

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



Fig. 1

## QUICK REFERENCE DATA

| DESCRIPTION                                                  | VALUE                   |
|--------------------------------------------------------------|-------------------------|
| Nominal case sizes<br>(Ø D x L in mm)                        | 22 x 25 to 35 x 40      |
| Rated capacitance range<br>(E6 / E12 series), C <sub>R</sub> | 560 µF to 47 000 µF     |
| Tolerance on C <sub>R</sub>                                  | ± 20 %                  |
| Rated voltage range, U <sub>R</sub>                          | 25 V to 100 V           |
| Category temperature range                                   | -40 °C to +105 °C       |
| Endurance test at 105 °C                                     | 2000 h                  |
| Useful life at 105 °C                                        | 5000 h                  |
| Useful life at 40 °C,<br>1.9 x I <sub>R</sub> applied        | 125 000 h               |
| Shelf life at 0 V, 105 °C                                    | 500 h                   |
| Based on sectional<br>specification                          | IEC 60384-4 / EN 130300 |
| Climatic category IEC 60068                                  | 40 / 105 / 56           |

## FEATURES

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



**RoHS**  
COMPLIANT

## APPLICATIONS

- General purpose, industrial, telecom 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)
- 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

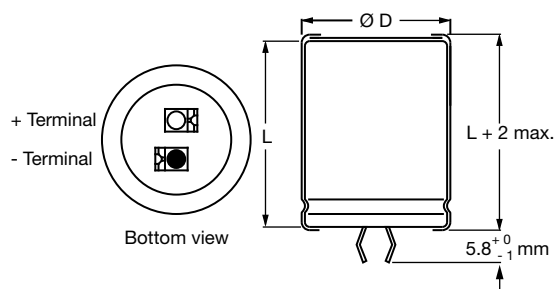
### SELECTION CHART FOR C<sub>B</sub>, U<sub>B</sub>, AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)

| C <sub>R</sub><br>(μF) | U <sub>R</sub> (V) |         |         |         |                    |                    |                    |                    |
|------------------------|--------------------|---------|---------|---------|--------------------|--------------------|--------------------|--------------------|
|                        | 16                 | 25      | 35      | 40      | 50                 | 63                 | 80                 | 100                |
| 560                    | -                  | -       | -       | -       | -                  | -                  | -                  | 22 x 25            |
| 680                    | -                  | -       | -       | -       | -                  | -                  | 22 x 25            | 22 x 30            |
| 1000                   | -                  | -       | -       | -       | -                  | -                  | 22 x 30            | 25 x 30            |
| 1200                   | -                  | -       | -       | -       | -                  | -                  | 25 x 30            | -                  |
| 1500                   | -                  | -       | -       | -       | -                  | 22 x 25            | -                  | 25 x 40<br>30 x 30 |
| 1800                   | -                  | -       | -       | -       | -                  | -                  | -                  | 30 x 35            |
| 2200                   | -                  | -       | -       | -       | 22 x 25            | 22 x 30            | 25 x 40<br>30 x 30 | 30 x 40            |
| 2700                   | -                  | -       | -       | -       | -                  | 25 x 30            | 30 x 35            | -                  |
| 3300                   | -                  | -       | -       | 22 x 25 | 22 x 30            | 25 x 40            | 30 x 40            | 35 x 40            |
| 3900                   | -                  | -       | -       | 22 x 30 | 25 x 30            | 25 x 40<br>30 x 30 | -                  | -                  |
| 4700                   | -                  | 22 x 25 | 22 x 30 | 22 x 30 | 25 x 30<br>25 x 40 | 30 x 30<br>30 x 35 | 35 x 40            | -                  |
| 5600                   | -                  | -       | -       | 25 x 30 | 25 x 40            | 30 x 35            | -                  | -                  |

