

## Aluminum Capacitors Power Standard Miniature Snap-In

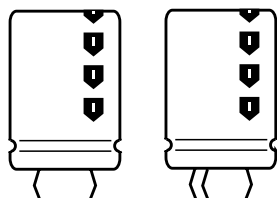
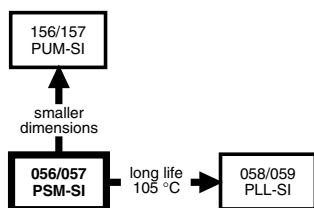


Fig. 1 Component outlines



### FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief on the top of the aluminum case
- Charge and discharge proof
- Long useful life: 12 000 hours at 85 °C
- High ripple current capability
- Keyed polarity version available



**RoHS**  
COMPLIANT

### APPLICATIONS

- General purpose, industrial and audio/video systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems

### MARKING

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

- Rated capacitance (in  $\mu\text{F}$ )
- Tolerance 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                                  |                             |
|--------------------------------------------------------|----------------------------------------|-----------------------------|
|                                                        | 056                                    | 057                         |
| Nominal case size<br>( $\varnothing D \times L$ in mm) | 22 x 25 to 35 x 50                     |                             |
| Rated capacitance range<br>(E6 series), $C_R$          | 470 to<br>68 000 $\mu\text{F}$         | 47 to<br>1500 $\mu\text{F}$ |
| Tolerance on $C_R$                                     | $\pm 20\%$                             |                             |
| Rated voltage range, $U_R$ <sup>(1)</sup>              | 10 to 100 V                            | 200 to 450 V                |
| Category temperature range                             | - 40 to + 85 °C                        | - 25 to + 85 °C             |
| Endurance test at 85 °C                                | 5000 hours (450 V: 2000 hours)         |                             |
| Useful life at 85 °C                                   | 12 000 hours<br>(450 V: 5000 hours)    |                             |
| Useful life at 40 °C and<br>1.4 x $I_R$ applied        | 210 000 hours<br>(450 V: 90 000 hours) |                             |
| Shelf life at 0 V, 85 °C                               | 500 hours                              |                             |
| Based on sectional<br>specification                    | IEC 60384-4/EN130300                   |                             |
| Climatic category IEC 60068                            | 40/085/056                             | 25/085/56                   |

#### Note

<sup>(1)</sup> A 420 V range is available on request

### SELECTION CHART FOR $C_R$ , $U_R$ AND RELEVANT NOMINAL CASE SIZES FOR 056 SERIES ( $\varnothing D \times L$ in mm)

| $C_R$<br>( $\mu\text{F}$ ) | $U_R$ (V) |    |         |         |         |         |         |
|----------------------------|-----------|----|---------|---------|---------|---------|---------|
|                            | 10        | 16 | 25      | 40      | 50      | 63      | 100     |
| 470                        | -         | -  | -       | -       | -       | -       | 22 x 25 |
| 680                        | -         | -  | -       | -       | -       | -       | 22 x 30 |
| 1000                       | -         | -  | -       | -       | -       | 22 x 25 | 25 x 30 |
|                            | -         | -  | -       | -       | -       | -       | 22 x 40 |
| 1500                       | -         | -  | -       | -       | 22 x 25 | 22 x 30 | 30 x 30 |
|                            | -         | -  | -       | -       | -       | -       | 25 x 40 |
| 2200                       | -         | -  | -       | 22 x 25 | 22 x 30 | 25 x 30 | 30 x 40 |
|                            | -         | -  | -       | -       | -       | 22 x 40 | 25 x 50 |
| 3300                       | -         | -  | 22 x 25 | 22 x 30 | 25 x 30 | 30 x 30 | 35 x 40 |
|                            | -         | -  | -       | -       | 22 x 40 | 25 x 40 | 30 x 50 |

**SELECTION CHART FOR C<sub>R</sub>, U<sub>R</sub> AND RELEVANT NOMINAL CASE SIZES FOR 056 SERIES (Ø D x L in mm)**

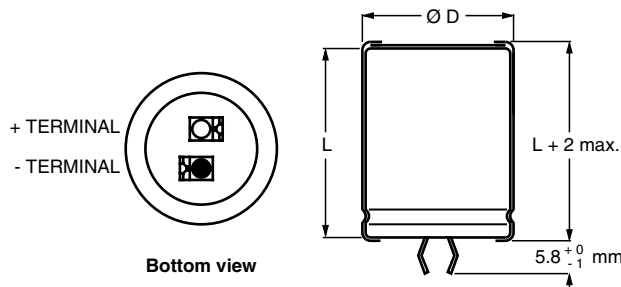
| C <sub>R</sub><br>(µF) | U <sub>R</sub> (V) |         |         |         |         |         |         |
|------------------------|--------------------|---------|---------|---------|---------|---------|---------|
|                        | 10                 | 16      | 25      | 40      | 50      | 63      | 100     |
| 4700                   | -                  | 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 | -       |
| 6800                   | 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 | -       |
| 10 000                 | 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 | -       | -       |
| 15 000                 | 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 | -       | -       | -       |
| 22 000                 | 30 x 30            | 30 x 40 | 35 x 40 | 35 x 50 | -       | -       | -       |
|                        | 25 x 40            | 25 x 50 | 30 x 50 | -       | -       | -       | -       |
| 33 000                 | 30 x 40            | 35 x 40 | 35 x 50 | -       | -       | -       | -       |
|                        | 25 x 50            | 30 x 50 | -       | -       | -       | -       | -       |
| 47 000                 | 35 x 40            | 35 x 50 | -       | -       | -       | -       | -       |
|                        | 30 x 50            | -       | -       | -       | -       | -       | -       |
| 68 000                 | 35 x 50            | -       | -       | -       | -       | -       | -       |

