

Aluminum Capacitors Radial Very Low Impedance

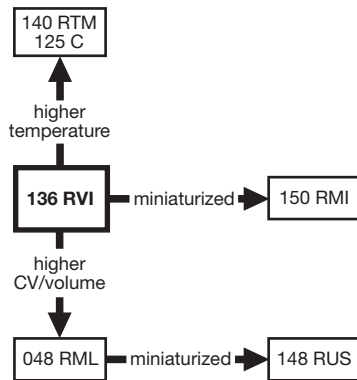


Fig. 1

| 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 µF to 10 000 µF |
| Tolerance on C_R | ± 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 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 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 | - | - | - | - | - | - |

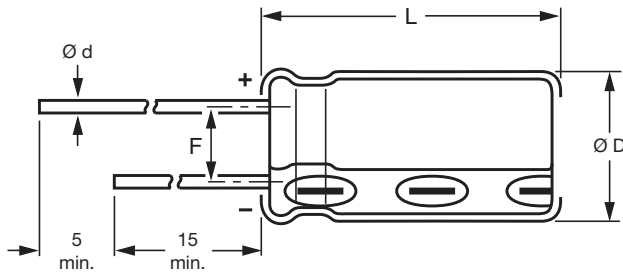
DIMENSIONS in millimeters AND AVAILABLE FORMS


Fig. 2 - Form CA: long leads

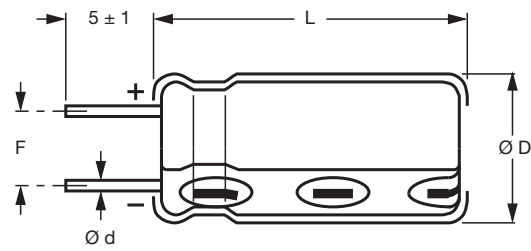


Fig. 3 - Form CB: cut leads

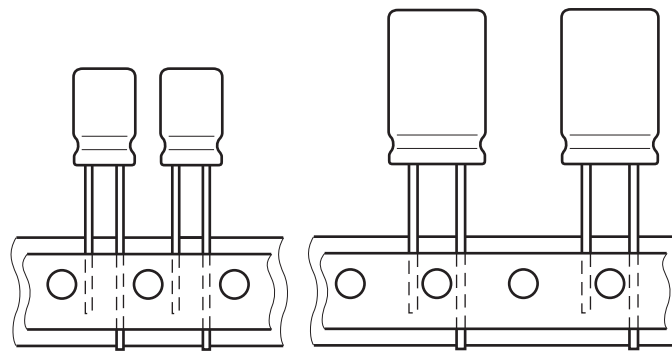


Fig. 4 - Form TFA: taped in box (ammopack)

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 |

ORDERING EXAMPLE

Electrolytic capacitor 136 series
 1000 µF/25 V; ± 20 %
 Nominal case size: Ø 12.5 mm x 25 mm; form TFA
 Ordering code: MAL2 136 36102 E3
 Former 12NC: 2222 136 36102

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 | - | |

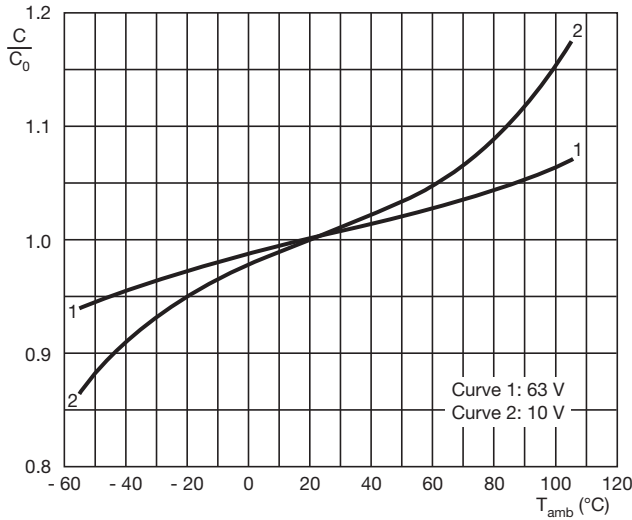


| ELECTRICAL DATA AND ORDERING INFORMATION | | | | | | | | | | |
|--|----------------------------------|---|---|----------------------------------|-----------------|--------------------------------|--------------------------------|-------------------------------|---------|----------|
| U _R (V) | C _R 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) | $ESR = \tan \delta / 2 \pi f C_R$ |

