

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

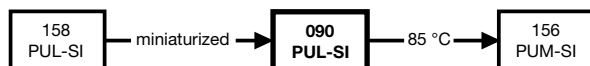


Fig. 1

## 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 30            |
| 820                    | -                  | -       | -       | -  | -       | -                  | 22 x 25            | -                  |
| 1000                   | -                  | -       | -       | -  | -       | -                  | 22 x 30            | 25 x 30            |
| 1500                   | -                  | -       | -       | -  | -       | 22 x 25            | 25 x 30            | 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 30 | 25 x 40            | 30 x 40            | 35 x 40            |
| 3900                   | -                  | -       | -       | -  | 25 x 30 | 25 x 40<br>30 x 30 | -                  | -                  |
| 4700                   | -                  | 22 x 25 | 22 x 30 | -  | 25 x 40 | 30 x 30<br>30 x 35 | 35 x 40            | -                  |
| 5600                   | -                  | -       | -       | -  | 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 40 | 30 x 30 | 30 x 40 | -  | -   |
| 8200                                                                                                  | -                  | 25 x 30            | -       | -       | 30 x 35 | 35 x 40 | -  | -   |
| 10 000                                                                                                | 22 x 30            | 25 x 40            | 30 x 30 | 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 | 35 x 40 | -       | -  | -   |
| 22 000                                                                                                | 25 x 40<br>30 x 30 | 35 x 40            | -       | -       | -       | -       | -  | -   |
| 27 000                                                                                                | 30 x 35            | -                  | -       | -       | -       | -       | -  | -   |
| 33 000                                                                                                | 30 x 40            | -                  | -       | -       | -       | -       | -  | -   |
| 39 000                                                                                                | -                  | -                  | -       | -       | -       | -       | -  | -   |
| 47 000                                                                                                | 35 x 40            | -                  | -       | -       | -       | -       | -  | -   |

## DIMENSIONS in millimeters AND AVAILABLE FORMS

### TWO TERMINAL SNAP-IN

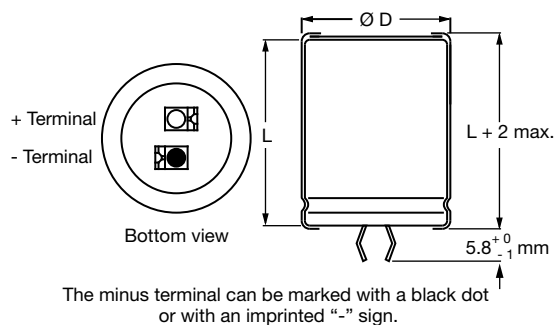


Fig. 2 - Two terminal snap-in

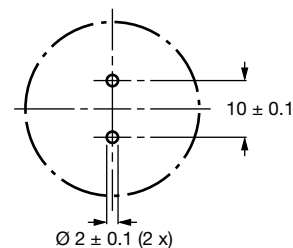


Fig. 3 - Mounting hole diagram

### THREE TERMINAL SNAP-IN

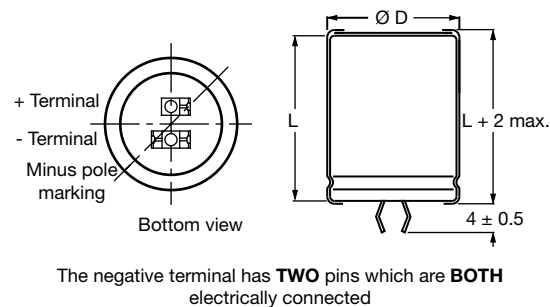
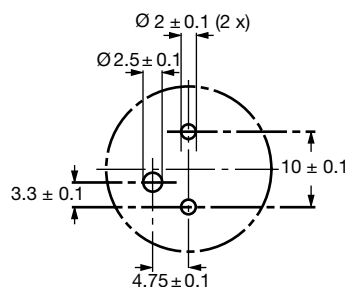


Fig. 4 - Three terminal snap-in



The 10 mm spacing of the 2 pin snap-in is used as the base layout and a third hole is added. The third hole is closer to the negative primary hole so that polarization is always maintained, together with added mechanical stability.

Fig. 5 - Mounting hole diagram

Table 1

| <b>DIMENSIONS in millimeters, MASS, AND PACKAGING QUANTITIES</b> |                     |                   |             |                                         |                                               |
|------------------------------------------------------------------|---------------------|-------------------|-------------|-----------------------------------------|-----------------------------------------------|
| 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                                |

| <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 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

| <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>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    |
|                                                 | 47 000                           | 35 x 40                              | 4.3                                       | 5.2                                       | 1508                             | 43                                        | 32                       | 45473E3                       | 85473E3    |
| 25                                              | 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    |
|                                                 | 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    |



