# Aluminum Capacitors, Power High Ripple Current, Screw Terminals



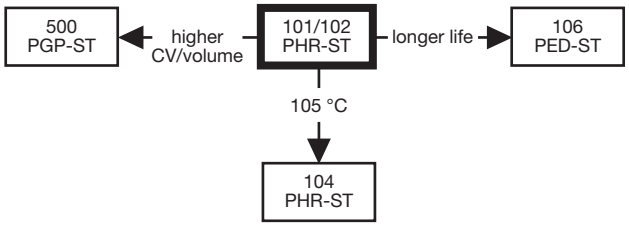



Fig. 1

## FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief in the sealing
- Long useful life
- Material categorization: For definitions please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT

## APPLICATIONS

- Buffering and filtering
- Motor drives, inverters, UPS, and traction systems
- Pulsed power supplies

## MARKING

The capacitors are marked 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 or in 2 digits according to IEC 60062)
- Name of manufacturer
- Code for factory of origin
- "-" sign to identify the negative terminal, visible from the top and side of the capacitor
- Code number
- Climatic category in accordance with IEC 60068

## QUICK REFERENCE DATA

| DESCRIPTION | VALUE | |
|---|---|---|
| | 101 | 102 |
| Nominal case size (Ø D x L in mm) | 35 x 60 to 90 x 220 | |
| Rated capacitance range (E6 series), $C_R$ | 220 µF to 1 F | |
| Tolerance on $C_R$ | ± 20 % | |
| Rated voltage range, $U_R$ | 25 V to 100 V | 200 V to 450 V |
| Category temperature range | - 40 °C to + 85 °C | |
| Endurance test at 85 °C | 2000 h | |
| Useful life at 85 °C | 10 000 h (D ≤ 50 mm) 15 000 h (D ≥ 65 mm) | 10 000 h |
| Useful life at 40 °C, 1.4 x $I_R$ applied | 400 000 h (D ≤ 50 mm) 600 000 h (D ≥ 65 mm) | 400 000 h |
| Shelf life at 0 V, 85 °C | 500 h | |
| Based on sectional specification | IEC 60384-4/EN130300 | |
| Climatic category IEC 60068 | 40/085/056 | |

## 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 | 200 | 250 | 350 | 385 | 400 | 450 |
| 220 | - | - | - | - | - | - | - | 35 x 60 | 35 x 60 | 35 x 60 |
| 330 | - | - | - | - | - | - | 35 x 60 | - | 35 x 60 | - |
| | - | - | - | - | - | - | - | - | 35 x 80 | - |
| 470 | - | - | - | - | - | 35 x 60 | - | 35 x 80 | 35 x 80 | - |
| | - | - | - | - | - | - | 35 x 80 | - | 35 x 105 | 35 x 105 |
| 680 | - | - | - | - | 35 x 60 | 35 x 80 | - | - | 35 x 105 | - |
| | - | - | - | - | - | - | - | - | 50 x 80 | 50 x 80 |
| 1000 | - | - | - | - | 35 x 80 | 35 x 80 | - | 50 x 80 | 50 x 80 | 50 x 80 |
| | - | - | - | - | 35 x 105 | 35 x 105 | - | - | 50 x 105 | 50 x 105 |
| 1500 | - | - | - | - | 35 x 105 | 35 x 105 | - | - | - | 50 x 105 |
| | - | - | - | - | 50 x 80 | 50 x 80 | 50 x 105 | 50 x 105 | 50 x 105 | 65 x 105 |
| 2200 | - | - | - | 35 x 60 | 50 x 80 | 50 x 80 | 50 x 105 | - | - | 65 x 105 |
| | - | - | - | - | - | 50 x 105 | 65 x 105 | 65 x 105 | 65 x 105 | 76 x 105 |



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| 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 | 200 | 250 | 350 | 385 | 400 | 450 |
| 3300 | - | - | - | 35 x 60 | 50 x 80 | 50 x 105 | - | - | 65 x 105 | 76 x 105 |
| | - | - | - | 35 x 80 | 50 x 105 | 65 x 105 | 65 x 105 | 76 x 105 | 76 x 105 | 76 x 146 |
| 4700 | - | - | 35 x 60 | 35 x 80 | - | 65 x 105 | 76 x 105 | 76 x 105 | 76 x 105 | 76 x 146 |
| | - | - | - | 35 x 105 | 65 x 105 | 76 x 105 | 76 x 146 | 76 x 146 | 76 x 146 | - |
| 5600 | - | - | - | - | - | - | - | - | - | - |
| 6800 | - | - | 35 x 60 | 35 x 105 | 65 x 105 | 76 x 105 | - | - | 76 x 146 | 76 x 220 |
| | - | - | 35 x 80 | 50 x 80 | 76 x 105 | 76 x 146 | 76 x 146 | 76 x 146 | - | 90 x 146 |
| 10 000 | - | 35 x 60 | 35 x 80 | 50 x 80 | 76 x 105 | 76 x 105 | 76 x 220 | - | - | - |
| | - | - | 35 x 105 | 50 x 105 | 76 x 146 | 76 x 146 | 90 x 146 | - | - | 90 x 220 |
| 15 000 | 35 x 60 | 35 x 60 | 35 x 105 | 50 x 105 | 76 x 146 | 76 x 146 | - | - | - | - |
| | - | 35 x 80 | 50 x 80 | - | - | - | 90 x 220 | - | - | - |
| 22 000 | 35 x 60 | 35 x 80 | 50 x 80 | 65 x 105 | 76 x 220 | 76 x 220 | - | - | - | - |
| | - | 50 x 80 | 50 x 105 | 76 x 105 | 90 x 146 | 90 x 146 | - | - | - | - |
| 33 000 | 35 x 80 | 35 x 105 | 50 x 105 | 76 x 105 | - | - | - | - | - | - |
| | 50 x 80 | 50 x 80 | 65 x 105 | 76 x 146 | 90 x 220 | 90 x 220 | - | - | - | - |
| 47 000 | 35 x 105 | 50 x 80 | 65 x 105 | - | - | - | - | - | - | - |
| | 50 x 80 | 50 x 105 | 76 x 105 | 76 x 146 | - | - | - | - | - | - |
| 68 000 | 50 x 80 | 50 x 105 | 76 x 105 | 76 x 146 | - | - | - | - | - | - |
| | 50 x 105 | 65 x 105 | 76 x 146 | - | - | - | - | - | - | - |
| 100 000 | 50 x 105 | 65 x 105 | - | 76 x 220 | - | - | - | - | - | - |
| | 65 x 105 | 76 x 105 | 76 x 146 | 90 x 146 | - | - | - | - | - | - |
| 150 000 | 65 x 105 | 76 x 105 | 76 x 146 | - | - | - | - | - | - | - |
| | 76 x 105 | 76 x 146 | - | 90 x 220 | - | - | - | - | - | - |
| 220 000 | 65 x 105 | - | 76 x 220 | - | - | - | - | - | - | - |
| | 76 x 105 | 76 x 146 | 90 x 146 | - | - | - | - | - | - | - |
| 330 000 | 76 x 146 | 76 x 220 | - | - | - | - | - | - | - | - |
| | - | 90 x 146 | 90 x 220 | - | - | - | - | - | - | - |
| 470 000 | 76 x 220 | - | - | - | - | - | - | - | - | - |
| | 90 x 146 | 90 x 220 | - | - | - | - | - | - | - | - |
| 680 000 | 76 x 220 | - | - | - | - | - | - | - | - | - |
| 1 000 000 | 90 x 220 | - | - | - | - | - | - | - | - | - |