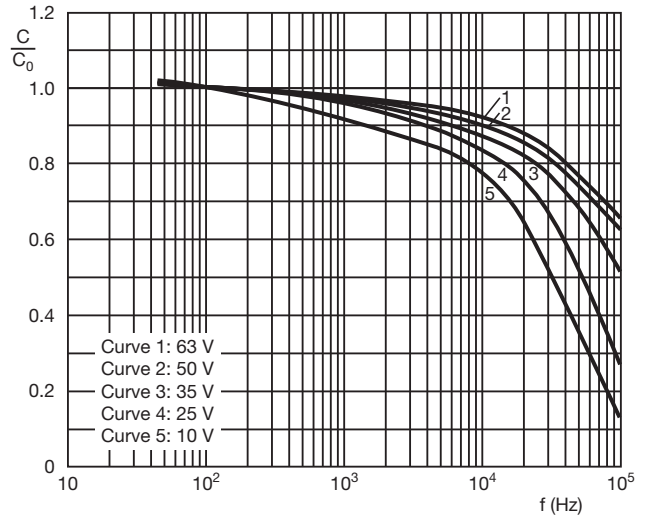


CAPACITANCE (C)



C_0 = Typical capacitance at 20 °C, 100 Hz

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

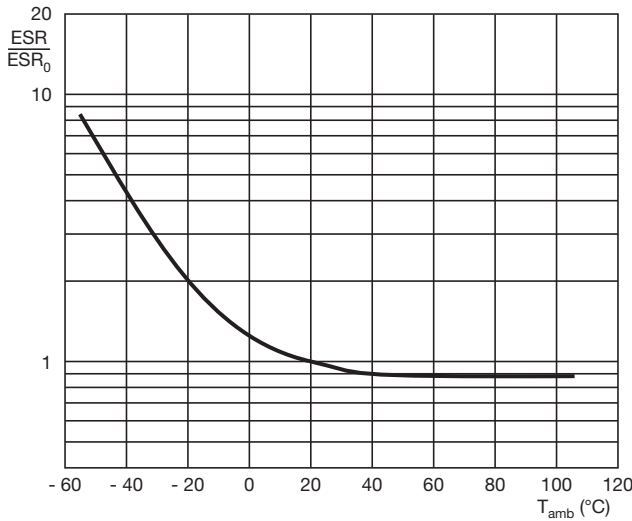


C_0 = Typical capacitance at 20 °C, 100 Hz

$T_{amb} = 20$ °C

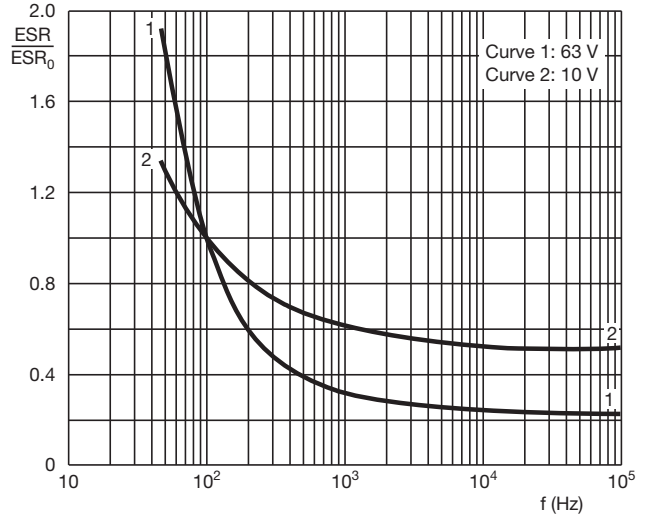
Fig. 6 - Typical multiplier of capacitance as a function of frequency

