

Aluminum Capacitors Radial Standard, High Voltage

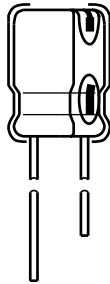
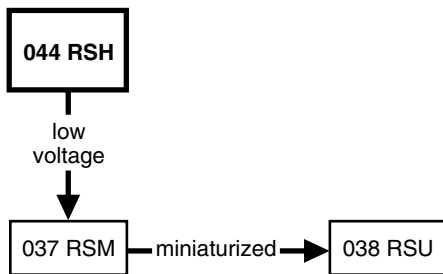


Fig.1 Component outline



Obsolete - please refer to: www.vishay.com/doc?28320

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, insulated with a blue vinyl sleeve
- Pressure relief
- Charge and discharge proof
- Reduced dimensions
- High rated voltage, up to 450 V
- Compliant to RoHS directive 2002/95/EC



APPLICATIONS

- General purpose, audio-video, lighting, general industrial
- Smoothing, filtering, buffering of high voltages

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 $\pm 20\%$)
- Rated voltage (in V)
- Date code, in accordance with IEC 60062
- Code indicating factory of origin
- Name of manufacturer
- Negative terminal identification
- Series number (044)

| QUICK REFERENCE DATA | |
|--|--|
| DESCRIPTION | VALUE |
| Nominal case sizes ($\varnothing D \times L$ in mm) | 6.3 x 11 to 16 x 31 |
| Rated capacitance range, C_R | 1.0 μF to 100 μF |
| Tolerance on C_R | $\pm 20\%$ |
| Rated voltage range, U_R | 160 to 450 V |
| Category temperature range | $\leq 400\text{ V}$: - 40 °C to + 85 °C; 450 V: - 25 °C to + 85 °C |
| Endurance test at 85 °C | 2000 hours |
| Useful life at 85 °C | 3000 hours |
| Useful life at 40 °C, 1.4 x I_R applied | 80 000 hours |
| Shelf life at 0 V, 85 °C | 500 hours |
| Based on sectional specification | IEC 60384-4/EN130300 |
| Climatic category IEC 60068 | $\leq 400\text{ V}$: 40/085/56; 450 V: 25/085/56 |

| SELECTION CHART FOR C_R , U_R AND RELEVANT NOMINAL CASE SIZES ($\varnothing D \times L$ in mm) | | | | | | |
|---|-----------|-----------|-----------|-----------|-----------|-----------|
| C_R (μF) | U_R (V) | | | | | |
| | 160 | 200 | 250 | 350 | 400 | 450 |
| 1.0 | - | - | 6.3 x 11 | - | 8 x 12 | 10 x 12 |
| 2.2 | - | - | 8 x 12 | 10 x 12 | 10 x 12 | 10 x 16 |
| 4.7 | - | 10 x 12 | 10 x 12 | 10 x 16 | 10 x 20 | 12.5 x 20 |
| 10 | 10 x 16 | 10 x 16 | 10 x 20 | 12.5 x 20 | 12.5 x 20 | 12.5 x 25 |
| 22 | 10 x 20 | 10 x 20 | 12.5 x 25 | 12.5 x 25 | 16 x 25 | 16 x 31 |
| 47 | - | 12.5 x 25 | 16 x 25 | 16 x 31 | - | - |
| 100 | 16 x 25 | 16 x 31 | - | - | - | - |

