

## Aluminum Electrolytic Capacitors Power Long Life Snap-In



Fig. 1


**RoHS  
COMPLIANT**

### FEATURES

- Long useful life: 10 000 h at +105 °C
- High ripple current capability
- Keyed polarity version available
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

### APPLICATIONS

- Computer, telecommunication and industrial systems
- Smoothing and filtering applications
- Standard and switched mode power supplies
- Energy storage in pulse systems

### MARKING

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

- Rated capacitance (in  $\mu\text{F}$ )
- Tolerance code on rated capacitance, code letter in accordance with IEC 60062 (M for  $\pm 20\%$ )
- Rated voltage (in V)
- Date code (YYMM)
- Name of manufacturer
- Code for factory of origin
- “-” sign to identify the negative terminal, visible from the top and side of the capacitor
- Code number
- Climatic category in accordance with IEC 60068

| QUICK REFERENCE DATA                            |   |                  |
|---|---|------------------|
| DESCRIPTION                                     | VALUE   |                  |
|   | 058   | 059              |
| Nominal case sizes ( $\varnothing$ D x L in mm) | 22 x 25 to 35 x 50                                |                  |
| Rated capacitance range (E6 series), $C_R$      | 33 $\mu\text{F}$ to 47 000 $\mu\text{F}$          |                  |
| Tolerance on $C_R$                              | $\pm 20\%$  |                  |
| Rated voltage range, $U_R$                      | 10 V to 100 V                                     | 200 V to 400 V   |
| Category temperature range                      | -40 °C to 105 °C                                  | -25 °C to 105 °C |
| Endurance test at 105 °C                        | $\leq 50$ V: 2000 h;<br>$\geq 63$ V: 5000 h       |                  |
| Useful life at 105 °C                           | $\leq 50$ V: 5000 h;<br>$\geq 63$ V: 10 000 h     |                  |
| Useful life at 40 °C, 1.9 x $I_R$ applied       | $\leq 50$ V: 125 000 h;<br>$\geq 63$ V: 250 000 h |                  |
| Shelf life at 0 V, 105 °C                       | 500 h   |                  |
| Max. RMS value of ripple voltage                | n/a   | 12 V             |
| Based on sectional specification                | IEC 60384-4 / EN130300                            |                  |
| Climatic category IEC 60068                     | 40 / 105 / 56                                     | 25 / 105 / 56    |

| SELECTION CHART FOR $C_R$ , $U_R$ , AND RELEVANT NOMINAL CASE SIZES FOR 058 SERIES ( $\varnothing$ D x L in mm) |           |    |    |         |         |         |         |
|---|-----------|----|----|---------|---------|---------|---------|
| $C_R$ ( $\mu\text{F}$ )   | $U_R$ (V) |    |    |         |         |         |         |
|   | 10        | 16 | 25 | 40      | 50      | 63      | 100     |
| 330   | -         | -  | -  | -       | -       | -       | 22 x 25 |
| 470   | -         | -  | -  | -       | -       | -       | 22 x 30 |
| 680   | -         | -  | -  | -       | -       | 22 x 25 | 25 x 30 |
|   | -         | -  | -  | -       | -       | -       | 22 x 40 |
| 1000  | -         | -  | -  | -       | 22 x 25 | 22 x 30 | 30 x 30 |
|   | -         | -  | -  | -       | -       | -       | 25 x 40 |
| 1500  | -         | -  | -  | 22 x 25 | 22 x 30 | 25 x 30 | 30 x 40 |
|   | -         | -  | -  | -       | -       | 22 x 40 | 25 x 50 |



| SELECTION CHART FOR C <sub>R</sub> , U <sub>R</sub> , AND RELEVANT NOMINAL CASE SIZES FOR 058 SERIES (∅ D x L in mm) |                    |         |         |         |         |         |         |
|--|--------------------|---------|---------|---------|---------|---------|---------|
| C <sub>R</sub><br>(μF)   | U <sub>R</sub> (V) |         |         |         |         |         |         |
|  | 10                 | 16      | 25      | 40      | 50      | 63      | 100     |
| 2200   | -                  | -       | 22 x 25 | 22 x 30 | 25 x 30 | 30 x 30 | 35 x 40 |
|  | -                  | -       | -       | -       | 22 x 40 | 25 x 40 | 30 x 50 |
| 3300   | -                  | 22 x 25 | 22 x 30 | 25 x 30 | 30 x 30 | 30 x 40 | 35 x 50 |
|  | -                  | -       | -       | 22 x 40 | 25 x 40 | 25 x 50 | -       |
| 4700   | 22 x 25            | 22 x 30 | 25 x 30 | 30 x 30 | 30 x 40 | 35 x 40 | -       |
|  | -                  | -       | 22 x 40 | 25 x 40 | 25 x 50 | 30 x 50 | -       |
| 6800   | 22 x 30            | 25 x 30 | 30 x 30 | 30 x 40 | 35 x 40 | 35 x 50 | -       |
|  | -                  | 22 x 40 | 25 x 40 | 25 x 50 | 30 x 50 | -       | -       |
| 10 000   | 25 x 30            | 30 x 30 | 30 x 40 | 35 x 40 | 35 x 50 | -       | -       |
|  | 22 x 40            | 25 x 40 | 25 x 50 | 30 x 50 | -       | -       | -       |
| 15 000   | 30 x 30            | 30 x 40 | 35 x 40 | 35 x 50 | -       | -       | -       |
|  | 25 x 40            | 25 x 50 | 30 x 50 | -       | -       | -       | -       |
| 22 000   | 30 x 40            | 35 x 40 | 35 x 50 | -       | -       | -       | -       |
|  | 25 x 50            | 30 x 50 | -       | -       | -       | -       | -       |
| 33 000   | 35 x 40            | 35 x 50 | -       | -       | -       | -       | -       |
|  | 30 x 50            | -       | -       | -       | -       | -       | -       |
| 47 000   | 35 x 50            | -       | -       | -       | -       | -       | -       |

