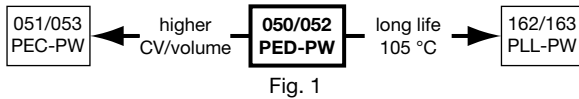




**THE DATASHEET OF  
MAL205256101E3**



## Aluminum Electrolytic Capacitors Power Eurodin Printed Wiring



### FEATURES

- Very long useful life: 15 000 h at 85 °C
- Low ESR, high ripple current capability
- High resistance to shock and vibration
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, cylindrical aluminum case, insulated with a blue sleeve
- Provided with keyed polarity
- 050 series also available in solder-lug (SL) versions
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS  
COMPLIANT**

### APPLICATIONS

- Computer, telecommunication, and industrial 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 on rated capacitance, code letter in accordance with IEC 60062 (Q for -10 % / +30 %)
- Rated voltage (in V)
- Date code (YYWW or in 2 digits according to IEC 60062)
- Name of manufacturer
- Code for factory of origin
- Polarity of the terminals and “-” sign to indicate the negative terminal, visible from the top and / or side of the capacitor
- Code number
- Climatic category in accordance with IEC 60068

| QUICK REFERENCE DATA                                |   |  |
|---|---|--|
| DESCRIPTION   | VALUE                                     |  |
|   | 050                                       | 052                                    |
| Nominal case size ( $\varnothing D \times L$ in mm) | 25 x 30 to 40 x 100                       |  |
| Rated capacitance range (E6 series), $C_R$          | 470 $\mu\text{F}$ to 68 000 $\mu\text{F}$ | 47 $\mu\text{F}$ to 1000 $\mu\text{F}$ |
| Tolerance on $C_R$                                  | -10 % to +30 %                            |  |
| Rated voltage range, $U_R$                          | 10 V to 100 V                             | 250 V to 400 V                         |
| Category temperature range                          | -40 °C to +85 °C                          |  |
| Endurance test at 85 °C                             | 5000 h                                    |  |
| Useful life at 85 °C                                | 15 000 h                                  |  |
| Useful life at 40 °C, 1.4 x $I_R$ applied           | 250 000 h                                 |  |
| Shelf life at 0 V, 85 °C                            | 500 h                                     |  |
| Based on sectional specification                    | IEC 60384-4 / EN 130300                   |  |
| Climatic category IEC 60068                         | 40 / 085 / 56                             |  |

| SELECTION CHART FOR $C_R$ , $U_R$ , AND RELEVANT NOMINAL CASE SIZES FOR 050 SERIES ( $\varnothing D \times L$ in mm) |           |          |          |          |          |          |
|--|-----------|----------|----------|----------|----------|----------|
| $C_R$<br>( $\mu\text{F}$ )   | $U_R$ (V) |          |          |          |          |          |
|  | 10        | 16       | 25       | 40       | 63       | 100      |
| 470  | -         | -        | -        | -        | -        | 25 x 30  |
| 680  | -         | -        | -        | -        | -        | 25 x 40  |
| 1000   | -         | -        | -        | -        | 25 x 30  | 30 x 40  |
| 1500   | -         | -        | -        | 25 x 30  | 25 x 40  | 35 x 40  |
| 2200   | -         | -        | 25 x 30  | 25 x 40  | 30 x 40  | 35 x 50  |
| 3300   | -         | 25 x 30  | 25 x 40  | 30 x 40  | 35 x 40  | 40 x 50  |
| 4700   | 25 x 30   | 25 x 40  | 30 x 40  | 35 x 40  | 35 x 50  | 40 x 70  |
| 6800   | 25 x 40   | 30 x 40  | 35 x 40  | 35 x 50  | 40 x 50  | 40 x 100 |
| 10 000   | 30 x 40   | 35 x 40  | 35 x 50  | 40 x 50  | 40 x 70  | -        |
| 15 000   | 35 x 40   | 35 x 50  | 40 x 50  | 40 x 70  | 40 x 100 | -        |
| 22 000   | 35 x 50   | 40 x 50  | 40 x 70  | 40 x 100 | -        | -        |
| 33 000   | 40 x 50   | 40 x 70  | 40 x 100 | -        | -        | -        |
| 47 000   | 40 x 70   | 40 x 100 | -        | -        | -        | -        |
| 68 000   | 40 x 100  | -        | -        | -        | -        | -        |

| <b>SELECTION CHART FOR <math>C_R</math>, <math>U_R</math>, AND RELEVANT NOMINAL CASE SIZES FOR 052 SERIES (<math>\varnothing D \times L</math> in mm)</b> |           |         |          |
|---|-----------|---------|----------|
| $C_R$<br>( $\mu F$ )  | $U_R$ (V) |         |          |
|   | 250       | 385     | 400      |
| 47  | -         | 25 x 30 | 25 x 30  |
| 68  | -         | 25 x 40 | 25 x 40  |
| 100   | 25 x 30   | 30 x 40 | 30 x 40  |
| 150   | 25 x 40   | 35 x 40 | 35 x 40  |
| 220   | 30 x 40   | 35 x 50 | 35 x 50  |
|   | -         | 40 x 40 | 40 x 40  |
| 330   | 35 x 40   | 40 x 50 | 40 x 50  |
| 470   | 35 x 50   | 40 x 70 | 40 x 70  |
|   | 40 x 40   | -       | -        |
| 680   | 40 x 50   | -       | 40 x 100 |
| 1000  | 40 x 70   | -       | -        |

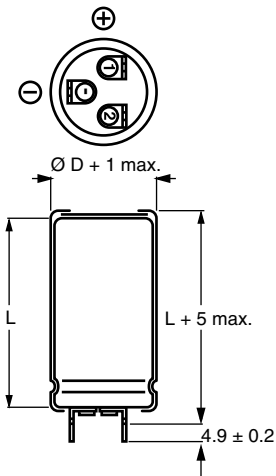
**DIMENSIONS in millimeters AND AVAILABLE FORMS**

