

## Aluminum Electrolytic Capacitors Power Ultra Miniature Snap-In


**RoHS  
COMPLIANT**

### FEATURES

- Up to 500 V
- Useful life: 5000 h at 85 °C
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, very small dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Keyed polarity version available
- Material categorization: for definitions of compliance 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  $\mu\text{F}$ )
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (M for  $\pm 20\%$ )
- Rated voltage (in V)
- Date code (YYMM 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 157 xxxxx
- Climatic category in accordance with IEC 60068



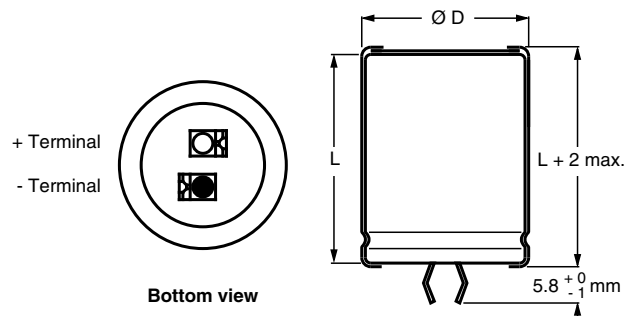
Fig. 1

| QUICK REFERENCE DATA                           |                                        |       |
|------------------------------------------------|----------------------------------------|-------|
| DESCRIPTION                                    | VALUE                                  |       |
| Nominal case sizes (Ø D x L in mm)             | 22 x 25 to 35 x 60                     |       |
| Rated capacitance range (E6/E12 series), $C_R$ | 56 $\mu\text{F}$ to 2200 $\mu\text{F}$ |       |
| Tolerance on $C_R$                             | $\pm 20\%$                             |       |
| Rated voltage range, $U_R$                     | 200 V, 250 V, 400 V, 450 V             | 500 V |
| Category temperature range                     | -25 °C to +85 °C                       |       |
| Endurance test at 85 °C                        | 3000 h                                 |       |
| Load life at 85 °C                             | 3000 h                                 |       |
| Useful life at 85 °C                           | 5000 h                                 |       |
| Useful life at 40 °C, 1.4 x $I_R$ applied      | 90 000 h                               |       |
| Shelf life at 0 V, 85 °C                       | 1000 h                                 |       |
| Max. RMS value of ripple voltage               | 12 V                                   | n/a   |
| Based on sectional specification               | IEC 60384-4 / EN130300                 |       |
| Climatic category IEC 60038                    | 25/085/56                              |       |

| SELECTION CHART FOR $C_R$ , $U_R$ , AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm) |           |     |         |         |         |
|-------------------------------------------------------------------------------------|-----------|-----|---------|---------|---------|
| $C_R$<br>( $\mu\text{F}$ )                                                          | $U_R$ (V) |     |         |         |         |
|                                                                                     | 200       | 250 | 400     | 450     | 500     |
| 47                                                                                  | -         | -   | -       | -       | 22 x 25 |
| 56                                                                                  | -         | -   | -       | 22 x 25 | -       |
| 68                                                                                  | -         | -   | 22 x 25 | 22 x 30 | 22 x 30 |
|                                                                                     | -         | -   | -       | -       | 25 x 25 |
| 82                                                                                  | -         | -   | 22 x 25 | 22 x 30 | -       |
|                                                                                     | -         | -   | -       | 25 x 25 | -       |
| 100                                                                                 | -         | -   | 22 x 30 | 22 x 35 | 22 x 35 |
|                                                                                     | -         | -   | -       | 25 x 30 | 25 x 30 |
|                                                                                     | -         | -   | -       | -       | 30 x 25 |



