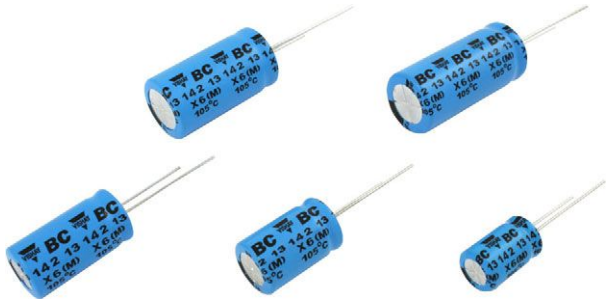
# Aluminum Electrolytic Capacitors
# Radial High Temperature Standard



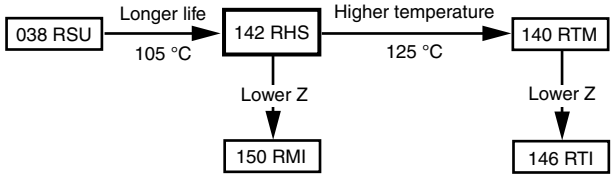



Fig. 1

| QUICK REFERENCE DATA | |
|---|---|
| **DESCRIPTION** | **VALUE** |
| Nominal case sizes (Ø D x L in mm) | 5 x 11 to 18 x 40 |
| Rated capacitance range, $C_R$ | 1 µF to 22 000 µF |
| Tolerance on $C_R$ | ± 20 % |
| Rated voltage range, $U_R$ | 10 V to 450 V |
| Category temperature range | -40 °C to +105 °C |
| Endurance test at 105 °C | 2000 h |
| Useful life at 105 °C | 2500 h |
| Useful life at 40 °C, 1.6 x $I_R$ applied | 140 000 h |
| Shelf life at 0 V, 105 °C | 1000 h |
| Based on sectional specification | IEC 60384-4 / EN130300 |
| Climatic category IEC 60068 | 40 / 105 / 56 |

## FEATURES

Pb-free

RoHS COMPLIANT

- Useful life: 2500 h at 105 °C
- Miniaturized, high CV-product per unit volume
- Charge and discharge proof
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief for case Ø D ≥ 6.3 mm
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

## APPLICATIONS

- Industrial, telecom and domestic appliances
- Decoupling, smoothing, filtering, buffering in SMPS
- Portable and mobile equipment (small size, low mass)

## 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, in accordance with IEC 60062
- Code indicating factory of origin
- Name or logo of manufacturer
- Negative terminal identification
- Series number (142)

| SELECTION CHART FOR $C_R$, $U_R$, AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm) | | | | | | | |
|---|---|---|---|---|---|---|---|
| $C_R$ (µF) | $U_R$ (V) | | | | | | |
| | 10 | 16 | 25 | 35 | 50 | 63 | 100 |
| 1.0 | → | → | → | → | → | 5 x 11 | - |
| 2.2 | → | → | → | → | → | → | 5 x 11 |
| 3.3 | → | → | → | → | → | 5 x 11 | - |
| 4.7 | → | → | → | → | → | 5 x 11 | 5 x 11 |
| | | | | | | | 6.3 x 11 |
| 6.8 | → | → | → | → | → | 5 x 11 | - |
| 10 | → | → | → | → | → | 5 x 11 | 6.3 x 11 |
| | | | | | | | 8 x 12 |
| 22 | → | → | → | → | 5 x 11 | 5 x 11 | 6.3 x 11 |
| | | | | | | 6.3 x 11 | 8 x 12 |
| 33 | → | → | 5 x 11 | → | 5 x 11 | 6.3 x 11 | 8 x 12 |
| | | | | | | | 10 x 12 |
| 47 | → | → | 5 x 11 | 5 x 11 | 6.3 x 11 | 6.3 x 11 | 10 x 16 |
| | | | | | | 8 x 12 | |
| 100 | → | 5 x 11 | 6.3 x 11 | 6.3 x 11 | 8 x 12 | 10 x 12 | 10 x 20 |
| 220 | 5 x 11 | 6.3 x 11 | 8 x 12 | 8 x 12 | 10 x 12 | 10 x 16 | 12.5 x 25 |
| 330 | 6.3 x 11 | 8 x 12 | 8 x 12 | 10 x 12 | 10 x 16 | 10 x 20 | 12.5 x 25 |
| | | | | | | | 16 x 25 |
| 470 | 6.3 x 11 | 8 x 12 | 10 x 12 | 10 x 16 | 10 x 20 | 12.5 x 20 | 16 x 31 |
| | 8 x 12 | 10 x 12 | | | 12.5 x 20 | | |
| 1000 | 10 x 12 | 10 x 16 | 10 x 20 | 12.5 x 20 | 12.5 x 25 | 16 x 25 | 18 x 40 |
| 2200 | 10 x 20 | 12.5 x 20 | 12.5 x 25 | 16 x 25 | 16 x 35 | 18 x 40 | - |
| 3300 | → | 12.5 x 25 | 16 x 25 | 16 x 31 | 18 x 35 | - | - |
| 4700 | 12.5 x 25 | 16 x 25 | 16 x 31 | 18 x 35 | - | - | - |
| 6800 | 16 x 25 | 16 x 31 | 18 x 35 | - | - | - | - |
| 10 000 | 16 x 31 | 18 x 31 | - | - | - | - | - |
| 22 000 | 18 x 40 | - | - | - | - | - | - |

