

## Aluminum Electrolytic Capacitors Power Ultra Miniature Snap-In


**RoHS  
COMPLIANT**

### FEATURES

- Long useful life: 5000 h at 85 °C
- Low ESR
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, very small dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Charge and discharge proof
- High ripple current capability
- 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 code on rated capacitance, code letter in accordance with IEC 60062 (M for  $\pm 20\%$ )
- Rated voltage (in V)
- Date code (YYMM)
- Name of manufacturer
- Code for factory of origin
- “-” sign to identify the negative terminal, visible from the top and side of the capacitor
- Code number
- Climatic category in accordance with IEC 60068



Fig. 1

### QUICK REFERENCE DATA

| DESCRIPTION                                         | VALUE                                      |
|-----------------------------------------------------|--------------------------------------------|
| Nominal case size ( $\varnothing D \times L$ in mm) | 22 x 25 to 35 x 60                         |
| Rated capacitance range (E6 series), $C_R$          | 1000 $\mu\text{F}$ to 22 000 $\mu\text{F}$ |
| Tolerance on $C_R$                                  | $\pm 20\%$                                 |
| Rated voltage range, $U_R$                          | 16 V to 100 V                              |
| Category temperature range                          | -40 °C to +85 °C                           |
| Endurance test at 85 °C                             | 2000 h                                     |
| Useful life at 85 °C                                | 5000 h                                     |
| Useful life at 40 °C and 1.4 x $I_R$ applied        | 90 000 h                                   |
| Shelf life at 0 V, 85 °C                            | 500 h                                      |
| Based on sectional specification                    | IEC 60384-4 / EN130300                     |
| Climatic category IEC 60068                         | 40 / 085 / 56                              |

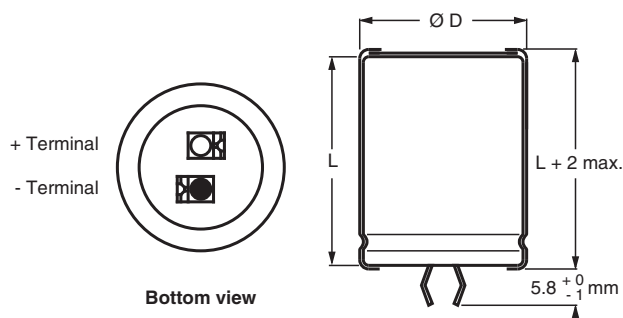
### SELECTION CHART FOR $C_R$ , $U_R$ , AND RELEVANT NOMINAL CASE SIZES ( $\varnothing D \times L$ in mm)

| $C_R$<br>( $\mu\text{F}$ ) | $U_R$ (V) |         |         |         |         |         |         |
|----------------------------|-----------|---------|---------|---------|---------|---------|---------|
|                            | 16        | 25      | 40      | 50      | 63      | 80      | 100     |
| 1000                       | -         | -       | -       | -       | -       | -       | 22 x 30 |
| 1200                       | -         | -       | -       | -       | -       | -       | 22 x 35 |
| 1500                       | -         | -       | -       | -       | 22 x 25 | 22 x 30 | 25 x 30 |
| 1800                       | -         | -       | -       | -       | 25 x 25 | -       | -       |
| 2200                       | -         | -       | -       | 22 x 25 | 22 x 30 | 25 x 30 | 25 x 40 |
|                            | -         | -       | -       | -       | 25 x 25 | -       | 30 x 30 |
| 2700                       | -         | -       | 22 x 25 | -       | 25 x 30 | -       | 30 x 35 |
| 3300                       | -         | -       | 22 x 30 | 22 x 30 | 25 x 35 | 25 x 40 | 30 x 40 |
|                            | -         | -       | 25 x 25 | -       | -       | -       | 35 x 30 |
| 3900                       | -         | -       | -       | 25 x 30 | 25 x 40 | -       | -       |
| 4700                       | -         | -       | 25 x 30 | 25 x 35 | 22 x 50 | 30 x 40 | 30 x 50 |
|                            | -         | 22 x 25 | -       | -       | 30 x 30 | -       | 35 x 40 |