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

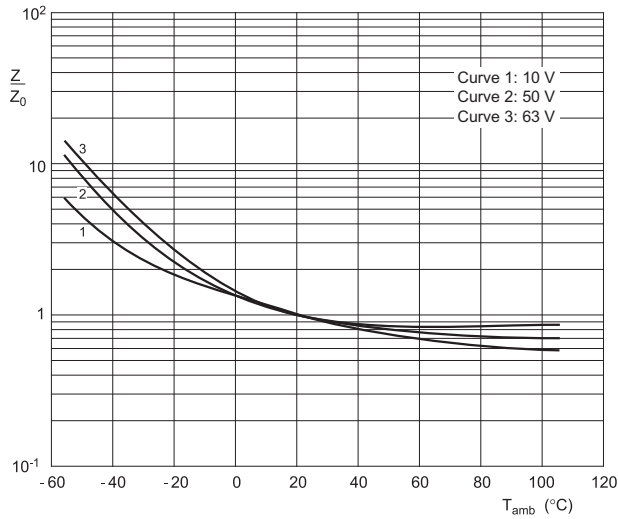


ESR_0 = Typical ESR at 20 °C, 100 Hz

$T_{amb} = 20$ °C

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

IMPEDANCE (Z)



Z₀ = Typical impedance at 20 °C, 100 kHz

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

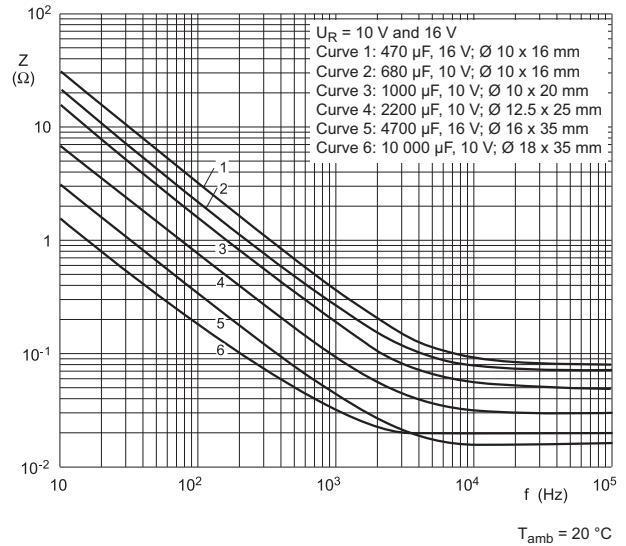


Fig. 10 - Typical impedance as a function of frequency

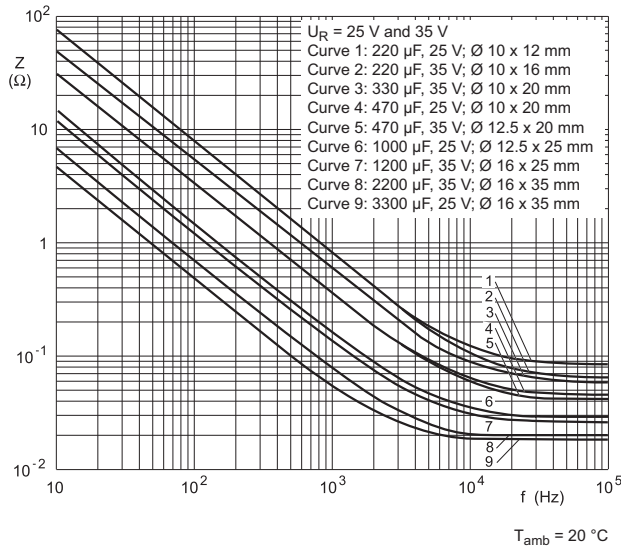


Fig. 11 - Typical impedance as a function of frequency

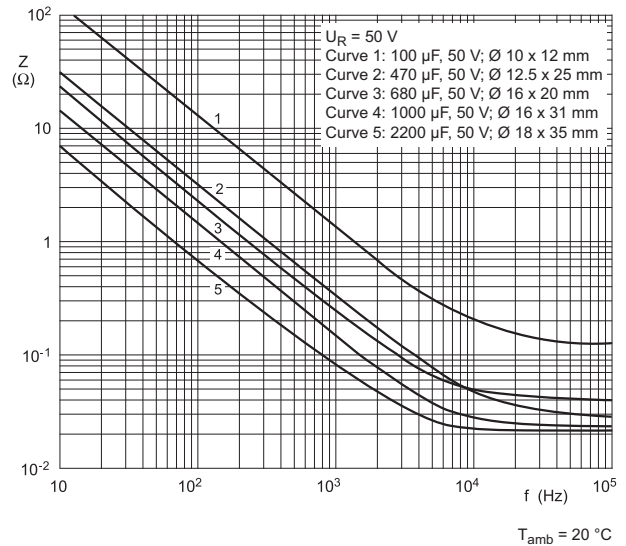


Fig. 12 - Typical impedance as a function of frequency

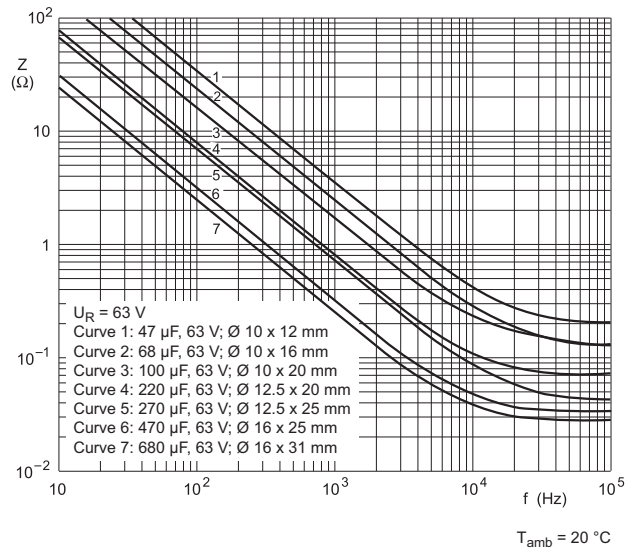