| SELECTION CHART FOR $C_R$, $U_R$, AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm) | | | | | |
|---|---|---|---|---|---|
| $C_R$ (µF) | $U_R$ (V) | | | | |
| | 200 | 250 | 350 | 400 | 450 |
| 1.0 | 5 x 11 | 5 x 11 | 6.3 x 11 | 6.3 x 11 | 8 x 12 |
| 2.2 | 6.3 x 11 | 6.3 x 11 | 8 x 12 | 8 x 12 | 10 x 12 |
| 4.7 | 8 x 12 | 8 x 12 | 10 x 12 | 10 x 12 | 10 x 16 |
| 10 | 10 x 12 | 10 x 12 | 10 x 16 | 10 x 20 | 12.5 x 20 |
| 22 | 10 x 16 | 10 x 20 | 12.5 x 20 | 12.5 x 25 | 16 x 20 |
| 33 | → | 12.5 x 20 | → | → | 16 x 25 |
| 47 | 12.5 x 20 | 12.5 x 25 | 16 x 25 | 16 x 31 | 16 x 35 |
| 100 | 16 x 25 | 16 x 31 | 18 x 35 | 18 x 40 | - |
| 220 | 18 x 35 | - | - | - | - |

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

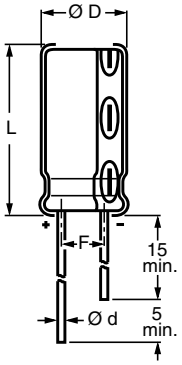



Fig. 2 - **Form CA**
Long leads

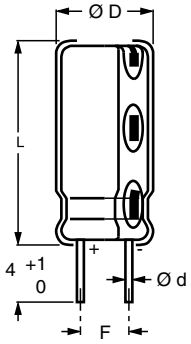
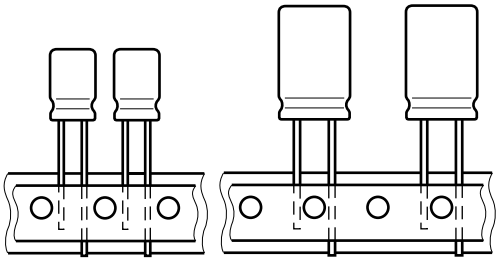
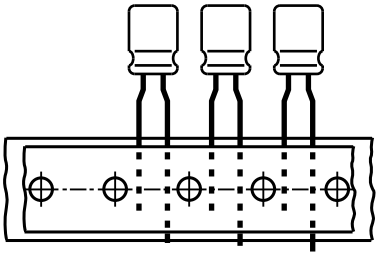



Fig. 3 - **Form CB**
Cut leads



Dimensions of lead space F see Table 2

Fig. 4 - **Form TNA, Form TFA**
Taped in box (ammopack), straight leads



Case Ø D = 5 mm to 8 mm;
Lead space F is 5 mm

Fig. 5 - **Form TFA**
Taped in box (ammopack), formed leads

**Table 1**

| **DIMENSIONS** in millimeters, **MASS AND PACKAGING QUANTITIES** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **NOMINAL CASE SIZE Ø D x L** | **CASE CODE** | **Ø d** | **Ø $D_{max.}$** | **$L_{max.}$** | **F** | **MASS (g)** | **PACKAGING QUANTITIES** | | |
| | | | | | | | **FORM CA** | **FORM CB** | **FORM TFA, TNA** |
| 5 x 11 | 11 | 0.5 | 5.5 | 12.5 | 2.0 ± 0.5 | ≈ 0.4 | 5000 | - | 2000 |
| 6.3 x 11 | 12 | 0.5 | 6.8 | 12.5 | 2.5 ± 0.5 | ≈ 0.6 | 5000 | - | 2000 |
| 8 x 12 | 13 | 0.6 | 8.5 | 13.0 | 3.5 ± 0.5 | ≈ 1.1 | 5000 | - | 1000 |
| 10 x 12 | 14 | 0.6 | 10.5 | 13.5 | 5.0 ± 0.5 | ≈ 1.6 | 3000 | 1000 | 500 |
| 10 x 16 | 15 | 0.6 | 10.5 | 17.5 | 5.0 ± 0.5 | ≈ 1.9 | 2500 | 1000 | 500 |
| 10 x 20 | 16 | 0.6 | 10.5 | 22.0 | 5.0 ± 0.5 | ≈ 2.2 | 2000 | 800 | 500 |
| 12.5 x 20 | 17 | 0.6 | 13.0 | 22.0 | 5.0 ± 0.5 | ≈ 4.0 | 1500 | 400 | 300 |
| 12.5 x 25 | 18 | 0.6 | 13.0 | 27.0 | 5.0 ± 0.5 | ≈ 5.0 | 1000 | 400 | 300 |
| 16 x 20 | 19a | 0.8 | 16.5 | 22.0 | 7.5 ± 0.5 | ≈ 6.0 | 1000 | 200 | 200 |
| 16 x 25 | 19 | 0.8 | 16.5 | 27.0 | 7.5 ± 0.5 | ≈ 8.0 | 750 | 200 | 200 |
| 16 x 31 | 20 | 0.8 | 16.5 | 33.5 | 7.5 ± 0.5 | ≈ 9.0 | 600 | 200 | 200 |
| 16 x 35 | 21 | 0.8 | 16.5 | 37.5 | 7.5 ± 0.5 | ≈ 11.0 | 500 | 200 | - |
| 18 x 31 | 1831 | 0.8 | 18.5 | 33.5 | 7.5 ± 0.5 | ≈ 12.5 | 400 | 150 | - |
| 18 x 35 | 22 | 0.8 | 18.5 | 37.5 | 7.5 ± 0.5 | ≈ 14.5 | 400 | 150 | - |
| 18 x 40 | 23 | 0.8 | 18.5 | 42.0 | 7.5 ± 0.5 | ≈ 16.0 | 400 | 150 | - |

