 40                                 | 1.58                                      | 1.17                             | 270                                       | 505                                       | 240                      | 400                      | 33471E3                       | 13471E3 |
|  | 470                              | 30 x 30                                 | 1.57                                      | 1.17                             | 270                                       | 505                                       | 240                      | 400                      | 43471E3                       | 23471E3 |
|  | 470                              | 35 x 25                                 | 1.37                                      | 1.17                             | 270                                       | 505                                       | 240                      | 400                      | 53471E3                       | 73471E3 |
|  | 560                              | 25 x 45                                 | 1.78                                      | 1.40                             | 230                                       | 425                                       | 185                      | 310                      | 43561E3                       | 23561E3 |
|  | 560                              | 30 x 35                                 | 1.71                                      | 1.40                             | 230                                       | 425                                       | 185                      | 310                      | 53561E3                       | 73561E3 |
|  | 560                              | 35 x 30                                 | 1.67                                      | 1.40                             | 230                                       | 425                                       | 185                      | 310                      | 63561E3                       | 83561E3 |
|  | 680                              | 30 x 40                                 | 1.93                                      | 1.70                             | 210                                       | 350                                       | 155                      | 260                      | 43681E3                       | 23681E3 |
|  | 680                              | 35 x 35                                 | 1.92                                      | 1.70                             | 210                                       | 350                                       | 155                      | 260                      | 53681E3                       | 73681E3 |
|  | 820                              | 30 x 45                                 | 2.16                                      | 2.05                             | 180                                       | 290                                       | 125                      | 210                      | 43821E3                       | 23821E3 |
|  | 820                              | 35 x 35                                 | 1.97                                      | 2.05                             | 180                                       | 290                                       | 125                      | 210                      | 53821E3                       | 73821E3 |
| 820                                      | 35 x 40                          | 2.16                                    | 2.05                                      | 180                              | 290                                       | 125                                       | 210                      | 63821E3                  | 83821E3                       |         |
| 1000                                     | 35 x 40                          | 2.22                                    | 2.50                                      | 140                              | 235                                       | 105                                       | 180                      | 53102E3                  | 73102E3                       |         |
| 1000                                     | 35 x 45                          | 2.41                                    | 2.50                                      | 140                              | 235                                       | 105                                       | 180                      | 63102E3                  | 83102E3                       |         |
| 1200                                     | 35 x 45                          | 2.46                                    | 3.00                                      | 130                              | 200                                       | 95  | 160                      | 43122E3                  | 23122E3                       |         |
| 1200                                     | 35 x 50                          | 2.65                                    | 3.00                                      | 130                              | 200                                       | 95  | 160                      | 53122E3                  | 73122E3                       |         |