## DIMENSIONS in millimeters AND AVAILABLE FORMS

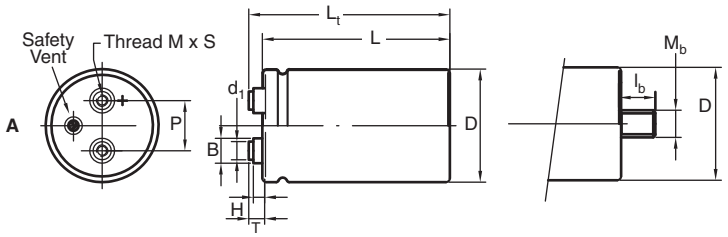
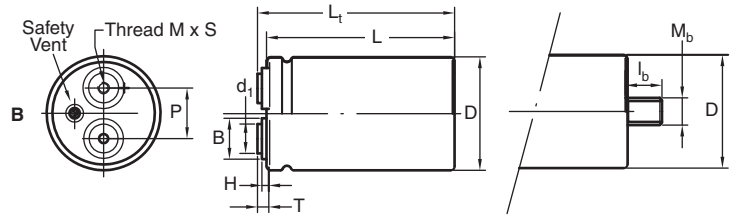



Fig. 2 **A**: Standard M5 disc: screw terminal (ST) and screw terminal bolt nut (STB)




**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 datasheet "Mounting Accessories".
The capacitors are delivered with screws and washers.

Fig. 2 **B**: High current M6 disc: screw terminal (ST) and screw terminal bolt nut (STB)


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**Table 1**

| **DIMENSIONS** in millimeters, **MASS AND PACKAGING QUANTITIES** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **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 | 4.6 | 11 | 7.9 | M5 | 9.5 | M8 | 12 | 75 |
| 35 x 80 | 2A | 81.3 | 86.7 | 35.3 | 12.8 | 7 | 4.6 | 11 | 7.9 | M5 | 9.5 | M8 | 12 | 95 |
| 35 x 105 | 2A | 103.3 | 108.7 | 35.3 | 12.8 | 7 | 4.6 | 11 | 7.9 | M5 | 9.5 | M8 | 12 | 130 |
| 50 x 80 | 2A | 82.8 | 88.8 | 51 | 22.2 | 7.1 | 4.8 | 11 | 7.9 | M5 | 9.5 | M12 | 16 | 200 |
| 50 x 105 | 2A | 104.8 | 110.8 | 51 | 22.2 | 7.1 | 4.8 | 11 | 7.9 | M5 | 9.5 | M12 | 16 | 300 |
| 65 x 105 | 2A | 104.8 | 110.7 | 65 | 28.5 | 7 | 4.6 | 11.9 | 7.9 | M5 | 9.5 | M12 | 16 | 480 |
| 65 x 105 HC | 2B | 104.8 | 109.2 | 65 | 28.5 | 5.5 | 3.5 | 18 | 13 | M6 | 8.5 | M12 | 16 | 480 |
| 76 x 105 | 2A | 105.8 | 111.7 | 76.4 | 31.8 | 7 | 4.6 | 11.7 | 7.9 | M5 | 9.5 | M12 | 16 | 700 |
| 76 x 105 HC | 2B | 105.8 | 110.2 | 76.4 | 31.8 | 5.5 | 3.5 | 18.3 | 13 | M6 | 8.5 | M12 | 16 | 700 |
| 76 x 146 | 2A | 145.8 | 151.7 | 76.4 | 31.8 | 7 | 4.6 | 11.7 | 7.9 | M5 | 9.5 | M12 | 16 | 1000 |
| 76 x 146 HC | 2B | 145.8 | 150.2 | 76.4 | 31.8 | 5.5 | 3.5 | 18.3 | 13 | M6 | 8.5 | M12 | 16 | 1000 |
| 76 x 220 | 2A | 219.8 | 225.7 | 76.4 | 31.8 | 7 | 4.6 | 11.7 | 7.9 | M5 | 9.5 | M12 | 16 | 1500 |
| 76 x 220 HC | 2B | 219.8 | 224.2 | 76.4 | 31.8 | 5.5 | 3.5 | 18.3 | 13 | M6 | 8.5 | M12 | 16 | 1500 |
| 90 x 146 HC | 2B | 150.1 | 155.4 | 89.4 | 31.8 | 7.9 | 0 | 13 | 13 | M6 | 10 | M12 | 16 | 1300 |
| 90 x 220 HC | 2B | 218.1 | 223.4 | 89.4 | 31.8 | 7.9 | 0 | 13 | 13 | M6 | 10 | M12 | 16 | 2000 |

**Note**

- For bolt version holds:
  L = L standard - 0.5 mm
  $L_t$ = $L_t$ standard - 0.5 mm

| **DIMENSIONS** in millimeters, **MASS AND PACKAGING QUANTITIES** | | |
|---|---|---|
| **DESIGN** | **PACKAGING QUANTITIES (units per box)** | **CARDBOX DIMENSIONS L x W x H (mm)** |
| 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 | 520 x 270 x 190 |
| 90 x 220 HC | 8 | 520 x 270 x 280 |

