Aluminium electrolytic capacitors
Radial Standard, High Voltage

044 RSH

FEATURES

- Polarized aluminium electrolytic capacitors, non-solid
- Radial leads, cylindrical aluminium case, insulated with a blue vinyl sleeve
- Pressure relief
- Charge and discharge proof
- Reduced dimensions
- High rated voltage, up to 450 V.

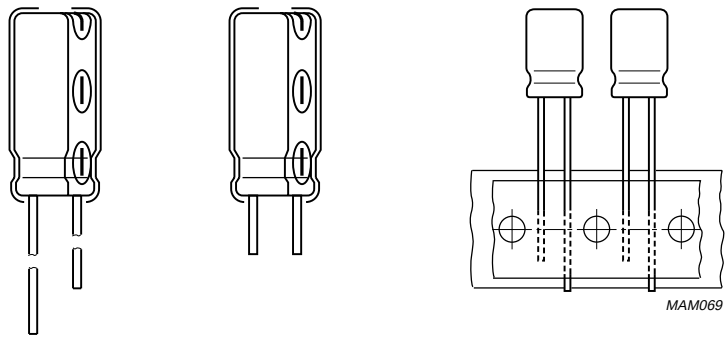
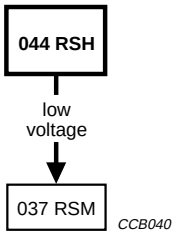


Fig.1 Component outlines

APPLICATIONS

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



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ 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, $1.4 \times I_R$ applied	80000 hours
Shelf life at 0 V, 85 °C	500 hours
Based on sectional specification	IEC 384-4/CECC 30300
Climatic category IEC 68	≤400 V: 40/085/56; 450 V: 25/085/56

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Selection chart for C_R, U_R and relevant nominal case sizes (∅D × L in mm)

Preferred types in **bold**.

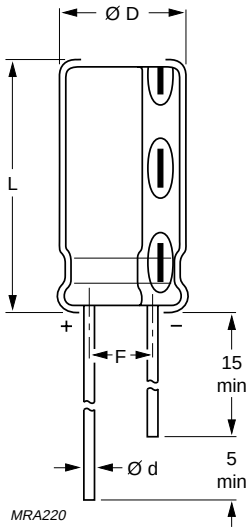
C_R (μF)	U_R (V)					
	160	**200**	**250**	**350**	**400**	**450**
1.0	–	–	**6.3 × 11**	–	**8 × 12**	10 × 12
2.2	–	–	**8 × 12**	**10 × 12**	**10 × 12**	10 × 16
4.7	–	10 × 12	10 × 12	**10 × 16**	**10 × 20**	12.5 × 20
10	10 × 16	10 × 16	**10 × 20**	12.5 × 20	**12.5 × 20**	12.5 × 25
22	10 × 20	**10 × 20**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

MARKING

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

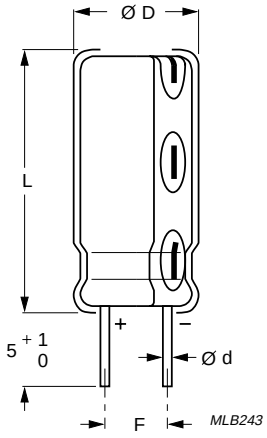
- Rated capacitance (in μF)
- Tolerance on rated capacitance, code letter in accordance with *"IEC 62"*
- Rated voltage (in V)
- Group number (044)
- Name of manufacturer (PHILIPS)
- Date code, in accordance with *"IEC 62"*
- Code indicating factory of origin
- Negative terminal identification.

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Dimensions in mm.
For dimensions see Table 1.

Fig.3 **Form CA**: Long leads.