 Case  $\varnothing D = 25 \text{ mm}$ 

Fig. 2 - Printed wiring pin version

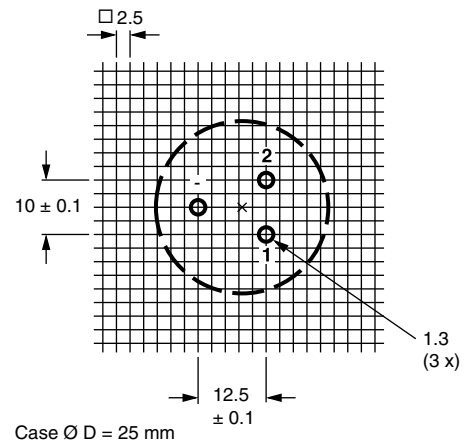


Fig. 3 - Mounting hole diagram viewed from component side

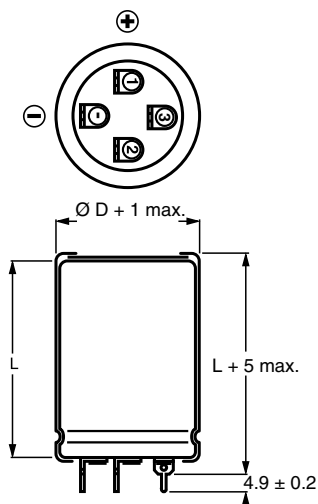

 Case  $\varnothing D = 30 \text{ mm}$ 

Fig. 4 - Printed wiring pin version

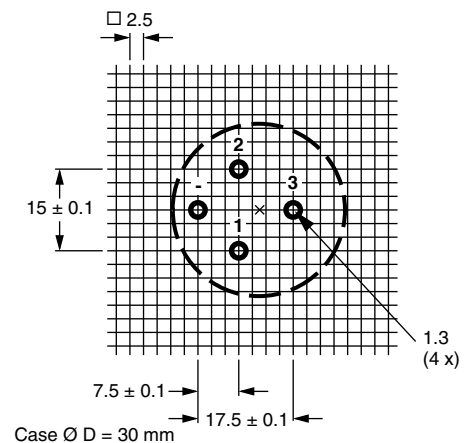


Fig. 5 - Mounting hole diagram viewed from component side

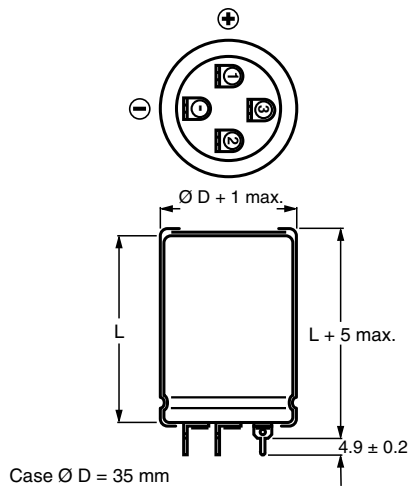


Fig. 6 - Printed wiring pin version

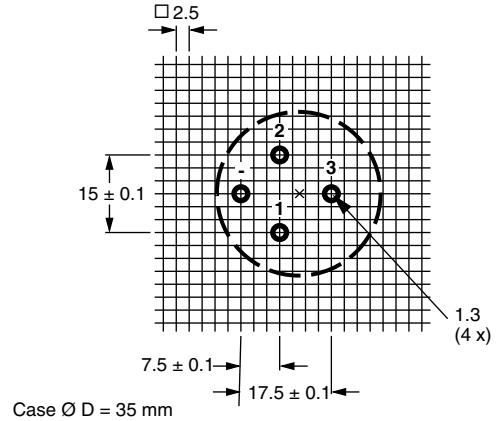


Fig. 7 - Mounting hole diagram viewed from component side

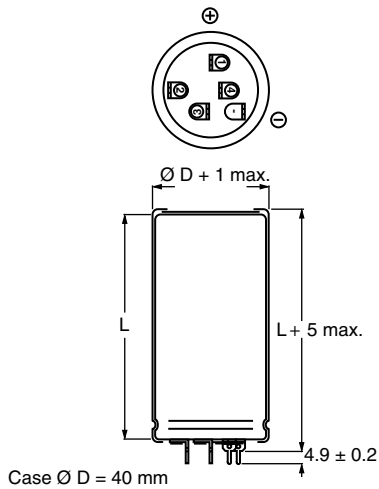


Fig. 8 - Printed wiring pin version

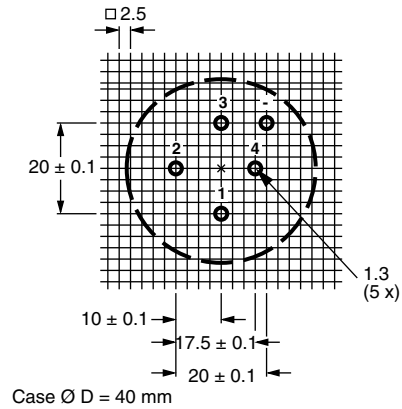


Fig. 9 - Mounting hole diagram viewed from component side

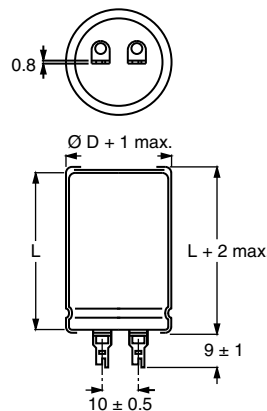


Fig. 10 - Solder-lug versions (SL): only available in 050 series

**MOUNTING**

When a number of capacitors are connected in a bank, they must not be closer together than 15 mm, when no derating of ripple current and / or temperature is applied.

**Pin number 1 is the positive terminal. Pin “-” is the negative terminal.**

**Pin numbers 2, 3 and 4 (if present) should be free from the electrical circuit or connected to the minus terminal.**



Table 1

| DIMENSIONS in millimeters, MASS, AND PACKAGING QUANTITIES |                     |                                  |                                  |             |   |  |
|---|---------------------|----------------------------------|----------------------------------|-------------|---|--|
| NOMINAL CASE SIZE<br>Ø D x L                              | Ø D <sub>max.</sub> | L <sub>max.</sub><br>SL VERSIONS | L <sub>max.</sub><br>PW VERSIONS | MASS<br>(g) | PACKAGING QUANTITIES<br>(units per box) | CARDBOARD<br>BOX DIMENSIONS<br>L x W x H |
| 25 x 30   | 26                  | 32                               | 35                               | ≈ 24        | 100                                     | 290 x 280 x 50                           |
| 25 x 40   | 26                  | 42                               | 45                               | ≈ 28        | 100                                     | 290 x 280 x 60                           |
| 30 x 40   | 31                  | 42                               | 45                               | ≈ 38        | 100                                     | 340 x 330 x 60                           |
| 35 x 40   | 36                  | 42                               | 45                               | ≈ 51        | 50                                      | 390 x 198 x 60                           |
| 35 x 50   | 36                  | 52                               | 55                               | ≈ 66        | 50                                      | 390 x 198 x 70                           |
| 40 x 40 <sup>(1)</sup>                                    | 41                  | -                                | 45                               | ≈ 78        | 50                                      | 440 x 223 x 60                           |
| 40 x 50   | 41                  | 52                               | 55                               | ≈ 82        | 50                                      | 440 x 223 x 70                           |
| 40 x 70   | 41                  | 72                               | 75                               | ≈ 110       | 25                                      | 230 x 230 x 90                           |
| 40 x 100  | 41                  | 102                              | 105                              | ≈ 176       | 25                                      | 230 x 230 x 120                          |

