

Aluminum electrolytic capacitors

Radial Standard, High Voltage

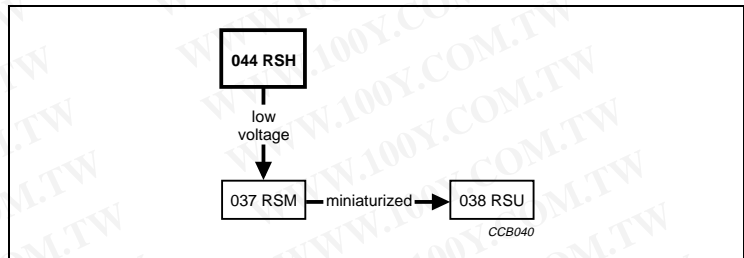
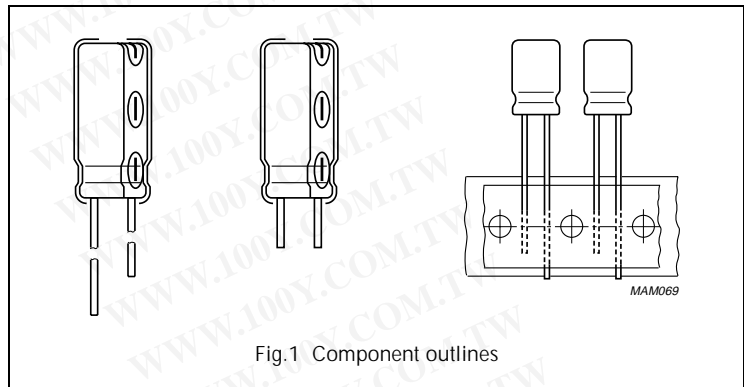
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FEATURES

- 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 × 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

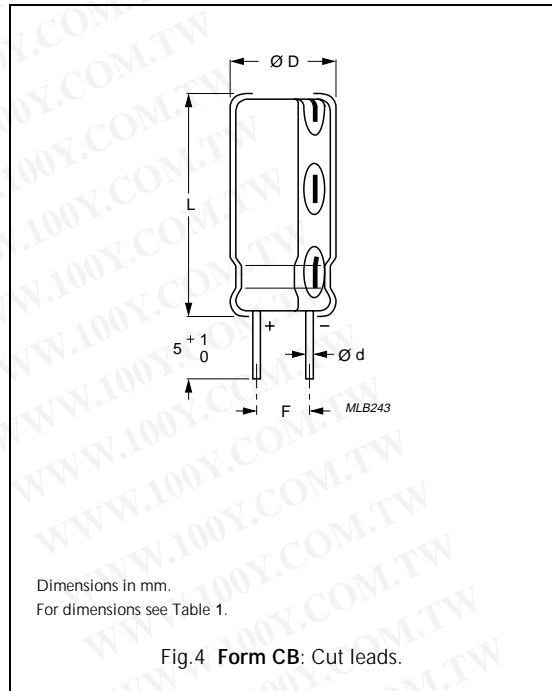
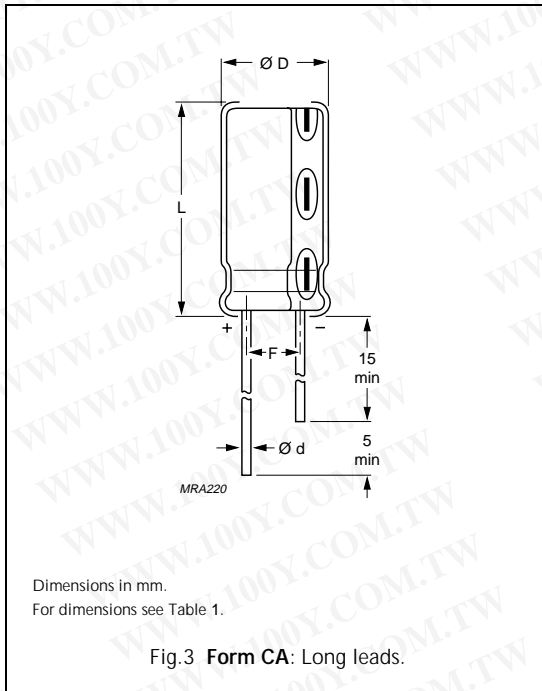


