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# Aluminum Electrolytic Capacitors, Power Eurodin, Screw Terminals







Fig. 1

## FEATURES

- Very long useful life: 20 000 h at 85 °C
- Extremely low ESR and ESL allowing very high ripple current load
- High resistance to shock and vibration
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, cylindrical aluminum case, insulated with a blue sleeve
- Also available in bolt version (106 PED-STB)
- Pressure relief in the sealing
- Charge and discharge proof
- High reliability
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

## APPLICATIONS

- Computer, telecommunications, and industrial systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems

## MARKING

The capacitors are marked 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 (YYMM)
- Name of manufacturer
- Code for factory of origin
- "-" sign to identify the negative terminal, visible from the top and side of the capacitor
- Code number
- Climatic category in accordance with IEC 60068
- "LL" for long life grade

## QUICK REFERENCE DATA

| DESCRIPTION | VALUE |
|---|---|
| Nominal case size (Ø D x L in mm) | 35 x 60 to 90 x 220 |
| Rated capacitance range (E6 series), $C_R$ | 1000 µF to 330 000 µF |
| Tolerance on $C_R$ | -10 % to +30 % |
| Rated voltage range, $U_R$ | 25 V to 100 V |
| Category temperature range | -40 °C to +85 °C |
| Endurance test at 85 °C | 8000 h |
| Useful life at 85 °C | 20 000 h |
| Shelf life at 0 V, 85 °C | 500 h |
| Based on sectional specification | IEC 60384-4 / EN 130300 |
| Climatic category IEC 60068 | 40 / 085 / 56 |

## SELECTION CHART FOR $C_R$, $U_R$, AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)

| $C_R$ (µF) | $U_R$ (V) | | | |
|---|---|---|---|---|
| | 25 | 40 | 63 | 100 |
| 1000 | - | - | - | 35 x 60 |
| 1500 | - | - | - | 35 x 60 |
| 2200 | - | - | 35 x 60 | 35 x 80 |
| 3300 | - | 35 x 60 | 35 x 60 | 35 x 105 |
| 4700 | 35 x 60 | 35 x 60 | 35 x 80 | 50 x 80 |
| 6800 | 35 x 60 | 35 x 80 | 35 x 105 | 50 x 105 |
| 10 000 | 35 x 80 | 35 x 105 | 50 x 80 | 65 x 105 |
| 15 000 | 35 x 105 | 50 x 80 | 50 x 105 | 65 x 105 |
| 22 000 | 50 x 80 | 50 x 105 | 65 x 105 | 76 x 105 |
| 33 000 | 50 x 105 | 65 x 105 | 65 x 105 | 76 x 146 |
| 47 000 | 65 x 105 | 65 x 105 | 76 x 105 | 76 x 220 |
| 68 000 | 65 x 105 | 76 x 105 | 76 x 146 | 90 x 220 |
| 100 000 | 76 x 105 | 76 x 146 | 76 x 220 | - |
| 150 000 | 76 x 146 | 76 x 220 | - | - |
| | - | 90 x 146 | 90 x 220 | - |
| 220 000 | 76 x 220 | - | - | - |
| | 90 x 146 | 90 x 220 | - | - |
| 330 000 | 90 x 220 | - | - | - |

