

DATA SHEET

O44 RSH
Aluminum electrolytic capacitors
Radial Standard, High Voltage

Product specification
Supersedes data of January 1998
File under BCcomponents, BC01

2000 Jan 18

Aluminum electrolytic capacitors

Radial Standard, High Voltage

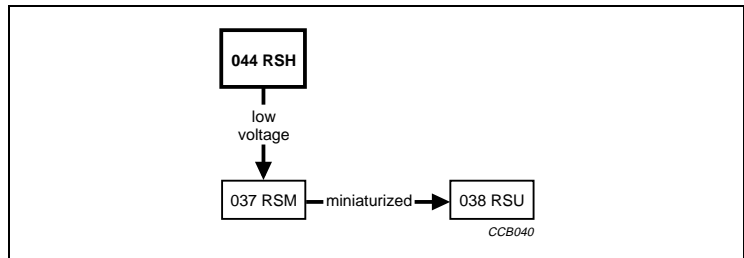
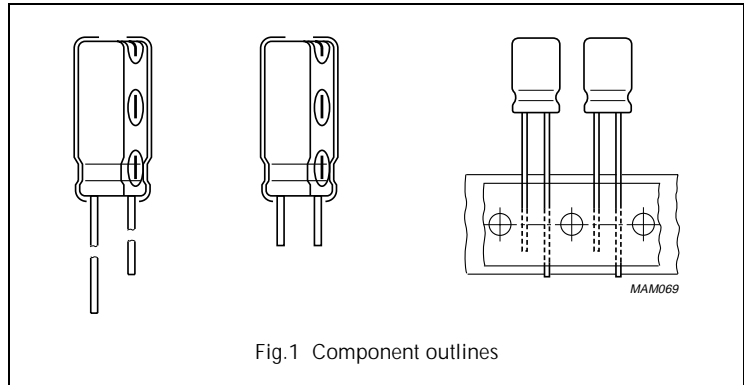
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FEATURES

- 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.

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 μ F
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 60384-4/EN130300
Climatic category IEC 60068	≤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 ($\varnothing D \times L$ 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 60062"
- Rated voltage (in V)
- Group number (O44)
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Code indicating factory of origin
- Negative terminal identification.

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MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

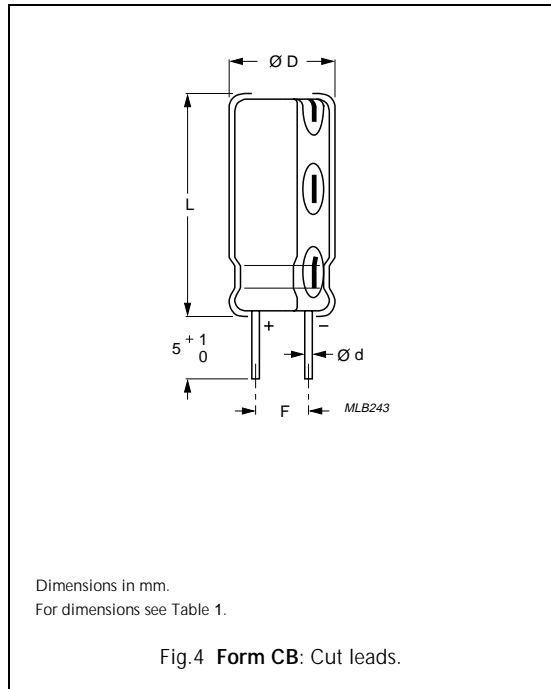
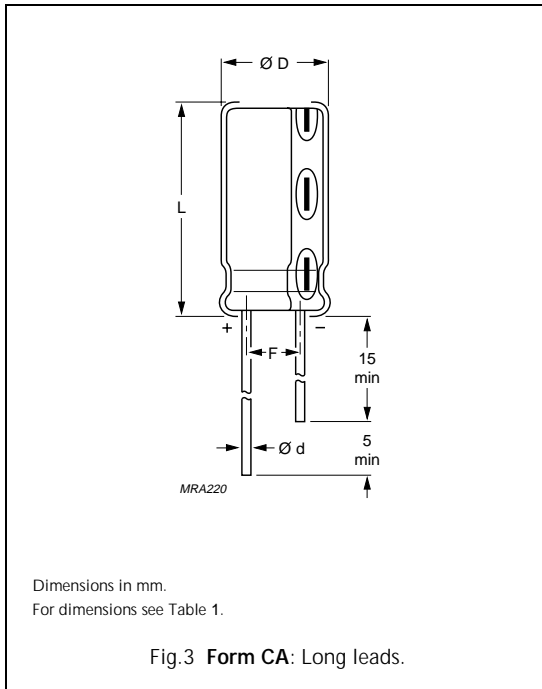