**Note**

(1) Not available in SL versions

| ELECTRICAL DATA |   |
|-----------------|---|
| SYMBOL          | DESCRIPTION   |
| C <sub>R</sub>  | Rated capacitance at 100 Hz                                   |
| I <sub>R</sub>  | Rated RMS ripple current at 100 Hz, 85 °C or at 20 kHz, 70 °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 050 series

10 000 µF / 25 V; -10 % / +30 %

Nominal case size: Ø 35 mm x 50 mm; PW version

Ordering code: MAL2 050 56103 E3

Former 12NC: 2222 050 56103

Table 2

| ELECTRICAL DATA AND ORDERING INFORMATION FOR 050 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>20 kHz<br>70 °C<br>(A) | I <sub>L1</sub><br>1 min<br>(mA) | I <sub>L5</sub><br>5 min<br>(mA) | ESR<br>100 Hz<br>(mΩ) | Z<br>10 kHz<br>(mΩ) | ORDERING<br>CODE SL<br>MAL2050..... | ORDERING<br>CODE PW<br>MAL2050..... |
| 10  | 4700                             | 25 x 30                                 | 2.4                                      | 4.6                                      | 0.28                             | 0.10                             | 74                    | 50                  | 14472E3                             | 54472E3                             |
|   | 6800                             | 25 x 40                                 | 3.2                                      | 6.1                                      | 0.41                             | 0.14                             | 51                    | 37                  | 14682E3                             | 54682E3                             |
|   | 10 000                           | 30 x 40                                 | 3.8                                      | 7.2                                      | 0.60                             | 0.20                             | 39                    | 29                  | 14103E3                             | 54103E3                             |
|   | 15 000                           | 35 x 40                                 | 4.1                                      | 7.8                                      | 0.90                             | 0.30                             | 35                    | 26                  | 14153E3                             | 54153E3                             |
|   | 22 000                           | 35 x 50                                 | 5.0                                      | 9.5                                      | 1.32                             | 0.44                             | 27                    | 21                  | 14223E3                             | 54223E3                             |
|   | 22 000                           | 40 x 40                                 | 4.2                                      | 8.0                                      | 1.32                             | 0.44                             | 36                    | 27                  | n/a                                 | 44223E3                             |
|   | 33 000                           | 40 x 50                                 | 5.0                                      | 9.5                                      | 1.98                             | 0.66                             | 29                    | 22                  | 14333E3                             | 54333E3                             |
|   | 47 000                           | 40 x 70                                 | 6.8                                      | 12.9                                     | 2.82                             | 0.94                             | 20                    | 17                  | 14473E3                             | 54473E3                             |
|   | 68 000                           | 40 x 100                                | 9.2                                      | 17.5                                     | 4.08                             | 1.36                             | 15                    | 14                  | 14683E3                             | 54683E3                             |



