Aluminum Capacitors
Radial Standard, High Voltage

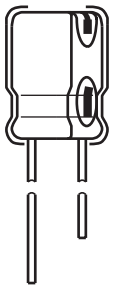
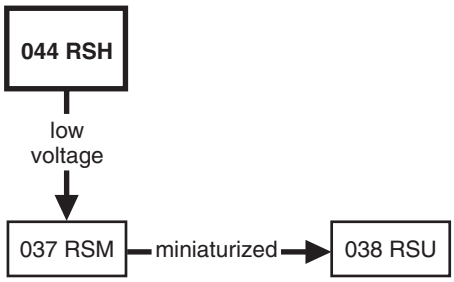


Fig.1 Component outline.



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.
- Lead (Pb)-free versions are RoHS compliant.

Pb-free Available

RoHS* COMPLIANT

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 ± 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 (∅D × L in mm)	6.3 × 11 to 16 × 31
Rated capacitance range, C_R	1.0 to 100 µF
Tolerance on C_R	± 20 %
Rated voltage range, U_R	160 to 450 V
Category temperature range	≤ 400 V: – 40 to + 85 °C; 450 V: – 25 to + 85 °C
Endurance test at 85 °C	2000 hours
Useful life at 85 °C	3000 hours
Useful life at 40 °C, 1.4 × I_R applied	80000 hours
Shelf life at 0 V, 85 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	≤ 400 V: 40/085/56; 450 V: 25/085/56

SELECTION CHART FOR C_R, U_R AND RELEVANT NOMINAL CASE SIZES (∅D × L in mm)

C_R (µF)	U_R (V)					
	160	200	250	350	400	450
1.0	–	–	6.3 × 11	–	8 × 12	10 × 12
2.2	–	–	8 × 12	10 × 12	10 × 12	10 × 16
4.7	–	10 × 12	10 × 12	10 × 16	10 × 20	12.5 × 20
10	10 × 16	10 × 16	10 × 20	12.5 × 20	12.5 × 20	12.5 × 25
22	10 × 20	10 × 20	12.5 × 25	12.5 × 25	16 × 25	16 × 31
47	–	12.5 × 25	16 × 25	16 × 31	–	–
100	16 × 25	16 × 31	–	–	–	–

* Pb containing terminations are not RoHS compliant, exemptions may apply

DIMENSIONS in millimeters, **AND AVAILABLE FORMS**

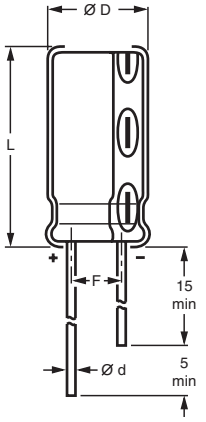


Fig.2 **Form CA**: Long leads.

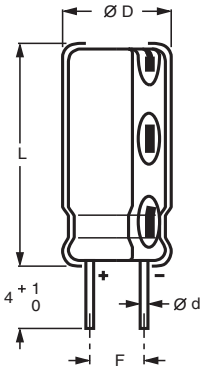
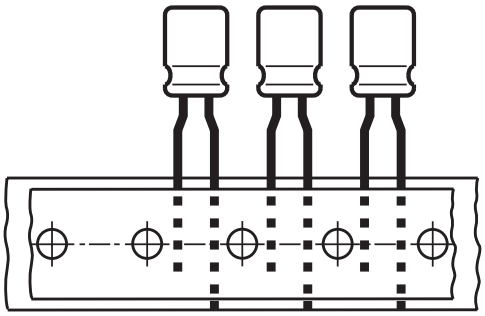
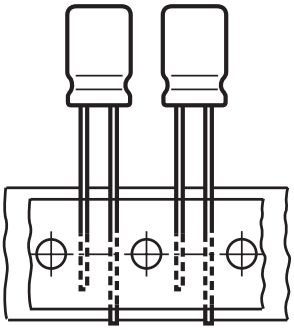


Fig.3 **Form CB**: Cut leads.



Case ∅D = 6.3 and 8 mm, pitch F = 5 mm

Fig.4 **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 ∅D × L	**CASE CODE**	**∅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 × 12	13	0.6	8.5	13.0	3.5 ± 0.5	≈ 1.1	1000	2000	1000
10 × 12	14	0.6	10.5	14.0	5.0 ± 0.5	≈ 1.6	2000	1500	800
10 × 16	15	0.6	10.5	17.5	5.0 ± 0.5	≈ 1.9	2000	1500	800
10 × 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 × 25	19	0.8	16.5	27.0	7.5 ± 0.5	≈ 8.0	500	500	–
16 × 31	20	0.8	16.5	33.5	7.5 ± 0.5	≈ 9.0	500	500	–

Note

1. Detailed tape dimensions see section ‘PACKAGING’.

ELECTRICAL DATA	
SYMBOL	**DESCRIPTION**
C_R	rated capacitance at 100 Hz, tolerance ± 20 %
I_R	rated RMS ripple current at 100 Hz, 85 °C
I_{L1}	max. leakage current after 1 minute at U_R
Tan δ	max. dissipation factor at 100 Hz
Z	max. impedance at 10 kHz and + 20 °C

Note

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

ORDERING EXAMPLE*

Electrolytic capacitor 044 series

47 µF/250 V; ± 20 %

Nominal case size: ∅16 × 25 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.

