

# Aluminum Capacitors

## Power Miniaturized Economy Long Life Snap-In


**RoHS**  
COMPLIANT

### FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, miniaturized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Useful life: 2000 h at 105 °C
- Compliant to RoHS Directive 2002/95/EC

### APPLICATIONS

- Consumer and telecom
- Whitegood motor control
- Electronic drives
- SMPS/UPS

### MARKING

The capacitors are marked (where possible) with the following information:

- Rated capacitance (in  $\mu\text{F}$ )
- Tolerance code on rated capacitance, code letter in accordance with IEC 60062 (M for  $\pm 20\%$ )
- Rated voltage (in V)
- Name of manufacturer
- Date code
- “-” sign to identify the negative terminal, visible from the top and side of the capacitor
- Code number (last 8 digits)
- Maximum operating temperature

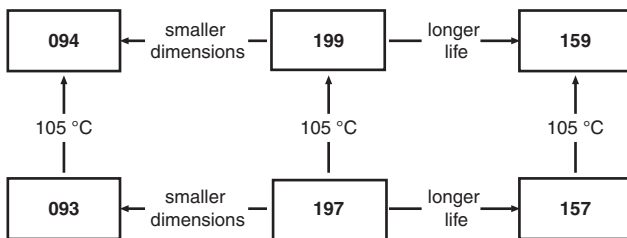
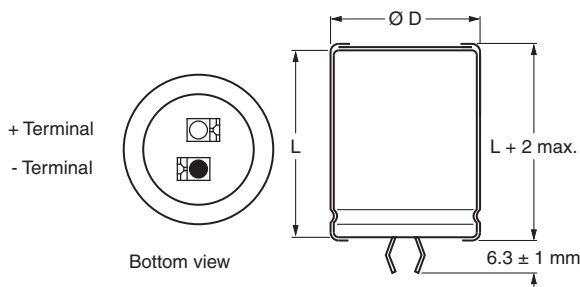


Fig. 1

| QUICK REFERENCE DATA                                |  |
|---|--|
| DESCRIPTION   | VALUE                                  |
| Nominal case size ( $\varnothing D \times L$ in mm) | 22 x 25 to 35 x 60                     |
| Rated capacitance range, $C_R$                      | 56 $\mu\text{F}$ to 2200 $\mu\text{F}$ |
| Tolerance on $C_R$                                  | $\pm 20\%$                             |
| Rated voltage range, $U_R$                          | 200 V to 450 V                         |
| Category temperature range                          | - 25 °C to + 105 °C                    |
| Useful life at 105 °C                               | 2000 h                                 |
| Useful life at 40 °C and 1.6 x $I_R$ applied        | 180 000 h                              |
| Shelf life at 0 V, 105 °C                           | 500 h                                  |
| Based on sectional specification                    | IEC 60384-4/EN130300/W of JISC5141     |

| SELECTION CHART FOR $C_R$ , $U_R$ AND RELEVANT NOMINAL CASE SIZES ( $\varnothing D \times L$ in mm) |           |     |         |         |         |
|---|-----------|-----|---------|---------|---------|
| $C_R$ ( $\mu\text{F}$ )   | $U_R$ (V) |     |         |         |         |
|   | 200       | 250 | 400     | 420     | 450     |
| 56  | -         | -   | 22 x 25 | 22 x 25 | 22 x 25 |
| 68  | -         | -   | 22 x 25 | 22 x 25 | 22 x 25 |
| 82  | -         | -   | 22 x 25 | 22 x 25 | 22 x 30 |
|   | -         | -   | -       | -       | 25 x 25 |
| 100   | -         | -   | 22 x 25 | 22 x 30 | 22 x 30 |
|   | -         | -   | -       | 25 x 25 | 25 x 25 |
| 120   | -         | -   | 22 x 30 | 22 x 30 | 22 x 35 |
|   | -         | -   | 25 x 25 | 25 x 25 | 25 x 30 |