| 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                 | 35                 | 40                 | 50      | 63      | 80 | 100 |
| 6800                                                                                                  | 22 x 25            | 22 x 30            | 25 x 30            | 25 x 40            | 30 x 30 | 30 x 40 | -  | -   |
| 8200                                                                                                  | -                  | 25 x 30            | -                  | 30 x 30            | 30 x 35 | 35 x 40 | -  | -   |
| 10 000                                                                                                | 22 x 30            | 25 x 40            | 25 x 40<br>30 x 30 | 30 x 35<br>30 x 40 | 30 x 40 | -       | -  | -   |
| 12 000                                                                                                | -                  | 25 x 40<br>30 x 30 | -                  | -                  | -       | -       | -  | -   |
| 15 000                                                                                                | 25 x 30            | 30 x 35<br>30 x 40 | 30 x 40            | 35 x 40            | -       | -       | -  | -   |
| 18 000                                                                                                | -                  | -                  | -                  | 35 x 40            | -       | -       | -  | -   |
| 22 000                                                                                                | 25 x 40<br>30 x 30 | 35 x 40            | 35 x 40            | -                  | -       | -       | -  | -   |
| 27 000                                                                                                | 30 x 35            | -                  | -                  | -                  | -       | -       | -  | -   |
| 33 000                                                                                                | 30 x 40            | -                  | -                  | -                  | -       | -       | -  | -   |
| 39 000                                                                                                | -                  | -                  | -                  | -                  | -       | -       | -  | -   |
| 47 000                                                                                                | 30 x 40<br>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

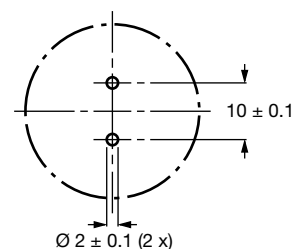
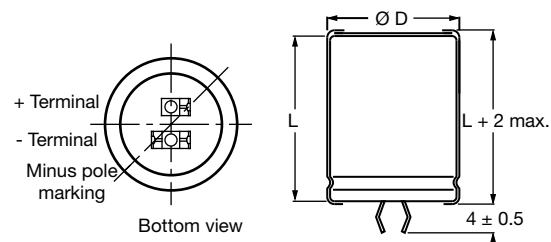


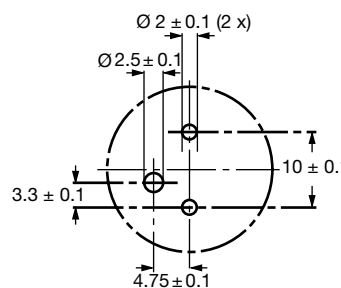
Fig. 3 - Mounting hole diagram

### 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

| DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES |                     |                   |             |                                         |                                               |
|----------------------------------------------------------|---------------------|-------------------|-------------|-----------------------------------------|-----------------------------------------------|
| NOMINAL CASE SIZE<br>Ø D x L                             | Ø D <sub>max.</sub> | L <sub>max.</sub> | MASS<br>(g) | PACKAGING QUANTITIES<br>(units per box) | CARDBOARD BOX DIMENSIONS<br>L x W x H<br>(mm) |
| 22 x 25                                                  | 23                  | 27                | 12          | 100                                     | 260 x 250 x 39                                |
| 22 x 30                                                  | 23                  | 32                | 16          | 100                                     | 260 x 250 x 44                                |
| 25 x 30                                                  | 26                  | 32                | 22          | 100                                     | 290 x 280 x 44                                |
| 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                | 40          | 100                                     | 340 x 330 x 54                                |
| 35 x 40                                                  | 36                  | 42                | 55          | 50                                      | 390 x 198 x 54                                |

