

## Aluminum Capacitors Power Standard Miniature Snap-In

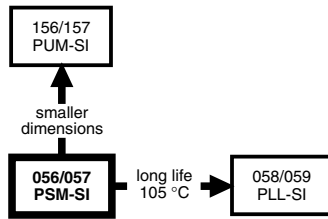


Fig. 1



### 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 h at 85 °C
- High ripple current capability
- Keyed polarity version available
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

### 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 or in 2 digits according to IEC 60062)
- 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 ( $\varnothing$ D x L in mm) | 22 x 25 to 35 x 50                        |  |
| Rated capacitance range (E6 series), $C_R$     | 470 $\mu\text{F}$ to 68 000 $\mu\text{F}$ | 47 $\mu\text{F}$ to 1500 $\mu\text{F}$ |
| Tolerance on $C_R$                             | $\pm 20\%$                                |  |
| Rated voltage range, $U_R$ <sup>(1)</sup>      | 10 V to 100 V                             | 200 V to 450 V                         |
| Category temperature range                     | -25 °C to +85 °C                          | -25 °C to +85 °C                       |
| Endurance test at 85 °C                        | 5000 h (450 V: 2000 h)                    |  |
| Useful life at 85 °C                           | 12 000 h (450 V: 5000 h)                  |  |
| Useful life at 40 °C and 1.4 x $I_R$ applied   | 210 000 h (450 V: 90 000 h)               |  |
| Shelf life at 0 V, 85 °C                       | 500 h                                     |  |
| Based on sectional specification               | IEC 60384-4/EN130300                      |  |
| Climatic category IEC 60068                    | 40/085/056                                | 25/085/56                              |

#### Note

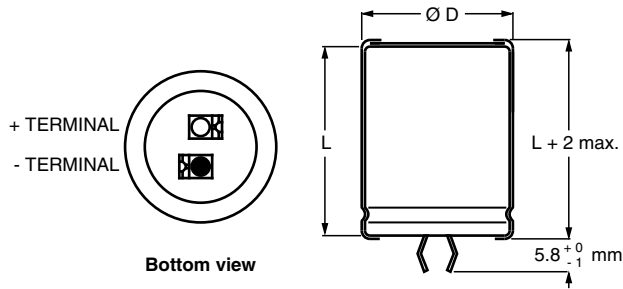
<sup>(1)</sup> A 420 V range is available on request

| SELECTION CHART FOR $C_R$ , $U_R$ , AND RELEVANT NOMINAL CASE SIZES FOR 056 SERIES ( $\varnothing$ D x L in mm) |           |    |    |         |         |         |         |
|---|-----------|----|----|---------|---------|---------|---------|
| $C_R$ ( $\mu\text{F}$ )   | $U_R$ (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 |



| SELECTION CHART FOR C <sub>R</sub> , U <sub>R</sub> , AND RELEVANT NOMINAL CASE SIZES FOR 056 SERIES (∅ D x L in mm) |                    |         |         |         |         |         |         |
|--|--------------------|---------|---------|---------|---------|---------|---------|
| C <sub>R</sub><br>(μF)   | U <sub>R</sub> (V) |         |         |         |         |         |         |
|  | 10                 | 16      | 25      | 40      | 50      | 63      | 100     |
| 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 |
| 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 (∅ 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 TERMINAL SNAP-IN**


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

Fig. 2 - Two terminal snap-in

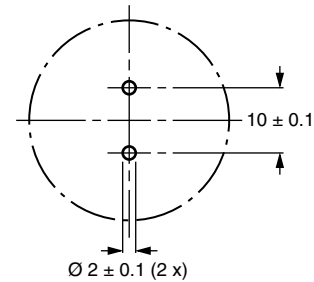
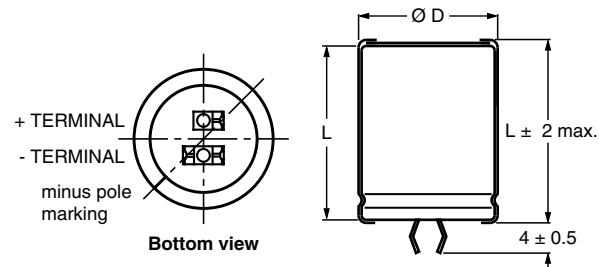
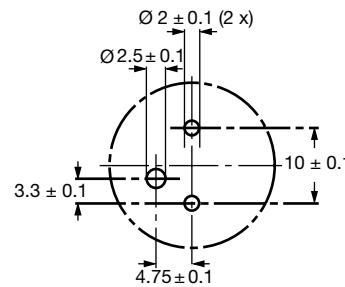


Fig. 3 - Mounting hole diagram

**THREE TERMINAL SNAP-IN**


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

Fig. 4 - Three terminal snap-in



The 10 mm spacing of the 2 pin snap-in is used as the base layout and a third hole is added. The third hole is closer to the negative primary hole so that polarization is always maintained, together with added mechanical stability.

