

## Aluminum Capacitors Power Long Life Snap-In

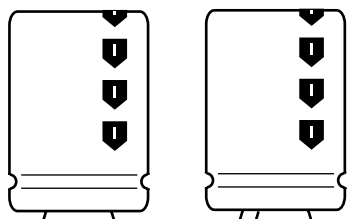
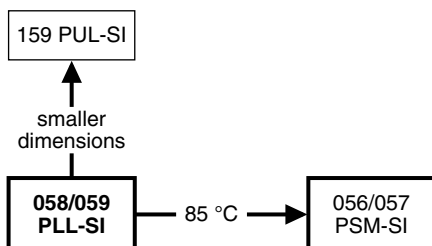


Fig.1 Component outlines



### QUICK REFERENCE DATA

| DESCRIPTION                                         | VALUE                                           |                |
|-----------------------------------------------------|-------------------------------------------------|----------------|
|                                                     | 058                                             | 059            |
| Nominal case sizes (Ø D x L in mm)                  | 22 x 25 to 35 x 50                              |                |
| Rated capacitance range (E6 series), C <sub>R</sub> | 33 to 47 000 µF                                 |                |
| Tolerance on C <sub>R</sub>                         | ± 20 %                                          |                |
| Rated voltage range, U <sub>R</sub>                 | 10 to 100 V                                     | 200 to 400 V   |
| Category temperature range                          | - 40 to + 105 °C                                | - 25 to 105 °C |
| Endurance test at 105 °C                            | ≤ 50 V: 2000 hours;<br>≥ 63 V: 5000 hours       |                |
| Useful life at 105 °C                               | ≤ 50 V: 5000 hours;<br>≥ 63 V: 10 000 hours     |                |
| Useful life at 40 °C, 1.9 x I <sub>R</sub> applied  | ≤ 50 V: 125 000 hours;<br>≥ 63 V: 250 000 hours |                |
| Shelf life at 0 V, 105 °C                           | 500 hours                                       |                |
| Based on sectional specification                    | IEC 60384-4/EN130300                            |                |
| Climatic category IEC 60068                         | 40/105/56                                       | 25/105/56      |

### FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Very long useful life: up to 10 000 hours at 105 °C
- Extended temperature range: 105 °C
- Low ESR, high ripple current capability
- Keyed polarity version available



**RoHS**  
COMPLIANT

### 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 µF)
- Tolerance code on rated capacitance, code letter in accordance with IEC 60062 (M for ± 20 %)
- Rated voltage (in V)
- Date code (YYMM)
- Name of manufacturer
- Code for factory of origin
- '-' sign to identify the negative terminal, visible from the top and side of the capacitor
- Code number
- Climatic category in accordance with IEC 60068

### SELECTION CHART FOR C<sub>R</sub>, U<sub>R</sub> AND RELEVANT NOMINAL CASE SIZES FOR 058 SERIES (Ø D x L in mm)

| C <sub>R</sub><br>(µF) | U <sub>R</sub> (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  $C_R$ ,  $U_R$  AND RELEVANT NOMINAL CASE SIZES FOR 058 SERIES ( $\varnothing D \times L$  in mm)**

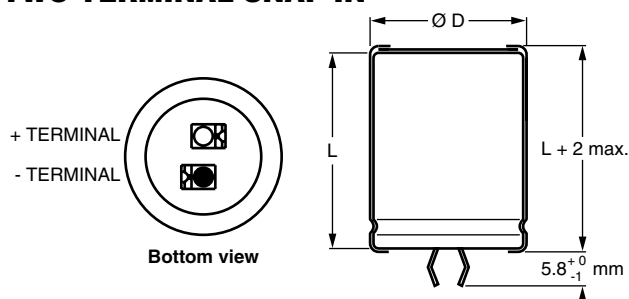
| $C_R$<br>( $\mu F$ ) | $U_R$ (V) |         |         |         |         |         |         |
|----------------------|-----------|---------|---------|---------|---------|---------|---------|
|                      | 10        | 16      | 25      | 40      | 50      | 63      | 100     |
| 2200                 | -         | -       | 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  $C_R$ ,  $U_R$  AND RELEVANT NOMINAL CASE SIZES FOR 059 SERIES ( $\varnothing D \times L$  in mm)**

| $C_R$<br>( $\mu F$ ) | $U_R$ (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