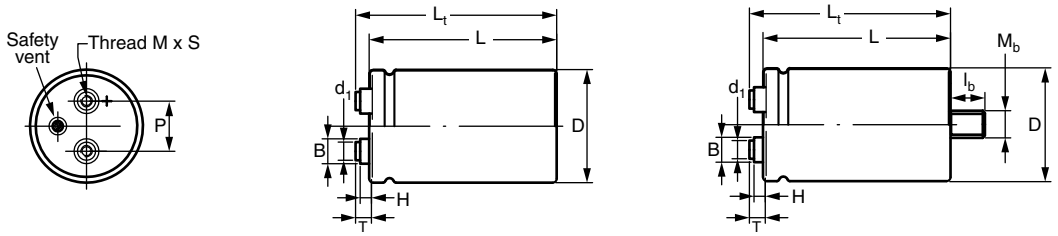


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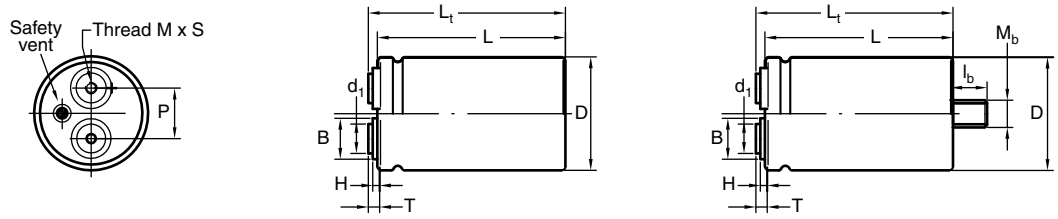
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## **DIMENSIONS** in millimeters **AND AVAILABLE FORMS**




Standard M5 disc | Clamp mounting (ST) | Threaded stud mounting (STB)

Fig. 2A - Mechanical drawings for standard M5 disc versions.
For details refer to Table 1




High current M6 disc | Clamp mounting (ST) | Threaded stud mounting (STB)

Fig. 2B - Mechanical drawings for high current M6 disc versions.
For details refer to Table 1

**Note**

- Maximum permissible torque which may be applied to the termination screws: 2 Nm for M5; 2.5 Nm for M6
  For accessories refer to document “Mounting Accessories”, see www.vishay.com/doc?28348
  The capacitors are delivered with screws and washers

**Table 1**

| **DIMENSIONS** in millimeters **AND MASS** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DESIGN** | **DRAWING** | **L ± 1** | **$L_t$ ± 1** | **D ± 1** | **P ± 0.3** | **T ± 0.2** | **H ± 0.3** | **B ± 0.3** | **$d_1$ ± 0.1** | **M** | **S - 0** | **$M_b$** | **$l_b$ ± 0.1** | **MASS (g)** |
| 35 x 60 | 2A | 63.3 | 68.7 | 35.3 | 12.8 | 7.0 | 4.6 | 11.0 | 7.9 | M5 | 9.5 | M8 | 12.0 | 75 |
| 35 x 80 | 2A | 81.3 | 86.7 | 35.3 | 12.8 | 7.0 | 4.6 | 11.0 | 7.9 | M5 | 9.5 | M8 | 12.0 | 95 |
| 35 x 105 | 2A | 103.3 | 108.7 | 35.3 | 12.8 | 7.0 | 4.6 | 11.0 | 7.9 | M5 | 9.5 | M8 | 12.0 | 130 |
| 50 x 80 | 2A | 82.8 | 88.8 | 51.0 | 22.2 | 7.1 | 4.8 | 11.0 | 7.9 | M5 | 9.5 | M12 | 16.0 | 200 |
| 50 x 105 | 2A | 104.8 | 110.8 | 51.0 | 22.2 | 7.1 | 4.8 | 11.0 | 7.9 | M5 | 9.5 | M12 | 16.0 | 300 |
| 65 x 105 | 2A | 104.8 | 110.7 | 65.0 | 28.5 | 7.0 | 4.6 | 11.9 | 7.9 | M5 | 9.5 | M12 | 16.0 | 480 |
| 65 x 105 HC | 2B | 104.8 | 109.2 | 65.0 | 28.5 | 5.5 | 3.5 | 18.0 | 13.0 | M6 | 8.5 | M12 | 16.0 | 480 |
| 76 x 105 | 2A | 105.8 | 111.7 | 76.4 | 31.8 | 7.0 | 4.6 | 11.7 | 7.9 | M5 | 9.5 | M12 | 16.0 | 700 |
| 76 x 105 HC | 2B | 105.8 | 110.2 | 76.4 | 31.8 | 5.5 | 3.5 | 18.3 | 13.0 | M6 | 8.5 | M12 | 16.0 | 700 |
| 76 x 146 | 2A | 145.8 | 151.7 | 76.4 | 31.8 | 7.0 | 4.6 | 11.7 | 7.9 | M5 | 9.5 | M12 | 16.0 | 1000 |
| 76 x 146 HC | 2B | 145.8 | 150.2 | 76.4 | 31.8 | 5.5 | 3.5 | 18.3 | 13.0 | M6 | 8.5 | M12 | 16.0 | 1000 |
| 76 x 220 | 2A | 219.8 | 225.7 | 76.4 | 31.8 | 7.0 | 4.6 | 11.7 | 7.9 | M5 | 9.5 | M12 | 16.0 | 1500 |
| 76 x 220 HC | 2B | 219.8 | 224.2 | 76.4 | 31.8 | 5.5 | 3.5 | 18.3 | 13.0 | M6 | 8.5 | M12 | 16.0 | 1500 |
| 90 x 146 HC | 2B | 150.1 | 155.4 | 89.4 | 31.8 | 7.9 | 0.0 | 13.0 | 13.0 | M6 | 10.0 | M12 | 16.0 | 1300 |
| 90 x 220 HC | 2B | 218.1 | 223.4 | 89.4 | 31.8 | 7.9 | 0.0 | 13.0 | 13.0 | M6 | 10.0 | M12 | 16.0 | 2000 |



