

DATA SHEET

159 PUL-SI

**Aluminum electrolytic capacitors
Power Ultra Long Life Snap-in**

Product specification
Supersedes data of 18th January 2000
File under BCcomponents, BC01

2000 Nov 06

Aluminum electrolytic capacitors Power Ultra Long Life Snap-in

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FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, very small dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief on the top of the aluminum case⁽¹⁾
- Charge and discharge proof
- Low ESR, high ripple current capability
- Useful life: 5 000 hours at 105 °C
- Keyed polarity version available.

APPLICATIONS

- General purpose, industrial and audio/video systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems.

(1) Pressure relief in the side, for case size 35 × 60 mm

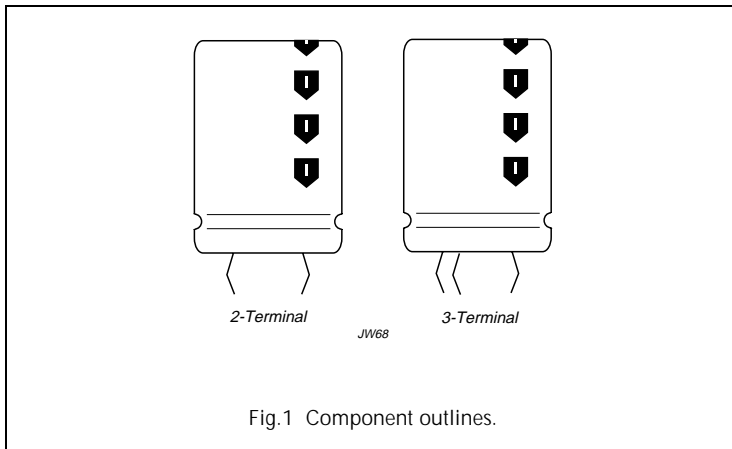
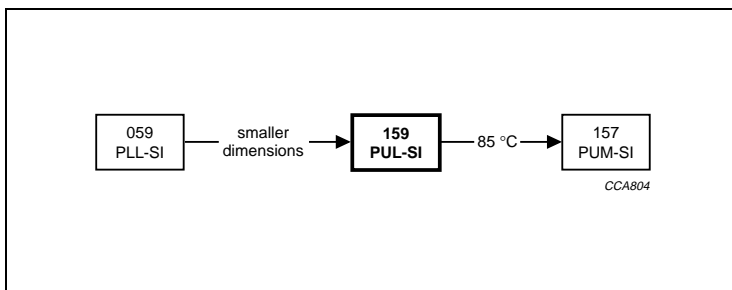


Fig.1 Component outlines.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
Case size ($\varnothing D_{nom} \times L_{nom}$ in mm)	22 × 25 to 35 × 60	
Rated capacitance range (E6/E12 series), C_R	56 to 1 800 μF	
Tolerance on C_R	±20%	
Rated voltage range, U_R ; note 1	200 V, 250 V	400 V, 450 V
Category temperature range	-40 to +105 °C	-25 to +105 °C
Endurance test at 105 °C	2000 hours	
Load life at 105 °C	2000 hours	
Useful life at 105 °C	5000 hours	
Useful life at 40 °C and $1.6 \times I_R$ applied	500 000 hours	
Shelf life at 0 V, 105 °C	1000 hours	
Based on sectional specification	IEC 60384-4-1/EN130300	
Climatic category IEC 60068	40/105/56	25/105/56

Note

1. A 160 volt range is available on request.

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Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm); preferred types (2-terminals) in bold

