

Aluminum Electrolytic Capacitors Axial Standard Miniature



Fig. 1

| QUICK REFERENCE DATA | |
|--|---|
| DESCRIPTION | VALUE |
| Nominal case sizes (Ø D x L in mm) | 4.5 x 10 to 10 x 25 10 x 30 to 21 x 38 |
| Rated capacitance range, C _R | 1 µF to 15 000 µF |
| Tolerance on C _R | ± 20 % |
| Rated voltage range, U _R | 6.3 V to 100 V |
| Category temperature range | -40 °C to +85 °C |
| Endurance test at 85 °C: | |
| U _R = 6.3 V to 25 V | 1000 h 5000 h |
| U _R = 40 V to 100 V | 2000 h 5000 h |
| Endurance test at 105 °C | - 2000 h |
| Useful life at 85 °C | 2500 h 8000 h |
| Useful life at 40 °C, 1.4 x I _R applied | 70 000 h 200 000 h |
| Shelf life at 0 V, 85 °C | 500 h |
| Based on sectional specification | IEC 60384-4 / EN 130300 |
| Climatic category IEC 60068 | 40 / 085 / 56 |

FEATURES

- Long useful life: 2500 h to 8000 h at 85 °C
- Miniaturized, high CV-product per unit volume
- Charge and discharge proof
- Taped versions up to case Ø 15 mm x 30 mm available for automatic insertion
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve
- Mounting ring version not available in insulated form
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


**RoHS
COMPLIANT**
APPLICATIONS

- General purpose, industrial, automotive, audio-video
- Coupling, decoupling, smoothing, filtering, buffering
- Portable and mobile equipment (small size, low mass)
- Low mounting height boards, vibration, and shock resistant

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)
- Upper category temperature (85 °C)
- Date code in accordance with IEC 60062
- Code for factory of origin
- Name of manufacturer
- Negative terminal identification
- Series number (021)

| C _R (µF) | U _R (V) | | | | | | |
|------------------------|--------------------|----|----|----------|----------|----------|----------|
| | 6.3 | 10 | 16 | 25 | 40 | 63 | 100 |
| 1.0 | - | - | - | - | - | 4.5 x 10 | 4.5 x 10 |
| 2.2 | - | - | - | - | - | 4.5 x 10 | 4.5 x 10 |
| 3.3 | - | - | - | - | - | 4.5 x 10 | - |
| 4.7 | - | - | - | - | - | 4.5 x 10 | 4.5 x 10 |
| 10 | - | - | - | - | - | 4.5 x 10 | 6 x 10 |
| 15 | - | - | - | - | - | 4.5 x 10 | 8 x 11 |
| | - | - | - | - | - | - | 6.5 x 18 |
| 22 | - | - | - | - | 4.5 x 10 | 6 x 10 | 8 x 11 |
| | - | - | - | - | - | - | 6.5 x 18 |
| 33 | - | - | - | - | - | 6 x 10 | 6.5 x 18 |
| 47 | - | - | - | 4.5 x 10 | 6 x 10 | 8 x 11 | 8 x 18 |
| | - | - | - | - | - | 6.5 x 18 | - |

