

Aluminum Capacitors Axial Standard Miniature



Fig. 1

| QUICK REFERENCE DATA | |
|----------------------------------------------------|---------------------------------------------|
| DESCRIPTION | VALUE |
| Nominal case sizes (\varnothing 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 | 0.47 μ F to 15 000 μ F |
| 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/EN130300 |
| 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 \varnothing 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 μ F)
- 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 (μ F) | U_R (V) | | | | | | |
|---------------------|-----------|----|----|----------|----------|----------|----------|
| | 6.3 | 10 | 16 | 25 | 40 | 63 | 100 |
| 0.47 | - | - | - | - | - | 4.5 x 10 | - |
| 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 38 | 21 x 38 | - | - | - | - |
| | - | 18 x 38 | 21 x 38 | - | - | - | - |
| 10 000 | - | 21 x 38 | - | - | - | - | - |
| | - | 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 |

ORDERING EXAMPLE

Electrolytic capacitor 021 series
 1000 μ F/16 V; $\pm 20\%$
 Nominal case size: \varnothing 10 mm x 25 mm; Form BA
 Ordering code: MAL202190518E3
 Former 12 NC: 2222 021 90518

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% .

Table 3

| ELECTRICAL DATA AND ORDERING INFORMATION | | | | | | | | | | | |
|------------------------------------------|-------------------------------|-----------------------------------------------------|----------------------------------|---------------------------------|-------------------------|-------------------------------|-----------------------------|----------------------------|--------------------------------|-------------------------------|--------------------------------|
| U_R (V) | C_R 100 Hz (μ F) | NOMINAL CASE SIZE \varnothing D x L (mm) | I_R 100 Hz 85 °C (mA) | I_{L5} 5 min (μ A) | $\tan \delta$ 100 Hz | ESR 100 Hz (Ω) | Z 10 kHz (Ω) | 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 | - | 23471E3 | 33471E3 | - |
| | 1000 | 8 x 18 | 440 | 17 | 0.25 | 0.400 | 0.500 | - | 23102E3 | 33102E3 | - |
| | 2200 | 10 x 25 | 710 | 32 | 0.29 | 0.210 | 0.160 | - | 90588E3 | 90589E3 | - |
| 10 | 100 | 4.5 x 10 | 100 | 6 | 0.20 | 3.200 | 2.000 | - | 24101E3 | 34101E3 | - |
| | 220 | 6 x 10 | 160 | 8.4 | 0.20 | 1.500 | 0.910 | - | 24221E3 | 34221E3 | - |
| | 330 | 8 x 11 | 230 | 11 | 0.20 | 1.000 | 0.610 | - | 24331E3 | 34331E3 | - |
| | 470 | 6.5 x 18 | 310 | 13 | 0.20 | 0.680 | 0.430 | - | 24471E3 | 34471E3 | - |
| | 680 | 8 x 18 | 400 | 18 | 0.20 | 0.470 | 0.290 | - | 24681E3 | 34681E3 | - |
| | 1000 | 10 x 18 | 550 | 24 | 0.20 | 0.320 | 0.200 | - | 24102E3 | 34102E3 | - |
| | 1500 | 10 x 25 | 690 | 34 | 0.23 | 0.250 | 0.180 | - | 90524E3 | 90525E3 | - |
| | 1500 | 10 x 30 | 740 | 34 | 0.23 | 0.245 | 0.180 | 14152E3 | 24152E3 | - | - |
| | 2200 | 12.5 x 30 | 980 | 48 | 0.25 | 0.177 | 0.095 | 14222E3 | 24222E3 | - | - |