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| PACKAGING QUANTITIES AND DIMENSIONS in millimeters | | |
|---|---|---|
| **DESIGN** | **PACKAGING QUANTITIES (units per box)** | **CARDBOX DIMENSIONS L x W x H** |
| 35 x 60 | 50 | 377 x 375 x 88 |
| 35 x 80 | 50 | 377 x 375 x 123 |
| 35 x 105 | 50 | 377 x 375 x 129 |
| 50 x 80 | 25 | 377 x 375 x 123 |
| 50 x 105 | 25 | 377 x 375 x 129 |
| 65 x 105 | 16 | 377 x 375 x 129 |
| 65 x 105 HC | 16 | 377 x 375 x 129 |
| 76 x 105 | 12 | 377 x 375 x 129 |
| 76 x 105 HC | 12 | 377 x 375 x 129 |
| 76 x 146 | 12 | 377 x 375 x 168 |
| 76 x 146 HC | 12 | 377 x 375 x 168 |
| 76 x 220 | 18 | 520 x 270 x 280 |
| 76 x 220 HC | 18 | 520 x 270 x 280 |
| 90 x 146 HC | 8 | 377 x 375 x 168 |
| 90 x 220 HC | 10 | 520 x 270 x 280 |

**Note**

- For STB version holds:
  H cardbox box: + 10 mm

| ELECTRICAL DATA | |
|---|---|
| **SYMBOL** | **DESCRIPTION** |
| $C_R$ | Rated capacitance at 100 Hz, tolerance -10 % to +30 % |
| $I_R$ | Rated RMS ripple current at 100 Hz, 85 °C |
| $I_{L5}$ | Max. leakage current after 5 min at $U_R$ |
| ESR | Max. equivalent series resistance at 100 Hz |
| Z | Max. impedance at 20 kHz |

**Note**

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

## ORDERING EXAMPLE

Electrolytic capacitor 106 PED-ST series

10 000 µF / 25 V; -10 % / +30 %

Nominal case size: Ø 35 mm x 80 mm, ST version

Ordering code: MAL2 10616103E3
Former 12NC: 2222 10616103

**Table 2**

| ELECTRICAL DATA AND ORDERING INFORMATION | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | STANDARD M5 DISC | | HIGH CURRENT M6 DISC | |
| **$U_R$ (V)** | **$C_R$ 100 Hz (µF)** | **NOMINAL CASE SIZE Ø D x L (mm)** | **$I_R$ 100 Hz 85 °C (A)** | **$I_{L5}$ 5 MIN. (mA)** | **ESR MAX. 100 Hz (mΩ)** | **Z MAX. 20 kHz (mΩ)** | **ST ORDERING CODE MAL2106.....** | **STB ORDERING CODE MAL2106.....** | **ST ORDERING CODE MAL2106.....** | **STB ORDERING CODE MAL2106.....** |
| | 4700 | 35 x 60 | 5.8 | 0.24 | 70 | 50 | 16472E3 | 56472E3 | - | - |
| | 6800 | 35 x 60 | 6.3 | 0.34 | 55 | 42 | 16682E3 | 56682E3 | - | - |
| | 10 000 | 35 x 80 | 7.7 | 0.50 | 40 | 31 | 16103E3 | 56103E3 | - | - |
| | 15 000 | 35 x 105 | 9.0 | 0.75 | 30 | 24 | 16153E3 | 56153E3 | - | - |
| | 22 000 | 50 x 80 | 13.5 | 1.10 | 19 | 15 | 16223E3 | 56223E3 | - | - |
| | 33 000 | 50 x 105 | 16.0 | 1.65 | 14 | 12 | 16333E3 | 56333E3 | - | - |
| 25 | 47 000 | 65 x 105 | 22.5 | 3.35 | 10 | 10 | 16473E3 | 56473E3 | 36473E3 | 76473E3 |
| | 68 000 | 65 x 105 | 23.0 | 3.40 | 10 | 10 | 16683E3 | 56683E3 | 36683E3 | 76683E3 |
| | 100 000 | 76 x 105 | 29.5 | 5.00 | 9 | 8 | 16104E3 | 56104E3 | 36104E3 | 76104E3 |
| | 150 000 | 76 x 146 | 34.0 | 7.5 | 8 | 8 | 16154E3 | 56154E3 | 36154E3 | 76154E3 |
| | 220 000 | 76 x 220 | 40.0 | 11.0 | 8 | 8 | 16224E3 | 56224E3 | 36224E3 | 76224E3 |
| | 220 000 | 90 x 146 | 50.0 | 11.0 | 8 | 8 | - | - | 46224E3 | 86224E3 |
| | 330 000 | 90 x 220 | 50.0 | 16.5 | 8 | 8 | - | - | 46334E3 | 86334E3 |