Note

(1) ESR at 120 Hz is approximately 0.95 x ESR 100 Hz



| ELECTRICAL DATA AND ORDERING INFORMATION |                                  |   |   |                                  |   |   |                          |                          |                               |         |
|--|----------------------------------|---|---|----------------------------------|---|---|--------------------------|--------------------------|-------------------------------|---------|
| U <sub>R</sub><br>(V)                    | C <sub>R</sub><br>100 Hz<br>(μF) | NOMINAL<br>CASE SIZE<br>Ø D x L<br>(mm) | I <sub>R</sub><br>120 Hz<br>105 °C<br>(A) | I <sub>L5</sub><br>5 min<br>(mA) | TYP. ESR<br>100 Hz <sup>(1)</sup><br>(mΩ) | MAX. ESR<br>100 Hz <sup>(1)</sup><br>(mΩ) | TYP. Z<br>10 kHz<br>(mΩ) | MAX. Z<br>10 kHz<br>(mΩ) | ORDERING CODE<br>MAL2159..... |         |
|  |                                  |   |   |                                  |   |   |                          |                          | 2-TERM.                       | 3-TERM. |
| 400                                      | 68                               | 22 x 25                                 | 0.51                                      | 0.27                             | 1600                                      | 3200                                      | 1170                     | 1950                     | 56689E3                       | 76689E3 |
|  | 82                               | 22 x 30                                 | 0.60                                      | 0.33                             | 1200                                      | 2400                                      | 910                      | 1520                     | 46829E3                       | 26829E3 |
|  | 82                               | 25 x 25                                 | 0.60                                      | 0.33                             | 1200                                      | 2400                                      | 910                      | 1520                     | 56829E3                       | 76829E3 |
|  | 100                              | 22 x 35                                 | 0.69                                      | 0.40                             | 990                                       | 1980                                      | 740                      | 1240                     | 46101E3                       | 26101E3 |
|  | 100                              | 25 x 30                                 | 0.70                                      | 0.40                             | 990                                       | 1980                                      | 740                      | 1240                     | 56101E3                       | 76101E3 |
|  | 120                              | 22 x 35                                 | 0.76                                      | 0.48                             | 800                                       | 1600                                      | 660                      | 1100                     | 46121E3                       | 26121E3 |
|  | 120                              | 25 x 30                                 | 0.76                                      | 0.48                             | 800                                       | 1600                                      | 660                      | 1100                     | 56121E3                       | 76121E3 |
|  | 120                              | 30 x 25                                 | 0.77                                      | 0.48                             | 800                                       | 1600                                      | 660                      | 1100                     | 66121E3                       | 86121E3 |
|  | 150                              | 22 x 40                                 | 0.86                                      | 0.60                             | 700                                       | 1400                                      | 510                      | 860                      | 36151E3                       | 16151E3 |
|  | 150                              | 25 x 35                                 | 0.89                                      | 0.60                             | 700                                       | 1400                                      | 510                      | 860                      | 46151E3                       | 26151E3 |
|  | 150                              | 30 x 30                                 | 0.92                                      | 0.60                             | 700                                       | 1400                                      | 510                      | 860                      | 56151E3                       | 76151E3 |
|  | 180                              | 25 x 40                                 | 1.01                                      | 0.72                             | 590                                       | 1170                                      | 420                      | 700                      | 36181E3                       | 16181E3 |
|  | 180                              | 30 x 30                                 | 0.99                                      | 0.72                             | 590                                       | 1170                                      | 420                      | 700                      | 46181E3                       | 26181E3 |
|  | 180                              | 35 x 25                                 | 0.96                                      | 0.72                             | 590                                       | 1170                                      | 420                      | 700                      | 56181E3                       | 76181E3 |
|  | 220                              | 25 x 45                                 | 1.15                                      | 0.88                             | 470                                       | 940                                       | 350                      | 590                      | 46221E3                       | 26221E3 |