C_R (μF)	U_R (V)			
	200	250	400	450
56	–	–	–	22 × 25
68	–	–	22 × 25	22 × 30/25 × 25
82	–	–	22 × 30	22 × 35
	–	–	25 × 25	–
100	–	–	22 × 35	22 × 40
	–	–	25 × 30	25 × 30/30 × 25
120	–	–	22 × 35	–
	–	–	25 × 30	25 × 35
	–	–	30 × 25	–
150	–	–	22 × 40	25 × 40
	–	–	25 × 35	30 × 30
	–	–	30 × 30	35 × 25
180	–	–	25 × 40	25 × 45
	–	–	30 × 30	30 × 35
	–	–	35 × 25	–
220	–	22 × 30	25 × 45	30 × 40
	–	25 × 25	30 × 35	35 × 30
	–	–	35 × 30	–
270	–	22 × 35	25 × 50	30 × 45
	–	25 × 30	30 × 40	35 × 35
	–	30 × 25	35 × 30	–
330	22 × 30	22 × 40	30 × 45	30 × 50
	–	25 × 30/30 × 25	35 × 35	35 × 40
390	22 × 35	25 × 35	30 × 50	35 × 45
	25 × 30	30 × 30	35 × 40	–
470	22 × 40	25 × 40	35 × 45	35 × 50
	30 × 25	30 × 30/35 × 25	–	–
560	–	25 × 45	35 × 50	35 × 60
	25 × 35	30 × 35	–	–
	30 × 30	35 × 30	–	–
680	25 × 45	30 × 40	35 × 60	–
	30 × 30	35 × 35	–	–
	35 × 25	–	–	–
820	25 × 50	30 × 45	–	–
	30 × 35	35 × 35	–	–
	35 × 30	35 × 40	–	–
1000	30 × 45	35 × 40	–	–
	35 × 35	35 × 45	–	–
1200	30 × 50	35 × 45	–	–
	35 × 35	35 × 50	–	–
1500	35 × 45	–	–	–
1800	35 × 50	–	–	–

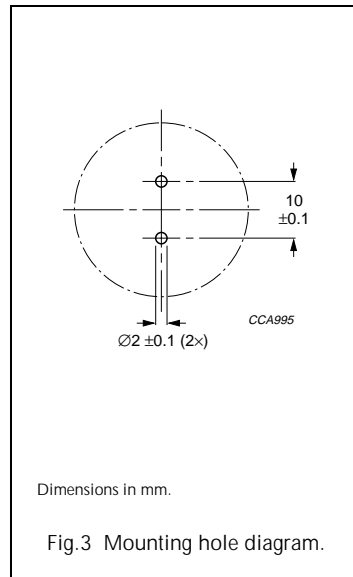
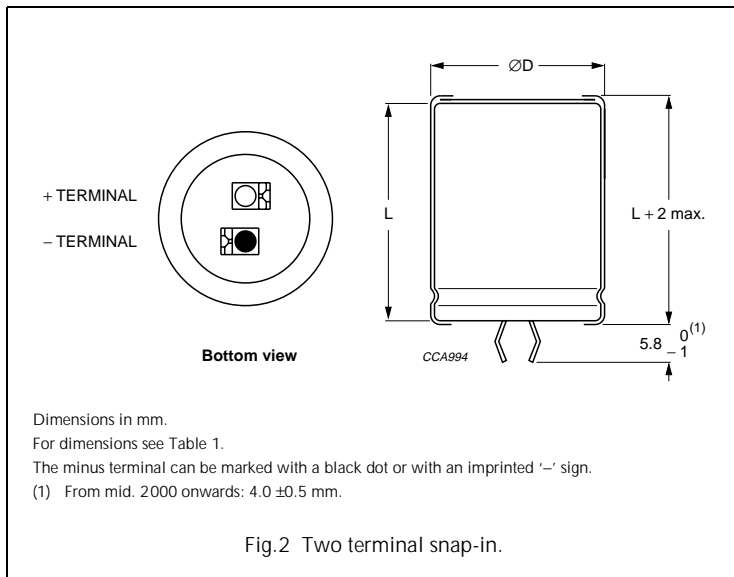
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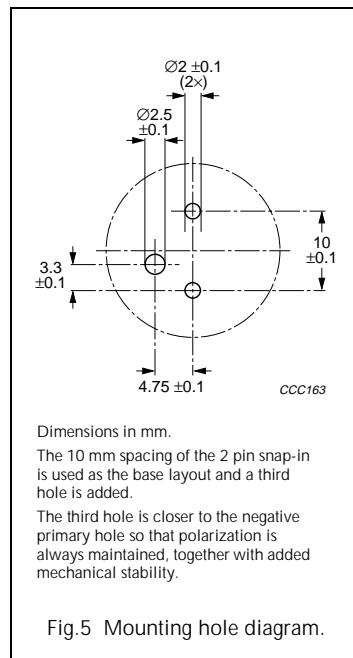
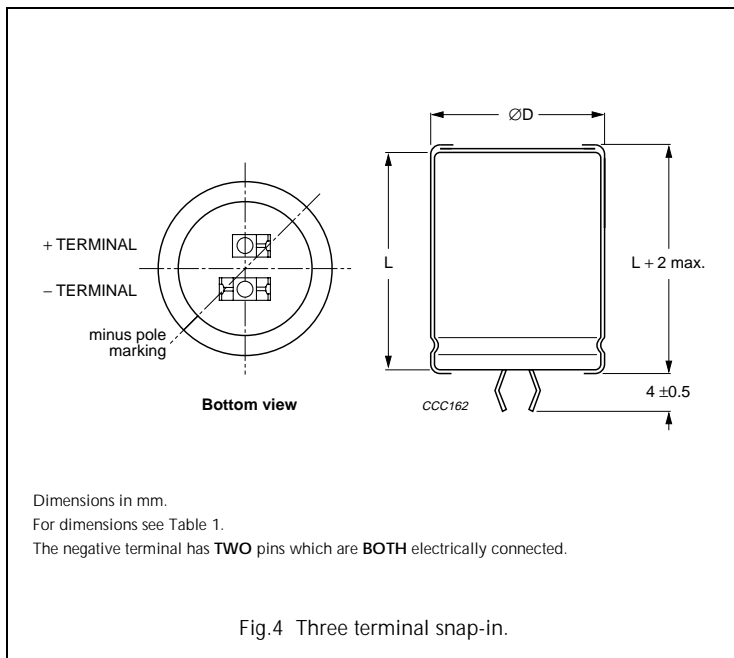
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MECHANICAL DATA AND PACKAGING QUANTITIES

