

## Aluminum Electrolytic Capacitors Power Eurodin Printed Wiring

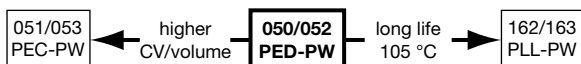


Fig. 1

### QUICK REFERENCE DATA

| DESCRIPTION                                         | VALUE                   |                  |
|-----------------------------------------------------|-------------------------|------------------|
|                                                     | 050                     | 052              |
| Nominal case size (Ø D x L in mm)                   | 25 x 30 to 40 x 100     |                  |
| Rated capacitance range (E6 series), C <sub>R</sub> | 470 µF to 68 000 µF     | 47 µF to 1000 µF |
| Tolerance on C <sub>R</sub>                         | -10 % to +30 %          |                  |
| Rated voltage range, U <sub>R</sub>                 | 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 <sub>R</sub> 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           |                  |

### 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 µF)
- 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

### SELECTION CHART FOR C<sub>R</sub>, U<sub>R</sub>, AND RELEVANT NOMINAL CASE SIZES FOR 050 SERIES (Ø D x L in mm)

| C <sub>R</sub><br>(µF) | U <sub>R</sub> (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  |
|                        | -                  | -        | -        | -        | -        | 40 x 40  |
| 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  |
|                        | -                  | -        | -        | -        | 40 x 40  | -        |
| 6800                   | 25 x 40            | 30 x 40  | 35 x 40  | 35 x 50  | 40 x 50  | 40 x 100 |
|                        | -                  | -        | -        | 40 x 40  | -        | -        |
| 10 000                 | 30 x 40            | 35 x 40  | 35 x 50  | 40 x 50  | 40 x 70  | -        |
|                        | -                  | -        | 40 x 40  | -        | -        | -        |
| 15 000                 | 35 x 40            | 35 x 50  | 40 x 50  | 40 x 70  | 40 x 100 | -        |
|                        | -                  | 40 x 40  | -        | -        | -        | -        |
| 22 000                 | 35 x 50            | 40 x 50  | 40 x 70  | 40 x 100 | -        | -        |
|                        | 40 x 40            | -        | -        | -        | -        | -        |
| 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> |                             |            |            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------|------------|
| <b><math>C_R</math><br/>(<math>\mu F</math>)</b>                                                                                                          | <b><math>U_R</math> (V)</b> |            |            |
|                                                                                                                                                           | <b>250</b>                  | <b>385</b> | <b>400</b> |
| 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