|  | 220                              | 30 x 35                                 | 1.15                                      | 0.88                             | 470                                       | 940                                       | 350                      | 590                      | 56221E3                       | 76221E3 |
|  | 220                              | 35 x 30                                 | 1.14                                      | 0.88                             | 470                                       | 940                                       | 350                      | 590                      | 66221E3                       | 86221E3 |
|  | 270                              | 25 x 50                                 | 1.31                                      | 1.08                             | 380                                       | 760                                       | 330                      | 550                      | 46271E3                       | 26271E3 |
|  | 270                              | 30 x 40                                 | 1.30                                      | 1.08                             | 380                                       | 760                                       | 330                      | 550                      | 56271E3                       | 76271E3 |
|  | 270                              | 35 x 30                                 | 1.21                                      | 1.08                             | 380                                       | 760                                       | 330                      | 550                      | 66271E3                       | 86271E3 |
| 330                                      | 30 x 45                          | 1.47                                    | 1.32                                      | 320                              | 640                                       | 270                                       | 450                      | 56331E3                  | 76331E3                       |         |
| 330                                      | 35 x 35                          | 1.40                                    | 1.32                                      | 320                              | 640                                       | 270                                       | 450                      | 66331E3                  | 86331E3                       |         |
| 390                                      | 30 x 50                          | 1.63                                    | 1.56                                      | 270                              | 540                                       | 240                                       | 410                      | 46391E3                  | 26391E3                       |         |
| 390                                      | 35 x 40                          | 1.57                                    | 1.56                                      | 270                              | 540                                       | 240                                       | 410                      | 56391E3                  | 76391E3                       |         |
| 470                                      | 35 x 45                          | 1.72                                    | 1.88                                      | 230                              | 450                                       | 200                                       | 330                      | 56471E3                  | 76471E3                       |         |
| 560                                      | 35 x 50                          | 1.84                                    | 2.24                                      | 210                              | 420                                       | 170                                       | 280                      | 56561E3                  | 76561E3                       |         |
| 680                                      | 35 x 60                          | 2.24                                    | 2.72                                      | 180                              | 350                                       | 130                                       | 230                      | 56681E3                  | 76681E3                       |         |
| 450                                      | 56                               | 22 x 25                                 | 0.48                                      | 0.25                             | 1600                                      | 3200                                      | 1120                     | 1880                     | 57569E3                       | 77569E3 |
|  | 68                               | 22 x 30                                 | 0.56                                      | 0.30                             | 1200                                      | 2400                                      | 910                      | 1530                     | 47689E3                       | 27689E3 |
|  | 68                               | 25 x 25                                 | 0.56                                      | 0.30                             | 1200                                      | 2400                                      | 910                      | 1530                     | 57689E3                       | 77689E3 |
|  | 82                               | 22 x 35                                 | 0.64                                      | 0.36                             | 1100                                      | 2200                                      | 770                      | 1290                     | 57829E3                       | 77829E3 |
|  | 100                              | 22 x 40                                 | 0.74                                      | 0.45                             | 900                                       | 1800                                      | 630                      | 1050                     | 37101E3                       | 17101E3 |