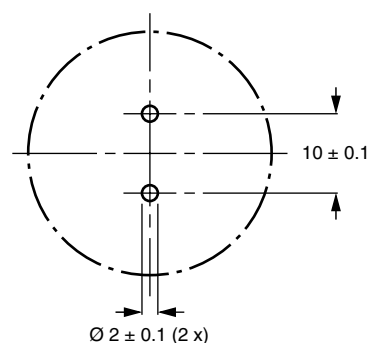
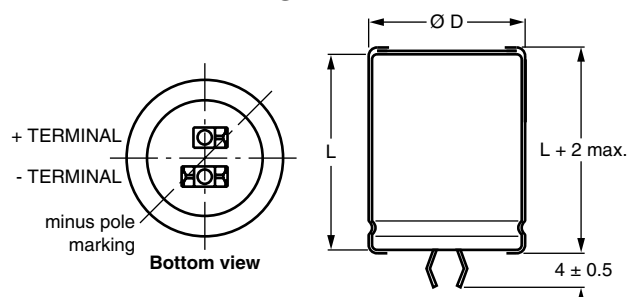


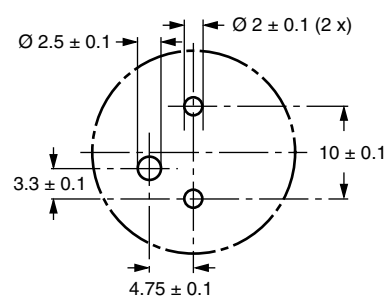
Fig.3 Mounting hole diagram

### 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

| DIMENSIONS IN MILLIMETERS, MASS AND PACKAGING QUANTITIES |                     |                   |          |                                      |                                    |
|----------------------------------------------------------|---------------------|-------------------|----------|--------------------------------------|------------------------------------|
| NOMINAL CASE SIZE Ø D x L                                | Ø D <sub>max.</sub> | L <sub>max.</sub> | MASS (g) | PACKAGING QUANTITIES (units per box) | CARDBOARD BOX DIMENSIONS L x W x H |
| 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                                                    |
| $C_R$           | rated capacitance at 100 Hz                                    |
| $I_R$           | rated RMS ripple current at 100 Hz or $\geq 10$ kHz and 105 °C |
| $I_{L1}$        | max. leakage current after 1 minute at $U_R$                   |
| $I_{L5}$        | max. leakage current after 5 minutes at $U_R$                  |
| ESR             | max. equivalent series resistance at 100 Hz                    |
| Z               | max. impedance at 10 kHz                                       |

**Note**

- Unless otherwise specified, all electrical values in Tables 2 and 3 apply at  $T_{amb} = 20$  °C,  $P = 86$  to 106 kPa, RH = 45 to 75 %

Table 2

| ELECTRICAL DATA AND ORDERING INFORMATION FOR 058 SERIES ( $\varnothing D \times L$ in mm) |                                |                                                          |                                  |                                         |                                  |                                  |                                |                             |                               |         |
|-------------------------------------------------------------------------------------------|--------------------------------|----------------------------------------------------------|----------------------------------|-----------------------------------------|----------------------------------|----------------------------------|--------------------------------|-----------------------------|-------------------------------|---------|
| $U_R$<br>(V)                                                                              | $C_R$<br>100 Hz<br>( $\mu F$ ) | NOMINAL<br>CASE SIZE<br>$\varnothing D \times L$<br>(mm) | $I_R$<br>100 Hz<br>105 °C<br>(A) | $I_R$<br>$\geq 10$ kHz<br>105 °C<br>(A) | $I_{L1}$<br>1 min<br>( $\mu A$ ) | $I_{L5}$<br>5 min<br>( $\mu A$ ) | ESR<br>100 Hz<br>(m $\Omega$ ) | Z<br>10 Hz<br>(m $\Omega$ ) | 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 |
| 16                                                                                        | 47 000                         | 35 x 50                                                  | 6.23                             | 7.35                                    | 2824                             | 944                              | 24                             | 21                          | 54473E3                       | 74473E3 |
|                                                                                           | 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 |
| 25                                                                                        | 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 |
|                                                                                           | 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 |
| 40                                                                                        | 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 |
|                                                                                           | 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 |
| 40                                                                                        | 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  $\mu F$ /25 V;  $\pm 20$  %Nominal case size:  $\varnothing 30 \times 40$  mm