| 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) |         |         |         |         |         |         |
|                                                                                                       | 16        | 25      | 40      | 50      | 63      | 80      | 100     |
| 5600                                                                                                  | -         | 25 x 25 | -       | 25 x 40 | 30 x 35 | -       | -       |
| 6800                                                                                                  | -         | -       | 25 x 40 | 30 x 30 | 30 x 40 | 30 x 50 | 35 x 50 |
| 8200                                                                                                  | -         | -       | 30 x 30 | 30 x 35 | 30 x 50 | -       | 35 x 60 |
| 10 000                                                                                                | 25 x 30   | 22 x 40 | 30 x 35 | 30 x 40 | 35 x 40 | 35 x 50 | -       |
| 12 000                                                                                                | -         | 25 x 40 | 30 x 40 | 30 x 50 | 35 x 50 | -       | -       |
| 15 000                                                                                                | 25 x 40   | 30 x 35 | 30 x 50 | -       | 35 x 60 | -       | -       |
|                                                                                                       | 30 x 30   | -       | -       | -       | -       | -       | -       |
| 18 000                                                                                                | -         | 30 x 40 | 35 x 40 | 35 x 50 | -       | -       | -       |
| 22 000                                                                                                | 30 x 35   | -       | 35 x 50 | 35 x 60 | -       | -       | -       |
| 27 000                                                                                                | -         | 35 x 40 | -       | -       | -       | -       | -       |
| 39 000                                                                                                | 35 x 40   | -       | -       | -       | -       | -       | -       |

## 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

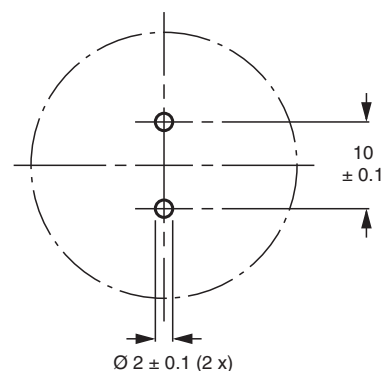
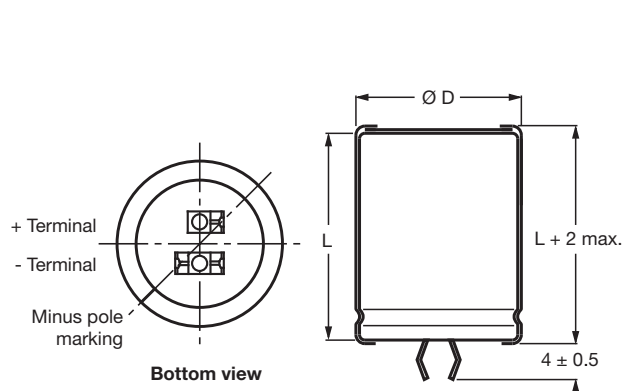


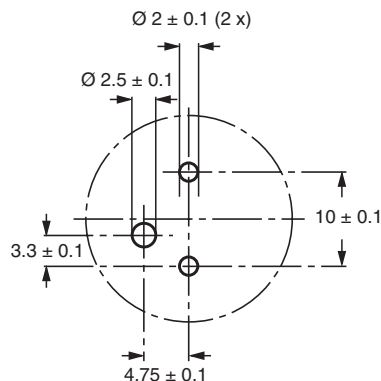
Fig. 3 - Mounting hole diagram

### 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> |                             |                           |             |                                         |                                       |
|------------------------------------------------------------------------|-----------------------------|---------------------------|-------------|-----------------------------------------|---------------------------------------|
| NOMINAL CASE SIZE<br>Ø D x L                                           | Ø D <sub>max.</sub><br>(mm) | L <sub>max.</sub><br>(mm) | MASS<br>(g) | PACKAGING QUANTITIES<br>(units per box) | CARDBOARD BOX DIMENSIONS<br>L x W x H |
| 22 x 25                                                                | 23                          | 27                        | ≈ 12        | 100                                     | 260 x 250 x 39                        |
| 22 x 30                                                                | 23                          | 32                        | ≈ 16        | 100                                     | 260 x 250 x 44                        |
| 22 x 35                                                                | 23                          | 37                        | ≈ 20        | 100                                     | 260 x 250 x 49                        |
| 22 x 40                                                                | 23                          | 42                        | ≈ 23        | 100                                     | 260 x 250 x 54                        |
| 22 x 50                                                                | 23                          | 52                        | ≈ 29        | 100                                     | 260 x 250 x 64                        |
| 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                        |
| 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                        | ≈ 42        | 100                                     | 340 x 330 x 54                        |
| 30 x 50                                                                | 31                          | 52                        | ≈ 52        | 100                                     | 340 x 330 x 64                        |
| 35 x 30                                                                | 36                          | 32                        | ≈ 40        | 50                                      | 390 x 198 x 44                        |
| 35 x 40                                                                | 36                          | 42                        | ≈ 55        | 50                                      | 390 x 198 x 54                        |
| 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> |                                                    |
|------------------------|----------------------------------------------------|
| SYMBOL                 | DESCRIPTION                                        |
| C <sub>R</sub>         | Rated capacitance at 100 Hz                        |
| I <sub>R</sub>         | Rated RMS ripple current at 100 Hz and 85 °C       |
| I <sub>L1</sub>        | Max. leakage current after 1 min at U <sub>R</sub> |
| ESR                    | Max. equivalent series resistance at 100 Hz        |
| Z                      | Max. impedance at 10 kHz                           |