|  | 100                              | 25 x 30                                 | 0.71                                      | 0.45                             | 900                                       | 1800                                      | 630                      | 1050                     | 47101E3                       | 27101E3 |
|  | 100                              | 30 x 25                                 | 0.73                                      | 0.45                             | 900                                       | 1800                                      | 630                      | 1050                     | 57101E3                       | 77101E3 |
|  | 120                              | 25 x 35                                 | 0.82                                      | 0.54                             | 750                                       | 1500                                      | 530                      | 885                      | 57121E3                       | 77121E3 |
|  | 150                              | 25 x 40                                 | 0.95                                      | 0.67                             | 600                                       | 1200                                      | 420                      | 705                      | 47151E3                       | 27151E3 |
|  | 150                              | 30 x 30                                 | 0.93                                      | 0.67                             | 600                                       | 1200                                      | 420                      | 705                      | 57151E3                       | 77151E3 |
|  | 150                              | 35 x 25                                 | 0.91                                      | 0.67                             | 600                                       | 1200                                      | 420                      | 705                      | 67151E3                       | 87151E3 |
|  | 180                              | 25 x 45                                 | 1.07                                      | 0.81                             | 500                                       | 1000                                      | 360                      | 605                      | 47181E3                       | 27181E3 |
|  | 180                              | 30 x 35                                 | 1.06                                      | 0.81                             | 500                                       | 1000                                      | 360                      | 605                      | 57181E3                       | 77181E3 |
|  | 220                              | 30 x 40                                 | 1.21                                      | 0.99                             | 370                                       | 740                                       | 310                      | 525                      | 47221E3                       | 27221E3 |
|  | 220                              | 35 x 30                                 | 1.14                                      | 0.99                             | 370                                       | 740                                       | 310                      | 525                      | 57221E3                       | 77221E3 |
|  | 270                              | 30 x 45                                 | 1.37                                      | 1.21                             | 350                                       | 700                                       | 270                      | 450                      | 47271E3                       | 27271E3 |
|  | 270                              | 35 x 35                                 | 1.32                                      | 1.21                             | 350                                       | 700                                       | 270                      | 450                      | 57271E3                       | 77271E3 |
|  | 330                              | 30 x 50                                 | 1.54                                      | 1.48                             | 300                                       | 600                                       | 230                      | 390                      | 47331E3                       | 27331E3 |
|  | 330                              | 35 x 40                                 | 1.49                                      | 1.48                             | 300                                       | 600                                       | 230                      | 390                      | 57331E3                       | 77331E3 |
|  | 390                              | 35 x 45                                 | 1.61                                      | 1.75                             | 250                                       | 500                                       | 200                      | 340                      | 57391E3                       | 77391E3 |
| 470                                      | 35 x 40                          | 1.90                                    | 1.50                                      | 210                              | 300                                       | 115                                       | 190                      | 90103E3D                 | -                             |         |
| 470                                      | 35 x 50                          | 1.72                                    | 2.11                                      | 210                              | 420                                       | 170                                       | 290                      | 57471E3                  | 77471E3                       |         |
| 560                                      | 35 x 60                          | 2.11                                    | 2.52                                      | 190                              | 380                                       | 140                                       | 240                      | 57561E3                  | 77561E3                       |         |