| <b>SELECTION CHART FOR <math>C_R</math>, <math>U_R</math> AND RELEVANT NOMINAL CASE SIZES (<math>\varnothing D \times L</math> in mm)</b> |           |         |         |         |         |
|---|-----------|---------|---------|---------|---------|
| $C_R$<br>( $\mu F$ )  | $U_R$ (V) |         |         |         |         |
|   | 200       | 250     | 400     | 420     | 450     |
| 150   | -         | -       | 22 x 35 | 22 x 35 | 22 x 40 |
|   | -         | -       | -       | 25 x 30 | 25 x 30 |
|   | -         | -       | -       | -       | 30 x 25 |
| 180   | -         | -       | 30 x 25 | 22 x 40 | 22 x 50 |
|   | -         | -       | -       | 25 x 30 | 25 x 35 |
|   | -         | -       | -       | 30 x 25 | 30 x 25 |
| 220   | 22 x 25   | 22 x 30 | 22 x 50 | 22 x 50 | 25 x 40 |
|   | -         | -       | 25 x 35 | 25 x 40 | 30 x 30 |
|   | -         | -       | 30 x 25 | 30 x 30 | 35 x 25 |
|   | -         | -       | -       | 35 x 25 | -       |
| 270   | 22 x 25   | 22 x 30 | 30 x 30 | 25 x 50 | 25 x 50 |
|   | -         | -       | 35 x 25 | -       | 30 x 35 |
|   | -         | -       | -       | -       | 35 x 30 |
| 330   | 22 x 30   | 22 x 35 | 25 x 50 | 35 x 30 | 30 x 45 |
|   | -         | -       | 30 x 35 | -       | 35 x 35 |
|   | -         | -       | 35 x 30 | -       | -       |
| 390   | 22 x 35   | 25 x 30 | 30 x 40 | 35 x 35 | 30 x 50 |
|   | 25 x 30   | -       | 35 x 30 | -       | 35 x 40 |
| 470   | 22 x 35   | 25 x 35 | 30 x 45 | 35 x 40 | 35 x 45 |
|   | 25 x 30   | -       | 35 x 35 | -       | -       |
| 560   | 25 x 30   | 25 x 40 | 30 x 50 | 35 x 45 | 35 x 50 |
|   | -         | -       | 35 x 40 | -       | -       |
| 680   | 22 x 50   | 30 x 30 | 35 x 45 | 35 x 50 | 35 x 60 |
|   | 25 x 40   | -       | -       | -       | -       |
| 820   | 30 x 30   | -       | -       | -       | -       |
| 1000  | 25 x 50   | 30 x 45 | -       | -       | -       |
|   | 30 x 35   | -       | -       | -       | -       |
| 1200  | 30 x 40   | 35 x 40 | -       | -       | -       |
| 1500  | 30 x 50   | 35 x 45 | -       | -       | -       |
|   | 35 x 40   | -       | -       | -       | -       |
| 1800  | -         | 35 x 50 | -       | -       | -       |
| 2200  | 35 x 50   | -       | -       | -       | -       |

**DIMENSIONS in millimeters AND AVAILABLE FORMS**


The minus and/or plus terminal can be marked with an imprinted sign.