2-terminal snap-in

Ordering code: MAL205856103E3

Former 12NC: 222205856103

3-terminal snap-in

Ordering code: MAL205876103E3

Former 12NC: 222205876103



| 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 Hz<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 |
| 63                                                                      | 10 000                           | 35 x 50                                 | 5.04                                      | 6.15                                        | 3004                             | 1004                             | 38                    | 24                 | 51103E3                       | 71103E3 |
|                                                                         | 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 |
| 100                                                                     | 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 |
|                                                                         | 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 |
| 200                                                                     | 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 |
|                                                                         | 680                              | 22 x 25                                 | 0.49                                      | 1.06                                        | 106                              | 38                               | 1640                  | 760                | 53689E3                       | 73689E3 |
|                                                                         | 100                              | 22 x 30                                 | 0.62                                      | 1.54                                        | 154                              | 54                               | 1110                  | 570                | 53101E3                       | 73101E3 |
|                                                                         | 150                              | 22 x 35                                 | 0.82                                      | 2.29                                        | 229                              | 79                               | 795                   | 440                | 33151E3                       | 73151E3 |
| 250                                                                     | 150                              | 25 x 30                                 | 0.82                                      | 2.29                                        | 229                              | 79                               | 795                   | 440                | 53151E3                       | 73151E3 |
|                                                                         | 220                              | 25 x 35                                 | 1.03                                      | 334                                         | 114                              | 540                              | 300                   | 300                | 33221E3                       | 73221E3 |
|                                                                         | 220                              | 30 x 30                                 | 1.06                                      | 334                                         | 114                              | 540                              | 300                   | 300                | 53221E3                       | 73221E3 |
|                                                                         | 330                              | 30 x 35                                 | 1.43                                      | 499                                         | 169                              | 385                              | 225                   | 225                | 33331E3                       | 73331E3 |
|                                                                         | 330                              | 25 x 50                                 | 1.40                                      | 499                                         | 169                              | 385                              | 225                   | 225                | 43331E3                       | 23331E3 |
|                                                                         | 470                              | 30 x 45                                 | 1.79                                      | 709                                         | 239                              | 270                              | 155                   | 155                | 33471E3                       | 73471E3 |
|                                                                         | 470                              | 35 x 35                                 | 1.79                                      | 709                                         | 239                              | 270                              | 155                   | 155                | 63471E3                       | 83471E3 |
|                                                                         | 680                              | 35 x 45                                 | 2.25                                      | 1024                                        | 344                              | 190                              | 125                   | 125                | 43681E3                       | 23681E3 |
|                                                                         | 680                              | 30 x 45                                 | 1.79                                      | 709                                         | 239                              | 270                              | 155                   | 155                | 63471E3                       | 83471E3 |
|                                                                         | 680                              | 35 x 45                                 | 2.25                                      | 1024                                        | 344                              | 190                              | 125                   | 125                | 43681E3                       | 23681E3 |

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 kHz<br>(µΩ) | 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                       | 73151E3 |
|                                                         | 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**

| $U_R$<br>(V) | $C_R$<br>100 Hz<br>( $\mu$ F) | NOMINAL<br>CASE SIZE<br>$\varnothing D \times L$<br>(mm) | $I_R$<br>100 Hz<br>105 °C<br>(A) | $I_{L1}$<br>1 min<br>( $\mu$ A) | $I_{L5}$<br>5 min<br>( $\mu$ A) | ESR<br>100 kHz<br>( $\mu\Omega$ ) | Z<br>10 kHz<br>(m $\Omega$ ) | ORDERING CODE<br>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 |
| 400          | 330                           | 35 x 50                                                  | 1.75                             | 766                             | 258                             | 390                               | 320                          | 58331E3                       | 78331E3 |
|              | 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                       | 76331E3 |