**Note**

- For detailed tape dimensions please refer to packaging information: www.vishay.com/doc?28360

| ELECTRICAL DATA | |
|---|---|
| SYMBOL | DESCRIPTION |
| $C_R$ | Rated capacitance at 100 Hz, tolerance ± 20 % |
| $I_R$ | Rated RMS ripple current at 100 Hz, 105 °C |
| $I_{L2}$ | Max. leakage current after 2 min at $U_R$ = 10 V to 100 V |
| $I_{L5}$ | Max. leakage current after 5 min at $U_R$ = 200 V to 450 V |
| tan δ | Max. dissipation factor at 100 Hz |

**Note**

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

## ORDERING EXAMPLE

Electrolytic capacitor 142 series

470 µF / 25 V; ± 20 %

Nominal case size: Ø 10 mm x 12 mm; Form TFA

Ordering Code: MAL214236471E3

**Table 2**

**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 105 °C (mA) | $I_{L2}$ 2 min (µA) | tan δ 100 Hz | FREQ. CODE (1) | ORDERING CODE MAL2142... | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | BULK PACKAGING | | | | TAPED AMMOPACK | | | |
| | | | | | | | LONG LEADS | | CUT LEADS | | | | | |
| | | | | | | | FORM CA | F (mm) | FORM CB | F (mm) | FORM TNA | F (mm) | FORM TFA | F (mm) |
| 10 | 220 | 5 x 11 | 115 | 22 | 0.20 | MF2 | 54221E3 | 2.0 | - | - | 74221E3 | 2.5 | 34221E3 | 5.0 |
| | 330 | 6.3 x 11 | 200 | 33 | 0.20 | MF2 | 54331E3 | 2.5 | - | - | 74331E3 | 2.5 | 34331E3 | 5.0 |
| | 470 | 6.3 x 11 | 204 | 47 | 0.20 | MF2 | 94475E3 | 2.5 | - | - | 94477E3 | 2.5 | 94473E3 | 5.0 |
| | 470 | 8 x 12 | 290 | 47 | 0.20 | MF2 | 54471E3 | 3.5 | - | - | 74471E3 | 3.5 | 34471E3 | 5.0 |
| | 1000 | 10 x 12 | 460 | 100 | 0.20 | MF2 | 54102E3 | 5.0 | 64102E3 | 5.0 | - | - | 34102E3 | 5.0 |
| | 2200 | 10 x 20 | 760 | 220 | 0.22 | MF3 | 54222E3 | 5.0 | 64222E3 | 5.0 | - | - | 34222E3 | 5.0 |
| | 4700 | 12.5 x 25 | 1260 | 470 | 0.26 | MF3 | 54472E3 | 5.0 | 64472E3 | 5.0 | - | - | 34472E3 | 5.0 |
| | 6800 | 16 x 25 | 1690 | 680 | 0.28 | MF3 | 54682E3 | 7.5 | 64682E3 | 7.5 | - | - | 34682E3 | 7.5 |
| | 10 000 | 16 x 31 | 2120 | 1000 | 0.30 | MF3 | 54103E3 | 7.5 | 64103E3 | 7.5 | - | - | 34103E3 | 7.5 |
| | 22 000 | 18 x 40 | 3100 | 2200 | 0.32 | MF3 | 54223E3 | 7.5 | 64223E3 | 7.5 | - | - | - | - |
| 16 | 100 | 5 x 11 | 110 | 16 | 0.16 | MF2 | 55101E3 | 2.0 | - | - | 75101E3 | 2.5 | 35101E3 | 5.0 |
| | 220 | 6.3 x 11 | 190 | 35 | 0.16 | MF2 | 55221E3 | 2.5 | - | - | 75221E3 | 2.5 | 35221E3 | 5.0 |
| | 330 | 8 x 12 | 270 | 53 | 0.16 | MF2 | 55331E3 | 3.5 | - | - | 75331E3 | 3.5 | 35331E3 | 5.0 |
| | 470 | 8 x 12 | 310 | 75 | 0.16 | MF2 | 95475E3 | 3.5 | - | - | 95477E3 | 3.5 | 95473E3 | 5.0 |
| | 470 | 10 x 12 | 370 | 75 | 0.16 | MF2 | 55471E3 | 5.0 | 65471E3 | 5.0 | - | - | 35471E3 | 5.0 |
| | 1000 | 10 x 16 | 560 | 160 | 0.16 | MF2 | 55102E3 | 5.0 | 65102E3 | 5.0 | - | - | 35102E3 | 5.0 |
| | 2200 | 12.5 x 20 | 920 | 352 | 0.18 | MF3 | 55222E3 | 5.0 | 65222E3 | 5.0 | - | - | 35222E3 | 5.0 |
| | 3300 | 12.5 x 25 | 1170 | 528 | 0.20 | MF3 | 55332E3 | 5.0 | 65332E3 | 5.0 | - | - | 35332E3 | 5.0 |
| | 4700 | 16 x 25 | 1480 | 752 | 0.22 | MF3 | 55472E3 | 7.5 | 65472E3 | 7.5 | - | - | 35472E3 | 7.5 |
| | 6800 | 16 x 31 | 1930 | 1088 | 0.24 | MF3 | 55682E3 | 7.5 | 65682E3 | 7.5 | - | - | 35682E3 | 7.5 |
| | 10 000 | 18 x 31 | 2330 | 1600 | 0.26 | MF3 | 55103E3 | 7.5 | 65103E3 | 7.5 | - | - | - | - |
| 25 | 33 | 5 x 11 | 68 | 8 | 0.14 | MF1 | 56339E3 | 2.0 | - | - | 76339E3 | 2.5 | 36339E3 | 5.0 |
| | 47 | 5 x 11 | 97 | 12 | 0.14 | MF1 | 56479E3 | 2.0 | - | - | 76479E3 | 2.5 | 36479E3 | 5.0 |
| | 100 | 6.3 x 11 | 142 | 25 | 0.14 | MF2 | 56101E3 | 2.5 | - | - | 76101E3 | 2.5 | 36101E3 | 5.0 |
| | 220 | 8 x 12 | 236 | 55 | 0.14 | MF2 | 56221E3 | 3.5 | - | - | 76221E3 | 3.5 | 36221E3 | 5.0 |
| | 330 | 8 x 12 | 310 | 82 | 0.14 | MF2 | 56331E3 | 3.5 | - | - | 76331E3 | 3.5 | 36331E3 | 5.0 |
| | 470 | 10 x 12 | 380 | 118 | 0.14 | MF2 | 56471E3 | 5.0 | 66471E3 | 5.0 | - | - | 36471E3 | 5.0 |
| | 1000 | 10 x 20 | 680 | 250 | 0.14 | MF2 | 56102E3 | 5.0 | 66102E3 | 5.0 | - | - | 36102E3 | 5.0 |
| | 2200 | 12.5 x 25 | 1110 | 550 | 0.16 | MF3 | 56222E3 | 5.0 | 66222E3 | 5.0 | - | - | 36222E3 | 5.0 |
| | 3300 | 16 x 25 | 1440 | 825 | 0.18 | MF3 | 56332E3 | 7.5 | 66332E3 | 7.5 | - | - | 36332E3 | 7.5 |
| | 4700 | 16 x 31 | 1710 | 1175 | 0.20 | MF3 | 56472E3 | 7.5 | 66472E3 | 7.5 | - | - | 36472E3 | 7.5 |
| | 6800 | 18 x 35 | 2160 | 1700 | 0.22 | MF3 | 56682E3 | 7.5 | 66682E3 | 7.5 | - | - | - | - |