**SELECTION CHART FOR C<sub>R</sub>, U<sub>R</sub> AND RELEVANT NOMINAL CASE SIZES FOR 057 SERIES (Ø D x L in mm)**

| C <sub>R</sub><br>(µF) | U <sub>R</sub> (V) |         |         |         |         |
|------------------------|--------------------|---------|---------|---------|---------|
|                        | 200                | 250     | 385     | 400     | 450     |
| 47                     | -                  | -       | 22 x 25 | 22 x 25 | 22 x 30 |
| 68                     | -                  | -       | 22 x 30 | 22 x 30 | 22 x 30 |
| 100                    | -                  | 22 x 25 | 25 x 30 | 25 x 30 | 30 x 30 |
|                        | -                  | -       | 22 x 40 | 22 x 35 | 25 x 35 |
|                        | -                  | -       | 22 x 35 | -       | -       |
| 150                    | 22 x 25            | 22 x 30 | 30 x 30 | 30 x 30 | 25 x 50 |
|                        | -                  | -       | 25 x 40 | -       | 30 x 35 |
|                        | -                  | -       | -       | 25 x 40 | -       |
| 220                    | 22 x 30            | 25 x 30 | 30 x 45 | 30 x 35 | 35 x 40 |
|                        | -                  | 22 x 40 | 30 x 40 | 25 x 40 | 30 x 45 |
|                        | -                  | -       | 30 x 35 | -       | -       |
|                        | -                  | -       | 25 x 50 | -       | -       |
| 330                    | 25 x 30            | 30 x 30 | 35 x 35 | 35 x 40 | 35 x 50 |
|                        | 22 x 40            | 25 x 40 | -       | 35 x 50 | 35 x 45 |
| 470                    | 30 x 30            | 30 x 40 | 35 x 50 | 35 x 50 | -       |
|                        | 25 x 40            | 25 x 50 | 35 x 45 | -       | -       |
| 680                    | 30 x 40            | 35 x 40 | -       | -       | -       |
|                        | 25 x 50            | 30 x 50 | -       | -       | -       |
| 1000                   | 35 x 40            | 35 x 50 | -       | -       | -       |
|                        | 30 x 50            | -       | -       | -       | -       |
| 1500                   | 35 x 50            | -       | -       | -       | -       |

**DIMENSIONS** in millimeters **AND AVAILABLE FORMS**

**TWO TERMINALS SNAP-IN**



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

Fig.2 Two terminal snap-in

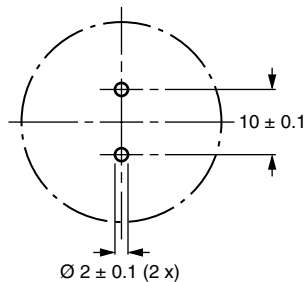
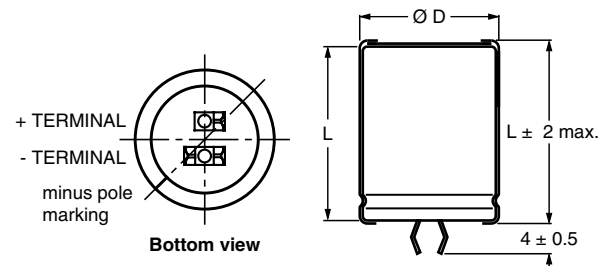


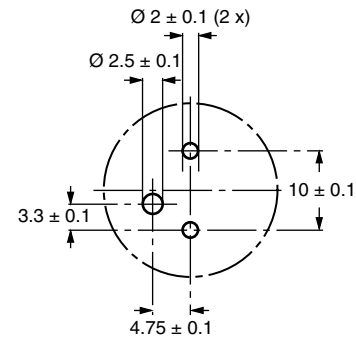
Fig.3 Mounting hole diagram

**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</b> in millimeters, <b>MASS AND PACKAGING QUANTITIES</b> |                               |                   |              |                                         |                                                           |
|------------------------------------------------------------------------|-------------------------------|-------------------|--------------|-----------------------------------------|-----------------------------------------------------------|
| NOMINAL CASE SIZE<br>$\varnothing D \times L$                          | $\varnothing D_{\text{max.}}$ | $L_{\text{max.}}$ | MASS<br>(g)  | PACKAGING QUANTITIES<br>(units per box) | CARDBOARD BOX DIMENSIONS<br>$L \times W \times H$<br>(mm) |
| 22 x 25                                                                | 23                            | 27                | $\approx 12$ | 100                                     | 260 x 250 x 39                                            |
| 22 x 30                                                                | 23                            | 32                | $\approx 16$ | 100                                     | 260 x 250 x 44                                            |
| 22 x 35                                                                | 23                            | 37                | $\approx 20$ | 100                                     | 260 x 250 x 49                                            |
| 22 x 40                                                                | 23                            | 42                | $\approx 23$ | 100                                     | 260 x 250 x 54                                            |
| 25 x 30                                                                | 26                            | 32                | $\approx 22$ | 100                                     | 290 x 280 x 44                                            |
| 25 x 35                                                                | 26                            | 37                | $\approx 24$ | 100                                     | 290 x 280 x 49                                            |
| 25 x 40                                                                | 26                            | 42                | $\approx 27$ | 100                                     | 290 x 280 x 54                                            |
| 25 x 50                                                                | 26                            | 52                | $\approx 38$ | 100                                     | 290 x 280 x 64                                            |
| 30 x 30                                                                | 31                            | 32                | $\approx 30$ | 100                                     | 340 x 330 x 44                                            |
| 30 x 35                                                                | 31                            | 37                | $\approx 35$ | 100                                     | 340 x 330 x 49                                            |
| 30 x 40                                                                | 31                            | 42                | $\approx 40$ | 100                                     | 340 x 330 x 54                                            |
| 30 x 45                                                                | 31                            | 47                | $\approx 45$ | 100                                     | 340 x 330 x 59                                            |
| 30 x 50                                                                | 31                            | 52                | $\approx 50$ | 100                                     | 340 x 330 x 64                                            |
| 35 x 35                                                                | 36                            | 37                | $\approx 48$ | 50                                      | 390 x 198 x 49                                            |
| 35 x 40                                                                | 36                            | 42                | $\approx 55$ | 50                                      | 390 x 198 x 54                                            |
| 35 x 45                                                                | 36                            | 47                | $\approx 63$ | 50                                      | 390 x 198 x 59                                            |
| 35 x 50                                                                | 36                            | 52                | $\approx 72$ | 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<br>or $\geq 10$ kHz and 85 °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 %

**ORDERING EXAMPLE**

Electrolytic capacitor 056 series

10 000  $\mu$ F/25 V;  $\pm 20$  %Nominal case size:  $\varnothing 25 \times 40$  mm