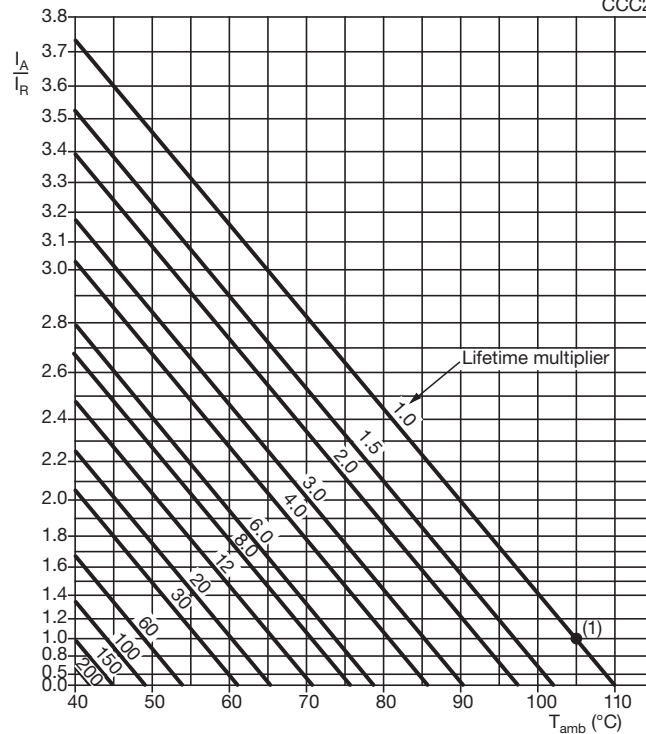
Fig. 13 - Typical impedance as a function of frequency

RIPPLE CURRENT AND USEFUL LIFE

Table 3

| ENDURANCE TEST AND USEFUL LIFE AS A FUNCTION OF CASE SIZE | | | |
|---|-----------|------------------------------------|---------------------------------|
| NOMINAL CASE SIZE \varnothing D x 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 | $\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ |



Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

Material Category Policy

Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.

Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.

Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.