

## Aluminum Capacitors Power Economic Printed Wiring

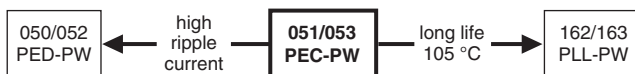


Fig. 1

### QUICK REFERENCE DATA

| DESCRIPTION                                         | VALUE                |                  |
|-----------------------------------------------------|----------------------|------------------|
|                                                     | 051                  | 053              |
| 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> | 680 µF to 150 000 µF | 68 µF to 2200 µF |
| Tolerance on C <sub>R</sub>                         | ± 20 %               |                  |
| Rated voltage range, U <sub>R</sub>                 | 10 V to 100 V        | 200 V to 400 V   |
| Category temperature range                          | -40 °C to +85 °C     |                  |
| Endurance test at 85 °C                             | 5000 h               |                  |
| Useful life at 85 °C                                | 12 000 h             |                  |
| Useful life at 40 °C, 1.4 x I <sub>R</sub> applied  | 200 000 h            |                  |
| Shelf life at 0 V, 85 °C                            | 500 h                |                  |
| Based on sectional specification                    | IEC 60384-4/EN130300 |                  |
| Climatic category IEC 60068                         | 40/085/56            |                  |

### FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types with reduced dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Provided with keyed polarity
- Long useful life: 12 000 h at 85 °C
- High ripple current capability
- High resistance to shock and vibration
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS  
COMPLIANT**

### APPLICATIONS

- General purpose, industrial, medical and audio/video systems
- 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 (M for ± 20 %)
- Rated voltage (in V)
- Date code (YYMM)
- 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 (Ø D x L in mm)

| C <sub>R</sub><br>(µF) | U <sub>R</sub> (V) |    |         |         |         |         |          |          |          |
|------------------------|--------------------|----|---------|---------|---------|---------|----------|----------|----------|
|                        | 10                 | 16 | 25      | 40      | 63      | 100     | 200      | 385      | 400      |
| 68                     | -                  | -  | -       | -       | -       | -       | -        | 25 x 30  | 25 x 30  |
| 100                    | -                  | -  | -       | -       | -       | -       | -        | 25 x 40  | 25 x 40  |
| 150                    | -                  | -  | -       | -       | -       | -       | 25 x 30  | 30 x 40  | 30 x 40  |
| 220                    | -                  | -  | -       | -       | -       | -       | 25 x 40  | 35 x 40  | 35 x 40  |
| 330                    | -                  | -  | -       | -       | -       | -       | 30 x 40  | 35 x 50  | 35 x 50  |
|                        | -                  | -  | -       | -       | -       | -       | -        | 40 x 40  | 40 x 40  |
| 470                    | -                  | -  | -       | -       | -       | -       | 35 x 40  | 40 x 50  | 40 x 50  |
| 680                    | -                  | -  | -       | -       | -       | 25 x 30 | 35 x 50  | 40 x 70  | 40 x 70  |
|                        | -                  | -  | -       | -       | -       | -       | 40 x 40  | -        | -        |
| 1000                   | -                  | -  | -       | -       | -       | 25 x 40 | 40 x 50  | 40 x 100 | 40 x 100 |
| 1500                   | -                  | -  | -       | -       | -       | 30 x 40 | 40 x 70  | -        | -        |
| 2200                   | -                  | -  | -       | -       | 25 x 30 | 35 x 40 | 40 x 100 | -        | -        |
| 3300                   | -                  | -  | -       | 25 x 30 | 25 x 40 | 35 x 50 | -        | -        | -        |
|                        | -                  | -  | -       | -       | -       | 40 x 40 | -        | -        | -        |
| 4700                   | -                  | -  | 25 x 30 | 25 x 40 | 30 x 40 | 40 x 50 | -        | -        | -        |

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

| $C_R$<br>( $\mu F$ ) | $U_R$ (V) |          |          |          |          |          |     |     |     |
|----------------------|-----------|----------|----------|----------|----------|----------|-----|-----|-----|
|                      | 10        | 16       | 25       | 40       | 63       | 100      | 200 | 385 | 400 |
| 6800                 | -         | 25 x 30  | 25 x 40  | 30 x 40  | 35 x 40  | 40 x 70  | -   | -   | -   |
| 10 000               | 25 x 30   | 25 x 40  | 30 x 40  | 35 x 40  | 35 x 50  | 40 x 100 | -   | -   | -   |
|                      | -         | -        | -        | -        | 40 x 40  | -        | -   | -   | -   |
| 15 000               | 25 x 40   | 30 x 40  | 35 x 40  | 35 x 50  | 40 x 70  | -        | -   | -   | -   |
|                      | -         | -        | -        | 40 x 40  | -        | -        | -   | -   | -   |
| 22 000               | 30 x 40   | 35 x 40  | 35 x 50  | 40 x 50  | 40 x 100 | -        | -   | -   | -   |
|                      | -         | -        | 40 x 40  | -        | -        | -        | -   | -   | -   |
| 33 000               | 35 x 40   | 35 x 50  | 40 x 50  | 40 x 70  | -        | -        | -   | -   | -   |
|                      | -         | 40 x 40  | -        | -        | -        | -        | -   | -   | -   |
| 47 000               | 35 x 50   | 40 x 50  | 40 x 70  | 40 x 100 | -        | -        | -   | -   | -   |
|                      | 40 x 40   | -        | -        | -        | -        | -        | -   | -   | -   |
| 68 000               | 40 x 50   | 40 x 70  | 40 x 100 | -        | -        | -        | -   | -   | -   |
| 100 000              | 40 x 70   | 40 x 100 | -        | -        | -        | -        | -   | -   | -   |
| 150 000              | 40 x 100  | -        | -        | -        | -        | -        | -   | -   | -   |