2-terminal snap-in

Ordering code: MAL205646103E3

Former 12NC: 222205646103

3-terminal snap-in

Ordering code: MAL205626103E3

Former 12NC: 222205626103

Table 2

| ELECTRICAL DATA AND ORDERING INFORMATION FOR 056 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>85 °C<br>(A) | $I_R$<br>$\geq 10$ kHz<br>85 °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 kHz<br>(m $\Omega$ ) | ORDERING CODE<br>MAL2056..... |         |
|                                                         |                               |                                                          |                                 |                                        |                                 |                                 |                                |                              | 2-TERM.                       | 3-TERM. |
| 10                                                      | 6800                          | 22 x 25                                                  | 2.04                            | 2.40                                   | 412                             | 140                             | 76                             | 62                           | 54682E3                       | 74682E3 |
|                                                         | 10 000                        | 22 x 30                                                  | 2.56                            | 3.02                                   | 608                             | 205                             | 56                             | 45                           | 54103E3                       | 74103E3 |
|                                                         | 15 000                        | 25 x 30                                                  | 3.12                            | 3.68                                   | 904                             | 304                             | 44                             | 39                           | 54153E3                       | 74153E3 |
|                                                         | 15 000                        | 22 x 40                                                  | 3.39                            | 4.00                                   | 904                             | 304                             | 41                             | 34                           | 44153E3                       | 24153E3 |
|                                                         | 22 000                        | 30 x 30                                                  | 3.47                            | 4.09                                   | 1324                            | 444                             | 44                             | 37                           | 54223E3                       | 74223E3 |
|                                                         | 22 000                        | 25 x 40                                                  | 4.12                            | 4.86                                   | 1324                            | 444                             | 34                             | 28                           | 44223E3                       | 24223E3 |
|                                                         | 33 000                        | 30 x 40                                                  | 4.58                            | 5.40                                   | 1984                            | 664                             | 32                             | 28                           | 54333E3                       | 74333E3 |
|                                                         | 33 000                        | 25 x 50                                                  | 4.70                            | 5.55                                   | 1984                            | 664                             | 30                             | 27                           | 44333E3                       | 24333E3 |
|                                                         | 47 000                        | 35 x 40                                                  | 5.10                            | 6.02                                   | 2824                            | 944                             | 31                             | 26                           | 54473E3                       | 74473E3 |
|                                                         | 47 000                        | 30 x 50                                                  | 5.39                            | 6.36                                   | 2824                            | 944                             | 28                             | 24                           | 44473E3                       | 24473E3 |
| 16                                                      | 68 000                        | 35 x 50                                                  | 5.88                            | 6.94                                   | 4084                            | 1364                            | 28                             | 23                           | 54683E3                       | 74683E3 |
|                                                         | 4700                          | 22 x 25                                                  | 2.01                            | 2.37                                   | 455                             | 154                             | 79                             | 62                           | 55472E3                       | 75472E3 |
|                                                         | 6800                          | 22 x 30                                                  | 2.54                            | 3.00                                   | 657                             | 222                             | 57                             | 45                           | 55682E3                       | 75682E3 |
|                                                         | 10 000                        | 25 x 30                                                  | 3.02                            | 3.56                                   | 964                             | 324                             | 47                             | 39                           | 55103E3                       | 75103E3 |
|                                                         | 10 000                        | 22 x 40                                                  | 3.28                            | 3.87                                   | 964                             | 324                             | 44                             | 34                           | 45103E3                       | 25103E3 |
|                                                         | 15 000                        | 30 x 30                                                  | 3.36                            | 3.96                                   | 1444                            | 484                             | 47                             | 37                           | 55153E3                       | 75153E3 |
|                                                         | 15 000                        | 25 x 40                                                  | 4.00                            | 4.72                                   | 1444                            | 484                             | 34                             | 28                           | 45153E3                       | 25153E3 |
|                                                         | 22 000                        | 30 x 40                                                  | 4.51                            | 5.32                                   | 2116                            | 708                             | 33                             | 28                           | 55223E3                       | 75223E3 |
|                                                         | 22 000                        | 25 x 50                                                  | 3.97                            | 4.68                                   | 2116                            | 708                             | 42                             | 41                           | 45223E3                       | 25223E3 |
|                                                         | 33 000                        | 35 x 40                                                  | 5.02                            | 5.92                                   | 3172                            | 1060                            | 32                             | 28                           | 55333E3                       | 75333E3 |
| 25                                                      | 33 000                        | 30 x 50                                                  | 4.75                            | 5.61                                   | 3172                            | 1060                            | 36                             | 34                           | 45333E3                       | 25333E3 |
|                                                         | 47 000                        | 35 x 50                                                  | 5.34                            | 6.30                                   | 4516                            | 1508                            | 34                             | 32                           | 55473E3                       | 75473E3 |
|                                                         | 3300                          | 22 x 25                                                  | 1.88                            | 2.22                                   | 499                             | 169                             | 89                             | 61                           | 56332E3                       | 76332E3 |
|                                                         | 4700                          | 22 x 30                                                  | 2.37                            | 2.80                                   | 709                             | 239                             | 65                             | 45                           | 56472E3                       | 76472E3 |
|                                                         | 6800                          | 25 x 30                                                  | 2.81                            | 3.32                                   | 1024                            | 344                             | 54                             | 41                           | 56682E3                       | 76682E3 |
|                                                         | 6800                          | 22 x 40                                                  | 3.16                            | 3.73                                   | 1024                            | 344                             | 47                             | 38                           | 46682E3                       | 26682E3 |
|                                                         | 10 000                        | 30 x 30                                                  | 3.25                            | 3.84                                   | 1504                            | 504                             | 50                             | 38                           | 56103E3                       | 76103E3 |
|                                                         | 10 000                        | 25 x 40                                                  | 3.73                            | 4.40                                   | 1504                            | 504                             | 39                             | 30                           | 46103E3                       | 26103E3 |
|                                                         | 15 000                        | 30 x 40                                                  | 4.73                            | 5.58                                   | 2254                            | 754                             | 30                             | 28                           | 56153E3                       | 76153E3 |
|                                                         | 15 000                        | 25 x 50                                                  | 3.92                            | 4.63                                   | 2254                            | 754                             | 43                             | 39                           | 46153E3                       | 26153E3 |
| 30                                                      | 22 000                        | 35 x 40                                                  | 4.48                            | 5.29                                   | 3304                            | 1104                            | 40                             | 28                           | 56223E3                       | 76223E3 |
|                                                         | 22 000                        | 30 x 50                                                  | 4.96                            | 5.85                                   | 3304                            | 1104                            | 36                             | 23                           | 46223E3                       | 26223E3 |
|                                                         | 33 000                        | 35 x 50                                                  | 4.98                            | 5.88                                   | 4954                            | 1654                            | 39                             | 33                           | 56333E3                       | 76333E3 |