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## ELECTRICAL DATA AND ORDERING INFORMATION

| $U_R$ (V) | $C_R$ 100 Hz (µF) | NOMINAL CASE SIZE Ø D x L (mm) | $I_R$ 100 Hz 85 °C (A) | $I_{L5}$ 5 MIN. (mA) | ESR MAX. 100 Hz (mΩ) | Z MAX. 20 kHz (mΩ) | STANDARD M5 DISC | | HIGH CURRENT M6 DISC | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | ST ORDERING CODE MAL2106..... | STB ORDERING CODE MAL2106..... | ST ORDERING CODE MAL2106..... | STB ORDERING CODE MAL2106..... |
| 40 | 3300 | 35 x 60 | 5.5 | 0.27 | 71 | 49 | 17332E3 | 57332E3 | - | - |
| | 4700 | 35 x 60 | 5.8 | 0.38 | 59 | 44 | 17472E3 | 57472E3 | - | - |
| | 6800 | 35 x 80 | 7.1 | 0.55 | 42 | 32 | 17682E3 | 57682E3 | - | - |
| | 10 000 | 35 x 105 | 10.6 | 0.80 | 23 | 16 | 17103E3 | 57103E3 | - | - |
| | 15 000 | 50 x 80 | 12.5 | 1.20 | 20 | 16 | 17153E3 | 57153E3 | - | - |
| | 22 000 | 50 x 105 | 14.5 | 1.76 | 16 | 12 | 17223E3 | 57223E3 | - | - |
| | 33 000 | 65 x 105 | 21.0 | 2.64 | 11 | 8 | 17333E3 | 57333E3 | 37333E3 | 77333E3 |
| | 47 000 | 65 x 105 | 24.5 | 3.76 | 8 | 8 | 17473E3 | 57473E3 | 37473E3 | 77473E3 |
| | 68 000 | 76 x 105 | 27.0 | 5.44 | 8 | 8 | 17683E3 | 57683E3 | 37683E3 | 77683E3 |
| | 100 000 | 76 x 146 | 31.5 | 8.0 | 8 | 8 | 17104E3 | 57104E3 | 37104E3 | 77104E3 |
| | 150 000 | 76 x 220 | 38.0 | 12.0 | 8 | 8 | 17154E3 | 57154E3 | 37154E3 | 77154E3 |
| | 150 000 | 90 x 146 | 50.0 | 12.0 | 8 | 8 | - | - | 47154E3 | 87154E3 |
| | 220 000 | 90 x 220 | 50.0 | 17.6 | 8 | 8 | - | - | 47224E3 | 87224E3 |
| 63 | 2200 | 35 x 60 | 5.4 | 0.28 | 68 | 47 | 18222E3 | 58222E3 | - | - |
| | 3300 | 35 x 60 | 7.2 | 0.42 | 40 | 27 | 18332E3 | 58332E3 | - | - |
| | 4700 | 35 x 80 | 8.8 | 0.60 | 29 | 19 | 18472E3 | 58472E3 | - | - |
| | 6800 | 35 x 105 | 10.6 | 0.86 | 22 | 15 | 18682E3 | 58682E3 | - | - |
| | 10 000 | 50 x 80 | 14.5 | 1.26 | 16 | 11 | 18103E3 | 58103E3 | - | - |
| | 15 000 | 50 x 105 | 17.0 | 1.89 | 12 | 9 | 18153E3 | 58153E3 | - | - |
| | 22 000 | 65 x 105 | 23.5 | 2.78 | 9 | 8 | 18223E3 | 58223E3 | 38223E3 | 78223E3 |