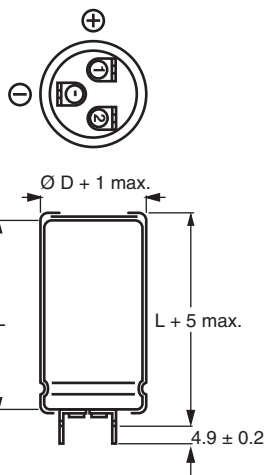
**DIMENSIONS in millimeters AND AVAILABLE FORMS**


Fig. 1 - Printed wiring pin version  
(case  $\varnothing D = 25$  mm)

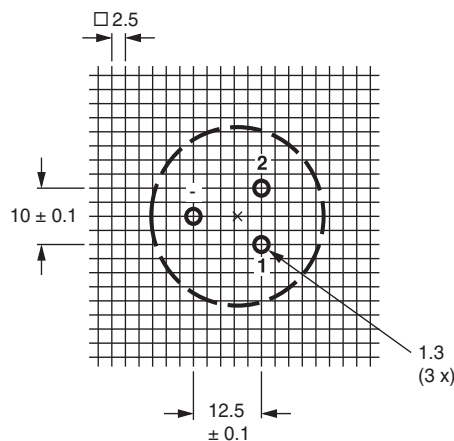


Fig. 2 - Mounting hole diagram viewed from component side  
(case  $\varnothing D = 25$  mm)

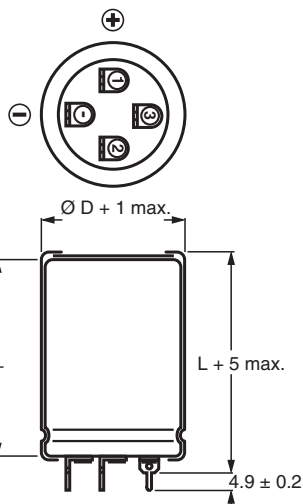


Fig. 3 - Printed wiring pin version  
(case  $\varnothing D = 30$  mm)

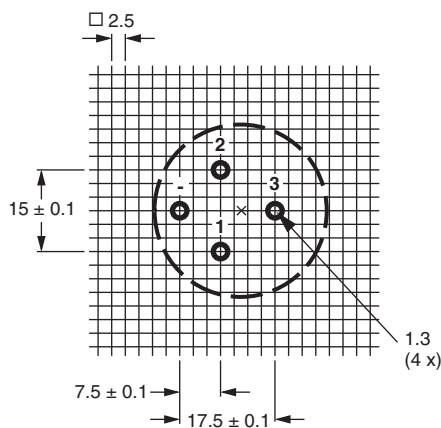


Fig. 4 - Mounting hole diagram viewed from component side  
(case  $\varnothing D = 30$  mm)

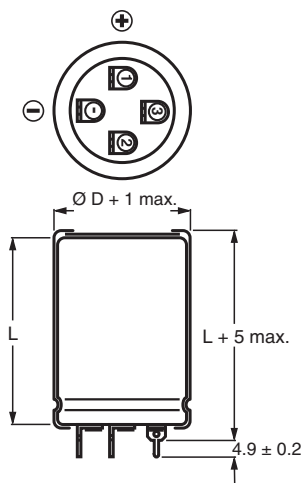


Fig. 5 - Printed wiring pin version  
(case Ø D = 35 mm)

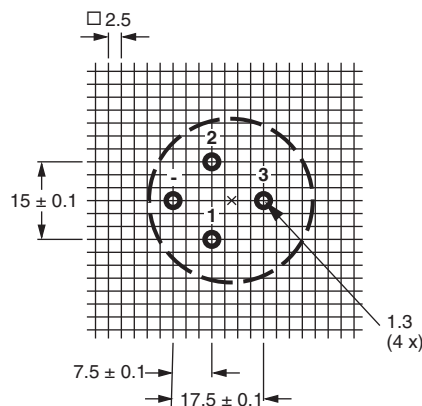


Fig. 6 - Mounting hole diagram viewed from component side  
(case Ø D = 35 mm)

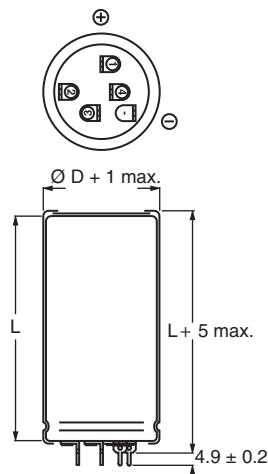


Fig. 7 - Printed wiring pin version  
(case Ø D = 40 mm)

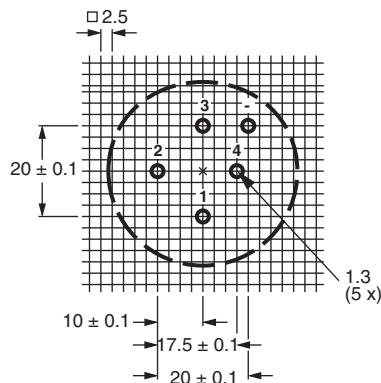


Fig. 8 - Mounting hole diagram viewed from component side  
(case Ø D = 40 mm)

## 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> | MASS<br>(g) | PACKAGING QUANTITIES<br>(units per box) | CARDBOARD BOX DIMENSIONS<br>L x W x H |
| 25 x 30                                                   | 26                  | 35                | ≈ 24        | 100                                     | 290 x 280 x 50                        |
| 25 x 40                                                   | 26                  | 45                | ≈ 28        | 100                                     | 290 x 280 x 60                        |
| 30 x 40                                                   | 31                  | 45                | ≈ 38        | 100                                     | 340 x 330 x 60                        |
| 35 x 40                                                   | 36                  | 45                | ≈ 51        | 50                                      | 390 x 198 x 60                        |
| 35 x 50                                                   | 36                  | 55                | ≈ 66        | 50                                      | 390 x 198 x 70                        |
| 40 x 40                                                   | 41                  | 45                | ≈ 78        | 50                                      | 440 x 223 x 60                        |
| 40 x 50                                                   | 41                  | 55                | ≈ 82        | 50                                      | 440 x 223 x 70                        |
| 40 x 70                                                   | 41                  | 75                | ≈ 110       | 25                                      | 230 x 230 x 90                        |
| 40 x 100                                                  | 41                  | 105               | ≈ 176       | 25                                      | 230 x 230 x 120                       |



| ELECTRICAL DATA |                                                               |
|-----------------|---------------------------------------------------------------|
| SYMBOL          | DESCRIPTION                                                   |
| $C_R$           | Rated capacitance at 100 Hz                                   |
| $I_R$           | Rated RMS ripple current at 100 Hz, 85 °C or at 20 kHz, 70 °C |
| $I_{L1}$        | Max. leakage current after 1 min at $U_R$                     |
| $I_{L5}$        | Max. leakage current after 5 min at $U_R$                     |
| ESR             | Max. equivalent series resistance at 100 Hz                   |
| Z               | Max. impedance at 10 kHz                                      |