| SELECTION CHART FOR C_R, U_R, AND RELEVANT NOMINAL CASE SIZES ($\varnothing D \times L$ in mm) | | | | | | | |
|--|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| C_R (μF) | U_R (V) | | | | | | |
| | 6.3 | 10 | 16 | 25 | 40 | 63 | 100 |
| 68 | - | - | 4.5 x 10 | - | - | 8 x 11 | 10 x 18 |
| | - | - | - | - | - | 6.5 x 18 | - |
| 100 | - | 4.5 x 10 | - | 6 x 10 | 8 x 11 | 8 x 18 | 10 x 25 |
| | - | - | - | - | 6.5 x 18 | - | 10 x 30 |
| 150 | - | - | 6 x 10 | 8 x 11 | 8 x 18 | 10 x 18 | 12.5 x 30 |
| | - | - | - | 6.5 x 18 | - | - | - |
| 220 | - | 6 x 10 | 8 x 11 | 6.5 x 18 | 10 x 18 | 10 x 25 | 12.5 x 30 |
| | - | - | - | - | - | 10 x 30 | - |
| 330 | - | 8 x 11 | 6.5 x 18 | 8 x 18 | 10 x 25 | 12.5 x 30 | 15 x 30 |
| | 8 x 11 | 6.5 x 18 | 8 x 18 | 10 x 18 | 10 x 25 | 12.5 x 30 | 18 x 30 |
| 470 | - | - | - | - | 10 x 30 | - | - |
| | - | 8 x 18 | 10 x 18 | 10 x 25 | 12.5 x 30 | 15 x 30 | 18 x 38 |
| 680 | - | - | - | 10 x 30 | - | - | - |
| | 8 x 18 | 10 x 18 | 10 x 25 | 12.5 x 30 | 12.5 x 30 | 18 x 30 | 21 x 38 |
| 1000 | - | - | 10 x 30 | - | - | - | - |
| | - | 10 x 25 | 12.5 x 30 | 12.5 x 30 | 15 x 30 | 18 x 38 | - |
| 1500 | - | 10 x 30 | - | - | - | - | - |
| | 10 x 25 | 12.5 x 30 | 12.5 x 30 | 15 x 30 | 18 x 30 | 21 x 38 | - |
| 3300 | - | 12.5 x 30 | 15 x 30 | 18 x 30 | 18 x 38 | - | - |
| | - | 15 x 30 | 18 x 30 | 18 x 38 | 21 x 38 | - | - |
| 4700 | - | 18 x 30 | 18 x 38 | 21 x 38 | - | - | - |
| | - | 18 x 30 | 18 x 38 | 21 x 38 | - | - | - |
| 6800 | - | 18 x 30 | 18 x 38 | 21 x 38 | - | - | - |
| | - | 18 x 38 | 21 x 38 | - | - | - | - |
| 10 000 | - | 18 x 38 | 21 x 38 | - | - | - | - |
| | - | 21 x 38 | - | - | - | - | - |
| 15 000 | - | 21 x 38 | - | - | - | - | - |
| | - | - | - | - | - | - | - |

DIMENSIONS in millimeters AND AVAILABLE FORMS


Form BR: Taped on reel
Form BA: Taped in box (ammopack)
 Case $\varnothing D \times L = 4.5 \text{ mm} \times 10 \text{ mm}$ to $8 \text{ mm} \times 11 \text{ mm}$

Fig. 2 - Forms BA and BR



Form BR: Taped on reel
 Case $\varnothing D \times L = 6.5 \text{ mm} \times 18 \text{ mm}$ to $15 \text{ mm} \times 30 \text{ mm}$
Form BA: Taped in box (ammopack)
 Case $\varnothing D \times L = 6.5 \text{ mm} \times 18 \text{ mm}$ to $10 \text{ mm} \times 25 \text{ mm}$

Fig. 3 - Forms BA and BR



Form AA: Axial in box
 Case $\varnothing D \times L = 10 \text{ mm} \times 30 \text{ mm}$ to $21 \text{ mm} \times 38 \text{ mm}$

Fig. 4 - Form AA

Table 1

| AXIAL; DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES | | | | | | | | | | |
|---|-----------|----------------------------|--------|---------------------|-------------------|-------------------|----------|----------------------|---------|---------|
| NOMINAL CASE SIZE Ø D x L | CASE CODE | AXIAL: FORM AA, BA, AND BR | | | | | MASS (g) | PACKAGING QUANTITIES | | |
| | | Ø d | l | Ø D _{max.} | L _{max.} | F _{min.} | | FORM AA | FORM BA | FORM BR |
| 4.5 x 10 | 2 | 0.6 | - | 5.0 | 10.5 | 15 | ≈ 0.5 | - | 1000 | 3000 |
| 6 x 10 | 3 | 0.6 | - | 6.3 | 10.5 | 15 | ≈ 0.7 | - | 1000 | 1000 |
| 8 x 11 | 5a | 0.6 | - | 8.5 | 11.5 | 15 | ≈ 1.1 | - | 500 | 500 |
| 6.5 x 18 | 4 | 0.8 | - | 6.9 | 18.5 | 25 | ≈ 1.3 | - | 1000 | 1000 |
| 8 x 18 | 5 | 0.8 | - | 8.5 | 18.5 | 25 | ≈ 1.7 | - | 500 | 500 |
| 10 x 18 | 6 | 0.8 | - | 10.5 | 18.5 | 25 | ≈ 2.5 | - | 500 | 500 |
| 10 x 25 | 7 | 0.8 | - | 10.5 | 25.5 | 30 | ≈ 3.3 | - | 500 | 500 |
| 10 x 30 | 00 | 0.8 | 55 ± 1 | 10.5 | 30.5 | 35 | ≈ 4.8 | 340 | - | 500 |
| 12.5 x 30 | 01 | 0.8 | 55 ± 1 | 13.0 | 30.5 | 35 | ≈ 7.4 | 260 | - | 400 |
| 15 x 30 | 02 | 0.8 | 55 ± 1 | 15.5 | 30.5 | 35 | ≈ 11.7 | 200 | - | 250 |
| 18 x 30 | 03 | 0.8 | 55 ± 1 | 18.5 | 30.5 | 35 | ≈ 12.9 | 120 | - | - |
| 18 x 38 | 04 | 0.8 | 34 ± 1 | 18.5 | 39.5 | 44 | ≈ 19.0 | 125 | - | - |
| 21 x 38 | 05 | 0.8 | 34 ± 1 | 21.5 | 39.5 | 44 | ≈ 24.0 | 100 | - | - |