Fig. 2 - Two terminal snap-in

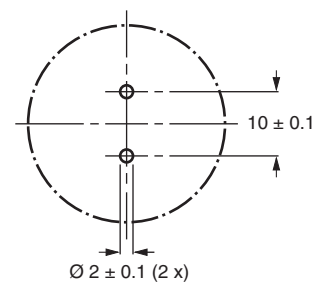


Fig. 3 - Mounting hole diagram



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 (g) | PACKAGING QUANTITIES | CARDBOARD BOX DIMENSIONS<br>L x W x H |
| 22 x 25  | 22.5                | 26.5              | ≈ 12     | 216                  | 280 x 240 x 140                       |
| 22 x 30  | 22.5                | 31.5              | ≈ 16     | 216                  | 280 x 240 x 140                       |
| 22 x 35  | 22.5                | 36.5              | ≈ 20     | 144                  | 280 x 240 x 105                       |
| 22 x 40  | 22.5                | 41.5              | ≈ 23     | 144                  | 280 x 240 x 105                       |
| 22 x 45  | 22.5                | 46.5              | ≈ 26     | 144                  | 280 x 240 x 140                       |
| 22 x 50  | 22.5                | 51.5              | ≈ 29     | 72                   | 280 x 240 x 105                       |
| 25 x 25  | 25.5                | 26.5              | ≈ 20     | 216                  | 280 x 240 x 140                       |
| 25 x 30  | 25.5                | 33.5              | ≈ 22     | 216                  | 280 x 240 x 140                       |
| 25 x 35  | 25.5                | 36.5              | ≈ 24     | 144                  | 280 x 240 x 105                       |
| 25 x 40  | 25.5                | 41.5              | ≈ 27     | 144                  | 280 x 240 x 105                       |
| 25 x 45  | 25.5                | 46.5              | ≈ 32     | 144                  | 280 x 240 x 140                       |
| 25 x 50  | 25.5                | 51.5              | ≈ 38     | 144                  | 280 x 240 x 140                       |
| 30 x 25  | 30.5                | 28.5              | ≈ 25     | 168                  | 280 x 240 x 140                       |
| 30 x 30  | 30.5                | 33.5              | ≈ 30     | 168                  | 280 x 240 x 140                       |
| 30 x 35  | 30.5                | 38.5              | ≈ 35     | 112                  | 280 x 240 x 105                       |
| 30 x 40  | 30.5                | 42.5              | ≈ 40     | 112                  | 280 x 240 x 105                       |
| 30 x 45  | 30.5                | 47.5              | ≈ 45     | 112                  | 280 x 240 x 140                       |
| 30 x 50  | 30.5                | 52.5              | ≈ 50     | 112                  | 280 x 240 x 140                       |
| 35 x 25  | 35.5                | 26.5              | ≈ 33     | 126                  | 280 x 240 x 140                       |
| 35 x 30  | 35.5                | 33.5              | ≈ 40     | 126                  | 280 x 240 x 140                       |
| 35 x 35  | 35.5                | 36.5              | ≈ 48     | 84                   | 280 x 240 x 105                       |
| 35 x 40  | 35.5                | 42.5              | ≈ 55     | 84                   | 280 x 240 x 105                       |
| 35 x 45  | 35.5                | 47.5              | ≈ 63     | 84                   | 280 x 240 x 140                       |
| 35 x 50  | 35.5                | 52.5              | ≈ 72     | 84                   | 280 x 240 x 140                       |
| 35 x 60  | 36.5                | 62.5              | ≈ 87     | 42                   | 280 x 240 x 105                       |

| ELECTRICAL DATA |  |
|-----------------|--|
| SYMBOL          | DESCRIPTION  |
| C <sub>R</sub>  | Rated capacitance at 120 Hz                                |
| I <sub>R</sub>  | Rated RMS ripple current at 120 Hz, 105 °C                 |
| I <sub>L5</sub> | Max. leakage current after 5 min at U <sub>R</sub>         |
| ESR             | Max. equivalent series resistance at 120 Hz <sup>(1)</sup> |

**Note**

- <sup>(1)</sup> ESR at 100 Hz is approximately 1.05 x ESR 120 Hz
- Unless otherwise specified, all electrical values in Table 2 apply at T<sub>amb</sub> = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %

**ORDERING EXAMPLE**

Electrolytic capacitor 094 series  
 330 µF/400 V; ± 20 %  
 Nominal case size: Ø 25 mm x 50 mm  
 2-terminal snap-in:  
 Ordering code: MAL2 094 46331 E3  
 Former 12NC: 2222 094 46331