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

## Notes

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

## ORDERING EXAMPLE

Electrolytic capacitor 090 series

3300 µF / 80 V; ± 20 %

Nominal case size: Ø 30 mm x 40 mm

## 2-terminal snap-in:

Ordering code: MAL209032332E3

Former 12NC: 2222 09032332

## 3-terminal snap-in:

Ordering code: MAL209072332E3

Former 12NC: 2222 09072332

Table 2

| ELECTRICAL DATA AND ORDERING INFORMATION |                                  |                                      |                                           |                                           |                                  |                                           |                          |                               |            |
|------------------------------------------|----------------------------------|--------------------------------------|-------------------------------------------|-------------------------------------------|----------------------------------|-------------------------------------------|--------------------------|-------------------------------|------------|
| 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>105 °C<br>(A) | I <sub>R</sub><br>10 kHz<br>105 °C<br>(A) | I <sub>L5</sub><br>5 min<br>(µA) | MAX. ESR<br>100 Hz <sup>(1)</sup><br>(mΩ) | MAX. Z<br>10 kHz<br>(mΩ) | ORDERING CODE<br>MAL2090..... |            |
|                                          |                                  |                                      |                                           |                                           |                                  |                                           |                          | 2-TERM. SI                    | 3-TERM. SI |
| 16                                       | 6800                             | 22 x 25                              | 2.5                                       | 3.0                                       | 222                              | 82                                        | 66                       | 15682E3                       | 55682E3    |
|                                          | 10 000                           | 22 x 30                              | 3.1                                       | 3.6                                       | 324                              | 59                                        | 48                       | 15103E3                       | 55103E3    |
|                                          | 15 000                           | 25 x 30                              | 3.2                                       | 3.9                                       | 484                              | 53                                        | 44                       | 25153E3                       | 65153E3    |
|                                          | 22 000                           | 25 x 40                              | 4.1                                       | 5.0                                       | 708                              | 38                                        | 33                       | 25223E3                       | 65223E3    |
|                                          | 22 000                           | 30 x 30                              | 3.3                                       | 4.1                                       | 708                              | 54                                        | 43                       | 35223E3                       | 75223E3    |
|                                          | 27 000                           | 30 x 35                              | 3.8                                       | 4.6                                       | 868                              | 45                                        | 36                       | 35273E3                       | 75273E3    |
|                                          | 33 000                           | 30 x 40                              | 4.2                                       | 5.0                                       | 1060                             | 39                                        | 32                       | 35333E3                       | 75333E3    |
| 25                                       | 47 000                           | 35 x 40                              | 4.3                                       | 5.2                                       | 1508                             | 43                                        | 32                       | 45473E3                       | 85473E3    |
|                                          | 4700                             | 22 x 25                              | 2.3                                       | 2.8                                       | 236                              | 89                                        | 66                       | 16472E3                       | 56472E3    |
|                                          | 6800                             | 22 x 30                              | 2.9                                       | 3.4                                       | 341                              | 65                                        | 49                       | 16682E3                       | 56682E3    |
|                                          | 8200                             | 25 x 30                              | 3.1                                       | 3.7                                       | 411                              | 60                                        | 46                       | 26822E3                       | 66822E3    |
|                                          | 10 000                           | 25 x 40                              | 3.9                                       | 4.6                                       | 501                              | 46                                        | 35                       | 26103E3                       | 66103E3    |
|                                          | 12 000                           | 25 x 40                              | 3.9                                       | 4.7                                       | 601                              | 43                                        | 34                       | 26123E3                       | 66123E3    |
|                                          | 12 000                           | 30 x 30                              | 3.3                                       | 4.1                                       | 601                              | 56                                        | 44                       | 36123E3                       | 76123E3    |
|                                          | 15 000                           | 30 x 35                              | 3.8                                       | 4.6                                       | 751                              | 46                                        | 36                       | 16153E3                       | 56153E3    |
|                                          | 15 000                           | 30 x 40                              | 4.3                                       | 5.1                                       | 751                              | 40                                        | 33                       | 36153E3                       | 76153E3    |
| 35                                       | 22 000                           | 35 x 40                              | 4.6                                       | 5.5                                       | 1101                             | 40                                        | 31                       | 46223E3                       | 86223E3    |
|                                          | 4700                             | 22 x 30                              | 2.5                                       | 3.1                                       | 330                              | 78                                        | 53                       | 10472E3                       | 50472E3    |
|                                          | 6800                             | 25 x 30                              | 2.7                                       | 3.2                                       | 477                              | 70                                        | 50                       | 20682E3                       | 60682E3    |
|                                          | 10 000                           | 25 x 40                              | 3.5                                       | 4.2                                       | 701                              | 49                                        | 36                       | 20103E3                       | 60103E3    |
|                                          | 10 000                           | 30 x 30                              | 2.9                                       | 3.5                                       | 701                              | 70                                        | 49                       | 30103E3                       | 70103E3    |
|                                          | 15 000                           | 30 x 40                              | 3.7                                       | 4.4                                       | 1051                             | 49                                        | 35                       | 30153E3                       | 70153E3    |
|                                          | 22 000                           | 35 x 40                              | 3.8                                       | 4.5                                       | 1541                             | 55                                        | 35                       | 40223E3                       | 80223E3    |