## 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 105 °C (mA) | $I_{L2}$ 2 min (µA) | tan δ 100 Hz | FREQ. CODE (1) | ORDERING CODE MAL2142... | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | BULK PACKAGING | | | | TAPED AMMOPACK | | | |
| | | | | | | | LONG LEADS | | CUT LEADS | | | | | |
| | | | | | | | FORM CA | F (mm) | FORM CB | F (mm) | FORM TNA | F (mm) | FORM TFA | F (mm) |
| 35 | 47 | 5 x 11 | 90 | 16 | 0.12 | MF1 | 50479E3 | 2.0 | - | - | 70479E3 | 2.5 | 30479E3 | 5.0 |
| | 100 | 6.3 x 11 | 150 | 35 | 0.12 | MF2 | 50101E3 | 2.5 | - | - | 70101E3 | 2.5 | 30101E3 | 5.0 |
| | 220 | 8 x 12 | 270 | 77 | 0.12 | MF2 | 50221E3 | 3.5 | - | - | 70221E3 | 3.5 | 30221E3 | 5.0 |
| | 330 | 10 x 12 | 350 | 116 | 0.12 | MF2 | 50331E3 | 5.0 | 60331E3 | 5.0 | - | - | 30331E3 | 5.0 |
| | 470 | 10 x 16 | 460 | 165 | 0.12 | MF2 | 50471E3 | 5.0 | 60471E3 | 5.0 | - | - | 30471E3 | 5.0 |
| | 1000 | 12.5 x 20 | 810 | 350 | 0.12 | MF2 | 50102E3 | 5.0 | 60102E3 | 5.0 | - | - | 30102E3 | 5.0 |
| | 2200 | 16 x 25 | 1260 | 770 | 0.14 | MF3 | 50222E3 | 7.5 | 60222E3 | 7.5 | - | - | 30222E3 | 7.5 |
| | 3300 | 16 x 31 | 1420 | 1155 | 0.16 | MF3 | 50332E3 | 7.5 | 60332E3 | 7.5 | - | - | 30332E3 | 7.5 |
| | 4700 | 18 x 35 | 1900 | 1645 | 0.18 | MF3 | 50472E3 | 7.5 | 60472E3 | 7.5 | - | - | - | - |
| 50 | 22 | 5 x 11 | 78 | 11 | 0.10 | MF1 | 51229E3 | 2.0 | - | - | 71229E3 | 2.5 | 31229E3 | 5.0 |
| | 33 | 5 x 11 | 90 | 16 | 0.10 | MF1 | 51339E3 | 2.0 | - | - | 71339E3 | 2.5 | 31339E3 | 5.0 |
| | 47 | 6.3 x 11 | 120 | 24 | 0.10 | MF1 | 51479E3 | 2.5 | - | - | 71479E3 | 2.5 | 31479E3 | 5.0 |
| | 100 | 8 x 12 | 188 | 50 | 0.10 | MF2 | 51101E3 | 3.5 | - | - | 71101E3 | 3.5 | 31101E3 | 5.0 |
| | 220 | 10 x 12 | 240 | 110 | 0.10 | MF2 | 51221E3 | 5.0 | 61221E3 | 5.0 | - | - | 31221E3 | 5.0 |
| | 330 | 10 x 16 | 410 | 165 | 0.10 | MF2 | 51331E3 | 5.0 | 61331E3 | 5.0 | - | - | 31331E3 | 5.0 |
| | 470 | 10 x 20 | 530 | 235 | 0.10 | MF2 | 91475E3 | 5.0 | 91476E3 | 5.0 | - | - | 91473E3 | 5.0 |
| | 470 | 12.5 x 20 | 530 | 235 | 0.10 | MF2 | 51471E3 | 5.0 | 61471E3 | 5.0 | - | - | 31471E3 | 5.0 |
| | 1000 | 12.5 x 25 | 950 | 500 | 0.10 | MF2 | 51102E3 | 5.0 | 61102E3 | 5.0 | - | - | 31102E3 | 5.0 |
| | 2200 | 16 x 35 | 1470 | 1100 | 0.12 | MF3 | 51222E3 | 7.5 | 61222E3 | 7.5 | - | - | - | - |
| | 3300 | 18 x 35 | 1770 | 1650 | 0.14 | MF3 | 51332E3 | 7.5 | 61332E3 | 7.5 | - | - | - | - |
| 63 | 1.0 | 5 x 11 | 13 | 3 | 0.09 | MF1 | 58108E3 | 2.0 | - | - | 78108E3 | 2.5 | 38108E3 | 5.0 |
| | 3.3 | 5 x 11 | 30 | 3 | 0.09 | MF1 | 58338E3 | 2.0 | - | - | 78338E3 | 2.5 | 38338E3 | 5.0 |
| | 4.7 | 5 x 11 | 36 | 3 | 0.09 | MF1 | 58478E3 | 2.0 | - | - | 78478E3 | 2.5 | 38478E3 | 5.0 |
| | 6.8 | 5 x 11 | 40 | 4 | 0.09 | MF1 | 58688E3 | 2.0 | - | - | 78688E3 | 2.5 | 38688E3 | 5.0 |
| | 10 | 5 x 11 | 54 | 6 | 0.09 | MF1 | 58109E3 | 2.0 | - | - | 78109E3 | 2.5 | 38109E3 | 5.0 |
| | 22 | 5 x 11 | 70 | 14 | 0.09 | MF1 | 98225E3 | 2.0 | - | - | 98227E3 | 2.5 | 98223E3 | 5.0 |
| | 22 | 6.3 x 11 | 86 | 14 | 0.09 | MF1 | 58229E3 | 2.5 | - | - | 78229E3 | 2.5 | 38229E3 | 5.0 |
| | 33 | 6.3 x 11 | 100 | 21 | 0.09 | MF1 | 58339E3 | 2.5 | - | - | 78339E3 | 2.5 | 38339E3 | 5.0 |
| | 47 | 6.3 x 11 | 130 | 30 | 0.09 | MF1 | 98475E3 | 2.5 | - | - | 98477E3 | 2.5 | 98473E3 | 5.0 |
| | 47 | 8 x 12 | 141 | 30 | 0.09 | MF1 | 58479E3 | 3.5 | - | - | 78479E3 | 3.5 | 38479E3 | 5.0 |
| | 100 | 10 x 12 | 235 | 63 | 0.09 | MF2 | 58101E3 | 5.0 | 68101E3 | 5.0 | - | - | 38101E3 | 5.0 |
| | 220 | 10 x 16 | 335 | 139 | 0.09 | MF2 | 58221E3 | 5.0 | 68221E3 | 5.0 | - | - | 38221E3 | 5.0 |
| | 330 | 10 x 20 | 510 | 208 | 0.09 | MF2 | 58331E3 | 5.0 | 68331E3 | 5.0 | - | - | 38331E3 | 5.0 |
| | 470 | 12.5 x 20 | 640 | 296 | 0.09 | MF2 | 58471E3 | 5.0 | 68471E3 | 5.0 | - | - | 38471E3 | 5.0 |
| | 1000 | 16 x 25 | 930 | 630 | 0.09 | MF2 | 58102E3 | 7.5 | 68102E3 | 7.5 | - | - | 38102E3 | 7.5 |
| | 2200 | 18 x 40 | 2340 | 1380 | 0.09 | MF3 | 58222E3 | 7.5 | 68222E3 | 7.5 | - | - | - | - |