**Note**

- 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 156 series

1000 µF / 25 V; ± 20 %

Nominal case size: Ø 25 x 40 mm

**2-terminal snap-in:**

Ordering code: MAL2 156 26123 E3

Former 12NC: 2222 156 26123

**3-terminal snap-in:**

Ordering code: MAL2 156 66123 E3

Former 12NC: 2222 156 66123

Table 2

| <b>ELECTRICAL DATA AND ORDERING INFORMATION</b> |                                  |                                      |                                          |                                  |                            |                          |                               |         |
|-------------------------------------------------|----------------------------------|--------------------------------------|------------------------------------------|----------------------------------|----------------------------|--------------------------|-------------------------------|---------|
| U <sub>R</sub><br>(V)                           | C <sub>R</sub><br>100 Hz<br>(µF) | NOMINAL CASE SIZE<br>Ø D x L<br>(mm) | I <sub>R</sub><br>100 Hz<br>85 °C<br>(A) | I <sub>L5</sub><br>5 min<br>(µA) | MAX. ESR<br>100 Hz<br>(mΩ) | MAX. Z<br>10 kHz<br>(mΩ) | ORDERING CODE<br>MAL2156..... |         |
|                                                 |                                  |                                      |                                          |                                  |                            |                          | 2-TERM.                       | 3-TERM. |
| 16                                              | 10 000                           | 25 x 30                              | 3.93                                     | 324                              | 49                         | 33                       | 25103E3                       | 65103E3 |
|                                                 | 15 000                           | 25 x 40                              | 4.98                                     | 484                              | 36                         | 26                       | 35153E3                       | 75153E3 |
|                                                 | 18 000                           | 30 x 30                              | 4.12                                     | 580                              | 53                         | 33                       | 35183E3                       | 75183E3 |
|                                                 | 22 000                           | 30 x 35                              | 4.71                                     | 708                              | 44                         | 29                       | 25223E3                       | 65223E3 |
|                                                 | 39 000                           | 35 x 40                              | 5.17                                     | 1252                             | 45                         | 26                       | 25393E3                       | 65393E3 |
| 25                                              | 4700                             | 22 x 25                              | 2.37                                     | 239                              | 100                        | 90                       | 16472E3                       | 56472E3 |
|                                                 | 5600                             | 25 x 25                              | 3.03                                     | 284                              | 74                         | 46                       | 26562E3                       | 66562E3 |
|                                                 | 10 000                           | 22 x 40                              | 4.40                                     | 504                              | 41                         | 27                       | 16103E3                       | 56103E3 |
|                                                 | 12 000                           | 25 x 40                              | 4.73                                     | 604                              | 40                         | 27                       | 26123E3                       | 66123E3 |
|                                                 | 15 000                           | 30 x 35                              | 4.55                                     | 754                              | 47                         | 31                       | 26153E3                       | 66153E3 |
|                                                 | 18 000                           | 30 x 40                              | 5.06                                     | 904                              | 41                         | 27                       | 16183E3                       | 56183E3 |
|                                                 | 27 000                           | 35 x 40                              | 5.04                                     | 1354                             | 47                         | 27                       | 26273E3                       | 66273E3 |