| 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     |
| 120                                                                                                   | -         | -       | 22 x 30 | 22 x 40 | 22 x 40 |
|                                                                                                       | -         | -       | -       | 25 x 30 | 25 x 35 |
|                                                                                                       | -         | -       | -       | 30 x 25 | -       |
| 150                                                                                                   | -         | -       | 22 x 35 | 25 x 35 | 25 x 40 |
|                                                                                                       | -         | -       | 25 x 30 | 25 x 40 | 30 x 30 |
|                                                                                                       | -         | -       | -       | 30 x 30 | -       |
| 180                                                                                                   | -         | -       | 22 x 40 | 25 x 40 | 25 x 45 |
|                                                                                                       | -         | -       | 25 x 35 | 30 x 35 | 30 x 35 |
|                                                                                                       | -         | -       | -       | 35 x 25 | -       |
| 220                                                                                                   | -         | 22 x 30 | 25 x 40 | 25 x 50 | 30 x 40 |
|                                                                                                       | -         | -       | 30 x 30 | 30 x 40 | 35 x 30 |
|                                                                                                       | -         | -       | 35 x 25 | 35 x 30 | -       |
| 270                                                                                                   | 22 x 25   | 22 x 30 | 25 x 45 | 30 x 45 | 30 x 45 |
|                                                                                                       | -         | 25 x 25 | 30 x 35 | 35 x 35 | 35 x 35 |
|                                                                                                       | -         | -       | 35 x 30 | -       | -       |
| 330                                                                                                   | 22 x 30   | 22 x 35 | 30 x 40 | 30 x 50 | 30 x 50 |
|                                                                                                       | -         | 25 x 30 | 35 x 30 | 35 x 40 | 35 x 40 |
| 390                                                                                                   | 22 x 30   | 22 x 40 | 30 x 45 | 35 x 45 | 35 x 45 |
|                                                                                                       | -         | 30 x 25 | 35 x 35 | -       | -       |
| 470                                                                                                   | 22 x 35   | 25 x 35 | 30 x 50 | 35 x 50 | 35 x 50 |
|                                                                                                       | 25 x 30   | 30 x 30 | 35 x 40 | -       | -       |
| 560                                                                                                   | 22 x 40   | 25 x 40 | 35 x 45 | -       | 35 x 60 |
|                                                                                                       | 25 x 35   | 30 x 30 | -       | -       | -       |
|                                                                                                       | 30 x 25   | 35 x 25 | -       | -       | -       |
| 680                                                                                                   | 25 x 40   | 25 x 45 | 35 x 50 | 35 x 60 | -       |
|                                                                                                       | 30 x 30   | 30 x 35 | -       | -       | -       |
|                                                                                                       | 35 x 25   | 35 x 30 | -       | -       | -       |
| 820                                                                                                   | 25 x 45   | 30 x 40 | 35 x 60 | -       | -       |
|                                                                                                       | 30 x 35   | 35 x 35 | -       | -       | -       |
|                                                                                                       | 35 x 30   | -       | -       | -       | -       |
| 1000                                                                                                  | 30 x 40   | 30 x 45 | -       | -       | -       |
|                                                                                                       | 35 x 30   | 35 x 40 | -       | -       | -       |
| 1200                                                                                                  | 30 x 45   | 35 x 45 | -       | -       | -       |
|                                                                                                       | 35 x 35   | -       | -       | -       | -       |
| 1500                                                                                                  | 30 x 50   | 35 x 50 | -       | -       | -       |
|                                                                                                       | 35 x 40   | -       | -       | -       | -       |
| 1800                                                                                                  | 35 x 45   | -       | -       | -       | -       |
| 2200                                                                                                  | 35 x 50   | -       | -       | -       | -       |

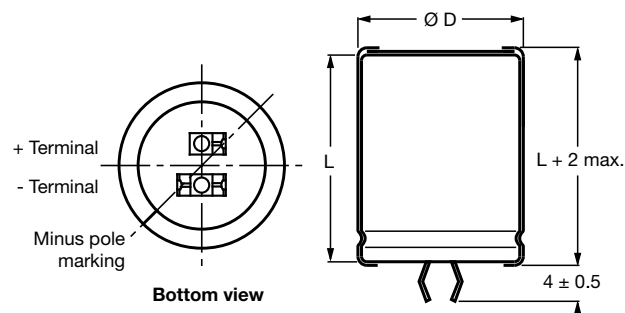
**DIMENSIONS in millimeters AND AVAILABLE FORMS**
**TWO TERMINAL SNAP-IN**


The minus terminal can be marked with a black dot or with an imprinted “-” sign.

Fig. 2 - Two terminal snap-in

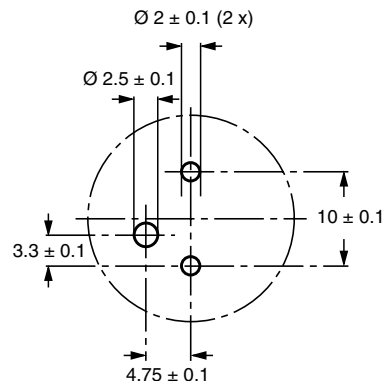


Fig. 3 - Mounting hole diagram

**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 in millimeters, 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 QUANTITIES<br/>(units per box)</b> |
| 22 x 25                                                         | 23                        | 27                      | ≈ 12                | 100                                             |
| 22 x 30                                                         | 23                        | 32                      | ≈ 16                | 100                                             |
| 22 x 35                                                         | 23                        | 37                      | ≈ 20                | 100                                             |
| 22 x 40                                                         | 23                        | 42                      | ≈ 23                | 100                                             |
| 25 x 25                                                         | 26                        | 27                      | ≈ 20                | 100                                             |
| 25 x 30                                                         | 26                        | 32                      | ≈ 22                | 100                                             |
| 25 x 35                                                         | 26                        | 37                      | ≈ 24                | 100                                             |
| 25 x 40                                                         | 26                        | 42                      | ≈ 27                | 100                                             |
| 25 x 45                                                         | 26                        | 47                      | ≈ 32                | 100                                             |
| 25 x 50                                                         | 26                        | 52                      | ≈ 38                | 100                                             |