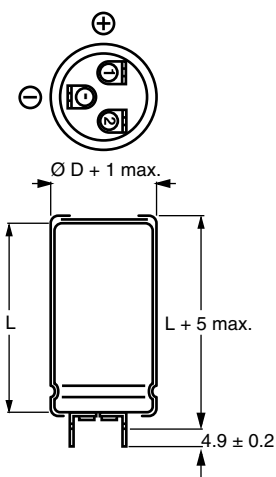

Case  $\varnothing D = 25$  mm

Fig. 2 - Printed wiring pin version

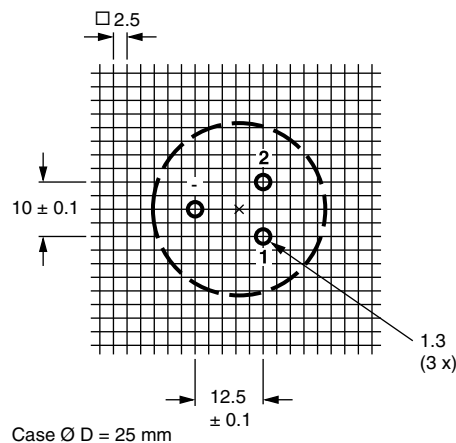


Fig. 3 - Mounting hole diagram viewed from component side

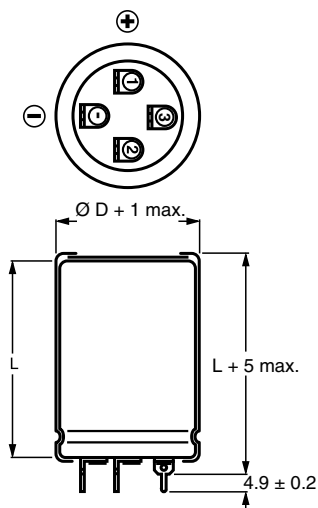

Case  $\varnothing D = 30$  mm

Fig. 4 - Printed wiring pin version

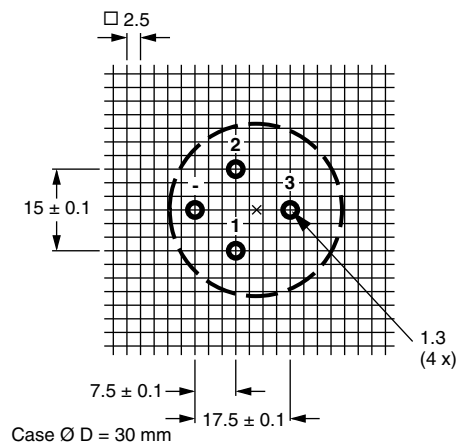


Fig. 5 - Mounting hole diagram viewed from component side

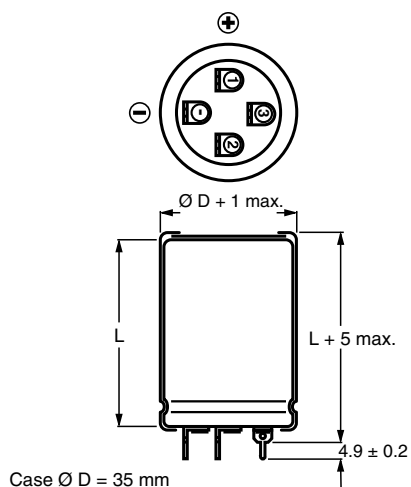


Fig. 6 - Printed wiring pin version

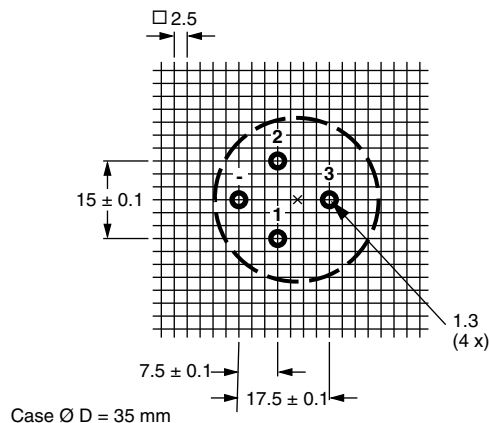


Fig. 7 - Mounting hole diagram viewed from component side

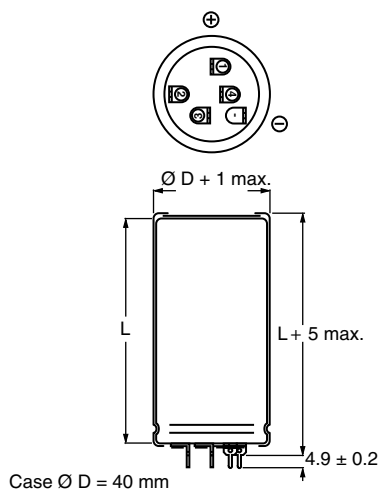


Fig. 8 - Printed wiring pin version

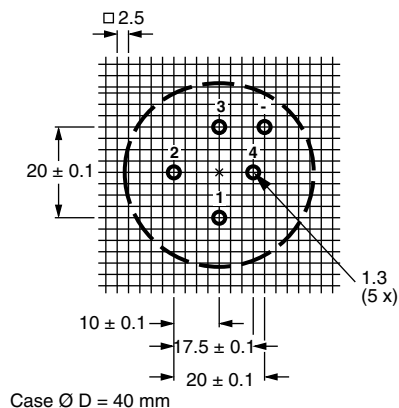


Fig. 9 - Mounting hole diagram viewed from component side

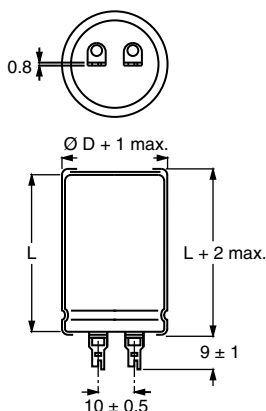


Fig. 10 - Solder-lug versions (SL): only available in 050 series

## 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 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**

<sup>(1)</sup> 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 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 CODE SL<br>MAL2050..... | ORDERING 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**

| $U_R$<br>(V) | $C_R$<br>100 Hz<br>( $\mu$ F) | NOMINAL<br>CASE SIZE<br>$\varnothing$ D x L<br>(mm) | $I_R$<br>100 Hz<br>85 °C<br>(A) | $I_R$<br>20 kHz<br>70 °C<br>(A) | $I_{L1}$<br>1 min<br>(mA) | $I_{L5}$<br>5 min<br>(mA) | ESR<br>100 Hz<br>(m $\Omega$ ) | Z<br>10 kHz<br>(m $\Omega$ ) | 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 |                               |                                                          |                                 |                                 |                           |                           |                                |                              |                                  |