| SELECTION CHART FOR C <sub>R</sub> , U <sub>R</sub> , AND RELEVANT NOMINAL CASE SIZES FOR 059 SERIES (∅ D x L in mm) |                    |         |         |         |
|--|--------------------|---------|---------|---------|
| C <sub>R</sub><br>(μF)   | U <sub>R</sub> (V) |         |         |         |
|  | 200                | 250     | 385     | 400     |
| 33   | -                  | -       | 22 x 25 | -       |
| 47   | -                  | -       | 22 x 30 | 22 x 30 |
| 68   | -                  | 22 x 25 | 22 x 35 | 22 x 35 |
|  | -                  | -       | 25 x 30 | 25 x 30 |
| 100  | 22 x 25            | 22 x 30 | 30 x 30 | 30 x 30 |
|  | -                  | -       | 25 x 40 | 25 x 40 |
| 150  | 22 x 30            | 22 x 35 | 25 x 50 | 30 x 35 |
|  | -                  | 25 x 30 | 30 x 40 | 25 x 50 |
| 220  | 22 x 35            | 30 x 30 | 35 x 40 | 35 x 40 |
|  | 25 x 30            | 25 x 35 | 30 x 50 | 30 x 50 |
| 330  | 30 x 30            | 30 x 35 | 35 x 50 | 35 x 50 |
|  | 25 x 40            | 25 x 50 | -       | -       |
| 470  | 30 x 35            | 35 x 35 | -       | -       |
|  | 25 x 50            | 30 x 45 | -       | -       |
| 680  | 35 x 35            | 35 x 45 | -       | -       |
|  | 30 x 45            | -       | -       | -       |
| 1000   | 35 x 50            | -       | -       | -       |

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


The minus terminal can be marked with a black dot or with an imprinted “-” sign.

Fig. 2 - Two terminal snap-in



Fig. 3 - Mounting hole diagram

**THREE TERMINAL SNAP-IN**


The negative terminal has **TWO** pins which are **BOTH** electrically connected.

Fig. 4 - Three terminal snap-in



The 10 mm spacing of the 2 pin snap-in is used as the base layout and a third hole is added.

The third hole is closer to the negative primary hole so that polarization is always maintained, together with added mechanical stability.

Fig. 5 - Mounting hole diagram

**Table 1**

| <b>DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES</b> |                           |                         |                 |   |   |
|---|---------------------------|-------------------------|-----------------|---|---|
| <b>NOMINAL CASE SIZE Ø D x L</b>                                | <b>Ø D<sub>MAX.</sub></b> | <b>L<sub>MAX.</sub></b> | <b>MASS (g)</b> | <b>PACKAGING QUANTITIES (units per box)</b> | <b>CARDBOARD BOX DIMENSIONS L x W x H</b> |
| 22 x 25   | 23                        | 27                      | ≈ 12            | 100   | 260 x 250 x 39                            |
| 22 x 30   | 23                        | 32                      | ≈ 16            | 100   | 260 x 250 x 44                            |
| 22 x 35   | 23                        | 37                      | ≈ 20            | 100   | 260 x 250 x 49                            |
| 22 x 40   | 23                        | 42                      | ≈ 23            | 100   | 260 x 250 x 54                            |
| 25 x 30   | 26                        | 32                      | ≈ 22            | 100   | 290 x 280 x 44                            |
| 25 x 35   | 26                        | 37                      | ≈ 24            | 100   | 290 x 280 x 49                            |
| 25 x 40   | 26                        | 42                      | ≈ 27            | 100   | 290 x 280 x 54                            |
| 25 x 50   | 26                        | 52                      | ≈ 38            | 100   | 290 x 280 x 64                            |
| 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                            |
| 30 x 45   | 31                        | 47                      | ≈ 45            | 100   | 340 x 330 x 59                            |
| 30 x 50   | 31                        | 52                      | ≈ 50            | 100   | 340 x 330 x 64                            |
| 35 x 35   | 36                        | 37                      | ≈ 48            | 50  | 390 x 198 x 49                            |
| 35 x 40   | 36                        | 42                      | ≈ 55            | 50  | 390 x 198 x 54                            |
| 35 x 45   | 36                        | 47                      | ≈ 63            | 50  | 390 x 198 x 59                            |
| 35 x 50   | 36                        | 52                      | ≈ 72            | 50  | 390 x 198 x 64                            |



| 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 and 105 °C |
| I <sub>L1</sub> | Max. leakage current after 1 min at U <sub>R</sub>        |
| I <sub>L5</sub> | Max. leakage current after 5 min at U <sub>R</sub>        |
| ESR             | Max. equivalent series resistance at 100 Hz               |
| Z               | Max. impedance at 10 kHz                                  |

**Note**

- Unless otherwise specified, all electrical values in Table 2 and 3 apply at T<sub>amb</sub> = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %

**Table 2**

| ELECTRICAL DATA AND ORDERING INFORMATION FOR 058 SERIES (∅ D x L in mm) |                                  |   |   |   |                                  |                                  |                       |                     |                               |         |
|---|----------------------------------|---|---|---|----------------------------------|----------------------------------|-----------------------|---------------------|-------------------------------|---------|
| U <sub>R</sub><br>(V)   | C <sub>R</sub><br>100 Hz<br>(μF) | NOMINAL<br>CASE SIZE<br>∅ 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>L1</sub><br>1 min<br>(μA) | I <sub>L5</sub><br>5 min<br>(μA) | ESR<br>100 Hz<br>(mΩ) | Z<br>10 kHz<br>(mΩ) | ORDERING CODE<br>MAL2058..... |         |
|   |                                  |   |   |   |                                  |                                  |                       |                     | 2-TERM.                       | 3-TERM. |
| 10  | 4700                             | 22 x 25                                 | 1.95                                      | 2.30  | 286                              | 98                               | 82                    | 57                  | 54472E3                       | 74472E3 |
|   | 6800                             | 22 x 30                                 | 2.44                                      | 2.88  | 412                              | 140                              | 61                    | 44                  | 54682E3                       | 74682E3 |
|   | 10 000                           | 25 x 30                                 | 2.81                                      | 3.32  | 604                              | 204                              | 54                    | 42                  | 54103E3                       | 74103E3 |
|   | 10 000                           | 22 x 40                                 | 3.29                                      | 3.88  | 604                              | 204                              | 43                    | 32                  | 44103E3                       | 24103E3 |
|   | 15 000                           | 30 x 30                                 | 3.53                                      | 4.17  | 904                              | 304                              | 42                    | 34                  | 54153E3                       | 74153E3 |
|   | 15 000                           | 25 x 40                                 | 3.78                                      | 4.46  | 904                              | 304                              | 38                    | 30                  | 44153E3                       | 24153E3 |
|   | 22 000                           | 30 x 40                                 | 4.62                                      | 5.45  | 1324                             | 444                              | 31                    | 25                  | 54223E3                       | 74223E3 |
|   | 22 000                           | 25 x 50                                 | 4.68                                      | 5.52  | 1324                             | 444                              | 31                    | 24                  | 44223E3                       | 24223E3 |
|   | 33 000                           | 35 x 40                                 | 5.15                                      | 6.08  | 1984                             | 664                              | 30                    | 24                  | 54333E3                       | 74333E3 |
|   | 33 000                           | 30 x 50                                 | 5.70                                      | 6.73  | 1984                             | 664                              | 24                    | 21                  | 44333E3                       | 24333E3 |
|   | 47 000                           | 35 x 50                                 | 6.23                                      | 7.35  | 2824                             | 944                              | 24                    | 21                  | 54473E3                       | 74473E3 |
| 16  | 3300                             | 22 x 25                                 | 1.90                                      | 2.24  | 321                              | 110                              | 86                    | 57                  | 55332E3                       | 75332E3 |
|   | 4700                             | 22 x 30                                 | 2.36                                      | 2.78  | 455                              | 154                              | 65                    | 44                  | 55472E3                       | 75472E3 |
|   | 6800                             | 25 x 30                                 | 2.75                                      | 3.25  | 657                              | 222                              | 56                    | 42                  | 55682E3                       | 75682E3 |
|   | 6800                             | 22 x 40                                 | 3.18                                      | 3.75  | 657                              | 222                              | 46                    | 32                  | 45682E3                       | 25682E3 |
|   | 10 000                           | 30 x 30                                 | 3.44                                      | 4.06  | 964                              | 324                              | 44                    | 34                  | 55103E3                       | 75103E3 |
|   | 10 000                           | 25 x 40                                 | 3.66                                      | 4.32  | 964                              | 324                              | 40                    | 30                  | 45103E3                       | 25103E3 |
|   | 15 000                           | 30 x 40                                 | 4.55                                      | 5.37  | 1444                             | 484                              | 32                    | 25                  | 55153E3                       | 75153E3 |
|   | 15 000                           | 25 x 50                                 | 4.55                                      | 5.37  | 1444                             | 484                              | 32                    | 24                  | 45153E3                       | 25153E3 |
|   | 22 000                           | 35 x 40                                 | 5.07                                      | 5.98  | 2116                             | 708                              | 31                    | 24                  | 55223E3                       | 75223E3 |
|   | 22 000                           | 30 x 50                                 | 5.67                                      | 6.69  | 2116                             | 708                              | 25                    | 21                  | 45223E3                       | 25223E3 |
|   | 33 000                           | 35 x 50                                 | 6.23                                      | 7.35  | 3172                             | 1060                             | 25                    | 21                  | 55333E3                       | 75333E3 |
| 25  | 2200                             | 22 x 25                                 | 1.76                                      | 2.08  | 334                              | 114                              | 100                   | 57                  | 56222E3                       | 76222E3 |
|   | 3300                             | 22 x 30                                 | 2.23                                      | 2.63  | 499                              | 169                              | 73                    | 44                  | 56332E3                       | 76332E3 |
|   | 4700                             | 25 x 30                                 | 2.60                                      | 3.07  | 709                              | 239                              | 62                    | 42                  | 56472E3                       | 76472E3 |
|   | 4700                             | 22 x 40                                 | 3.00                                      | 3.54  | 709                              | 239                              | 52                    | 32                  | 46472E3                       | 26472E3 |
|   | 6800                             | 30 x 30                                 | 3.26                                      | 3.85  | 1024                             | 344                              | 49                    | 34                  | 56682E3                       | 76682E3 |
|   | 6800                             | 25 x 40                                 | 3.49                                      | 4.12  | 1024                             | 344                              | 44                    | 30                  | 46682E3                       | 26682E3 |
|   | 10 000                           | 30 x 40                                 | 4.37                                      | 5.16  | 1504                             | 504                              | 35                    | 25                  | 56103E3                       | 76103E3 |
|   | 10 000                           | 25 x 50                                 | 4.37                                      | 5.16  | 1504                             | 504                              | 35                    | 24                  | 46103E3                       | 26103E3 |
|   | 15 000                           | 35 x 40                                 | 4.91                                      | 5.79  | 2254                             | 754                              | 33                    | 24                  | 56153E3                       | 76153E3 |
|   | 15 000                           | 30 x 50                                 | 5.43                                      | 6.41  | 2254                             | 754                              | 27                    | 21                  | 46153E3                       | 26153E3 |
|   | 22 000                           | 35 x 50                                 | 6.07                                      | 7.16  | 3304                             | 1104                             | 27                    | 21                  | 56223E3                       | 76223E3 |
| 40  | 1500                             | 22 x 25                                 | 1.65                                      | 2.01  | 364                              | 124                              | 114                   | 65                  | 57152E3                       | 77152E3 |
|   | 2200                             | 22 x 30                                 | 2.04                                      | 2.49  | 532                              | 180                              | 87                    | 50                  | 57222E3                       | 77222E3 |
|   | 3300                             | 25 x 30                                 | 2.43                                      | 2.99  | 796                              | 268                              | 71                    | 45                  | 57332E3                       | 77332E3 |
|   | 3300                             | 22 x 40                                 | 2.78                                      | 3.39  | 796                              | 268                              | 60                    | 37                  | 47332E3                       | 27332E3 |
|   | 4700                             | 30 x 30                                 | 2.96                                      | 3.61  | 1132                             | 380                              | 59                    | 40                  | 57472E3                       | 77472E3 |
|   | 4700                             | 25 x 40                                 | 3.26                                      | 3.90  | 1132                             | 380                              | 51                    | 32                  | 47472E3                       | 27472E3 |
|   | 6800                             | 30 x 40                                 | 3.94                                      | 4.81  | 1636                             | 548                              | 42                    | 29                  | 57682E3                       | 77682E3 |
|   | 6800                             | 25 x 50                                 | 4.10                                      | 5.00  | 1636                             | 548                              | 39                    | 26                  | 47682E3                       | 27682E3 |
|   | 10 000                           | 35 x 40                                 | 4.18                                      | 5.10  | 2404                             | 804                              | 46                    | 29                  | 57103E3                       | 77103E3 |
|   | 10 000                           | 30 x 50                                 | 4.98                                      | 6.08  | 2404                             | 804                              | 36                    | 24                  | 47103E3                       | 27103E3 |
|   | 15 000                           | 35 x 50                                 | 5.21                                      | 6.36  | 3604                             | 1204                             | 36                    | 24                  | 57153E3                       | 77153E3 |