**DIMENSIONS** in millimeters, **MASS AND PACKAGING QUANTITIES**

| NOMINAL<br>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) |
|---------------------------------|---------------------|-------------------|-------------|-----------------------------------------|
| 30 x 25                         | 31                  | 27                | ≈ 25        | 100                                     |
| 30 x 30                         | 31                  | 32                | ≈ 30        | 100                                     |
| 30 x 35                         | 31                  | 37                | ≈ 35        | 100                                     |
| 30 x 40                         | 31                  | 42                | ≈ 40        | 100                                     |
| 30 x 45                         | 31                  | 47                | ≈ 45        | 100                                     |
| 30 x 50                         | 31                  | 52                | ≈ 50        | 100                                     |
| 35 x 25                         | 36                  | 27                | ≈ 33        | 50                                      |
| 35 x 30                         | 36                  | 32                | ≈ 40        | 50                                      |
| 35 x 35                         | 36                  | 37                | ≈ 48        | 50                                      |
| 35 x 40                         | 36                  | 42                | ≈ 55        | 50                                      |
| 35 x 45                         | 36                  | 47                | ≈ 63        | 50                                      |
| 35 x 50                         | 36                  | 52                | ≈ 72        | 50                                      |
| 35 x 60                         | 36                  | 62                | ≈ 82        | 50                                      |

**ELECTRICAL DATA**

| SYMBOL          | DESCRIPTION                                                     |
|-----------------|-----------------------------------------------------------------|
| C <sub>R</sub>  | Rated capacitance at 100 Hz/120 Hz                              |
| I <sub>R</sub>  | Rated RMS ripple current at 120 Hz, 85 °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**

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

**ORDERING EXAMPLE**

Electrolytic capacitor 157 series

1000 µF/200 V; ± 20 %

Nominal case size: Ø 30 x 40 mm

2-terminal snap-in:

Ordering code: MAL2 157 52102 E3

Former 12NC: 2222 157 52102

3-terminal snap-in:

Ordering code: MAL2 157 72102 E3

Former 12NC: 2222 157 72102



Table 2

| <b>ELECTRICAL DATA AND ORDERING INFORMATION</b> |                                                      |                                                                     |                                                                     |                                                      |                                                                |                                                                |                                               |                                               |                                             |                |
|-------------------------------------------------|------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------|-----------------------------------------------|---------------------------------------------|----------------|
| <b>U<sub>R</sub></b><br><b>(V)</b>              | <b>C<sub>R</sub></b><br><b>100 Hz</b><br><b>(μF)</b> | <b>NOMINAL</b><br><b>CASE SIZE</b><br><b>Ø D x L</b><br><b>(mm)</b> | <b>I<sub>R</sub></b><br><b>120 Hz</b><br><b>85 °C</b><br><b>(A)</b> | <b>I<sub>L5</sub></b><br><b>5 min</b><br><b>(mA)</b> | <b>TYP. ESR</b><br><b>100 Hz <sup>(1)</sup></b><br><b>(mΩ)</b> | <b>MAX. ESR</b><br><b>100 Hz <sup>(1)</sup></b><br><b>(mΩ)</b> | <b>TYP. Z</b><br><b>10 kHz</b><br><b>(mΩ)</b> | <b>MAX. Z</b><br><b>10 kHz</b><br><b>(mΩ)</b> | <b>ORDERING CODE</b><br><b>MAL2157.....</b> |                |
|                                                 |                                                      |                                                                     |                                                                     |                                                      |                                                                |                                                                |                                               |                                               | <b>2-TERM.</b>                              | <b>3-TERM.</b> |
| 200                                             | 270                                                  | 22 x 25                                                             | 1.15                                                                | 0.54                                                 | 550                                                            | 880                                                            | 420                                           | 700                                           | 52271E3                                     | 72271E3        |
|                                                 | 330                                                  | 22 x 30                                                             | 1.36                                                                | 0.66                                                 | 430                                                            | 720                                                            | 300                                           | 500                                           | 52331E3                                     | 72331E3        |
|                                                 | 390                                                  | 22 x 30                                                             | 1.46                                                                | 0.78                                                 | 390                                                            | 650                                                            | 295                                           | 490                                           | 52391E3                                     | 72391E3        |
|                                                 | 470                                                  | 22 x 35                                                             | 1.68                                                                | 0.94                                                 | 350                                                            | 580                                                            | 240                                           | 400                                           | 32471E3                                     | 12471E3        |
|                                                 | 470                                                  | 25 x 30                                                             | 1.67                                                                | 0.94                                                 | 350                                                            | 580                                                            | 240                                           | 400                                           | 52471E3                                     | 72471E3        |
|                                                 | 560                                                  | 22 x 40                                                             | 1.91                                                                | 1.12                                                 | 255                                                            | 425                                                            | 235                                           | 390                                           | 42561E3                                     | 22561E3        |
|                                                 | 560                                                  | 25 x 35                                                             | 1.91                                                                | 1.12                                                 | 255                                                            | 425                                                            | 235                                           | 390                                           | 32561E3                                     | 12561E3        |
|                                                 | 560                                                  | 30 x 25                                                             | 1.89                                                                | 1.12                                                 | 255                                                            | 425                                                            | 235                                           | 390                                           | 52561E3                                     | 72561E3        |
|                                                 | 680                                                  | 25 x 40                                                             | 2.18                                                                | 1.36                                                 | 210                                                            | 350                                                            | 205                                           | 340                                           | 42681E3                                     | 22681E3        |
|                                                 | 680                                                  | 30 x 30                                                             | 2.04                                                                | 1.36                                                 | 210                                                            | 350                                                            | 205                                           | 340                                           | 52681E3                                     | 72681E3        |
|                                                 | 680                                                  | 35 x 25                                                             | 2.06                                                                | 1.36                                                 | 210                                                            | 350                                                            | 205                                           | 340                                           | 62681E3                                     | 82681E3        |
|                                                 | 820                                                  | 25 x 45                                                             | 2.46                                                                | 1.64                                                 | 170                                                            | 290                                                            | 145                                           | 240                                           | 62821E3                                     | 82821E3        |
|                                                 | 820                                                  | 30 x 35                                                             | 2.35                                                                | 1.64                                                 | 170                                                            | 290                                                            | 145                                           | 240                                           | 32821E3                                     | 12821E3        |
|                                                 | 820                                                  | 35 x 30                                                             | 2.29                                                                | 1.64                                                 | 170                                                            | 290                                                            | 145                                           | 240                                           | 52821E3                                     | 72821E3        |
|                                                 | 1000                                                 | 30 x 40                                                             | 2.66                                                                | 2.00                                                 | 140                                                            | 235                                                            | 135                                           | 225                                           | 52102E3                                     | 72102E3        |
|                                                 | 1000                                                 | 35 x 30                                                             | 2.33                                                                | 2.00                                                 | 140                                                            | 235                                                            | 135                                           | 225                                           | 62102E3                                     | 82102E3        |
|                                                 | 1200                                                 | 30 x 45                                                             | 2.98                                                                | 2.40                                                 | 120                                                            | 200                                                            | 110                                           | 190                                           | 32122E3                                     | 12122E3        |
|                                                 | 1200                                                 | 35 x 35                                                             | 2.69                                                                | 2.40                                                 | 120                                                            | 200                                                            | 110                                           | 190                                           | 62122E3                                     | 82122E3        |
|                                                 | 1500                                                 | 30 x 50                                                             | 3.31                                                                | 3.00                                                 | 110                                                            | 180                                                            | 95                                            | 155                                           | 42152E3                                     | 22152E3        |
|                                                 | 1500                                                 | 35 x 40                                                             | 3.04                                                                | 3.00                                                 | 110                                                            | 180                                                            | 95                                            | 155                                           | 52152E3                                     | 72152E3        |