Note

- For detailed tape dimensions, please see www.vishay.com/doc?28361.


Form MR:

Case Ø D x L = 15 mm x 30 mm to 21 mm x 38 mm

Especially for applications with severe shocks and vibrations

 Fig. 5 - Mounting hole diagram and outline. **Form MR:** With mounting ring and pins

Table 2

| MOUNTING RING; DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES | | | | | | | | | |
|---|-----------|------------------------|-----------|----------------------|------------|-------------------|----------|----------------------|--|
| NOMINAL CASE SIZE Ø D x L | CASE CODE | MOUNTING RING: FORM MR | | | | | MASS (g) | PACKAGING QUANTITIES | |
| | | Ø d1 | Ø d2 | Ø D2 _{max.} | D3 | L _{max.} | | | |
| 15 x 30 | 02 | 0.8 | 1.0 + 0.4 | 17.5 | 16.5 ± 0.2 | 33 | ≈ 11.7 | 200 | |
| 18 x 30 | 03 | 0.8 | 1.0 + 0.4 | 19.5 | 18.5 ± 0.2 | 33 | ≈ 12.9 | 240 | |
| 18 x 38 | 04 | 0.8 | 1.0 + 0.4 | 19.5 | 18.5 ± 0.2 | 42 | ≈ 19.0 | 100 | |
| 21 x 38 | 05 | 0.8 | 1.0 + 0.4 | 22.5 | 21.5 ± 0.2 | 42 | ≈ 24.0 | 100 | |



| ELECTRICAL DATA | |
|-----------------|---|
| SYMBOL | DESCRIPTION |
| C_R | Rated capacitance at 100 Hz, tolerance $\pm 20\%$ |
| I_R | Rated RMS ripple current at 100 Hz, 85 °C |
| I_{L5} | Max. leakage current after 5 min at U_R |
| $\tan \delta$ | Max. dissipation factor at 100 Hz |
| ESR | Equivalent series resistance at 100 Hz (calculated from $\tan \delta_{max}$ and C_R) |
| Z | Max. impedance at 10 kHz |