Table 1 Physical dimensions, mass and packaging quantities; see Figs 3 and 4

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	–

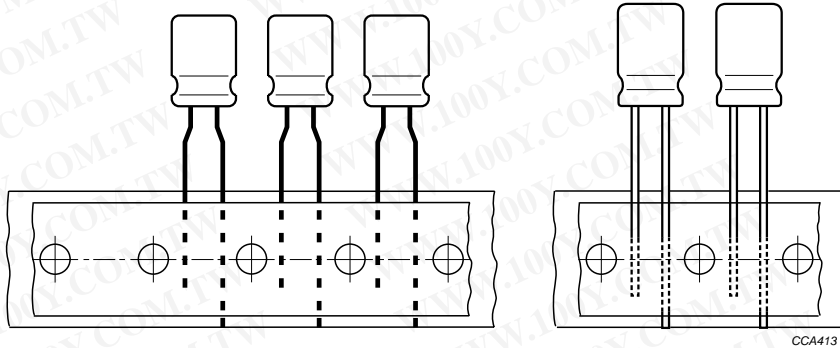
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Taped products



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

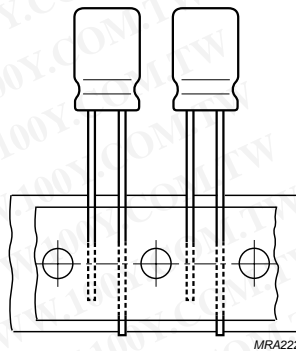
Form TNA: pitch $F = 2.5$ or 3.5 mm.

Case $\varnothing D = 6.3$ and 8 mm.

Tape dimensions are specified in this handbook, section "Packaging".

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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 $T_{amb} = 20\text{ }^{\circ}\text{C}$, $P = 86$ 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, $85\text{ }^{\circ}\text{C}$
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 $-25\text{ }^{\circ}\text{C}$

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 $85\text{ }^{\circ}\text{C}$ (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz $+20\text{ }^{\circ}\text{C}$ (Ω)	Z 10 kHz $-25\text{ }^{\circ}\text{C}$ (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 μ F/250 V; \pm 20%

Nominal case size: \varnothing 16 \times 25 mm; Form CB

Catalogue number: 2222 044 63479.

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

U _R (V)	C _R 100 Hz (μ F)	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)