**Note**

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

| **ELECTRICAL DATA** | |
|---|---|
| **SYMBOL** | **DESCRIPTION** |
| $C_R$ | Rated capacitance at 100 Hz, tolerance ± 20 % |
| $I_R$ | 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 101 series

10 000 µF/40 V; ± 20 %

Nominal case size: Ø 35 mm x 60 mm;
ST version, high post M5 disc

Ordering code: MAL2 10117103E3
Former 12NC: 2222 10117103



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**Table 2**

| ELECTRICAL DATA AND ORDERING INFORMATION FOR 101 SERIES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $U_R$ (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 HIGH POST M5 DISC | | HIGH CURRENT M6 DISC | |
| | | | | | | | ST ORDERING CODE MAL2101..... | ST BOLT NUT ORDERING CODE MAL2101..... | ST ORDERING CODE MAL2101..... | ST BOLT NUT ORDERING CODE MAL2101..... |
| 25 | 15 000 | 35 x 60 | 7.7 | 0.75 | 29 | 22 | 16153E3 | 56153E3 | - | - |
| | 22 000 | 35 x 60 | 8.3 | 1.10 | 27 | 22 | 16223E3 | 56223E3 | - | - |
| | 33 000 | 35 x 80 | 9.0 | 1.65 | 19 | 17 | 16333E3 | 56333E3 | - | - |
| | 33 000 | 50 x 80 | 10.0 | 1.65 | 17 | 14 | 26333E3 | 66333E3 | - | - |
| | 47 000 | 35 x 105 | 12.1 | 2.35 | 15 | 13 | 16473E3 | 56473E3 | - | - |
| | 47 000 | 50 x 80 | 14.8 | 2.35 | 12 | 10 | 26473E3 | 66473E3 | - | - |
| | 68 000 | 50 x 80 | 12.8 | 3.40 | 15 | 13 | 16683E3 | 56683E3 | - | - |
| | 68 000 | 50 x 105 | 17.1 | 3.40 | 9 | 8 | 26683E3 | 66683E3 | - | - |
| | 100 000 | 50 x 105 | 14.7 | 5.00 | 12 | 11 | 16104E3 | 56104E3 | - | - |
| | 100 000 | 65 x 105 | 19.6 | 5.00 | 7 | 6 | 26104E3 | 66104E3 | 46104E3 | 86104E3 |
| | 150 000 | 65 x 105 | 17.6 | 7.50 | 8 | 7 | 16154E3 | 56154E3 | 36154E3 | 76154E3 |
| | 150 000 | 76 x 105 | 21.4 | 7.50 | 6 | 5 | 26154E3 | 66154E3 | 46154E3 | 86154E3 |
| | 220 000 | 65 x 105 | 20.2 | 11.0 | 6 | 5 | 16224E3 | 56224E3 | 36224E3 | 76224E3 |
| | 220 000 | 76 x 105 | 22.5 | 11.0 | 6 | 5 | 26224E3 | 66224E3 | 46224E3 | 86224E3 |
| | 330 000 | 76 x 146 | 25.8 | 16.5 | 4 | 4 | 26334E3 | 66334E3 | 46334E3 | 86334E3 |
| | 470 000 | 76 x 220 | 29.9 | 23.5 | 5 | 5 | 16474E3 | 56474E3 | 36474E3 | 76474E3 |
| | 470 000 | 90 x 146 | 38.2 | 23.5 | 5 | 5 | - | - | 46474E3 | 86474E3 |
| | 680 000 | 76 x 220 | 29.0 | 34.0 | 5 | 5 | 16684E3 | 56684E3 | 36684E3 | 76684E3 |
| | 1 000 000 | 90 x 220 | 46.6 | 50.0 | 5 | 5 | - | - | 46105E3 | 86105E3 |
| 40 | 10 000 | 35 x 60 | 7.1 | 0.80 | 31 | 23 | 17103E3 | 57103E3 | - | - |
| | 15 000 | 35 x 60 | 7.8 | 1.20 | 28 | 22 | 17153E3 | 57153E3 | - | - |
| | 15 000 | 35 x 80 | 8.7 | 1.20 | 22 | 17 | 27153E3 | 67153E3 | - | - |
| | 22 000 | 35 x 80 | 9.4 | 1.76 | 20 | 17 | 17223E3 | 57223E3 | - | - |
| | 22 000 | 50 x 80 | 11.2 | 1.76 | 19 | 15 | 27223E3 | 67223E3 | - | - |
| | 33 000 | 35 x 105 | 11.0 | 2.64 | 15 | 13 | 17333E3 | 57333E3 | - | - |
| | 33 000 | 50 x 80 | 13.7 | 2.64 | 13 | 10 | 27333E3 | 67333E3 | - | - |
| | 47 000 | 50 x 80 | 14.6 | 3.76 | 12 | 10 | 17473E3 | 57473E3 | - | - |
| | 47 000 | 50 x 105 | 15.9 | 3.76 | 10 | 8 | 27473E3 | 67473E3 | - | - |
| | 68 000 | 50 x 105 | 16.9 | 5.44 | 9 | 8 | 17683E3 | 57683E3 | - | - |
| | 68 000 | 65 x 105 | 18.1 | 5.44 | 7 | 6 | 27683E3 | 67683E3 | 47683E3 | 87683E3 |
| | 100 000 | 65 x 105 | 19.2 | 8.0 | 7 | 6 | 17104E3 | 57104E3 | 37104E3 | 77104E3 |
| | 100 000 | 76 x 105 | 21.3 | 8.0 | 7 | 6 | 27104E3 | 67104E3 | 47104E3 | 87104E3 |
| | 150 000 | 76 x 105 | 20.5 | 12.0 | 7 | 6 | 17154E3 | 57154E3 | 37154E3 | 77154E3 |
| | 150 000 | 76 x 146 | 24.0 | 12.0 | 5 | 5 | 27154E3 | 67154E3 | 47154E3 | 87154E3 |
| | 220 000 | 76 x 146 | 24.5 | 17.6 | 5 | 5 | 27224E3 | 67224E3 | 47224E3 | 87224E3 |
| | 330 000 | 76 x 220 | 28.2 | 26.4 | 5 | 5 | 17334E3 | 57334E3 | 37334E3 | 77334E3 |
| | 330 000 | 90 x 146 | 38.6 | 26.4 | 5 | 5 | - | - | 47334E3 | 87334E3 |
| | 470 000 | 90 x 220 | 41.5 | 37.6 | 5 | 5 | - | - | 47474E3 | 87474E3 |