| ELECTRICAL DATA AND ORDERING INFORMATION FOR 056 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>85 °C<br>(A) | I <sub>R</sub><br>≥ 10 kHz<br>85 °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>MAL2056..... |         |
|                                                         |                                  |                                         |                                          |                                            |                                  |                                  |                       |                     | 2-TERM.                       | 3-TERM. |
| 40                                                      | 2200                             | 22 x 25                                 | 1.85                                     | 2.26                                       | 532                              | 180                              | 92                    | 61                  | 57222E3                       | 77222E3 |
|                                                         | 3300                             | 22 x 30                                 | 2.09                                     | 2.55                                       | 796                              | 260                              | 67                    | 45                  | 57332E3                       | 77332E3 |
|                                                         | 4700                             | 25 x 30                                 | 2.28                                     | 2.78                                       | 1132                             | 380                              | 82                    | 70                  | 57472E3                       | 77472E3 |
|                                                         | 4700                             | 22 x 40                                 | 3.10                                     | 3.78                                       | 1132                             | 380                              | 49                    | 38                  | 47472E3                       | 27472E3 |
|                                                         | 6800                             | 30 x 30                                 | 3.16                                     | 3.85                                       | 1636                             | 548                              | 53                    | 38                  | 57682E3                       | 77682E3 |
|                                                         | 6800                             | 25 x 40                                 | 3.06                                     | 3.73                                       | 1636                             | 548                              | 58                    | 50                  | 47682E3                       | 27682E3 |
|                                                         | 10 000                           | 30 x 40                                 | 4.20                                     | 5.12                                       | 2404                             | 804                              | 38                    | 28                  | 57103E3                       | 77103E3 |
|                                                         | 10 000                           | 25 x 50                                 | 3.88                                     | 4.73                                       | 2404                             | 804                              | 44                    | 39                  | 47103E3                       | 27103E3 |
|                                                         | 15 000                           | 35 x 40                                 | 4.05                                     | 4.94                                       | 3604                             | 1204                             | 49                    | 41                  | 57153E3                       | 77153E3 |
|                                                         | 15 000                           | 30 x 50                                 | 4.45                                     | 5.43                                       | 3604                             | 1204                             | 41                    | 34                  | 47153E3                       | 27153E3 |
|                                                         | 22 000                           | 35 x 50                                 | 4.86                                     | 5.93                                       | 5284                             | 1764                             | 40                    | 33                  | 57223E3                       | 77223E3 |
| 50                                                      | 1500                             | 22 x 25                                 | 1.36                                     | 1.66                                       | 454                              | 154                              | 170                   | 130                 | 51152E3                       | 71152E3 |
|                                                         | 2200                             | 22 x 30                                 | 1.75                                     | 2.14                                       | 664                              | 224                              | 120                   | 91                  | 51222E3                       | 71222E3 |
|                                                         | 3300                             | 25 x 30                                 | 2.17                                     | 2.65                                       | 994                              | 334                              | 90                    | 72                  | 51332E3                       | 71332E3 |
|                                                         | 3300                             | 22 x 40                                 | 2.42                                     | 2.95                                       | 994                              | 334                              | 80                    | 63                  | 41332E3                       | 21332E3 |
|                                                         | 4700                             | 30 x 30                                 | 2.65                                     | 3.23                                       | 1414                             | 474                              | 75                    | 63                  | 51472E3                       | 71472E3 |
|                                                         | 4700                             | 25 x 40                                 | 2.89                                     | 3.53                                       | 1414                             | 474                              | 65                    | 52                  | 41472E3                       | 21472E3 |
|                                                         | 6800                             | 30 x 40                                 | 3.56                                     | 4.34                                       | 2044                             | 684                              | 53                    | 45                  | 51682E3                       | 71682E3 |
|                                                         | 6800                             | 25 x 50                                 | 3.75                                     | 4.58                                       | 2044                             | 684                              | 50                    | 43                  | 41682E3                       | 21682E3 |
|                                                         | 10 000                           | 35 x 40                                 | 4.05                                     | 4.94                                       | 3004                             | 1004                             | 49                    | 42                  | 51103E3                       | 71103E3 |
|                                                         | 10 000                           | 30 x 50                                 | 4.50                                     | 5.49                                       | 3004                             | 1004                             | 40                    | 35                  | 41103E3                       | 21103E3 |
|                                                         | 15 000                           | 35 x 50                                 | 4.98                                     | 6.08                                       | 4504                             | 1504                             | 39                    | 33                  | 51153E3                       | 71153E3 |
| 63                                                      | 1000                             | 22 x 25                                 | 1.46                                     | 1.78                                       | 382                              | 130                              | 148                   | 104                 | 58102E3                       | 78102E3 |
|                                                         | 1500                             | 22 x 30                                 | 1.87                                     | 2.28                                       | 571                              | 193                              | 105                   | 72                  | 58152E3                       | 78152E3 |
|                                                         | 2200                             | 25 x 30                                 | 2.32                                     | 2.83                                       | 836                              | 281                              | 79                    | 59                  | 58222E3                       | 78222E3 |
|                                                         | 2200                             | 22 x 40                                 | 2.54                                     | 3.10                                       | 836                              | 281                              | 73                    | 53                  | 48222E3                       | 28222E3 |
|                                                         | 3300                             | 30 x 30                                 | 2.87                                     | 3.50                                       | 1251                             | 420                              | 64                    | 50                  | 58332E3                       | 78332E3 |
|                                                         | 3300                             | 25 x 40                                 | 3.14                                     | 3.83                                       | 1251                             | 420                              | 55                    | 44                  | 48332E3                       | 28332E3 |
|                                                         | 4700                             | 30 x 40                                 | 3.67                                     | 4.48                                       | 1780                             | 596                              | 50                    | 38                  | 58472E3                       | 78472E3 |
|                                                         | 4700                             | 25 x 50                                 | 3.71                                     | 4.53                                       | 1780                             | 596                              | 48                    | 38                  | 48472E3                       | 28472E3 |
|                                                         | 6800                             | 35 x 40                                 | 4.33                                     | 5.28                                       | 2574                             | 861                              | 43                    | 38                  | 58682E3                       | 78682E3 |
|                                                         | 6800                             | 30 x 50                                 | 4.75                                     | 5.80                                       | 2574                             | 861                              | 42                    | 37                  | 48682E3                       | 28682E3 |
|                                                         | 10 000                           | 35 x 50                                 | 5.26                                     | 6.42                                       | 3784                             | 1264                             | 35                    | 30                  | 58103E3                       | 78103E3 |
| 100                                                     | 470                              | 22 x 25                                 | 0.77                                     | 0.94                                       | 286                              | 98                               | 535                   | 470                 | 59471E3                       | 79471E3 |
|                                                         | 680                              | 22 x 30                                 | 0.99                                     | 1.21                                       | 412                              | 160                              | 375                   | 328                 | 59681E3                       | 79681E3 |
|                                                         | 1000                             | 25 x 30                                 | 1.27                                     | 1.55                                       | 604                              | 204                              | 265                   | 235                 | 59102E3                       | 79102E3 |
|                                                         | 1000                             | 22 x 40                                 | 1.35                                     | 1.65                                       | 604                              | 204                              | 260                   | 225                 | 49102E3                       | 29102E3 |
|                                                         | 1500                             | 30 x 30                                 | 1.67                                     | 2.04                                       | 904                              | 304                              | 190                   | 170                 | 59152E3                       | 79152E3 |
|                                                         | 1500                             | 25 x 40                                 | 1.75                                     | 2.14                                       | 904                              | 304                              | 180                   | 160                 | 49152E3                       | 29152E3 |
|                                                         | 2200                             | 30 x 40                                 | 2.27                                     | 2.77                                       | 1324                             | 444                              | 130                   | 120                 | 59222E3                       | 79222E3 |
|                                                         | 2200                             | 25 x 50                                 | 2.30                                     | 2.80                                       | 1324                             | 444                              | 125                   | 110                 | 49222E3                       | 29222E3 |
|                                                         | 3300                             | 35 x 40                                 | 2.84                                     | 3.46                                       | 1984                             | 664                              | 100                   | 95                  | 59332E3                       | 79332E3 |
|                                                         | 3300                             | 30 x 50                                 | 2.97                                     | 3.62                                       | 1984                             | 664                              | 92                    | 85                  | 49332E3                       | 29332E3 |
|                                                         | 4700                             | 35 x 50                                 | 3.59                                     | 4.38                                       | 2824                             | 677                              | 75                    | 70                  | 59472E3                       | 79472E3 |