| <b>ELECTRICAL DATA AND ORDERING INFORMATION</b> |                                                      |                                                                     |                                                                      |                                                                      |                                                      |                                                                |                                               |                                             |                   |
|-------------------------------------------------|------------------------------------------------------|---------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------|---------------------------------------------|-------------------|
| <b>U<sub>R</sub></b><br><b>(V)</b>              | <b>C<sub>R</sub></b><br><b>100 Hz</b><br><b>(μF)</b> | <b>NOMINAL</b><br><b>CASE SIZE</b><br><b>Ø D x L</b><br><b>(mm)</b> | <b>I<sub>R</sub></b><br><b>100 Hz</b><br><b>105 °C</b><br><b>(A)</b> | <b>I<sub>R</sub></b><br><b>10 kHz</b><br><b>105 °C</b><br><b>(A)</b> | <b>I<sub>L5</sub></b><br><b>5 min</b><br><b>(μA)</b> | <b>MAX. ESR</b><br><b>100 Hz <sup>(1)</sup></b><br><b>(mΩ)</b> | <b>MAX. Z</b><br><b>10 kHz</b><br><b>(mΩ)</b> | <b>ORDERING CODE</b><br><b>MAL2090.....</b> |                   |
|                                                 |                                                      |                                                                     |                                                                      |                                                                      |                                                      |                                                                |                                               | <b>2-TERM. SI</b>                           | <b>3-TERM. SI</b> |
| 40                                              | 6800                                                 | 25 x 40                                                             | 3.5                                                                  | 4.2                                                                  | 545                                                  | 51                                                             | 38                                            | 27682E3                                     | 67682E3           |
|                                                 | 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                                              | 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 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           |
|                                                 | 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           |
| 63                                              | 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           |
|                                                 | 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           |
| 80                                              | 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           |
|                                                 | 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           |
| 100                                             | 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

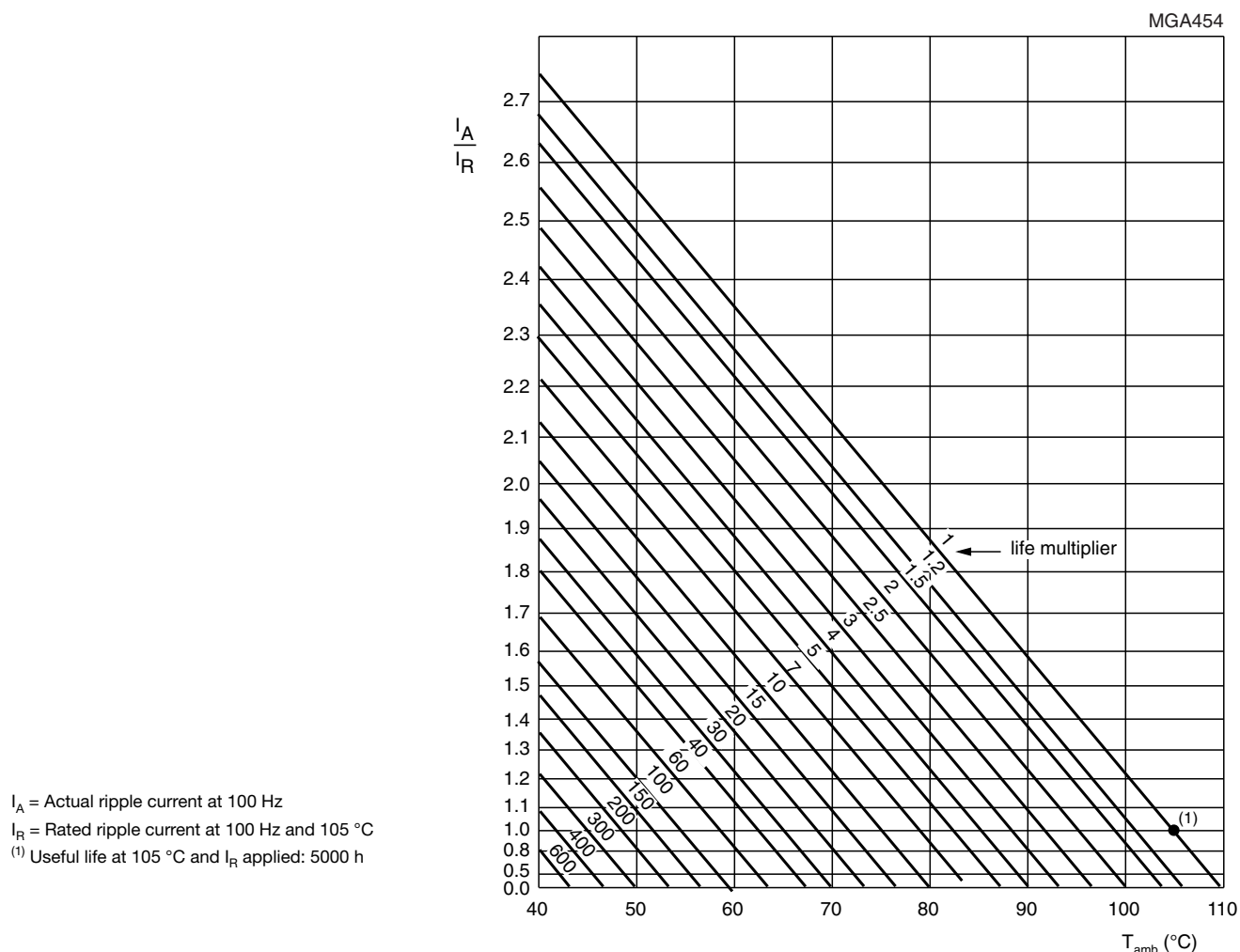


Fig. 6 - Multiplier of useful life as a function of ambient temperature and ripple current load



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 | $T_{amb} = 105\,^{\circ}\text{C}$ ; $U_R$ 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                | $T_{amb} = 105\,^{\circ}\text{C}$ ; $U_R$ 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 | $T_{amb} = 105\,^{\circ}\text{C}$ ; 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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