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## ELECTRICAL DATA AND ORDERING INFORMATION FOR 101 SERIES

| $U_R$ (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 HIGH POST M5 DISC | | HIGH CURRENT M6 DISC | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | ST ORDERING CODE MAL2101..... | ST BOLT NUT ORDERING CODE MAL2101..... | ST ORDERING CODE MAL2101..... | ST BOLT NUT ORDERING CODE MAL2101..... |
| 63 | 4700 | 35 x 60 | 5.9 | 0.59 | 42 | 25 | 18472E3 | 58472E3 | - | - |
| | 6800 | 35 x 60 | 6.6 | 0.86 | 38 | 25 | 18682E3 | 58682E3 | - | - |
| | 6800 | 35 x 80 | 7.3 | 0.86 | 30 | 19 | 28682E3 | 68682E3 | - | - |
| | 10 000 | 35 x 80 | 8.1 | 1.26 | 27 | 19 | 18103E3 | 58103E3 | - | - |
| | 10 000 | 35 x 105 | 8.8 | 1.26 | 22 | 14 | 28103E3 | 68103E3 | - | - |
| | 15 000 | 35 x 105 | 9.7 | 1.89 | 19 | 14 | 18153E3 | 58153E3 | - | - |
| | 15 000 | 50 x 80 | 12.1 | 1.89 | 16 | 11 | 28153E3 | 68153E3 | - | - |
| | 22 000 | 50 x 80 | 11.1 | 2.77 | 19 | 15 | 18223E3 | 58223E3 | - | - |
| | 22 000 | 50 x 105 | 14.3 | 2.77 | 12 | 9 | 28223E3 | 68223E3 | - | - |
| | 33 000 | 50 x 105 | 12.9 | 4.16 | 14 | 12 | 18333E3 | 58333E3 | - | - |
| | 33 000 | 65 x 105 | 16.5 | 4.16 | 9 | 6 | 28333E3 | 68333E3 | 48333E3 | 88333E3 |
| | 47 000 | 65 x 105 | 15.6 | 5.92 | 10 | 8 | 18473E3 | 58473E3 | 38473E3 | 78473E3 |
| | 47 000 | 76 x 105 | 18.6 | 5.92 | 8 | 6 | 28473E3 | 68473E3 | 48473E3 | 88473E3 |
| | 68 000 | 76 x 105 | 20.0 | 8.57 | 7 | 6 | 18683E3 | 58683E3 | 38683E3 | 78683E3 |
| | 68 000 | 76 x 146 | 21.9 | 8.57 | 6 | 5 | 28683E3 | 68683E3 | 48683E3 | 88683E3 |
| | 100 000 | 76 x 146 | 23.4 | 12.6 | 5 | 5 | 28104E3 | 68104E3 | 48104E3 | 88104E3 |
| | 150 000 | 76 x 146 | 22.2 | 18.9 | 6 | 5 | 18154E3 | 58154E3 | 38154E3 | 78154E3 |
| | 220 000 | 76 x 220 | 27.0 | 27.7 | 5 | 5 | 18224E3 | 58224E3 | 38224E3 | 78224E3 |
| | 220 000 | 90 x 146 | 36.5 | 27.7 | 5 | 5 | - | - | 48224E3 | 88224E3 |
| | 330 000 | 90 x 220 | 42.9 | 41.6 | 5 | 5 | - | - | 48334E3 | 88334E3 |
| 100 | 2200 | 35 x 60 | 5.2 | 0.44 | 50 | 29 | 19222E3 | 59222E3 | - | - |
| | 3300 | 35 x 60 | 6.0 | 0.66 | 42 | 27 | 19332E3 | 59332E3 | - | - |
| | 3300 | 35 x 80 | 6.6 | 0.66 | 35 | 21 | 29332E3 | 69332E3 | - | - |
| | 4700 | 35 x 80 | 7.3 | 0.94 | 31 | 20 | 19472E3 | 59472E3 | - | - |
| | 4700 | 35 x 105 | 7.9 | 0.94 | 26 | 16 | 29472E3 | 69472E3 | - | - |
| | 6800 | 35 x 105 | 8.8 | 1.36 | 23 | 15 | 19682E3 | 59682E3 | - | - |
| | 6800 | 50 x 80 | 10.9 | 1.36 | 19 | 12 | 29682E3 | 69682E3 | - | - |
| | 10 000 | 50 x 80 | 10.5 | 2.00 | 21 | 15 | 19103E3 | 59103E3 | - | - |
| | 10 000 | 50 x 105 | 13.1 | 2.00 | 14 | 9 | 29103E3 | 69103E3 | - | - |
| | 15 000 | 50 x 105 | 12.3 | 3.00 | 16 | 12 | 19153E3 | 59153E3 | - | - |
| | 22 000 | 65 x 105 | 14.8 | 4.40 | 11 | 8 | 19223E3 | 59223E3 | 39223E3 | 79223E3 |
| | 22 000 | 76 x 105 | 17.4 | 4.40 | 9 | 6 | 29223E3 | 69223E3 | 49223E3 | 89223E3 |
| | 33 000 | 76 x 105 | 19.0 | 6.60 | 8 | 6 | 19333E3 | 59333E3 | 39333E3 | 79333E3 |
| | 33 000 | 76 x 146 | 20.7 | 6.60 | 7 | 5 | 29333E3 | 69333E3 | 49333E3 | 89333E3 |
| | 47 000 | 76 x 146 | 22.4 | 9.40 | 6 | 5 | 29473E3 | 69473E3 | 49473E3 | 89473E3 |
| | 68 000 | 76 x 146 | 25.6 | 13.6 | 6 | 5 | 19683E3 | 59683E3 | 39683E3 | 79683E3 |
| | 100 000 | 76 x 220 | 31.2 | 20.0 | 5 | 5 | 19104E3 | 59104E3 | 39104E3 | 79104E3 |
| | 100 000 | 90 x 146 | 41.5 | 20.0 | 5 | 5 | - | - | 49104E3 | 89104E3 |
| | 150 000 | 90 x 220 | 49.1 | 30.0 | 5 | 5 | - | - | 49154E3 | 89154E3 |