Note

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

ORDERING EXAMPLE

Electrolytic capacitor 021 series

1000 μF / 16 V; $\pm 20\%$

Nominal case size: $\varnothing 10\text{ mm} \times 25\text{ mm}$; Form BA

Ordering code: MAL202190518E3

Former 12 NC: 2222 021 90518

Table 3

| ELECTRICAL DATA AND ORDERING INFORMATION | | | | | | | | | | | | | |
|--|--------------------------------------|--|----------------------------------|--|-------------------------|-------------------------------|-----------------------------|------------------|----------------------------|--------------------------------|-------------------------------|--------------------------------|--|
| U_R (V) | C_R 100 Hz (μF) | NOMINAL CASE SIZE $\varnothing D \times L$ (mm) | I_R 100 Hz 85 °C (mA) | I_{L5} 5 min (μA) | $\tan \delta$ 100 Hz | ESR 100 Hz (Ω) | Z 10 kHz (Ω) | LIFE CODE (1) | ORDERING CODE MAL2021..... | | | | |
| | | | | | | | | | IN BOX FORM AA | TAPED ON REEL FORM BR | TAPED IN BOX FORM BA | MOUNTING RING FORM MR | |
| 6.3 | 470 | 8 x 11 | 260 | 10 | 0.25 | 0.850 | 0.640 | L1 | - | 23471E3 | 33471E3 | - | |
| | 1000 | 8 x 18 | 440 | 17 | 0.25 | 0.400 | 0.500 | L1 | - | 23102E3 | 33102E3 | - | |
| | 2200 | 10 x 25 | 710 | 32 | 0.29 | 0.210 | 0.160 | L1 | - | 90588E3 | 90589E3 | - | |
| 10 | 100 | 4.5 x 10 | 100 | 6 | 0.20 | 3.200 | 2.000 | L1 | - | 24101E3 | 34101E3 | - | |
| | 220 | 6 x 10 | 160 | 8.4 | 0.20 | 1.500 | 0.910 | L1 | - | 24221E3 | 34221E3 | - | |
| | 330 | 8 x 11 | 230 | 11 | 0.20 | 1.000 | 0.610 | L1 | - | 24331E3 | 34331E3 | - | |
| | 470 | 6.5 x 18 | 310 | 13 | 0.20 | 0.680 | 0.430 | L1 | - | 24471E3 | 34471E3 | - | |
| | 680 | 8 x 18 | 400 | 18 | 0.20 | 0.470 | 0.290 | L1 | - | 24681E3 | 34681E3 | - | |
| | 1000 | 10 x 18 | 550 | 24 | 0.20 | 0.320 | 0.200 | L1 | - | 24102E3 | 34102E3 | - | |
| | 1500 | 10 x 25 | 690 | 34 | 0.23 | 0.250 | 0.180 | L1 | - | 90524E3 | 90525E3 | - | |
| | 1500 | 10 x 30 | 740 | 34 | 0.23 | 0.245 | 0.180 | L3 | 14152E3 | 24152E3 | - | | |
| | 2200 | 12.5 x 30 | 980 | 48 | 0.25 | 0.177 | 0.095 | L3 | 14222E3 | 24222E3 | - | | |
| | 3300 | 12.5 x 30 | 1090 | 70 | 0.27 | 0.128 | 0.095 | L3 | 14332E3 | 24332E3 | - | | |
| | 4700 | 15 x 30 | 1320 | 98 | 0.29 | 0.100 | 0.070 | L3 | 14472E3 | 24472E3 | - | | |
| | 6800 | 18 x 30 | 1590 | 140 | 0.34 | 0.079 | 0.065 | L3 | 14682E3 | - | 44472E3 | | |
| 10 000 | 18 x 38 | 2090 | 204 | 0.40 | 0.064 | 0.040 | L3 | 14103E3 | - | - | 44103E3 | | |
| 15 000 | 21 x 38 | 2250 | 304 | 0.50 | 0.054 | 0.035 | L3 | 14153E3 | - | - | 44153E3 | | |
| 16 | 68 | 4.5 x 10 | 90 | 6.2 | 0.16 | 3.800 | 2.400 | L1 | - | 25689E3 | 35689E3 | - | |
| | 150 | 6 x 10 | 140 | 8.8 | 0.16 | 1.700 | 1.100 | L1 | - | 25151E3 | 35151E3 | - | |
| | 220 | 8 x 11 | 210 | 11 | 0.16 | 1.200 | 0.730 | L1 | - | 25221E3 | 35221E3 | - | |
| | 330 | 6.5 x 18 | 290 | 15 | 0.16 | 0.770 | 0.480 | L1 | - | 25331E3 | 35331E3 | - | |
| | 470 | 8 x 18 | 380 | 19 | 0.16 | 0.550 | 0.340 | L1 | - | 25471E3 | 35471E3 | - | |
| | 680 | 10 x 18 | 500 | 26 | 0.16 | 0.380 | 0.240 | L1 | - | 25681E3 | 35681E3 | - | |
| | 1000 | 10 x 25 | 660 | 36 | 0.16 | 0.260 | 0.180 | L1 | - | 90517E3 | 90518E3 | - | |
| | 1000 | 10 x 30 | 700 | 36 | 0.16 | 0.260 | 0.175 | L3 | 15102E3 | 25102E3 | - | | |
| | 1500 | 12.5 x 30 | 950 | 52 | 0.19 | 0.205 | 0.095 | L3 | 15152E3 | 25152E3 | - | | |
| | 2200 | 12.5 x 30 | 1040 | 74 | 0.21 | 0.150 | 0.095 | L3 | 15222E3 | 25222E3 | - | | |
| | 3300 | 15 x 30 | 1290 | 110 | 0.23 | 0.111 | 0.070 | L3 | 15332E3 | 25332E3 | - | | |
| | 4700 | 18 x 30 | 1560 | 154 | 0.25 | 0.087 | 0.065 | L3 | 15472E3 | - | - | 45332E3 | |
| 6800 | 18 x 38 | 2040 | 222 | 0.30 | 0.070 | 0.040 | L3 | 15682E3 | - | - | 45682E3 | | |
| 10 000 | 21 x 38 | 2170 | 324 | 0.36 | 0.058 | 0.035 | L3 | 15103E3 | - | - | 45103E3 | | |
| 25 | 47 | 4.5 x 10 | 80 | 6.4 | 0.14 | 4.800 | 2.600 | L1 | - | 26479E3 | 36479E3 | - | |
| | 100 | 6 x 10 | 150 | 9 | 0.14 | 2.300 | 1.200 | L1 | - | 26101E3 | 36101E3 | - | |
| | 150 | 8 x 11 | 190 | 12 | 0.14 | 1.500 | 0.800 | L1 | - | 90534E3 | 90535E3 | - | |
| | 150 | 6.5 x 18 | 210 | 12 | 0.14 | 1.500 | 0.800 | L1 | - | 26151E3 | 36151E3 | - | |
| | 220 | 6.5 x 18 | 250 | 15 | 0.14 | 1.000 | 0.550 | L1 | - | 26221E3 | 36221E3 | - | |
| | 330 | 8 x 18 | 340 | 21 | 0.14 | 0.680 | 0.360 | L1 | - | 26331E3 | 36331E3 | - | |
| | 470 | 10 x 18 | 450 | 28 | 0.14 | 0.480 | 0.260 | L1 | - | 26471E3 | 36471E3 | - | |
| | 680 | 10 x 25 | 560 | 38 | 0.14 | 0.330 | 0.180 | L1 | - | 90527E3 | 90528E3 | - | |
| | 680 | 10 x 30 | 640 | 38 | 0.14 | 0.323 | 0.175 | L3 | 16681E3 | 26681E3 | - | | |
| | 1000 | 12.5 x 30 | 840 | 54 | 0.14 | 0.220 | 0.095 | L3 | 16102E3 | 26102E3 | - | | |
| | 1500 | 12.5 x 30 | 950 | 79 | 0.17 | 0.179 | 0.095 | L3 | 16152E3 | 26152E3 | - | | |
| | 2200 | 15 x 30 | 1180 | 114 | 0.19 | 0.132 | 0.070 | L3 | 16222E3 | 26222E3 | - | | |
| | 3300 | 18 x 30 | 1470 | 169 | 0.21 | 0.099 | 0.065 | L3 | 16332E3 | - | - | 46222E3 | |
| | 4700 | 18 x 38 | 1920 | 239 | 0.23 | 0.079 | 0.040 | L3 | 16472E3 | - | - | 46332E3 | |
| 6800 | 21 x 38 | 2070 | 344 | 0.28 | 0.064 | 0.035 | L3 | 16682E3 | - | - | 46472E3 | | |