| | 3300 | 12.5 x 30 | 1090 | 70 | 0.27 | 0.128 | 0.095 | 14332E3 | 24332E3 | - | - |
| | 4700 | 15 x 30 | 1320 | 98 | 0.29 | 0.100 | 0.070 | 14472E3 | 24472E3 | - | 44472E3 |
| | 6800 | 18 x 30 | 1590 | 140 | 0.34 | 0.079 | 0.065 | 14682E3 | - | - | 44682E3 |
| 10 000 | 18 x 38 | 2090 | 204 | 0.40 | 0.064 | 0.040 | 14103E3 | - | - | 44103E3 | |
| 15 000 | 21 x 38 | 2250 | 304 | 0.50 | 0.054 | 0.035 | 14153E3 | - | - | 44153E3 | |
| 16 | 68 | 4.5 x 10 | 90 | 6.2 | 0.16 | 3.800 | 2.400 | - | 25689E3 | 35689E3 | - |
| | 150 | 6 x 10 | 140 | 8.8 | 0.16 | 1.700 | 1.100 | - | 25151E3 | 35151E3 | - |
| | 220 | 8 x 11 | 210 | 11 | 0.16 | 1.200 | 0.730 | - | 25221E3 | 35221E3 | - |
| | 330 | 6.5 x 18 | 290 | 15 | 0.16 | 0.770 | 0.480 | - | 25331E3 | 35331E3 | - |
| | 470 | 8 x 18 | 380 | 19 | 0.16 | 0.550 | 0.340 | - | 25471E3 | 35471E3 | - |
| | 680 | 10 x 18 | 500 | 26 | 0.16 | 0.380 | 0.240 | - | 25681E3 | 35681E3 | - |
| | 1000 | 10 x 25 | 660 | 36 | 0.16 | 0.260 | 0.180 | - | 90517E3 | 90518E3 | - |
| | 1000 | 10 x 30 | 700 | 36 | 0.16 | 0.260 | 0.175 | 15102E3 | 25102E3 | - | - |
| | 1500 | 12.5 x 30 | 950 | 52 | 0.19 | 0.205 | 0.095 | 15152E3 | 25152E3 | - | - |
| | 2200 | 12.5 x 30 | 1040 | 74 | 0.21 | 0.150 | 0.095 | 15222E3 | 25222E3 | - | - |
| | 3300 | 15 x 30 | 1290 | 110 | 0.23 | 0.111 | 0.070 | 15332E3 | 25332E3 | - | 45332E3 |
| | 4700 | 18 x 30 | 1560 | 154 | 0.25 | 0.087 | 0.065 | 15472E3 | - | - | 45472E3 |
| 6800 | 18 x 38 | 2040 | 222 | 0.30 | 0.070 | 0.040 | 15682E3 | - | - | 45682E3 | |
| 10 000 | 21 x 38 | 2170 | 324 | 0.36 | 0.058 | 0.035 | 15103E3 | - | - | 45103E3 | |
| 25 | 47 | 4.5 x 10 | 80 | 6.4 | 0.14 | 4.800 | 2.600 | - | 26479E3 | 36479E3 | - |
| | 100 | 6 x 10 | 150 | 9 | 0.14 | 2.300 | 1.200 | - | 26101E3 | 36101E3 | - |
| | 150 | 8 x 11 | 190 | 12 | 0.14 | 1.500 | 0.800 | - | 90534E3 | 90535E3 | - |
| | 150 | 6.5 x 18 | 210 | 12 | 0.14 | 1.500 | 0.800 | - | 26151E3 | 36151E3 | - |
| | 220 | 6.5 x 18 | 250 | 15 | 0.14 | 1.000 | 0.550 | - | 26221E3 | 36221E3 | - |
| | 330 | 8 x 18 | 340 | 21 | 0.14 | 0.680 | 0.360 | - | 26331E3 | 36331E3 | - |
| | 470 | 10 x 18 | 450 | 28 | 0.14 | 0.480 | 0.260 | - | 26471E3 | 36471E3 | - |
| | 680 | 10 x 25 | 560 | 38 | 0.14 | 0.330 | 0.180 | - | 90527E3 | 90528E3 | - |
| | 680 | 10 x 30 | 640 | 38 | 0.14 | 0.323 | 0.175 | 16681E3 | 26681E3 | - | - |
| | 1000 | 12.5 x 30 | 840 | 54 | 0.14 | 0.220 | 0.095 | 16102E3 | 26102E3 | - | - |
| | 1500 | 12.5 x 30 | 950 | 79 | 0.17 | 0.179 | 0.095 | 16152E3 | 26152E3 | - | - |
| | 2200 | 15 x 30 | 1180 | 114 | 0.19 | 0.132 | 0.070 | 16222E3 | 26222E3 | - | 46222E3 |
| | 3300 | 18 x 30 | 1470 | 169 | 0.21 | 0.099 | 0.065 | 16332E3 | - | - | 46332E3 |
| | 4700 | 18 x 38 | 1920 | 239 | 0.23 | 0.079 | 0.040 | 16472E3 | - | - | 46472E3 |
| 6800 | 21 x 38 | 2070 | 344 | 0.28 | 0.064 | 0.035 | 16682E3 | - | - | 46682E3 | |