Table 3

| ELECTRICAL DATA AND ORDERING INFORMATION FOR 057 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>85 °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>MAL2057..... |         |
|                                                         |                                  |                                         |                                          |                                  |                                  |                       |                     | 2-TERM.                       | 3-TERM. |
| 200                                                     | 150                              | 22 x 25                                 | 0.77                                     | 184                              | 64                               | 950                   | 620                 | 52151E3                       | 72151E3 |
|                                                         | 220                              | 22 x 30                                 | 1.00                                     | 268                              | 92                               | 650                   | 435                 | 52221E3                       | 72221E3 |
|                                                         | 330                              | 25 x 30                                 | 1.36                                     | 400                              | 136                              | 430                   | 310                 | 52331E3                       | 72331E3 |
|                                                         | 330                              | 22 x 40                                 | 1.36                                     | 400                              | 136                              | 430                   | 310                 | 42331E3                       | 22331E3 |
|                                                         | 470                              | 30 x 30                                 | 1.80                                     | 568                              | 192                              | 310                   | 230                 | 52471E3                       | 72471E3 |
|                                                         | 470                              | 25 x 40                                 | 1.80                                     | 568                              | 192                              | 310                   | 230                 | 42471E3                       | 22471E3 |
|                                                         | 680                              | 30 x 40                                 | 2.39                                     | 820                              | 276                              | 210                   | 180                 | 52681E3                       | 72681E3 |
|                                                         | 680                              | 25 x 50                                 | 2.39                                     | 820                              | 276                              | 210                   | 180                 | 42681E3                       | 22681E3 |
|                                                         | 1000                             | 35 x 40                                 | 2.85                                     | 1204                             | 404                              | 160                   | 135                 | 52102E3                       | 72102E3 |
|                                                         | 1000                             | 30 x 50                                 | 2.85                                     | 1204                             | 404                              | 160                   | 135                 | 42102E3                       | 22102E3 |
| 250                                                     | 1500                             | 35 x 50                                 | 3.66                                     | 1804                             | 604                              | 120                   | 105                 | 52152E3                       | 72152E3 |
|                                                         | 100                              | 22 x 25                                 | 0.63                                     | 154                              | 54                               | 1440                  | 770                 | 53101E3                       | 73101E3 |
|                                                         | 150                              | 22 x 30                                 | 0.83                                     | 229                              | 79                               | 960                   | 520                 | 53151E3                       | 73151E3 |
|                                                         | 220                              | 25 x 30                                 | 1.10                                     | 334                              | 114                              | 660                   | 365                 | 53221E3                       | 73221E3 |
|                                                         | 220                              | 22 x 40                                 | 1.10                                     | 334                              | 114                              | 660                   | 365                 | 43221E3                       | 23221E3 |
|                                                         | 330                              | 30 x 30                                 | 1.49                                     | 499                              | 169                              | 440                   | 265                 | 53331E3                       | 73331E3 |
|                                                         | 330                              | 25 x 40                                 | 1.49                                     | 499                              | 169                              | 440                   | 265                 | 43331E3                       | 23331E3 |
|                                                         | 470                              | 30 x 40                                 | 1.98                                     | 709                              | 239                              | 310                   | 185                 | 53471E3                       | 73471E3 |
|                                                         | 470                              | 25 x 50                                 | 1.98                                     | 709                              | 239                              | 310                   | 185                 | 43471E3                       | 23471E3 |
|                                                         | 680                              | 35 x 40                                 | 2.60                                     | 1024                             | 344                              | 240                   | 145                 | 53681E3                       | 73681E3 |
| 385                                                     | 680                              | 30 x 50                                 | 2.60                                     | 1024                             | 344                              | 240                   | 145                 | 43681E3                       | 23681E3 |
|                                                         | 1000                             | 35 x 50                                 | 3.12                                     | 1504                             | 504                              | 160                   | 105                 | 53102E3                       | 73102E3 |
|                                                         | 47                               | 22 x 25                                 | 0.50                                     | 112                              | 40                               | 3000                  | 1400                | 58479E3                       | 78479E3 |
|                                                         | 68                               | 22 x 30                                 | 0.63                                     | 161                              | 56                               | 2100                  | 1000                | 58689E3                       | 68689E3 |
|                                                         | 100                              | 25 x 30                                 | 0.86                                     | 235                              | 81                               | 1400                  | 780                 | 58101E3                       | 78101E3 |
|                                                         | 100                              | 22 x 40                                 | 0.86                                     | 235                              | 81                               | 1400                  | 780                 | 48101E3                       | 68101E3 |
|                                                         | 100                              | 22 x 35                                 | 0.84                                     | 235                              | 81                               | 1400                  | 780                 | 38101E3                       | 88101E3 |
|                                                         | 150                              | 30 x 30                                 | 1.16                                     | 350                              | 119                              | 950                   | 520                 | 58151E3                       | 78151E3 |