Note

<sup>(1)</sup> ESR at 120 Hz is approximately 0.95 x ESR 100 Hz



| ELECTRICAL DATA AND ORDERING INFORMATION |                                  |   |   |                                  |   |   |                          |                          |                               |         |
|--|----------------------------------|---|---|----------------------------------|---|---|--------------------------|--------------------------|-------------------------------|---------|
| U <sub>R</sub><br>(V)                    | C <sub>R</sub><br>100 Hz<br>(μF) | NOMINAL<br>CASE SIZE<br>Ø D x L<br>(mm) | I <sub>R</sub><br>120 Hz<br>105 °C<br>(A) | I <sub>L5</sub><br>5 min<br>(mA) | TYP. ESR<br>100 Hz <sup>(1)</sup><br>(mΩ) | MAX. ESR<br>100 Hz <sup>(1)</sup><br>(mΩ) | TYP. Z<br>10 kHz<br>(mΩ) | MAX. Z<br>10 kHz<br>(mΩ) | ORDERING CODE<br>MAL2159..... |         |
|  |                                  |   |   |                                  |   |   |                          |                          | 2-TERM.                       | 3-TERM. |
| 500                                      | 56                               | 22 x 30                                 | 0.56                                      | 0.28                             | 1730                                      | 2310                                      | 1280                     | 1700                     | 19569E3                       | 89569E3 |
|  | 68                               | 22 x 35                                 | 0.63                                      | 0.34                             | 1430                                      | 1900                                      | 1050                     | 1400                     | 19689E3                       | 89689E3 |
|  | 68                               | 25 x 30                                 | 0.64                                      | 0.34                             | 1430                                      | 1910                                      | 1060                     | 1410                     | 29689E3                       | 69689E3 |
|  | 82                               | 22 x 35                                 | 0.69                                      | 0.41                             | 1190                                      | 1580                                      | 880                      | 1170                     | 19829E3                       | 89829E3 |
|  | 82                               | 25 x 30                                 | 0.69                                      | 0.41                             | 1190                                      | 1590                                      | 890                      | 1180                     | 29829E3                       | 69829E3 |
|  | 100                              | 22 x 40                                 | 0.80                                      | 0.50                             | 980                                       | 1300                                      | 720                      | 960                      | 19101E3                       | 89101E3 |
|  | 100                              | 25 x 35                                 | 0.80                                      | 0.50                             | 980                                       | 1310                                      | 720                      | 960                      | 29101E3                       | 69101E3 |
|  | 120                              | 25 x 40                                 | 0.92                                      | 0.60                             | 820                                       | 1090                                      | 610                      | 810                      | 29121E3                       | 89121E3 |
|  | 120                              | 30 x 30                                 | 0.91                                      | 0.60                             | 830                                       | 1110                                      | 620                      | 830                      | 19121E3                       | 69121E3 |
|  | 150                              | 25 x 45                                 | 1.07                                      | 0.75                             | 650                                       | 870                                       | 490                      | 650                      | 19151E3                       | 89151E3 |
|  | 150                              | 30 x 35                                 | 1.05                                      | 0.75                             | 670                                       | 890                                       | 500                      | 660                      | 29151E3                       | 69151E3 |
|  | 180                              | 25 x 50                                 | 1.23                                      | 0.90                             | 550                                       | 730                                       | 410                      | 540                      | 29181E3                       | 89181E3 |
|  | 180                              | 30 x 40                                 | 1.19                                      | 0.90                             | 560                                       | 740                                       | 410                      | 550                      | 19181E3                       | 69181E3 |
|  | 180                              | 35 x 30                                 | 1.20                                      | 0.90                             | 580                                       | 770                                       | 440                      | 590                      | 39181E3                       | 49181E3 |
|  | 220                              | 30 x 45                                 | 1.37                                      | 1.10                             | 460                                       | 610                                       | 340                      | 450                      | 29221E3                       | 89221E3 |
|  | 220                              | 35 x 35                                 | 1.37                                      | 1.10                             | 470                                       | 630                                       | 360                      | 480                      | 19221E3                       | 69221E3 |
|  | 270                              | 30 x 50                                 | 1.57                                      | 1.35                             | 380                                       | 500                                       | 280                      | 370                      | 19271E3                       | 89271E3 |
|  | 270                              | 35 x 40                                 | 1.55                                      | 1.35                             | 390                                       | 520                                       | 290                      | 390                      | 29271E3                       | 69271E3 |
|  | 330                              | 35 x 45                                 | 1.74                                      | 1.65                             | 320                                       | 430                                       | 240                      | 320                      | 19331E3                       | 89331E3 |
|  | 390                              | 35 x 55                                 | 2.02                                      | 1.95                             | 270                                       | 360                                       | 200                      | 270                      | 19391E3                       | 89391E3 |
| 470                                      | 35 x 60                          | 2.24                                    | 2.35                                      | 230                              | 300                                       | 170                                       | 230                      | 19471E3                  | 89471E3                       |         |