| 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>105 °C<br>(A) | I <sub>R</sub><br>10 kHz<br>105 °C<br>(A) | I <sub>L5</sub><br>5 min<br>(μA) | MAX. ESR<br>100 Hz <sup>(1)</sup><br>(mΩ) | MAX. Z<br>10 kHz<br>(mΩ) | ORDERING CODE<br>MAL2090..... |            |
|                                          |                                  |                                         |                                           |                                           |                                  |                                           |                          | 2-TERM. SI                    | 3-TERM. SI |
| 40                                       | 3300                             | 22 x 25                                 | 2.2                                       | 2.6                                       | 265                              | 99                                        | 70                       | 17332E3                       | 57332E3    |
|                                          | 3900                             | 22 x 30                                 | 2.6                                       | 3.1                                       | 313                              | 76                                        | 54                       | 17392E3                       | 57392E3    |
|                                          | 4700                             | 22 x 30                                 | 2.6                                       | 3.2                                       | 377                              | 71                                        | 51                       | 17472E3                       | 57472E3    |
|                                          | 5600                             | 25 x 30                                 | 2.8                                       | 3.3                                       | 449                              | 69                                        | 50                       | 27562E3                       | 67562E3    |
|                                          | 6800                             | 25 x 40                                 | 3.5                                       | 4.2                                       | 545                              | 51                                        | 38                       | 27682E3                       | 67682E3    |
|                                          | 8200                             | 30 x 30                                 | 3.0                                       | 3.5                                       | 657                              | 69                                        | 49                       | 37822E3                       | 77822E3    |
|                                          | 10 000                           | 30 x 35                                 | 3.4                                       | 4.1                                       | 801                              | 56                                        | 41                       | 17103E3                       | 57103E3    |
|                                          | 10 000                           | 30 x 40                                 | 3.9                                       | 4.6                                       | 801                              | 48                                        | 36                       | 37103E3                       | 77103E3    |
|                                          | 15 000                           | 35 x 40                                 | 4.1                                       | 4.9                                       | 1201                             | 50                                        | 35                       | 47153E3                       | 87153E3    |
| 50                                       | 18 000                           | 35 x 40                                 | 3.9                                       | 4.6                                       | 1441                             | 54                                        | 35                       | 47183E3                       | 87183E3    |
|                                          | 2200                             | 22 x 25                                 | 1.9                                       | 2.3                                       | 221                              | 145                                       | 106                      | 11222E3                       | 51222E3    |
|                                          | 3300                             | 22 x 30                                 | 2.3                                       | 2.9                                       | 331                              | 101                                       | 76                       | 11332E3                       | 51332E3    |
|                                          | 3900                             | 25 x 30                                 | 2.5                                       | 3.1                                       | 391                              | 93                                        | 71                       | 21392E3                       | 61392E3    |
|                                          | 4700                             | 25 x 30                                 | 2.6                                       | 3.2                                       | 471                              | 85                                        | 70                       | 31472E3                       | 71472E3    |
|                                          | 4700                             | 25 x 40                                 | 3.2                                       | 3.9                                       | 471                              | 71                                        | 55                       | 21472E3                       | 61472E3    |
|                                          | 5600                             | 25 x 40                                 | 3.2                                       | 4.0                                       | 561                              | 66                                        | 51                       | 21562E3                       | 61562E3    |
|                                          | 6800                             | 30 x 30                                 | 2.8                                       | 3.3                                       | 681                              | 83                                        | 65                       | 31682E3                       | 71682E3    |
|                                          | 8200                             | 30 x 35                                 | 3.2                                       | 3.8                                       | 821                              | 68                                        | 54                       | 31822E3                       | 71822E3    |
| 63                                       | 10 000                           | 30 x 40                                 | 3.6                                       | 4.2                                       | 1001                             | 58                                        | 46                       | 31103E3                       | 71103E3    |
|                                          | 15 000                           | 35 x 40                                 | 3.6                                       | 4.4                                       | 1501                             | 63                                        | 45                       | 41153E3                       | 81153E3    |
|                                          | 1500                             | 22 x 25                                 | 1.9                                       | 2.3                                       | 190                              | 161                                       | 126                      | 18152E3                       | 58152E3    |
|                                          | 2200                             | 22 x 30                                 | 2.3                                       | 2.8                                       | 279                              | 114                                       | 90                       | 18222E3                       | 58222E3    |
|                                          | 2700                             | 25 x 30                                 | 2.5                                       | 3.1                                       | 342                              | 101                                       | 81                       | 28272E3                       | 68272E3    |
