

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



Fig. 1

| QUICK REFERENCE DATA                                      |                         |
|---|-------------------------|
| DESCRIPTION   | VALUE                   |
| Nominal case sizes (Ø D x L in mm)                        | 22 x 25 to 35 x 40      |
| Rated capacitance range (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, 1.9 x I <sub>R</sub> applied        | 125 000 h               |
| Shelf life at 0 V, 105 °C                                 | 500 h                   |
| Based on sectional 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 µF)
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (M for ± 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>R</sub> , U <sub>R</sub> , AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm) |                    |         |         |    |                    |                    |                    |                    |
|---|--------------------|---------|---------|----|--------------------|--------------------|--------------------|--------------------|
| C <sub>R</sub><br>(µF)  | U <sub>R</sub> (V) |         |         |    |                    |                    |                    |                    |
|   | 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 30<br>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            | 35 x 40 | -       | -       | -       | -  | -   |
| 27 000  | 30 x 35            | -                  | -       | -       | -       | -       | -  | -   |
| 33 000  | 30 x 40            | -                  | -       | -       | -       | -       | -  | -   |
| 39 000  | -                  | -                  | -       | -       | -       | -       | -  | -   |
| 47 000  | 35 x 40            | -                  | -       | -       | -       | -       | -  | -   |

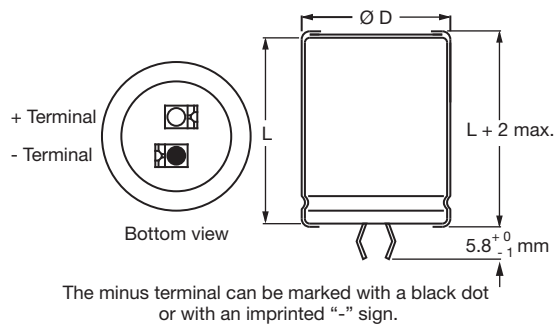
**DIMENSIONS in millimeters AND AVAILABLE FORMS**
**TWO TERMINAL SNAP-IN**


Fig. 2 - Two terminal snap-in

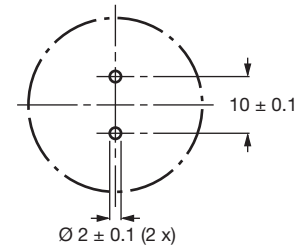


Fig. 3 - Mounting hole diagram

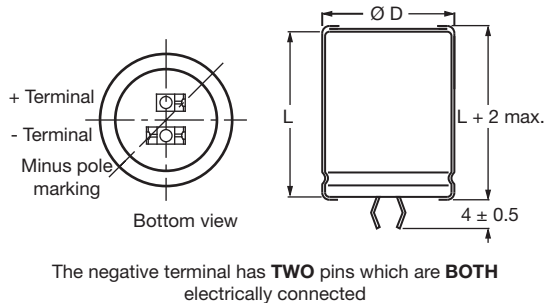
**THREE TERMINAL SNAP-IN**


Fig. 4 - Three terminal snap-in

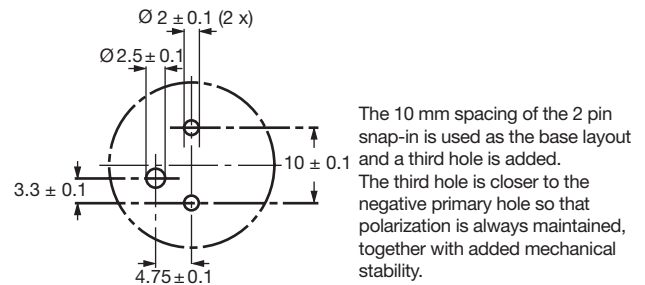


Fig. 5 - Mounting hole diagram



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    |
|  | 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    |
| 22 000                                   | 35 x 40                          | 4.6                                  | 5.5                                       | 1101                                      | 40                               | 31  | 46223E3                  | 86223E3                       |            |
| 35                                       | 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    |
|  | 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                                       | 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 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    |
|  | 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