**ORDERING EXAMPLE**

Electrolytic capacitor 058 series

10 000 μF / 25 V; ± 20 %

Nominal case size: ∅ 30 mm x 40 mm

**2-terminal snap-in:**

Ordering code: MAL2 058 56103 E3

Former 12NC: 2222 058 56103

**3-terminal snap-in:**

Ordering code: MAL2 058 76103 E3

Former 12NC: 2222 058 76103



| ELECTRICAL DATA AND ORDERING INFORMATION FOR 058 SERIES (Ø D x L in mm) |                                  |   |   |   |                                  |                                  |                       |                     |                               |         |
|---|----------------------------------|---|---|---|----------------------------------|----------------------------------|-----------------------|---------------------|-------------------------------|---------|
| 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>L1</sub><br>1 min<br>(µA) | I <sub>L5</sub><br>5 min<br>(µA) | ESR<br>100 Hz<br>(mΩ) | Z<br>10 kHz<br>(mΩ) | ORDERING CODE<br>MAL2058..... |         |
|   |                                  |   |   |   |                                  |                                  |                       |                     | 2-TERM.                       | 3-TERM. |
| 50  | 1000                             | 22 x 25                                 | 1.50                                      | 1.83  | 304                              | 104                              | 138                   | 69                  | 51102E3                       | 71102E3 |
|   | 1500                             | 22 x 30                                 | 1.88                                      | 2.29  | 454                              | 154                              | 102                   | 54                  | 51152E3                       | 71152E3 |
|   | 2200                             | 25 x 30                                 | 2.27                                      | 2.77  | 664                              | 124                              | 82                    | 47                  | 51222E3                       | 71222E3 |
|   | 2200                             | 22 x 40                                 | 2.55                                      | 3.11  | 664                              | 124                              | 71                    | 38                  | 41222E3                       | 21222E3 |
|   | 3300                             | 30 x 30                                 | 2.81                                      | 3.43  | 994                              | 334                              | 66                    | 41                  | 51332E3                       | 71332E3 |
|   | 3300                             | 25 x 40                                 | 3.07                                      | 3.75  | 994                              | 334                              | 57                    | 33                  | 41332E3                       | 21332E3 |
|   | 4700                             | 30 x 40                                 | 3.77                                      | 4.60  | 1414                             | 474                              | 47                    | 30                  | 51472E3                       | 71472E3 |
|   | 4700                             | 25 x 50                                 | 3.85                                      | 4.70  | 1414                             | 474                              | 43                    | 27                  | 41472E3                       | 21472E3 |
|   | 6800                             | 35 x 40                                 | 4.01                                      | 4.89  | 2044                             | 684                              | 49                    | 30                  | 51682E3                       | 71682E3 |
|   | 6800                             | 30 x 50                                 | 4.74                                      | 5.78  | 2044                             | 684                              | 38                    | 24                  | 41682E3                       | 21682E3 |
|   | 10 000                           | 35 x 50                                 | 5.04                                      | 6.15  | 3004                             | 1004                             | 38                    | 24                  | 51103E3                       | 71103E3 |
| 63  | 680                              | 22 x 25                                 | 1.17                                      | 1.43  | 261                              | 90                               | 228                   | 150                 | 58681E3                       | 78681E3 |
|   | 1000                             | 22 x 30                                 | 1.46                                      | 1.78  | 382                              | 130                              | 170                   | 115                 | 58102E3                       | 78102E3 |
|   | 1500                             | 25 x 30                                 | 1.76                                      | 2.15  | 571                              | 193                              | 137                   | 85                  | 58152E3                       | 78152E3 |
|   | 1500                             | 22 x 40                                 | 2.00                                      | 2.44  | 571                              | 193                              | 115                   | 85                  | 48152E3                       | 28152E3 |
|   | 2200                             | 30 x 30                                 | 2.27                                      | 2.77  | 836                              | 281                              | 101                   | 70                  | 58222E3                       | 78222E3 |
|   | 2200                             | 25 x 40                                 | 2.40                                      | 2.93  | 836                              | 281                              | 94                    | 70                  | 48222E3                       | 28222E3 |
|   | 3300                             | 30 x 40                                 | 3.07                                      | 3.75  | 1251                             | 420                              | 70                    | 50                  | 58332E3                       | 78332E3 |
|   | 3300                             | 25 x 50                                 | 3.07                                      | 3.75  | 1251                             | 420                              | 70                    | 50                  | 48332E3                       | 28332E3 |
|   | 4700                             | 35 x 40                                 | 3.65                                      | 4.45  | 1781                             | 596                              | 60                    | 45                  | 58472E3                       | 78472E3 |
|   | 4700                             | 30 x 50                                 | 3.88                                      | 4.73  | 1781                             | 596                              | 53                    | 45                  | 48472E3                       | 28472E3 |
|   | 6800                             | 35 x 50                                 | 4.58                                      | 5.59  | 2574                             | 861                              | 46                    | 35                  | 58682E3                       | 78682E3 |
| 100   | 330                              | 22 x 25                                 | 0.92                                      | 1.12  | 202                              | 70                               | 370                   | 250                 | 59331E3                       | 79331E3 |
|   | 470                              | 22 x 30                                 | 1.14                                      | 1.39  | 286                              | 98                               | 280                   | 190                 | 59471E3                       | 79471E3 |
|   | 680                              | 25 x 30                                 | 1.35                                      | 1.65  | 412                              | 140                              | 232                   | 140                 | 59681E3                       | 79681E3 |
|   | 680                              | 22 x 40                                 | 1.57                                      | 1.92  | 412                              | 140                              | 190                   | 140                 | 49681E3                       | 29681E3 |
|   | 1000                             | 30 x 30                                 | 1.79                                      | 2.40  | 604                              | 204                              | 163                   | 115                 | 59102E3                       | 79102E3 |
|   | 1000                             | 25 x 40                                 | 1.85                                      | 2.26  | 604                              | 204                              | 158                   | 115                 | 49102E3                       | 29102E3 |
|   | 1500                             | 30 x 40                                 | 2.45                                      | 2.99  | 904                              | 304                              | 111                   | 85                  | 59152E3                       | 79152E3 |
|   | 1500                             | 25 x 50                                 | 2.38                                      | 2.90  | 904                              | 304                              | 116                   | 85                  | 49152E3                       | 29152E3 |
|   | 2200                             | 35 x 40                                 | 3.05                                      | 3.72  | 1324                             | 444                              | 86                    | 65                  | 59222E3                       | 79222E3 |
|   | 2200                             | 30 x 50                                 | 3.13                                      | 3.82  | 1324                             | 444                              | 82                    | 65                  | 49222E3                       | 29222E3 |
|   | 3300                             | 35 x 50                                 | 3.84                                      | 4.68  | 1984                             | 664                              | 64                    | 50                  | 59332E3                       | 79332E3 |