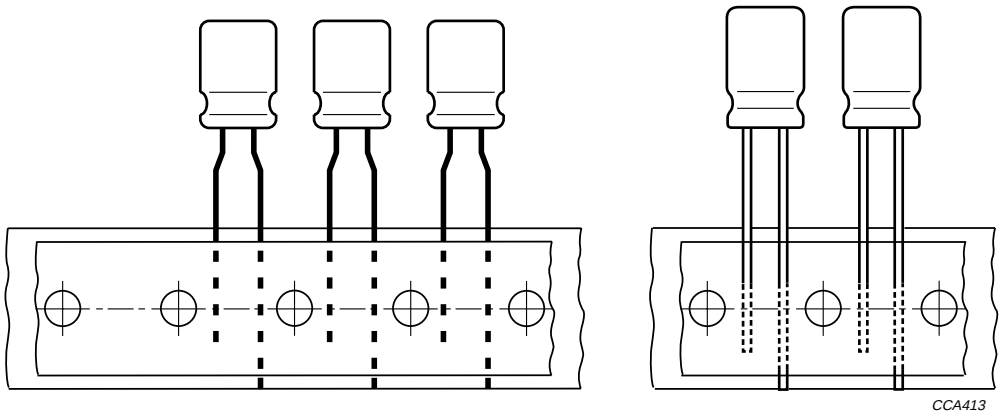
Dimensions in mm.
For dimensions see Table 1.

Fig.4 **Form CB**: Cut leads.

Table 1 Physical dimensions, mass and packaging quantities; see Figs 3 and 4

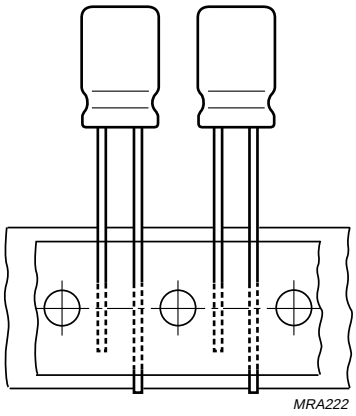
NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	∅d (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES		
							FORM CA	FORM CB	FORM TFA, TNA
6.3 × 11	12	0.5	6.8	12.5	2.5 ±0.5	≈0.6	2000	2000	2000
8 × 12	13	0.6	8.5	13.0	3.5 ±0.5	≈1.1	1000	2000	1000
10 × 12	14	0.6	10.5	14.0	5.0 ±0.5	≈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 × 20	17	0.6	13.0	22.0	5.0 ±0.5	≈4.0	1000	1500	500
12.5 × 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	–

Taped products



Form TFA: formed, pitch F = 5 mm.
Form TNA: pitch F = 2.5 or 3.5 mm.
Case ∅D = 6.3 and 8 mm.
Tape dimensions are specified in this handbook, Section *"Packaging"*.

Fig.5 Taped in box (ammopack).



Form TFA: pitch F = 5 mm.
Case ∅D = 10 and 12.5 mm.
Tape dimensions are specified in this handbook, Section *"Packaging"*.

Fig.6 Taped in box (ammopack).

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ELECTRICAL DATA

Unless otherwise specified, all electrical values in Tables 2 and 4 apply at T_{amb} = 20 °C, P = 86 to 106 kPa, RH = 45 to 75%.

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
I_{L5}	max. leakage current after 5 minutes at U_R
Tan δ	max. dissipation factor at 100 Hz
ESR	equivalent series resistance at 100 Hz (calculated from tan δ_{max} and C_R)
Z	max. impedance at 10 kHz and +20 or –25 °C

Table 2 Electrical data; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz +20 °C (Ω)	Z 10 kHz –25 °C (Ω)
160	10	10 × 16	15	83	120	54	0.14	22	12	180
	22	10 × 20	16	140	180	83	0.14	10	5.5	82
	100	16 × 25	19	380	550	270	0.14	2.2	1.8	26
200	4.7	10 × 12	14	51	96	43	0.14	47	26	380
	10	10 × 16	15	85	130	60	0.14	22	12	180
	22	**10 × 20**	**16**	140	200	96	0.14	10	5.5	82
	47	12.5 × 25	18	230	350	170	0.14	4.7	2.6	38
	100	**16 × 31**	**20**	400	670	330	0.14	2.2	1.5	22
250	**1.0**	**6.3 × 11**	**12**	17	55	23	0.14	220	110	1800
	2.2	**8 × 12**	**13**	30	73	32	0.14	100	55	820
	4.7	10 × 12	14	51	110	48	0.14	47	26	380
	10	**10 × 20**	**16**	95	150	68	0.14	22	12	180
	22	12.5 × 25	18	160	240	110	0.14	10	5.5	82
	47	**16 × 25**	**19**	260	420	210	0.14	4.7	2.6	38
350	**2.2**	**10 × 12**	**14**	39	86	38	0.13	94	39	550
	4.7	**10 × 16**	**15**	63	120	55	0.13	44	18	260
	10	12.5 × 20	17	120	180	83	0.13	21	8.5	120
	22	**12.5 × 25**	**18**	180	300	150	0.13	9.4	3.9	55
	47	16 × 31	20	320	560	280	0.13	4.4	2.3	31