|                                                         | 150                              | 25 x 40                                 | 1.16                                     | 350                              | 119                              | 950                   | 520                 | 48151E3                       | 68151E3 |
|                                                         | 220                              | 30 x 40                                 | 1.57                                     | 512                              | 173                              | 650                   | 400                 | 58221E3                       | 78221E3 |
| 400                                                     | 220                              | 30 x 35                                 | 1.50                                     | 512                              | 173                              | 650                   | 400                 | 38221E3                       | 90051E3 |
|                                                         | 220                              | 25 x 50                                 | 1.57                                     | 512                              | 173                              | 650                   | 400                 | 48221E3                       | 68221E3 |
|                                                         | 330                              | 35 x 35                                 | 1.73                                     | 766                              | 258                              | 480                   | 280                 | 68331E3                       | 88331E3 |
|                                                         | 330                              | 30 x 45                                 | 1.75                                     | 766                              | 258                              | 480                   | 280                 | 38331E3                       | 78331E3 |
|                                                         | 470                              | 35 x 50                                 | 2.40                                     | 1089                             | 366                              | 340                   | 220                 | 58471E3                       | 78471E3 |
|                                                         | 470                              | 35 x 45                                 | 2.29                                     | 1089                             | 366                              | 340                   | 220                 | 48471E3                       | 28471E3 |
|                                                         | 47                               | 22 x 25                                 | 0.50                                     | 117                              | 42                               | 3000                  | 1400                | 56479E3                       | 76479E3 |
|                                                         | 68                               | 22 x 30                                 | 0.63                                     | 167                              | 58                               | 2100                  | 1000                | 56689E3                       | 76689E3 |
|                                                         | 100                              | 25 x 30                                 | 0.86                                     | 244                              | 84                               | 1400                  | 780                 | 56101E3                       | 76101E3 |
|                                                         | 100                              | 22 x 35                                 | 0.84                                     | 240                              | 84                               | 1400                  | 780                 | 36101E3                       | 66101E3 |
| 450                                                     | 150                              | 30 x 30                                 | 1.16                                     | 364                              | 124                              | 950                   | 520                 | 56151E3                       | 90054E3 |
|                                                         | 150                              | 25 x 40                                 | 1.16                                     | 364                              | 124                              | 950                   | 520                 | 46151E3                       | 86151E3 |
|                                                         | 220                              | 30 x 35                                 | 1.50                                     | 532                              | 180                              | 650                   | 400                 | 36221E3                       | 90055E3 |
|                                                         | 220                              | 25 x 50                                 | 1.57                                     | 532                              | 180                              | 650                   | 400                 | 46221E3                       | 86221E3 |
|                                                         | 330                              | 35 x 40                                 | 1.85                                     | 796                              | 268                              | 480                   | 280                 | 56331E3                       | 76331E3 |
|                                                         | 330                              | 30 x 50                                 | 1.85                                     | 796                              | 268                              | 480                   | 280                 | 46331E3                       | 26331E3 |
|                                                         | 470                              | 35 x 50                                 | 2.40                                     | 1132                             | 380                              | 340                   | 220                 | 56471E3                       | 76471E3 |
|                                                         | 47                               | 22 x 30                                 | 0.26                                     | 131                              | 45                               | 5600                  | 4400                | 67479E3                       | 87479E3 |
|                                                         | 68                               | 22 x 30                                 | 0.33                                     | 188                              | 65                               | 3900                  | 3100                | 57689E3                       | 77689E3 |
|                                                         | 100                              | 30 x 30                                 | 0.48                                     | 274                              | 94                               | 2600                  | 2100                | 57101E3                       | 77101E3 |
| 450                                                     | 100                              | 25 x 35                                 | 0.46                                     | 274                              | 94                               | 2600                  | 2100                | 37101E3                       | 17101E3 |
|                                                         | 150                              | 30 x 35                                 | 0.66                                     | 409                              | 140                              | 1600                  | 1300                | 37151E3                       | 17151E3 |
|                                                         | 150                              | 25 x 50                                 | 0.70                                     | 409                              | 140                              | 1600                  | 1300                | 47151E3                       | 27151E3 |
|                                                         | 220                              | 35 x 40                                 | 0.92                                     | 598                              | 202                              | 1100                  | 900                 | 57221E3                       | 77221E3 |
|                                                         | 220                              | 30 x 45                                 | 0.73                                     | 598                              | 202                              | 1100                  | 900                 | 37221E3                       | 17221E3 |
|                                                         | 330                              | 35 x 50                                 | 1.26                                     | 895                              | 301                              | 700                   | 600                 | 57331E3                       | 77331E3 |
|                                                         | 330                              | 35 x 45                                 | 1.20                                     | 895                              | 301                              | 700                   | 600                 | 47331E3                       | 27331E3 |