## 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 105 °C (mA) | $I_{L2}$ 2 min (µA) | tan δ 100 Hz | FREQ. CODE (1) | ORDERING CODE MAL2142... | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | BULK PACKAGING | | | | TAPED AMMOPACK | | | |
| | | | | | | | LONG LEADS | | CUT LEADS | | | | | |
| | | | | | | | FORM CA | F (mm) | FORM CB | F (mm) | FORM TNA | F (mm) | FORM TFA | F (mm) |
| 100 | 2.2 | 5 x 11 | 30 | 3 | 0.08 | MF1 | 59228E3 | 2.0 | - | - | 79228E3 | 2.5 | 39228E3 | 5.0 |
| | 4.7 | 5 x 11 | 36 | 5 | 0.08 | MF1 | 99475E3 | 2.0 | - | - | 99477E3 | 2.5 | 99473E3 | 5.0 |
| | 4.7 | 6.3 x 11 | 40 | 5 | 0.08 | MF1 | 59478E3 | 2.5 | - | - | 79478E3 | 2.5 | 39478E3 | 5.0 |
| | 10 | 6.3 x 11 | 54 | 10 | 0.08 | MF1 | 99105E3 | 2.5 | - | - | 99107E3 | 2.5 | 99103E3 | 5.0 |
| | 10 | 8 x 12 | 66 | 10 | 0.08 | MF1 | 59109E3 | 3.5 | - | - | 79109E3 | 3.5 | 39109E3 | 5.0 |
| | 22 | 6.3 x 11 | 93 | 22 | 0.08 | MF1 | 99225E3 | 2.5 | - | - | 99227E3 | 2.5 | 99223E3 | 5.0 |
| | 22 | 8 x 12 | 99 | 22 | 0.08 | MF1 | 59229E3 | 3.5 | - | - | 79229E3 | 3.5 | 39229E3 | 5.0 |
| | 33 | 8 x 12 | 130 | 33 | 0.08 | MF1 | 99395E3 | 3.5 | - | - | 99397E3 | 3.5 | 99393E3 | 5.0 |
| | 33 | 10 x 12 | 148 | 33 | 0.08 | MF1 | 59339E3 | 5.0 | 69339E3 | 5.0 | - | - | 39339E3 | 5.0 |
| | 47 | 10 x 16 | 180 | 47 | 0.08 | MF1 | 59479E3 | 5.0 | 69479E3 | 5.0 | - | - | 39479E3 | 5.0 |
| | 100 | 10 x 20 | 265 | 100 | 0.08 | MF2 | 59101E3 | 5.0 | 69101E3 | 5.0 | - | - | 39101E3 | 5.0 |
| | 220 | 12.5 x 25 | 440 | 220 | 0.08 | MF2 | 59221E3 | 5.0 | 69221E3 | 5.0 | - | - | 39221E3 | 5.0 |
| | 330 | 12.5 x 25 | 400 | 330 | 0.08 | MF2 | 99315E3 | 5.0 | 99316E3 | 5.0 | - | - | 99313E3 | 5.0 |
| | 330 | 16 x 25 | 540 | 330 | 0.08 | MF2 | 59331E3 | 7.5 | 69331E3 | 7.5 | - | - | 39331E3 | 7.5 |
| | 470 | 16 x 31 | 715 | 470 | 0.08 | MF2 | 59471E3 | 7.5 | 69471E3 | 7.5 | - | - | 39471E3 | 7.5 |
| | 1000 | 18 x 40 | 985 | 1000 | 0.08 | MF2 | 59102E3 | 7.5 | 69102E3 | 7.5 | - | - | - | - |
| 200 | 1.0 | 5 x 11 | 18 | 21 | 0.14 | MF1 | 52108E3 | 2.0 | - | - | 72108E3 | 2.5 | 32108E3 | 5.0 |
| | 2.2 | 6.3 x 11 | 30 | 28 | 0.14 | MF1 | 52228E3 | 2.5 | - | - | 72228E3 | 2.5 | 32228E3 | 5.0 |
| | 4.7 | 8 x 12 | 54 | 43 | 0.14 | MF1 | 52478E3 | 3.5 | - | - | 72478E3 | 3.5 | 32478E3 | 5.0 |
| | 10 | 10 x 12 | 94 | 65 | 0.14 | MF1 | 52109E3 | 5.0 | 62109E3 | 5.0 | - | - | 32109E3 | 5.0 |
| | 22 | 10 x 16 | 142 | 113 | 0.14 | MF1 | 52229E3 | 5.0 | 62229E3 | 5.0 | - | - | 32229E3 | 5.0 |
| | 47 | 12.5 x 20 | 250 | 213 | 0.14 | MF1 | 52479E3 | 5.0 | 62479E3 | 5.0 | - | - | 32479E3 | 5.0 |
| | 100 | 16 x 25 | 485 | 425 | 0.14 | MF2 | 52101E3 | 7.5 | 62101E3 | 7.5 | - | - | 32101E3 | 7.5 |
| | 220 | 18 x 35 | 835 | 905 | 0.14 | MF2 | 52221E3 | 7.5 | 62221E3 | 7.5 | - | - | - | - |
| 250 | 1.0 | 5 x 11 | 16 | 23 | 0.17 | MF1 | 51083E3 | 2.0 | - | - | 71083E3 | 2.5 | 31083E3 | 5.0 |