| ELECTRICAL DATA AND ORDERING INFORMATION FOR 050 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>20 kHz<br>70 °C<br>(A) | I <sub>L1</sub><br>1 min<br>(mA) | I <sub>L5</sub><br>5 min<br>(mA) | ESR<br>100 Hz<br>(mΩ) | Z<br>10 kHz<br>(mΩ) | ORDERING<br>CODE SL<br>MAL2050..... | ORDERING<br>CODE PW<br>MAL2050..... |
| 16  | 3300                             | 25 x 30                                 | 2.4                                      | 4.6                                      | 0.32                             | 0.11                             | 75                    | 50                  | 15332E3                             | 55332E3                             |
|   | 4700                             | 25 x 40                                 | 3.1                                      | 5.9                                      | 0.45                             | 0.15                             | 52                    | 37                  | 15472E3                             | 55472E3                             |
|   | 6800                             | 30 x 40                                 | 3.7                                      | 7.0                                      | 0.65                             | 0.22                             | 40                    | 30                  | 15682E3                             | 55682E3                             |
|   | 10 000                           | 35 x 40                                 | 4.1                                      | 7.8                                      | 0.96                             | 0.32                             | 36                    | 27                  | 15103E3                             | 55103E3                             |
|   | 15 000                           | 35 x 50                                 | 5.0                                      | 9.5                                      | 1.44                             | 0.48                             | 28                    | 21                  | 15153E3                             | 55153E3                             |
|   | 15 000                           | 40 x 40                                 | 4.2                                      | 8.0                                      | 1.44                             | 0.48                             | 36                    | 27                  | n/a                                 | 45153E3                             |
|   | 22 000                           | 40 x 50                                 | 5.0                                      | 9.5                                      | 2.12                             | 0.71                             | 29                    | 22                  | 15223E3                             | 55223E3                             |
|   | 33 000                           | 40 x 70                                 | 6.7                                      | 12.7                                     | 3.17                             | 1.06                             | 20                    | 17                  | 15333E3                             | 55333E3                             |
| 47 000  | 40 x 100                         | 9.1                                     | 17.3                                     | 4.51                                     | 1.51                             | 15                               | 14                    | 15473E3             | 55473E3                             |                                     |
| 25  | 2200                             | 25 x 30                                 | 2.3                                      | 4.4                                      | 0.33                             | 0.11                             | 78                    | 52                  | 16222E3                             | 56222E3                             |
|   | 3300                             | 25 x 40                                 | 3.1                                      | 5.9                                      | 0.49                             | 0.17                             | 53                    | 38                  | 16332E3                             | 56332E3                             |
|   | 4700                             | 30 x 40                                 | 3.7                                      | 7.0                                      | 0.70                             | 0.24                             | 42                    | 31                  | 16472E3                             | 56472E3                             |
|   | 6800                             | 35 x 40                                 | 4.1                                      | 7.8                                      | 1.02                             | 0.34                             | 37                    | 28                  | 16682E3                             | 56682E3                             |
|   | 10 000                           | 35 x 50                                 | 5.0                                      | 9.5                                      | 1.50                             | 0.50                             | 28                    | 21                  | 16103E3                             | 56103E3                             |
|   | 10 000                           | 40 x 40                                 | 4.2                                      | 8.0                                      | 1.50                             | 0.50                             | 36                    | 27                  | n/a                                 | 46103E3                             |
|   | 15 000                           | 40 x 50                                 | 5.0                                      | 9.5                                      | 2.25                             | 0.75                             | 29                    | 22                  | 16153E3                             | 56153E3                             |
|   | 22 000                           | 40 x 70                                 | 6.8                                      | 12.9                                     | 3.30                             | 1.10                             | 20                    | 17                  | 16223E3                             | 56223E3                             |
| 33 000  | 40 x 100                         | 9.2                                     | 17.5                                     | 4.95                                     | 1.65                             | 15                               | 14                    | 16333E3             | 56333E3                             |                                     |
| 40  | 1500                             | 25 x 30                                 | 2.0                                      | 3.8                                      | 0.36                             | 0.12                             | 112                   | 68                  | 17152E3                             | 57152E3                             |
|   | 2200                             | 25 x 40                                 | 2.7                                      | 5.1                                      | 0.53                             | 0.18                             | 76                    | 51                  | 17222E3                             | 57222E3                             |
|   | 3300                             | 30 x 40                                 | 3.3                                      | 6.3                                      | 0.79                             | 0.27                             | 57                    | 41                  | 17332E3                             | 57332E3                             |
|   | 4700                             | 35 x 40                                 | 3.8                                      | 7.2                                      | 1.13                             | 0.38                             | 48                    | 35                  | 17472E3                             | 57472E3                             |
|   | 6800                             | 35 x 50                                 | 4.7                                      | 8.9                                      | 1.64                             | 0.55                             | 36                    | 27                  | 17682E3                             | 57682E3                             |
|   | 6800                             | 40 x 40                                 | 4.1                                      | 7.8                                      | 1.64                             | 0.55                             | 45                    | 33                  | n/a                                 | 47682E3                             |
|   | 10 000                           | 40 x 50                                 | 4.9                                      | 9.3                                      | 2.40                             | 0.80                             | 35                    | 27                  | 17103E3                             | 57103E3                             |
|   | 15 000                           | 40 x 70                                 | 6.6                                      | 12.5                                     | 3.60                             | 1.20                             | 25                    | 20                  | 17153E3                             | 57153E3                             |
| 22 000  | 40 x 100                         | 9.0                                     | 17.1                                     | 5.28                                     | 1.76                             | 18                               | 16                    | 17223E3             | 57223E3                             |                                     |
| 63  | 1000                             | 25 x 30                                 | 1.8                                      | 3.4                                      | 0.38                             | 0.13                             | 122                   | 74                  | 18102E3                             | 58102E3                             |
|   | 1500                             | 25 x 40                                 | 2.5                                      | 4.7                                      | 0.57                             | 0.19                             | 83                    | 54                  | 18152E3                             | 58152E3                             |
|   | 2200                             | 30 x 40                                 | 3.1                                      | 5.9                                      | 0.83                             | 0.28                             | 57                    | 41                  | 18222E3                             | 58222E3                             |
|   | 3300                             | 35 x 40                                 | 3.6                                      | 6.8                                      | 1.25                             | 0.42                             | 48                    | 35                  | 18332E3                             | 58332E3                             |
|   | 4700                             | 35 x 50                                 | 4.4                                      | 8.3                                      | 1.78                             | 0.60                             | 36                    | 27                  | 18472E3                             | 58472E3                             |
|   | 4700                             | 40 x 40                                 | 3.8                                      | 7.2                                      | 1.78                             | 0.60                             | 45                    | 33                  | n/a                                 | 48472E3                             |
|   | 6800                             | 40 x 50                                 | 4.7                                      | 8.9                                      | 2.57                             | 0.86                             | 35                    | 27                  | 18682E3                             | 58682E3                             |
|   | 10 000                           | 40 x 70                                 | 6.2                                      | 11.8                                     | 3.78                             | 1.26                             | 25                    | 20                  | 18103E3                             | 58103E3                             |
| 15 000  | 40 x 100                         | 8.5                                     | 16.1                                     | 5.67                                     | 1.89                             | 18                               | 16                    | 18153E3             | 58153E3                             |                                     |
| 100   | 470                              | 25 x 30                                 | 1.4                                      | 2.7                                      | 0.28                             | 0.10                             | 247                   | 172                 | 19471E3                             | 59471E3                             |
|   | 680                              | 25 x 40                                 | 1.9                                      | 3.6                                      | 0.41                             | 0.14                             | 170                   | 116                 | 19681E3                             | 59681E3                             |
|   | 1000                             | 30 x 40                                 | 2.5                                      | 4.7                                      | 0.60                             | 0.20                             | 123                   | 88                  | 19102E3                             | 59102E3                             |
|   | 1500                             | 35 x 40                                 | 3.1                                      | 5.8                                      | 0.90                             | 0.30                             | 94                    | 71                  | 19152E3                             | 59152E3                             |
|   | 2200                             | 35 x 50                                 | 3.9                                      | 7.4                                      | 1.32                             | 0.44                             | 69                    | 55                  | 19222E3                             | 59222E3                             |
|   | 2200                             | 40 x 40                                 | 3.6                                      | 6.8                                      | 1.32                             | 0.44                             | 81                    | 65                  | n/a                                 | 49222E3                             |
|   | 3300                             | 40 x 50                                 | 4.6                                      | 8.7                                      | 1.98                             | 0.66                             | 59                    | 48                  | 19332E3                             | 59332E3                             |
|   | 4700                             | 40 x 70                                 | 6.2                                      | 11.7                                     | 2.82                             | 0.94                             | 42                    | 36                  | 19472E3                             | 59472E3                             |
| 6800  | 40 x 100                         | 8.2                                     | 15.5                                     | 4.08                                     | 1.36                             | 32                               | 28                    | 19682E3             | 59682E3                             |                                     |



