

Aluminum Capacitors Radial Very Low Impedance

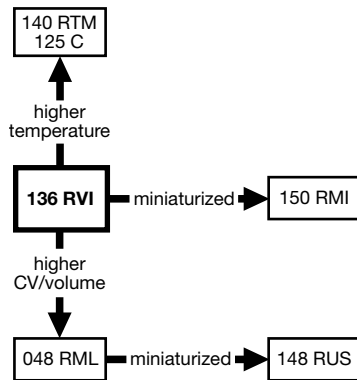


Fig. 1

| QUICK REFERENCE DATA | |
|----------------------------------------------|----------------------------------------------------|
| DESCRIPTION | VALUE |
| Nominal case sizes (Ø D x L in mm) | 10 x 12 to 18 x 35 |
| Rated capacitance range, C_R | 22 μ F to 10 000 μ F |
| Tolerance on C_R | $\pm 20 \%$ |
| Rated voltage range, C_R | 10 V to 100 V |
| Category temperature range | -55 °C to +105 °C |
| Endurance test at 105 °C | 3000 h to 5000 h (dependent on case size) |
| Useful life at 105 °C | 4000 h to 10 000 h (dependent on case size) |
| Useful life at 40 °C, 1.8 x I_R applied | 200 000 h to 500 000 h (dependent on case size) |
| Shelf life at 0 V, 105 °C | 1000 h |
| Based on sectional specification | IEC 60384-4/EN130300 |
| Climatic category IEC 60068 | 55/105/56 |

FEATURES

- Very low impedance and low ESR
- Very long useful life:
4000 h to 10 000 h at 105 °C, very high reliability
- Excellent ripple current capability
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case with pressure relief, insulated with a blue sleeve
- Charge and discharge proof
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912


**RoHS
COMPLIANT**

APPLICATIONS

- Power supplies (SMPS, DC/DC converters) for general industrial, EDP, audio-video, and telecommunications
- Smoothing, filtering, buffering

MARKING

The capacitors are marked (where possible) with the following information:

- Rated capacitance value (in μ F)
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (M for $\pm 20 \%$)
- Rated voltage (in V)
- Date code, in accordance with IEC 60062
- Code indicating factory of origin
- Name of manufacturer
- Upper category temperature (105 °C)
- Negative terminal identification
- Series number (136)



| SELECTION CHART FOR C _R , U _R , AND RELEVANT NOMINAL CASE SIZES (∅ D x L in mm) | | | | | | | |
|-------------------------------------------------------------------------------------------------------|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| C _R (μF) | U _R (V) | | | | | | |
| | 10 | 16 | 25 | 35 | 50 | 63 | 100 |
| 22 | - | - | - | - | - | - | 10 x 12 |
| 33 | - | - | - | - | - | - | 10 x 12 |
| 47 | - | - | - | - | - | 10 x 12 | 10 x 16 |
| 56 | - | - | - | - | - | 10 x 12 | - |
| 68 | - | - | - | - | - | 10 x 16 | 10 x 20 |
| 82 | - | - | - | - | 10 x 12 | - | - |
| 100 | - | - | - | - | 10 x 12 | 10 x 16 | 12.5 x 20 |
| 120 | - | - | - | 10 x 12 | 10 x 16 | 10 x 20 | - |
| | - | - | - | - | - | 12.5 x 16 | - |
| 150 | - | - | - | 10 x 12 | 10 x 20 | 10 x 25 | 16 x 20 |
| 180 | - | - | 10 x 12 | - | 10 x 20 | 10 x 30 | - |
| | - | - | - | - | 12.5 x 16 | - | - |
| 220 | - | - | 10 x 12 | 10 x 16 | 10 x 25 | 12.5 x 20 | 16 x 25 |
| 270 | - | 10 x 12 | - | - | - | 12.5 x 25 | - |
| 330 | - | 10 x 12 | 10 x 16 | 10 x 20 | 10 x 30 | 16 x 20 | 16 x 31 |
| | - | - | - | 12.5 x 16 | 12.5 x 20 | - | - |
| 390 | 10 x 12 | - | - | 10 x 25 | - | 12.5 x 31 | - |
| 470 | 10 x 12 | 10 x 16 | 10 x 20 | 12.5 x 20 | 12.5 x 25 | 16 x 25 | 16 x 35 |
| | - | - | 12.5 x 16 | - | - | - | 18 x 31 |
| 560 | - | - | 10 x 25 | 10 x 30 | 12.5 x 31 | - | - |
| | - | - | - | 12.5 x 20 | - | - | - |
| 680 | 10 x 16 | 10 x 20 | - | 12.5 x 25 | 16 x 20 | 16 x 31 | 18 x 35 |
| | - | 12.5 x 16 | - | - | - | 18 x 25 | - |
| 820 | - | 10 x 25 | 10 x 30 | - | 16 x 25 | 16 x 35 | - |
| | - | - | 12.5 x 20 | - | - | - | - |
| 1000 | 10 x 20 | 12.5 x 20 | 12.5 x 25 | 12.5 x 31 | 16 x 31 | 18 x 31 | - |
| | 12.5 x 16 | - | - | 16 x 20 | 18 x 20 | - | - |
| 1200 | 10 x 25 | 10 x 30 | - | 16 x 25 | 16 x 35 | - | - |
| | - | 12.5 x 20 | - | - | - | - | - |
| 1500 | 10 x 30 | 12.5 x 25 | 12.5 x 31 | 16 x 25 | 18 x 31 | 18 x 35 | - |
| | 12.5 x 20 | - | 16 x 20 | - | - | - | - |
| 1800 | 12.5 x 20 | - | 16 x 25 | 16 x 31 | - | - | - |
| 2200 | 12.5 x 25 | 12.5 x 31 | 16 x 31 | 16 x 35 | 18 x 35 | - | - |
| | - | 16 x 20 | 18 x 20 | 18 x 31 | - | - | - |
| 2700 | 12.5 x 31 | 16 x 25 | 16 x 31 | - | - | - | - |
| 3300 | 16 x 20 | 16 x 25 | 16 x 35 | 18 x 35 | - | - | - |
| | - | - | 18 x 31 | - | - | - | - |
| 3900 | 16 x 25 | 16 x 31 | - | - | - | - | - |
| 4700 | 16 x 31 | 16 x 35 | 18 x 35 | - | - | - | - |
| | - | 18 x 31 | - | - | - | - | - |
| 5600 | 16 x 31 | - | - | - | - | - | - |
| | 18 x 25 | - | - | - | - | - | - |
| 6800 | 16 x 35 | 18 x 35 | - | - | - | - | - |
| | 18 x 31 | - | - | - | - | - | - |
| 10 000 | 18 x 35 | - | - | - | - | - | - |