Fig. 5 - Mounting hole diagram

**Table 1**

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



| ELECTRICAL DATA |  |
|-----------------|--|
| SYMBOL          | DESCRIPTION  |
| C <sub>R</sub>  | Rated capacitance at 100 Hz                              |
| I <sub>R</sub>  | Rated RMS ripple current at 100 Hz or ≥ 10 kHz and 85 °C |
| I <sub>L1</sub> | Max. leakage current after 1 min at U <sub>R</sub>       |
| I <sub>L5</sub> | Max. leakage current after 5 min at U <sub>R</sub>       |
| ESR             | Max. equivalent series resistance at 100 Hz              |
| Z               | Max. impedance at 10 kHz                                 |

**Note**

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

**ORDERING EXAMPLE**

Electrolytic capacitor 056 series

10 000 µF/25 V; ± 20 %

Nominal case size: Ø 25 mm x 40 mm

2-terminal snap-in:

Ordering code: MAL2 05646103E3

Former 12NC: 2222 05646103

3-terminal snap-in:

Ordering code: MAL2 05626103E3

Former 12NC: 2222 05626103

**Table 2**

| 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. |
| 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 |
| 68 000  | 35 x 50                          | 5.88                                    | 6.94                                     | 4084                                       | 1364                             | 28                               | 23                    | 54683E3             | 74683E3                       |         |
| 16  | 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 |
|   | 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                       |         |
| 25  | 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 |
|   | 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 (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 |
|   | 1500                          | 35 x 50                                 | 3.66                                     | 1804                             | 604                              | 120                   | 105                 | 52152E3                       | 72152E3 |
| 250   | 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 |
|   | 680                           | 30 x 50                                 | 2.60                                     | 1024                             | 344                              | 240                   | 145                 | 43681E3                       | 23681E3 |
|   | 1000                          | 35 x 50                                 | 3.12                                     | 1504                             | 504                              | 160                   | 105                 | 53102E3                       | 73102E3 |
| 385   | 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 |
|   | 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                       |         |
| 400   | 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 |
|   | 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 |
| 450   | 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 |
|   | 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                      | ≤ 250 V versions     | $U_s = 1.15 \times U_R$                            |
|                                    | ≥ 385 V versions     | $U_s = 1.1 \times U_R$                             |
| Reverse voltage                    |                      | $U_{rev} \leq 1 \text{ V}$                         |
| <b>Current</b>                     |                      |  |
| Leakage current                    | after 1 min at $U_R$ | $I_{L1} \leq 0.006 C_R \times U_R + 4 \mu\text{A}$ |
|                                    | after 5 min at $U_R$ | $I_{L5} \leq 0.002 C_R \times U_R + 4 \mu\text{A}$ |
| <b>Inductance</b>                  |                      |  |
| Equivalent series inductance (ESL) | all case sizes       | typ. 19 nH   |
|                                    |                      | max. 25 nH   |