DIMENSIONS in millimeters, **AND AVAILABLE FORMS**

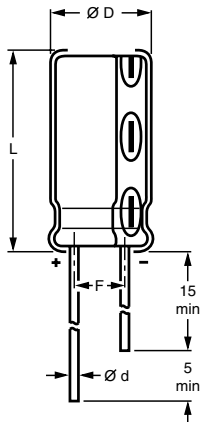


Fig.0 **Form CA:** Long leads

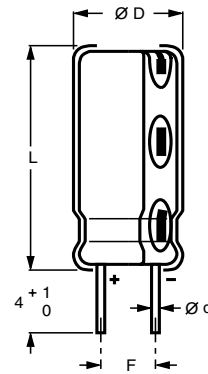
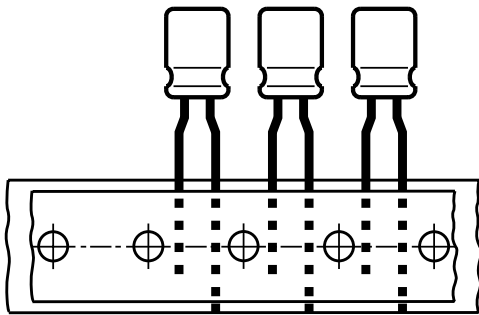
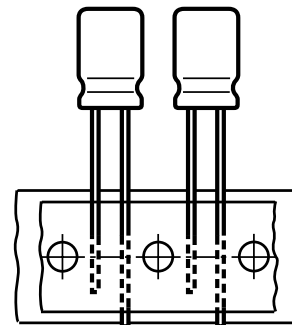


Fig.3 **Form CB:** Cut leads



Case $\varnothing D = 6.3$ and 8 mm, pitch $F = 5$ mm

Fig.3 **Form TFA:** Taped in box (ammopack), formed leads



Dimensions of pitch F see table 1 and 2

Fig 5 **Form TNA, TFA:** Taped in box (ammopack), straight leads

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, TNA |
| 6.3 x 11 | 12 | 0.5 | 6.8 | 12.5 | 2.5 ± 0.5 | ≈ 0.6 | 2000 | 2000 | 2000 |
| 8 x 12 | 13 | 0.6 | 8.5 | 13.0 | 3.5 ± 0.5 | ≈ 1.1 | 1000 | 2000 | 1000 |
| 10 x 12 | 14 | 0.6 | 10.5 | 14.0 | 5.0 ± 0.5 | ≈ 1.6 | 2000 | 1500 | 800 |
| 10 x 16 | 15 | 0.6 | 10.5 | 17.5 | 5.0 ± 0.5 | ≈ 1.9 | 2000 | 1500 | 800 |
| 10 x 20 | 16 | 0.6 | 10.5 | 22.0 | 5.0 ± 0.5 | ≈ 2.2 | 2000 | 1500 | 800 |
| 12.5 x 20 | 17 | 0.6 | 13.0 | 22.0 | 5.0 ± 0.5 | ≈ 4.0 | 1000 | 1500 | 500 |
| 12.5 x 25 | 18 | 0.6 | 13.0 | 27.0 | 5.0 ± 0.5 | ≈ 5.0 | 1000 | 1500 | 500 |
| 16 x 25 | 19 | 0.8 | 16.5 | 27.0 | 7.5 ± 0.5 | ≈ 8.0 | 500 | 500 | - |
| 16 x 31 | 20 | 0.8 | 16.5 | 33.5 | 7.5 ± 0.5 | ≈ 9.0 | 500 | 500 | - |

Note

Detailed tape dimensions see section 'PACKAGING'.



Aluminum Capacitors
Radial Standard, High Voltage

Vishay BCcomponents

| 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_{L1} | max. leakage current after 1 minute at U_R |
| $\tan \delta$ | max. dissipation factor at 100 Hz |
| Z | max. impedance at 10 kHz and + 20 °C |

ORDERING EXAMPLE*

Electrolytic capacitor 044 series

47 $\mu\text{F}/250\text{ V}$; $\pm 20\%$

Nominal case size: $\varnothing 16\text{ mm} \times 25\text{ mm}$; Form CB

Catalog number: 2222 044 63479

* To ensure delivery of lead (Pb)-free parts during the transition period, please contact your Vishay sales agent.