|---------------------------------------------------------|-------------------------------|----------------------------------------------------------|---------------------------------|---------------------------------|---------------------------|---------------------------|--------------------------------|------------------------------|----------------------------------|
| $U_R$<br>(V)                                            | $C_R$<br>100 Hz<br>( $\mu$ F) | NOMINAL<br>CASE SIZE<br>$\varnothing D \times L$<br>(mm) | $I_R$<br>100 Hz<br>85 °C<br>(A) | $I_R$<br>20 kHz<br>70 °C<br>(A) | $I_{L1}$<br>1 min<br>(mA) | $I_{L5}$<br>5 min<br>(mA) | ESR<br>100 Hz<br>(m $\Omega$ ) | Z<br>10 kHz<br>(m $\Omega$ ) | 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                      | $\leq 250$ V versions                  | $U_s = 1.15 \times U_R$                      |
|                                    | $\geq 385$ V versions                  | $U_s = 1.1 \times U_R$                       |
| Reverse voltage                    |                                        | $U_{rev} \leq 1$ V                           |
| <b>Current</b>                     |                                        |                                              |
| Leakage current                    | After 1 min at $U_R$                   | $I_{L1} \leq 0.006 C_R \times U_R + 4 \mu A$ |
|                                    | After 5 min at $U_R$                   | $I_{L5} \leq 0.002 C_R \times U_R + 4 \mu A$ |
| <b>Inductance</b>                  |                                        |                                              |
| Equivalent series inductance (ESL) | Case $\varnothing D = 25$ mm           | Max. 25 nH                                   |
|                                    | Case $\varnothing D = 30$ mm and 35 mm | Max. 30 nH                                   |
|                                    | Case $\varnothing D = 40$ mm           | Max. 35 nH                                   |