| 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                                   |

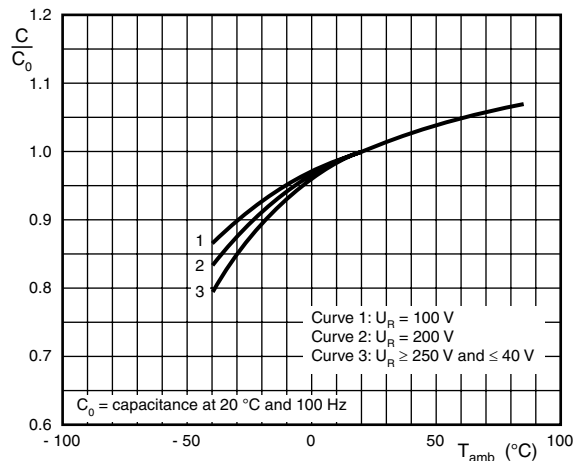
**CAPACITANCE (C)**


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

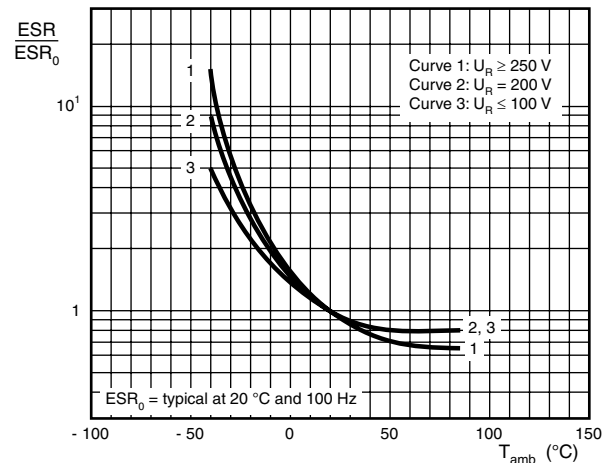
**EQUIVALENT SERIES RESISTANCE (ESR)**


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

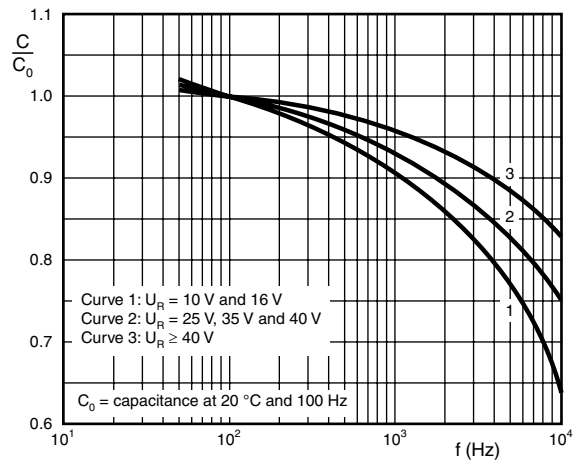


Fig.7 Typical multiplier of capacitance as a function of frequency

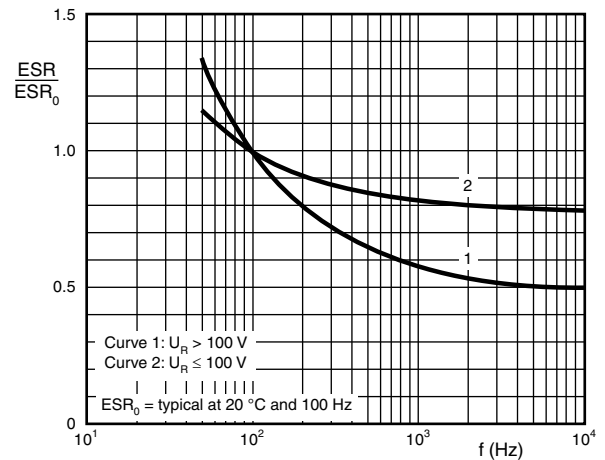


Fig.9 Typical multiplier of ESR as a function of frequency

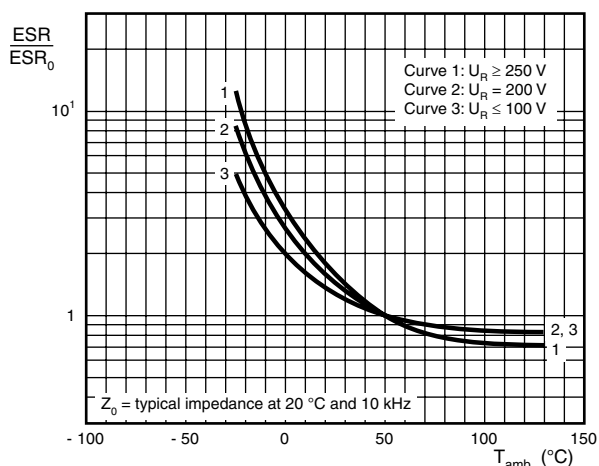
**IMPEDANCE (Z)**

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

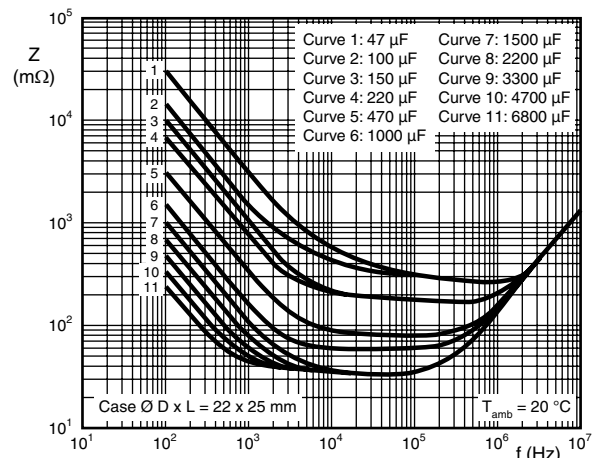


Fig.11 Typical impedance as a function of frequency

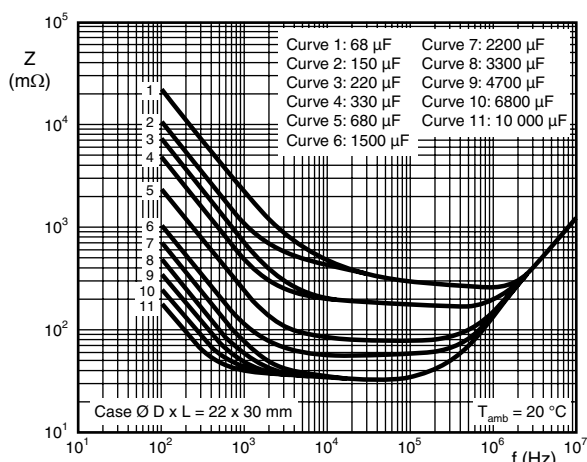


Fig.12 Typical impedance as a function of frequency

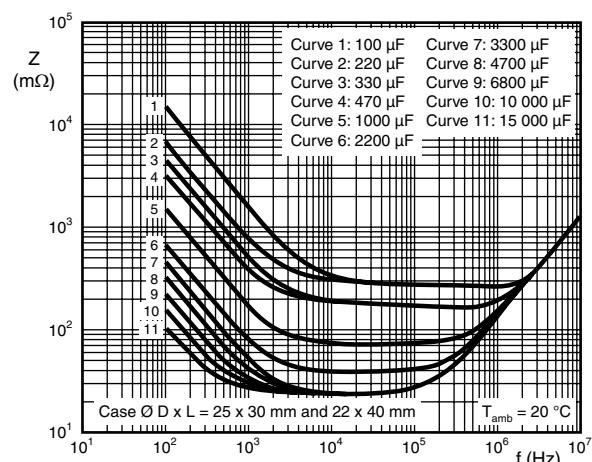


Fig.13 Typical impedance as a function of frequency

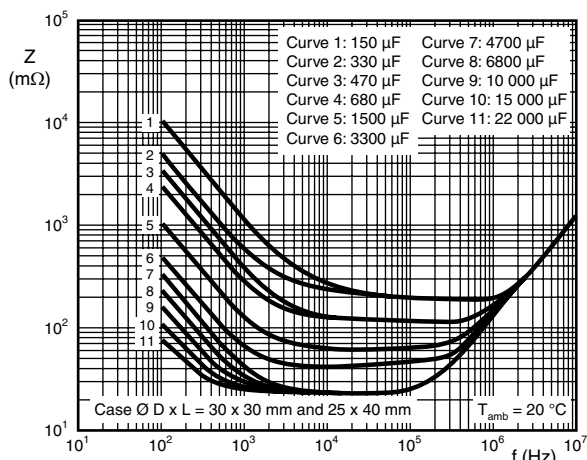


Fig.14 Typical impedance as a function of frequency

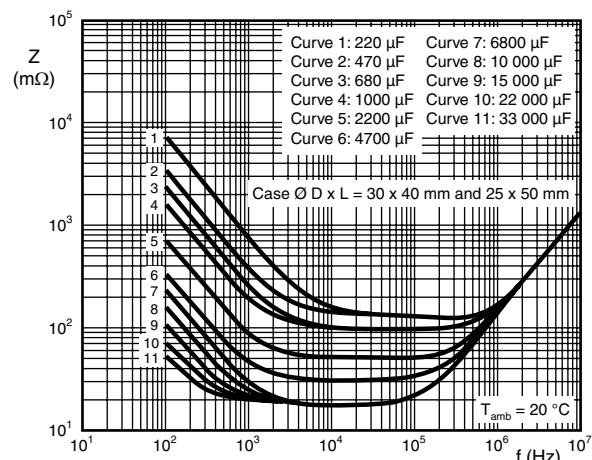


Fig.15 Typical impedance as a function of frequency



## IMPEDANCE (Z)

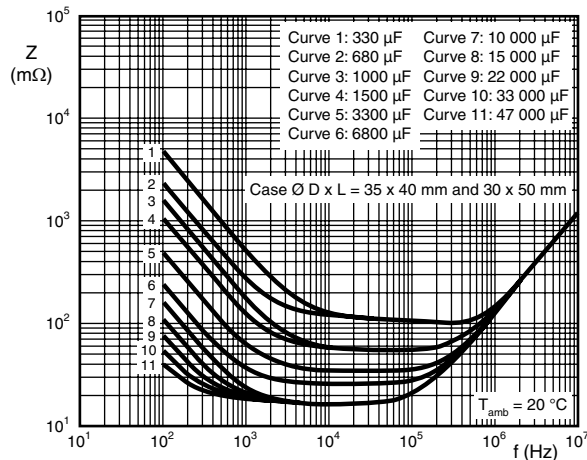


Fig.16 Typical impedance as a function of frequency

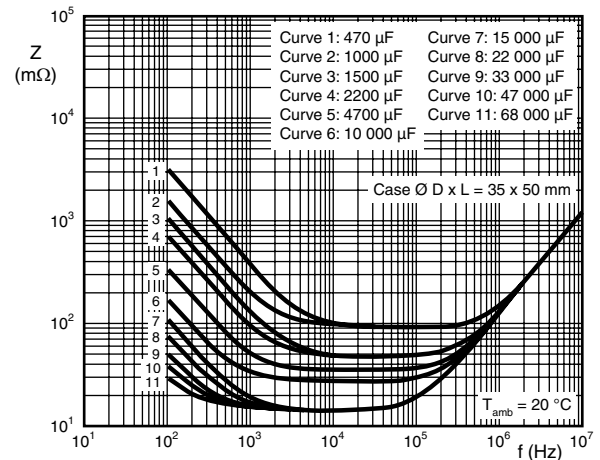
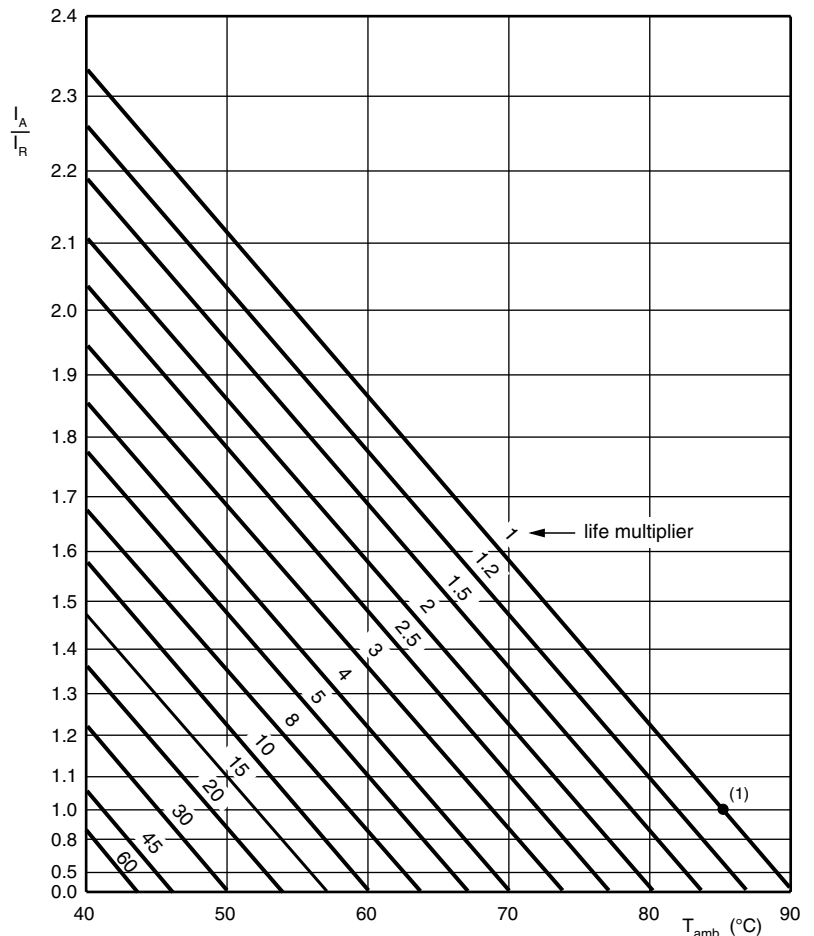


Fig.17 Typical impedance as a function of frequency