| 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>100 Hz<br>85 °C<br>(A) | I <sub>L5</sub><br>5 min<br>(μA) | MAX. ESR<br>100 Hz<br>(mΩ) | MAX. Z<br>10 kHz<br>(mΩ) | ORDERING CODE<br>MAL2156..... |         |
|                                          |                                  |                                         |                                          |                                  |                            |                          | 2-TERM.                       | 3-TERM. |
| 40                                       | 2700                             | 22 x 25                                 | 2.47                                     | 220                              | 97                         | 57                       | 17272E3                       | 57272E3 |
|                                          | 3300                             | 22 x 30                                 | 2.98                                     | 268                              | 74                         | 43                       | 27332E3                       | 67332E3 |
|                                          | 3300                             | 25 x 25                                 | 2.69                                     | 268                              | 93                         | 58                       | 17332E3                       | 57332E3 |
|                                          | 4700                             | 25 x 30                                 | 3.32                                     | 380                              | 68                         | 44                       | 27472E3                       | 67472E3 |
|                                          | 6800                             | 25 x 40                                 | 4.26                                     | 548                              | 49                         | 33                       | 37682E3                       | 77682E3 |
|                                          | 8200                             | 30 x 30                                 | 3.49                                     | 660                              | 74                         | 44                       | 37822E3                       | 77822E3 |
|                                          | 10 000                           | 30 x 35                                 | 4.02                                     | 804                              | 60                         | 38                       | 17103E3                       | 57103E3 |
|                                          | 12 000                           | 30 x 40                                 | 4.49                                     | 964                              | 52                         | 33                       | 17123E3                       | 57123E3 |
|                                          | 15 000                           | 30 x 50                                 | 5.39                                     | 1204                             | 41                         | 28                       | 37153E3                       | 77153E3 |
|                                          | 18 000                           | 35 x 40                                 | 4.39                                     | 1444                             | 62                         | 33                       | 17183E3                       | 57183E3 |
|                                          | 22 000                           | 35 x 50                                 | 5.34                                     | 1764                             | 47                         | 28                       | 27223E3                       | 67223E3 |
| 50                                       | 2200                             | 22 x 25                                 | 2.34                                     | 224                              | 107                        | 62                       | 11222E3                       | 51222E3 |
|                                          | 3300                             | 22 x 30                                 | 2.92                                     | 334                              | 76                         | 46                       | 11332E3                       | 51332E3 |
|                                          | 3900                             | 25 x 30                                 | 3.17                                     | 394                              | 74                         | 47                       | 21392E3                       | 61392E3 |
|                                          | 4700                             | 25 x 35                                 | 3.64                                     | 474                              | 62                         | 40                       | 21472E3                       | 61472E3 |
|                                          | 5600                             | 25 x 40                                 | 4.09                                     | 564                              | 53                         | 35                       | 21562E3                       | 61562E3 |
|                                          | 6800                             | 30 x 30                                 | 3.35                                     | 684                              | 79                         | 48                       | 21682E3                       | 61682E3 |
|                                          | 8200                             | 30 x 35                                 | 3.88                                     | 824                              | 65                         | 40                       | 21822E3                       | 61822E3 |
|                                          | 10 000                           | 30 x 40                                 | 4.32                                     | 1004                             | 56                         | 35                       | 11103E3                       | 51103E3 |
|                                          | 12 000                           | 30 x 50                                 | 5.23                                     | 1204                             | 43                         | 29                       | 11123E3                       | 51123E3 |
|                                          | 18 000                           | 35 x 50                                 | 5.18                                     | 1804                             | 50                         | 29                       | 11183E3                       | 51183E3 |
|                                          | 22 000                           | 35 x 60                                 | 5.97                                     | 2204                             | 51                         | 46                       | 11223E3                       | 51223E3 |
| 63                                       | 1500                             | 22 x 25                                 | 2.13                                     | 193                              | 128                        | 68                       | 18152E3                       | 58152E3 |
|                                          | 1800                             | 25 x 25                                 | 2.37                                     | 231                              | 120                        | 69                       | 18182E3                       | 58182E3 |
|                                          | 2200                             | 22 x 30                                 | 2.66                                     | 281                              | 92                         | 50                       | 18222E3                       | 58222E3 |
|                                          | 2200                             | 25 x 25                                 | 2.42                                     | 281                              | 115                        | 70                       | 28222E3                       | 68222E3 |
|                                          | 2700                             | 25 x 30                                 | 2.95                                     | 344                              | 86                         | 51                       | 28272E3                       | 68272E3 |
|                                          | 3300                             | 25 x 35                                 | 3.39                                     | 420                              | 71                         | 43                       | 28332E3                       | 68332E3 |
|                                          | 3900                             | 25 x 40                                 | 3.81                                     | 495                              | 61                         | 37                       | 28392E3                       | 68392E3 |
|                                          | 4700                             | 22 x 50                                 | 4.26                                     | 596                              | 50                         | 30                       | 18472E3                       | 58472E3 |
|                                          | 4700                             | 30 x 30                                 | 3.25                                     | 596                              | 85                         | 53                       | 38472E3                       | 78472E3 |
|                                          | 5600                             | 30 x 35                                 | 3.75                                     | 710                              | 69                         | 45                       | 28562E3                       | 68562E3 |
|                                          | 6800                             | 30 x 40                                 | 4.19                                     | 861                              | 59                         | 39                       | 18682E3                       | 58682E3 |
|                                          | 6800                             | 35 x 30                                 | 3.28                                     | 861                              | 97                         | 53                       | 28682E3                       | 68682E3 |
|                                          | 8200                             | 30 x 50                                 | 5.05                                     | 1037                             | 46                         | 32                       | 38822E3                       | 78822E3 |
|                                          | 10 000                           | 35 x 40                                 | 4.23                                     | 1264                             | 67                         | 39                       | 18103E3                       | 58103E3 |
|                                          | 12 000                           | 35 x 50                                 | 5.15                                     | 1516                             | 51                         | 32                       | 18123E3                       | 58123E3 |
|                                          | 15 000                           | 35 x 60                                 | 5.89                                     | 1894                             | 52                         | 47                       | 18153E3                       | 58153E3 |