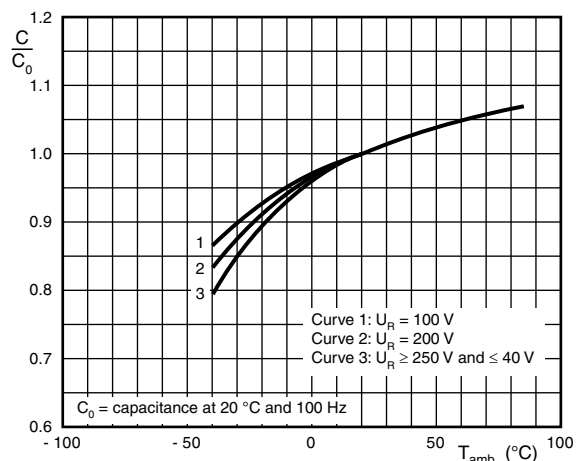
**CAPACITANCE (C)**


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

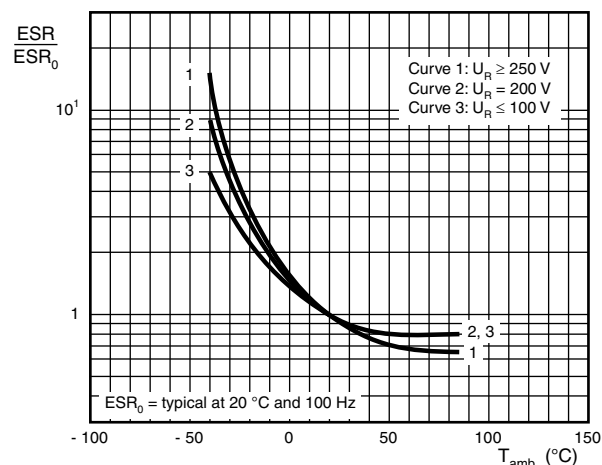
**EQUIVALENT SERIES RESISTANCE (ESR)**


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

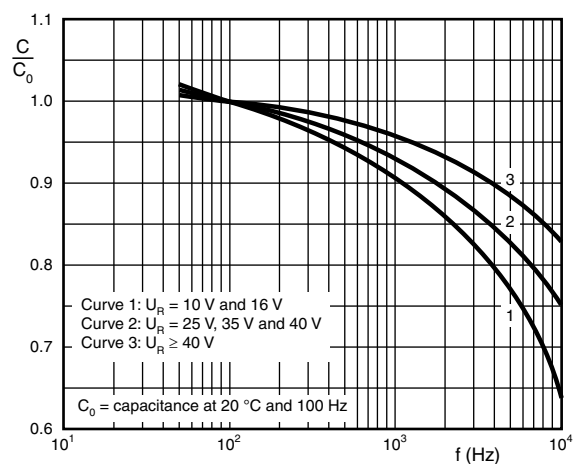


Fig. 7 - Typical multiplier of capacitance as a function of frequency

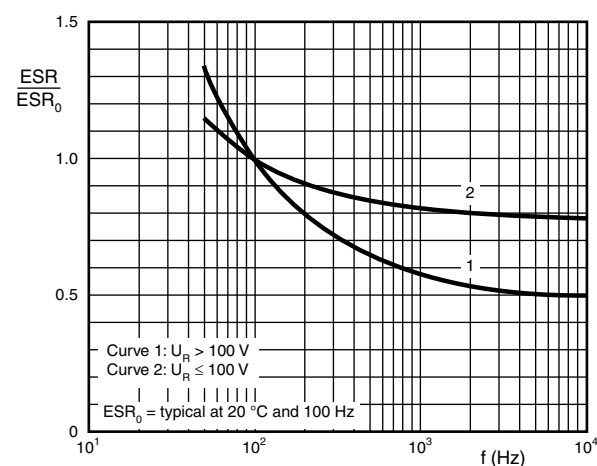


Fig. 9 - Typical multiplier of ESR as a function of frequency



**IMPEDANCE (Z)**

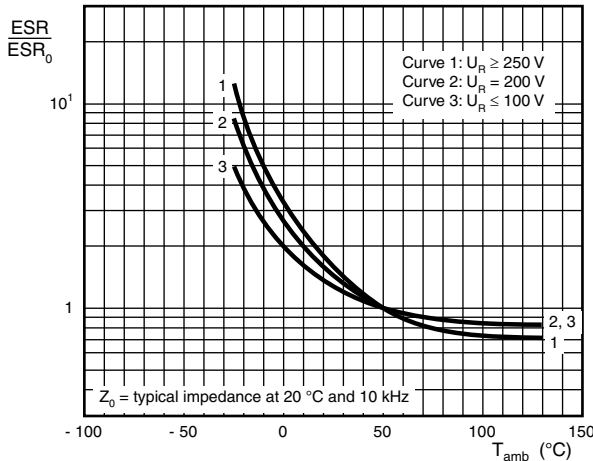


Fig. 10 - Typical multiplier of impedance as a function of ambient temperature

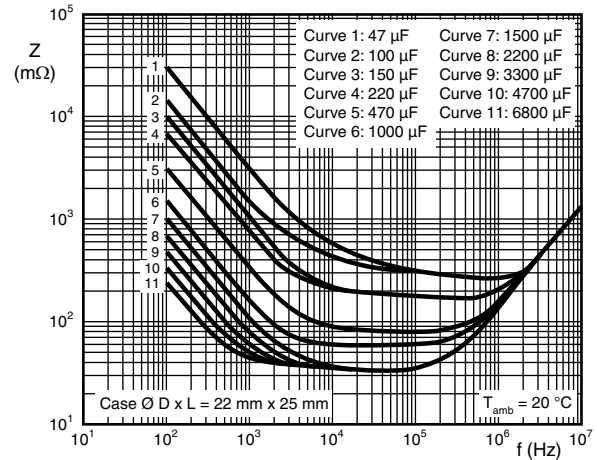


Fig. 13 - Typical impedance as a function of frequency

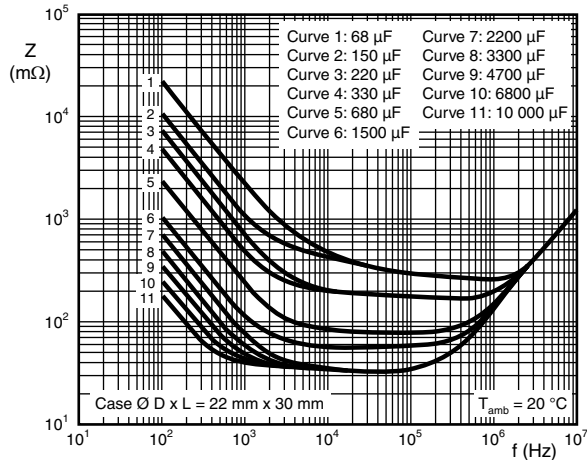


Fig. 11 - Typical impedance as a function of frequency

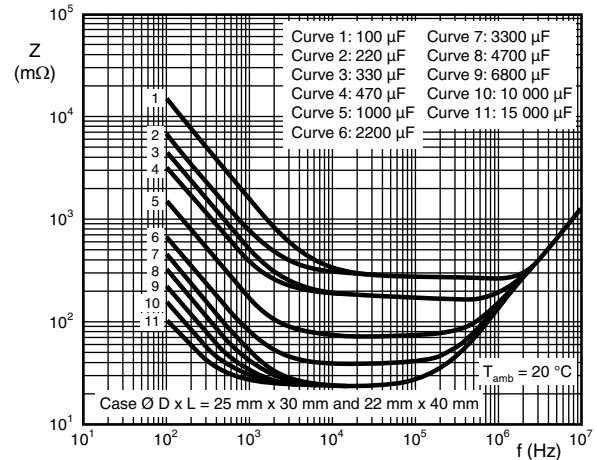


Fig. 14 - Typical impedance as a function of frequency

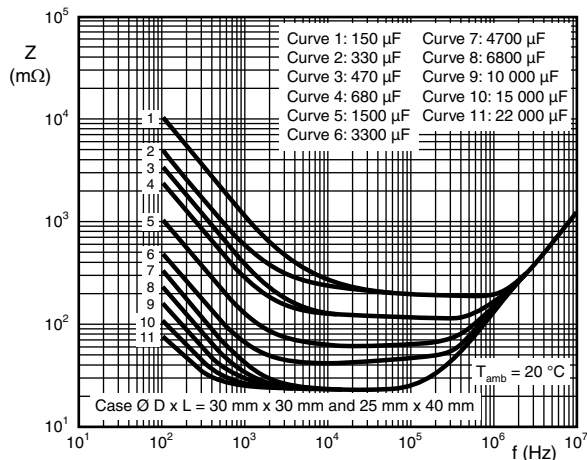


Fig. 12 - Typical impedance as a function of frequency

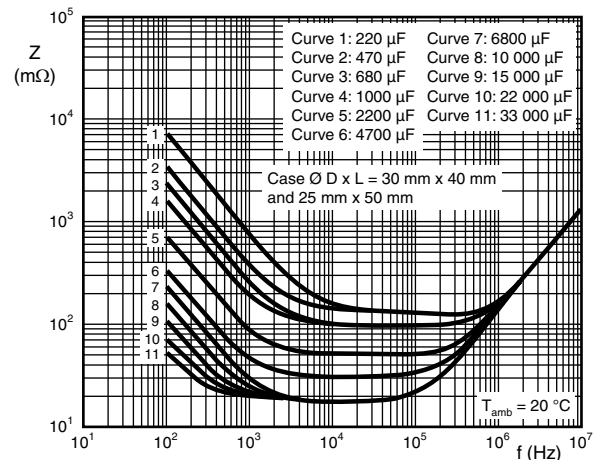


Fig. 15 - Typical impedance as a function of frequency