| 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) | 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 | - | 27229E3 | 37229E3 | - |
| | 47 | 6 x 10 | 110 | 7.8 | 0.11 | 3.800 | 1.500 | - | 27479E3 | 37479E3 | - |
| | 100 | 8 x 11 | 170 | 12 | 0.11 | 1.800 | 0.700 | - | 90537E3 | 90538E3 | - |
| | 100 | 6.5 x 18 | 190 | 12 | 0.11 | 1.800 | 0.700 | - | 27101E3 | 37101E3 | - |
| | 150 | 8 x 18 | 250 | 16 | 0.11 | 1.100 | 0.470 | - | 27151E3 | 37151E3 | - |
| | 220 | 10 x 18 | 330 | 22 | 0.11 | 0.800 | 0.320 | - | 27221E3 | 37221E3 | - |
| | 330 | 10 x 25 | 430 | 30 | 0.11 | 0.530 | 0.210 | - | 27331E3 | 37331E3 | - |
| | 470 | 10 x 25 | 520 | 42 | 0.11 | 0.370 | 0.180 | - | 90514E3 | 90515E3 | - |
| | 470 | 10 x 30 | 590 | 42 | 0.12 | 0.404 | 0.175 | 17471E3 | 27471E3 | - | - |
| | 680 | 12.5 x 30 | 800 | 58 | 0.12 | 0.297 | 0.110 | 17681E3 | 27681E3 | - | - |
| | 1000 | 12.5 x 30 | 900 | 84 | 0.12 | 0.190 | 0.110 | 17102E3 | 27102E3 | - | - |
| | 1500 | 15 x 30 | 1120 | 124 | 0.15 | 0.159 | 0.070 | 17152E3 | 27152E3 | - | 47152E3 |
| | 2200 | 18 x 30 | 1390 | 180 | 0.17 | 0.118 | 0.065 | 17222E3 | - | - | 47222E3 |
| | 3300 | 18 x 38 | 1810 | 268 | 0.19 | 0.090 | 0.040 | 17332E3 | - | - | 47332E3 |
| | 4700 | 21 x 38 | 1940 | 380 | 0.21 | 0.072 | 0.035 | 17472E3 | - | - | 47472E3 |
| 63 | 0.47 | 4.5 x 10 | 8 | 4.1 | 0.09 | 310.0 | 120.0 | - | 28477E3 | 38477E3 | - |
| | 1 | 4.5 x 10 | 12 | 4.1 | 0.09 | 150.0 | 55.00 | - | 28108E3 | 38108E3 | - |
| | 2.2 | 4.5 x 10 | 21 | 4.3 | 0.09 | 65.00 | 25.00 | - | 28228E3 | 38228E3 | - |
| | 3.3 | 4.5 x 10 | 25 | 4.4 | 0.09 | 44.00 | 17.00 | - | 28338E3 | 38338E3 | - |
| | 4.7 | 4.5 x 10 | 31 | 4.6 | 0.09 | 31.00 | 12.00 | - | 28478E3 | 38478E3 | - |
| | 10 | 4.5 x 10 | 50 | 5.3 | 0.08 | 13.00 | 5.500 | - | 28109E3 | 38109E3 | - |
| | 15 | 4.5 x 10 | 55 | 5.9 | 0.08 | 8.500 | 3.700 | - | 28159E3 | 38159E3 | - |
| | 22 | 6 x 10 | 90 | 6.8 | 0.08 | 5.800 | 2.500 | - | 28229E3 | 38229E3 | - |
| | 33 | 6 x 10 | 100 | 8.2 | 0.08 | 3.900 | 1.700 | - | 28339E3 | 38339E3 | - |
| | 47 | 8 x 11 | 140 | 10 | 0.08 | 2.700 | 1.200 | - | 90541E3 | 90542E3 | - |
| | 47 | 6.5 x 18 | 150 | 10 | 0.08 | 2.700 | 1.200 | - | 28479E3 | 38479E3 | - |
| | 68 | 8 x 11 | 160 | 13 | 0.08 | 1.900 | 0.810 | - | 90544E3 | 90545E3 | - |
| | 68 | 6.5 x 18 | 170 | 13 | 0.08 | 1.900 | 0.810 | - | 28689E3 | 38689E3 | - |