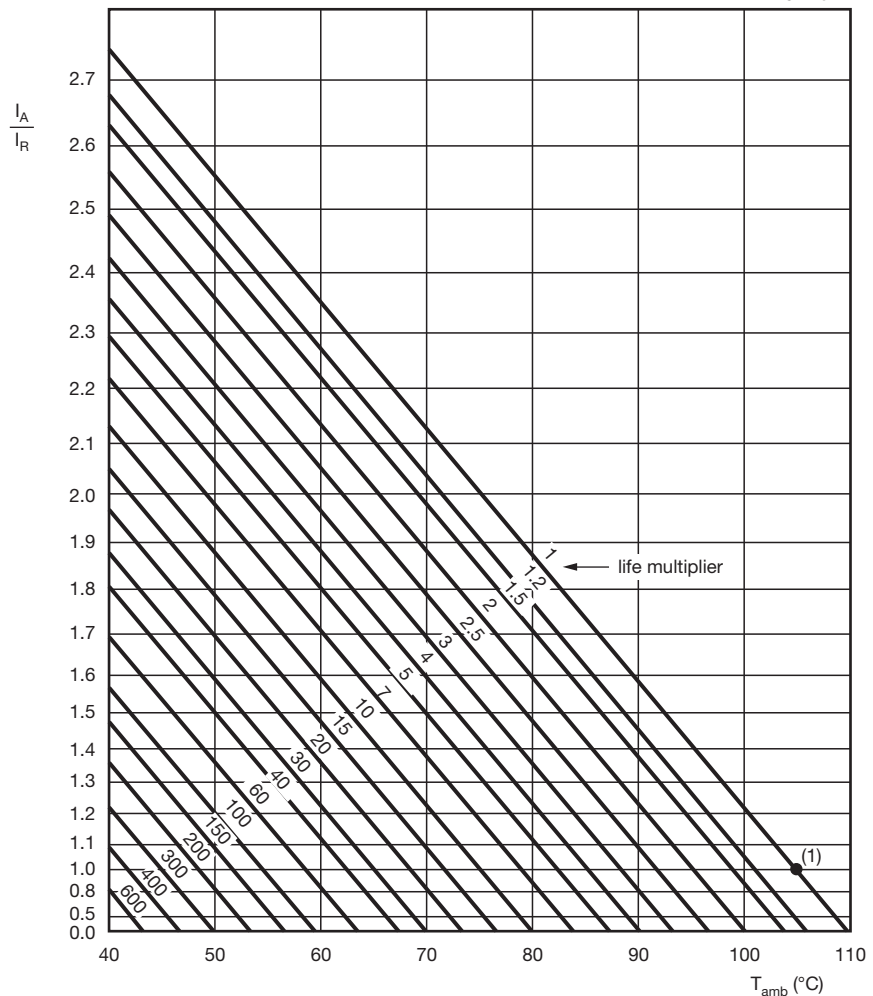
**Note**

<sup>(1)</sup> ESR at 120 Hz is approximately 0.95 x ESR 100 Hz

| ADDITIONAL ELECTRICAL DATA         |                               |  |
|------------------------------------|-------------------------------|--|
| PARAMETER                          | CONDITIONS                    | VALUE  |
| <b>Voltage</b>                     |                               |  |
| Surge voltage                      | ≥ 400 V versions              | U <sub>s</sub> = 1.1 x U <sub>R</sub>                  |
|                                    | ≤ 250 V versions              | U <sub>s</sub> = 1.15 x U <sub>R</sub>                 |
| Reverse voltage                    |                               | ≤ 1 V  |
| <b>Current</b>                     |                               |  |
| Leakage current                    | After 5 min at U <sub>R</sub> | I <sub>L5</sub> ≤ 0.01 C <sub>R</sub> x U <sub>R</sub> |
| <b>Inductance</b>                  |                               |  |
| Equivalent series inductance (ESL) | All case sizes                | Typ. 19 nH   |
|                                    |                               | Max. 25 nH   |

**RIPPLE CURRENT AND USEFUL LIFE**

MGA454



$I_A$  = Actual ripple current at 120 Hz  
 $I_R$  = Rated ripple current at 120 Hz and 105 °C  
 (1) Useful life at 105 °C and  $I_R$  applied: 5000 h

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

Table 3

| ENDURANCE TEST DURATION AND USEFUL LIFE |                           |
|---|---------------------------|
| ENDURANCE AT 105 °C (h)                 | USEFUL LIFE AT 105 °C (h) |
| 2000                                    | 5000                      |

**Note**

- Multiplier of useful life code: MGA454

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  | 0.95 | 1.00 | 1.15 | 1.30 | 1.40     |



Table 5

| TEST PROCEDURES AND REQUIREMENTS            |                                       |  |  |
|---|---------------------------------------|--|--|
| TEST  |                                       | PROCEDURE<br>(quick reference)   | REQUIREMENTS   |
| NAME OF TEST                                | REFERENCE                             |  |  |
| Endurance                                   | IEC 60384-4 / EN130300 subclause 4.13 | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; $U_R$ applied; 2000 h  | $\Delta C/C: \pm 15\%$<br>ESR $\leq 1.3 \times$ spec. limit<br>$I_{L5} \leq$ spec. limit                                       |
| Load life                                   |                                       | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied; 2000 h  | $\Delta C/C: \pm 20\%$<br>ESR $\leq 2 \times$ spec. limit<br>$I_{L5} \leq$ spec. limit   |
| Useful life                                 | CECC 30301 subclause 1.8.1            | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied; 5000 h  | $\Delta C/C: \pm 30\%$<br>ESR $\leq 3 \times$ spec. limit<br>$I_{L5} \leq$ spec. limit<br>total failure percentage: $\leq 3\%$ |
| Shelf life<br>(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: $U_R$ to be applied for 30 min, 24 h to 48 h before measurement | $\Delta C/C: \pm 15\%$<br>ESR $\leq 1.5 \times$ spec. limit<br>$I_{L5} \leq$ 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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