ORDERING INFORMATION

Ordering example

Electrolytic capacitor 044 series

47 µF/250 V; ±20%

Nominal case size: ∅16 × 25 mm; Form CB

Catalogue number: 2222 044 63479.

Table 3 Ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (µF)	CASE CODE	CATALOGUE NUMBER 2222							
			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	15	044 51109	5.0	044 61109	5.0	044 31109	5.0	–	–
	22	16	044 51229	5.0	044 61229	5.0	044 31229	5.0	–	–
	100	19	044 51101	7.5	044 61101	7.5	–	–	–	–
200	4.7	14	044 52478	5.0	044 62478	5.0	044 32478	5.0	–	–
	10	15	044 52109	5.0	044 62109	5.0	044 32109	5.0	–	–
	22	**16**	044 52229	5.0	**044 62229**	5.0	**044 32229**	5.0	–	–
	47	18	044 90516	5.0	044 90517	5.0	044 90519	5.0	–	–
	100	**20**	044 52101	7.5	**044 62101**	7.5	–	–	–	–
250	**1.0**	**12**	**044 90501**	2.5	–	–	**044 90506**	5.0	044 90507	2.5
	2.2	**13**	**044 90015**	3.5	–	–	**044 90019**	5.0	044 90529	3.5
	4.7	14	044 53478	5.0	044 63478	5.0	044 33478	5.0	–	–
	10	**16**	044 53109	5.0	**044 63109**	5.0	**044 33109**	5.0	–	–
	22	18	044 53229	5.0	044 63229	5.0	044 33229	5.0	–	–
	47	**19**	044 53479	7.5	**044 63479**	7.5	–	–	–	–
350	**2.2**	**14**	044 55228	5.0	**044 65228**	5.0	**044 35228**	5.0	–	–
	4.7	**15**	044 55478	5.0	**044 65478**	5.0	**044 35478**	5.0	–	–
	10	17	044 55109	5.0	044 65109	5.0	044 35109	5.0	–	–
	22	**18**	044 90525	5.0	**044 90526**	5.0	**044 90528**	5.0	–	–
	47	20	044 55479	7.5	044 65479	7.5	–	–	–	–

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ELECTRICAL DATA (continued)

Table 4 Electrical data continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz +20 °C (Ω)	Z 10 kHz −25 °C (Ω)
400	**1.0**	**8 × 12**	**13**	22	64	27	0.15	240	85	1200
	2.2	**10 × 12**	**14**	39	93	41	0.15	110	39	550
	4.7	**10 × 20**	**16**	70	130	58	0.15	51	18	260
	10	**12.5 × 20**	**17**	110	190	90	0.15	24	8.5	120
	22	**16 × 25**	**19**	200	330	160	0.15	11	3.9	55
450	1.0	10 × 14	14	25	67	29	0.26	410	120	2000
	2.2	10 × 16	15	42	99	45	0.26	190	55	910
	4.7	12.5 × 20	17	75	130	62	0.26	88	26	380
	10	12.5 × 25	18	120	210	100	0.26	41	12	260
	22	16 × 31	20	210	370	180	0.26	19	5.5	82

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage for short periods	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	$I_{L1} \leq 0.06 C_R \times U_R + 40$ μA
	CV > 1000 μC	$I_{L1} \leq 0.03 C_R \times U_R + 70$ μA
	after 5 minutes at U_R:	
	CV ≤ 1000 μC	$I_{L5} \leq 0.03 C_R \times U_R + 15$ μA
	CV > 1000 μC	$I_{L5} \leq 0.015 C_R \times U_R + 30$ μA
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