| 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 (mA) | I _{L5} 5 min (μA) | tan δ 100 Hz | ESR 100 Hz (Ω) | Z 10 kHz (Ω) | LIFE CODE (1) | ORDERING CODE MAL2021..... | | | |
| | | | | | | | | | IN BOX FORM AA | TAPED ON REEL FORM BR | TAPED IN BOX FORM BA | MOUNTING RING FORM MR |
| 40 | 22 | 4.5 x 10 | 60 | 5.8 | 0.11 | 8.000 | 3.200 | L2 | - | 27229E3 | 37229E3 | - |
| | 47 | 6 x 10 | 110 | 7.8 | 0.11 | 3.800 | 1.500 | L2 | - | 27479E3 | 37479E3 | - |
| | 100 | 8 x 11 | 170 | 12 | 0.11 | 1.800 | 0.700 | L2 | - | 90537E3 | 90538E3 | - |
| | 100 | 6.5 x 18 | 190 | 12 | 0.11 | 1.800 | 0.700 | L2 | - | 27101E3 | 37101E3 | - |
| | 150 | 8 x 18 | 250 | 16 | 0.11 | 1.100 | 0.470 | L2 | - | 27151E3 | 37151E3 | - |
| | 220 | 10 x 18 | 330 | 22 | 0.11 | 0.800 | 0.320 | L2 | - | 27221E3 | 37221E3 | - |
| | 330 | 10 x 25 | 430 | 30 | 0.11 | 0.530 | 0.210 | L2 | - | 27331E3 | 37331E3 | - |
| | 470 | 10 x 25 | 520 | 42 | 0.11 | 0.370 | 0.180 | L2 | - | 90514E3 | 90515E3 | - |
| | 470 | 10 x 30 | 590 | 42 | 0.12 | 0.404 | 0.175 | L3 | 17471E3 | 27471E3 | - | - |
| | 680 | 12.5 x 30 | 800 | 58 | 0.12 | 0.297 | 0.110 | L3 | 17681E3 | 27681E3 | - | - |
| | 1000 | 12.5 x 30 | 900 | 84 | 0.12 | 0.190 | 0.110 | L3 | 17102E3 | 27102E3 | - | - |
| | 1500 | 15 x 30 | 1120 | 124 | 0.15 | 0.159 | 0.070 | L3 | 17152E3 | 27152E3 | - | 47152E3 |
| | 2200 | 18 x 30 | 1390 | 180 | 0.17 | 0.118 | 0.065 | L3 | 17222E3 | - | - | 47222E3 |
| | 3300 | 18 x 38 | 1810 | 268 | 0.19 | 0.090 | 0.040 | L3 | 17332E3 | - | - | 47332E3 |
| 4700 | 21 x 38 | 1940 | 380 | 0.21 | 0.072 | 0.035 | L3 | 17472E3 | - | - | 47472E3 | |
| 63 | 1.0 | 4.5 x 10 | 12 | 4.1 | 0.09 | 150.0 | 55.00 | L2 | - | 28108E3 | 38108E3 | - |
| | 2.2 | 4.5 x 10 | 21 | 4.3 | 0.09 | 65.00 | 25.00 | L2 | - | 28228E3 | 38228E3 | - |
| | 3.3 | 4.5 x 10 | 25 | 4.4 | 0.09 | 44.00 | 17.00 | L2 | - | 28338E3 | 38338E3 | - |
| | 4.7 | 4.5 x 10 | 31 | 4.6 | 0.09 | 31.00 | 12.00 | L2 | - | 28478E3 | 38478E3 | - |
| | 10 | 4.5 x 10 | 50 | 5.3 | 0.08 | 13.00 | 5.500 | L2 | - | 28109E3 | 38109E3 | - |
| | 15 | 4.5 x 10 | 55 | 5.9 | 0.08 | 8.500 | 3.700 | L2 | - | 28159E3 | 38159E3 | - |
| | 22 | 6 x 10 | 90 | 6.8 | 0.08 | 5.800 | 2.500 | L2 | - | 28229E3 | 38229E3 | - |
| | 33 | 6 x 10 | 100 | 8.2 | 0.08 | 3.900 | 1.700 | L2 | - | 28339E3 | 38339E3 | - |
| | 47 | 8 x 11 | 140 | 10 | 0.08 | 2.700 | 1.200 | L2 | - | 90541E3 | 90542E3 | - |
| | 47 | 6.5 x 18 | 150 | 10 | 0.08 | 2.700 | 1.200 | L2 | - | 28479E3 | 38479E3 | - |
| | 68 | 8 x 11 | 160 | 13 | 0.08 | 1.900 | 0.810 | L2 | - | 90544E3 | 90545E3 | - |