Table 3

| ELECTRICAL DATA AND ORDERING INFORMATION FOR 059 SERIES |                                  |   |   |                                  |                                  |                       |                     |                               |         |  |
|---|----------------------------------|---|---|----------------------------------|----------------------------------|-----------------------|---------------------|-------------------------------|---------|--|
| 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>L1</sub><br>1 min<br>(µA) | I <sub>L5</sub><br>5 min<br>(µA) | ESR<br>100 Hz<br>(mΩ) | Z<br>10 kHz<br>(mΩ) | ORDERING CODE<br>MAL2059..... |         |  |
|   |                                  |   |   |                                  |                                  |                       |                     | 2-TERM.                       | 3-TERM. |  |
| 200   | 100                              | 22 x 25                                 | 0.53                                      | 124                              | 44                               | 1280                  | 730                 | 52101E3                       | 72101E3 |  |
|   | 150                              | 22 x 30                                 | 0.67                                      | 184                              | 64                               | 850                   | 540                 | 52151E3                       | 72151E3 |  |
|   | 220                              | 22 x 35                                 | 0.86                                      | 268                              | 92                               | 610                   | 430                 | 32221E3                       | 12221E3 |  |
|   | 220                              | 25 x 30                                 | 0.87                                      | 268                              | 92                               | 610                   | 430                 | 52221E3                       | 72221E3 |  |
|   | 330                              | 30 x 30                                 | 1.12                                      | 400                              | 136                              | 435                   | 300                 | 52331E3                       | 72331E3 |  |
|   | 330                              | 25 x 40                                 | 1.12                                      | 400                              | 136                              | 435                   | 300                 | 42331E3                       | 22331E3 |  |
|   | 470                              | 30 x 35                                 | 1.46                                      | 568                              | 192                              | 335                   | 225                 | 32471E3                       | 12471E3 |  |
|   | 470                              | 25 x 50                                 | 1.25                                      | 568                              | 192                              | 335                   | 225                 | 42471E3                       | 22471E3 |  |
|   | 680                              | 30 x 45                                 | 1.87                                      | 820                              | 276                              | 235                   | 155                 | 32681E3                       | 12681E3 |  |
|   | 680                              | 35 x 35                                 | 1.85                                      | 820                              | 276                              | 235                   | 155                 | 62681E3                       | 82681E3 |  |
|   | 1000                             | 35 x 50                                 | 2.45                                      | 1204                             | 404                              | 160                   | 125                 | 52102E3                       | 72102E3 |  |
| 250   | 68                               | 22 x 25                                 | 0.49                                      | 106                              | 38                               | 1640                  | 760                 | 53689E3                       | 73689E3 |  |
|   | 100                              | 22 x 30                                 | 0.62                                      | 154                              | 54                               | 1110                  | 570                 | 53101E3                       | 73101E3 |  |
|   | 150                              | 22 x 35                                 | 0.82                                      | 229                              | 79                               | 795                   | 440                 | 33151E3                       | 13151E3 |  |
|   | 150                              | 25 x 30                                 | 0.82                                      | 229                              | 79                               | 795                   | 440                 | 53151E3                       | 73151E3 |  |
|   | 220                              | 25 x 35                                 | 1.03                                      | 334                              | 114                              | 540                   | 300                 | 33221E3                       | 13221E3 |  |
|   | 220                              | 30 x 30                                 | 1.06                                      | 334                              | 114                              | 540                   | 300                 | 53221E3                       | 73221E3 |  |
|   | 330                              | 30 x 35                                 | 1.43                                      | 499                              | 169                              | 385                   | 225                 | 33331E3                       | 13331E3 |  |
|   | 330                              | 25 x 50                                 | 1.40                                      | 499                              | 169                              | 385                   | 225                 | 43331E3                       | 23331E3 |  |
|   | 470                              | 30 x 45                                 | 1.79                                      | 709                              | 239                              | 270                   | 155                 | 33471E3                       | 13471E3 |  |
|   | 470                              | 35 x 35                                 | 1.79                                      | 709                              | 239                              | 270                   | 155                 | 63471E3                       | 83471E3 |  |
|   | 680                              | 35 x 45                                 | 2.25                                      | 1024                             | 344                              | 190                   | 125                 | 43681E3                       | 23681E3 |  |