ORDERING INFORMATION (continued)

Table 5 Ordering information continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS					
			FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
400	**1.0**	**13**	**044 56108**	3.5	–	–	**044 36108**	5.0	044 76108	3.5
	2.2	**14**	044 56228	5.0	**044 66228**	5.0	**044 36228**	5.0	–	–
	4.7	**16**	044 56478	5.0	**044 66478**	5.0	**044 36478**	5.0	–	–
	10	**17**	044 56109	5.0	**044 66109**	5.0	**044 36109**	5.0	–	–
	22	**19**	044 56229	7.5	**044 66229**	7.5	–	–	–	–
450	1.0	14	044 57108	5.0	044 67108	5.0	044 37108	5.0	–	–
	2.2	15	044 57228	5.0	044 67228	5.0	044 37228	5.0	–	–
	4.7	17	044 57478	5.0	044 67478	5.0	044 37478	5.0	–	–
	10	18	044 57109	5.0	044 67109	5.0	044 37109	5.0	–	–
	22	20	044 57229	7.5	044 67229	7.5	–	–	–	–

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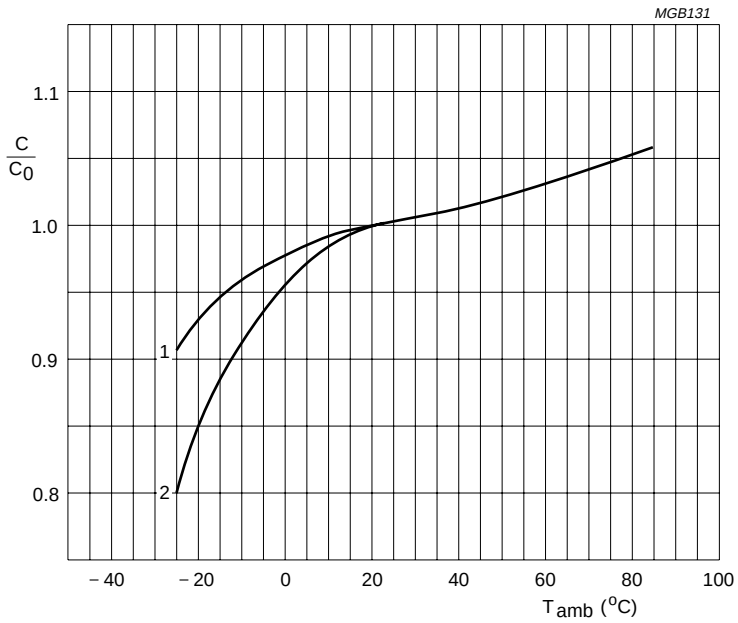
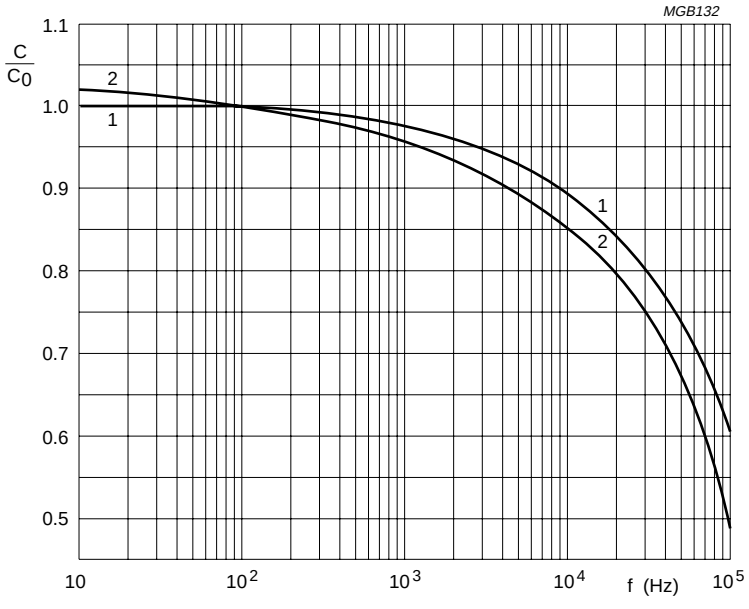
ELECTRICAL DATA (continued)

Capacitance (C)



Curve 1: U_R = 160 to 250 V.
Curve 2: U_R = 350 to 450 V.
C_0 = capacitance at 20 °C, 100 Hz.