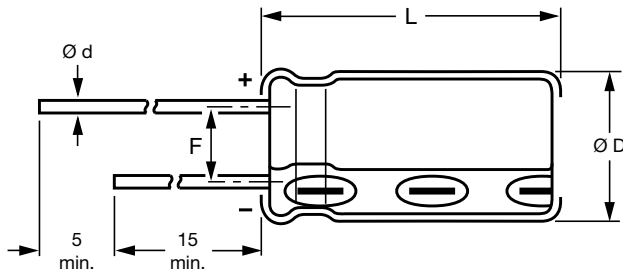
DIMENSIONS in millimeters AND AVAILABLE FORMS


Fig. 2 - Form CA: Long leads

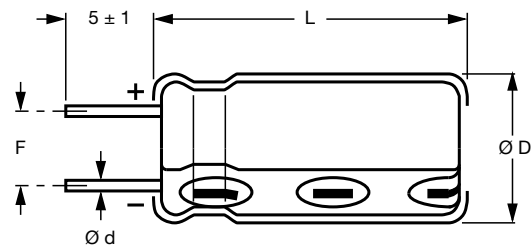


Fig. 3 - Form CB: Cut leads

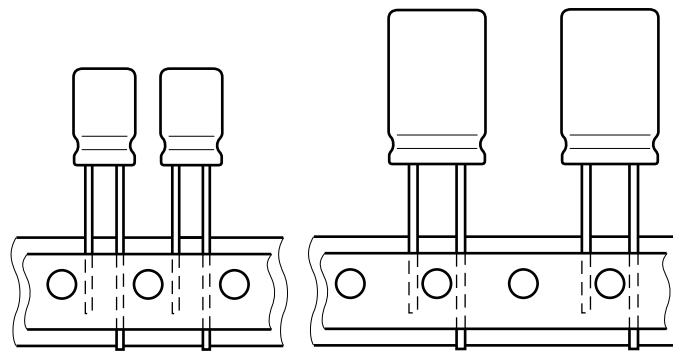


Fig. 4 - Form TFA: Taped in box (ammopack)

Table 1

| DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES | | | | | | | | | |
|----------------------------------------------------------|-----------|-----------------|------------------------|------------|---------------|----------------|----------------------|---------|----------|
| NOMINAL CASE SIZE $\varnothing D \times L$ | CASE CODE | $\varnothing d$ | $\varnothing D_{max.}$ | $L_{max.}$ | F | MASS (g) | PACKAGING QUANTITIES | | |
| | | | | | | | FORM CA | FORM CB | FORM TFA |
| 10 x 12 | 14 | 0.6 | 10.5 | 13.5 | 5.0 ± 0.5 | ≈ 1.6 | 1000 | 500 | 800 |
| 10 x 16 | 15 | 0.6 | 10.5 | 17.5 | 5.0 ± 0.5 | ≈ 1.9 | 500 | 500 | 800 |
| 10 x 20 | 16 | 0.6 | 10.5 | 22.0 | 5.0 ± 0.5 | ≈ 2.2 | 500 | 500 | 800 |
| 10 x 25 | 16L | 0.6 | 10.5 | 27.0 | 5.0 ± 0.5 | ≈ 3.0 | 1000 | 1500 | 800 |
| 10 x 30 | 16LL | 0.6 | 10.5 | 32.0 | 5.0 ± 0.5 | ≈ 3.5 | 1000 | 750 | - |
| 12.5 x 16 | 17a | 0.6 | 13.0 | 17.5 | 5.0 ± 0.5 | ≈ 2.7 | 1000 | 1500 | 500 |
| 12.5 x 20 | 17 | 0.6 | 13.0 | 22.0 | 5.0 ± 0.5 | ≈ 4.0 | 500 | 500 | 500 |
| 12.5 x 25 | 18 | 0.6 | 13.0 | 27.0 | 5.0 ± 0.5 | ≈ 5.0 | 250 | 250 | 500 |
| 12.5 x 31 | 18L | 0.6 | 13.0 | 33.5 | 5.0 ± 0.5 | ≈ 5.5 | 1000 | 750 | - |
| 16 x 20 | 19a | 0.8 | 16.5 | 22.0 | 7.5 ± 0.5 | ≈ 6.0 | 250 | 250 | 250 |
| 16 x 25 | 19 | 0.8 | 16.5 | 27.0 | 7.5 ± 0.5 | ≈ 8.0 | 250 | 250 | 250 |
| 16 x 31 | 20 | 0.8 | 16.5 | 33.5 | 7.5 ± 0.5 | ≈ 9.0 | 100 | 100 | 250 |
| 16 x 35 | 21 | 0.8 | 16.5 | 37.5 | 7.5 ± 0.5 | ≈ 11.0 | 100 | 100 | - |
| 18 x 20 | 1820 | 0.8 | 18.5 | 22.0 | 7.5 ± 0.5 | ≈ 8.0 | 100 | 100 | - |
| 18 x 25 | 1825 | 0.8 | 18.5 | 27.0 | 7.5 ± 0.5 | ≈ 10.0 | 100 | 100 | - |
| 18 x 31 | 1831 | 0.8 | 18.5 | 33.5 | 7.5 ± 0.5 | ≈ 12.5 | 100 | 100 | - |
| 18 x 35 | 22 | 0.8 | 18.5 | 37.5 | 7.5 ± 0.5 | ≈ 14.5 | 100 | 100 | - |

Note

- For detailed tape dimensions 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 kHz, 105 °C |
| I _{L2} | Max. leakage current after 2 min at U _R |
| tan δ | Max. dissipation factor at 100 Hz |
| Z | Max. impedance at 100 kHz |