Two terminal snap-in



Three terminal snap-in



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Table 1 Physical dimensions, mass and packaging information; see Figs 2 and 4

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$\varnothing D_{\max}$ (mm)	L_{\max} (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS $l \times w \times h$ (mm)
22 × 25	23	27	≈12	100	260 × 250 × 39
22 × 30	23	32	≈16	100	260 × 250 × 44
22 × 35	23	37	≈20	100	260 × 250 × 49
22 × 40	23	42	≈23	100	260 × 250 × 54
25 × 25	26	27	≈20	100	290 × 280 × 39
25 × 30	26	32	≈22	100	290 × 280 × 44
25 × 35	26	37	≈24	100	290 × 280 × 49
25 × 40	26	42	≈27	100	290 × 280 × 54
25 × 45	26	47	≈32	100	290 × 280 × 59
25 × 50	26	52	≈38	100	290 × 280 × 64
30 × 25	31	27	≈25	100	340 × 330 × 39
30 × 30	31	32	≈30	100	340 × 330 × 44
30 × 35	31	37	≈35	100	340 × 330 × 49
30 × 40	31	42	≈40	100	340 × 330 × 54
30 × 45	31	47	≈45	100	340 × 330 × 59
30 × 50	31	52	≈50	100	340 × 330 × 64
35 × 25	36	27	≈33	50	390 × 198 × 39
35 × 30	36	32	≈40	50	390 × 198 × 44
35 × 35	36	37	≈48	50	390 × 198 × 49
35 × 40	36	42	≈55	50	390 × 198 × 54
35 × 45	36	47	≈63	50	390 × 198 × 59
35 × 50	36	52	≈72	50	390 × 198 × 64
35 × 60	36	62	≈84	50	390 × 198 × 74

MARKING

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

- Rated capacitance (in μF)
- Tolerance code on rated capacitance (M for $\pm 20\%$)
- Rated voltage (in V)
- Climatic category in accordance with "IEC 60068"
- Date code (year and week) in accordance with "IEC 60062"
- Code for factory of origin
- Name of manufacturer
- '-' sign to indicate the negative terminal, visible from the top and side of the capacitor
- Code number (last 8 digits)
- Code for basic specification in accordance with "IEC 60384-4-1" and "CECC 30301".

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ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 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
I_R	rated RMS ripple current at 120 Hz, 105 °C
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	typ./max. equivalent series resistance at 100 Hz; note 1
Z	typ./max. impedance at 10 kHz

Note

1. ESR at 120 Hz is approximately $0.95 \times \text{ESR } 100\text{ Hz}$.

Ordering examples

Electrolytic capacitor 159 series

1 000 $\mu\text{F}/200\text{ V}; \pm 20\%$
Nominal case size: $\varnothing 30 \times 45\text{ mm}$

2-TERMINAL SNAP-IN:

Catalogue number: 2222 159 42102.