| | 68 | 6.5 x 18 | 170 | 13 | 0.08 | 1.900 | 0.810 | L2 | - | 28689E3 | 38689E3 | - |
| | 100 | 8 x 18 | 250 | 17 | 0.08 | 1.300 | 0.550 | L2 | - | 28101E3 | 38101E3 | - |
| | 150 | 10 x 18 | 320 | 23 | 0.08 | 0.850 | 0.370 | L2 | - | 28151E3 | 38151E3 | - |
| | 220 | 10 x 25 | 430 | 32 | 0.08 | 0.600 | 0.250 | L2 | - | 90511E3 | 90512E3 | - |
| | 220 | 10 x 30 | 480 | 32 | 0.08 | 0.614 | 0.260 | L3 | 18221E3 | 28221E3 | - | - |
| | 330 | 12.5 x 30 | 610 | 46 | 0.08 | 0.409 | 0.190 | L3 | 18331E3 | 28331E3 | - | - |
| | 470 | 12.5 x 30 | 700 | 63 | 0.08 | 0.287 | 0.130 | L3 | 18471E3 | 28471E3 | - | - |
| 680 | 15 x 30 | 890 | 90 | 0.08 | 0.199 | 0.095 | L3 | 18681E3 | 28681E3 | - | 48681E3 | |
| 1000 | 18 x 30 | 1170 | 130 | 0.08 | 0.135 | 0.075 | L3 | 18102E3 | - | - | 48102E3 | |
| 1500 | 18 x 38 | 1530 | 193 | 0.11 | 0.122 | 0.045 | L3 | 18152E3 | - | - | 48152E3 | |
| 2200 | 21 x 38 | 1780 | 281 | 0.13 | 0.099 | 0.040 | L3 | 18222E3 | - | - | 48222E3 | |
| 100 | 1.0 | 4.5 x 10 | 14 | 4.2 | 0.08 | 130.0 | 90.00 | L2 | - | 29108E3 | 39108E3 | - |
| | 2.2 | 4.5 x 10 | 20 | 4.4 | 0.08 | 58.00 | 41.00 | L2 | - | 29228E3 | 39228E3 | - |
| | 4.7 | 4.5 x 10 | 30 | 4.9 | 0.08 | 27.00 | 19.00 | L2 | - | 29478E3 | 39478E3 | - |
| | 10 | 6 x 10 | 65 | 6 | 0.08 | 13.00 | 9.000 | L2 | - | 29109E3 | 39109E3 | - |
| | 15 | 8 x 11 | 77 | 7 | 0.08 | 8.500 | 6.000 | L2 | - | 90547E3 | 90548E3 | - |
| | 15 | 6.5 x 18 | 85 | 7 | 0.08 | 8.500 | 6.000 | L2 | - | 29159E3 | 39159E3 | - |
| | 22 | 8 x 11 | 95 | 8.4 | 0.08 | 5.800 | 4.100 | L2 | - | 90551E3 | 90552E3 | - |
| | 22 | 6.5 x 18 | 100 | 8.4 | 0.08 | 5.800 | 4.100 | L2 | - | 29229E3 | 39229E3 | - |
| | 33 | 6.5 x 18 | 120 | 10.6 | 0.08 | 3.900 | 2.700 | L2 | - | 29339E3 | 39339E3 | - |
| | 47 | 8 x 18 | 160 | 13.4 | 0.08 | 2.700 | 1.900 | L2 | - | 29479E3 | 39479E3 | - |
| | 68 | 10 x 18 | 220 | 17.6 | 0.08 | 1.900 | 1.300 | L2 | - | 29689E3 | 39689E3 | - |
| | 100 | 10 x 25 | 300 | 24 | 0.08 | 1.300 | 0.900 | L2 | - | 90531E3 | 90532E3 | - |
| | 100 | 10 x 30 | 340 | 24 | 0.07 | 1.150 | 1.000 | L3 | 19101E3 | 29101E3 | - | - |
| | 150 | 12.5 x 30 | 490 | 34 | 0.07 | 0.645 | 0.610 | L3 | 19151E3 | 29151E3 | - | - |
| | 220 | 12.5 x 30 | 560 | 48 | 0.08 | 0.610 | 0.560 | L3 | 19221E3 | 29221E3 | - | - |
| | 330 | 15 x 30 | 740 | 70 | 0.09 | 0.420 | 0.400 | L3 | 19331E3 | 29331E3 | - | 49331E3 |
| 470 | 18 x 30 | 980 | 98 | 0.09 | 0.310 | 0.290 | L3 | 19471E3 | - | - | 49471E3 | |
| 680 | 18 x 38 | 1260 | 140 | 0.09 | 0.195 | 0.180 | L3 | 19681E3 | - | - | 49681E3 | |
| 1000 | 21 x 38 | 1470 | 204 | 0.10 | 0.160 | 0.150 | L3 | 19102E3 | - | - | 49102E3 | |