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 %

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 kHz 105 °C (mA) | I _{L2} 2 min (µA) | tan δ 100 Hz | Z 100 kHz +20 °C (mΩ) | Z 100 kHz -10 °C (mΩ) | ORDERING CODE MAL2136..... | | |
| | | | | | | | | BULK PACKAGING | | TAPED |
| | | | | | | | | FORM CA | FORM CB | FORM TFA |
| 10 | 390 | 10 x 12 | 630 | 39 | 0.19 | 120 | 240 | 54391E3 | 64391E3 | 34391E3 |
| | 470 | 10 x 12 | 630 | 47 | 0.19 | 120 | 240 | 54471E3 | 64471E3 | 34471E3 |
| | 680 | 10 x 16 | 830 | 68 | 0.19 | 84 | 170 | 54681E3 | 64681E3 | 34681E3 |
| | 1000 | 10 x 20 | 1000 | 100 | 0.19 | 62 | 130 | 54102E3 | 64102E3 | 34102E3 |
| | 1000 | 12.5 x 16 | 940 | 100 | 0.19 | 76 | 160 | 94105E3 | 94106E3 | 94103E3 |
| | 1200 | 10 x 25 | 1300 | 120 | 0.19 | 52 | 110 | 54122E3 | 64122E3 | 34122E3 |
| | 1500 | 10 x 30 | 1400 | 150 | 0.19 | 44 | 88 | 94155E3 | 94156E3 | - |
| | 1500 | 12.5 x 20 | 1300 | 150 | 0.19 | 46 | 92 | 54152E3 | 64152E3 | 34152E3 |
| | 1800 | 12.5 x 20 | 1340 | 180 | 0.19 | 46 | 92 | 54182E3 | 64182E3 | 34182E3 |
| | 2200 | 12.5 x 25 | 1700 | 220 | 0.21 | 34 | 68 | 54222E3 | 64222E3 | 34222E3 |
| | 2700 | 12.5 x 31 | 2000 | 270 | 0.21 | 30 | 60 | 54272E3 | 64272E3 | - |
| | 3300 | 16 x 20 | 1600 | 330 | 0.23 | 38 | 76 | 54332E3 | 64332E3 | 34332E3 |
| | 3900 | 16 x 25 | 2100 | 390 | 0.23 | 28 | 56 | 54392E3 | 64392E3 | 34392E3 |
| | 4700 | 16 x 31 | 2400 | 470 | 0.25 | 25 | 50 | 54472E3 | 64472E3 | 34472E3 |
| | 5600 | 16 x 31 | 2400 | 560 | 0.27 | 25 | 50 | 54562E3 | 64562E3 | 34562E3 |
| | 5600 | 18 x 25 | 2270 | 560 | 0.27 | 25 | 50 | 94565E3 | 94566E3 | - |
| 6800 | 16 x 35 | 2600 | 680 | 0.29 | 22 | 44 | 54682E3 | 64682E3 | - | |
| 6800 | 18 x 31 | 2760 | 680 | 0.29 | 23 | 46 | 94685E3 | 94686E3 | - | |
| 10 000 | 18 x 35 | 3180 | 1000 | 0.31 | 21 | 42 | 54103E3 | 64103E3 | - | |
| 16 | 270 | 10 x 12 | 630 | 43 | 0.16 | 120 | 240 | 55271E3 | 65271E3 | 35271E3 |
| | 330 | 10 x 12 | 630 | 53 | 0.16 | 120 | 240 | 55331E3 | 65331E3 | 35331E3 |
| | 470 | 10 x 16 | 830 | 75 | 0.16 | 84 | 170 | 55471E3 | 65471E3 | 35471E3 |
| | 680 | 10 x 20 | 1000 | 110 | 0.16 | 62 | 130 | 55681E3 | 65681E3 | 35681E3 |
| | 680 | 12.5 x 16 | 940 | 110 | 0.16 | 76 | 160 | 95685E3 | 95686E3 | 95683E3 |
| | 820 | 10 x 25 | 1300 | 130 | 0.16 | 52 | 110 | 55821E3 | 65821E3 | 35821E3 |
| | 1000 | 12.5 x 20 | 1300 | 160 | 0.16 | 48 | 96 | 55102E3 | 65102E3 | 35102E3 |
| | 1200 | 10 x 30 | 1400 | 190 | 0.16 | 44 | 88 | 95125E3 | 95126E3 | - |
| | 1200 | 12.5 x 20 | 1300 | 190 | 0.16 | 46 | 92 | 55122E3 | 65122E3 | 35122E3 |
| | 1500 | 12.5 x 25 | 1700 | 240 | 0.16 | 34 | 68 | 55152E3 | 65152E3 | 35152E3 |
| | 2200 | 12.5 x 31 | 2000 | 350 | 0.18 | 30 | 60 | 95225E3 | 95226E3 | - |
| | 2200 | 16 x 20 | 1600 | 350 | 0.18 | 38 | 76 | 55222E3 | 65222E3 | 35222E3 |
| | 2700 | 16 x 25 | 2100 | 430 | 0.18 | 28 | 56 | 55272E3 | 65272E3 | 35272E3 |
| | 3300 | 16 x 25 | 2100 | 530 | 0.20 | 28 | 56 | 55332E3 | 65332E3 | 35332E3 |
| | 3900 | 16 x 31 | 2400 | 620 | 0.20 | 25 | 50 | 55392E3 | 65392E3 | 35392E3 |
| | 4700 | 16 x 35 | 2600 | 750 | 0.22 | 22 | 44 | 55472E3 | 65472E3 | - |
| 4700 | 18 x 31 | 2560 | 750 | 0.22 | 23 | 46 | 95475E3 | 95476E3 | - | |
| 6800 | 18 x 35 | 3000 | 1090 | 0.24 | 21 | 42 | 55682E3 | 65682E3 | - | |