**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>100 Hz<br>85 °C<br>(A) | $I_{L5}$<br>5 min<br>( $\mu$ A) | MAX. ESR<br>100 Hz<br>(m $\Omega$ ) | MAX. Z<br>10 kHz<br>(m $\Omega$ ) | ORDERING CODE<br>MAL2156..... |         |
|--------------|-------------------------------|-----------------------------------------------------|---------------------------------|---------------------------------|-------------------------------------|-----------------------------------|-------------------------------|---------|
|              |                               |                                                     |                                 |                                 |                                     |                                   | 2-TERM.                       | 3-TERM. |
| 80           | 1500                          | 22 x 30                                             | 1.83                            | 244                             | 318                                 | 308                               | 12152E3                       | 52152E3 |
|              | 2200                          | 25 x 30                                             | 2.23                            | 356                             | 230                                 | 224                               | 22222E3                       | 62222E3 |
|              | 3300                          | 25 x 40                                             | 2.92                            | 532                             | 155                                 | 152                               | 22332E3                       | 62332E3 |
|              | 4700                          | 30 x 40                                             | 3.44                            | 756                             | 121                                 | 119                               | 12472E3                       | 52472E3 |
|              | 6800                          | 30 x 50                                             | 4.18                            | 1092                            | 88                                  | 87                                | 12682E3                       | 52682E3 |
|              | 10 000                        | 35 x 50                                             | 4.51                            | 1604                            | 74                                  | 73                                | 12103E3                       | 52103E3 |
| 100          | 1000                          | 22 x 30                                             | 1.72                            | 204                             | 338                                 | 312                               | 19102E3                       | 59102E3 |
|              | 1200                          | 22 x 35                                             | 1.98                            | 244                             | 282                                 | 261                               | 29122E3                       | 59122E3 |
|              | 1500                          | 25 x 30                                             | 2.12                            | 304                             | 239                                 | 223                               | 29152E3                       | 69152E3 |
|              | 2200                          | 25 x 40                                             | 2.77                            | 444                             | 164                                 | 154                               | 29222E3                       | 69222E3 |
|              | 2200                          | 30 x 30                                             | 2.55                            | 444                             | 181                                 | 171                               | 39222E3                       | 79222E3 |
|              | 2700                          | 30 x 35                                             | 2.94                            | 544                             | 148                                 | 140                               | 29272E3                       | 69272E3 |
|              | 3300                          | 30 x 40                                             | 3.32                            | 664                             | 123                                 | 116                               | 19332E3                       | 59332E3 |
|              | 3300                          | 35 x 30                                             | 2.84                            | 664                             | 147                                 | 140                               | 29332E3                       | 69332E3 |
|              | 4700                          | 30 x 50                                             | 4.04                            | 944                             | 90                                  | 86                                | 19472E3                       | 59472E3 |
|              | 4700                          | 35 x 40                                             | 3.67                            | 944                             | 102                                 | 98                                | 29472E3                       | 69472E3 |
|              | 6800                          | 35 x 50                                             | 4.39                            | 1364                            | 76                                  | 73                                | 19682E3                       | 59682E3 |
|              | 8200                          | 35 x 60                                             | 5.21                            | 1644                            | 63                                  | 61                                | 19822E3                       | 59822E3 |