|                                          | 3300                             | 25 x 40                                 | 3.2                                       | 3.8                                       | 417                              | 79                                        | 63                       | 28332E3                       | 68332E3    |
|                                          | 3900                             | 25 x 40                                 | 3.2                                       | 3.9                                       | 493                              | 71                                        | 58                       | 28392E3                       | 68392E3    |
|                                          | 3900                             | 30 x 30                                 | 2.8                                       | 3.4                                       | 493                              | 89                                        | 74                       | 38392E3                       | 78392E3    |
|                                          | 4700                             | 30 x 30                                 | 2.8                                       | 3.3                                       | 594                              | 88                                        | 71                       | 18472E3                       | 58472E3    |
| 80                                       | 4700                             | 30 x 35                                 | 3.2                                       | 3.9                                       | 594                              | 74                                        | 61                       | 38472E3                       | 78472E3    |
|                                          | 5600                             | 30 x 35                                 | 3.2                                       | 3.8                                       | 707                              | 71                                        | 59                       | 38562E3                       | 78562E3    |
|                                          | 6800                             | 30 x 40                                 | 3.6                                       | 4.2                                       | 858                              | 61                                        | 51                       | 38682E3                       | 78682E3    |
|                                          | 8200                             | 35 x 40                                 | 3.9                                       | 4.6                                       | 1035                             | 61                                        | 50                       | 48822E3                       | 88822E3    |
|                                          | 820                              | 22 x 25                                 | 1.4                                       | 1.6                                       | 133                              | 244                                       | 184                      | 12821E3                       | 52821E3    |
|                                          | 1000                             | 22 x 30                                 | 1.6                                       | 1.9                                       | 161                              | 196                                       | 146                      | 12102E3                       | 52102E3    |
|                                          | 1500                             | 25 x 30                                 | 1.9                                       | 2.3                                       | 241                              | 145                                       | 113                      | 22152E3                       | 62152E3    |
|                                          | 2200                             | 25 x 40                                 | 2.5                                       | 3.0                                       | 353                              | 101                                       | 79                       | 22222E3                       | 62222E3    |
|                                          | 2200                             | 30 x 30                                 | 2.3                                       | 2.7                                       | 353                              | 119                                       | 96                       | 32222E3                       | 72222E3    |
| 100                                      | 2700                             | 30 x 35                                 | 2.5                                       | 3.1                                       | 433                              | 98                                        | 79                       | 32272E3                       | 72272E3    |
|                                          | 3300                             | 30 x 40                                 | 2.9                                       | 3.4                                       | 529                              | 81                                        | 66                       | 32332E3                       | 72332E3    |
|                                          | 4700                             | 35 x 40                                 | 3.1                                       | 3.7                                       | 753                              | 75                                        | 63                       | 42472E3                       | 82472E3    |
|                                          | 560                              | 22 x 25                                 | 1.3                                       | 1.4                                       | 113                              | 269                                       | 184                      | 19561E3                       | 59561E3    |
|                                          | 680                              | 22 x 30                                 | 1.4                                       | 1.7                                       | 137                              | 216                                       | 146                      | 19681E3                       | 59681E3    |
|                                          | 1000                             | 25 x 30                                 | 1.7                                       | 2.1                                       | 201                              | 163                                       | 114                      | 29102E3                       | 69102E3    |
|                                          | 1500                             | 25 x 40                                 | 2.3                                       | 2.8                                       | 301                              | 111                                       | 79                       | 29152E3                       | 69152E3    |
|                                          | 1500                             | 30 x 30                                 | 2.1                                       | 2.4                                       | 301                              | 130                                       | 98                       | 39152E3                       | 79152E3    |
|                                          | 1800                             | 30 x 35                                 | 2.3                                       | 2.9                                       | 361                              | 108                                       | 80                       | 39182E3                       | 79182E3    |
|                                          | 2200                             | 30 x 40                                 | 2.7                                       | 3.2                                       | 441                              | 90                                        | 68                       | 39222E3                       | 79222E3    |
|                                          | 3300                             | 35 x 40                                 | 2.9                                       | 3.4                                       | 661                              | 81                                        | 64                       | 49332E3                       | 89332E3    |