ELECTRICAL DATA AND ORDERING INFORMATION

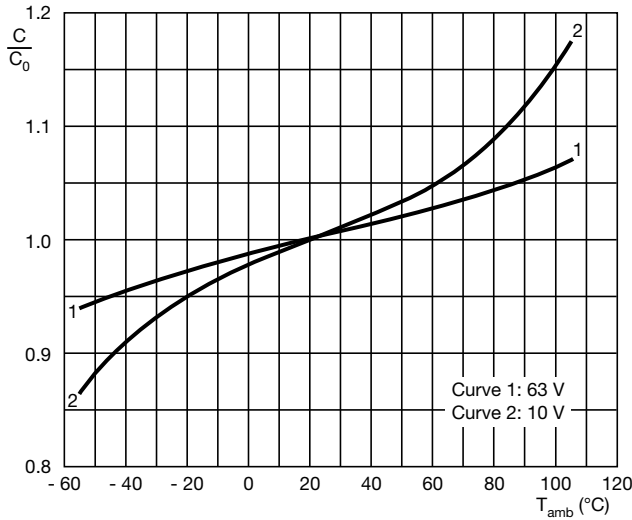
| U _R (V) | C _R 100 Hz (μF) | NOMINAL CASE SIZE Ø D x L (mm) | I _R 100 kHz 105 °C (mA) | I _{L2} 2 min (μA) | tan δ 100 Hz | Z 100 kHz +20 °C (mΩ) | Z 100 kHz -10 °C (mΩ) | ORDERING CODE MAL2136..... | | |
|-----------------------|----------------------------------|-----------------------------------------|---------------------------------------------|----------------------------------|-----------------|--------------------------------|--------------------------------|-------------------------------|---------|----------|
| | | | | | | | | BULK PACKAGING | | TAPED |
| | | | | | | | | FORM CA | FORM CB | FORM TFA |
| 25 | 180 | 10 x 12 | 630 | 45 | 0.14 | 120 | 240 | 56181E3 | 66181E3 | 36181E3 |
| | 220 | 10 x 12 | 630 | 55 | 0.14 | 120 | 240 | 56221E3 | 66221E3 | 36221E3 |
| | 330 | 10 x 16 | 830 | 83 | 0.14 | 84 | 170 | 56331E3 | 66331E3 | 36331E3 |
| | 470 | 10 x 20 | 1000 | 120 | 0.14 | 62 | 130 | 56471E3 | 66471E3 | 36471E3 |
| | 470 | 12.5 x 16 | 940 | 120 | 0.14 | 76 | 160 | 96475E3 | 96476E3 | 96473E3 |
| | 560 | 10 x 25 | 1300 | 140 | 0.14 | 52 | 110 | 56561E3 | 66561E3 | 36561E3 |
| | 820 | 10 x 30 | 1400 | 210 | 0.14 | 44 | 88 | 96825E3 | 96826E3 | - |
| | 820 | 12.5 x 20 | 1300 | 210 | 0.14 | 46 | 92 | 56821E3 | 66821E3 | 36821E3 |
| | 1000 | 12.5 x 25 | 1700 | 250 | 0.14 | 34 | 68 | 56102E3 | 66102E3 | 36102E3 |
| | 1500 | 12.5 x 31 | 2000 | 380 | 0.14 | 30 | 60 | 96155E3 | 96156E3 | - |
| | 1500 | 16 x 20 | 1700 | 380 | 0.14 | 38 | 76 | 56152E3 | 66152E3 | 36152E3 |
| | 1800 | 16 x 25 | 2100 | 450 | 0.14 | 28 | 56 | 56182E3 | 66182E3 | 36182E3 |
| | 2200 | 16 x 31 | 2400 | 550 | 0.16 | 25 | 50 | 56222E3 | 66222E3 | 36222E3 |
| | 2200 | 18 x 20 | 1680 | 550 | 0.16 | 28 | 56 | 96225E3 | 96226E3 | - |
| | 2700 | 16 x 31 | 2400 | 680 | 0.16 | 25 | 50 | 56272E3 | 66272E3 | 36272E3 |
| | 3300 | 16 x 35 | 2600 | 830 | 0.18 | 22 | 44 | 56332E3 | 66332E3 | - |
| 3300 | 18 x 31 | 2490 | 830 | 0.18 | 27 | 54 | 96335E3 | 96336E3 | - | |
| 4700 | 18 x 35 | 3000 | 1180 | 0.20 | 21 | 42 | 56472E3 | 66472E3 | - | |
| 35 | 120 | 10 x 12 | 630 | 42 | 0.12 | 120 | 240 | 50121E3 | 60121E3 | 30121E3 |
| | 150 | 10 x 12 | 630 | 53 | 0.12 | 120 | 240 | 50151E3 | 60151E3 | 30151E3 |
| | 220 | 10 x 16 | 830 | 77 | 0.12 | 84 | 170 | 50221E3 | 60221E3 | 30221E3 |
| | 330 | 10 x 20 | 1000 | 120 | 0.12 | 62 | 130 | 50331E3 | 60331E3 | 30331E3 |
| | 330 | 12.5 x 16 | 940 | 120 | 0.12 | 76 | 160 | 90335E3 | 90336E3 | 90333E3 |
| | 390 | 10 x 25 | 1300 | 140 | 0.12 | 52 | 110 | 50391E3 | 60391E3 | 30391E3 |
| | 470 | 12.5 x 20 | 1300 | 170 | 0.12 | 48 | 96 | 50471E3 | 60471E3 | 30471E3 |
| | 560 | 10 x 30 | 1400 | 200 | 0.12 | 44 | 88 | 90565E3 | 90566E3 | - |
| | 560 | 12.5 x 20 | 1300 | 200 | 0.12 | 46 | 92 | 50561E3 | 60561E3 | 30561E3 |
| | 680 | 12.5 x 25 | 1700 | 240 | 0.12 | 34 | 68 | 50681E3 | 60681E3 | 30681E3 |
| | 1000 | 12.5 x 31 | 2000 | 350 | 0.12 | 30 | 60 | 90105E3 | 90106E3 | - |
| | 1000 | 16 x 20 | 1700 | 350 | 0.12 | 38 | 76 | 50102E3 | 60102E3 | 30102E3 |
| | 1200 | 16 x 25 | 2100 | 420 | 0.12 | 28 | 56 | 50122E3 | 60122E3 | 30122E3 |
| | 1500 | 16 x 25 | 2100 | 530 | 0.12 | 28 | 56 | 50152E3 | 60152E3 | 30152E3 |
| | 1800 | 16 x 31 | 2400 | 630 | 0.12 | 25 | 50 | 50182E3 | 60182E3 | 30182E3 |
| | 2200 | 16 x 35 | 2600 | 770 | 0.14 | 22 | 44 | 50222E3 | 60222E3 | - |
| 2200 | 18 x 31 | 2320 | 770 | 0.14 | 27 | 54 | 90225E3 | 90226E3 | - | |
| 3300 | 18 x 35 | 2890 | 1160 | 0.16 | 21 | 42 | 50332E3 | 60332E3 | - | |
| 50 | 82 | 10 x 12 | 480 | 41 | 0.10 | 200 | 400 | 51829E3 | 61829E3 | 31829E3 |
| | 100 | 10 x 12 | 480 | 50 | 0.10 | 200 | 400 | 51101E3 | 61101E3 | 31101E3 |
| | 120 | 10 x 16 | 760 | 60 | 0.10 | 100 | 200 | 51121E3 | 61121E3 | 31121E3 |
| | 150 | 10 x 20 | 850 | 75 | 0.10 | 90 | 180 | 51151E3 | 61151E3 | 31151E3 |
| | 180 | 10 x 20 | 950 | 90 | 0.10 | 75 | 150 | 51181E3 | 61181E3 | 31181E3 |
| | 180 | 12.5 x 16 | 780 | 90 | 0.10 | 59 | 120 | 91185E3 | 91186E3 | 91183E3 |
| | 220 | 10 x 25 | 1200 | 110 | 0.10 | 63 | 130 | 51221E3 | 61221E3 | 31221E3 |
| | 330 | 10 x 30 | 1300 | 170 | 0.10 | 54 | 110 | 91335E3 | 91336E3 | - |
| | 330 | 12.5 x 20 | 1200 | 170 | 0.10 | 59 | 120 | 51331E3 | 61331E3 | 31331E3 |
| | 470 | 12.5 x 25 | 1500 | 240 | 0.10 | 44 | 88 | 51471E3 | 61471E3 | 31471E3 |
| | 560 | 12.5 x 31 | 1700 | 280 | 0.10 | 39 | 78 | 51561E3 | 61561E3 | - |
| | 680 | 16 x 20 | 1400 | 340 | 0.10 | 50 | 100 | 51681E3 | 61681E3 | 31681E3 |
| | 820 | 16 x 25 | 1900 | 410 | 0.10 | 34 | 68 | 51821E3 | 61821E3 | 31821E3 |
| | 1000 | 16 x 31 | 2200 | 500 | 0.10 | 30 | 60 | 51102E3 | 61102E3 | 31102E3 |
| | 1000 | 18 x 20 | 1510 | 500 | 0.10 | 41 | 82 | 91105E3 | 91106E3 | - |
| | 1200 | 16 x 35 | 2300 | 600 | 0.10 | 27 | 54 | 51122E3 | 61122E3 | - |
| 1500 | 18 x 31 | 2200 | 750 | 0.10 | 31 | 62 | 51152E3 | 61152E3 | - | |
| 2200 | 18 x 35 | 2650 | 1100 | 0.12 | 27 | 54 | 51222E3 | 61222E3 | - | |