**Note**

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

**Table 2**

| ELECTRICAL DATA AND ORDERING INFORMATION 051 SERIES |                                      |                                                          |                                 |                                 |                           |                           |                                |                              |                               |
|-----------------------------------------------------|--------------------------------------|----------------------------------------------------------|---------------------------------|---------------------------------|---------------------------|---------------------------|--------------------------------|------------------------------|-------------------------------|
| $U_R$<br>(V)                                        | $C_R$<br>100 Hz<br>( $\mu\text{F}$ ) | 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 CODE<br>MAL2051..... |
| 10                                                  | 10 000                               | 25 x 30                                                  | 3.1                             | 5.9                             | 0.60                      | 0.20                      | 51                             | 40                           | 54103E3                       |
|                                                     | 15 000                               | 25 x 40                                                  | 4.1                             | 7.8                             | 0.90                      | 0.30                      | 37                             | 30                           | 54153E3                       |
|                                                     | 22 000                               | 30 x 40                                                  | 5.0                             | 9.5                             | 1.32                      | 0.44                      | 30                             | 25                           | 54223E3                       |
|                                                     | 33 000                               | 35 x 40                                                  | 5.5                             | 10.4                            | 1.98                      | 0.66                      | 28                             | 24                           | 54333E3                       |
|                                                     | 47 000                               | 35 x 50                                                  | 6.8                             | 12.9                            | 2.82                      | 0.94                      | 23                             | 20                           | 54473E3                       |
|                                                     | 47 000                               | 40 x 40                                                  | 5.8                             | 10.4                            | 2.82                      | 0.94                      | 29                             | 22                           | 44473E3                       |
|                                                     | 68 000                               | 40 x 50                                                  | 7.1                             | 13.5                            | 4.08                      | 1.36                      | 24                             | 20                           | 54683E3                       |
|                                                     | 100 000                              | 40 x 70                                                  | 9.2                             | 17.4                            | 6.00                      | 2.00                      | 19                             | 16                           | 54104E3                       |
| 16                                                  | 150 000                              | 40 x 100                                                 | 12.0                            | 22.7                            | 9.00                      | 3.00                      | 16                             | 14                           | 54154E3                       |
|                                                     | 6800                                 | 25 x 30                                                  | 3.1                             | 5.9                             | 0.65                      | 0.22                      | 53                             | 42                           | 55682E3                       |
|                                                     | 10 000                               | 25 x 40                                                  | 4.0                             | 7.6                             | 0.96                      | 0.32                      | 39                             | 34                           | 55103E3                       |
|                                                     | 15 000                               | 30 x 40                                                  | 5.0                             | 9.5                             | 1.44                      | 0.48                      | 31                             | 27                           | 55153E3                       |
|                                                     | 22 000                               | 35 x 40                                                  | 5.5                             | 10.4                            | 2.12                      | 0.71                      | 29                             | 26                           | 55223E3                       |
|                                                     | 33 000                               | 35 x 50                                                  | 6.7                             | 12.7                            | 3.17                      | 1.06                      | 23                             | 21                           | 55333E3                       |
|                                                     | 33 000                               | 40 x 40                                                  | 5.7                             | 10.8                            | 3.17                      | 1.06                      | 30                             | 24                           | 45333E3                       |
|                                                     | 47 000                               | 40 x 50                                                  | 7.0                             | 13.3                            | 4.52                      | 1.51                      | 24                             | 20                           | 55473E3                       |
| 25                                                  | 68 000                               | 40 x 70                                                  | 9.2                             | 17.4                            | 6.53                      | 2.18                      | 19                             | 16                           | 55683E3                       |
|                                                     | 100 000                              | 40 x 100                                                 | 12.0                            | 22.7                            | 9.60                      | 3.20                      | 16                             | 14                           | 55104E3                       |
|                                                     | 4700                                 | 25 x 30                                                  | 2.9                             | 5.5                             | 0.71                      | 0.24                      | 60                             | 42                           | 56472E3                       |
|                                                     | 6800                                 | 25 x 40                                                  | 3.9                             | 7.4                             | 1.02                      | 0.34                      | 42                             | 34                           | 56682E3                       |
|                                                     | 10 000                               | 30 x 40                                                  | 4.8                             | 9.1                             | 1.50                      | 0.50                      | 34                             | 27                           | 56103E3                       |
|                                                     | 15 000                               | 35 x 40                                                  | 5.3                             | 10.0                            | 2.25                      | 0.75                      | 30                             | 26                           | 56153E3                       |
|                                                     | 22 000                               | 35 x 50                                                  | 6.5                             | 12.3                            | 3.30                      | 1.10                      | 24                             | 21                           | 56223E3                       |
|                                                     | 22 000                               | 40 x 40                                                  | 5.7                             | 10.8                            | 3.30                      | 1.10                      | 31                             | 24                           | 46223E3                       |
| 40                                                  | 33 000                               | 40 x 50                                                  | 7.0                             | 13.3                            | 4.95                      | 1.65                      | 25                             | 20                           | 56333E3                       |
|                                                     | 47 000                               | 40 x 70                                                  | 9.2                             | 17.4                            | 7.05                      | 2.35                      | 19                             | 16                           | 56473E3                       |
|                                                     | 68 000                               | 40 x 100                                                 | 12.0                            | 22.7                            | 10.20                     | 3.40                      | 16                             | 14                           | 56683E3                       |
|                                                     | 3300                                 | 25 x 30                                                  | 2.9                             | 5.5                             | 0.80                      | 0.27                      | 87                             | 63                           | 57332E3                       |
|                                                     | 4700                                 | 25 x 40                                                  | 3.8                             | 7.2                             | 1.13                      | 0.38                      | 62                             | 47                           | 57472E3                       |
|                                                     | 6800                                 | 30 x 40                                                  | 4.7                             | 8.9                             | 1.64                      | 0.55                      | 49                             | 38                           | 57682E3                       |
|                                                     | 10 000                               | 35 x 40                                                  | 5.2                             | 9.8                             | 2.40                      | 0.80                      | 48                             | 37                           | 57103E3                       |
|                                                     | 15 000                               | 35 x 50                                                  | 6.3                             | 11.9                            | 3.60                      | 1.20                      | 37                             | 28                           | 57153E3                       |
| 40                                                  | 15 000                               | 40 x 40                                                  | 5.6                             | 10.6                            | 3.60                      | 1.20                      | 50                             | 35                           | 47153E3                       |
|                                                     | 22 000                               | 40 x 50                                                  | 5.8                             | 11.0                            | 5.28                      | 1.76                      | 39                             | 28                           | 57223E3                       |
|                                                     | 33 000                               | 40 x 70                                                  | 7.8                             | 14.8                            | 7.92                      | 2.64                      | 28                             | 21                           | 57333E3                       |
|                                                     | 47 000                               | 40 x 100                                                 | 10.4                            | 19.7                            | 11.28                     | 3.76                      | 22                             | 17                           | 57473E3                       |