| | 2.2 | 6.3 x 11 | 35 | 32 | 0.17 | MF1 | 52283E3 | 2.5 | - | - | 72283E3 | 2.5 | 32283E3 | 5.0 |
| | 4.7 | 8 x 12 | 60 | 50 | 0.17 | MF1 | 54783E3 | 3.5 | - | - | 74783E3 | 3.5 | 34783E3 | 5.0 |
| | 10 | 10 x 12 | 92 | 75 | 0.17 | MF1 | 51093E3 | 5.0 | 61093E3 | 5.0 | - | - | 31093E3 | 5.0 |
| | 22 | 10 x 20 | 215 | 135 | 0.17 | MF1 | 52293E3 | 5.0 | 62293E3 | 5.0 | - | - | 32293E3 | 5.0 |
| | 33 | 12.5 x 20 | 315 | 190 | 0.17 | MF1 | 53393E3 | 5.0 | 63393E3 | 5.0 | - | - | 33393E3 | 5.0 |
| | 47 | 12.5 x 25 | 350 | 260 | 0.17 | MF1 | 54793E3 | 5.0 | 64793E3 | 5.0 | - | - | 34793E3 | 5.0 |
| | 100 | 16 x 31 | 530 | 525 | 0.17 | MF2 | 51013E3 | 7.5 | 61013E3 | 7.5 | - | - | 31013E3 | 7.5 |
| 350 | 1.0 | 6.3 x 11 | 23 | 26 | 0.20 | MF1 | 51085E3 | 2.5 | - | - | 71085E3 | 2.5 | 31085E3 | 5.0 |
| | 2.2 | 8 x 12 | 41 | 38 | 0.20 | MF1 | 52285E3 | 3.5 | - | - | 72285E3 | 3.5 | 32285E3 | 5.0 |
| | 4.7 | 10 x 12 | 65 | 58 | 0.20 | MF1 | 54785E3 | 5.0 | 64785E3 | 5.0 | - | - | 34785E3 | 5.0 |
| | 10 | 10 x 16 | 105 | 95 | 0.20 | MF1 | 51095E3 | 5.0 | 61095E3 | 5.0 | - | - | 31095E3 | 5.0 |
| | 22 | 12.5 x 20 | 210 | 179 | 0.20 | MF1 | 52295E3 | 5.0 | 62295E3 | 5.0 | - | - | 32295E3 | 5.0 |
| | 47 | 16 x 25 | 365 | 354 | 0.20 | MF1 | 54795E3 | 7.5 | 64795E3 | 7.5 | - | - | 34795E3 | 7.5 |
| | 100 | 18 x 35 | 505 | 725 | 0.20 | MF2 | 51015E3 | 7.5 | 61015E3 | 7.5 | - | - | - | - |
| 400 | 1.0 | 6.3 x 11 | 21 | 27 | 0.25 | MF1 | 51086E3 | 2.5 | - | - | 71086E3 | 2.5 | 31086E3 | 5.0 |
| | 2.2 | 8 x 12 | 39 | 41 | 0.25 | MF1 | 52286E3 | 3.5 | - | - | 72286E3 | 3.5 | 32286E3 | 5.0 |
| | 4.7 | 10 x 12 | 70 | 63 | 0.25 | MF1 | 54786E3 | 5.0 | 64786E3 | 5.0 | - | - | 34786E3 | 5.0 |
| | 10 | 10 x 20 | 125 | 105 | 0.25 | MF1 | 51096E3 | 5.0 | 61096E3 | 5.0 | - | - | 31096E3 | 5.0 |
| | 22 | 12.5 x 25 | 235 | 201 | 0.25 | MF1 | 52296E3 | 5.0 | 62296E3 | 5.0 | - | - | 32296E3 | 5.0 |
| | 47 | 16 x 31 | 390 | 401 | 0.25 | MF1 | 54796E3 | 7.5 | 64796E3 | 7.5 | - | - | 34796E3 | 7.5 |
| | 100 | 18 x 40 | 530 | 825 | 0.25 | MF2 | 51016E3 | 7.5 | 61016E3 | 7.5 | - | - | - | - |
| 450 | 1.0 | 8 x 12 | 27 | 29 | 0.25 | MF1 | 57108E3 | 3.5 | - | - | 77108E3 | 3.5 | 37108E3 | 5.0 |
| | 2.2 | 10 x 12 | 48 | 45 | 0.25 | MF1 | 57228E3 | 5.0 | 67228E3 | 5.0 | - | - | 37228E3 | 5.0 |
| | 4.7 | 10 x 16 | 75 | 67 | 0.25 | MF1 | 57478E3 | 5.0 | 67478E3 | 5.0 | - | - | 37478E3 | 5.0 |
| | 10 | 12.5 x 20 | 145 | 115 | 0.25 | MF1 | 57109E3 | 5.0 | 67109E3 | 5.0 | - | - | 37109E3 | 5.0 |
| | 22 | 16 x 20 | 245 | 223 | 0.25 | MF1 | 57229E3 | 7.5 | 67229E3 | 7.5 | - | - | 37229E3 | 7.5 |
| | 33 | 16 x 25 | 325 | 322 | 0.25 | MF1 | 57339E3 | 7.5 | 67339E3 | 7.5 | - | - | 37339E3 | 7.5 |
| | 47 | 16 x 35 | 420 | 448 | 0.25 | MF1 | 57479E3 | 7.5 | 67479E3 | 7.5 | - | - | - | - |