| ELECTRICAL DATA AND ORDERING INFORMATION | | | | | | | | | | |
|------------------------------------------|----------------------------------|-----------------------------------------|---------------------------------------------|----------------------------------|-----------------|--------------------------------|--------------------------------|-------------------------------|---------|----------|
| U _R (V) | C _R 100 Hz (μF) | NOMINAL CASE SIZE Ø D x L (mm) | I _R 100 kHz 105 °C (mA) | I _{L2} 2 min (μA) | tan δ 100 Hz | Z 100 kHz +20 °C (mΩ) | Z 100 kHz -10 °C (mΩ) | ORDERING CODE MAL2136..... | | |
| | | | | | | | | BULK PACKAGING | | TAPED |
| | | | | | | | | FORM CA | FORM CB | FORM TFA |
| 63 | 47 | 10 x 12 | 380 | 30 | 0.10 | 300 | 750 | 58479E3 | 68479E3 | 38479E3 |
| | 56 | 10 x 12 | 420 | 35 | 0.10 | 270 | 680 | 58569E3 | 68569E3 | 38569E3 |
| | 68 | 10 x 16 | 520 | 43 | 0.10 | 210 | 530 | 58689E3 | 68689E3 | 38689E3 |
| | 100 | 10 x 16 | 580 | 63 | 0.10 | 190 | 480 | 58101E3 | 68101E3 | 38101E3 |
| | 120 | 10 x 20 | 650 | 76 | 0.10 | 160 | 400 | 58121E3 | 68121E3 | 38121E3 |
| | 120 | 12.5 x 16 | 610 | 76 | 0.10 | 180 | 450 | 98125E3 | 98126E3 | 98123E3 |
| | 150 | 10 x 25 | 780 | 95 | 0.10 | 130 | 330 | 58151E3 | 68151E3 | 38151E3 |
| | 180 | 10 x 30 | 960 | 110 | 0.10 | 100 | 250 | 58181E3 | 68181E3 | - |
| | 220 | 12.5 x 20 | 870 | 140 | 0.10 | 110 | 280 | 58221E3 | 68221E3 | 38221E3 |
| | 270 | 12.5 x 25 | 1200 | 170 | 0.10 | 74 | 190 | 58271E3 | 68271E3 | 38271E3 |
| | 330 | 16 x 20 | 1100 | 210 | 0.10 | 85 | 220 | 58331E3 | 68331E3 | 38331E3 |
| | 390 | 12.5 x 31 | 1300 | 250 | 0.10 | 68 | 170 | 58391E3 | 68391E3 | - |
| | 470 | 16 x 25 | 1500 | 300 | 0.10 | 55 | 140 | 58471E3 | 68471E3 | 38471E3 |
| | 680 | 16 x 31 | 1700 | 430 | 0.10 | 46 | 120 | 58681E3 | 68681E3 | 38681E3 |
| | 680 | 18 x 25 | 1470 | 430 | 0.10 | 54 | 108 | 98685E3 | 98686E3 | - |
| 820 | 16 x 35 | 1900 | 520 | 0.10 | 40 | 100 | 58821E3 | 68821E3 | - | |
| 1000 | 18 x 31 | 1950 | 630 | 0.10 | 39 | 78 | 58102E3 | 68102E3 | - | |
| 1500 | 18 x 35 | 2350 | 950 | 0.10 | 33 | 66 | 58152E3 | 68152E3 | - | |
| 100 | 22 | 10 x 12 | 300 | 22 | 0.07 | 450 | 2300 | 59229E3 | 69229E3 | 39229E3 |
| | 33 | 10 x 12 | 320 | 33 | 0.07 | 390 | 2000 | 59339E3 | 69339E3 | 39339E3 |
| | 47 | 10 x 16 | 450 | 47 | 0.07 | 320 | 1600 | 59479E3 | 69479E3 | 39479E3 |
| | 68 | 10 x 20 | 520 | 68 | 0.07 | 240 | 1200 | 59689E3 | 69689E3 | 39689E3 |
| | 100 | 12.5 x 20 | 800 | 100 | 0.07 | 150 | 750 | 59101E3 | 69101E3 | 39101E3 |
| | 150 | 16 x 20 | 1000 | 150 | 0.07 | 110 | 550 | 59151E3 | 69151E3 | 39151E3 |
| | 220 | 16 x 25 | 1300 | 220 | 0.07 | 81 | 400 | 59221E3 | 69221E3 | 39221E3 |
| | 330 | 16 x 31 | 1600 | 330 | 0.07 | 58 | 290 | 59331E3 | 69331E3 | 39331E3 |
| | 470 | 16 x 35 | 1800 | 470 | 0.07 | 45 | 230 | 59471E3 | 69471E3 | - |
| | 470 | 18 x 31 | 1800 | 470 | 0.07 | 45 | 230 | 99475E3 | 99476E3 | - |
| 680 | 18 x 35 | 2000 | 680 | 0.07 | 39 | 200 | 59681E3 | 69681E3 | - | |