| 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 105 °C (h)                 | USEFUL LIFE AT 105 °C (h) |
| 2000                                    | 5000                      |

**Note**

- Multiplier of useful life code: MGA454

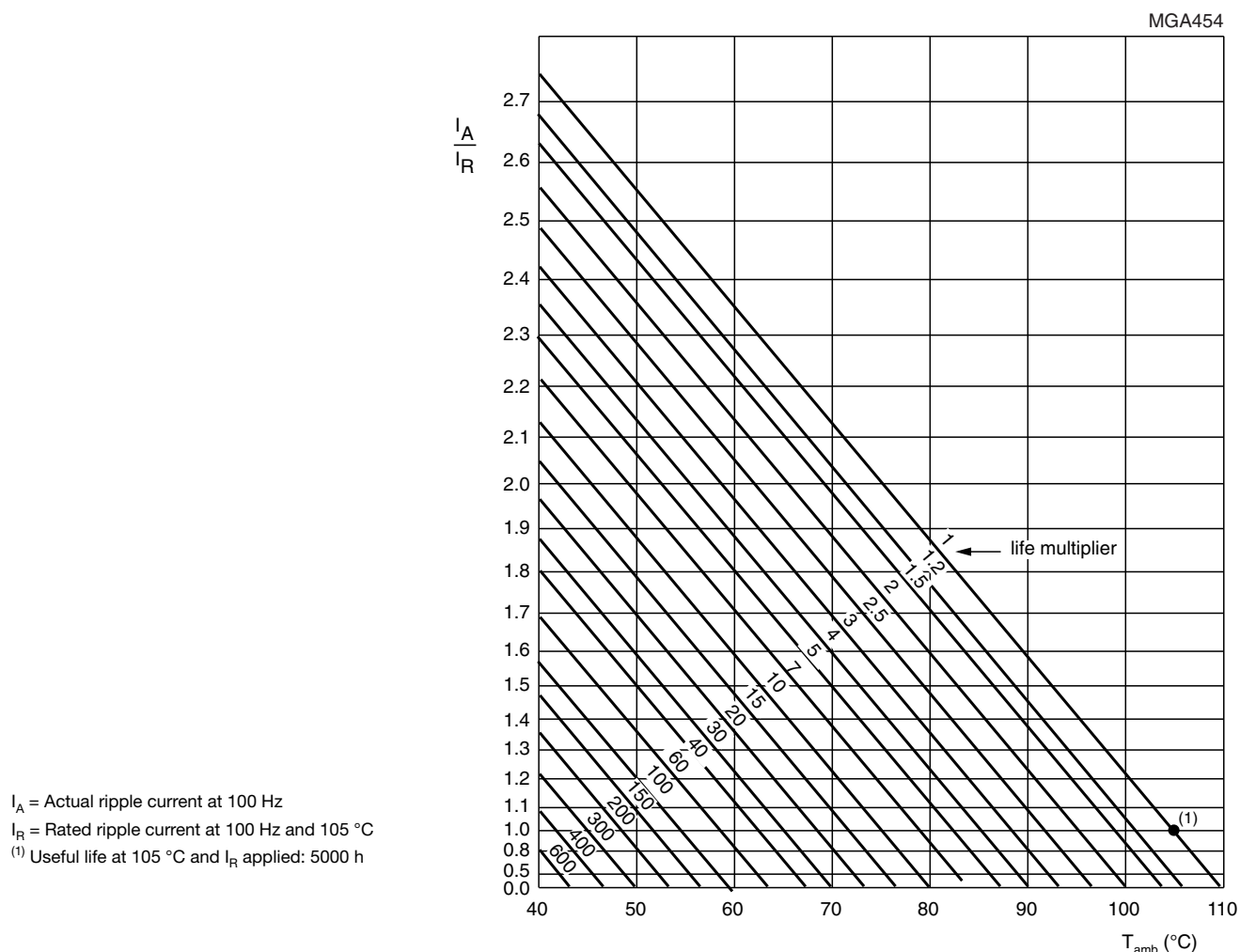


Fig. 6 - Multiplier of useful life as a function of ambient temperature and ripple current load



Table 4

| MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY |      |      |      |      |      |      |                |
|-------------------------------------------------------------------|------|------|------|------|------|------|----------------|
| FREQUENCY (Hz)                                                    |      |      |      |      |      |      |                |
| 50                                                                | 100  | 200  | 400  | 1000 | 2000 | 4000 | $\geq 10\,000$ |
| $I_R$ MULTIPLIER                                                  |      |      |      |      |      |      |                |
| 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>EN 130300<br>subclause 4.13 | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; $U_R$ applied;<br>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                | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied;<br>5000 h                                                                             | $\Delta C/C: \pm 20\%$<br>$ESR \leq 3 \times \text{spec. limit}$<br>$Z \leq 3 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$<br>no short or open circuit,<br>no visible damage<br>total failure percentage:<br>$U_R: \leq 1\%$ |
| Shelf life<br>(storage at<br>high temperature) | IEC 60384-4 /<br>EN 130300<br>subclause 4.17 | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; no voltage applied;<br>500 h<br>After test: $U_R$ to be applied for 30 min,<br>24 h to 48 h before measurement | $\Delta C/C: \pm 15\%$<br>$ESR \leq 1.5 \times \text{spec. limit}$<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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