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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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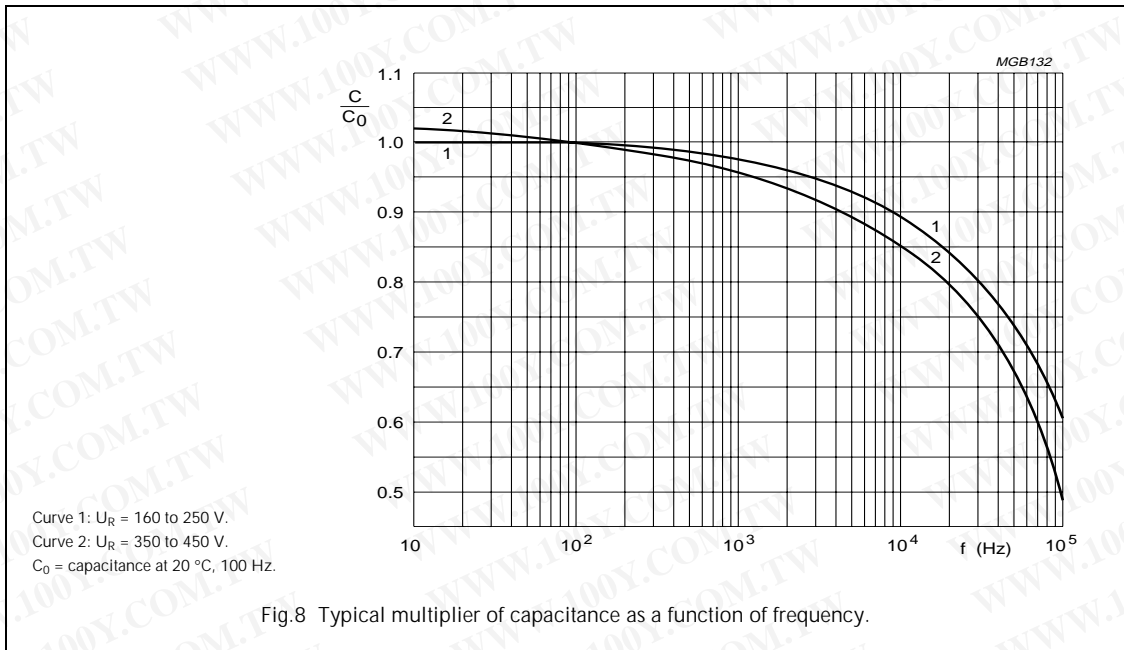
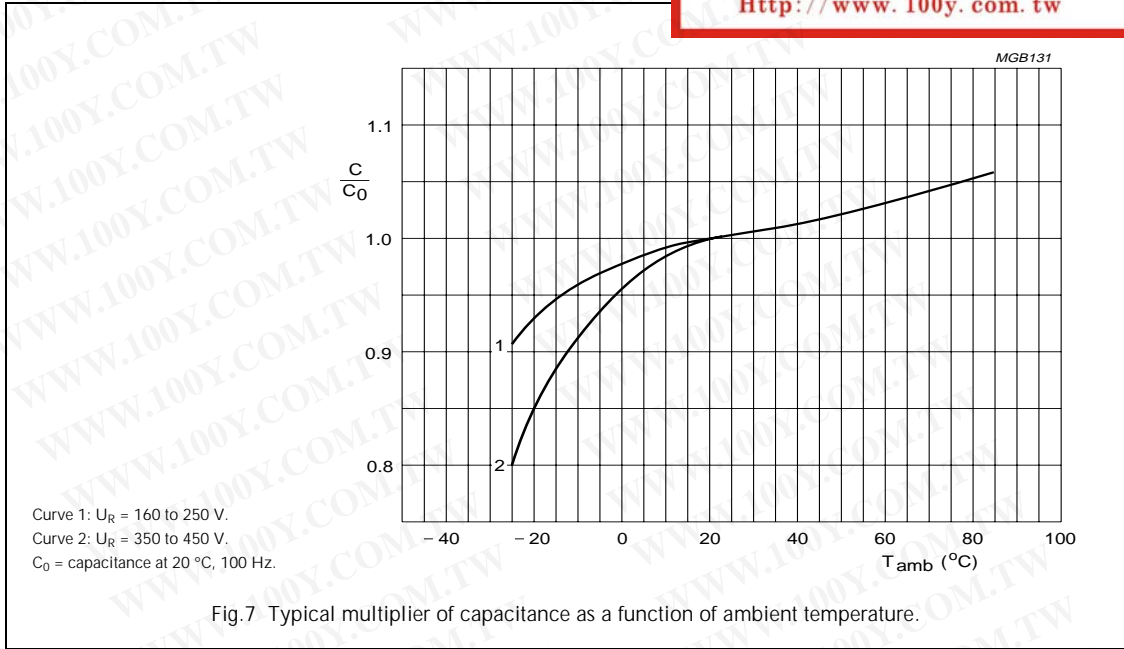
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ELECTRICAL DATA (continued)

Capacitance (C)



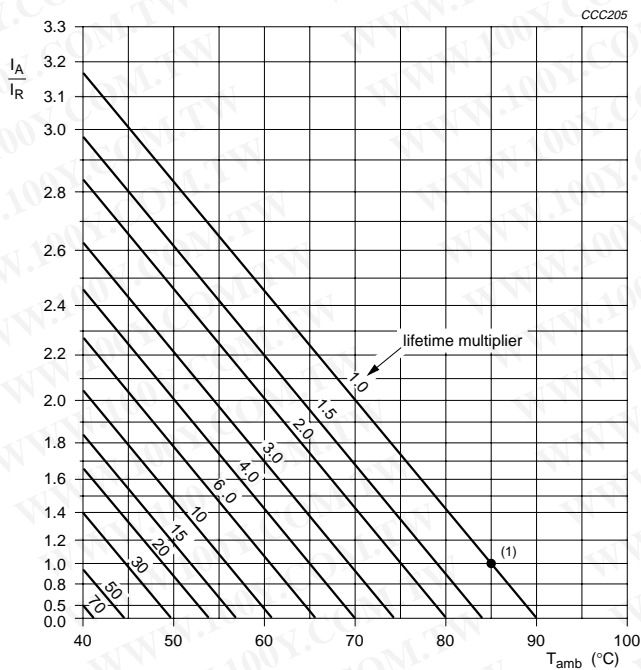
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RIPPLE CURRENT AND USEFUL LIFE

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.

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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	$T_{amb} = 85\text{ }^{\circ}\text{C}$; 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	$T_{amb} = 85\text{ }^{\circ}\text{C}$; 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	$T_{amb} = 85\text{ }^{\circ}\text{C}$; 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 $I_{L5} \leq 2 \times \text{spec. limit}$

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