**IMPEDANCE (Z)**

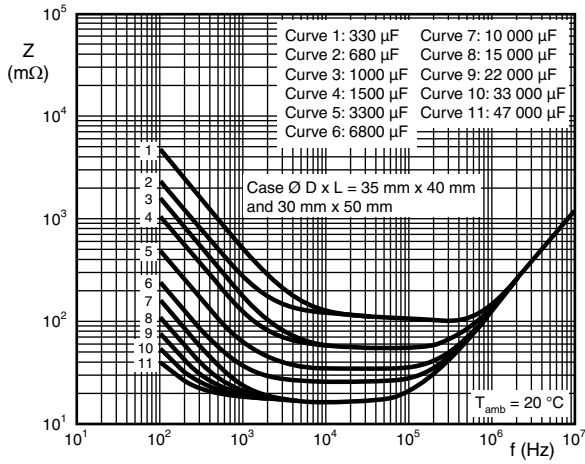


Fig. 16 - Typical impedance as a function of frequency

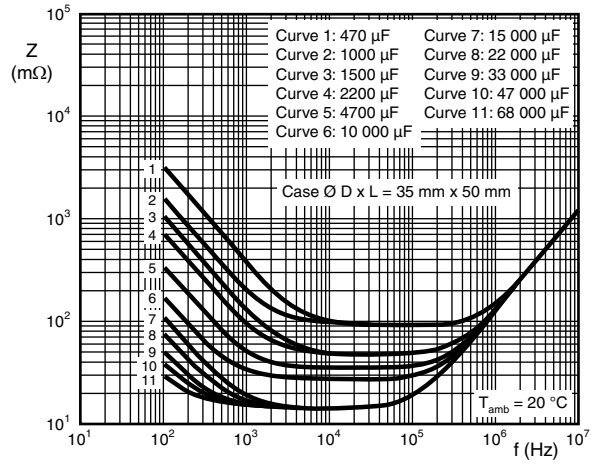


Fig. 17 - Typical impedance as a function of frequency

**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 h (450 V types: 5000 h)

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

**Table 4**

| <b>MULTIPLIER OF RIPPLE CURRENT (<math>I_R</math>) AS A FUNCTION OF FREQUENCY</b> |  |   |   |
|---|--|---|---|
| <b>FREQUENCY<br/>(Hz)</b>   | <b><math>I_R</math> MULTIPLIER</b>                   |   |   |
|   | <b><math>U_R = 10\text{ V to }25\text{ V}</math></b> | <b><math>U_R = 40\text{ V to }100\text{ V}</math></b> | <b><math>U_R &gt; 100\text{ V}</math></b> |
| 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**

| <b>TEST PROCEDURES AND REQUIREMENTS</b>        |  |  |   |
|--|--|--|---|
| <b>TEST</b>                                    |  | <b>PROCEDURE<br/>(quick reference)</b>   | <b>REQUIREMENTS</b>   |
| <b>NAME OF TEST</b>                            | <b>REFERENCE</b>                           |  |   |