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**Table 3**

| ELECTRICAL DATA AND ORDERING INFORMATION FOR 102 SERIES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $U_R$ (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) | HIGH POST M5 DISC | | HIGH CURRENT M6 DISC | |
| | | | | | | | ST ORDERING CODE MAL2102..... | ST BOLT NUT ORDERING CODE MAL2102..... | ST ORDERING CODE MAL2102..... | ST BOLT NUT ORDERING CODE MAL2102..... |
| 200 | 680 | 35 x 60 | 3.5 | 0.27 | 207 | 136 | 12681E3 | 52681E3 | - | - |
| | 1000 | 35 x 80 | 4.4 | 0.40 | 144 | 95 | 12102E3 | 52102E3 | - | - |
| | 1000 | 35 x 105 | 4.7 | 0.40 | 140 | 91 | 22102E3 | 62102E3 | - | - |
| | 1500 | 35 x 105 | 5.5 | 0.60 | 100 | 67 | 12152E3 | 52152E3 | - | - |
| | 1500 | 50 x 80 | 6.2 | 0.60 | 106 | 74 | 22152E3 | 62152E3 | - | - |
| | 2200 | 50 x 80 | 8.0 | 0.88 | 67 | 44 | 12222E3 | 52222E3 | - | - |
| | 3300 | 50 x 80 | 8.9 | 1.32 | 50 | 35 | 12332E3 | 52332E3 | - | - |
| | 3300 | 50 x 105 | 9.9 | 1.32 | 46 | 32 | 22332E3 | 62332E3 | - | - |
| | 4700 | 65 x 105 | 12.5 | 1.88 | 37 | 26 | 22472E3 | 62472E3 | 42472E3 | 82472E3 |
| | 6800 | 65 x 105 | 15.2 | 2.72 | 25 | 18 | 12682E3 | 52682E3 | 32682E3 | 72682E3 |
| | 6800 | 76 x 105 | 16.9 | 2.72 | 25 | 18 | 22682E3 | 62682E3 | 42682E3 | 82682E3 |
| | 10 000 | 76 x 105 | 19.9 | 4.00 | 18 | 13 | 12103E3 | 52103E3 | 32103E3 | 72103E3 |
| | 10 000 | 76 x 146 | 20.4 | 4.00 | 18 | 13 | 22103E3 | 62103E3 | 42103E3 | 82103E3 |
| | 15 000 | 76 x 146 | 24.1 | 6.00 | 12 | 9 | 12153E3 | 52153E3 | 32153E3 | 72153E3 |
| | 22 000 | 76 x 220 | 29.5 | 8.8 | 9 | 7 | 12223E3 | 52223E3 | 32223E3 | 72223E3 |
| | 22 000 | 90 x 146 | 34.1 | 8.8 | 8 | 6 | - | - | 42223E3 | 82223E3 |
| | 33 000 | 90 x 220 | 41.7 | 13.2 | 6 | 5 | - | - | 42333E3 | 82333E3 |
| 250 | 470 | 35 x 60 | 3.1 | 0.24 | 250 | 152 | 13471E3 | 53471E3 | - | - |
| | 680 | 35 x 80 | 3.8 | 0.34 | 175 | 107 | 13681E3 | 53681E3 | - | - |
| | 1000 | 35 x 80 | 4.4 | 0.50 | 128 | 82 | 13102E3 | 53102E3 | - | - |
| | 1000 | 35 x 105 | 4.8 | 0.50 | 122 | 76 | 23102E3 | 63102E3 | - | - |
| | 1500 | 35 x 105 | 5.4 | 0.75 | 90 | 58 | 13152E3 | 53152E3 | - | - |
| | 1500 | 50 x 80 | 7.0 | 0.75 | 81 | 50 | 23152E3 | 63152E3 | - | - |
| | 2200 | 50 x 80 | 8.0 | 1.10 | 60 | 39 | 13222E3 | 53222E3 | - | - |
| | 2200 | 50 x 105 | 8.7 | 1.10 | 57 | 35 | 23222E3 | 63222E3 | - | - |
| | 3300 | 50 x 105 | 9.8 | 1.65 | 42 | 28 | 13332E3 | 53332E3 | - | - |
| | 3300 | 65 x 105 | 11.4 | 1.65 | 42 | 28 | 23332E3 | 63332E3 | 43332E3 | 83332E3 |
| | 4700 | 65 x 105 | 13.8 | 2.35 | 29 | 19 | 13472E3 | 53472E3 | 33472E3 | 73472E3 |
| | 4700 | 76 x 105 | 15.3 | 2.35 | 29 | 19 | 23472E3 | 63472E3 | 43472E3 | 83472E3 |
| | 6800 | 76 x 105 | 18.1 | 3.40 | 21 | 14 | 13682E3 | 53682E3 | 33682E3 | 73682E3 |
| | 6800 | 76 x 146 | 18.6 | 3.40 | 21 | 14 | 23682E3 | 63682E3 | 43682E3 | 83682E3 |
| | 10 000 | 76 x 105 | 19.3 | 5.00 | 17 | 12 | 13103E3 | 53103E3 | 33103E3 | 73103E3 |
| | 10 000 | 76 x 146 | 22.0 | 5.00 | 15 | 10 | 23103E3 | 63103E3 | 43103E3 | 83103E3 |
| | 15 000 | 76 x 146 | 23.3 | 7.5 | 12 | 10 | 13153E3 | 53153E3 | 33153E3 | 73153E3 |
| | 22 000 | 76 x 220 | 29.1 | 11.0 | 9 | 7 | 13223E3 | 53223E3 | 33223E3 | 73223E3 |
| | 22 000 | 90 x 146 | 35.3 | 11.0 | 7 | 5 | - | - | 43223E3 | 83223E3 |
| | 33 000 | 90 x 220 | 43.2 | 16.5 | 5 | 5 | - | - | 43333E3 | 83333E3 |
| 350 | 330 | 35 x 60 | 2.5 | 0.23 | 435 | 305 | 15331E3 | 55331E3 | - | - |
| | 470 | 35 x 80 | 3.1 | 0.33 | 308 | 216 | 25471E3 | 65471E3 | - | - |
| | 680 | 35 x 105 | 3.8 | 0.48 | 216 | 152 | 25681E3 | 65681E3 | - | - |
| | 1000 | 50 x 80 | 5.6 | 0.70 | 145 | 102 | 25102E3 | 65102E3 | - | - |
| | 1500 | 50 x 80 | 6.5 | 1.05 | 102 | 74 | 15152E3 | 55152E3 | - | - |
| | 1500 | 50 x 105 | 7.0 | 1.05 | 99 | 70 | 25152E3 | 65152E3 | - | - |
| | 2200 | 50 x 105 | 8.0 | 1.54 | 72 | 52 | 15222E3 | 55222E3 | - | - |
| | 2200 | 65 x 105 | 9.3 | 1.54 | 72 | 52 | 25222E3 | 65222E3 | 45222E3 | 85222E3 |
| | 3300 | 65 x 105 | 11.4 | 2.31 | 48 | 35 | 25332E3 | 65332E3 | 45332E3 | 85332E3 |
| | 4700 | 76 x 105 | 15.0 | 3.29 | 34 | 25 | 15472E3 | 55472E3 | 35472E3 | 75472E3 |
| | 4700 | 76 x 146 | 15.4 | 3.29 | 34 | 25 | 25472E3 | 65472E3 | 45472E3 | 85472E3 |
| | 6800 | 76 x 146 | 18.3 | 4.76 | 24 | 18 | 25682E3 | 65682E3 | 45682E3 | 85682E3 |
| | 10 000 | 76 x 220 | 23.2 | 7.0 | 15 | 12 | 15103E3 | 55103E3 | 35103E3 | 75103E3 |
| | 10 000 | 90 x 146 | 25.1 | 7.0 | 15 | 12 | - | - | 45103E3 | 85103E3 |
| | 15 000 | 90 x 220 | 31.2 | 10.5 | 10 | 8 | - | - | 45153E3 | 85153E3 |