## RIPPLE CURRENT AND USEFUL LIFE



$I_A$  = actual ripple current at 100 Hz and 85 °C  
 $I_R$  = rated ripple current at 100 Hz and 85 °C  
 (1) Useful life at 85 °C and  $I_R$  applied:  
 12 000 hours (450 V types: 5000 hours)

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                    |                                      |                       |
|                                                                   | $U_R = 10 \text{ to } 25 \text{ V}$ | $U_R = 40 \text{ to } 100 \text{ V}$ | $U_R > 100 \text{ V}$ |
| 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 | $T_{amb} = 85\text{ °C}$ ; $U_R$ applied;<br>5000 hours (450 V types: 2000 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              | $T_{amb} = 85\text{ °C}$ ; $U_R$ and $I_R$ applied;<br>12 000 hours (450 V types: 5000 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>$U_R \leq 100 \text{ V}$ : $\leq 1\%$ ;<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 | $T_{amb} = 85\text{ °C}$ ; no voltage applied;<br>500 hours<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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**Наши контакты:**

**Телефон:** +7 812 627 14 35

**Электронная почта:** [sales@st-electron.ru](mailto:sales@st-electron.ru)

**Адрес:** 198099, Санкт-Петербург,  
Промышленная ул, дом № 19, литера Н,  
помещение 100-Н Офис 331