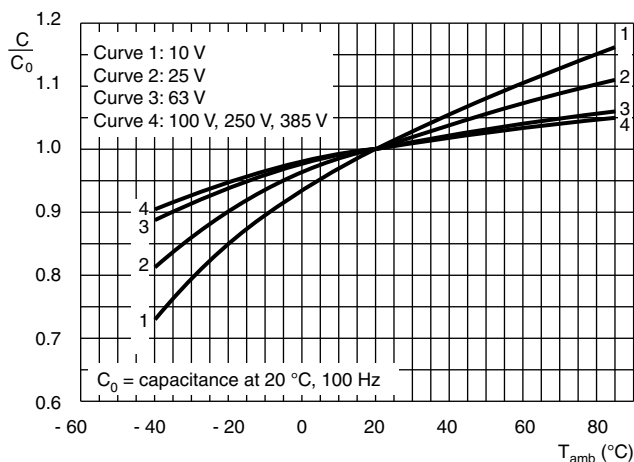
**CAPACITANCE (C)**


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

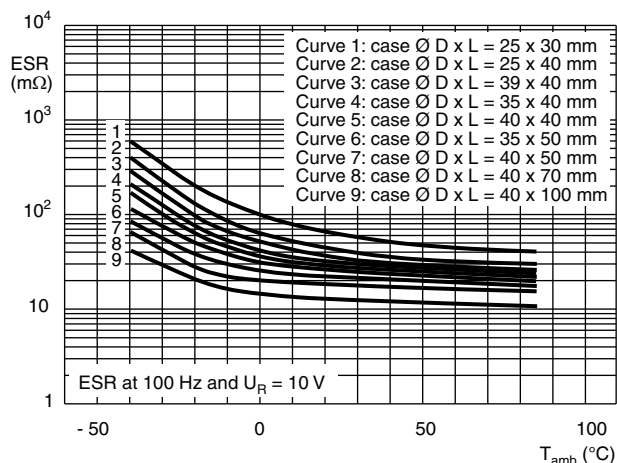
**EQUIVALENT SERIES RESISTANCE (ESR)**


Fig. 12 - Typical ESR as a function of temperature

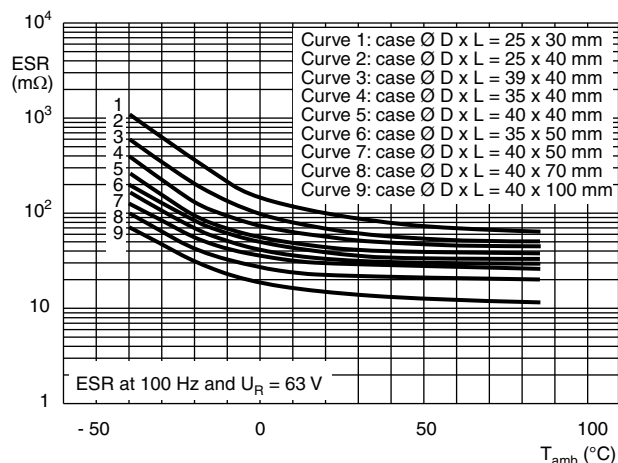


Fig. 13 - Typical ESR as a function of temperature

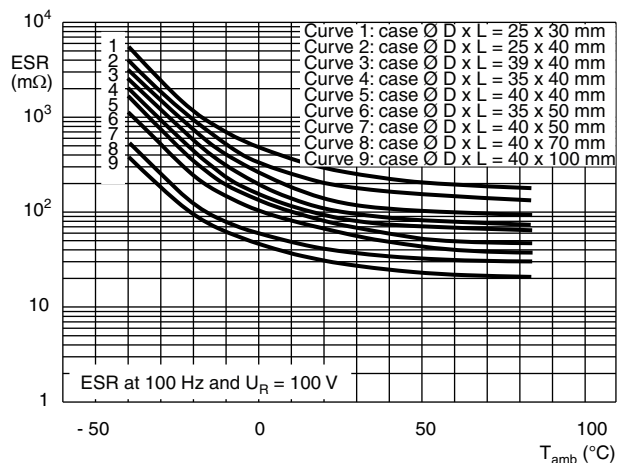


Fig. 14 - Typical ESR as a function of temperature