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## ELECTRICAL DATA AND ORDERING INFORMATION FOR 102 SERIES

| $U_R$ (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) | HIGH POST M5 DISC | | HIGH CURRENT M6 DISC | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | ST ORDERING CODE MAL2102..... | ST BOLT NUT ORDERING CODE MAL2102..... | ST ORDERING CODE MAL2102..... | ST BOLT NUT ORDERING CODE MAL2102..... |
| | 220 | 35 x 60 | 2.1 | 0.17 | 575 | 380 | 18221E3 | 58221E3 | - | - |
| | 330 | 35 x 80 | 2.7 | 0.26 | 386 | 257 | 18331E3 | 58331E3 | - | - |
| | 470 | 35 x 80 | 3.1 | 0.37 | 279 | 188 | 18471E3 | 58471E3 | - | - |
| | 680 | 35 x 105 | 3.9 | 0.53 | 196 | 133 | 18681E3 | 58681E3 | - | - |
| | 1000 | 50 x 80 | 5.6 | 0.77 | 132 | 89 | 18102E3 | 58102E3 | - | - |
| 385 | 1500 | 50 x 105 | 7.1 | 1.16 | 90 | 61 | 18152E3 | 58152E3 | - | - |
| | 2200 | 65 x 105 | 10.0 | 1.70 | 61 | 42 | 18222E3 | 58222E3 | 38222E3 | 78222E3 |
| | 3300 | 76 x 105 | 13.4 | 2.55 | 42 | 29 | 18332E3 | 58332E3 | 38332E3 | 78332E3 |
| | 4700 | 76 x 105 | 15.0 | 3.62 | 31 | 22 | 18472E3 | 58472E3 | 38472E3 | 78472E3 |
| | 4700 | 76 x 146 | 16.3 | 3.62 | 29 | 20 | 28472E3 | 68472E3 | 48472E3 | 88472E3 |
| | 6800 | 76 x 146 | 18.3 | 5.24 | 22 | 16 | 18682E3 | 58682E3 | 38682E3 | 78682E3 |
| | 220 | 35 x 60 | 2.1 | 0.18 | 557 | 363 | 16221E3 | 56221E3 | - | - |
| | 330 | 35 x 60 | 2.5 | 0.26 | 383 | 254 | 16331E3 | 56331E3 | - | - |
| | 330 | 35 x 80 | 2.7 | 0.26 | 374 | 245 | 26331E3 | 66331E3 | - | - |
| | 470 | 35 x 80 | 3.1 | 0.38 | 271 | 180 | 16471E3 | 56471E3 | - | - |
| | 470 | 35 x 105 | 3.3 | 0.38 | 265 | 175 | 26471E3 | 66471E3 | - | - |
| | 680 | 35 x 105 | 3.9 | 0.55 | 191 | 128 | 16681E3 | 56681E3 | - | - |
| | 680 | 50 x 80 | 4.5 | 0.54 | 199 | 136 | 26681E3 | 66681E3 | - | - |
| | 1000 | 50 x 80 | 5.7 | 0.80 | 128 | 86 | 16102E3 | 56102E3 | - | - |
| 400 | 1000 | 50 x 105 | 6.0 | 0.80 | 125 | 83 | 26102E3 | 66102E3 | - | - |
| | 1500 | 50 x 105 | 7.1 | 1.20 | 88 | 59 | 26152E3 | 66152E3 | - | - |
| | 2200 | 65 x 105 | 10.0 | 1.76 | 60 | 40 | 26222E3 | 66222E3 | 46222E3 | 86222E3 |
| | 3300 | 65 x 105 | 12.1 | 2.64 | 40 | 27 | 16332E3 | 56332E3 | 36332E3 | 76332E3 |
| | 3300 | 76 x 105 | 13.4 | 2.64 | 40 | 27 | 26332E3 | 66332E3 | 46332E3 | 86332E3 |
| | 4700 | 76 x 105 | 15.0 | 3.76 | 31 | 21 | 16472E3 | 56472E3 | 36472E3 | 76472E3 |
| | 4700 | 76 x 146 | 16.4 | 3.76 | 28 | 19 | 26472E3 | 66472E3 | 46472E3 | 86472E3 |
| | 6800 | 76 x 146 | 18.3 | 5.44 | 22 | 15 | 26682E3 | 66682E3 | 46682E3 | 86682E3 |
| | 10000 | 76 x 220 | 22.1 | 8.0 | 14 | 11 | 16103E3 | 56103E3 | 36103E3 | 76103E3 |
| | 220 | 35 x 60 | 2.1 | 0.20 | 503 | 313 | 17221E3 | 57221E3 | - | - |
| | 330 | 35 x 80 | 2.7 | 0.30 | 339 | 212 | 27331E3 | 67331E3 | - | - |
| | 470 | 35 x 105 | 3.4 | 0.42 | 241 | 151 | 27471E3 | 67471E3 | - | - |
| | 680 | 50 x 80 | 4.9 | 0.61 | 159 | 98 | 27681E3 | 67681E3 | - | - |
| | 1000 | 50 x 80 | 5.7 | 0.90 | 118 | 75 | 17102E3 | 57102E3 | - | - |
| | 1000 | 50 x 105 | 6.1 | 0.90 | 114 | 72 | 27102E3 | 67102E3 | - | - |
| | 1500 | 50 x 105 | 7.1 | 1.35 | 81 | 52 | 17152E3 | 57152E3 | - | - |
| | 1500 | 65 x 105 | 8.3 | 1.35 | 81 | 52 | 27152E3 | 67152E3 | 47152E3 | 87152E3 |
| 450 | 2200 | 65 x 105 | 10.1 | 1.98 | 55 | 35 | 17222E3 | 57222E3 | 37222E3 | 77222E3 |
| | 2200 | 76 x 105 | 11.2 | 1.98 | 55 | 35 | 27222E3 | 67222E3 | 47222E3 | 87222E3 |
| | 3300 | 76 x 105 | 13.5 | 2.97 | 37 | 24 | 17332E3 | 57332E3 | 37332E3 | 77332E3 |
| | 3300 | 76 x 146 | 13.9 | 2.97 | 37 | 24 | 27332E3 | 67332E3 | 47332E3 | 87332E3 |
| | 4700 | 76 x 146 | 16.4 | 4.23 | 26 | 17 | 17472E3 | 57472E3 | 37472E3 | 77472E3 |
| | 5600 | 76 x 146 | 17.3 | 5.04 | 23 | 15 | 17562E3 | 57562E3 | 37562E3 | 77562E3 |
| | 6800 | 76 x 220 | 19.8 | 6.1 | 25 | 20 | 17682E3 | 57682E3 | 37682E3 | 77682E3 |
| | 6800 | 90 x 146 | 21.3 | 6.1 | 24 | 19 | - | - | 47682E3 | 87682E3 |
| | 10 000 | 90 x 220 | 26.5 | 9.0 | 17 | 14 | - | - | 47103E3 | 87103E3 |