**ADDITIONAL ELECTRICAL DATA**

| PARAMETER                          | CONDITIONS               | VALUE                                        |
|------------------------------------|--------------------------|----------------------------------------------|
| <b>Voltage</b>                     |                          |                                              |
| Surge voltage                      | $\leq 250$ V versions    | $U_s = 1.15 \times U_R$                      |
|                                    | $\geq 385$ V versions    | $U_s = 1.1 \times U_R$                       |
| Reverse voltage                    |                          | $U_{rev} \leq 1$ V                           |
| <b>Current</b>                     |                          |                                              |
| Leakage current                    | After 1 minute at $U_R$  | $I_{L1} \leq 0.006 C_R \times U_R + 4 \mu A$ |
|                                    | After 5 minutes at $U_R$ | $I_{L5} \leq 0.002 C_R \times U_R + 4 \mu A$ |
| <b>Inductance</b>                  |                          |                                              |
| Equivalent series inductance (ESL) | All case sizes           | typ. 19 nH                                   |
|                                    |                          | max. 25 nH                                   |

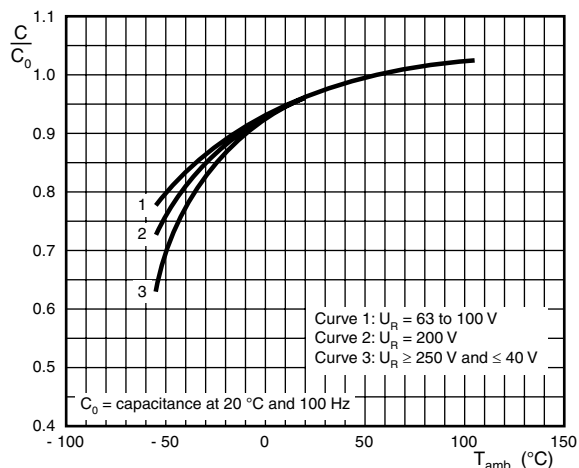
**CAPACITANCE (C)**

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

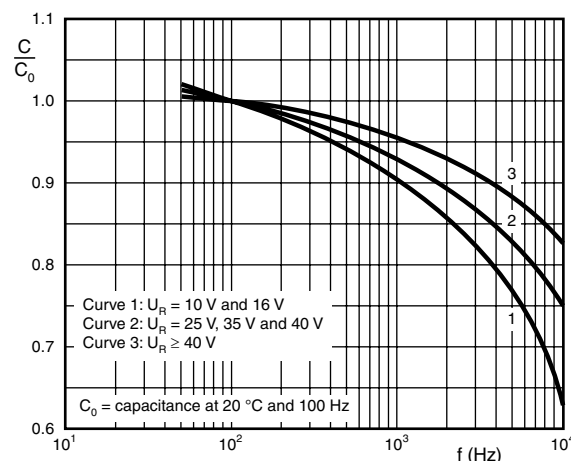


Fig.7 Typical multiplier of capacitance as a function of frequency

## EQUIVALENT SERIES RESISTANCE (ESR)

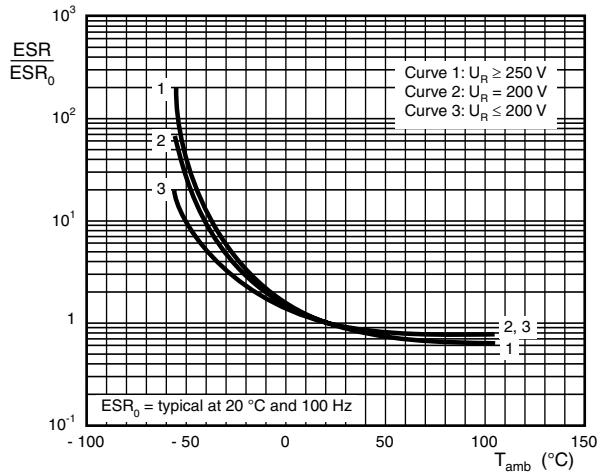


Fig.8 Typical multiplier of ESR as a function of ambient temperature

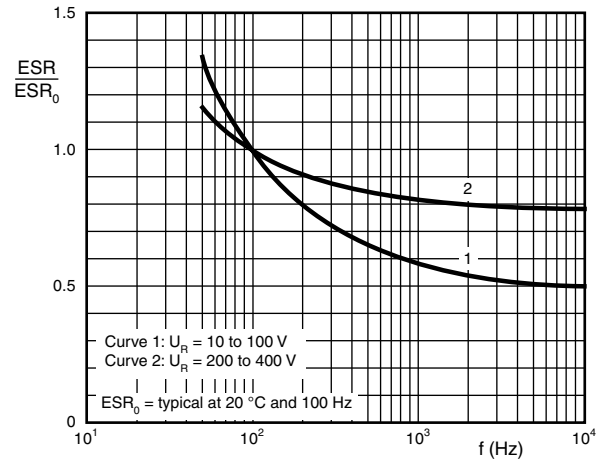


Fig.9 Typical multiplier of ESR as a function of frequency

## IMPEDANCE (Z)

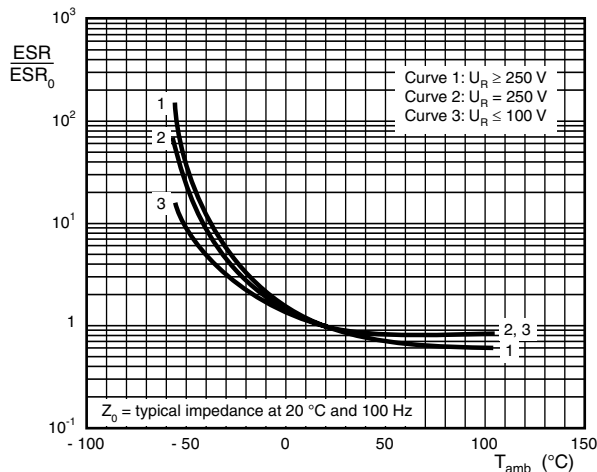