Note

(1) Determines the applicable row in the table "Endurance Test Duration and Useful Life"



| ADDITIONAL ELECTRICAL DATA | | | |
|------------------------------------|------------------------------|--|---------------|
| PARAMETER | CONDITIONS | VALUE | |
| | | AXIAL | MOUNTING RING |
| Voltage | | | |
| Surge voltage | | $U_s \leq 1.15 \times U_R$ | |
| Reverse voltage | | $U_{rev} \leq 1 \text{ V}$ | |
| Current | | | |
| Leakage current | After 1 min at U_R | $I_{L1} \leq 0.006 C_R \times U_R + 4 \mu\text{A}$ | |
| | After 5 min at U_R | $I_{L5} \leq 0.002 C_R \times U_R + 4 \mu\text{A}$ | |
| Inductance | | | |
| Equivalent series inductance (ESL) | Case \varnothing D x L mm: | | |
| | 4.5 x 10 | Typ. 10 nH | - |
| | 6 x 10 | Typ. 22 nH | - |
| | 8 x 11 | Typ. 85 nH | - |
| | 6.5 x 18 | Typ. 25 nH | - |
| | 8 x 18 | Typ. 40 nH | - |
| | 10 x 18 | Typ. 61 nH | - |
| | 10 x 25 | Typ. 38 nH | - |
| | 10 x 30 | Typ. 38 nH | - |
| | 12.5 x 30 | Typ. 46 nH | - |
| | 15 x 30 | Typ. 48 nH | Typ. 39 nH |
| | 18 x 30 | Typ. 50 nH | Typ. 39 nH |
| 18 x 38 | Typ. 54 nH | Typ. 39 nH | |
| 21 x 38 | Typ. 59 nH | Typ. 39 nH | |