**ORDERING EXAMPLE**

Electrolytic capacitor 051 series

10 000  $\mu\text{F}$ /25 V;  $\pm 20\text{ %}$ Nominal case size:  $\varnothing 30\text{ mm} \times 40\text{ mm}$ 

Ordering code: MAL2 051 56103 E3

Former 12NC: 2222 051 56103



| ELECTRICAL DATA AND ORDERING INFORMATION 051 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 CODE<br>MAL2051..... |
| 63                                                  | 2200                          | 25 x 30                                             | 2.5                             | 4.7                             | 0.84                      | 0.28                      | 83                             | 62                           | 58222E3                       |
|                                                     | 3300                          | 25 x 40                                             | 3.3                             | 6.2                             | 1.25                      | 0.42                      | 58                             | 42                           | 58332E3                       |
|                                                     | 4700                          | 30 x 40                                             | 4.1                             | 7.8                             | 1.78                      | 0.60                      | 49                             | 38                           | 58472E3                       |
|                                                     | 6800                          | 35 x 40                                             | 4.5                             | 8.5                             | 2.57                      | 0.86                      | 48                             | 37                           | 58682E3                       |
|                                                     | 10 000                        | 35 x 50                                             | 5.4                             | 10.2                            | 3.78                      | 1.26                      | 37                             | 28                           | 58103E3                       |
|                                                     | 10 000                        | 40 x 40                                             | 4.6                             | 8.7                             | 3.78                      | 1.26                      | 52                             | 37                           | 48103E3                       |
|                                                     | 15 000                        | 40 x 70                                             | 7.5                             | 14.2                            | 5.67                      | 1.89                      | 29                             | 24                           | 58153E3                       |
|                                                     | 22 000                        | 40 x 100                                            | 10.0                            | 19.0                            | 8.32                      | 2.77                      | 22                             | 19                           | 58223E3                       |
| 100                                                 | 680                           | 25 x 30                                             | 1.74                            | 3.30                            | 0.41                      | 0.14                      | 190                            | 130                          | 59681E3                       |
|                                                     | 1000                          | 25 x 40                                             | 2.34                            | 4.44                            | 0.60                      | 0.20                      | 130                            | 90                           | 59102E3                       |
|                                                     | 1500                          | 30 x 40                                             | 2.95                            | 5.59                            | 0.90                      | 0.30                      | 95                             | 67                           | 59152E3                       |
|                                                     | 2200                          | 35 x 40                                             | 3.69                            | 7.00                            | 1.32                      | 0.44                      | 71                             | 53                           | 59222E3                       |
|                                                     | 3300                          | 35 x 50                                             | 4.37                            | 8.29                            | 1.98                      | 0.66                      | 55                             | 41                           | 59332E3                       |
|                                                     | 3300                          | 40 x 40                                             | 4.16                            | 7.89                            | 1.98                      | 0.66                      | 64                             | 48                           | 49332E3                       |
|                                                     | 4700                          | 40 x 50                                             | 5.21                            | 9.88                            | 2.82                      | 0.94                      | 49                             | 38                           | 59472E3                       |
|                                                     | 6800                          | 40 x 70                                             | 6.97                            | 13.22                           | 4.08                      | 1.36                      | 35                             | 28                           | 59682E3                       |
|                                                     | 10 000                        | 40 x 100                                            | 9.50                            | 18.00                           | 6.00                      | 2.00                      | 26                             | 21                           | 59103E3                       |