**ADDITIONAL ELECTRICAL DATA**

| PARAMETER                          | CONDITIONS           | VALUE                                              |
|------------------------------------|----------------------|----------------------------------------------------|
| <b>Voltage</b>                     |                      |                                                    |
| Surge voltage                      |                      | $U_S = 1.15 \times U_R$                            |
| Reverse voltage                    |                      | $U_{rev} \leq 1 \text{ V}$                         |
| <b>Current</b>                     |                      |                                                    |
| Leakage current                    | After 1 min at $U_R$ | $I_{L1} \leq 0.006 C_R \times U_R + 4 \mu\text{A}$ |
|                                    | After 5 min at $U_R$ | $I_{L5} \leq 0.002 C_R \times U_R + 4 \mu\text{A}$ |
| <b>Inductance</b>                  |                      |                                                    |
| Equivalent series inductance (ESL) | All case sizes       | Typ. 19 nH                                         |
|                                    |                      | Max. 25 nH                                         |

**RIPPLE CURRENT AND USEFUL LIFE**

Table 3

| ENDURANCE TEST DURATION AND USEFUL LIFE |                          |
|-----------------------------------------|--------------------------|
| ENDURANCE AT 85 °C (h)                  | USEFUL LIFE AT 85 °C (h) |
| 2000                                    | 5000                     |