| | 33 000 | 65 x 105 | 23.5 | 4.16 | 8 | 8 | 18333E3 | 58333E3 | 38333E3 | 78333E3 |
| | 47 000 | 76 x 105 | 25.0 | 5.93 | 8 | 8 | 18473E3 | 58473E3 | 38473E3 | 78473E3 |
| | 68 000 | 76 x 146 | 29.5 | 8.6 | 8 | 8 | 18683E3 | 58683E3 | 38683E3 | 78683E3 |
| | 100 000 | 76 x 220 | 36.5 | 12.6 | 8 | 8 | 18104E3 | 58104E3 | 38104E3 | 78104E3 |
| | 150 000 | 90 x 220 | 50.0 | 18.9 | 8 | 8 | - | - | 48154E3 | 88154E3 |
| 100 | 1000 | 35 x 60 | 3.7 | 0.20 | 96 | 48 | 19102E3 | 59102E3 | - | - |
| | 1500 | 35 x 60 | 4.8 | 0.30 | 59 | 27 | 19152E3 | 59152E3 | - | - |
| | 2200 | 35 x 80 | 5.9 | 0.44 | 42 | 20 | 19222E3 | 59222E3 | - | - |
| | 3300 | 35 x 105 | 7.3 | 0.66 | 29 | 15 | 19332E3 | 59332E3 | - | - |
| | 4700 | 50 x 80 | 10.1 | 0.94 | 22 | 12 | 19472E3 | 59472E3 | - | - |
| | 6800 | 50 x 105 | 12.1 | 1.36 | 16 | 9 | 19682E3 | 59682E3 | - | - |
| | 10 000 | 65 x 105 | 16.7 | 2.00 | 11 | 7 | 19103E3 | 59103E3 | 39103E3 | 79103E3 |
| | 15 000 | 65 x 105 | 17.6 | 3.00 | 10 | 6 | 19153E3 | 59153E3 | 39153E3 | 79153E3 |
| | 22 000 | 76 x 105 | 19.5 | 4.40 | 9 | 6 | 19223E3 | 59223E3 | 39223E3 | 79223E3 |
| | 33 000 | 76 x 146 | 23.0 | 6.6 | 8 | 6 | 19333E3 | 59333E3 | 39333E3 | 79333E3 |
| | 47 000 | 76 x 220 | 28.6 | 9.4 | 5 | 5 | 19473E3 | 59473E3 | 39473E3 | 79473E3 |
| | 68 000 | 90 x 220 | 50.0 | 13.6 | 5 | 5 | - | - | 49683E3 | 89683E3 |


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| ADDITIONAL ELECTRICAL DATA | | |
|---|---|---|
| **PARAMETER** | **CONDITIONS** | **VALUE** |
| **Voltage** | | |
| Surge voltage | | $U_s = 1.15 \times U_R$ |
| Reverse voltage | | $U_{rev} \leq 1$ V |
| **Current** | | |
| Leakage current | After 1 min at $U_R$ | $I_{L1} \leq 0.006\ C_R \times U_R + 4$ µF |
| | After 5 min at $U_R$ | $I_{L5} \leq 0.002\ C_R \times U_R + 4$ µF |
| **Inductance** | | |
| Equivalent series inductance (ESL) | Case Ø D = 35 mm | Typ. 13 nH |
| | Case Ø D = 50 mm | Typ. 16 nH |
| | Case Ø D = 65 mm | Typ. 19 nH (1) |
| | Case Ø D = 76 mm | Typ. 20 nH (1) |
| | Case Ø D = 90 mm | Typ. 21 nH (1) |