3-TERMINAL SNAP-IN:

Catalogue number: 2222 159 22102.

Table 2 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 120 Hz 105 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 100 Hz ⁽¹⁾ (m Ω)	MAX. ESR 100 Hz ⁽¹⁾ (m Ω)	TYP. Z 10 kHz (m Ω)	MAX. Z 10 kHz (m Ω)	CATALOGUE NUMBER 2222 159	
									2-TERM.	3-TERM.
200	330	22 × 30	1.08	0.66	450	730	300	500	52331	72331
	390	22 × 35	1.23	0.78	380	610	280	470	42391	22391
	390	25 × 30	1.23	0.78	380	610	280	470	52391	72391
	470	22 × 40	1.37	0.94	300	505	240	400	32471	12471
	470	30 × 25	1.27	0.94	300	505	240	400	52471	72471
	560	25 × 35	1.50	1.12	260	425	235	390	42561	22561
	560	30 × 30	1.52	1.12	260	425	235	390	52561	72561
	680	25 × 45	1.82	1.36	210	350	205	340	42681	22681
	680	30 × 30	1.59	1.36	210	350	205	340	52681	72681
	680	35 × 25	1.44	1.36	210	350	205	340	62681	82681
	820	25 × 50	2.04	1.64	180	290	145	240	32821	12821
	820	30 × 35	1.83	1.64	180	290	145	240	42821	22821
	820	35 × 30	1.77	1.64	180	290	145	240	52821	72821
	1000	30 × 45	2.23	2.00	150	235	135	225	42102	22102
	1000	35 × 35	2.04	2.00	150	235	135	225	52102	72102
	1200	30 × 50	2.47	2.40	130	210	115	190	42122	22122
1200	35 × 35	2.07	2.40	130	210	115	190	52122	72122	
1500	35 × 45	2.56	3.00	100	170	95	155	52152	72152	
1800	35 × 50	2.80	3.60	90	150	80	130	52182	72182	

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U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	I _R 120 Hz 105 °C (A)	I _{L5} 5 min (mA)	TYP. ESR 100 Hz ⁽¹⁾ (mΩ)	MAX. ESR 100 Hz ⁽¹⁾ (mΩ)	TYP. Z 10 kHz (mΩ)	MAX. Z 10 kHz (mΩ)	CATALOGUE NUMBER 2222 159	
									2-TERM.	3-TERM.
250	220	22 × 30	1.00	0.55	540	1080	420	700	43221	23221
	220	25 × 25	1.00	0.55	540	1080	420	700	53221	73221
	270	22 × 35	1.07	0.67	440	880	335	560	43271	23271
	270	25 × 30	1.08	0.67	440	880	335	560	53271	73271
	270	30 × 25	1.08	0.67	440	880	335	560	63271	83271
	330	22 × 40	1.20	0.82	360	720	255	430	33331	13331
	330	25 × 30	1.21	0.82	360	720	255	430	43331	23331
	330	30 × 25	1.19	0.82	360	720	255	430	53331	73331
	390	25 × 35	1.39	0.97	330	610	245	410	43391	23391
	390	30 × 30	1.41	0.97	330	610	245	410	53391	73391
	470	25 × 40	1.58	1.17	270	505	240	400	33471	13471
	470	30 × 30	1.57	1.17	270	505	240	400	43471	23471
	470	35 × 25	1.37	1.17	270	505	240	400	53471	73471
	560	25 × 45	1.78	1.40	230	425	185	310	43561	23561
	560	30 × 35	1.71	1.40	230	425	185	310	53561	73561
	560	35 × 30	1.67	1.40	230	425	185	310	63561	83561
	680	30 × 40	1.93	1.70	210	350	155	260	43681	23681
	680	35 × 35	1.92	1.70	210	350	155	260	53681	73681
	820	30 × 45	2.16	2.05	180	290	125	210	43821	23821
	820	35 × 35	1.97	2.05	180	290	125	210	53821	73821
820	35 × 40	2.16	2.05	180	290	125	210	63821	83821	
1000	35 × 40	2.22	2.50	140	235	105	180	53102	73102	
1000	35 × 45	2.41	2.50	140	235	105	180	63102	83102	
1200	35 × 45	2.46	3.00	130	200	95	160	43122	23122	
1200	35 × 50	2.65	3.00	130	200	95	160	53122	73122	