Table 1 Physical dimensions, mass and packaging quantities; see Figs 3 and 4

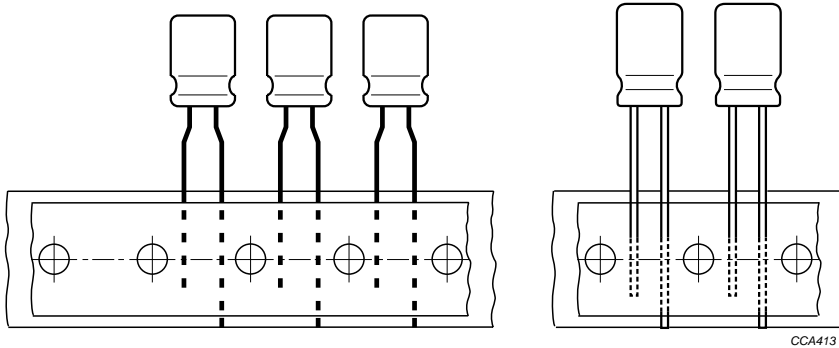
NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	Ød (mm)	ØD _{max} (mm)	L _{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES		
							FORM CA	FORM CB	FORM TFA, TNA
6.3 × 11	12	0.5	6.8	12.5	2.5 ±0.5	≈0.6	2000	2000	2000
8 × 12	13	0.6	8.5	13.0	3.5 ±0.5	≈1.1	1000	2000	1000
10 × 12	14	0.6	10.5	14.0	5.0 ±0.5	≈1.6	2000	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	–

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Taped products



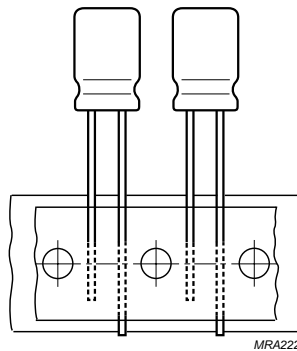
Form TFA: formed, pitch $F = 5$ mm.

Form TNA: pitch $F = 2.5$ or 3.5 mm.

Case $\varnothing D = 6.3$ 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 $\varnothing D = 10$ 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 $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

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
I_{L5}	max. leakage current after 5 minutes at U_R
$\tan \delta$	max. dissipation factor at 100 Hz
ESR	equivalent series resistance at 100 Hz (calculated from $\tan \delta_{max}$ 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 $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\tan \delta$ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz $+20\text{ °C}$ (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

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ORDERING INFORMATION

Ordering example

Electrolytic capacitor 044 series

47 μF /250 V; $\pm 20\%$

Nominal case size: $\varnothing 16 \times 25$ 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 TFA	F (mm)	FORM TNA	F (mm)
			FORM CA	F (mm)	FORM CB	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 $\varnothing D \times L$ (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	$U_R = 160$ 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 : $CV \leq 1000 \mu\text{C}$ $CV > 1000 \mu\text{C}$	$I_{L1} \leq 0.06C_R \times U_R + 40 \mu\text{A}$ $I_{L1} \leq 0.03C_R \times U_R + 70 \mu\text{A}$
	after 5 minutes at U_R : $CV \leq 1000 \mu\text{C}$ $CV > 1000 \mu\text{C}$	$I_{L5} \leq 0.03C_R \times U_R + 15 \mu\text{A}$ $I_{L5} \leq 0.015C_R \times U_R + 30 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 6.3$ and 8 mm	typ. 13 nH
	case $\varnothing D = 10$ mm	typ. 16 nH
	case $\varnothing D \geq 12.5$ mm	typ. 18 nH

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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	–	–	–	–