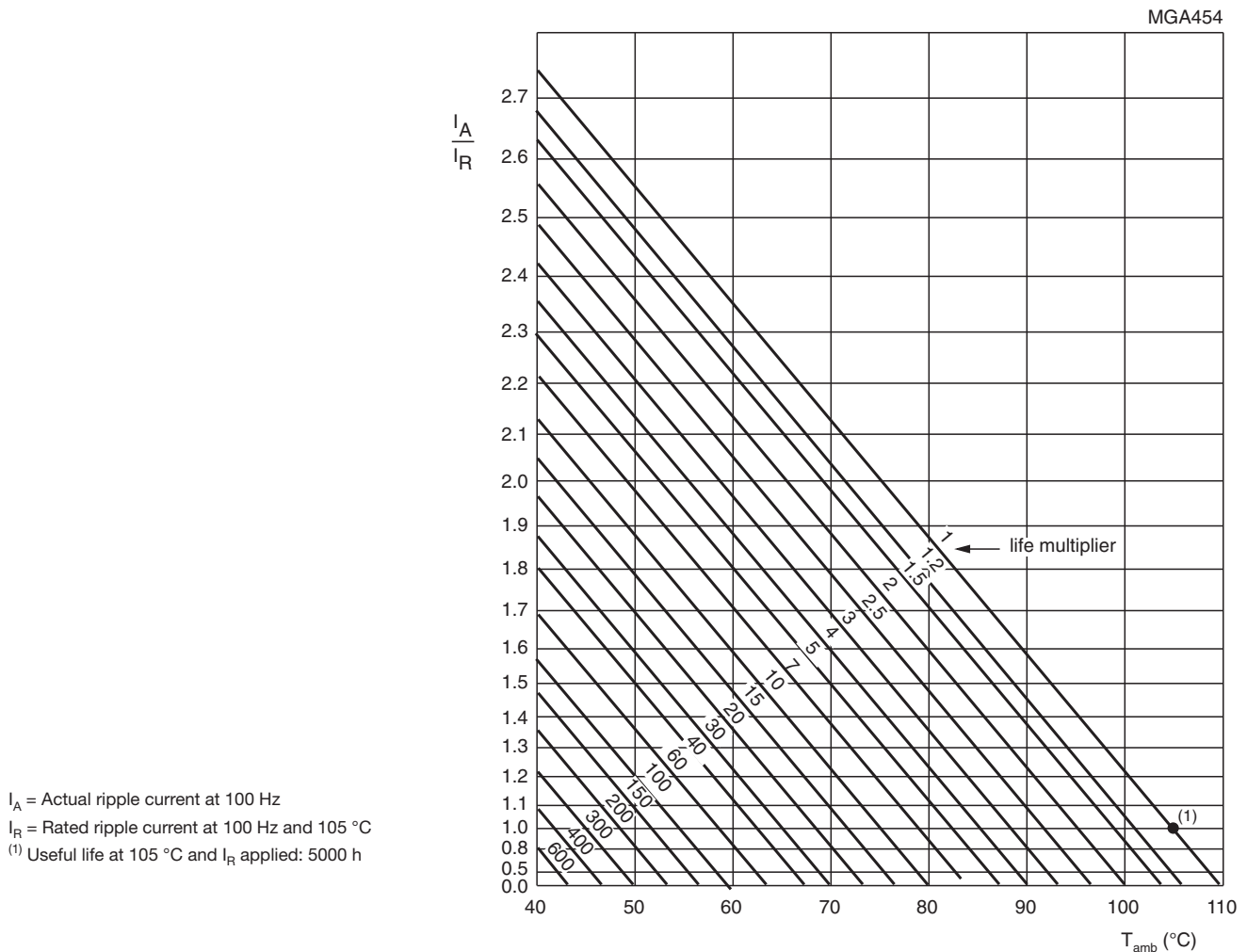


Fig. 6 - Multiplier of useful life as a function of ambient temperature and ripple current load

**Table 4**

| <b>MULTIPLIER OF RIPPLE CURRENT (<math>I_R</math>) AS A FUNCTION OF FREQUENCY</b> |      |      |      |      |      |      |          |
|---|------|------|------|------|------|------|----------|
| FREQUENCY (Hz)  |      |      |      |      |      |      |          |
| 50  | 100  | 200  | 400  | 1000 | 2000 | 4000 | ≥ 10 000 |
| $I_R$ MULTIPLIER  |      |      |      |      |      |      |          |
| 0.91  | 1.00 | 1.05 | 1.09 | 1.13 | 1.15 | 1.18 | 1.22     |

**Table 5**

| <b>TEST PROCEDURES AND REQUIREMENTS</b>        |  |  |  |
|--|--|--|--|
| TEST   |  | PROCEDURE<br>(quick reference)   | REQUIREMENTS   |
| NAME OF TEST                                   | REFERENCE                                    |  |  |
| Endurance                                      | IEC 60384-4 /<br>EN 130300<br>subclause 4.13 | $T_{amb} = 105\text{ °C}$ ; $U_R$ applied;<br>2000 h   | $\Delta C/C: \pm 15\%$<br>ESR ≤ 1.3 x spec. limit<br>$Z \leq 2$ x spec. limit<br>$I_{L5} \leq$ spec. limit   |
| Useful life                                    | CECC 30301<br>subclause 1.8.1                | $T_{amb} = 105\text{ °C}$ ; $U_R$ and $I_R$ applied;<br>5000 h   | $\Delta C/C: \pm 20\%$<br>ESR ≤ 3 x spec. limit<br>$Z \leq 3$ x spec. limit<br>$I_{L5} \leq$ 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 | $T_{amb} = 105\text{ °C}$ ; 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 ≤ 1.5 x spec. limit<br>$I_{L5} \leq 2$ x 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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