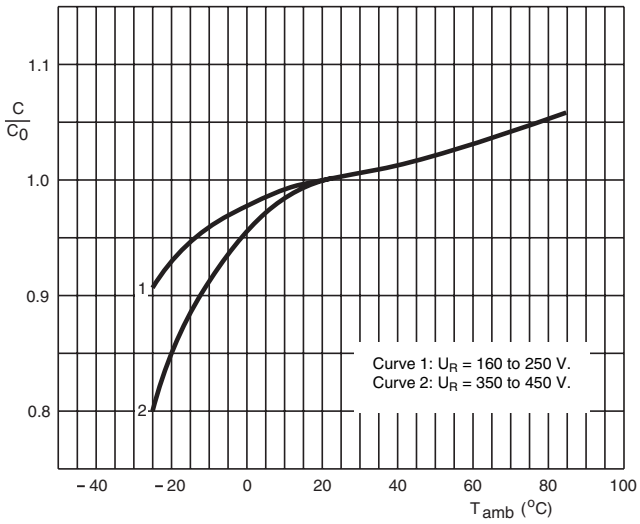
Table 2

ELECTRICAL DATA AND ORDERING INFORMATION

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

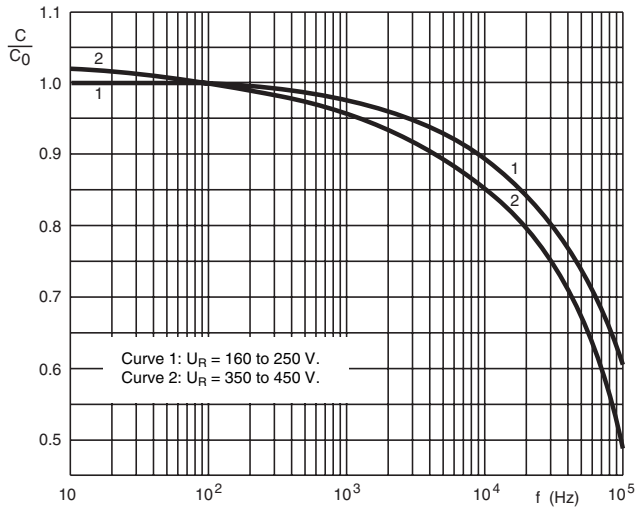
ADDITIONAL ELECTRICAL DATA		
PARAMETER	**CONDITIONS**	**VALUE**
Voltage		
Surge voltage	U_R = 160 to 250 V	$U_s \leq 1.15 \times U_R$
	U_R = 350 to 450 V	$U_s \leq 1.1 \times U_R$
Reverse voltage		$U_{rev} \leq 1$ V
Current		
Leakage current	after 1 minute at U_R:	
	CV ≤ 1000 μC	$I_{L1} \leq 0.06\ C_R \times U_R + 40\ \mu A$
	CV > 1000 μC	$I_{L1} \leq 0.03\ C_R \times U_R + 70\ \mu A$
	after 5 minutes at U_R:	
	CV ≤ 1000 μC	$I_{L5} \leq 0.03\ C_R \times U_R + 15\ \mu A$
	CV > 1000 μC	$I_{L5} \leq 0.015\ C_R \times U_R + 30\ \mu A$
Inductance		
Equivalent series inductance (ESL)	case ∅D = 6.3 and 8 mm	typ. 13 nH
	case ∅D = 10 mm	typ. 16 nH
	case ∅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 δ / $2\pi f C_R$

CAPACITANCE (C)



C_0 = capacitance at 20 °C, 100 Hz.

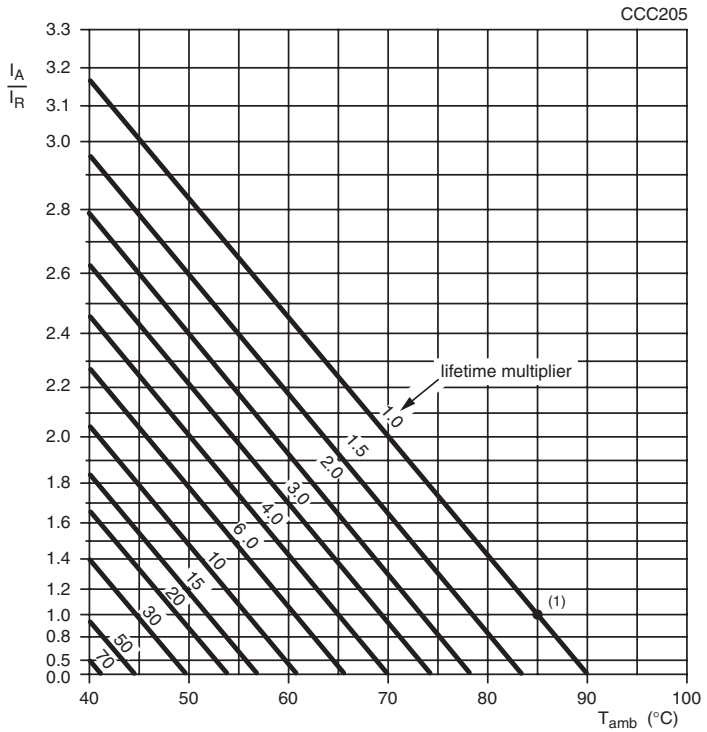
Fig.6 Typical multiplier of capacitance as a function of ambient temperature.



C_0 = capacitance at 20 °C, 100 Hz. T_{amb} = 20 °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 °C; U_R applied; 2000 hours	ΔC/C: ± 20 % ≤ 400 V: tan δ ≤ 2 × spec. limit 450 V: tan δ ≤ 1.5 × spec. limit I_{L5} ≤ spec. limit
Useful life	CECC 30301 subclause 1.8.1	T_{amb} = 85 °C; U_R and I_R applied; 3000 hours	ΔC/C: ± 50 % tan δ ≤ 3 × spec. limit I_{L5} ≤ spec. limit no short or open circuit total failure percentage: ≤ 3 %
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	T_{amb} = 85 °C; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	ΔC/C, tan δ, Z: for requirements see 'Endurance test' above I_{L5} ≤ 2 × spec. limit

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