

## Aluminum 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, 250 V   400 V, 450 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

- 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
- Useful life: 5000 h at 105 °C
- Keyed polarity snap-in version available
- Material categorization: For definitions please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

### APPLICATIONS

- 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

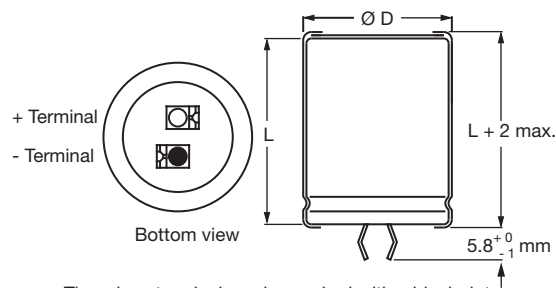
### SELECTION CHART FOR C<sub>R</sub>, U<sub>R</sub>, AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)

| C <sub>R</sub><br>(µF) | U <sub>R</sub> (V) |         |         |         |
|------------------------|--------------------|---------|---------|---------|
|                        | 200                | 250     | 400     | 450     |
| 56                     | -                  | -       | -       | 22 x 25 |
| 68                     | -                  | -       | 22 x 25 | 22 x 30 |
|                        | -                  | -       | -       | 25 x 25 |
| 82                     | -                  | -       | 22 x 30 | 22 x 35 |
|                        | -                  | -       | 25 x 25 | -       |
| 100                    | -                  | -       | 22 x 35 | 22 x 40 |
|                        | -                  | -       | 25 x 30 | 25 x 30 |
|                        | -                  | -       | -       | 30 x 25 |
|                        | -                  | -       | 22 x 35 | -       |
| 120                    | -                  | -       | 25 x 30 | 25 x 35 |
|                        | -                  | -       | 30 x 25 | -       |
|                        | -                  | -       | 22 x 40 | 25 x 40 |
| 150                    | -                  | -       | 25 x 35 | 30 x 30 |
|                        | -                  | -       | 30 x 30 | 35 x 25 |
|                        | -                  | -       | 25 x 40 | 25 x 45 |
| 180                    | -                  | -       | 30 x 30 | 30 x 35 |
|                        | -                  | -       | 35 x 25 | -       |
|                        | -                  | 22 x 30 | 25 x 45 | 30 x 40 |
| 220                    | -                  | 25 x 25 | 30 x 35 | 35 x 30 |
|                        | -                  | -       | 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     |
| 270                                                                                                   | -         | 22 x 35 | 25 x 50 | 30 x 45 |
|                                                                                                       | -         | 25 x 30 | 30 x 40 | 35 x 35 |
|                                                                                                       | -         | 30 x 25 | 35 x 30 | -       |
| 330                                                                                                   | 22 x 30   | 22 x 40 | 30 x 45 | 30 x 50 |
|                                                                                                       | -         | 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 |
|                                                                                                       | 25 x 30   | 30 x 30 | 35 x 40 | -       |
| 470                                                                                                   | 22 x 40   | 25 x 40 | 35 x 45 | 35 x 50 |
|                                                                                                       | 30 x 25   | 30 x 30 | -       | 35 x 40 |
|                                                                                                       | -         | 35 x 25 | -       | -       |
| 560                                                                                                   | -         | 25 x 45 | -       | 35 x 60 |
|                                                                                                       | 25 x 35   | 30 x 35 | -       | -       |
|                                                                                                       | 30 x 30   | 35 x 30 | -       | -       |
| 680                                                                                                   | 25 x 45   | 30 x 40 | 35 x 60 | -       |
|                                                                                                       | 30 x 30   | 35 x 35 | -       | -       |
|                                                                                                       | 35 x 25   | -       | -       | -       |
| 820                                                                                                   | 25 x 50   | 30 x 45 | -       | -       |
|                                                                                                       | 30 x 35   | 35 x 35 | -       | -       |
|                                                                                                       | 35 x 30   | 35 x 40 | -       | -       |
| 1000                                                                                                  | 30 x 45   | 35 x 40 | -       | -       |
|                                                                                                       | 35 x 35   | 35 x 45 | -       | -       |
| 1200                                                                                                  | 30 x 50   | 35 x 45 | -       | -       |
|                                                                                                       | 35 x 35   | 35 x 50 | -       | -       |
| 1500                                                                                                  | 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