Fig.7 Typical multiplier of capacitance as a function of ambient temperature.



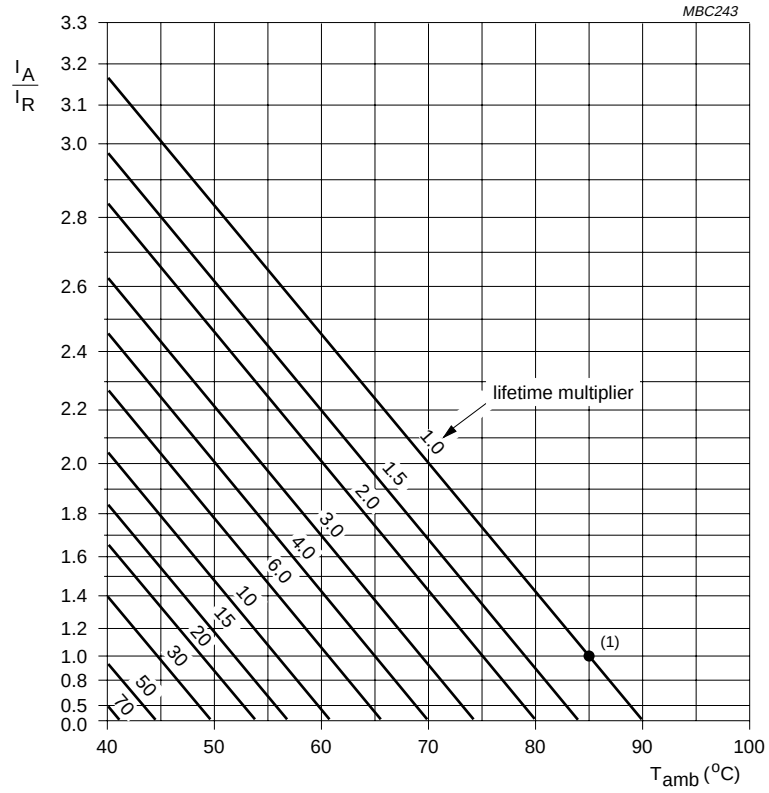
Curve 1: U_R = 160 to 250 V.
Curve 2: U_R = 350 to 450 V.
C_0 = capacitance at 20 °C, 100 Hz.

Fig.8 Typical multiplier of capacitance as a function of frequency.

RIPPLE CURRENT AND USEFUL LIFE

Table 6 Multiplier of ripple current (I_R/I_{RO}) as a function of frequency; I_{RO} = ripple current at 100 Hz

FREQUENCY (Hz)	I_R MULTIPLIER
50	0.75
100	1.0
300	1.2
1000	1.35
3000	1.45
≥10000	1.5



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

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SPECIFIC TESTS AND REQUIREMENTS

General tests and requirements are specified in this handbook, Section *"Tests and Requirements"*.

Table 7 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	**REFERENCE**		
Endurance	IEC 384-4/ CECC 30300 subclause 4.13	T_{amb} = 85 °C; U_R applied; 2000 hours	$\Delta C/C$: ±20% ≤400 V: tan $\delta \leq 2 \times$ spec. limit 450 V: tan $\delta \leq 1.5 \times$ spec. limit $I_{L5} \leq$ spec. limit
Useful life	CECC 30301 subclause 1.8.1	T_{amb} = 85 °C; U_R and I_R applied; 3000 hours	$\Delta C/C$: ±50% tan $\delta \leq 3 \times$ spec. limit $I_{L5} \leq$ spec. limit no short or open circuit total failure percentage: ≤3%
Shelf life (storage at high temperature)	IEC 384-4/ CECC 30300 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	$\Delta C/C$, tan δ, Z: for requirements see 'Endurance test' above $I_{L5} \leq 2 \times$ spec. limit

NOTES