Table 3

| ELECTRICAL DATA AND ORDERING INFORMATION 053 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 CODE<br>MAL2053..... |
| 200                                                 | 150                           | 25 x 30                                             | 0.70                            | 1.33                            | 0.18                      | 0.06                      | 1000                           | 770                          | 52151E3                       |
|                                                     | 220                           | 25 x 40                                             | 0.94                            | 1.78                            | 0.26                      | 0.09                      | 680                            | 525                          | 52221E3                       |
|                                                     | 330                           | 30 x 40                                             | 1.27                            | 2.41                            | 0.40                      | 0.14                      | 460                            | 360                          | 52331E3                       |
|                                                     | 470                           | 35 x 40                                             | 1.66                            | 3.15                            | 0.57                      | 0.19                      | 320                            | 250                          | 52471E3                       |
|                                                     | 680                           | 35 x 50                                             | 2.19                            | 4.15                            | 0.82                      | 0.28                      | 220                            | 170                          | 52681E3                       |
|                                                     | 680                           | 40 x 40                                             | 2.17                            | 4.11                            | 0.82                      | 0.28                      | 220                            | 170                          | 42681E3                       |
|                                                     | 1000                          | 40 x 50                                             | 2.86                            | 5.42                            | 1.20                      | 0.40                      | 150                            | 115                          | 52102E3                       |
|                                                     | 1500                          | 40 x 70                                             | 3.81                            | 7.22                            | 1.80                      | 0.60                      | 110                            | 85                           | 52152E3                       |
|                                                     | 2200                          | 40 x 100                                            | 5.20                            | 9.86                            | 2.64                      | 0.88                      | 80                             | 60                           | 52222E3                       |
| 385                                                 | 68                            | 25 x 30                                             | 0.47                            | 0.89                            | 0.16                      | 0.06                      | 2200                           | 1480                         | 58689E3                       |
|                                                     | 100                           | 25 x 40                                             | 0.64                            | 1.21                            | 0.23                      | 0.08                      | 1500                           | 1020                         | 58101E3                       |
|                                                     | 150                           | 30 x 40                                             | 0.90                            | 1.71                            | 0.35                      | 0.12                      | 1000                           | 700                          | 58151E3                       |
|                                                     | 220                           | 35 x 40                                             | 1.15                            | 2.18                            | 0.51                      | 0.17                      | 680                            | 480                          | 58221E3                       |
|                                                     | 330                           | 35 x 50                                             | 1.53                            | 2.90                            | 0.77                      | 0.26                      | 450                            | 340                          | 58331E3                       |
|                                                     | 330                           | 40 x 40                                             | 1.52                            | 2.88                            | 0.77                      | 0.26                      | 450                            | 340                          | 48331E3                       |
|                                                     | 470                           | 40 x 50                                             | 1.96                            | 3.72                            | 1.09                      | 0.36                      | 320                            | 260                          | 58471E3                       |
|                                                     | 680                           | 40 x 70                                             | 2.70                            | 5.12                            | 1.58                      | 0.53                      | 220                            | 190                          | 58681E3                       |
|                                                     | 1000                          | 40 x 100                                            | 3.70                            | 7.02                            | 2.31                      | 0.78                      | 180                            | 140                          | 58102E3                       |
| 400                                                 | 68                            | 25 x 30                                             | 0.54                            | 1.02                            | 0.16                      | 0.06                      | 2100                           | 1000                         | 56689E3                       |
|                                                     | 100                           | 25 x 40                                             | 0.73                            | 1.38                            | 0.24                      | 0.08                      | 1400                           | 780                          | 56101E3                       |
|                                                     | 150                           | 30 x 40                                             | 0.98                            | 1.86                            | 0.36                      | 0.12                      | 950                            | 520                          | 56151E3                       |
|                                                     | 220                           | 35 x 40                                             | 1.28                            | 2.43                            | 0.52                      | 0.17                      | 650                            | 400                          | 56221E3                       |
|                                                     | 330                           | 35 x 50                                             | 1.67                            | 3.17                            | 0.79                      | 0.26                      | 480                            | 280                          | 56331E3                       |
|                                                     | 330                           | 40 x 40                                             | 1.67                            | 3.17                            | 0.79                      | 0.26                      | 480                            | 280                          | 46331E3                       |
|                                                     | 470                           | 40 x 50                                             | 2.12                            | 4.02                            | 1.12                      | 0.37                      | 340                            | 220                          | 56471E3                       |
|                                                     | 680                           | 40 x 70                                             | 2.90                            | 5.50                            | 1.63                      | 0.54                      | 235                            | 155                          | 56681E3                       |
|                                                     | 1000                          | 40 x 100                                            | 4.05                            | 7.68                            | 2.40                      | 0.80                      | 160                            | 110                          | 56102E3                       |



| 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                                   |