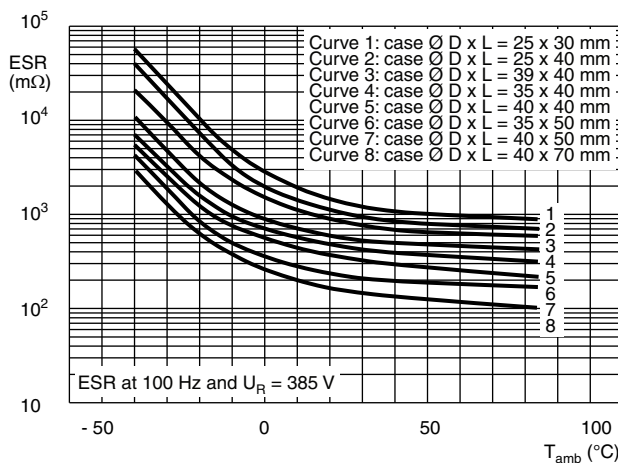


Fig. 15 - Typical ESR as a function of temperature



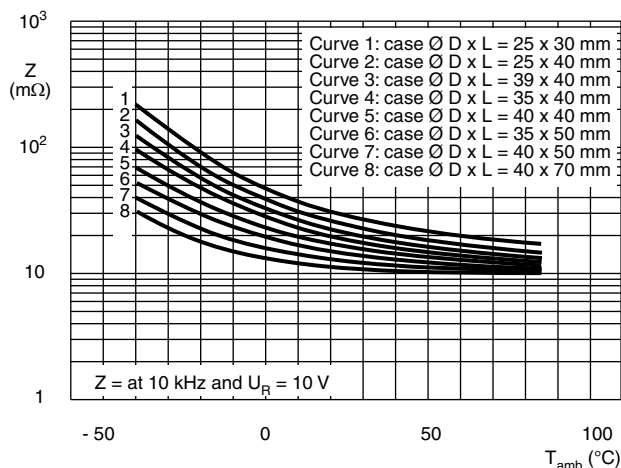
**IMPEDANCE (Z)**


Fig. 16 - Typical impedance as a function of temperature

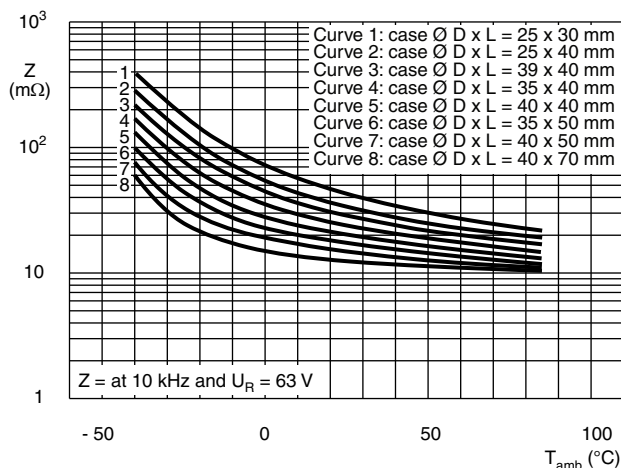


Fig. 17 - Typical impedance as a function of temperature

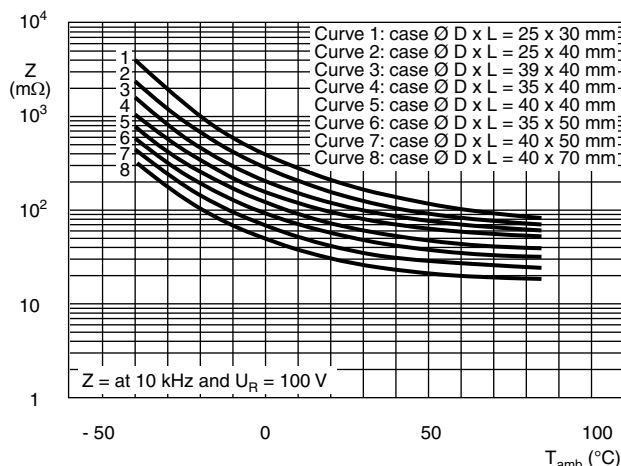


Fig. 18 - Typical impedance as a function of temperature

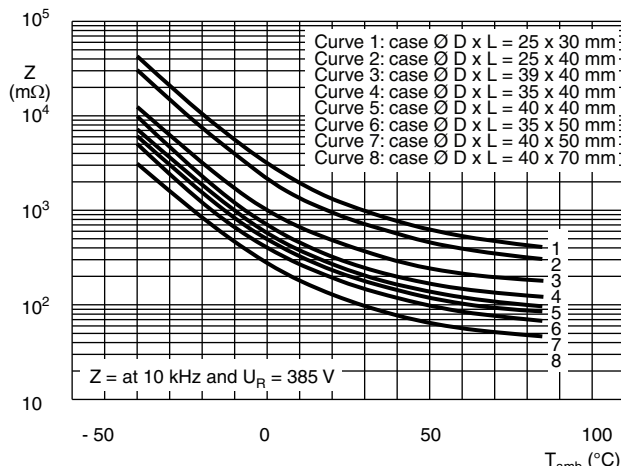