| Endurance                                      | IEC 60384-4/<br>EN130300<br>subclause 4.13 | $T_{amb} = 85\text{ °C}$ ; $U_R$ applied;<br>5000 h (450 V types: 2000 h)  | $U_R \leq 100\text{ V}$ ; $\Delta C/C: \pm 15\%$<br>$U_R > 100\text{ V}$ ; $\Delta C/C: \pm 10\%$<br>$ESR \leq 1.3 \times \text{spec. limit}$<br>$Z \leq 2 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$   |
| Useful life                                    | CECC 30301<br>subclause 1.8.1              | $T_{amb} = 85\text{ °C}$ ; $U_R$ and $I_R$ applied;<br>12 000 h (450 V types: 2000 h)  | $U_R \leq 100\text{ V}$ ; $\Delta C/C: \pm 45\%$<br>$U_R > 100\text{ V}$ ; $\Delta C/C: \pm 30\%$<br>$ESR \leq 3 \times \text{spec. limit}$<br>$Z \leq 3 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$<br>no short or open circuit,<br>no visible damage<br>total failure percentage:<br>$U_R \leq 100\text{ V}$ ; $\leq 1\%$<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; 500 h<br>after test: $U_R$ to be applied for 30 min,<br>24 h to 48 h before measurement | $\Delta C/C: \pm 10\%$<br>$ESR \leq 1.2 \times \text{spec. limit}$<br>$I_{L5} \leq 2 \times \text{spec. limit}$   |



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