Table 3

| ELECTRICAL DATA AND ORDERING INFORMATION FOR 052 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>20 kHz<br>70 °C<br>(A) | I <sub>L1</sub><br>1 min<br>(mA) | I <sub>L5</sub><br>5 min<br>(mA) | ESR<br>100 Hz<br>(mΩ) | Z<br>10 kHz<br>(mΩ) | ORDERING<br>CODE<br>MAL2052..... |
| 250   | 100                              | 25 x 30                                 | 0.6                                      | 1.15                                     | 0.15                             | 0.05                             | 1800                  | 1300                | 53101E3                          |
|   | 150                              | 25 x 40                                 | 0.8                                      | 1.5                                      | 0.23                             | 0.08                             | 1100                  | 850                 | 53151E3                          |
|   | 220                              | 30 x 40                                 | 1.0                                      | 1.9                                      | 0.33                             | 0.11                             | 750                   | 550                 | 53221E3                          |
|   | 330                              | 35 x 40                                 | 1.4                                      | 2.65                                     | 0.49                             | 0.17                             | 500                   | 400                 | 53331E3                          |
|   | 470                              | 35 x 50                                 | 1.8                                      | 3.4                                      | 0.70                             | 0.24                             | 360                   | 290                 | 53471E3                          |
|   | 470                              | 40 x 40                                 | 1.8                                      | 3.4                                      | 0.70                             | 0.24                             | 420                   | 350                 | 43471E3                          |
|   | 680                              | 40 x 50                                 | 2.3                                      | 4.4                                      | 1.02                             | 0.34                             | 250                   | 190                 | 53681E3                          |
|   | 1000                             | 40 x 70                                 | 3.0                                      | 5.7                                      | 1.50                             | 0.50                             | 170                   | 140                 | 53102E3                          |
| 385   | 47                               | 25 x 30                                 | 0.5                                      | 0.94                                     | 0.11                             | 0.04                             | 2370                  | 1550                | 58479E3                          |
|   | 68                               | 25 x 40                                 | 0.67                                     | 1.27                                     | 0.16                             | 0.06                             | 1640                  | 1100                | 58689E3                          |
|   | 100                              | 30 x 40                                 | 0.84                                     | 1.59                                     | 0.23                             | 0.08                             | 1275                  | 950                 | 58101E3                          |
|   | 150                              | 35 x 40                                 | 1.13                                     | 2.14                                     | 0.34                             | 0.11                             | 850                   | 635                 | 58151E3                          |
|   | 220                              | 35 x 50                                 | 1.48                                     | 2.8                                      | 0.50                             | 0.17                             | 580                   | 430                 | 58221E3                          |
|   | 220                              | 40 x 40                                 | 1.48                                     | 2.8                                      | 0.50                             | 0.17                             | 580                   | 430                 | 48221E3                          |
|   | 330                              | 40 x 50                                 | 1.97                                     | 3.73                                     | 0.75                             | 0.25                             | 385                   | 300                 | 58331E3                          |
|   | 470                              | 40 x 70                                 | 2.7                                      | 5.11                                     | 1.06                             | 0.36                             | 270                   | 215                 | 58471E3                          |
| 400   | 47                               | 25 x 30                                 | 0.47                                     | 0.89                                     | 0.11                             | 0.04                             | 2700                  | 2125                | 56479E3                          |
|   | 68                               | 25 x 40                                 | 0.63                                     | 1.29                                     | 0.16                             | 0.06                             | 1875                  | 1470                | 56689E3                          |
|   | 100                              | 30 x 40                                 | 0.84                                     | 1.59                                     | 0.24                             | 0.08                             | 1275                  | 1000                | 56101E3                          |
|   | 150                              | 35 x 40                                 | 1.13                                     | 2.14                                     | 0.36                             | 0.12                             | 850                   | 665                 | 56151E3                          |
|   | 220                              | 35 x 50                                 | 1.41                                     | 2.67                                     | 0.52                             | 0.17                             | 650                   | 450                 | 56221E3                          |
|   | 220                              | 40 x 40                                 | 1.41                                     | 2.67                                     | 0.52                             | 0.17                             | 650                   | 450                 | 46221E3                          |
|   | 330                              | 40 x 50                                 | 1.86                                     | 3.52                                     | 0.79                             | 0.26                             | 435                   | 315                 | 56331E3                          |
|   | 470                              | 40 x 70                                 | 2.54                                     | 4.81                                     | 1.12                             | 0.37                             | 305                   | 225                 | 56471E3                          |
|   | 680                              | 40 x 100                                | 3.56                                     | 6.75                                     | 1.63                             | 0.54                             | 210                   | 155                 | 56681E3                          |

| ADDITIONAL ELECTRICAL DATA         |                               |  |
|------------------------------------|-------------------------------|--|
| PARAMETER                          | CONDITIONS                    | VALUE  |
| <b>Voltage</b>                     |                               |  |
| Surge voltage                      | ≤ 250 V versions              | U <sub>s</sub> = 1.15 x U <sub>R</sub>                         |
|                                    | ≥ 385 V versions              | U <sub>s</sub> = 1.1 x U <sub>R</sub>                          |
| Reverse voltage                    |                               | U <sub>rev</sub> ≤ 1 V   |
| <b>Current</b>                     |                               |  |
| Leakage current                    | After 1 min at U <sub>R</sub> | I <sub>L1</sub> ≤ 0.006 C <sub>R</sub> x U <sub>R</sub> + 4 µA |
|                                    | After 5 min at U <sub>R</sub> | I <sub>L5</sub> ≤ 0.002 C <sub>R</sub> x U <sub>R</sub> + 4 µA |
| <b>Inductance</b>                  |                               |  |
| Equivalent series inductance (ESL) | Case Ø D = 25 mm              | Max. 25 nH   |
|                                    | Case Ø D = 30 mm and 35 mm    | Max. 30 nH   |
|                                    | Case Ø D = 40 mm              | Max. 35 nH   |



CAPACITANCE (C)

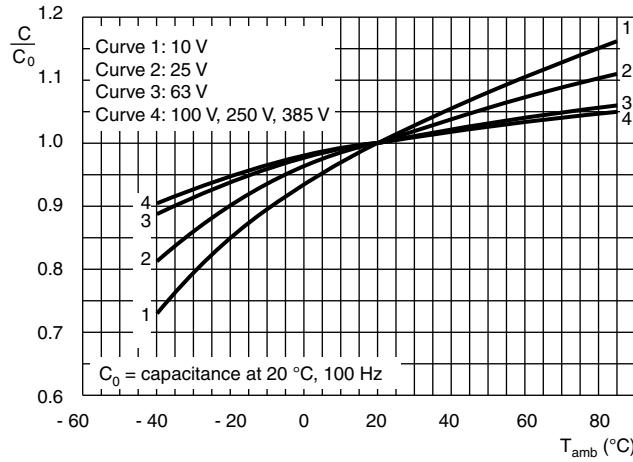


Fig. 11 - Typical multiplier of capacitance as a function of ambient temperature

EQUIVALENT SERIES RESISTANCE (ESR)