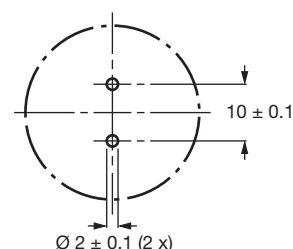
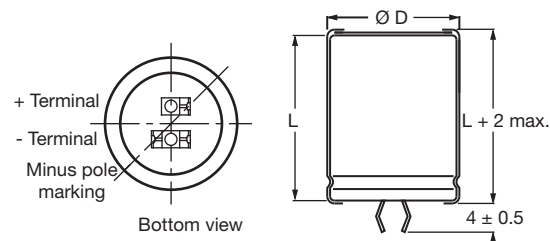


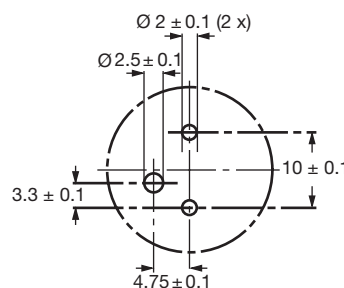
Fig. 3 - Mounting hole diagram

### 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

| <b>DIMENSIONS</b> in millimeters, <b>MASS AND PACKAGING QUANTITIES</b> |                           |                         |                     |                                                     |                                                   |
|------------------------------------------------------------------------|---------------------------|-------------------------|---------------------|-----------------------------------------------------|---------------------------------------------------|
| <b>NOMINAL CASE SIZE<br/>Ø D x L</b>                                   | <b>Ø D<sub>max.</sub></b> | <b>L<sub>max.</sub></b> | <b>MASS<br/>(g)</b> | <b>PACKAGING<br/>QUANTITIES<br/>(units per box)</b> | <b>CARDBOARD BOX<br/>DIMENSIONS<br/>L x W x H</b> |
| 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 60                                                                | 36                        | 62                      | ≈ 84                | 50                                                  | 390 x 198 x 74                                    |

| <b>ELECTRICAL DATA</b> |                                                                 |
|------------------------|-----------------------------------------------------------------|
| <b>SYMBOL</b>          | <b>DESCRIPTION</b>                                              |
| 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: MAL2 15942102E3

Former 12NC: 2222 15942102

3-terminal snap-in:

Ordering code: MAL2 15922102E3

Former 12NC: 2222 15922102



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**<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. |
| 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

| ADDITIONAL ELECTRICAL DATA         |                       |                                   |
|------------------------------------|-----------------------|-----------------------------------|
| PARAMETER                          | CONDITIONS            | VALUE                             |
| <b>Voltage</b>                     |                       |                                   |
| Surge voltage                      | $\geq 400$ V versions | $U_s = 1.1 \times U_R$            |
|                                    | $\leq 250$ V versions | $U_s = 1.15 \times U_R$           |
| Reverse voltage                    |                       | $\leq 1$ V                        |
| <b>Current</b>                     |                       |                                   |
| Leakage current                    | After 5 min at $U_R$  | $I_{L5} \leq 0.01 C_R \times U_R$ |
| <b>Inductance</b>                  |                       |                                   |
| Equivalent series inductance (ESL) | All case sizes        | Typ. 19 nH                        |
|                                    |                       | Max. 25 nH                        |