| ELECTRICAL DATA AND ORDERING INFORMATION FOR 059 SERIES |                            |                                |                                  |                            |                            |                 |               |                            |         |
|---|----------------------------|--------------------------------|----------------------------------|----------------------------|----------------------------|-----------------|---------------|----------------------------|---------|
| U <sub>R</sub> (V)                                      | C <sub>R</sub> 100 Hz (μF) | NOMINAL CASE SIZE Ø D x L (mm) | I <sub>R</sub> 100 Hz 105 °C (A) | I <sub>L1</sub> 1 min (μA) | I <sub>L5</sub> 5 min (μA) | ESR 100 Hz (mΩ) | Z 10 kHz (mΩ) | ORDERING CODE MAL2059..... |         |
|   |                            |                                |                                  |                            |                            |                 |               | 2-TERM.                    | 3-TERM. |
| 385   | 33                         | 22 x 25                        | 0.32                             | 80                         | 29                         | 3860            | 3000          | 58339E3                    | 78339E3 |
|   | 47                         | 22 x 30                        | 0.41                             | 113                        | 40                         | 2710            | 2100          | 58479E3                    | 78479E3 |
|   | 68                         | 22 x 35                        | 0.53                             | 161                        | 56                         | 1870            | 1460          | 38689E3                    | 18689E3 |
|   | 68                         | 25 x 30                        | 0.52                             | 161                        | 56                         | 1870            | 1460          | 58689E3                    | 78689E3 |
|   | 100                        | 30 x 30                        | 0.72                             | 235                        | 81                         | 1270            | 1010          | 58101E3                    | 78101E3 |
|   | 100                        | 25 x 40                        | 0.72                             | 235                        | 81                         | 1270            | 1010          | 48101E3                    | 28101E3 |
|   | 150                        | 30 x 40                        | 0.99                             | 351                        | 119                        | 850             | 675           | 58151E3                    | 78151E3 |
|   | 150                        | 25 x 50                        | 0.99                             | 351                        | 119                        | 850             | 675           | 48151E3                    | 28151E3 |
|   | 220                        | 35 x 40                        | 1.31                             | 512                        | 173                        | 580             | 465           | 58221E3                    | 78221E3 |
|   | 220                        | 30 x 50                        | 1.31                             | 512                        | 173                        | 580             | 465           | 48221E3                    | 28221E3 |
|   | 330                        | 35 x 50                        | 1.75                             | 766                        | 258                        | 390             | 320           | 58331E3                    | 78331E3 |
| 400   | 47                         | 22 x 30                        | 0.30                             | 117                        | 42                         | 4260            | 3490          | 56479E3                    | 76479E3 |
|   | 68                         | 22 x 35                        | 0.38                             | 167                        | 58                         | 2950            | 2420          | 36689E3                    | 16689E3 |
|   | 68                         | 25 x 30                        | 0.41                             | 167                        | 58                         | 2950            | 2420          | 56689E3                    | 76689E3 |
|   | 100                        | 30 x 30                        | 0.55                             | 244                        | 84                         | 2020            | 1660          | 56101E3                    | 76101E3 |
|   | 100                        | 25 x 40                        | 0.55                             | 244                        | 84                         | 2020            | 1660          | 46101E3                    | 26101E3 |
|   | 150                        | 30 x 35                        | 0.68                             | 364                        | 124                        | 1350            | 1110          | 36151E3                    | 16151E3 |
|   | 150                        | 25 x 50                        | 0.78                             | 364                        | 124                        | 1350            | 1110          | 46151E3                    | 26151E3 |
|   | 220                        | 35 x 40                        | 0.94                             | 532                        | 180                        | 930             | 760           | 56221E3                    | 76221E3 |
|   | 220                        | 30 x 50                        | 0.94                             | 532                        | 180                        | 930             | 760           | 46221E3                    | 26221E3 |
|   |                            | 330                            | 35 x 50                          | 1.25                       | 796                        | 260             | 620           | 510                        | 56331E3 |

| ADDITIONAL ELECTRICAL DATA         |                               |  |
|------------------------------------|-------------------------------|--|
| PARAMETER                          | CONDITIONS                    | VALUE  |
| <b>Voltage</b>                     |                               |  |
| Surge voltage                      | ≤ 250 V versions              | U <sub>s</sub> = 1.15 x U <sub>R</sub>                         |
|                                    | ≥ 385 V versions              | U <sub>s</sub> = 1.1 x U <sub>R</sub>                          |
| Reverse voltage                    |                               | U <sub>rev</sub> ≤ 1 V   |
| <b>Current</b>                     |                               |  |
| Leakage current                    | After 1 min at U <sub>R</sub> | I <sub>L1</sub> ≤ 0.006 C <sub>R</sub> x U <sub>R</sub> + 4 μA |
|                                    | After 5 min at U <sub>R</sub> | I <sub>L5</sub> ≤ 0.002 C <sub>R</sub> x U <sub>R</sub> + 4 μA |
| <b>Inductance</b>                  |                               |  |
| Equivalent series inductance (ESL) | All case sizes                | Typ. 19 nH   |
|                                    |                               | Max. 25 nH   |

