



Aluminum Capacitors Radial Standard, High Voltage

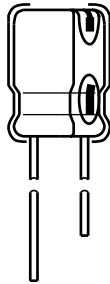
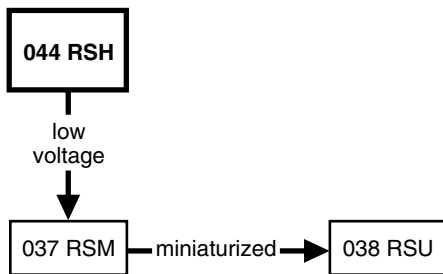


Fig.1 Component outline



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**

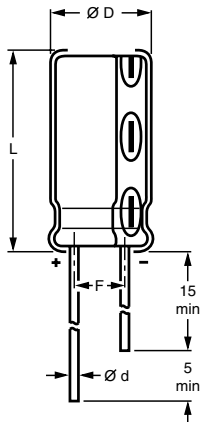


Fig.0 **Form CA:** Long leads

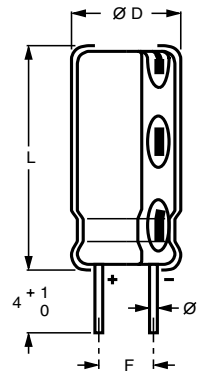
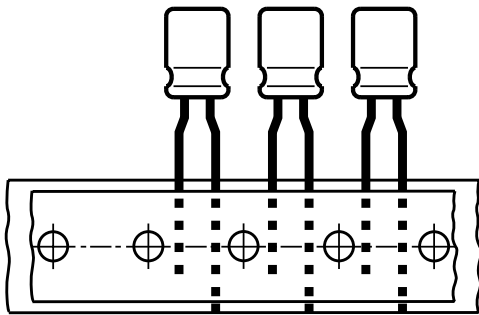
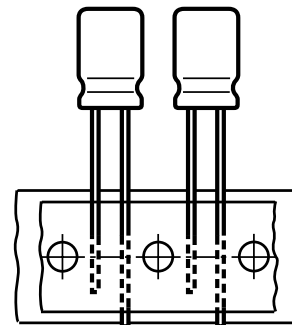


Fig.3 **Form CB:** Cut leads



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'.



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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 $T_{amb} = 20\text{ °C}$, $P = 86\text{ kPa}$ to 106 kPa , $RH = 45\%$ to 75% .

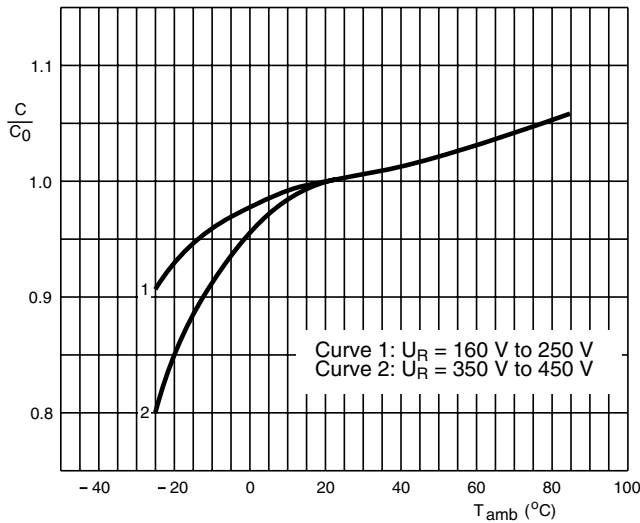
Table 2

ELECTRICAL DATA AND ORDERING INFORMATION														
U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (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	-	-	-	-



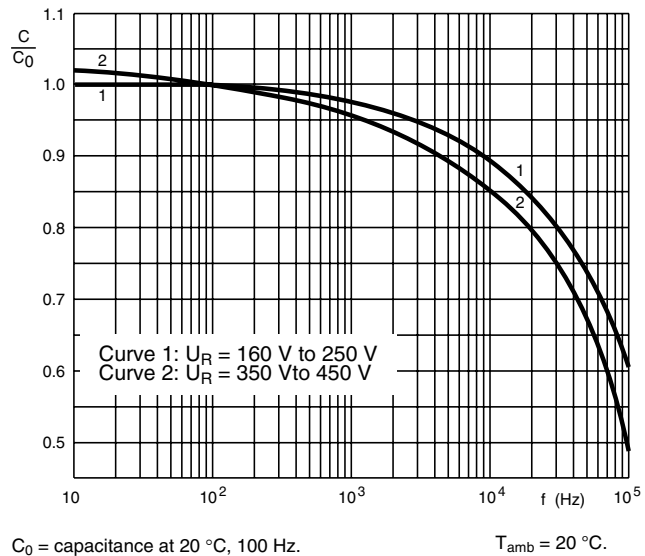
ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	$U_R = 160 \text{ to } 250 \text{ V}$	$U_S \leq 1.15 \times U_R$
	$U_R = 350 \text{ to } 450 \text{ V}$	$U_S \leq 1.1 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R :	
	$CV \leq 1000 \mu\text{C}$	$I_{L1} \leq 0.06 C_R \times U_R + 40 \mu\text{A}$
	$CV > 1000 \mu\text{C}$	$I_{L1} \leq 0.03 C_R \times U_R + 70 \mu\text{A}$
	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 $\varnothing D = 6.3 \text{ mm and } 8 \text{ mm}$	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.



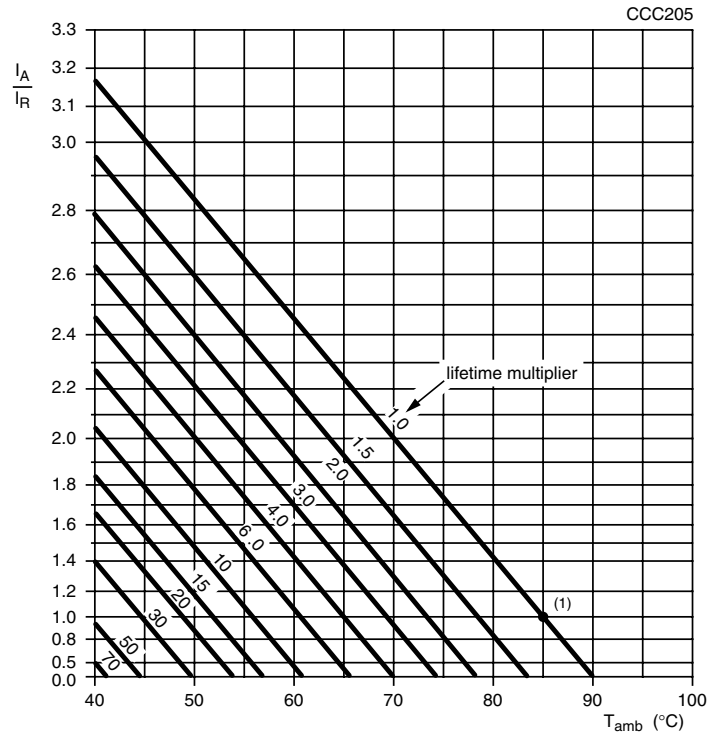
C_0 = capacitance at 20 °C, 100 Hz.

$T_{amb} = 20 \text{ °C}$.

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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