Note

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

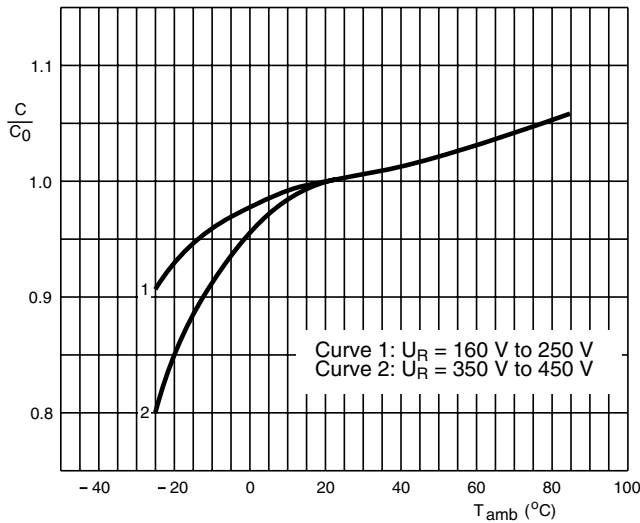
Table 2

| 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_{L1} 1 min (μA) | $\tan \delta$ 100 Hz | Z 10 kHz (Ω) | CATALOG NUMBER 2222 044 | | | | | | | |
| | | | | | | | BULK PACKAGING | | | | TAPED AMMOPACK | | | |
| | | | | | | | LONG LEADS | | CUT LEADS | | FORM TFA | | FORM TNA | |
| | | | | | | | FORM CA | F (mm) | FORM CB | F (mm) | FORM TFA | F (mm) | FORM TNA | F (mm) |
| 160 | 10 | 10 x 16 | 83 | 120 | 0.14 | 12 | 51109 | 5.0 | 61109 | 5.0 | 31109 | 5.0 | - | - |
| | 22 | 10 x 20 | 140 | 180 | 0.14 | 5.5 | 51229 | 5.0 | 61229 | 5.0 | 31229 | 5.0 | - | - |
| | 100 | 16 x 25 | 380 | 550 | 0.14 | 1.8 | 51101 | 7.5 | 61101 | 7.5 | - | - | - | - |
| 200 | 4.7 | 10 x 12 | 51 | 96 | 0.14 | 26 | 52478 | 5.0 | 62478 | 5.0 | 32478 | 5.0 | - | - |
| | 10 | 10 x 16 | 85 | 130 | 0.14 | 12 | 52109 | 5.0 | 62109 | 5.0 | 32109 | 5.0 | - | - |
| | 22 | 10 x 20 | 140 | 200 | 0.14 | 5.5 | 52229 | 5.0 | 62229 | 5.0 | 32229 | 5.0 | - | - |
| | 47 | 12.5 x 25 | 230 | 350 | 0.14 | 2.6 | 90516 | 5.0 | 90517 | 5.0 | 90519 | 5.0 | - | - |
| | 100 | 16 x 31 | 400 | 670 | 0.14 | 1.5 | 52101 | 7.5 | 62101 | 7.5 | - | - | - | - |
| 250 | 1.0 | 6.3 x 11 | 17 | 55 | 0.14 | 110 | 90501 | 2.5 | - | - | 90506 | 5.0 | 90507 | 2.5 |
| | 2.2 | 8 x 12 | 30 | 73 | 0.14 | 55 | 90015 | 3.5 | - | - | 90019 | 5.0 | 90529 | 3.5 |
| | 4.7 | 10 x 12 | 51 | 110 | 0.14 | 26 | 53478 | 5.0 | 63478 | 5.0 | 33478 | 5.0 | - | - |
| | 10 | 10 x 20 | 95 | 150 | 0.14 | 12 | 53109 | 5.0 | 63109 | 5.0 | 33109 | 5.0 | - | - |
| | 22 | 12.5 x 25 | 160 | 240 | 0.14 | 5.5 | 53229 | 5.0 | 63229 | 5.0 | 33229 | 5.0 | - | - |
| | 47 | 16 x 25 | 260 | 420 | 0.14 | 2.6 | 53479 | 7.5 | 63479 | 7.5 | - | - | - | - |
| 350 | 2.2 | 10 x 12 | 39 | 86 | 0.13 | 39 | 55228 | 5.0 | 65228 | 5.0 | 35228 | 5.0 | - | - |
| | 4.7 | 10 x 16 | 63 | 120 | 0.13 | 18 | 55478 | 5.0 | 65478 | 5.0 | 35478 | 5.0 | - | - |
| | 10 | 12.5 x 20 | 120 | 180 | 0.13 | 8.5 | 55109 | 5.0 | 65109 | 5.0 | 35109 | 5.0 | - | - |
| | 22 | 12.5 x 25 | 180 | 300 | 0.13 | 3.9 | 90525 | 5.0 | 90526 | 5.0 | 90528 | 5.0 | - | - |
| | 47 | 16 x 31 | 320 | 560 | 0.13 | 2.3 | 55479 | 7.5 | 65479 | 7.5 | - | - | - | - |
| 400 | 1.0 | 8 x 12 | 22 | 64 | 0.15 | 85 | 56108 | 3.5 | - | - | 36108 | 5.0 | 76108 | 3.5 |
| | 2.2 | 10 x 12 | 39 | 93 | 0.15 | 39 | 56228 | 5.0 | 66228 | 5.0 | 36228 | 5.0 | - | - |
| | 4.7 | 10 x 20 | 70 | 130 | 0.15 | 18 | 56478 | 5.0 | 66478 | 5.0 | 36478 | 5.0 | - | - |
| | 10 | 12.5 x 20 | 110 | 190 | 0.15 | 8.5 | 56109 | 5.0 | 66109 | 5.0 | 36109 | 5.0 | - | - |
| | 22 | 16 x 25 | 200 | 330 | 0.15 | 3.9 | 56229 | 7.5 | 66229 | 7.5 | - | - | - | - |
| 450 | 1.0 | 10 x 12 | 25 | 67 | 0.26 | 120 | 57108 | 5.0 | 67108 | 5.0 | 37108 | 5.0 | - | - |
| | 2.2 | 10 x 16 | 42 | 99 | 0.26 | 55 | 57228 | 5.0 | 67228 | 5.0 | 37228 | 5.0 | - | - |
| | 4.7 | 12.5 x 20 | 75 | 130 | 0.26 | 26 | 57478 | 5.0 | 67478 | 5.0 | 37478 | 5.0 | - | - |
| | 10 | 12.5 x 25 | 120 | 210 | 0.26 | 12 | 57109 | 5.0 | 67109 | 5.0 | 37109 | 5.0 | - | - |
| | 22 | 16 x 31 | 210 | 370 | 0.26 | 5.5 | 57229 | 7.5 | 67229 | 7.5 | - | - | - | - |