Table 2

| ELECTRICAL DATA AND ORDERING INFORMATION |                               |   |                        |                  |   |                                  |                                  |
|--|-------------------------------|---|------------------------|------------------|---|----------------------------------|----------------------------------|
| $U_R$<br>(V)                             | $C_R$<br>120 Hz<br>( $\mu$ F) | NOMINAL<br>CASE SIZE<br>$\varnothing$ D x L<br>(mm) | $I_R$<br>120 Hz<br>(A) | $I_{L5}$<br>(mA) | MAX. ESR<br>120 Hz <sup>(1)</sup><br>( $\Omega$ ) | MAX. Z<br>10 kHz<br>( $\Omega$ ) | ORDERING<br>CODE<br>MAL2094..... |
| 200                                      | 220                           | 22 x 25   | 1.04                   | 0.88             | 0.46  | 0.30                             | 52221E3                          |
|  | 270                           | 22 x 25   | 1.12                   | 1.08             | 0.40  | 0.26                             | 52271E3                          |
|  | 330                           | 22 x 30   | 1.30                   | 1.32             | 0.32  | 0.21                             | 52331E3                          |
|  | 390                           | 22 x 35   | 1.49                   | 1.50             | 0.27  | 0.17                             | 52391E3                          |
|  | 390                           | 25 x 30   | 1.47                   | 1.50             | 0.27  | 0.18                             | 42391E3                          |
|  | 470                           | 22 x 35   | 1.58                   | 1.50             | 0.24  | 0.15                             | 52471E3                          |
|  | 470                           | 25 x 30   | 1.55                   | 1.50             | 0.24  | 0.16                             | 42471E3                          |
|  | 560                           | 25 x 30   | 1.61                   | 1.50             | 0.22  | 0.15                             | 42561E3                          |
|  | 680                           | 22 x 50   | 1.96                   | 1.50             | 0.16  | 0.10                             | 52681E3                          |
|  | 680                           | 25 x 40   | 1.98                   | 1.50             | 0.17  | 0.11                             | 42681E3                          |
|  | 820                           | 30 x 30   | 1.86                   | 1.50             | 0.18  | 0.13                             | 32821E3                          |
|  | 1000                          | 25 x 50   | 2.56                   | 1.50             | 0.12  | 0.08                             | 42102E3                          |
|  | 1000                          | 30 x 35   | 2.04                   | 1.50             | 0.16  | 0.12                             | 32102E3                          |
|  | 1200                          | 30 x 40   | 2.35                   | 1.50             | 0.13  | 0.09                             | 32122E3                          |
|  | 1500                          | 30 x 50   | 2.87                   | 1.50             | 0.10  | 0.07                             | 32152E3                          |
| 1500                                     | 35 x 40                       | 2.54  | 1.50                   | 0.13             | 0.09  | 22152E3                          |                                  |
| 2200                                     | 35 x 50                       | 3.02  | 1.50                   | 0.10             | 0.07  | 22222E3                          |                                  |
| 250                                      | 220                           | 22 x 30   | 1.33                   | 1.10             | 0.41  | 0.25                             | 53221E3                          |
|  | 270                           | 22 x 30   | 1.22                   | 1.35             | 0.35  | 0.22                             | 53271E3                          |
|  | 330                           | 22 x 35   | 1.40                   | 1.50             | 0.29  | 0.18                             | 53331E3                          |
|  | 390                           | 25 x 30   | 1.46                   | 1.50             | 0.26  | 0.17                             | 43391E3                          |
|  | 470                           | 25 x 35   | 1.64                   | 1.50             | 0.22  | 0.14                             | 43471E3                          |
|  | 560                           | 25 x 40   | 1.87                   | 1.50             | 0.19  | 0.12                             | 43561E3                          |