| | 100 | 8 x 18 | 250 | 17 | 0.08 | 1.300 | 0.550 | - | 28101E3 | 38101E3 | - |
| | 150 | 10 x 18 | 320 | 23 | 0.08 | 0.850 | 0.370 | - | 28151E3 | 38151E3 | - |
| | 220 | 10 x 25 | 430 | 32 | 0.08 | 0.600 | 0.250 | - | 90511E3 | 90512E3 | - |
| | 220 | 10 x 30 | 480 | 32 | 0.08 | 0.614 | 0.260 | 18221E3 | 28221E3 | - | - |
| | 330 | 12.5 x 30 | 610 | 46 | 0.08 | 0.409 | 0.190 | 18331E3 | 28331E3 | - | - |
| | 470 | 12.5 x 30 | 700 | 63 | 0.08 | 0.287 | 0.130 | 18471E3 | 28471E3 | - | - |
| 680 | 15 x 30 | 890 | 90 | 0.08 | 0.199 | 0.095 | 18681E3 | 28681E3 | - | 48681E3 | |
| 1000 | 18 x 30 | 1170 | 130 | 0.08 | 0.135 | 0.075 | 18102E3 | - | - | 48102E3 | |
| 1500 | 18 x 38 | 1530 | 193 | 0.11 | 0.122 | 0.045 | 18152E3 | - | - | 48152E3 | |
| 2200 | 21 x 38 | 1780 | 281 | 0.13 | 0.099 | 0.040 | 18222E3 | - | - | 48222E3 | |
| 100 | 1 | 4.5 x 10 | 14 | 4.2 | 0.08 | 130.0 | 90.00 | - | 29108E3 | 39108E3 | - |
| | 2.2 | 4.5 x 10 | 20 | 4.4 | 0.08 | 58.00 | 41.00 | - | 29228E3 | 39228E3 | - |
| | 4.7 | 4.5 x 10 | 30 | 4.9 | 0.08 | 27.00 | 19.00 | - | 29478E3 | 39478E3 | - |
| | 10 | 6 x 10 | 65 | 6 | 0.08 | 13.00 | 9.000 | - | 29109E3 | 39109E3 | - |
| | 15 | 8 x 11 | 77 | 7 | 0.08 | 8.500 | 6.000 | - | 90547E3 | 90548E3 | - |
| | 15 | 6.5 x 18 | 85 | 7 | 0.08 | 8.500 | 6.000 | - | 29159E3 | 39159E3 | - |
| | 22 | 8 x 11 | 95 | 8.4 | 0.08 | 5.800 | 4.100 | - | 90551E3 | 90552E3 | - |
| | 22 | 6.5 x 18 | 100 | 8.4 | 0.08 | 5.800 | 4.100 | - | 29229E3 | 39229E3 | - |
| | 33 | 6.5 x 18 | 120 | 10.6 | 0.08 | 3.900 | 2.700 | - | 29339E3 | 39339E3 | - |
| | 47 | 8 x 18 | 160 | 13.4 | 0.08 | 2.700 | 1.900 | - | 29479E3 | 39479E3 | - |
| | 68 | 10 x 18 | 220 | 17.6 | 0.08 | 1.900 | 1.300 | - | 29689E3 | 39689E3 | - |
| | 100 | 10 x 25 | 300 | 24 | 0.08 | 1.300 | 0.900 | - | 90531E3 | 90532E3 | - |
| | 100 | 10 x 30 | 340 | 24 | 0.07 | 1.150 | 1.000 | 19101E3 | 29101E3 | - | - |
| | 150 | 12.5 x 30 | 490 | 34 | 0.07 | 0.645 | 0.610 | 19151E3 | 29151E3 | - | - |
| | 220 | 12.5 x 30 | 560 | 48 | 0.08 | 0.610 | 0.560 | 19221E3 | 29221E3 | - | - |
| | 330 | 15 x 30 | 740 | 70 | 0.09 | 0.420 | 0.400 | 19331E3 | 29331E3 | - | 49331E3 |
| | 470 | 18 x 30 | 980 | 98 | 0.09 | 0.310 | 0.290 | 19471E3 | - | - | 49471E3 |
| 680 | 18 x 38 | 1260 | 140 | 0.09 | 0.195 | 0.180 | 19681E3 | - | - | 49681E3 | |
| 1000 | 21 x 38 | 1470 | 204 | 0.10 | 0.160 | 0.150 | 19102E3 | - | - | 49102E3 | |