Fig.10 Typical multiplier of impedance as a function of ambient temperature

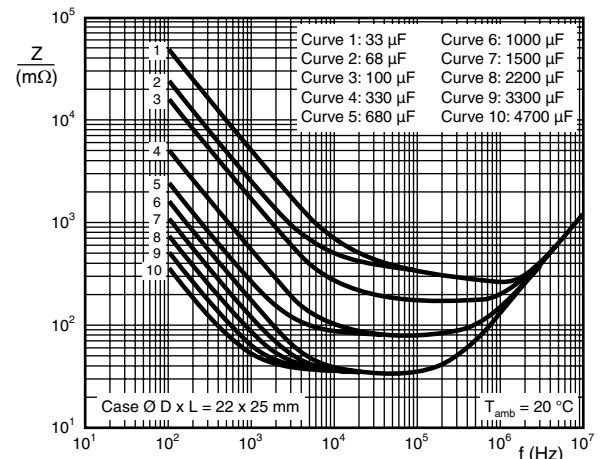


Fig.11 Typical impedance as a function of frequency

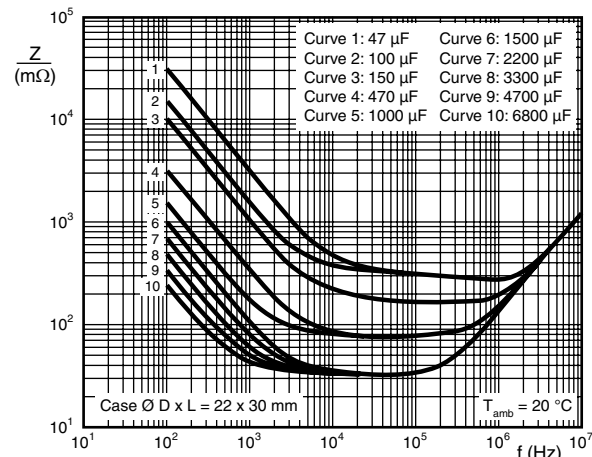


Fig.12 Typical impedance as a function of frequency

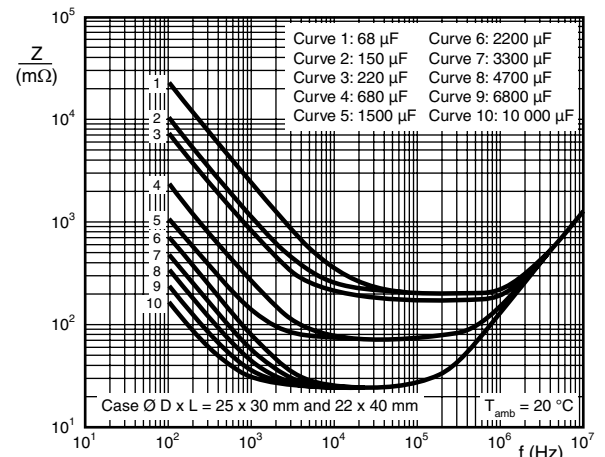


Fig.13 Typical impedance as a function of frequency

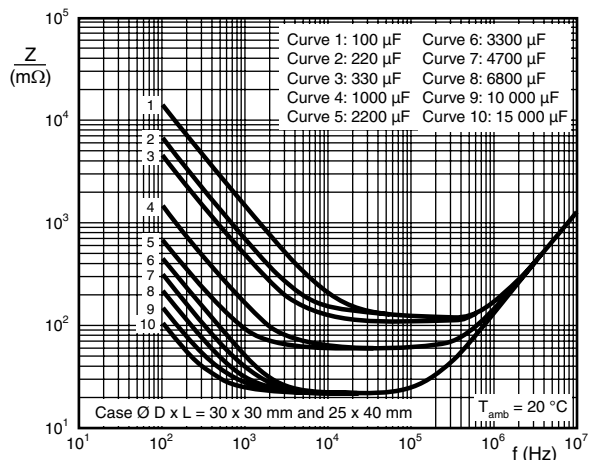
**IMPEDANCE (Z)**

Fig.14 Typical impedance as a function of frequency

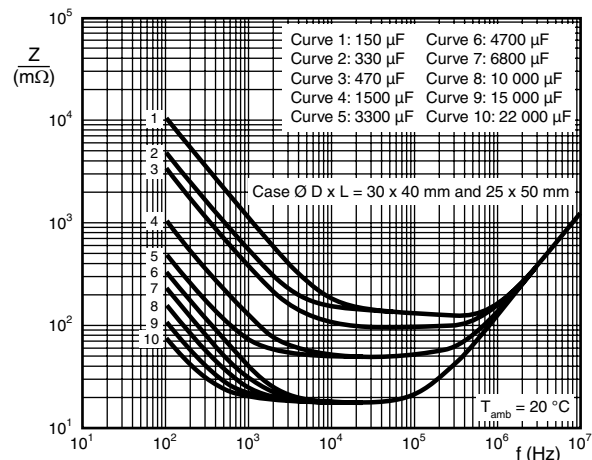


Fig.15 Typical impedance as a function of frequency

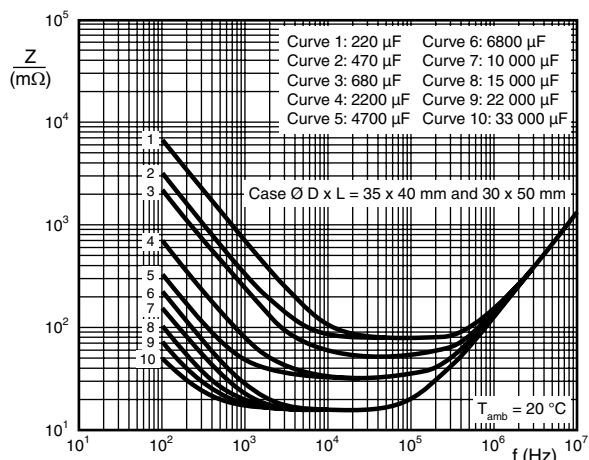


Fig.16 Typical impedance as a function of frequency

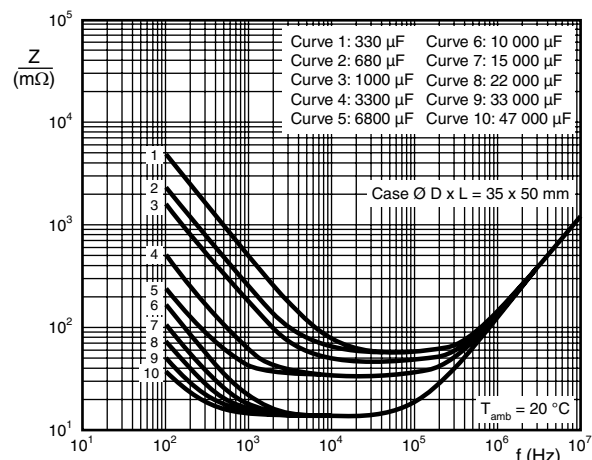


Fig.17 Typical impedance as a function of frequency

## RIPPLE CURRENT AND USEFUL LIFE

$I_A$  = actual ripple current at 100 Hz  
 $I_R$  = rated ripple current at 100 Hz and 105 °C  
 (1) Useful life at 105 °C and  $I_R$  applied:  
 5000 hours for  $\leq 50$  V types