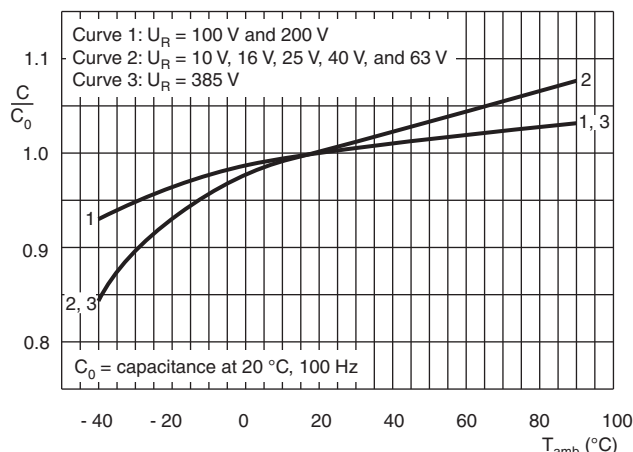
**CAPACITANCE (C)**

Fig. 9 - Typical multiplier of capacitance as a function of ambient temperature

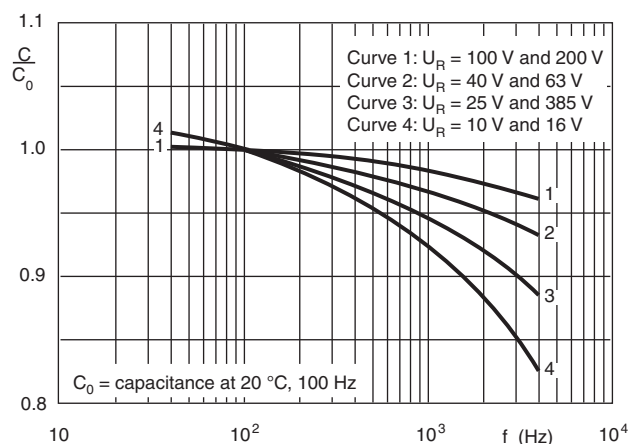


Fig. 10 - Typical multiplier of capacitance as a function of frequency

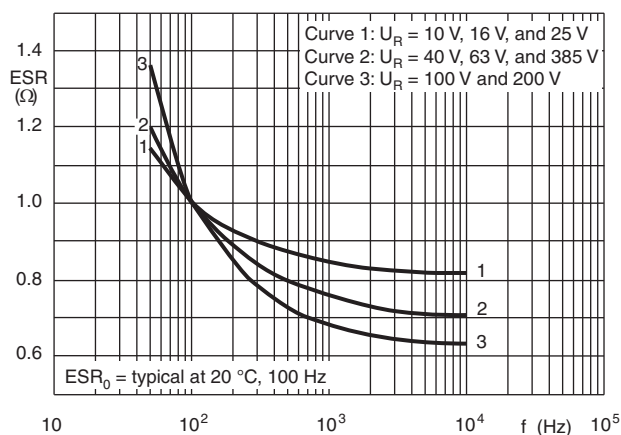
**EQUIVALENT SERIES RESISTANCE (ESR)**

Fig. 11 - Typical multiplier of typical ESR as a function of frequency

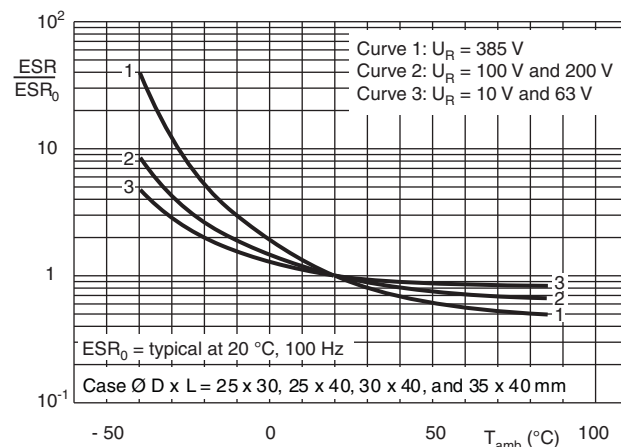


Fig. 12 - Typical multiplier of ESR as a function of ambient temperature

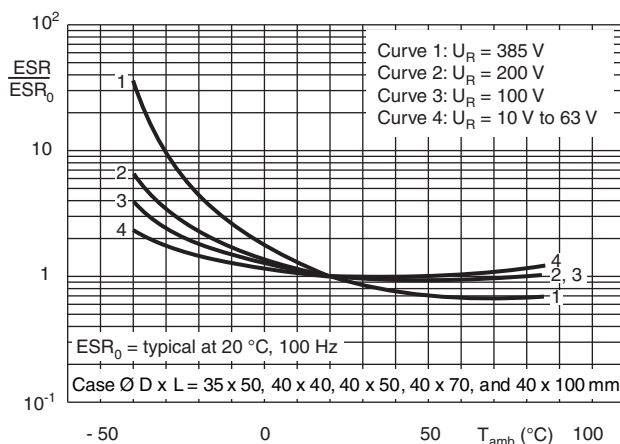


Fig. 13 - Typical multiplier of ESR as a function of ambient temperature

## IMPEDANCE (Z)

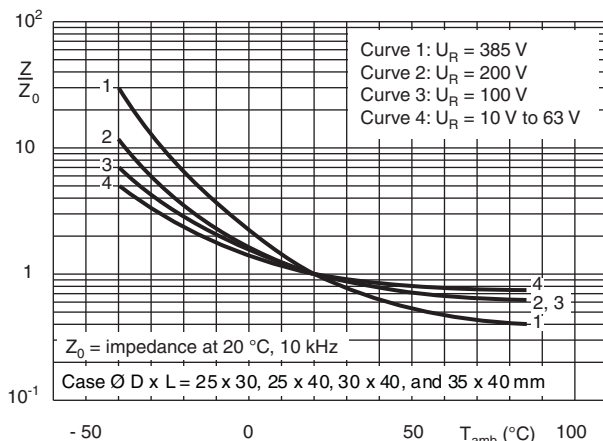


Fig. 14 - Typical multiplier of impedance as a function of ambient temperature

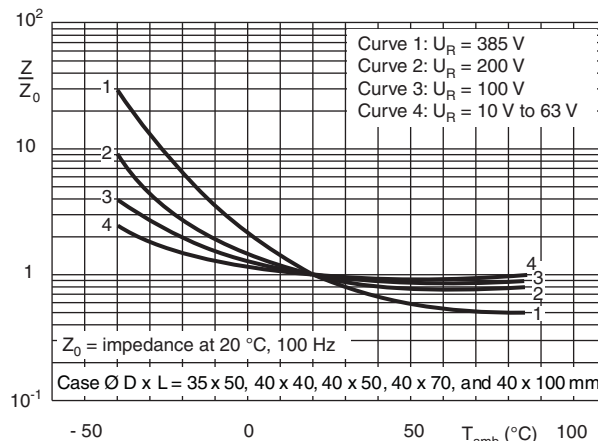


Fig. 15 - Typical multiplier of impedance as a function of ambient temperature

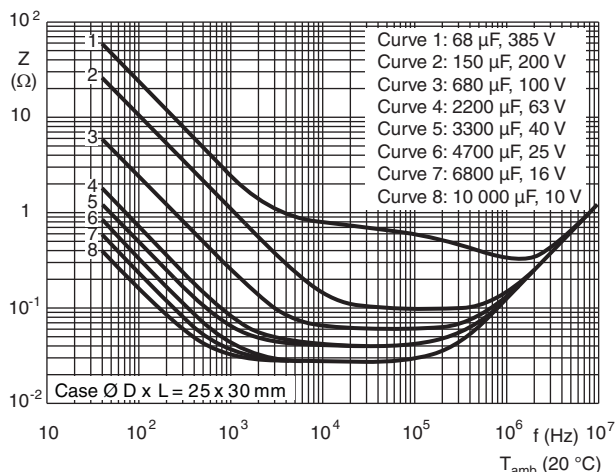


Fig. 16 - Typical impedance as a function of frequency

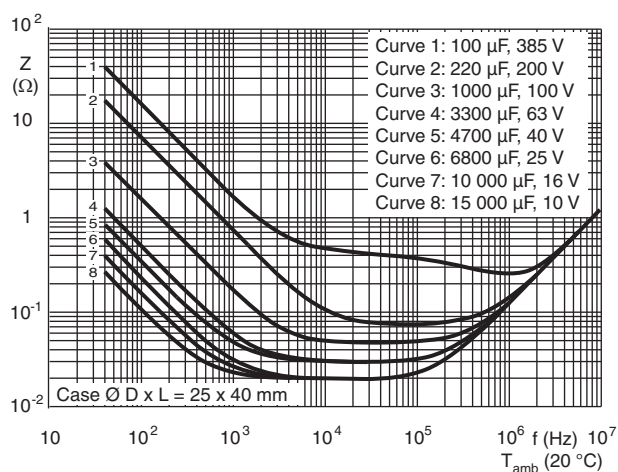


Fig. 17 - Typical impedance as a function of frequency

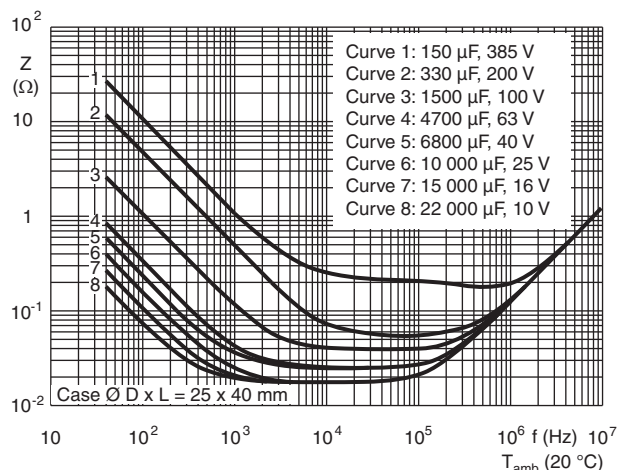


Fig. 18 - Typical impedance as a function of frequency

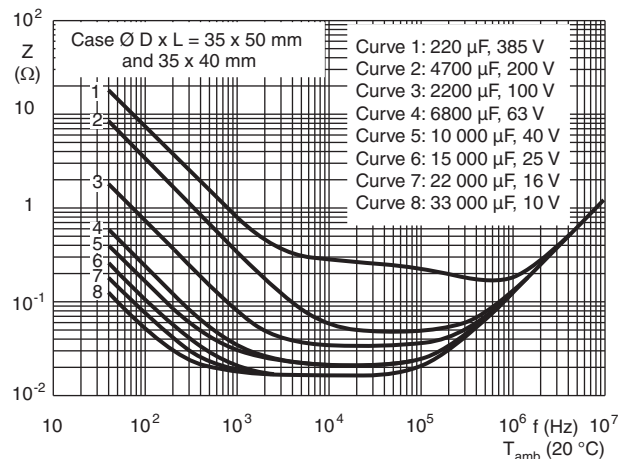


Fig. 19 - Typical impedance as a function of frequency

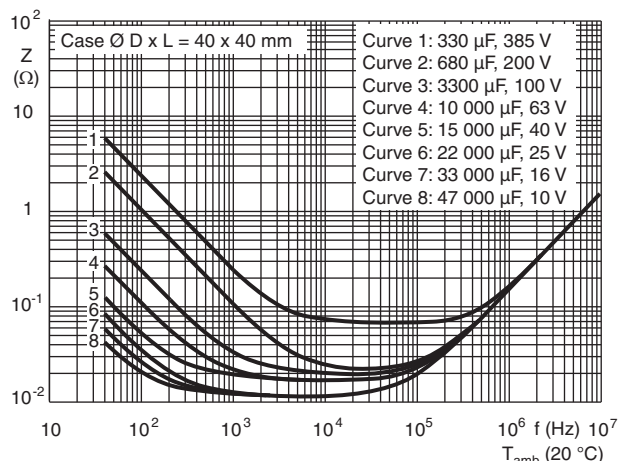


Fig. 20 - Typical impedance as a function of frequency

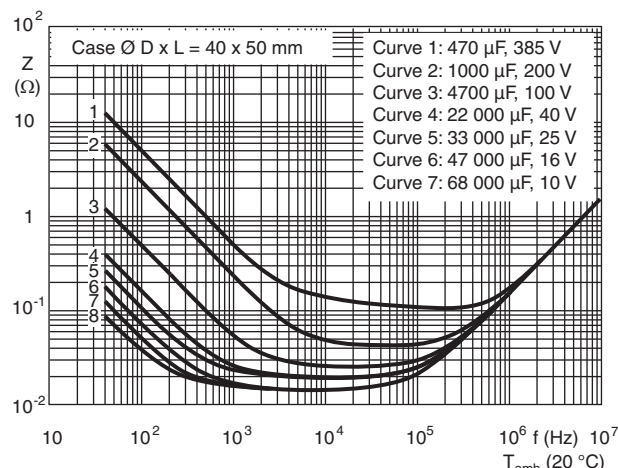


Fig. 21 - Typical impedance as a function of frequency

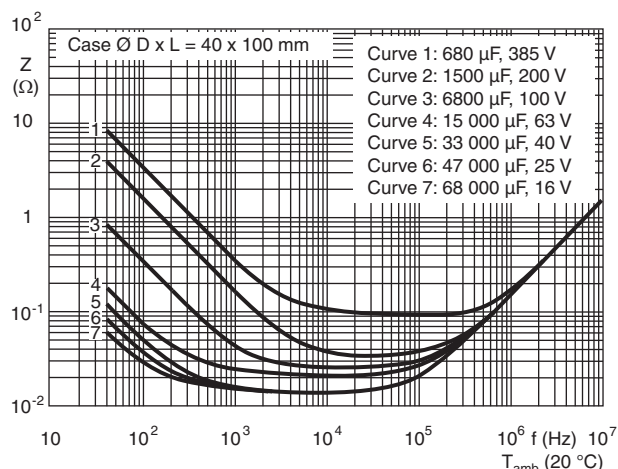


Fig. 22 - Typical impedance as a function of frequency

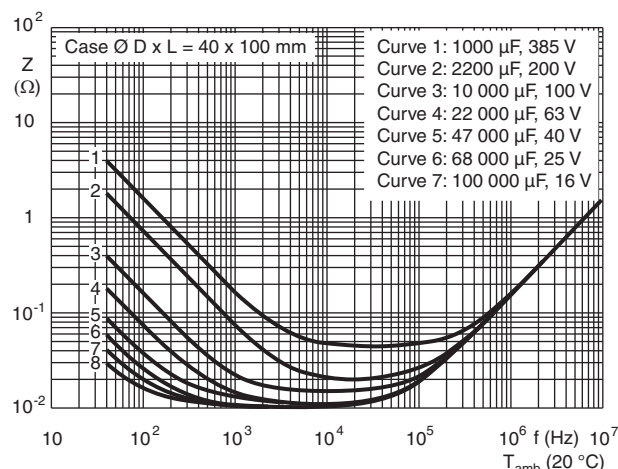


Fig. 23 - Typical impedance as a function of frequency

**RIPPLE CURRENT AND USEFUL LIFE**

$I_A$  = Actual ripple current at 100 Hz  
 $I_R$  = Rated ripple current at 100 Hz and 85 °C  
<sup>(1)</sup> Useful life at 85 °C and  $I_R$  applied: 12 000 h

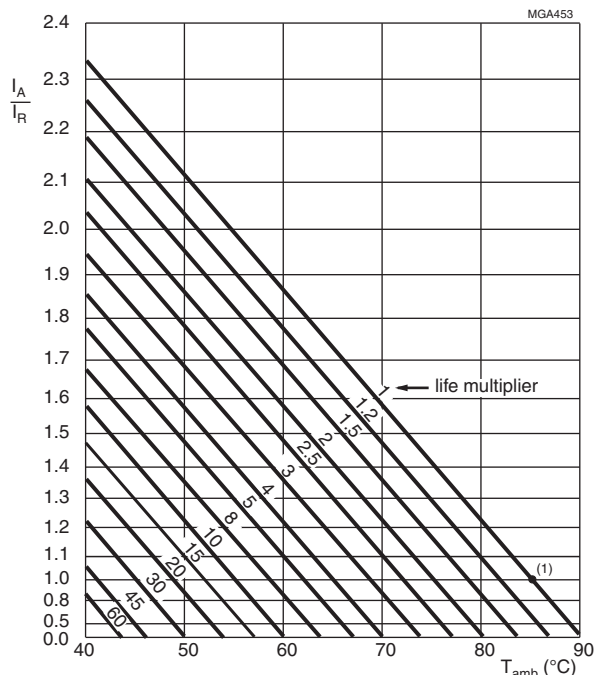