**Note**

- Multiplier of useful life code: MGA453

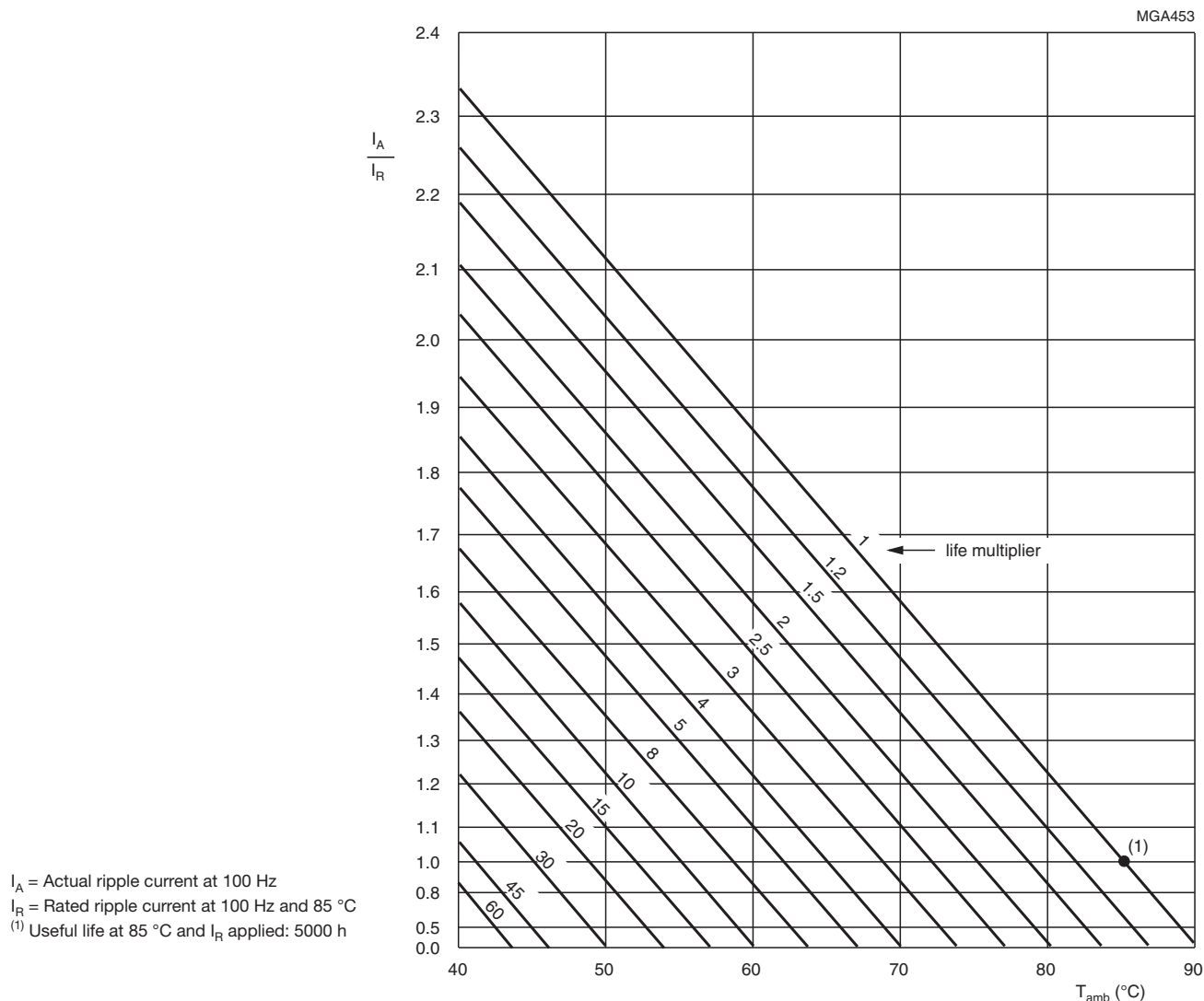


Fig. 6 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 4

| MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY |                  |      |      |      |      |      |      |          |
|-------------------------------------------------------------------|------------------|------|------|------|------|------|------|----------|
| $U_R$<br>(V)                                                      | FREQUENCY (Hz)   |      |      |      |      |      |      |          |
|                                                                   | 50               | 100  | 200  | 400  | 1000 | 2000 | 4000 | ≥ 10 000 |
|                                                                   | $I_R$ MULTIPLIER |      |      |      |      |      |      |          |
| 16                                                                | 0.93             | 1.00 | 1.04 | 1.07 | 1.11 | 1.13 | 1.15 | 1.18     |
| 25                                                                | 0.93             | 1.00 | 1.04 | 1.07 | 1.11 | 1.13 | 1.15 | 1.18     |
| 40                                                                | 0.91             | 1.00 | 1.05 | 1.09 | 1.13 | 1.15 | 1.18 | 1.22     |
| 50                                                                | 0.91             | 1.00 | 1.05 | 1.09 | 1.13 | 1.15 | 1.18 | 1.22     |
| 63                                                                | 0.91             | 1.00 | 1.05 | 1.09 | 1.13 | 1.15 | 1.18 | 1.22     |
| 80                                                                | 0.91             | 1.00 | 1.05 | 1.09 | 1.13 | 1.15 | 1.18 | 1.22     |
| 100                                                               | 0.91             | 1.00 | 1.05 | 1.09 | 1.13 | 1.15 | 1.18 | 1.22     |



Table 5

| 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: 2000 h                                                                                       | $\Delta C/C: \pm 15\%$<br>$ESR \leq 1.3 \times \text{spec. limit}$<br>$Z \leq 2 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$                                                                                         |
| Useful life                                    | CECC 30301<br>subclause 1.8.1               | $T_{amb} = 85\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied: 5000 h                                                                             | $\Delta C/C: \pm 15\%$<br>$ESR \leq 3 \times \text{spec. limit}$<br>$Z \leq 3 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$<br>no short or open circuit,<br>no visible damage<br>total failure percentage: $\leq 1\%$ |
| 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; 500 h<br>After test: $U_R$ to be applied for 30 min,<br>24 h to 48 h before measurement | $\Delta C/C: \pm 10\%$<br>$ESR \leq 1.2 \times \text{spec. limit}$<br>$I_{L5} \leq 2 \times \text{spec. limit}$                                                                                                                        |

Statements about product lifetime are based on calculations and internal testing. They should only be interpreted as estimations. Also due to external factors, the lifetime in the field application may deviate from the calculated lifetime. In general, nothing stated herein shall be construed as a guarantee of durability.



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