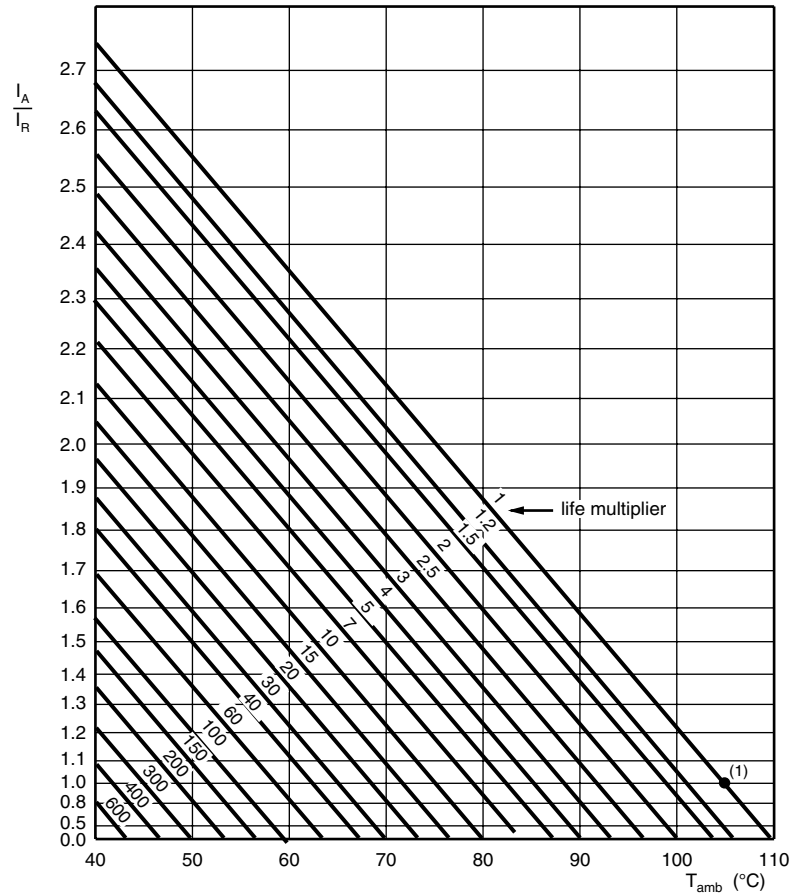


Fig.18 Multiplier of useful life as a function of ambient temperature and ripple current load

Table 4

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

Table 5

| TEST PROCEDURES AND REQUIREMENTS               |                                            |                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------------------------|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TEST                                           |                                            | PROCEDURE<br>(quick reference)                                                                                                                                              | REQUIREMENTS                                                                                                                                                                                                                                                                                                                                      |
| NAME OF TEST                                   | REFERENCE                                  |                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                   |
| Endurance                                      | IEC 60384-4/<br>EN130300<br>subclause 4.13 | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; $U_R$ applied;<br>$\leq 50\text{ V}$ types: 2000 hours;<br>$\geq 63\text{ V}$ types: 5000 hours                                   | $U_R \leq 100\text{ V}$ ; $\Delta C/C$ : $\pm 15\%$<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 hours;<br>$\geq 63\text{ V}$ types: 10 000 hours                       | $U_R \leq 100\text{ V}$ ; $\Delta C/C$ : $\pm 45\%$<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>EN130300<br>subclause 4.17 | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; no voltage applied;<br>500 hours<br><br>After test: $U_R$ to be applied for 30 minutes<br>24 hours to 48 hours before measurement | $\Delta C/C$ : $\pm 10\%$<br>$ESR \leq 1.2 \times \text{spec. limit}$<br>$I_{L5} \leq 2 \times \text{spec. limit}$                                                                                                                                                                                                                                |



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Тел: +7 (812) 336 43 04 (многоканальный)

Email: [org@lifeelectronics.ru](mailto:org@lifeelectronics.ru)

[www.lifeelectronics.ru](http://www.lifeelectronics.ru)