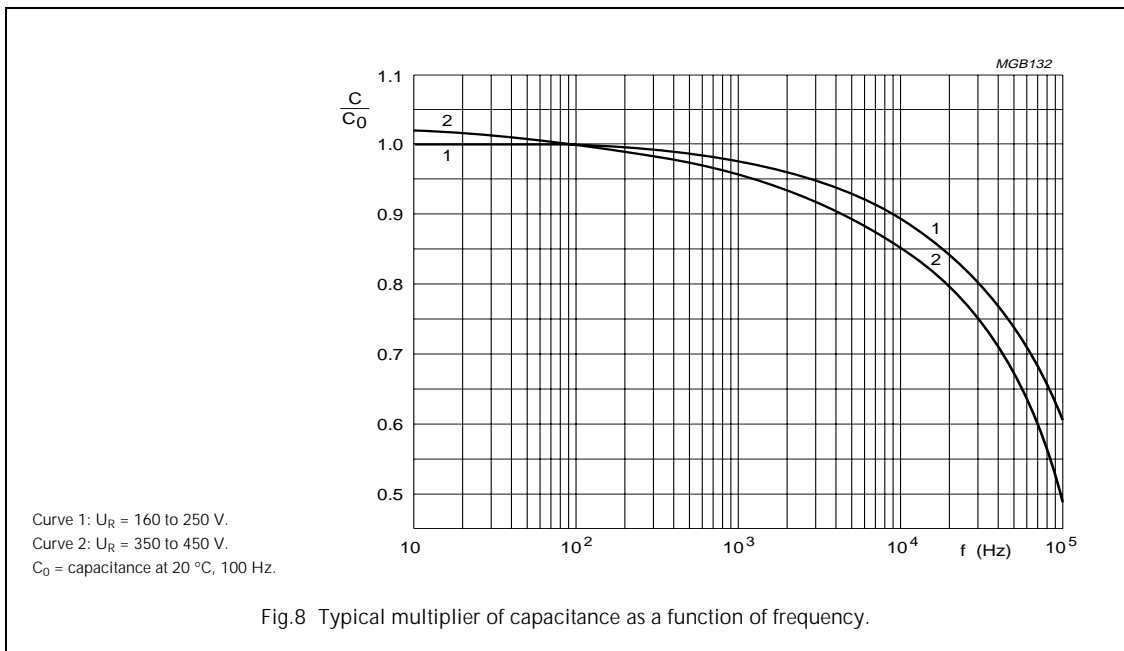
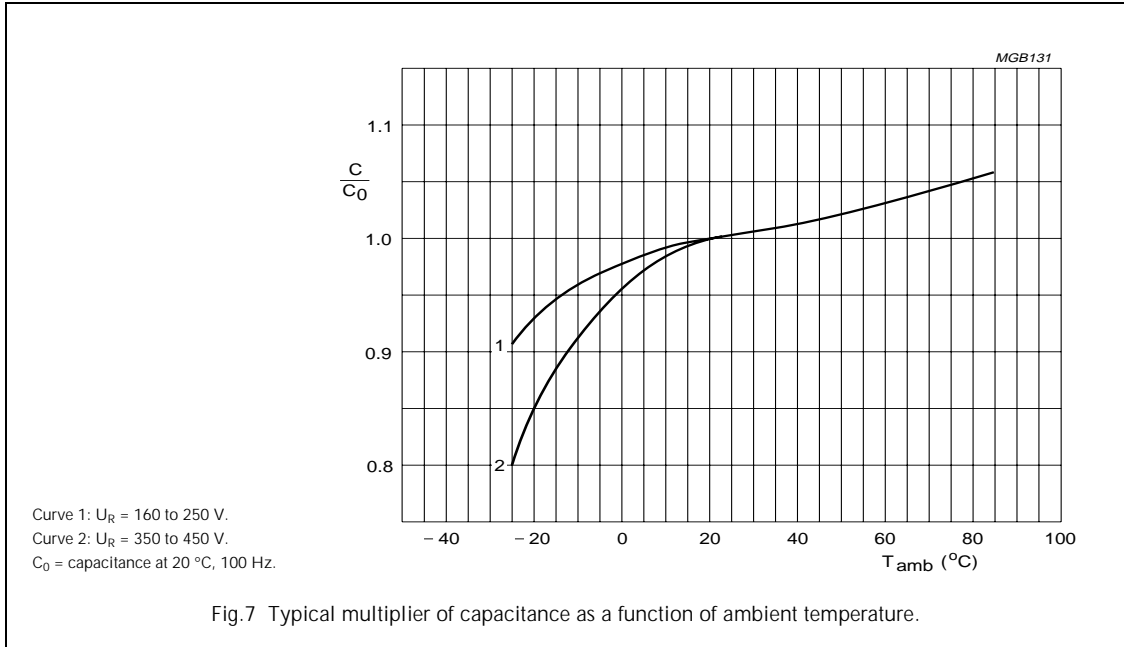
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ELECTRICAL DATA (continued)

Capacitance (C)



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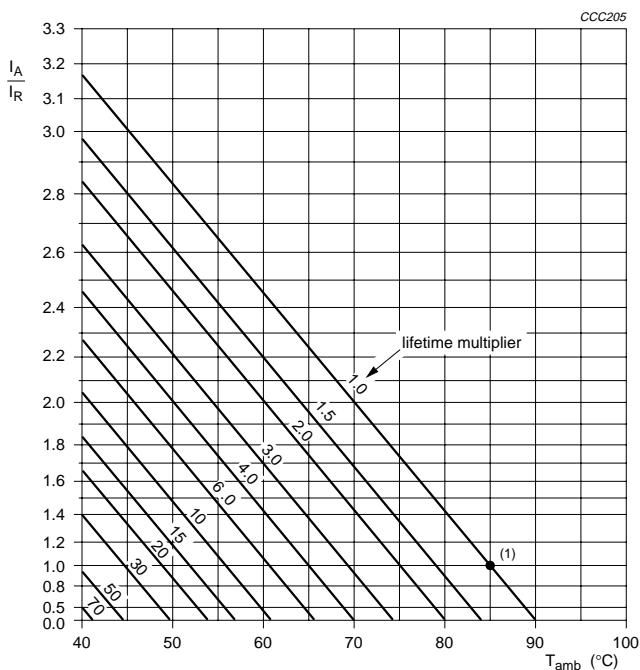
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RIPPLE CURRENT AND USEFUL LIFE

Table 6 Multiplier of ripple current (I_R) as a function of frequency

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 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 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 to 48 hours before measurement	$\Delta C/C$, $\tan \delta$, Z : for requirements see 'Endurance test' above $I_{L5} \leq 2 \times \text{spec. limit}$