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| ADDITIONAL ELECTRICAL DATA | | |
|---|---|---|
| **PARAMETER** | **CONDITIONS** | **VALUE** |
| **Voltage** | | |
| Surge voltage | ≤ 250 V versions | $U_S = 1.15 \times U_R$ |
| | ≥ 350 V versions | $U_S = 1.1 \times U_R$ |
| Reverse voltage | | $U_{rev} \leq 1$ V |
| **Current** | | |
| Leakage current | After 1 min at $U_R$ | $I_{L1} \leq 0.006\ C_R \times U_R$ |
| | After 5 min at $U_R$ | $I_{L5} \leq 0.002\ C_R \times U_R$ |
| **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

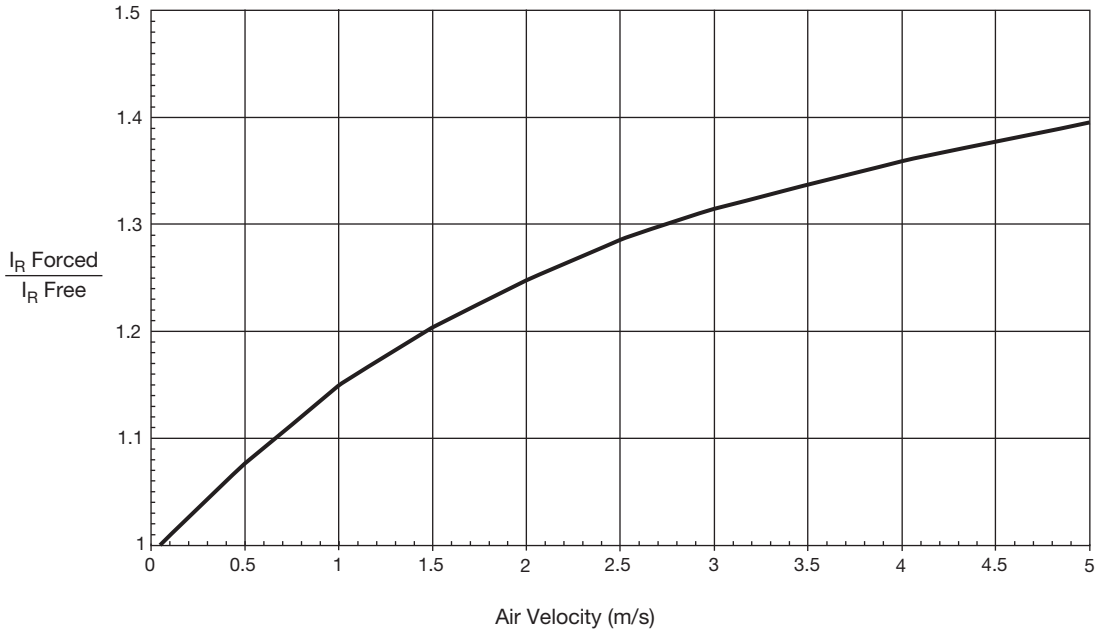



Fig. 3 - Multiplier of ripple current ($I_R$) as a function of air flow

| MAXIMUM RIPPLE CURRENT | | | |
|---|---|---|---|
| **PARAMETER** | **CONDITION** | **MAXIMUM RIPPLE CURRENT MULTIPLIER** | **VALUE** |
| Ambient temperature ($T_{amb}$) | 70 °C | from nomogam; see fig. 4 | 1.6 |
| Operating frequency (f) | 400 Hz | from frequency; see table 4 | 1.3 |
| Air flow | 2 m/s | from air flow; see fig. 3 | 1.25 |