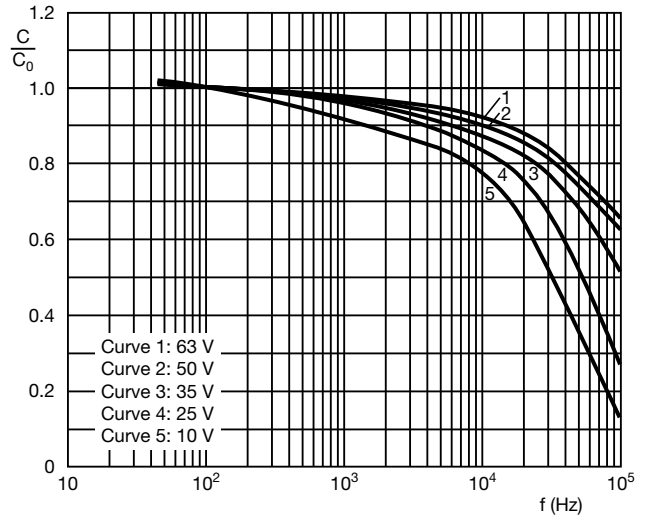
| ADDITIONAL ELECTRICAL DATA | | |
|------------------------------------|-----------------------------------------------------------------------|-----------------------------------|
| PARAMETER | CONDITIONS | VALUE |
| Voltage | | |
| Surge voltage | | $U_S \leq 1.15 \times U_R$ |
| Reverse voltage | | $U_{rev} \leq 1 V$ |
| Current | | |
| Leakage current | After 2 min at U _R | $I_{L2} \leq 0.01 C_R \times U_R$ |
| Inductance | | |
| Equivalent series inductance (ESL) | 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 δ _{max} and C _R (see Table 2) | $ESR = \tan \delta / 2 \pi f C_R$ |

CAPACITANCE (C)



C_0 = Typical capacitance at 20 °C, 100 Hz

Fig. 5 - Typical multiplier of capacitance as a function of ambient temperature

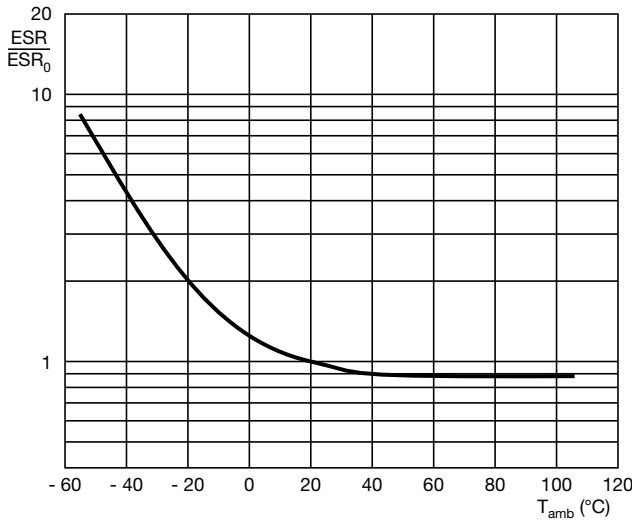


C_0 = Typical capacitance at 20 °C, 100 Hz

$T_{amb} = 20$ °C

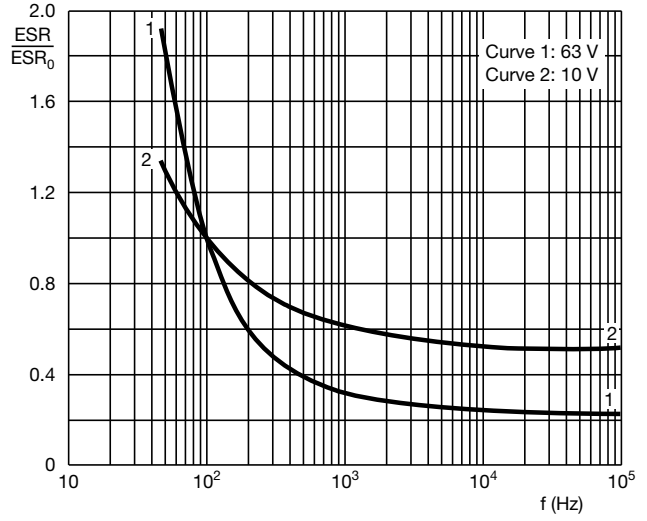
Fig. 6 - Typical multiplier of capacitance as a function of frequency