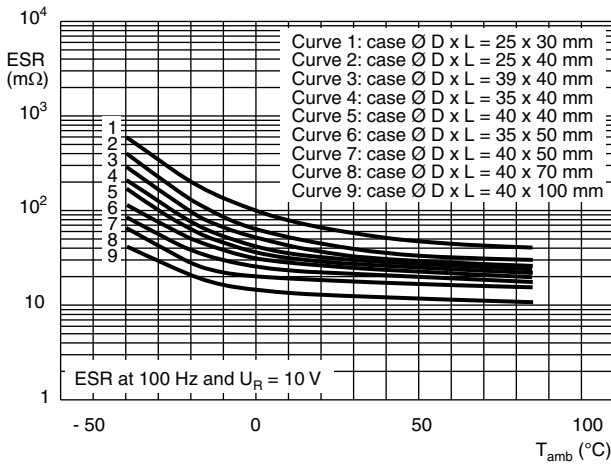


Fig. 12 - Typical ESR as a function of temperature

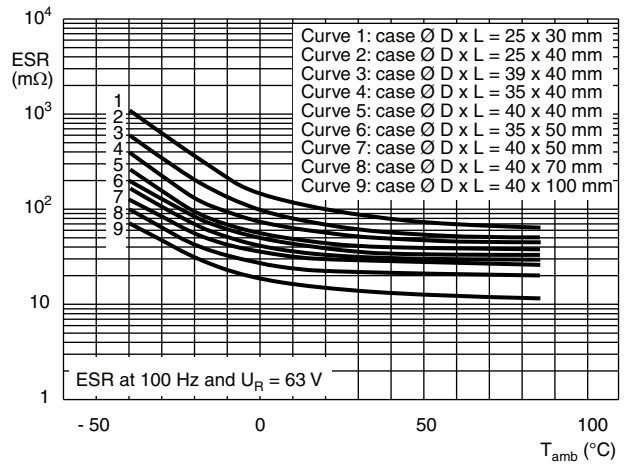


Fig. 13 - Typical ESR as a function of temperature

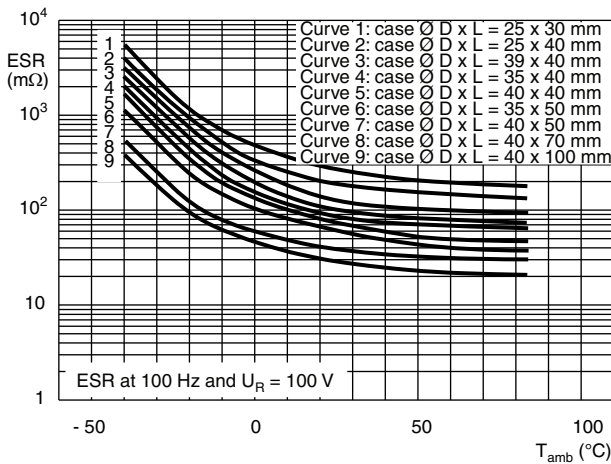


Fig. 14 - Typical ESR as a function of temperature

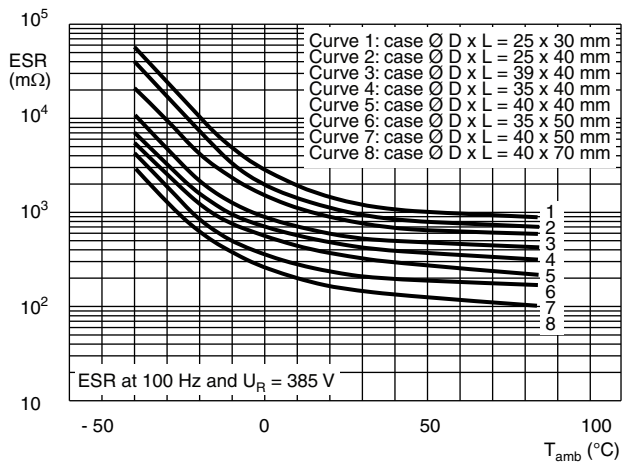


Fig. 15 - Typical ESR as a function of temperature



IMPEDANCE (Z)