**Note**

(1) Determines the applicable row in the table "Multiplier of Ripple Current ($I_R$) as a Function of Frequency"

| ADDITIONAL ELECTRICAL DATA | | |
|---|---|---|
| **PARAMETER** | **CONDITIONS** | **VALUE** |
| **Voltage** | | |
| Surge voltage | | $U_s \leq 1.15 \times U_R$ |
| Reverse voltage | | $U_{rev} \leq 1$ V |
| **Current** | | |
| Leakage current | After 2 min at $U_R$ = 10 V to 100 V | $I_{L2} \leq 0.01\ C_R \times U_R$ or 3 µA, whichever is greater |
| | After 5 min at $U_R$ = 200 V to 450 V | $I_{L5} \leq 0.03\ C_R \times U_R + 15$ µA ($C_R \times U_R \leq 1000$)<br>$I_{L5} \leq 0.02\ C_R \times U_R + 25$ µA ($C_R \times U_R > 1000$) |
| **Inductance** | | |
| Equivalent series inductance (ESL) | Case Ø D ≤ 8 mm | Typ. 13 nH |
| | Case Ø D = 10 mm | Typ. 16 nH |
| | Case Ø D ≥ 12.5 mm | Typ. 18 nH |
| **Resistance** | | |
| Equivalent series resistance (ESR) | Calculated from tan $\delta_{max.}$ and $C_R$ (see Table 2) | ESR = tan $\delta/2\ \pi\ f\ C_R$ |