|                                                 | 1800                                                 | 35 x 45                                                             | 3.36                                                                | 3.60                                                 | 100                                                            | 160                                                            | 80                                            | 130                                           | 42182E3                                     | 22182E3        |
|                                                 | 2200                                                 | 35 x 50                                                             | 3.68                                                                | 4.40                                                 | 90                                                             | 150                                                            | 65                                            | 105                                           | 52222E3                                     | 72222E3        |
| 250                                             | 220                                                  | 22 x 30                                                             | 1.23                                                                | 0.55                                                 | 600                                                            | 1080                                                           | 420                                           | 700                                           | 53221E3                                     | 73221E3        |
|                                                 | 270                                                  | 22 x 30                                                             | 1.32                                                                | 0.67                                                 | 490                                                            | 880                                                            | 335                                           | 560                                           | 43271E3                                     | 23271E3        |
|                                                 | 270                                                  | 25 x 25                                                             | 1.23                                                                | 0.67                                                 | 490                                                            | 880                                                            | 335                                           | 560                                           | 53271E3                                     | 73271E3        |
|                                                 | 330                                                  | 22 x 35                                                             | 1.53                                                                | 0.82                                                 | 400                                                            | 720                                                            | 255                                           | 430                                           | 33331E3                                     | 13331E3        |
|                                                 | 330                                                  | 25 x 30                                                             | 1.56                                                                | 0.82                                                 | 400                                                            | 720                                                            | 255                                           | 430                                           | 53331E3                                     | 73331E3        |
|                                                 | 390                                                  | 22 x 40                                                             | 1.74                                                                | 0.97                                                 | 330                                                            | 610                                                            | 250                                           | 425                                           | 43391E3                                     | 23391E3        |
|                                                 | 390                                                  | 30 x 25                                                             | 1.58                                                                | 0.97                                                 | 330                                                            | 610                                                            | 250                                           | 425                                           | 53391E3                                     | 73391E3        |
|                                                 | 470                                                  | 25 x 35                                                             | 1.87                                                                | 1.17                                                 | 280                                                            | 505                                                            | 190                                           | 320                                           | 33471E3                                     | 13471E3        |
|                                                 | 470                                                  | 30 x 30                                                             | 1.89                                                                | 1.17                                                 | 280                                                            | 505                                                            | 190                                           | 320                                           | 53471E3                                     | 73471E3        |
|                                                 | 560                                                  | 25 x 40                                                             | 2.12                                                                | 1.40                                                 | 240                                                            | 425                                                            | 185                                           | 310                                           | 43561E3                                     | 23561E3        |
|                                                 | 560                                                  | 30 x 30                                                             | 1.97                                                                | 1.40                                                 | 240                                                            | 425                                                            | 185                                           | 310                                           | 53561E3                                     | 73561E3        |
|                                                 | 560                                                  | 35 x 25                                                             | 1.80                                                                | 1.40                                                 | 240                                                            | 425                                                            | 185                                           | 310                                           | 63561E3                                     | 83561E3        |
|                                                 | 680                                                  | 25 x 45                                                             | 2.29                                                                | 1.70                                                 | 200                                                            | 350                                                            | 155                                           | 260                                           | 63681E3                                     | 83681E3        |
|                                                 | 680                                                  | 30 x 35                                                             | 2.28                                                                | 1.70                                                 | 200                                                            | 350                                                            | 155                                           | 260                                           | 33681E3                                     | 13681E3        |
|                                                 | 680                                                  | 35 x 30                                                             | 2.20                                                                | 1.70                                                 | 200                                                            | 350                                                            | 155                                           | 260                                           | 53681E3                                     | 73681E3        |
|                                                 | 820                                                  | 30 x 40                                                             | 2.57                                                                | 2.05                                                 | 160                                                            | 290                                                            | 125                                           | 210                                           | 53821E3                                     | 73821E3        |
|                                                 | 820                                                  | 35 x 35                                                             | 2.54                                                                | 2.05                                                 | 160                                                            | 290                                                            | 125                                           | 210                                           | 63821E3                                     | 83821E3        |
|                                                 | 1000                                                 | 30 x 45                                                             | 2.88                                                                | 2.50                                                 | 140                                                            | 235                                                            | 105                                           | 180                                           | 33102E3                                     | 13102E3        |
|                                                 | 1000                                                 | 35 x 40                                                             | 2.86                                                                | 2.50                                                 | 140                                                            | 235                                                            | 105                                           | 180                                           | 53102E3                                     | 73102E3        |
|                                                 | 1200                                                 | 35 x 45                                                             | 3.17                                                                | 3.00                                                 | 120                                                            | 200                                                            | 95                                            | 160                                           | 43122E3                                     | 23122E3        |
|                                                 | 1500                                                 | 35 x 50                                                             | 3.49                                                                | 3.75                                                 | 90                                                             | 160                                                            | 85                                            | 140                                           | 53152E3                                     | 73152E3        |