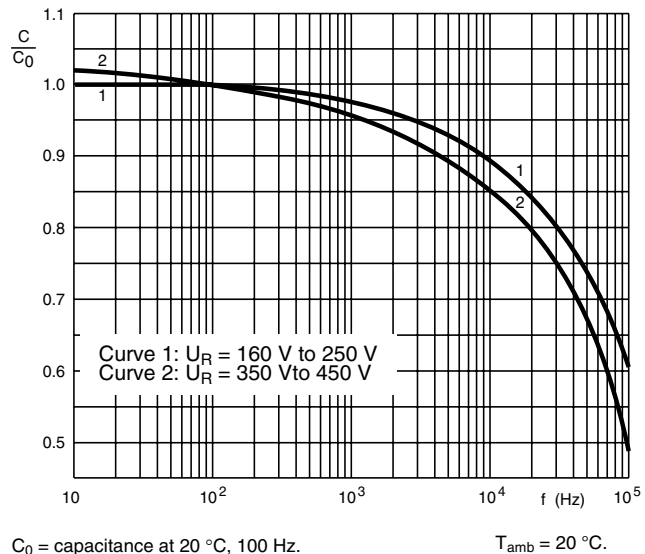
| ADDITIONAL ELECTRICAL DATA | | |
|------------------------------------|---|--|
| PARAMETER | CONDITIONS | VALUE |
| Voltage | | |
| Surge voltage | $U_R = 160 \text{ to } 250 \text{ V}$ | $U_S \leq 1.15 \times U_R$ |
| | $U_R = 350 \text{ to } 450 \text{ V}$ | $U_S \leq 1.1 \times U_R$ |
| Reverse voltage | | $U_{rev} \leq 1 \text{ V}$ |
| Current | | |
| Leakage current | after 1 minute at U_R : | |
| | $CV \leq 1000 \mu\text{C}$ | $I_{L1} \leq 0.06 C_R \times U_R + 40 \mu\text{A}$ |
| | $CV > 1000 \mu\text{C}$ | $I_{L1} \leq 0.03 C_R \times U_R + 70 \mu\text{A}$ |
| | after 5 minutes at U_R : | |
| $CV \leq 1000 \mu\text{C}$ | $I_{L5} \leq 0.03 C_R \times U_R + 15 \mu\text{A}$ | |
| $CV > 1000 \mu\text{C}$ | $I_{L5} \leq 0.015 C_R \times U_R + 30 \mu\text{A}$ | |
| Inductance | | |
| Equivalent series inductance (ESL) | case $\varnothing D = 6.3 \text{ mm}$ and 8 mm | typ. 13 nH |
| | case $\varnothing D = 10 \text{ mm}$ | typ. 16 nH |
| | case $\varnothing D \geq 12.5 \text{ mm}$ | typ. 18 nH |
| Resistance | | |
| Equivalent series resistance (ESR) | calculated from $\tan \delta_{max}$ and C_R (see Table 2) | $ESR = \tan \delta / 2 \pi f C_R$ |