## CAPACITANCE (C)

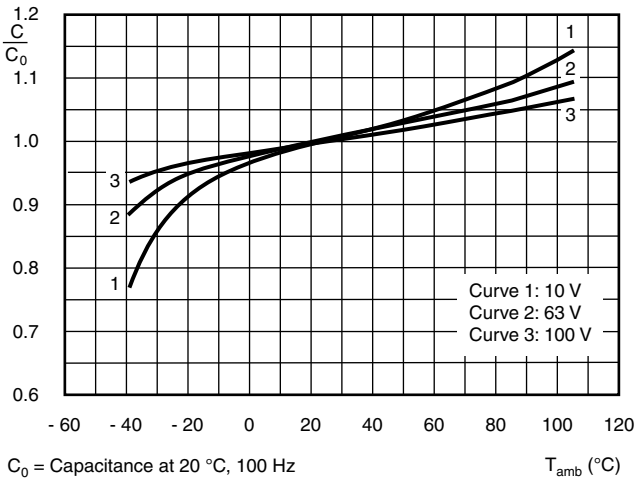



Fig. 6 - Typical multiplier of capacitance as a function of ambient temperature

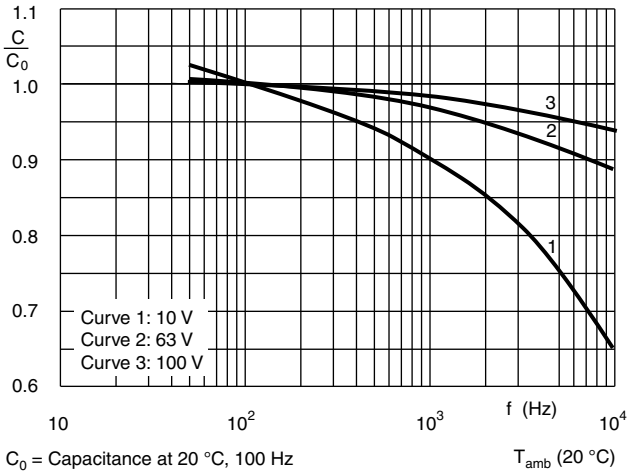



Fig. 7 - Typical multiplier of capacitance as a function of frequency

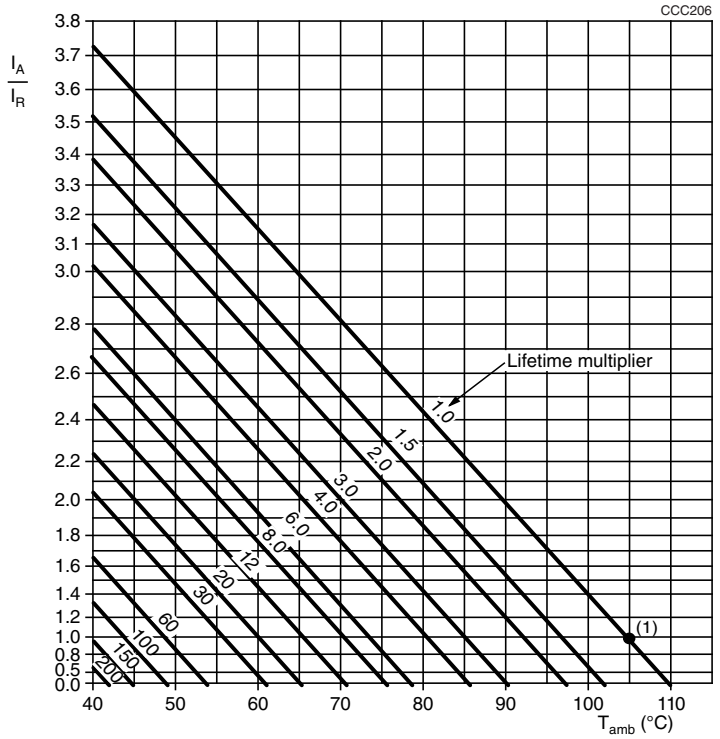
## RIPPLE CURRENT AND USEFUL LIFE

**Table 3**

| ENDURANCE TEST DURATION AND USEFUL LIFE | |
|---|---|
| **ENDURANCE AT 105 °C (h)** | **USEFUL LIFE AT 105 °C (h)** |
| 2000 | 2500 |

**Note**

- Multiplier of useful life code: CCC206




$I_A$ = Actual ripple current at 100 Hz, 105 °C
$I_R$ = Rated ripple current at 100 Hz, 105 °C

(1) Useful life at 105 °C and $I_R$ applied

Fig. 8 - 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 | | | | | |
|---|---|---|---|---|---|
| FREQ. CODE | FREQUENCY (Hz) | | | | |
| | 50 | 100 | 500 | 1000 | ≥ 10 000 |
| | $I_R$ MULTIPLIER | | | | |
| MF1 | 0.70 | 1.00 | 1.30 | 1.40 | 1.50 |
| MF2 | 0.75 | 1.00 | 1.20 | 1.30 | 1.35 |
| MF3 | 0.80 | 1.00 | 1.10 | 1.12 | 1.15 |

**Table 5**

| TEST PROCEDURES AND REQUIREMENTS | | | |
|---|---|---|---|
| TEST | | PROCEDURE (quick reference) | REQUIREMENTS |
| NAME OF TEST | REFERENCE | | |
| Endurance | IEC 60384-4 / EN130300 subclause 4.13 | $T_{amb}$ = 105 °C; $U_R$ applied; 2000 h | ΔC/C: ± 20 %<br>tan δ ≤ 2 x spec. limit<br>$I_{L5}$ ≤ spec. limit |
| Useful life | CECC 30301 subclause 1.8.1 | $T_{amb}$ = 105 °C; $U_R$ and $I_R$ applied; 2500 h | ΔC/C: ± 30 %<br>tan δ ≤ 3 x spec. limit<br>$I_{L5}$ ≤ spec. limit<br>no short or open circuit<br>total failure percentage: ≤ 1 % |
| Shelf life (storage at high temperature) | IEC 60384-4 / EN130300 subclause 4.17 | $T_{amb}$ = 105 °C; no voltage applied; 1000 h<br>After test: $U_R$ to be applied for 30 min, 24 h to 48 h before measurement | ΔC/C: ± 20 %<br>tan δ ≤ 2 x spec. limit<br>$I_{L5}$ ≤ spec. limit |
| Surge | IEC 60384-4 / EN130300 subclause 4.14 | From source of 1.15 x $U_R$:<br>RC = 0.1 s ± 0.05 s;<br>1000 cycles of 30 s on, 330 s off, at 105 °C | ΔC/C: ± 25 %<br>tan δ ≤ 1.5 x spec. limit<br>$I_{L5}$ ≤ 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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