RIPPLE CURRENT AND USEFUL LIFE

Table 4

| ENDURANCE TEST DURATION AND USEFUL LIFE | | | |
|---|------------------------|-------------------------|--------------------------|
| LIFE CODE | ENDURANCE AT 85 °C (h) | ENDURANCE AT 105 °C (h) | USEFUL LIFE AT 85 °C (h) |
| L1 | 1000 | - | 2500 |
| L2 | 2000 | - | 2500 |
| L3 | 5000 | 2000 | 8000 |

Note

- Multiplier of useful life code: CCC205

CCC205



I_A = Actual ripple current at 100 Hz
 I_R = Rated ripple current at 100 Hz, 85 °C

(1) Useful life at 85 °C and I_R applied:
 Case \varnothing D x L = 4.5 mm x 10 mm to 10 mm x 25 mm: 2500 h
 Case \varnothing D x L = 10 mm x 30 mm to 21 mm x 38 mm: 8000 h

Fig. 6 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 5

| MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY | | | | | | |
|---|------------------|------|------|------|------|----------------|
| U_R | FREQUENCY (Hz) | | | | | |
| | 50 | 100 | 300 | 1000 | 3000 | $\geq 10\ 000$ |
| | I_R MULTIPLIER | | | | | |
| 6.3 | 0.95 | 1.00 | 1.07 | 1.12 | 1.15 | 1.20 |
| 10 | 0.95 | 1.00 | 1.07 | 1.12 | 1.15 | 1.20 |
| 16 | 0.95 | 1.00 | 1.07 | 1.12 | 1.15 | 1.20 |
| 25 | 0.90 | 1.00 | 1.12 | 1.20 | 1.25 | 1.30 |
| 40 | 0.90 | 1.00 | 1.12 | 1.20 | 1.25 | 1.30 |
| 63 | 0.85 | 1.00 | 1.20 | 1.30 | 1.35 | 1.40 |
| 100 | 0.85 | 1.00 | 1.20 | 1.30 | 1.35 | 1.40 |

Table 6

| TEST PROCEDURES AND REQUIREMENTS | | | |
|---|---------------------------------------|---|--|
| TEST | | PROCEDURE (quick reference) | REQUIREMENTS |
| NAME OF TEST | REFERENCE | | |
| Endurance | IEC 60384-4 / EN130300 subclause 4.13 | $T_{amb} = 85\text{ °C}$; U_R applied; case $\varnothing D \times L = 4.5\text{ mm} \times 10\text{ mm}$ to $10\text{ mm} \times 25\text{ mm}$: $U_R = 6.3\text{ V}$ to 25 V : 1000 h; $U_R = 40\text{ V}$ to 100 V : 2000 h; case $\varnothing D \times L = 10\text{ mm} \times 30\text{ mm}$ to $21\text{ mm} \times 38\text{ mm}$: $U_R = 6.3\text{ V}$ to 100 V : 5000 h | $U_R \leq 6.3\text{ V}$; $\Delta C/C$: +15 % / -30 % $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ |
| | | $T_{amb} = 105\text{ °C}$; U_R applied; case $\varnothing D \times L = 10\text{ mm} \times 30\text{ mm}$ to $21\text{ mm} \times 38\text{ mm}$: 2000 h | $\Delta C/C$: $\leq \pm 20\%$ $\tan \delta \leq 1.6 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ |
| Useful life | CECC 30301 subclause 1.8.1 | $T_{amb} = 85\text{ °C}$; U_R and I_R applied; case $\varnothing D \times L = 4.5\text{ mm} \times 10\text{ mm}$ to $10\text{ mm} \times 25\text{ mm}$: 2500 h; case $\varnothing D \times L = 10\text{ mm} \times 30\text{ mm}$ to $21\text{ mm} \times 38\text{ mm}$: 8000 h | $U_R \leq 6.3\text{ V}$; $\Delta C/C$: +45 % / -50 % $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$ |
| Shelf life (storage at high temperature) | IEC 60384-4 / EN130300 subclause 4.17 | $T_{amb} = 85\text{ °C}$; no voltage applied; 500 h After test: U_R to be applied for 30 min, 24 h to 48 h before measurement | $\Delta C/C$, $\tan \delta$, Z : for requirements see "Endurance test" above $I_{L5} \leq 2 \times \text{spec. limit}$ |

Statements about product lifetime are based on calculations and internal testing. They should only be interpreted as estimations. Also due to external factors, the lifetime in the field application may deviate from the calculated lifetime. In general, nothing stated herein shall be construed as a guarantee of durability.



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