## RIPPLE CURRENT AND USEFUL LIFE

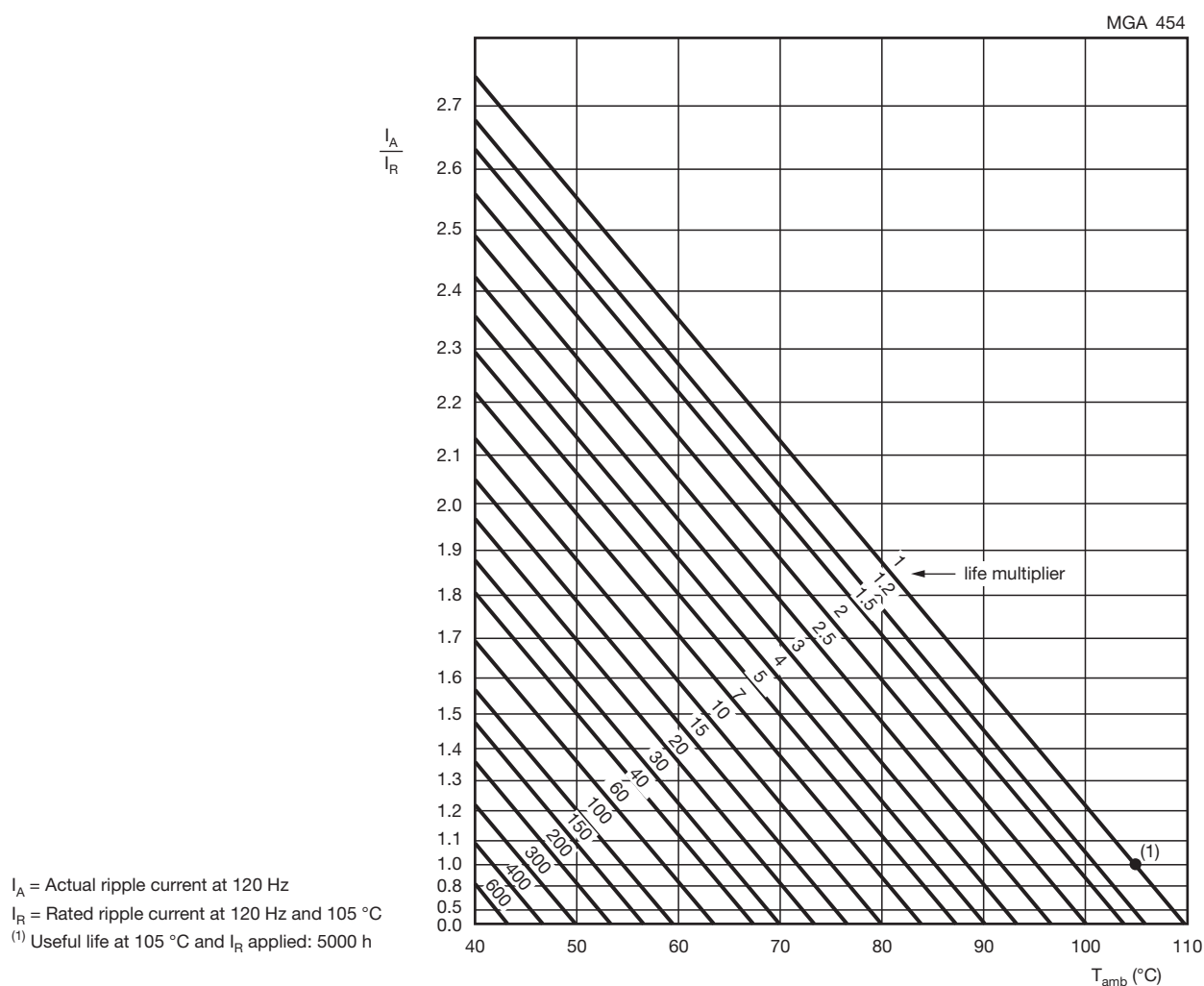


Fig. 6 - Multiplier of useful life as a function of ambient temperature and ripple current load



Table 3

| MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY |                  |
|-------------------------------------------------------------------|------------------|
| FREQUENCY (Hz)                                                    | $I_R$ MULTIPLIER |
| 50                                                                | 0.90             |
| 100                                                               | 0.95             |
| 120                                                               | 1.00             |
| 200                                                               | 1.15             |
| 1000                                                              | 1.30             |
| $\geq 10\,000$                                                    | 1.40             |

Table 4

| TEST PROCEDURES AND REQUIREMENTS               |                                            |                                                                                                                                                  |                                                                                                                                                  |
|------------------------------------------------|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| TEST                                           |                                            | PROCEDURE<br>(quick reference)                                                                                                                   | REQUIREMENTS                                                                                                                                     |
| NAME OF TEST                                   | REFERENCE                                  |                                                                                                                                                  |                                                                                                                                                  |
| Endurance                                      | IEC 60384-4/<br>EN130300<br>subclause 4.13 | $T_{amb} = 105\,^{\circ}\text{C}$ ; $U_R$ applied; 2000 h                                                                                        | $\Delta C/C: \pm 15\,\%$<br>$ESR \leq 1.3 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$                                         |
| Load life                                      |                                            | $T_{amb} = 105\,^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied; 2000 h                                                                              | $\Delta C/C: \pm 20\,\%$<br>$ESR \leq 2 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$                                           |
| Useful life                                    | CECC 30301<br>subclause 1.8.1              | $T_{amb} = 105\,^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied; 5000 h                                                                              | $\Delta C/C: \pm 30\,\%$<br>$ESR \leq 3 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$<br>total failure percentage: $\leq 3\,\%$ |
| Shelf life<br>(storage at<br>high temperature) | IEC 60384-4/<br>EN130300<br>subclause 4.17 | $T_{amb} = 105\,^{\circ}\text{C}$ ; no voltage applied; 1000 h<br>after test: $U_R$ to be applied for 30 min,<br>24 h to 48 h before measurement | $\Delta C/C: \pm 15\,\%$<br>$ESR \leq 1.5 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$                                         |



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