| 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>85 °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>MAL2157..... |         |
|                                          |                                  |                                         |                                          |                                  |                                           |                                           |                          |                          | 2-TERM.                       | 3-TERM. |
| 400                                      | 68                               | 22 x 25                                 | 0.71                                     | 0.27                             | 1400                                      | 2800                                      | 1170                     | 1950                     | 56689E3                       | 76689E3 |
|                                          | 82                               | 22 x 25                                 | 0.77                                     | 0.33                             | 1250                                      | 2500                                      | 970                      | 1620                     | 56829E3                       | 76829E3 |
|                                          | 100                              | 22 x 30                                 | 0.94                                     | 0.40                             | 1125                                      | 2250                                      | 750                      | 1220                     | 56101E3                       | 76101E3 |
|                                          | 120                              | 22 x 30                                 | 0.97                                     | 0.48                             | 990                                       | 1980                                      | 700                      | 1140                     | 56121E3                       | 76121E3 |
|                                          | 150                              | 22 x 35                                 | 1.13                                     | 0.60                             | 750                                       | 1500                                      | 540                      | 900                      | 36151E3                       | 16151E3 |
|                                          | 150                              | 25 x 30                                 | 1.16                                     | 0.60                             | 750                                       | 1500                                      | 540                      | 900                      | 56151E3                       | 76151E3 |
|                                          | 180                              | 22 x 40                                 | 1.29                                     | 0.72                             | 630                                       | 1260                                      | 435                      | 725                      | 46181E3                       | 26181E3 |
|                                          | 180                              | 25 x 35                                 | 1.35                                     | 0.72                             | 630                                       | 1260                                      | 435                      | 725                      | 36181E3                       | 16181E3 |
|                                          | 220                              | 25 x 40                                 | 1.54                                     | 0.88                             | 520                                       | 1040                                      | 355                      | 590                      | 46221E3                       | 26221E3 |
|                                          | 220                              | 30 x 30                                 | 1.50                                     | 0.88                             | 520                                       | 1040                                      | 355                      | 590                      | 56221E3                       | 76221E3 |
|                                          | 220                              | 35 x 25                                 | 1.42                                     | 0.88                             | 520                                       | 1040                                      | 355                      | 590                      | 66221E3                       | 86221E3 |
|                                          | 270                              | 25 x 45                                 | 1.72                                     | 1.08                             | 430                                       | 860                                       | 335                      | 560                      | 66271E3                       | 86271E3 |
|                                          | 270                              | 30 x 35                                 | 1.74                                     | 1.08                             | 430                                       | 860                                       | 335                      | 560                      | 36271E3                       | 16271E3 |
|                                          | 270                              | 35 x 30                                 | 1.71                                     | 1.08                             | 430                                       | 860                                       | 335                      | 560                      | 56271E3                       | 76271E3 |
|                                          | 330                              | 30 x 40                                 | 1.97                                     | 1.32                             | 350                                       | 700                                       | 315                      | 525                      | 56331E3                       | 76331E3 |
|                                          | 330                              | 35 x 30                                 | 1.76                                     | 1.32                             | 350                                       | 700                                       | 315                      | 525                      | 66331E3                       | 86331E3 |
|                                          | 390                              | 30 x 45                                 | 2.19                                     | 1.56                             | 300                                       | 610                                       | 250                      | 420                      | 56391E3                       | 76391E3 |
|                                          | 390                              | 35 x 35                                 | 2.04                                     | 1.56                             | 300                                       | 610                                       | 250                      | 420                      | 36391E3                       | 16391E3 |
|                                          | 470                              | 30 x 50                                 | 2.40                                     | 1.88                             | 250                                       | 505                                       | 210                      | 350                      | 46471E3                       | 26471E3 |
|                                          | 470                              | 35 x 40                                 | 2.30                                     | 1.88                             | 250                                       | 505                                       | 210                      | 350                      | 56471E3                       | 76471E3 |
| 450                                      | 560                              | 35 x 45                                 | 2.55                                     | 2.24                             | 210                                       | 425                                       | 180                      | 305                      | 46561E3                       | 26561E3 |
|                                          | 680                              | 35 x 50                                 | 2.79                                     | 2.72                             | 190                                       | 380                                       | 160                      | 265                      | 56681E3                       | 76681E3 |
|                                          | 820                              | 35 x 60                                 | 3.33                                     | 3.28                             | 155                                       | 315                                       | 115                      | 215                      | 56821E3                       | 76821E3 |
|                                          | 56                               | 22 x 25                                 | 0.68                                     | 0.25                             | 1650                                      | 3300                                      | 1120                     | 1880                     | 57569E3                       | 77569E3 |
|                                          | 68                               | 22 x 30                                 | 0.80                                     | 0.30                             | 1400                                      | 2800                                      | 920                      | 1530                     | 57689E3                       | 77689E3 |
|                                          | 82                               | 22 x 30                                 | 0.87                                     | 0.36                             | 1200                                      | 2400                                      | 780                      | 1290                     | 47829E3                       | 27829E3 |
|                                          | 82                               | 25 x 25                                 | 0.85                                     | 0.36                             | 1200                                      | 2400                                      | 780                      | 1290                     | 57829E3                       | 77829E3 |
|                                          | 100                              | 22 x 35                                 | 1.00                                     | 0.45                             | 1000                                      | 2000                                      | 630                      | 1050                     | 37101E3                       | 17101E3 |
|                                          | 100                              | 25 x 30                                 | 1.02                                     | 0.45                             | 1000                                      | 2000                                      | 630                      | 1050                     | 57101E3                       | 77101E3 |
|                                          | 120                              | 22 x 40                                 | 1.15                                     | 0.54                             | 800                                       | 1600                                      | 530                      | 885                      | 47121E3                       | 27121E3 |
|                                          | 120                              | 25 x 30                                 | 1.09                                     | 0.54                             | 800                                       | 1600                                      | 530                      | 885                      | 57121E3                       | 77121E3 |
|                                          | 120                              | 30 x 25                                 | 1.10                                     | 0.54                             | 800                                       | 1600                                      | 530                      | 885                      | 67121E3                       | 87121E3 |
|                                          | 150                              | 25 x 40                                 | 1.35                                     | 0.67                             | 650                                       | 1300                                      | 420                      | 705                      | 47151E3                       | 27151E3 |
|                                          | 150                              | 25 x 35                                 | 1.27                                     | 0.67                             | 650                                       | 1300                                      | 420                      | 705                      | 67151E3                       | 87151E3 |
|                                          | 150                              | 30 x 30                                 | 1.32                                     | 0.67                             | 650                                       | 1300                                      | 420                      | 705                      | 57151E3                       | 77151E3 |
|                                          | 180                              | 25 x 40                                 | 1.45                                     | 0.81                             | 570                                       | 1150                                      | 360                      | 605                      | 47181E3                       | 27181E3 |
|                                          | 180                              | 30 x 35                                 | 1.49                                     | 0.81                             | 570                                       | 1150                                      | 360                      | 605                      | 57181E3                       | 77181E3 |
|                                          | 180                              | 35 x 25                                 | 1.35                                     | 0.81                             | 570                                       | 1150                                      | 360                      | 605                      | 67181E3                       | 87181E3 |
|                                          | 220                              | 25 x 50                                 | 1.73                                     | 0.99                             | 450                                       | 900                                       | 315                      | 525                      | 47221E3                       | 27221E3 |
|                                          | 220                              | 30 x 40                                 | 1.72                                     | 0.99                             | 450                                       | 900                                       | 315                      | 525                      | 57221E3                       | 77221E3 |
|                                          | 220                              | 35 x 30                                 | 1.61                                     | 0.99                             | 450                                       | 900                                       | 315                      | 525                      | 67221E3                       | 87221E3 |
|                                          | 270                              | 30 x 45                                 | 1.95                                     | 1.21                             | 380                                       | 770                                       | 270                      | 450                      | 37271E3                       | 17271E3 |
|                                          | 270                              | 35 x 35                                 | 1.86                                     | 1.21                             | 380                                       | 770                                       | 270                      | 450                      | 67271E3                       | 87271E3 |
|                                          | 330                              | 30 x 50                                 | 2.19                                     | 1.48                             | 300                                       | 600                                       | 230                      | 390                      | 47331E3                       | 27331E3 |
|                                          | 330                              | 35 x 40                                 | 2.10                                     | 1.48                             | 300                                       | 600                                       | 230                      | 390                      | 57331E3                       | 77331E3 |
|                                          | 390                              | 35 x 45                                 | 2.34                                     | 1.75                             | 250                                       | 500                                       | 190                      | 340                      | 47391E3                       | 27391E3 |
|                                          | 470                              | 35 x 50                                 | 2.60                                     | 2.11                             | 210                                       | 420                                       | 170                      | 290                      | 57471E3                       | 77471E3 |
|                                          | 680                              | 35 x 60                                 | 3.15                                     | 3.06                             | 150                                       | 300                                       | 110                      | 200                      | 57681E3                       | 77681E3 |