|  | 680                           | 30 x 30   | 1.76                   | 1.50             | 0.20  | 0.14                             | 33681E3                          |
|  | 1000                          | 30 x 45   | 2.48                   | 1.50             | 0.13  | 0.09                             | 33102E3                          |
|  | 1200                          | 35 x 40   | 2.47                   | 1.50             | 0.13  | 0.10                             | 23122E3                          |
|  | 1500                          | 35 x 45   | 2.73                   | 1.50             | 0.12  | 0.09                             | 23152E3                          |
| 1800                                     | 35 x 50                       | 2.96  | 1.50                   | 0.10             | 0.07  | 23182E3                          |                                  |
| 400                                      | 56                            | 22 x 25   | 0.53                   | 0.45             | 2.39  | 1.79                             | 56569E3                          |
|  | 68                            | 22 x 25   | 0.58                   | 0.54             | 1.98  | 1.49                             | 56689E3                          |
|  | 82                            | 22 x 25   | 0.64                   | 0.66             | 1.66  | 1.25                             | 56829E3                          |
|  | 100                           | 22 x 25   | 0.68                   | 0.80             | 1.51  | 1.16                             | 56101E3                          |
|  | 120                           | 22 x 30   | 0.79                   | 0.96             | 1.16  | 0.87                             | 56121E3                          |
|  | 120                           | 25 x 25   | 0.79                   | 0.96             | 1.17  | 0.89                             | 46121E3                          |
|  | 150                           | 22 x 35   | 0.92                   | 1.20             | 0.92  | 0.69                             | 56151E3                          |
|  | 180                           | 30 x 25   | 1.03                   | 1.44             | 0.81  | 0.62                             | 36181E3                          |
|  | 220                           | 22 x 50   | 1.15                   | 1.50             | 0.59  | 0.44                             | 56221E3                          |
|  | 220                           | 25 x 35   | 1.11                   | 1.50             | 0.68  | 0.52                             | 46221E3                          |
|  | 220                           | 30 x 25   | 1.08                   | 1.50             | 0.71  | 0.55                             | 36221E3                          |
|  | 270                           | 30 x 30   | 1.26                   | 1.50             | 0.55  | 0.42                             | 36271E3                          |
|  | 270                           | 35 x 25   | 1.25                   | 1.50             | 0.63  | 0.50                             | 26271E3                          |
|  | 330                           | 25 x 50   | 1.61                   | 1.50             | 0.43  | 0.33                             | 46331E3                          |
|  | 330                           | 30 x 35   | 1.41                   | 1.50             | 0.47  | 0.37                             | 36331E3                          |
|  | 330                           | 35 x 30   | 1.50                   | 1.50             | 0.46  | 0.36                             | 26331E3                          |
|  | 390                           | 30 x 40   | 1.62                   | 1.50             | 0.39  | 0.30                             | 36391E3                          |
|  | 390                           | 35 x 30   | 1.56                   | 1.50             | 0.43  | 0.34                             | 26391E3                          |
|  | 470                           | 30 x 45   | 1.82                   | 1.50             | 0.33  | 0.26                             | 36471E3                          |
|  | 470                           | 35 x 35   | 1.70                   | 1.50             | 0.37  | 0.30                             | 26471E3                          |
|  | 560                           | 30 x 50   | 2.03                   | 1.50             | 0.29  | 0.23                             | 36561E3                          |
|  | 560                           | 35 x 40   | 1.95                   | 1.50             | 0.30  | 0.24                             | 26561E3                          |
| 680                                      | 35 x 45                       | 2.15  | 1.50                   | 0.26             | 0.21  | 26681E3                          |                                  |