Fig. 19 - Typical impedance as a function of temperature

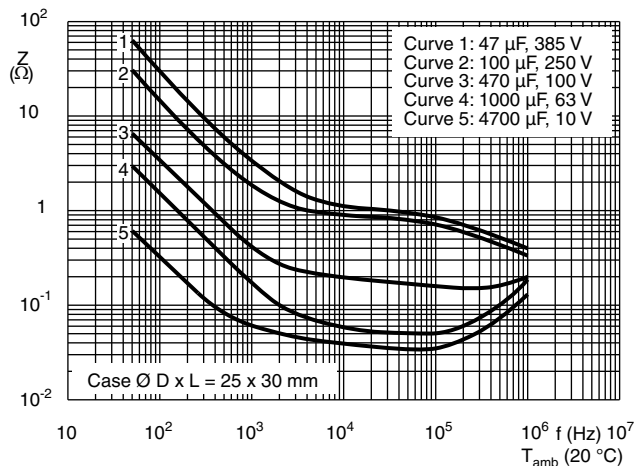


Fig. 20 - Typical impedance as a function of temperature

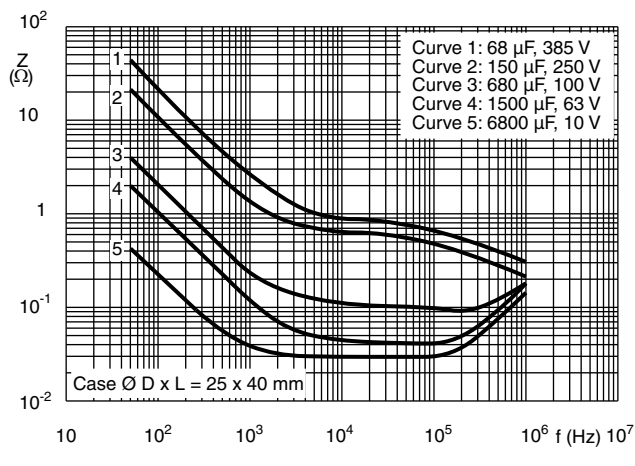


Fig. 21 - Typical impedance as a function of temperature



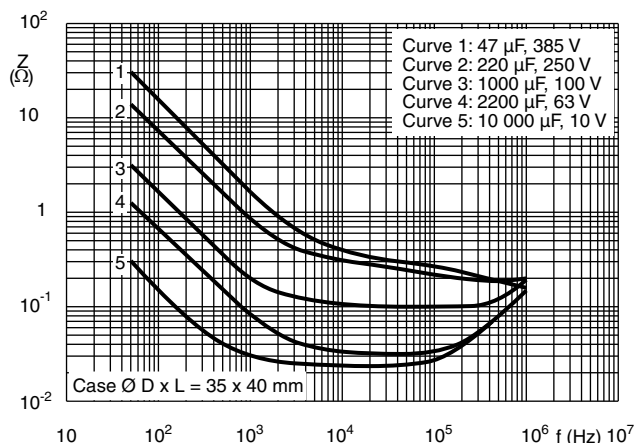


Fig. 22 - Typical impedance as a function of frequency

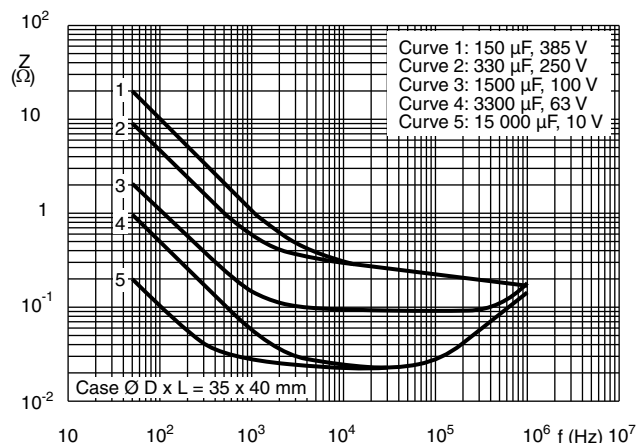


Fig. 23 - Typical impedance as a function of frequency