**Note**

(1) Low ESL designs available on request

## RIPPLE CURRENT AND USEFUL LIFE

**Table 3**

| ENDURANCE TEST DURATION AND USEFUL LIFE | |
|---|---|
| **ENDURANCE AT 85 °C (h)** | **USEFUL LIFE AT 85 °C (h)** |
| 8000 | 20 000 |

**Note**

- Multiplier of useful life code: CCC205-05

$I_A$ = actual ripple current at 100 Hz
$I_R$ = actual ripple current at 100 Hz and 85 °C
With an absolute maximum of 50 A at 85 °C
(1) Useful life at 85 °C and $I_R$ applied: 20 000 h

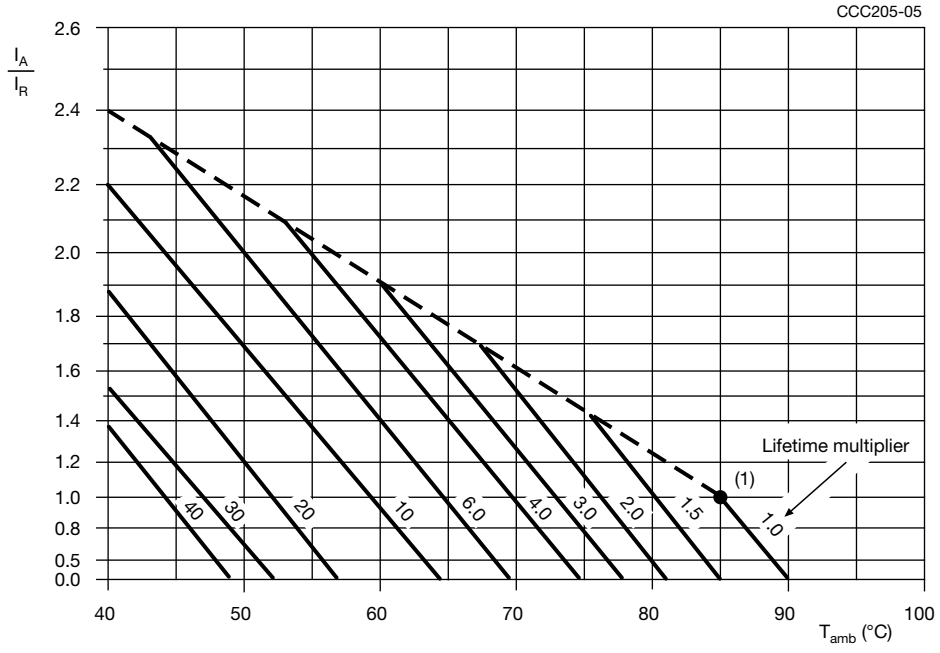



Fig. 3 - Multiplier of useful life as a function of ambient temperature and ripple current load



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**Table 4**

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

**Table 5**

| TEST PROCEDURES AND REQUIREMENTS | | | |
|---|---|---|---|
| TEST | | PROCEDURE (quick reference) | REQUIREMENTS |
| NAME OF TEST | REFERENCE | | |
| Endurance | IEC 60384-4 / EN 130300 subclause 4.13 | $T_{amb}$ = 85 °C; $U_R$ applied; 8000 h | ΔC/C: ± 15 %<br>tan δ ≤ 1.3 x spec. limit<br>Z ≤ 2 x spec. limit<br>$I_{L5}$ ≤ spec. limit |
| Useful life | CECC 30301 subclause 1.8.1 | $T_{amb}$ = 85 °C; $U_R$ and $I_R$ applied; 20 000 h | ΔC/C: ± 45 %<br>tan δ ≤ 3 x spec. limit<br>Z ≤ 3 x spec. limit<br>$I_{L5}$ ≤ spec. limit<br>no short or open circuit,<br>no visible damage<br>total failure percentage ≤ 1 % |
| Shelf life (storage at high temperature) | IEC 60384-4 / EN 130300 subclause 4.17 | $T_{amb}$ = 85 °C; no voltage applied; 500 h<br>after test: $U_R$ to be applied for 30 min, 24 h to 48 h before measurement | ΔC/C: ± 10 %<br>tan δ ≤ 1.2 x spec. limit<br>$I_{L5}$ ≤ 2 x 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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