| ELECTRICAL DATA AND ORDERING INFORMATION |                                  |   |                                 |                         |  |                         |                                  |
|--|----------------------------------|---|---------------------------------|-------------------------|--|-------------------------|----------------------------------|
| U <sub>R</sub><br>(V)                    | C <sub>R</sub><br>120 Hz<br>(μF) | NOMINAL<br>CASE SIZE<br>Ø D x L<br>(mm) | I <sub>R</sub><br>120 Hz<br>(A) | I <sub>L5</sub><br>(mA) | MAX. ESR<br>120 Hz <sup>(1)</sup><br>(Ω) | MAX. Z<br>10 kHz<br>(Ω) | ORDERING<br>CODE<br>MAL2094..... |
| 420                                      | 56                               | 22 x 25                                 | 0.54                            | 0.47                    | 2.24                                     | 1.64                    | 54569E3                          |
|  | 68                               | 22 x 25                                 | 0.59                            | 0.57                    | 1.86                                     | 1.36                    | 54689E3                          |
|  | 82                               | 22 x 25                                 | 0.64                            | 0.69                    | 1.60                                     | 1.20                    | 54829E3                          |
|  | 100                              | 22 x 30                                 | 0.74                            | 0.84                    | 1.27                                     | 0.93                    | 54101E3                          |
|  | 100                              | 25 x 25                                 | 0.74                            | 0.84                    | 1.29                                     | 0.96                    | 44101E3                          |
|  | 120                              | 22 x 30                                 | 0.79                            | 1.01                    | 1.15                                     | 0.87                    | 54121E3                          |
|  | 120                              | 25 x 25                                 | 0.79                            | 1.01                    | 1.16                                     | 0.89                    | 44121E3                          |
|  | 150                              | 22 x 35                                 | 0.92                            | 1.26                    | 0.91                                     | 0.69                    | 54151E3                          |
|  | 150                              | 25 x 30                                 | 0.93                            | 1.26                    | 0.86                                     | 0.64                    | 44151E3                          |
|  | 180                              | 22 x 40                                 | 1.06                            | 1.50                    | 0.76                                     | 0.57                    | 54181E3                          |
|  | 180                              | 25 x 30                                 | 1.00                            | 1.50                    | 0.78                                     | 0.59                    | 44181E3                          |
|  | 180                              | 30 x 25                                 | 1.03                            | 1.50                    | 0.76                                     | 0.58                    | 34181E3                          |
|  | 220                              | 22 x 50                                 | 1.15                            | 1.50                    | 0.59                                     | 0.44                    | 54221E3                          |
|  | 220                              | 25 x 40                                 | 1.22                            | 1.50                    | 0.59                                     | 0.44                    | 44221E3                          |
|  | 220                              | 30 x 30                                 | 1.19                            | 1.50                    | 0.59                                     | 0.44                    | 34221E3                          |
|  | 220                              | 35 x 25                                 | 1.19                            | 1.50                    | 0.67                                     | 0.52                    | 24221E3                          |
|  | 270                              | 25 x 50                                 | 1.50                            | 1.50                    | 0.47                                     | 0.34                    | 44271E3                          |
|  | 330                              | 35 x 30                                 | 1.49                            | 1.50                    | 0.45                                     | 0.35                    | 24331E3                          |
|  | 390                              | 35 x 35                                 | 1.65                            | 1.50                    | 0.39                                     | 0.31                    | 24391E3                          |
|  | 470                              | 35 x 40                                 | 1.86                            | 1.50                    | 0.32                                     | 0.25                    | 24471E3                          |
| 560                                      | 35 x 45                          | 2.06                                    | 1.50                            | 0.27                    | 0.21                                     | 24561E3                 |                                  |
| 680                                      | 35 x 50                          | 2.30                                    | 1.50                            | 0.23                    | 0.18                                     | 24681E3                 |                                  |
| 450                                      | 56                               | 22 x 25                                 | 0.55                            | 0.50                    | 2.06                                     | 1.46                    | 57569E3                          |