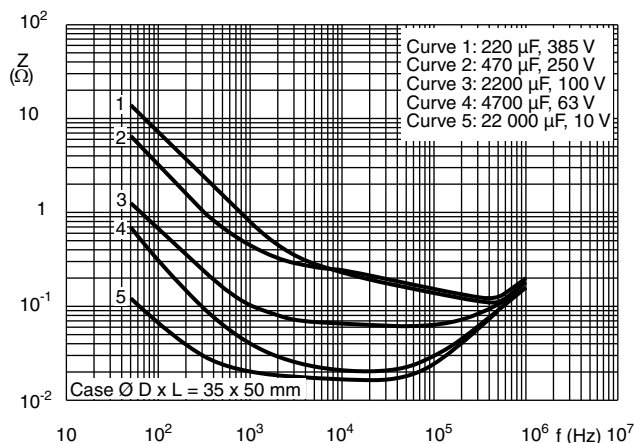


Fig. 24 - Typical impedance as a function of frequency

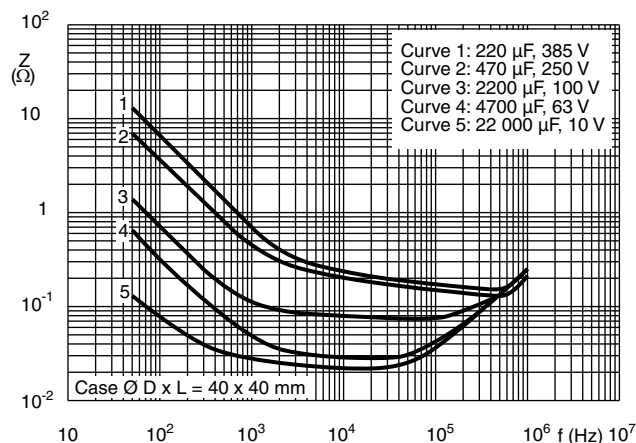


Fig. 25 - Typical impedance as a function of frequency

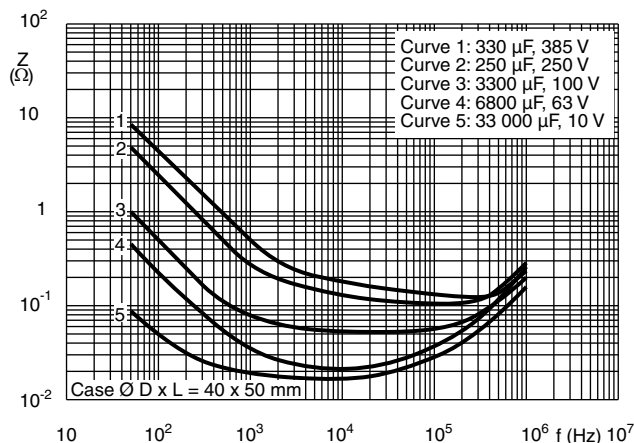


Fig. 26 - Typical impedance as a function of frequency

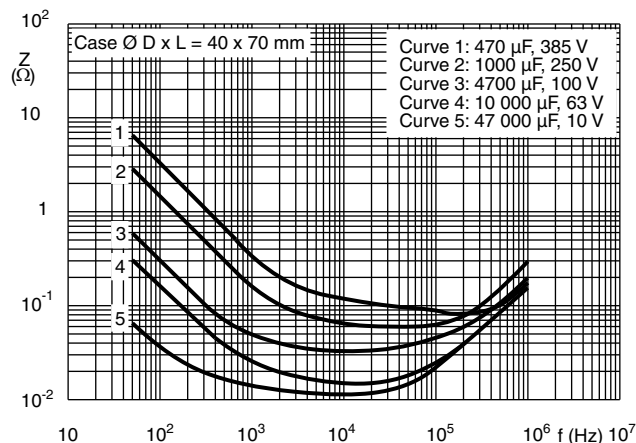


Fig. 27 - Typical impedance as a function of frequency

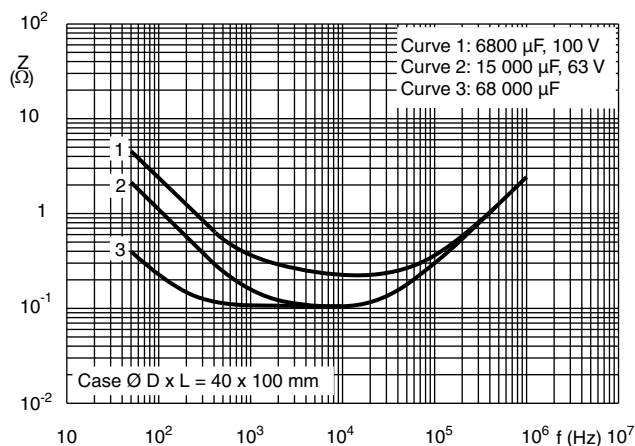