Fig. 24 - Multiplier of useful life as a function of ambient temperature and ripple current load

**Table 4**

| <b>MULTIPLIER OF RIPPLE CURRENT (<math>I_R</math>) AS A FUNCTION OF FREQUENCY</b> |                                    |
|-----------------------------------------------------------------------------------|------------------------------------|
| <b>FREQUENCY (Hz)</b>                                                             | <b><math>I_R</math> MULTIPLIER</b> |
| 50                                                                                | 0.83                               |
| 100                                                                               | 1.00                               |
| 200                                                                               | 1.10                               |
| 400                                                                               | 1.15                               |
| 1000                                                                              | 1.19                               |
| ≥ 2000                                                                            | 1.20                               |

**Table 5**

| <b>TEST PROCEDURES AND REQUIREMENTS</b>        |                                            |                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>TEST</b>                                    |                                            | <b>PROCEDURE<br/>(quick reference)</b>                                                                                                 | <b>REQUIREMENTS</b>                                                                                                                                                                                                                                                                                                                                                             |
| <b>NAME OF TEST</b>                            | <b>REFERENCE</b>                           |                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                 |
| Endurance                                      | IEC 60384-4/<br>EN130300<br>subclause 4.13 | $T_{amb} = 85\text{ °C}$ ; $U_R$ applied;<br>5000 h                                                                                    | $U_R \leq 100\text{ V}$ ; $\Delta C/C: \pm 15\%$<br>$U_R > 100\text{ V}$ ; $\Delta C/C: \pm 10\%$<br>$ESR \leq 1.3 \times \text{spec. limit}$<br>$Z \leq 2 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$                                                                                                                                                       |
| Useful life                                    | CECC 30301<br>subclause 1.8.1              | $T_{amb} = 85\text{ °C}$ ; $U_R$ and $I_R$ applied;<br>12 000 h                                                                        | $U_R \leq 100\text{ V}$ ; $\Delta C/C: \pm 45\%$<br>$U_R > 100\text{ V}$ ; $\Delta C/C: \pm 30\%$<br>$ESR \leq 3 \times \text{spec. limit}$<br>$Z \leq 3 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$<br>no short or open circuit,<br>no visible damage<br>total failure percentage:<br>$U_R \leq 100\text{ V}: \leq 1\%$ ;<br>$U_R > 100\text{ V}: \leq 3\%$ |
| Shelf life<br>(storage at<br>high temperature) | IEC 60384-4/<br>EN130300<br>subclause 4.17 | $T_{amb} = 85\text{ °C}$ ; no voltage applied; 500 h<br>after test: $U_R$ to be applied for 30 min, 24 h to 48 h<br>before measurement | $\Delta C/C: \pm 10\%$<br>$ESR \leq 1.2 \times \text{spec. limit}$<br>$I_{L5} \leq 2 \times \text{spec. limit}$                                                                                                                                                                                                                                                                 |



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