EQUIVALENT SERIES RESISTANCE (ESR)



ESR_0 = Typical ESR at 20 °C, 100 Hz

Fig. 7 - Typical multiplier of ESR as a function of ambient temperature

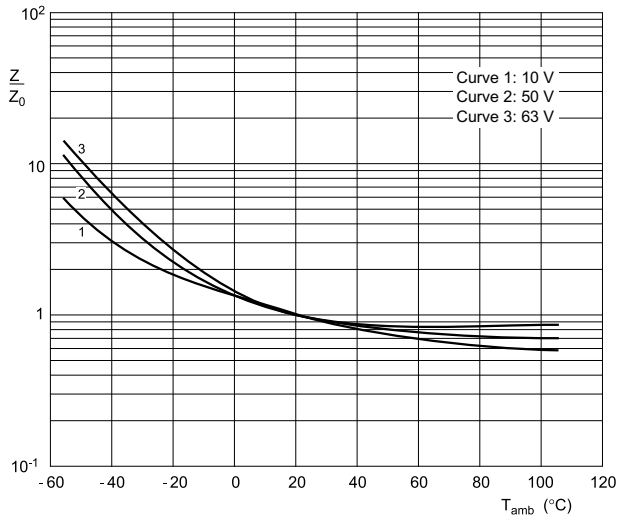


ESR_0 = Typical ESR at 20 °C, 100 Hz

$T_{amb} = 20$ °C

Fig. 8 - Typical multiplier of ESR as a function of frequency

IMPEDANCE (Z)