Fig. 28 - Typical impedance as a function of frequency

## 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  
<sup>(1)</sup> Useful life at 85 °C and  $I_R$  applied: 15 000 h

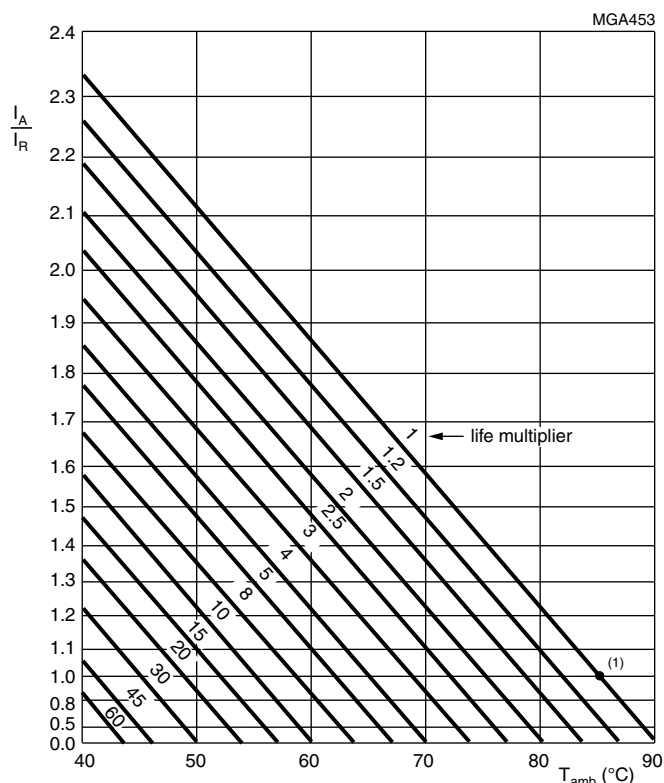


Fig. 29 - Multiplier of useful life as a function of ambient temperature and ripple current load

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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