|  | 68                               | 22 x 25                                 | 0.59                            | 0.61                    | 1.72                                     | 1.23                    | 57689E3                          |
|  | 82                               | 22 x 30                                 | 0.68                            | 0.74                    | 1.41                                     | 1.01                    | 57829E3                          |
|  | 82                               | 25 x 25                                 | 0.68                            | 0.74                    | 1.43                                     | 1.03                    | 47829E3                          |
|  | 100                              | 22 x 30                                 | 0.74                            | 0.90                    | 1.25                                     | 0.92                    | 57101E3                          |
|  | 100                              | 25 x 25                                 | 0.74                            | 0.90                    | 1.25                                     | 0.91                    | 47101E3                          |
|  | 120                              | 22 x 35                                 | 0.85                            | 1.08                    | 1.01                                     | 0.73                    | 57121E3                          |
|  | 120                              | 25 x 30                                 | 0.86                            | 1.08                    | 0.98                                     | 0.70                    | 47121E3                          |
|  | 150                              | 22 x 40                                 | 0.99                            | 1.35                    | 0.81                                     | 0.59                    | 57151E3                          |
|  | 150                              | 25 x 30                                 | 0.93                            | 1.35                    | 0.83                                     | 0.61                    | 47151E3                          |
|  | 150                              | 30 x 25                                 | 0.97                            | 1.35                    | 0.83                                     | 0.61                    | 37151E3                          |
|  | 180                              | 22 x 50                                 | 1.07                            | 1.50                    | 0.64                                     | 0.45                    | 57181E3                          |
|  | 180                              | 25 x 35                                 | 1.05                            | 1.50                    | 0.73                                     | 0.53                    | 47181E3                          |
|  | 180                              | 30 x 25                                 | 1.03                            | 1.50                    | 0.75                                     | 0.56                    | 37181E3                          |
|  | 220                              | 25 x 40                                 | 1.20                            | 1.50                    | 0.60                                     | 0.44                    | 47221E3                          |
|  | 220                              | 30 x 30                                 | 1.19                            | 1.50                    | 0.59                                     | 0.43                    | 37221E3                          |
|  | 220                              | 35 x 25                                 | 1.19                            | 1.50                    | 0.67                                     | 0.51                    | 27221E3                          |
|  | 270                              | 25 x 50                                 | 1.50                            | 1.50                    | 0.47                                     | 0.34                    | 47271E3                          |
|  | 270                              | 30 x 35                                 | 1.34                            | 1.50                    | 0.50                                     | 0.38                    | 37271E3                          |
|  | 270                              | 35 x 30                                 | 1.42                            | 1.50                    | 0.49                                     | 0.37                    | 27271E3                          |
| 330                                      | 30 x 45                          | 1.64                                    | 1.50                            | 0.38                    | 0.28                                     | 37331E3                 |                                  |
| 330                                      | 35 x 35                          | 1.58                                    | 1.50                            | 0.42                    | 0.32                                     | 27331E3                 |                                  |
| 390                                      | 30 x 50                          | 1.85                                    | 1.50                            | 0.33                    | 0.25                                     | 37391E3                 |                                  |
| 390                                      | 35 x 40                          | 1.78                                    | 1.50                            | 0.35                    | 0.26                                     | 27391E3                 |                                  |
| 470                                      | 35 x 45                          | 1.97                                    | 1.50                            | 0.29                    | 0.22                                     | 27471E3                 |                                  |
| 560                                      | 35 x 50                          | 2.20                                    | 1.50                            | 0.25                    | 0.19                                     | 27561E3                 |                                  |
| 680                                      | 35 x 60                          | 2.60                                    | 1.50                            | 0.21                    | 0.16                                     | 27681E3                 |                                  |