Z_0 = Typical impedance at 20 °C, 100 kHz

Fig. 9 - Typical multiplier of impedance as a function of ambient temperature

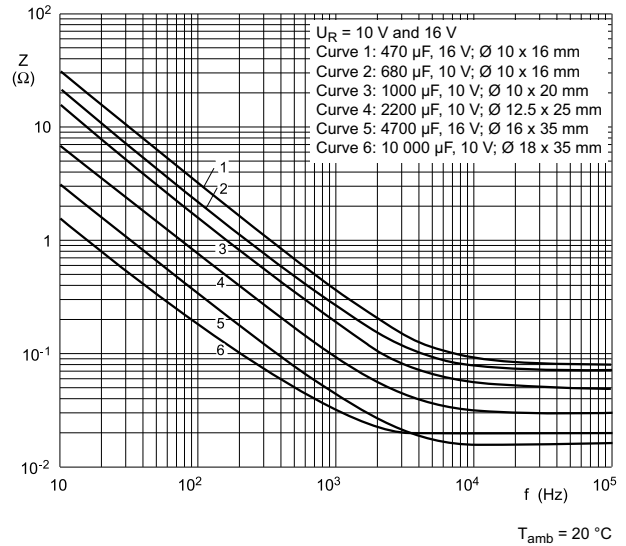


Fig. 10 - Typical impedance as a function of frequency

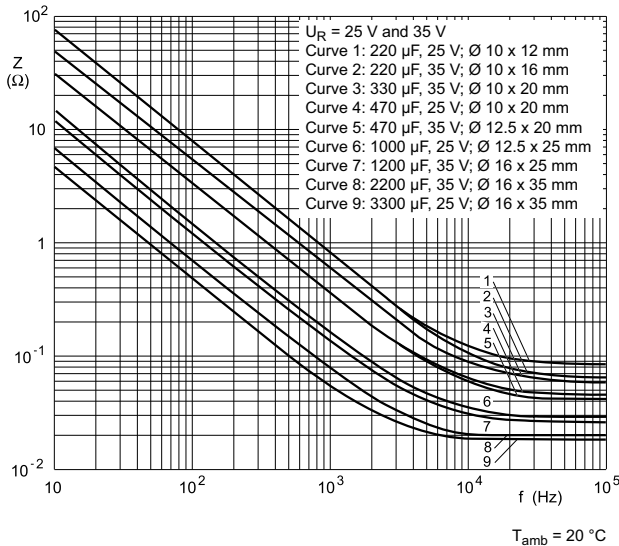


Fig. 11 - Typical impedance as a function of frequency

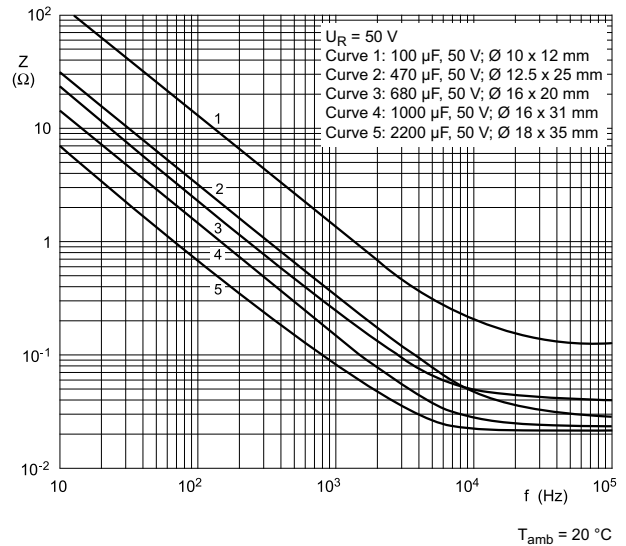


Fig. 12 - Typical impedance as a function of frequency

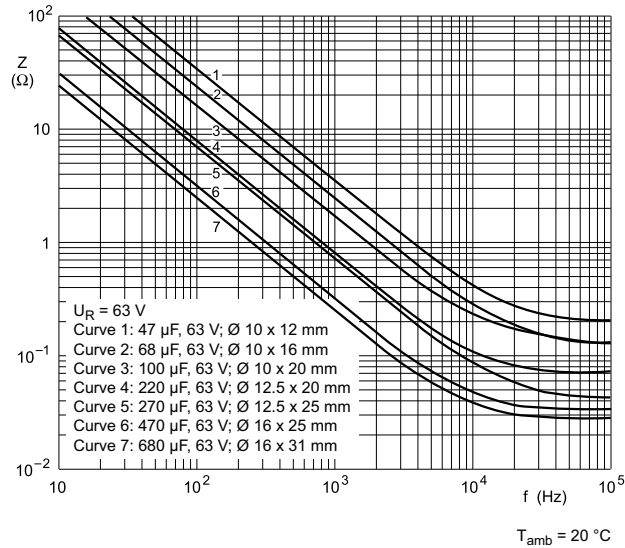


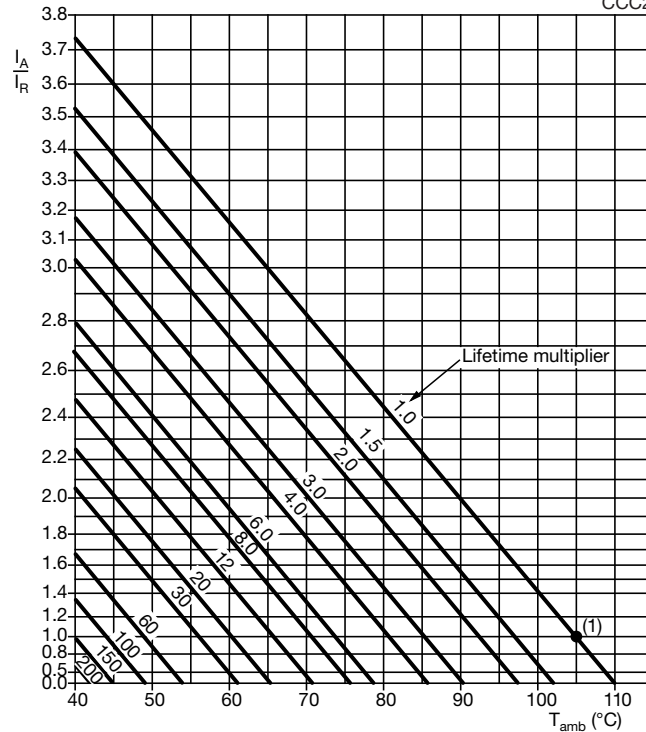
Fig. 13 - Typical impedance as a function of frequency

RIPPLE CURRENT AND USEFUL LIFE

Table 3

| ENDURANCE TEST AND USEFUL LIFE AS A FUNCTION OF CASE SIZE | | | |
|-----------------------------------------------------------|-----------|------------------------------------|---------------------------------|
| NOMINAL CASE SIZE $\varnothing D \times L$ (mm) | CASE CODE | ENDURANCE TEST AT 105 °C (h) | USEFUL LIFE AT 105 °C (h) |
| 10 x 12 | 14 | 3000 | 4000 |
| 10 x 16 | 15 | 3000 | 6000 |
| 10 x 20 | 16 | 3000 | 6000 |
| 10 x 25 | 16L | 5000 | 7000 |
| 10 x 30 | 16LL | 5000 | 7000 |
| 12.5 x 16 | 17a | 3000 | 5000 |
| 12.5 x 20 | 17 | 3000 | 7000 |
| 12.5 x 25 | 18 | 5000 | 8000 |
| 12.5 x 31 | 18L | 5000 | 8000 |
| 16 x 20 | 19a | 3000 | 7000 |
| 16 x 25 | 19 | 5000 | 10 000 |
| 16 x 31 | 20 | 5000 | 10 000 |
| 16 x 35 | 21 | 5000 | 10 000 |
| 18 x 20 | 1820 | 3000 | 7000 |
| 18 x 25 | 1825 | 5000 | 10 000 |
| 18 x 31 | 1831 | 5000 | 10 000 |
| 18 x 35 | 22 | 5000 | 10 000 |

CCC206



I_A = Actual ripple current at 100 Hz
 I_R = Rated ripple current at 100 Hz, 105 °C
 (1) Useful life at 105 °C and I_R applied; see Table 3

Fig. 14 - 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 | | | | | | | |
| | $U_R = 10\text{ V}$ | | $U_R = 16\text{ V AND } 25\text{ V}$ | | $U_R = 35\text{ V AND } 50\text{ V}$ | | $U_R = 63\text{ V AND } 100\text{ V}$ | |
| | $\varnothing \leq 12.5$ | $\varnothing \geq 16$ | $\varnothing \leq 12.5$ | $\varnothing \geq 16$ | $\varnothing \leq 12.5$ | $\varnothing \geq 16$ | $\varnothing \leq 12.5$ | $\varnothing \geq 16$ |
| 100 | 0.70 | 0.83 | 0.63 | 0.69 | 0.50 | 0.60 | 0.35 | 0.50 |
| 300 | 0.80 | 0.90 | 0.72 | 0.79 | 0.61 | 0.71 | 0.51 | 0.64 |
| 1000 | 0.88 | 0.95 | 0.80 | 0.87 | 0.72 | 0.80 | 0.66 | 0.74 |
| 3000 | 0.92 | 0.98 | 0.88 | 0.92 | 0.81 | 0.88 | 0.76 | 0.83 |
| 10 000 | 0.96 | 0.99 | 0.92 | 0.96 | 0.88 | 0.93 | 0.85 | 0.90 |
| 30 000 | 0.99 | 1.00 | 0.98 | 0.99 | 0.94 | 0.96 | 0.92 | 0.95 |
| 100 000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

Table 5

| TEST PROCEDURES AND REQUIREMENTS | | | |
|------------------------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TEST | | PROCEDURE | REQUIREMENTS |
| NAME OF TEST | REFERENCE | (quick reference) | |
| Endurance | IEC 60384-4/EN130300 subclause 4.13 | $T_{amb} = 105\text{ °C}$; U_R applied; for test duration see Table 3 | $\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ |
| Useful life | CECC 30301 subclause 1.8.1 | $T_{amb} = 105\text{ °C}$; U_R and I_R applied; for test duration see Table 3 | $\Delta C/C: \pm 30\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$ |
| Shelf life (storage at high temperature) | IEC 60384-4/EN130300 subclause 4.17 | $T_{amb} = 105\text{ °C}$; no voltage applied; 1000 h after test: U_R to be applied for 30 min, 24 h to 48 h before measurement | $\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ |



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