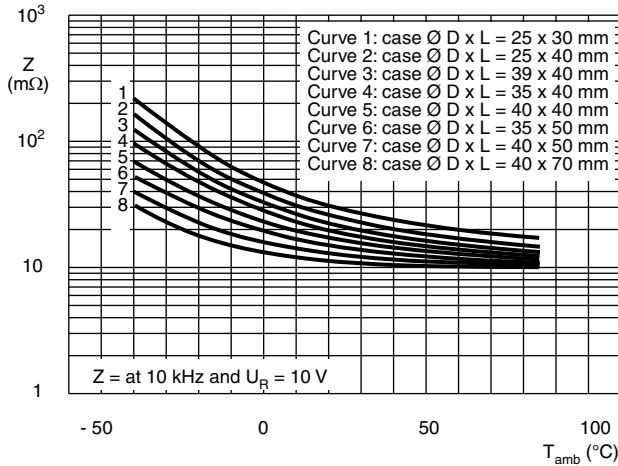


Fig. 16 - Typical impedance as a function of temperature

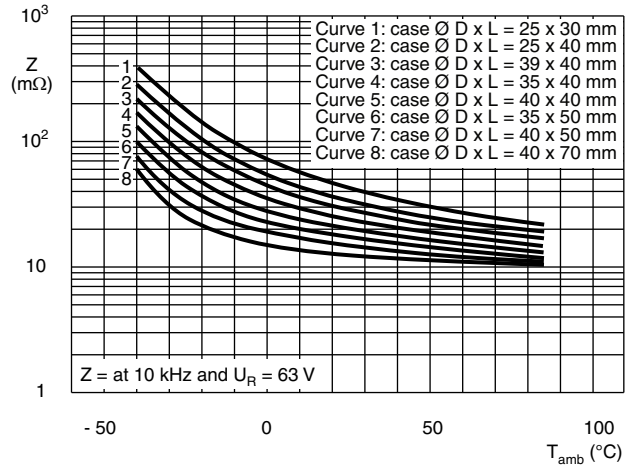


Fig. 17 - Typical impedance as a function of temperature

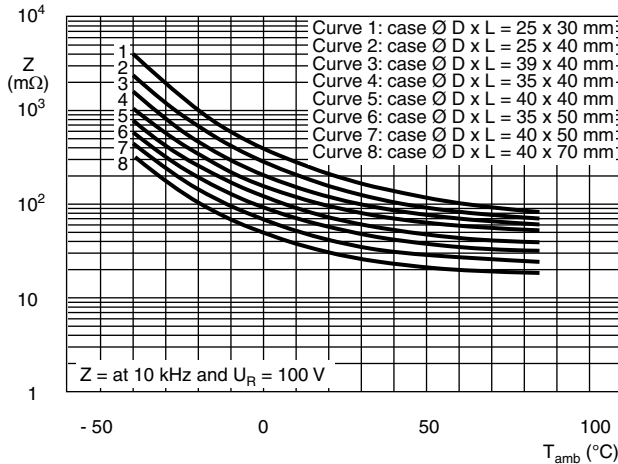


Fig. 18 - Typical impedance as a function of temperature

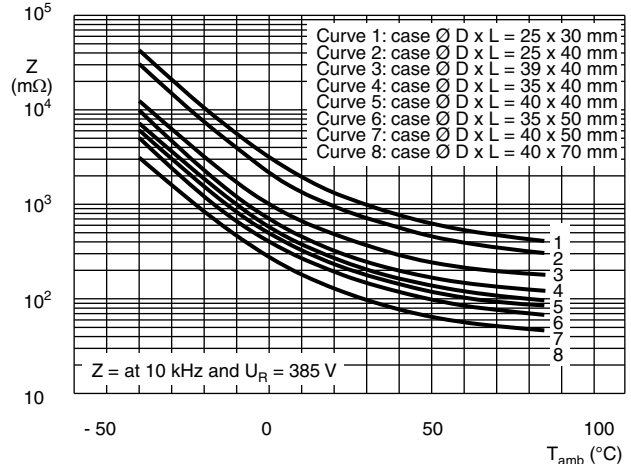


Fig. 19 - Typical impedance as a function of temperature

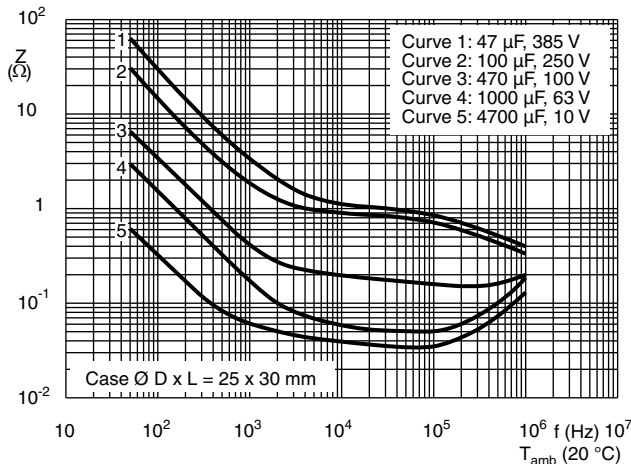


Fig. 20 - Typical impedance as a function of temperature

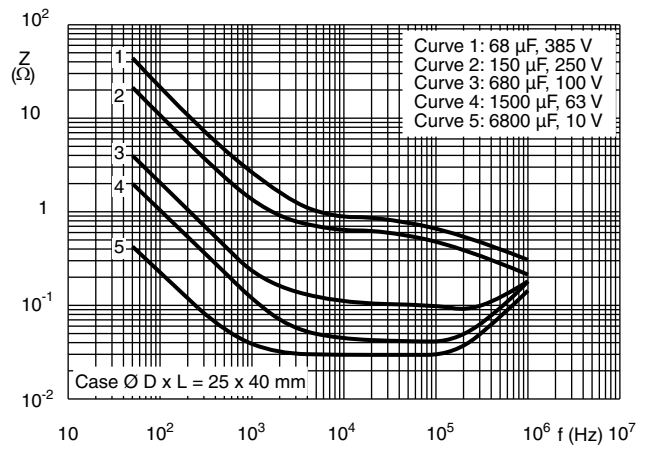


Fig. 21 - Typical impedance as a function of temperature

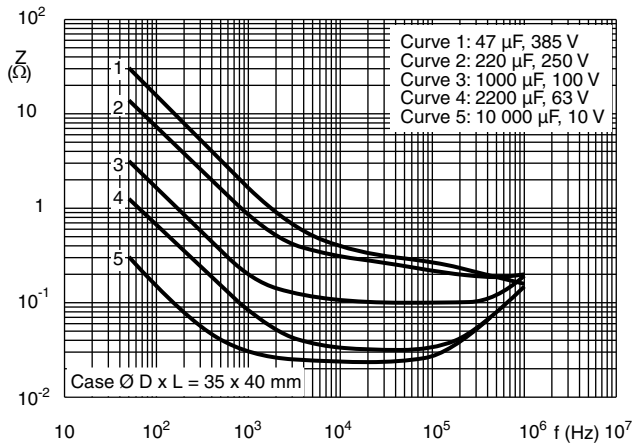


Fig. 22 - Typical impedance as a function of frequency

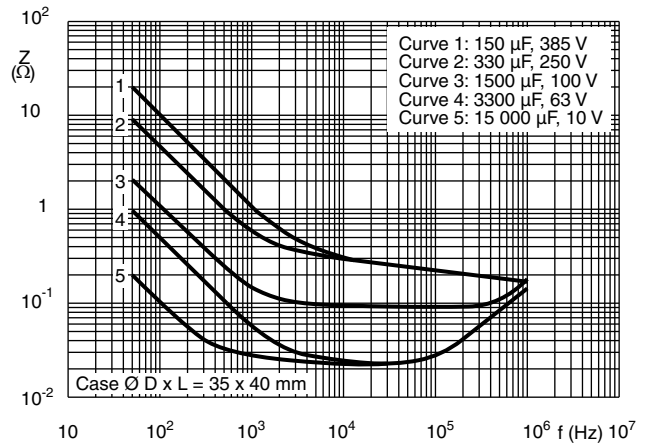


Fig. 23 - Typical impedance as a function of frequency

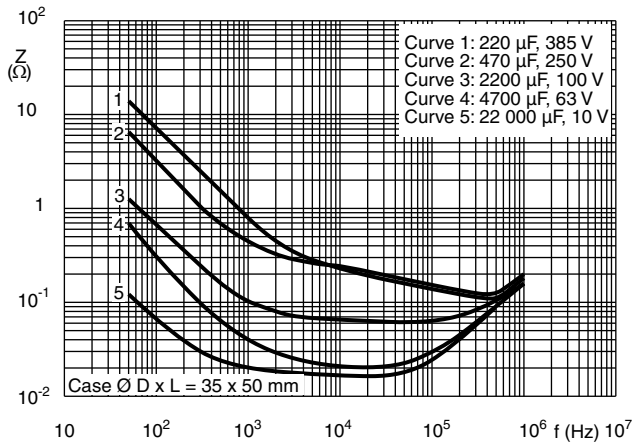


Fig. 24 - Typical impedance as a function of frequency

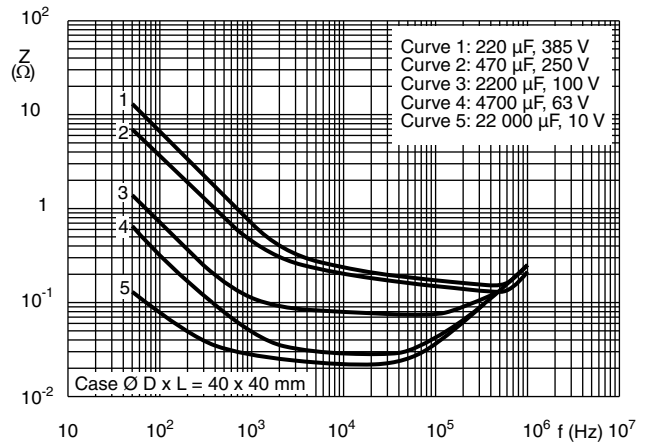


Fig. 25 - Typical impedance as a function of frequency

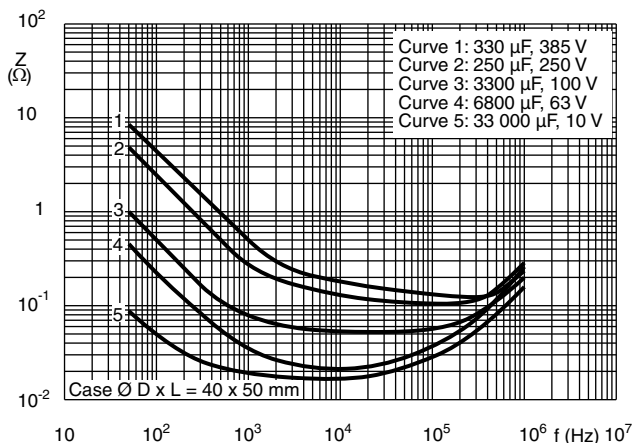


Fig. 26 - Typical impedance as a function of frequency

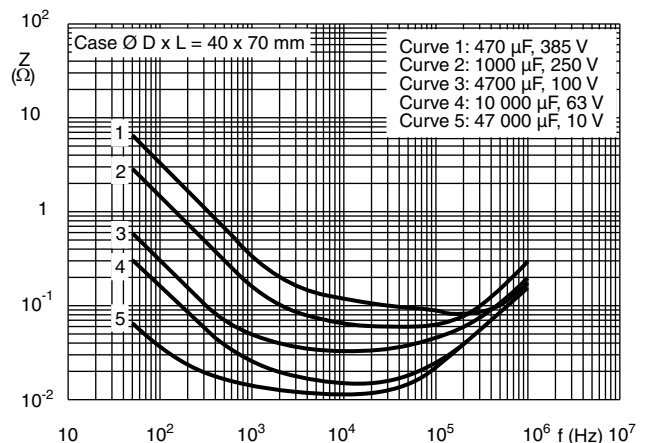


Fig. 27 - Typical impedance as a function of frequency

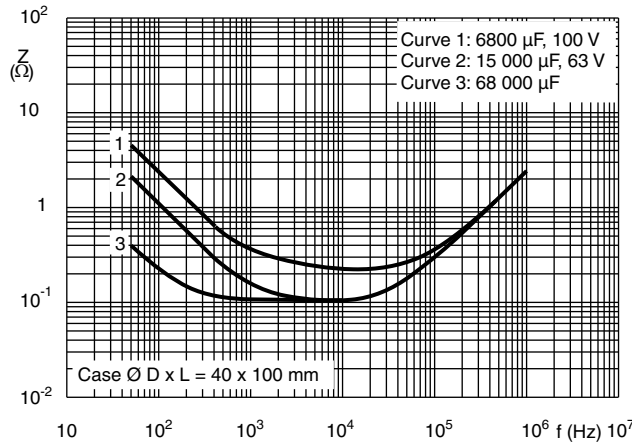


Fig. 28 - Typical impedance as a function of frequency

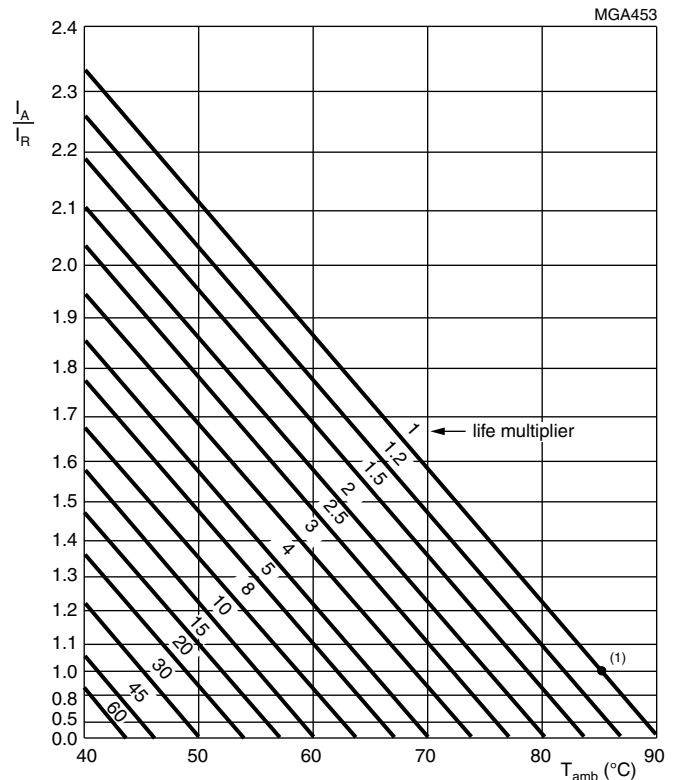
**RIPPLE CURRENT AND USEFUL LIFE**

Table 4

| ENDURANCE TEST DURATION AND USEFUL LIFE |                          |
|---|--------------------------|
| ENDURANCE AT 85 °C (h)                  | USEFUL LIFE AT 85 °C (h) |
| 5000                                    | 15 000                   |

**Note**

- Multiplier of useful life code: MGA453



$I_A$  = Actual ripple current  
 $I_R$  = Rated ripple current at 100 Hz and 85 °C  
 (1) Useful life at 85 °C and  $I_R$  applied: 15 000 h

Fig. 29 - Multiplier of useful life as a function of ambient temperature and ripple current load



Table 5

| MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY |      |      |      |      |             |
|---|------|------|------|------|-------------|
| FREQUENCY (Hz)  |      |      |      |      |             |
| 50  | 100  | 200  | 400  | 1000 | $\geq 2000$ |
| $I_R$ MULTIPLIER  |      |      |      |      |             |
| 0.83  | 1.00 | 1.10 | 1.15 | 1.19 | 1.20        |

Table 6

| TEST PROCEDURES AND REQUIREMENTS               |  |   |   |
|--|--|---|---|
| TEST   |  | PROCEDURE<br>(QUICK REFERENCE)  | REQUIREMENTS  |
| NAME OF TEST                                   | REFERENCE                                    |   |   |
| Endurance                                      | IEC 60384-4 /<br>EN 130300<br>subclause 4.13 | $T_{amb} = 85\text{ }^\circ\text{C}$ ; $U_R$ applied;<br>5000 h   | $U_R \leq 100\text{ V}$ ; $\Delta C/C: \pm 15\%$<br>$U_R > 100\text{ V}$ ; $\Delta C/C: \pm 10\%$<br>$ESR \leq 1.3 \times \text{spec. limit}$<br>$Z \leq 2 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$   |
| Useful life                                    | CECC 30301<br>subclause 1.8.1                | $T_{amb} = 85\text{ }^\circ\text{C}$ ; $U_R$ and $I_R$ applied;<br>15 000 h   | $U_R \leq 100\text{ V}$ ; $\Delta C/C: \pm 45\%$<br>$U_R > 100\text{ V}$ ; $\Delta C/C: \pm 30\%$<br>$ESR \leq 3 \times \text{spec. limit}$<br>$Z \leq 3 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$<br>no short or open circuit,<br>no visible damage<br>total failure percentage:<br>$U_R \leq 100\text{ V}: \leq 1\%$ ;<br>$U_R > 100\text{ V}: \leq 3\%$ |
| Shelf life<br>(storage at<br>high temperature) | IEC 60384-4 /<br>EN 130300<br>subclause 4.17 | $T_{amb} = 85\text{ }^\circ\text{C}$ ; no voltage applied;<br>500 h<br>After test: $U_R$ to be applied for 30 min,<br>24 h to 48 h before measurement | $\Delta C/C: \pm 10\%$<br>$ESR \leq 1.2 \times \text{spec. limit}$<br>$I_{L5} \leq 2 \times \text{spec. limit}$   |

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



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