**Note**

<sup>(1)</sup> ESR at 100 Hz is approximately 1.05 x ESR 120 Hz



| ADDITIONAL ELECTRICAL DATA         |                      |   |
|------------------------------------|----------------------|---|
| PARAMETER                          | CONDITIONS           | VALUE   |
| <b>Voltage</b>                     |                      |   |
| Surge voltage                      | ≥ 200 V versions     | $U_s = 1.1 \times U_R$  |
| Reverse voltage                    | ≤ 1 V                | -   |
| <b>Current</b>                     |                      |   |
| Leakage current                    | After 5 min at $U_R$ | $I_{L5} \leq 0.02 C_R \times U_R$ or 1.5 mA, whichever is smaller |
| <b>Inductance</b>                  |                      |   |
| Equivalent series inductance (ESL) | All case sizes       | 19 nH typical/25 nH max.  |

Table 3

| LOW TEMPERATURE CHARACTERISTIC (at 120 Hz) |                                     |   |
|--|-------------------------------------|---|
| DESCRIPTION                                | $U_R$ (V) <sup>(1)</sup>            |   |
|  | 200 TO 450                          |   |
| Impedance ratio                            | $Z(-25\text{ °C})/Z(+20\text{ °C})$ | 4 |

**Note**

(1) Impedance ratio shall not exceed the given values

**RIPPLE CURRENT AND USEFUL LIFE**

$I_A$  = Actual ripple current at 120 Hz  
 $I_R$  = Rated ripple current at 120 Hz and 105 °C  
 (1) Useful life at 105 °C and  $I_R$  applied: 2000 h

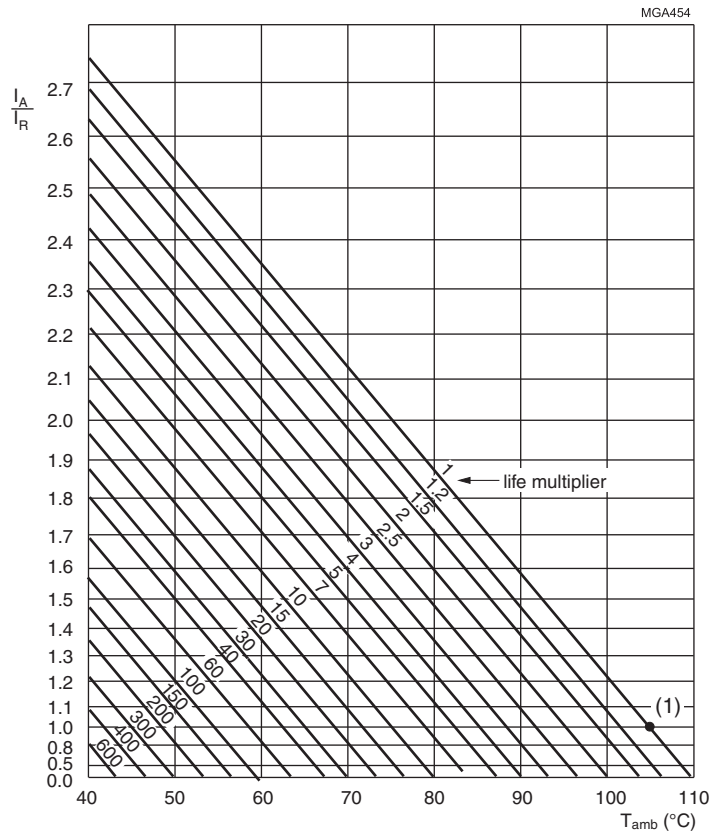


Fig. 4 - Multiplier of useful life as a function of ambient temperature and ripple current load



Table 4

| MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY |                  |
|---|------------------|
| FREQUENCY (Hz)  | $I_R$ MULTIPLIER |
| 60  | 0.90             |
| 100   | 0.95             |
| 120   | 1.00             |
| 500   | 1.20             |
| 1000  | 1.30             |
| $\geq 10\ 000$  | 1.40             |

Table 5

| TEST PROCEDURES AND REQUIREMENTS               |  |  |   |
|--|--|--|---|
| TEST   |  | PROCEDURE<br>(quick reference)   | REQUIREMENTS  |
| NAME OF TEST                                   | REFERENCE                                  |  |   |
| Useful life                                    | CECC 30301<br>subclause 1.8.1              | $T_{amb} = 105\ ^\circ\text{C}$ ;<br>$U_R$ and $I_R$ applied: 2000 h   | $\Delta C/C: \pm 30\ \%$<br>$ESR \leq 3 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$<br>no short or open circuit,<br>no visible damage,<br>total failure percentage: $\leq 3\ \%$ |
| Shelf life<br>(storage at<br>high temperature) | IEC 60384-4/<br>EN130300<br>subclause 4.17 | $T_{amb} = 105\ ^\circ\text{C}$ ; 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 | $\Delta C/C: \pm 20\ \%$<br>$ESR \leq 2 \times \text{spec. limit}$<br>$I_{L5} \leq 1 \times \text{spec. limit}$   |



## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

## Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**