**CAPACITANCE (C)**



Fig. 6 - Typical multiplier of capacitance as a function of ambient temperature

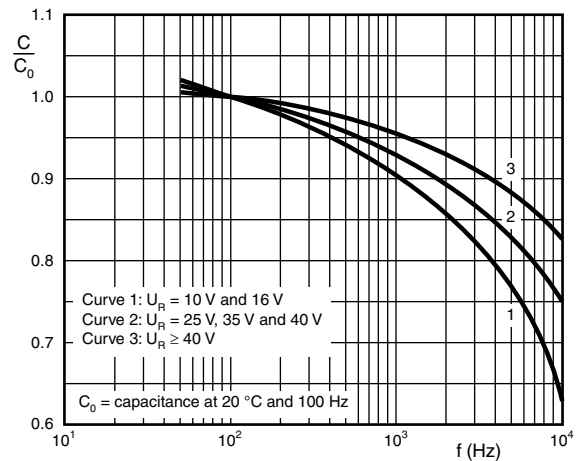


Fig. 7 - Typical multiplier of capacitance as a function of frequency

**EQUIVALENT SERIES RESISTANCE (ESR)**

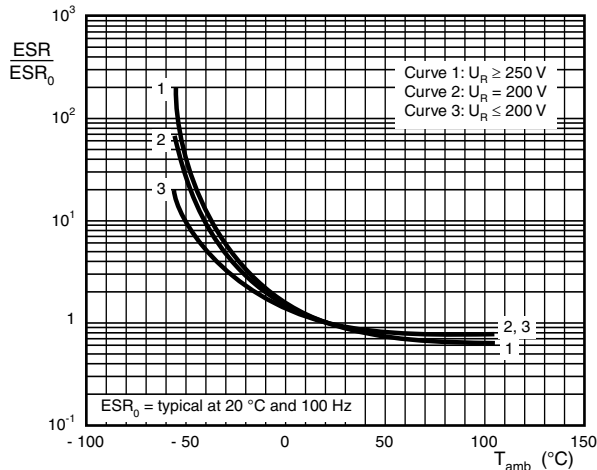


Fig. 8 - Typical multiplier of ESR as a function of ambient temperature



Fig. 9 - Typical multiplier of ESR as a function of frequency

**IMPEDANCE (Z)**

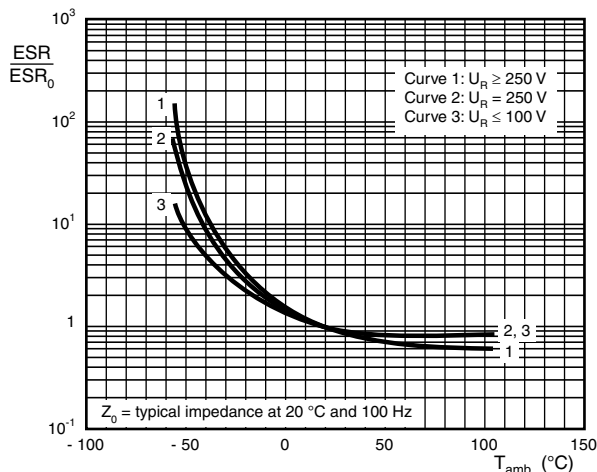


Fig. 10 - Typical multiplier of impedance as a function of ambient temperature

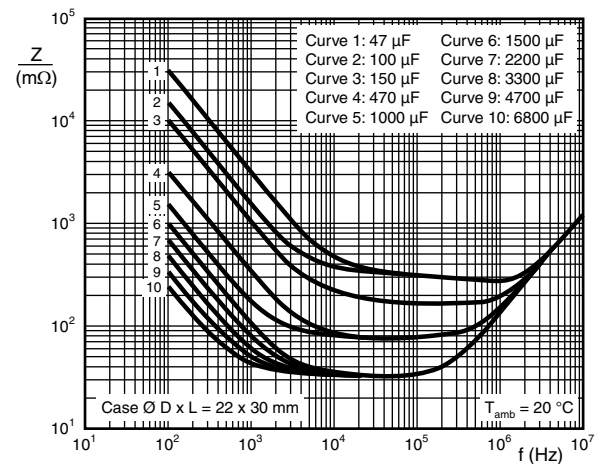


Fig. 12 - Typical impedance as a function of frequency

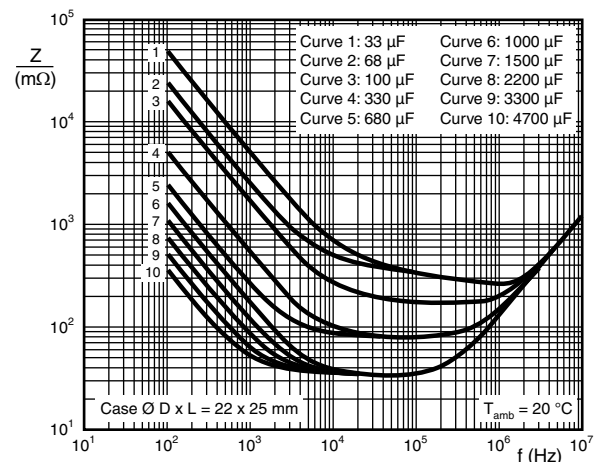


Fig. 11 - Typical impedance as a function of frequency

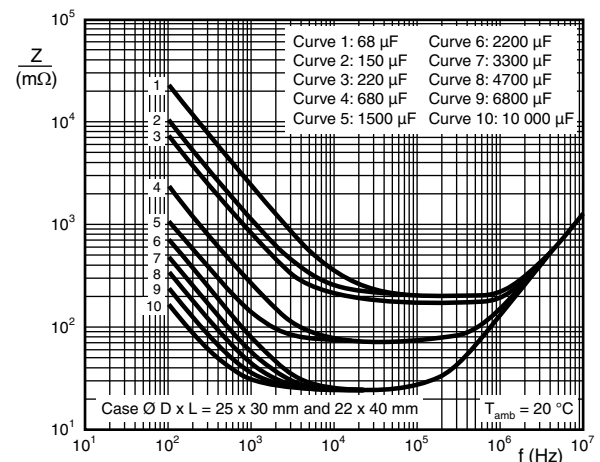


Fig. 13 - Typical impedance as a function of frequency



**IMPEDANCE (Z)**

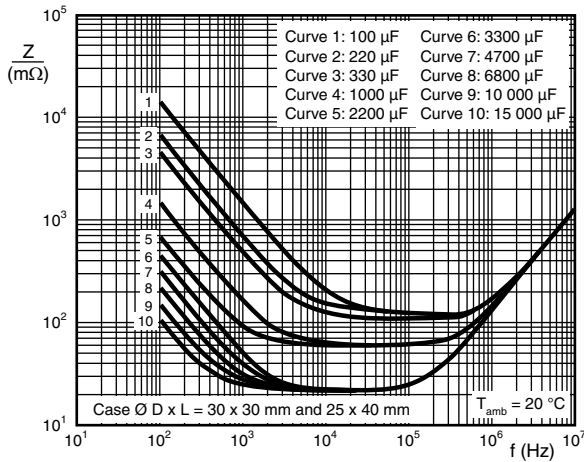


Fig. 14 - Typical impedance as a function of frequency

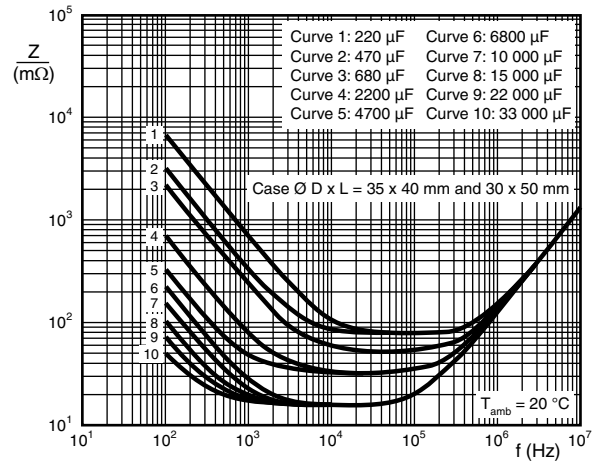


Fig. 16 - Typical impedance as a function of frequency

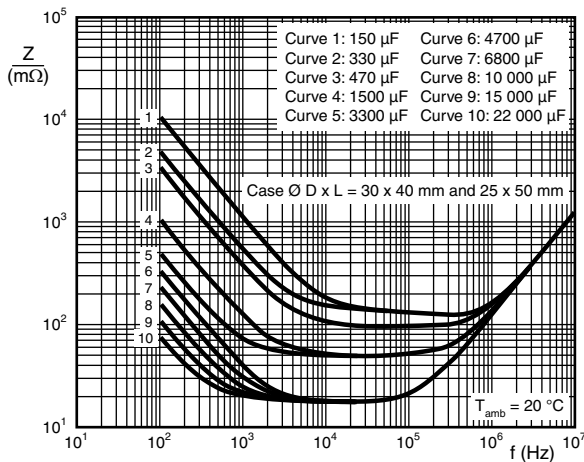


Fig. 15 - Typical impedance as a function of frequency

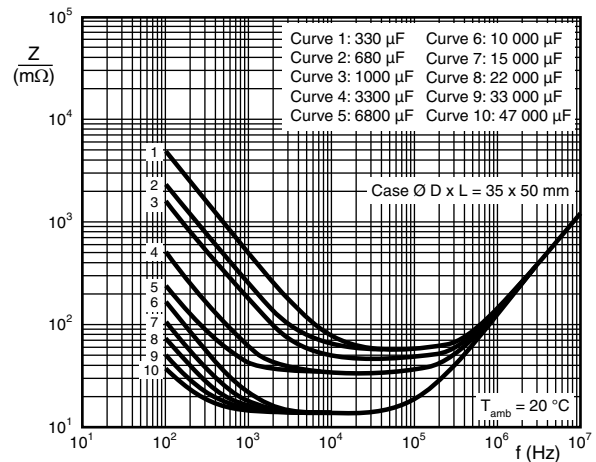


Fig. 17 - Typical impedance as a function of frequency

**RIPPLE CURRENT AND USEFUL LIFE**

Table 4

| ENDURANCE TEST DURATION AND USEFUL LIFE |                            |                              |
|---|----------------------------|------------------------------|
| $U_R$<br>(V)                            | ENDURANCE<br>AT 105 °C (h) | USEFUL LIFE<br>AT 105 °C (h) |
| 10                                      | 2000                       | 5000                         |
| 16                                      | 2000                       | 5000                         |
| 25                                      | 2000                       | 5000                         |
| 40                                      | 2000                       | 5000                         |
| 50                                      | 2000                       | 5000                         |
| 63                                      | 5000                       | 10 000                       |
| 100                                     | 5000                       | 10 000                       |
| 200                                     | 5000                       | 10 000                       |
| 250                                     | 5000                       | 10 000                       |
| 385                                     | 5000                       | 10 000                       |
| 400                                     | 5000                       | 10 000                       |

**Note**

- Multiplier of useful life code: MGA454





Fig. 18 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 5

| MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY |                  |      |      |      |      |      |      |          |
|---|------------------|------|------|------|------|------|------|----------|
| $U_R$<br>(V)  | FREQUENCY (Hz)   |      |      |      |      |      |      |          |
|   | 50               | 100  | 200  | 400  | 1000 | 2000 | 4000 | ≥ 10 000 |
|   | $I_R$ MULTIPLIER |      |      |      |      |      |      |          |
| 10  | 0.93             | 1.00 | 1.04 | 1.07 | 1.11 | 1.13 | 1.15 | 1.18     |
| 16  | 0.93             | 1.00 | 1.04 | 1.07 | 1.11 | 1.13 | 1.15 | 1.18     |
| 25  | 0.93             | 1.00 | 1.04 | 1.07 | 1.11 | 1.13 | 1.15 | 1.18     |
| 40  | 0.91             | 1.00 | 1.05 | 1.09 | 1.13 | 1.15 | 1.18 | 1.22     |
| 50  | 0.91             | 1.00 | 1.05 | 1.09 | 1.13 | 1.15 | 1.18 | 1.22     |
| 63  | 0.91             | 1.00 | 1.05 | 1.09 | 1.13 | 1.15 | 1.18 | 1.22     |
| 100   | 0.91             | 1.00 | 1.05 | 1.09 | 1.13 | 1.15 | 1.18 | 1.22     |
| 200   | 0.86             | 1.00 | 1.13 | 1.21 | 1.29 | 1.32 | 1.35 | 1.40     |
| 250   | 0.86             | 1.00 | 1.13 | 1.21 | 1.29 | 1.32 | 1.35 | 1.40     |
| 385   | 0.86             | 1.00 | 1.13 | 1.21 | 1.29 | 1.32 | 1.35 | 1.40     |
| 400   | 0.86             | 1.00 | 1.13 | 1.21 | 1.29 | 1.32 | 1.35 | 1.40     |



Table 6

| TEST PROCEDURES AND REQUIREMENTS               |  |   |  |
|--|--|---|--|
| TEST   |  | PROCEDURE<br>(quick reference)  | REQUIREMENTS   |
| NAME OF TEST                                   | REFERENCE                                    |   |  |
| Endurance                                      | IEC 60384-4 /<br>EN 130300<br>subclause 4.13 | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; $U_R$ applied;<br>$\leq 50\text{ V}$ types: 2000 h;<br>$\geq 63\text{ V}$ types: 5000 h                       | $U_R \leq 100\text{ V}$ ; $\Delta C/C: \pm 15\%$<br>$U_R > 100\text{ V}$ ; $\Delta C/C: \pm 10\%$<br>$ESR \leq 1.3 \times \text{spec. limit}$<br>$Z \leq 2 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$  |
| Useful life                                    | CECC 30301<br>subclause 1.8.1                | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied;<br>$\leq 50\text{ V}$ types: 5000 h;<br>$\geq 63\text{ V}$ types: 10 000 h           | $U_R \leq 100\text{ V}$ ; $\Delta C/C: \pm 45\%$<br>$U_R > 100\text{ V}$ ; $\Delta C/C: \pm 30\%$<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>$U_R > 100\text{ V}: \leq 3\%$ |
| Shelf life<br>(storage at<br>high temperature) | IEC 60384-4 /<br>EN 130300<br>subclause 4.17 | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; no voltage applied;<br>500 h<br>After test: $U_R$ to be applied for 30 min<br>24 h to 48 h before measurement | $\Delta C/C: \pm 10\%$<br>$ESR \leq 1.2 \times \text{spec. limit}$<br>$I_{L5} \leq 2 \times \text{spec. limit}$  |

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



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