CAPACITANCE (C)



C_0 = capacitance at 20 °C, 100 Hz.

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



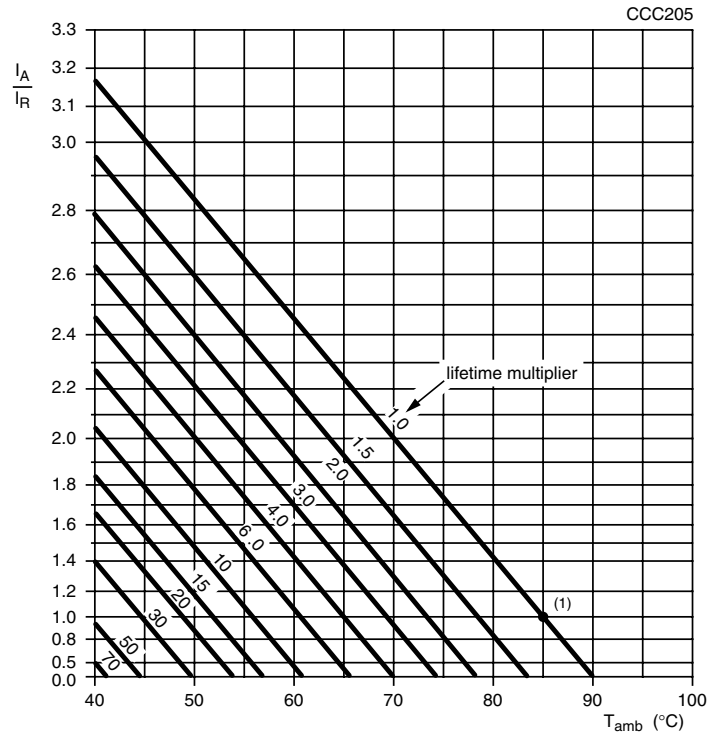
C_0 = capacitance at 20 °C, 100 Hz.

$T_{amb} = 20 \text{ °C}$.

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



RIPPLE CURRENT AND USEFUL LIFE



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: 3000 hours.

Fig.8 Multiplier of useful life as a function of ambient temperature and ripple current load.

Table 3

| MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY | |
|---|------------------|
| FREQUENCY (Hz) | I_R MULTIPLIER |
| 50 | 0.75 |
| 100 | 1.00 |
| 300 | 1.20 |
| 1000 | 1.35 |
| 3000 | 1.45 |
| ≥ 10000 | 1.50 |

Table 4

| 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; 2000 hours | $\Delta C/C: \pm 20\%$ $\leq 400\text{ V}: \tan \delta \leq 2 \times \text{spec. limit}$ $450\text{ V}: \tan \delta \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ |
| Useful life | CECC 30301 subclause 1.8.1 | $T_{amb} = 85\text{ °C}$; U_R and I_R applied; 3000 hours | $\Delta C/C: \pm 50\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 3\%$ |
| Shelf life (storage at high temperature) | IEC 60384-4/ EN130300 subclause 4.17 | $T_{amb} = 85\text{ °C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 hours to 48 hours 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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