| 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 $\varnothing D \times L$ 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


Fig. 6 - 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 | | |
| | $U_R = 6.3 \text{ V TO } 16 \text{ V}$ | $U_R = 25 \text{ V TO } 40 \text{ V}$ | $U_R = 63 \text{ V TO } 100 \text{ V}$ |
| 50 | 0.95 | 0.90 | 0.85 |
| 100 | 1.00 | 1.00 | 1.00 |
| 300 | 1.07 | 1.12 | 1.20 |
| 1000 | 1.12 | 1.20 | 1.30 |
| 3000 | 1.15 | 1.25 | 1.35 |
| $\geq 10\,000$ | 1.20 | 1.30 | 1.40 |

Table 5

| TEST PROCEDURES AND REQUIREMENTS | | | |
|------------------------------------------------|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TEST | | PROCEDURE (quick reference) | REQUIREMENTS |
| NAME OF TEST | REFERENCE | | |
| Endurance | IEC 60384-4/ EN130300 subclause 4.13 | $T_{amb} = 85 \text{ }^\circ\text{C}$; U_R applied; case $\emptyset D \times L = 4.5 \text{ mm} \times 10 \text{ mm}$ to 10 mm x 25 mm: $U_R = 6.3 \text{ V to } 25 \text{ V}$: 1000 h; $U_R = 40 \text{ V to } 100 \text{ V}$: 2000 h; case $\emptyset D \times L = 10 \text{ mm} \times 30 \text{ mm}$ to 21 mm x 38 mm: $U_R = 6.3 \text{ V to } 100 \text{ V}$: 5000 h | $U_R \leq 6.3 \text{ V}$; $\Delta C/C$: + 15 %/- 30 % $U_R > 6.3 \text{ V}$; $\Delta C/C$: $\pm 15 \%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ |
| | | $T_{amb} = 105 \text{ }^\circ\text{C}$; U_R applied; case $\emptyset D \times L = 10 \text{ mm} \times 30 \text{ mm}$ to 21 mm x 38 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 | $T_{amb} = 85 \text{ }^\circ\text{C}$; U_R and I_R applied; case $\emptyset D \times L = 4.5 \text{ mm} \times 10 \text{ mm}$ to 10 mm x 25 mm: 2500 h; case $\emptyset D \times L = 10 \text{ mm} \times 30 \text{ mm}$ to 21 mm x 38 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 | $T_{amb} = 85 \text{ }^\circ\text{C}$; 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 $I_{L5} \leq 2 \times \text{spec. limit}$ |



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