**ELECTRICAL DATA AND ORDERING INFORMATION**

| $U_R$<br>(V) | $C_R$<br>100 Hz<br>( $\mu$ F) | NOMINAL<br>CASE SIZE<br>$\varnothing$ D x L<br>(mm) | $I_R$<br>120 Hz<br>85 °C<br>(A) | $I_{L5}$<br>5 min<br>(mA) | TYP. ESR<br>100 Hz <sup>(1)</sup><br>(m $\Omega$ ) | MAX. ESR<br>100 Hz <sup>(1)</sup><br>(m $\Omega$ ) | TYP. Z<br>10 kHz<br>(m $\Omega$ ) | MAX. Z<br>10 kHz<br>(m $\Omega$ ) | ORDERING CODE<br>MAL2157..... |         |
|--------------|-------------------------------|-----------------------------------------------------|---------------------------------|---------------------------|----------------------------------------------------|----------------------------------------------------|-----------------------------------|-----------------------------------|-------------------------------|---------|
|              |                               |                                                     |                                 |                           |                                                    |                                                    |                                   |                                   | 2-TERM.                       | 3-TERM. |
| 500          | 47                            | 22 x 25                                             | 0.68                            | 0.24                      | 2834                                               | 3540                                               | 2095                              | 2930                              | 59479E3                       | 79479E3 |
|              | 68                            | 22 x 30                                             | 0.85                            | 0.34                      | 1961                                               | 2450                                               | 1451                              | 2030                              | 59689E3                       | 79689E3 |
|              | 68                            | 25 x 25                                             | 0.86                            | 0.34                      | 1979                                               | 2470                                               | 1469                              | 2060                              | 49689E3                       | 29689E3 |
|              | 100                           | 22 x 35                                             | 1.07                            | 0.50                      | 1339                                               | 1670                                               | 992                               | 1390                              | 59101E3                       | 79101E3 |
|              | 100                           | 25 x 30                                             | 1.08                            | 0.50                      | 1349                                               | 1690                                               | 1003                              | 1400                              | 49101E3                       | 29101E3 |
|              | 100                           | 30 x 25                                             | 1.13                            | 0.50                      | 1375                                               | 1720                                               | 1030                              | 1440                              | 39101E3                       | 19101E3 |
|              | 120                           | 22 x 40                                             | 1.24                            | 0.60                      | 1117                                               | 1400                                               | 828                               | 1160                              | 59121E3                       | 79121E3 |
|              | 120                           | 25 x 35                                             | 1.23                            | 0.60                      | 1122                                               | 1400                                               | 833                               | 1170                              | 49121E3                       | 29121E3 |
|              | 150                           | 25 x 40                                             | 1.43                            | 0.75                      | 901                                                | 1130                                               | 670                               | 940                               | 59151E3                       | 79151E3 |
|              | 150                           | 30 x 30                                             | 1.42                            | 0.75                      | 922                                                | 1150                                               | 693                               | 970                               | 49151E3                       | 29151E3 |
|              | 180                           | 25 x 45                                             | 1.65                            | 0.90                      | 752                                                | 940                                                | 560                               | 780                               | 59181E3                       | 79181E3 |
|              | 180                           | 30 x 35                                             | 1.61                            | 0.90                      | 765                                                | 960                                                | 573                               | 800                               | 49181E3                       | 29181E3 |
|              | 220                           | 30 x 40                                             | 1.84                            | 1.10                      | 629                                                | 790                                                | 472                               | 660                               | 59221E3                       | 79221E3 |
|              | 220                           | 35 x 30                                             | 1.83                            | 1.10                      | 660                                                | 830                                                | 505                               | 710                               | 49221E3                       | 29221E3 |
|              | 270                           | 30 x 45                                             | 2.11                            | 1.35                      | 515                                                | 640                                                | 387                               | 540                               | 59271E3                       | 79271E3 |
|              | 270                           | 35 x 35                                             | 2.09                            | 1.35                      | 534                                                | 670                                                | 408                               | 570                               | 49271E3                       | 29271E3 |
|              | 330                           | 30 x 50                                             | 2.40                            | 1.65                      | 426                                                | 530                                                | 322                               | 450                               | 59331E3                       | 79331E3 |
|              | 330                           | 35 x 40                                             | 2.36                            | 1.65                      | 441                                                | 550                                                | 337                               | 470                               | 49331E3                       | 29331E3 |
|              | 390                           | 35 x 45                                             | 2.63                            | 1.95                      | 374                                                | 470                                                | 286                               | 400                               | 59391E3                       | 79391E3 |
|              | 470                           | 35 x 50                                             | 2.92                            | 2.35                      | 316                                                | 400                                                | 244                               | 340                               | 59471E3                       | 79471E3 |
|              | 560                           | 35 x 60                                             | 3.40                            | 2.80                      | 262                                                | 330                                                | 201                               | 280                               | 59561E3                       | 79561E3 |