**Note**

- Calculation example for 102 series. maximum ripple current multiplier = 1.6 x 1.3 x 1.25 = 2.6


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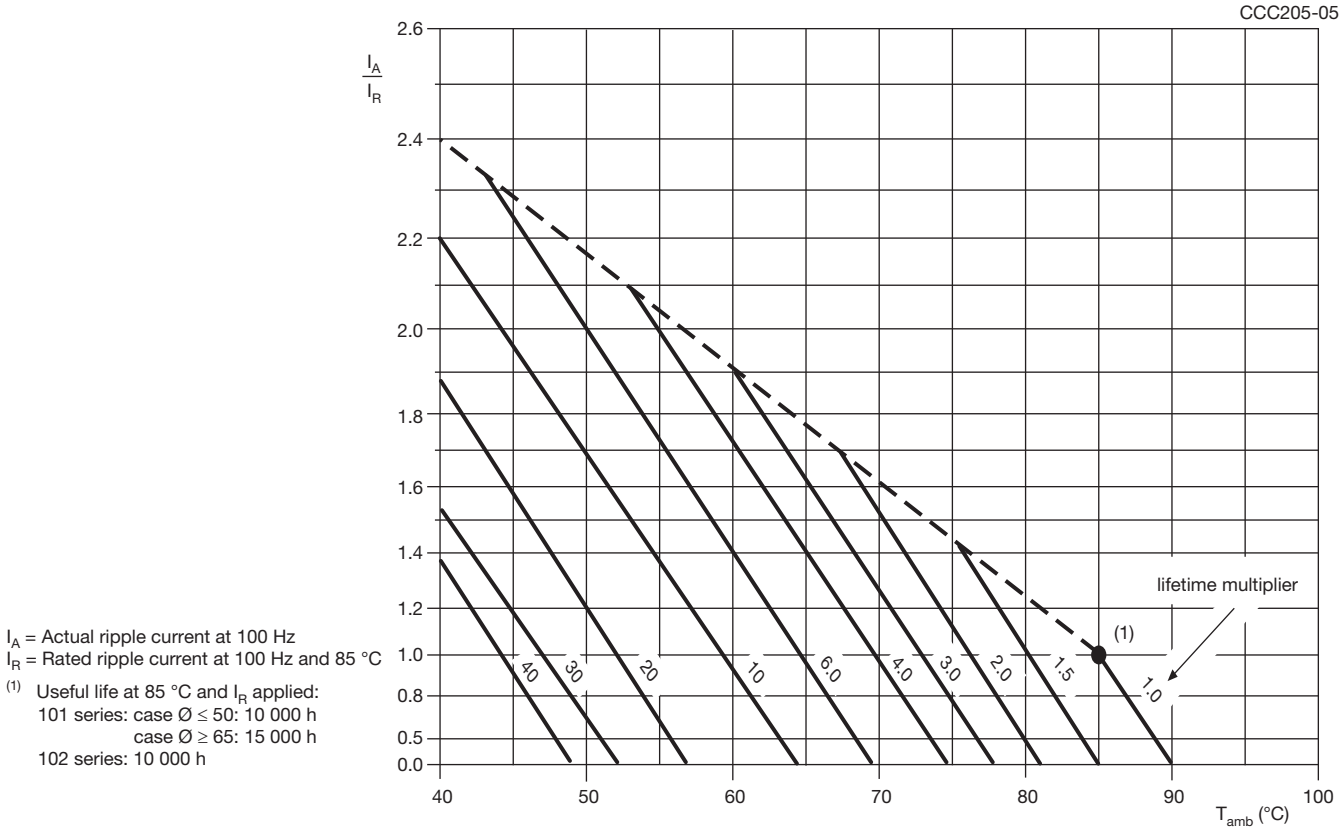



Fig. 4 - Multiplier of useful life as a function of ambient temperature and ripple current load

**Table 4**

| MULTIPLIER OF RIPPLE CURRENT ($I_R$) AS A FUNCTION OF FREQUENCY | | |
|---|---|---|
| FREQUENCY (Hz) | $I_R$ MULTIPLIER | |
| | 101 | 102 |
| 50 | 0.85 | 0.90 |
| 100 | 1.00 | 1.00 |
| 200 | 1.10 | 1.20 |
| 400 | 1.15 | 1.30 |
| 1000 | 1.20 | 1.40 |
| 10 000 | 1.30 | 1.50 |



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**Table 5**

| TEST PROCEDURES AND REQUIREMENTS | | | |
|---|---|---|---|
| **TEST** | | **PROCEDURE (quick reference)** | **REQUIREMENTS** |
| **NAME OF TEST** | **REFERENCE** | | |
| Endurance | IEC 60384-4/EN130300 subclause 4.13 | $T_{amb}$ = 85 °C; $U_R$ applied; 2000 h | $U_R \leq 100$ V; $\Delta C/C$: ± 15 %<br>$U_R > 100$ V; $\Delta C/C$: ± 10 %<br>tan $\delta \leq 1.3$ x spec. limit<br>$Z \leq 2$ x spec. limit<br>$I_{L5} \leq$ spec. limit |
| Useful life | CECC 30301 subclause 1.8.1 | $T_{amb}$ = 85 °C; $U_R$ and $I_R$ applied<br><br>101 series:<br>case Ø D ≤ 50: 10 000 h<br>case Ø D ≥ 65: 15 000 h<br><br>102 series:<br>10 000 h | $U_R \leq 100$ V; $\Delta C/C$: ± 45 %<br>$U_R > 100$ V; $\Delta C/C$: ± 30 %<br>tan $\delta \leq 3$ x spec. limit<br>$Z \leq 3$ x spec. limit<br>$I_{L5} \leq$ spec. limit<br>no short or open circuit, no visible damage<br>Total failure percentage:<br>$U_R \leq 100$ V; ≤ 1 %<br>$U_R > 100$ V; ≤ 3 % |
| Shelf life (storage at high temperature) | IEC 60384-4/EN130300 subclause 4.17 | $T_{amb}$ = 85 °C; no voltage applied; 500 h<br><br>after test: $U_R$ to be applied for 30 min, 24 h to 48 h before measurement | $\Delta C/C$: ± 10 %<br>tan $\delta \leq 1.2$ x spec. limit<br>$I_{L5} \leq 2$ x spec. limit |


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