**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                        |

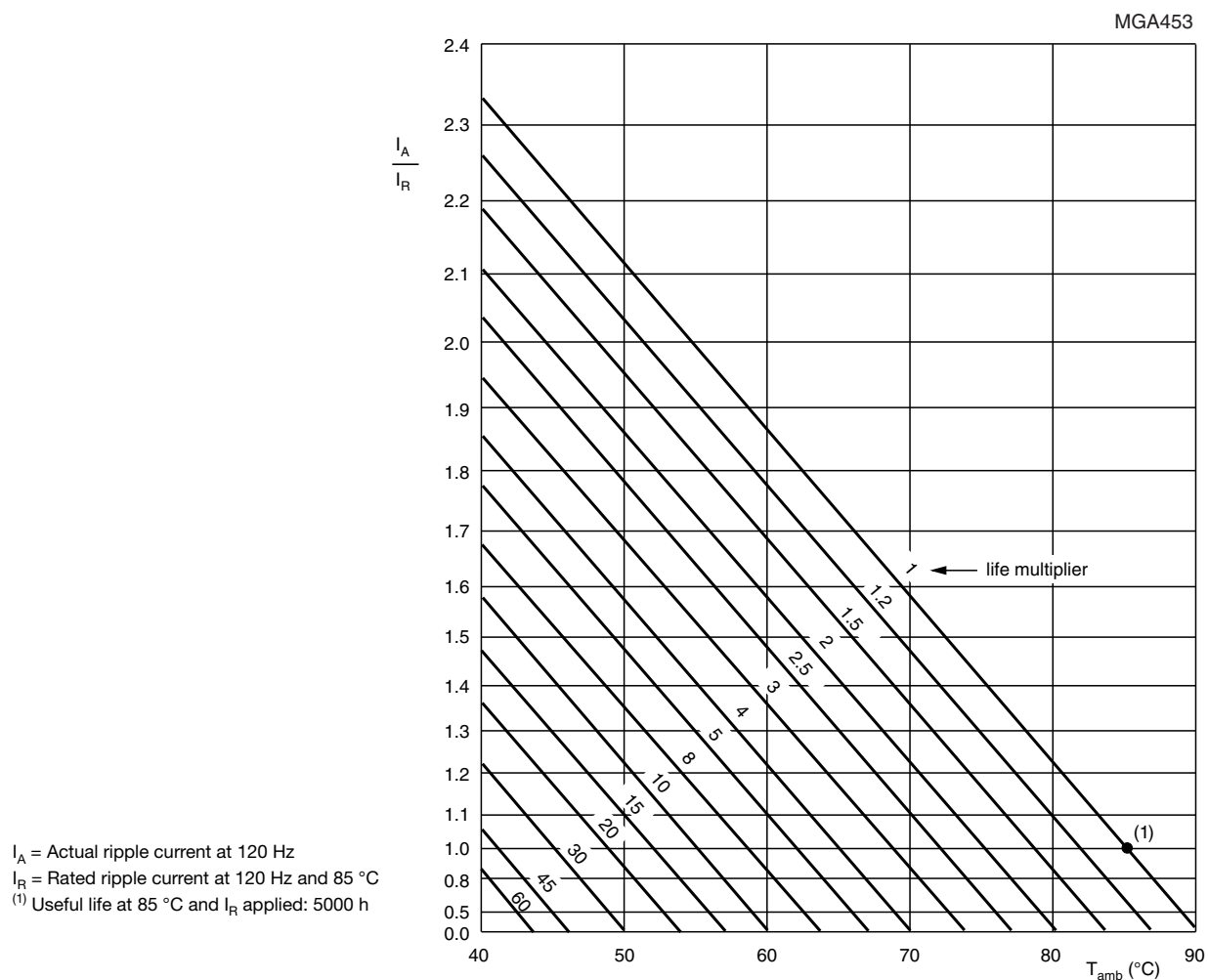
**RIPPLE CURRENT AND USEFUL LIFE**


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<br>(Hz)                                                 | $I_R$ MULTIPLIER |
| 50                                                                | 0.90             |
| 100                                                               | 0.95             |
| 120                                                               | 1.00             |
| 200                                                               | 1.15             |
| 1000                                                              | 1.30             |
| ≥ 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 | $T_{amb} = 85\text{ }^{\circ}\text{C}$ ; $U_R$ applied;<br>3000 h                                                                                        | $\Delta C/C: \pm 10\%$<br>$ESR \leq 2 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$                                                                                           |
| Load life                                      |                                            | $T_{amb} = 85\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied;<br>3000 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              | $T_{amb} = 85\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied;<br>5000 h                                                                              | $\Delta C/C: \pm 30\%$<br>$ESR \leq 3 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$<br>no short or open circuit,<br>no visible damage<br>total failure percentage: $\leq 3\%$ |
| Shelf life<br>(storage at<br>high temperature) | IEC 60384-4/<br>EN130300<br>subclause 4.17 | $T_{amb} = 85\text{ }^{\circ}\text{C}$ ; no voltage applied;<br>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>$I_{L5} \leq 1 \times \text{spec. limit}$                                                                                |



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