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U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	I _R 120 Hz 105 °C (A)	I _{L5} 5 min (mA)	TYP. ESR 100 Hz ⁽¹⁾ (mΩ)	MAX. ESR 100 Hz ⁽¹⁾ (mΩ)	TYP. Z 10 kHz (mΩ)	MAX. Z 10 kHz (mΩ)	CATALOGUE NUMBER 2222 159	
									2-TERM.	3-TERM.
400	68	22 × 25	0.51	0.27	1600	3200	1170	1950	56689	76689
	82	22 × 30	0.60	0.33	1200	2400	910	1520	46829	26829
	82	25 × 25	0.60	0.33	1200	2400	910	1520	56829	76829
	100	22 × 35	0.69	0.40	990	1980	740	1240	46101	26101
	100	25 × 30	0.70	0.40	990	1980	740	1240	56101	76101
	120	22 × 35	0.76	0.48	800	1600	660	1100	46121	26121
	120	25 × 30	0.76	0.48	800	1600	660	1100	56121	76121
	120	30 × 25	0.77	0.48	800	1600	660	1100	66121	86121
	150	22 × 40	0.86	0.60	700	1400	510	860	36151	16151
	150	25 × 35	0.89	0.60	700	1400	510	860	46151	26151
	150	30 × 30	0.92	0.60	700	1400	510	860	56151	76151
	180	25 × 40	1.01	0.72	590	1170	420	700	36181	16181
	180	30 × 30	0.99	0.72	590	1170	420	700	46181	26181
	180	35 × 25	0.96	0.72	590	1170	420	700	56181	76181
	220	25 × 45	1.15	0.88	470	940	350	590	46221	26221
	220	30 × 35	1.15	0.88	470	940	350	590	56221	76221
	220	35 × 30	1.14	0.88	470	940	350	590	66221	86221
	270	25 × 50	1.31	1.08	380	760	330	550	46271	26271
	270	30 × 40	1.30	1.08	380	760	330	550	56271	76271
	270	35 × 30	1.21	1.08	380	760	330	550	66271	86271
	330	30 × 45	1.47	1.32	320	640	270	450	56331	76331
	330	35 × 35	1.40	1.32	320	640	270	450	66331	86331
	390	30 × 50	1.63	1.56	270	540	240	410	46391	26391
390	35 × 40	1.57	1.56	270	540	240	410	56391	76391	
470	35 × 45	1.72	1.88	230	450	200	330	56471	76471	
560	35 × 50	1.84	2.24	210	420	170	280	56561	76561	
680	35 × 60	2.24	2.72	180	350	130	230	56681	76681	

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U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	I _R 120 Hz 105 °C (A)	I _{L5} 5 min (mA)	TYP. ESR 100 Hz ⁽¹⁾ (mΩ)	MAX. ESR 100 Hz ⁽¹⁾ (mΩ)	TYP. Z 10 kHz (mΩ)	MAX. Z 10 kHz (mΩ)	CATALOGUE NUMBER 2222 159	
									2-TERM.	3-TERM.
450	56	22 × 25	0.48	0.25	1600	3200	1120	1880	57569	77569
	68	22 × 30	0.56	0.30	1200	2400	910	1530	47689	27689
	68	25 × 25	0.56	0.30	1200	2400	910	1530	57689	77689
	82	22 × 35	0.64	0.36	1100	2200	770	1290	57829	77829
	100	22 × 40	0.74	0.45	900	1800	630	1050	37101	17101
	100	25 × 30	0.71	0.45	900	1800	630	1050	47101	27101
	100	30 × 25	0.73	0.45	900	1800	630	1050	57101	77101
	120	25 × 35	0.82	0.54	750	1500	530	885	57121	77121
	150	25 × 40	0.95	0.67	600	1200	420	705	47151	27151
	150	30 × 30	0.93	0.67	600	1200	420	705	57151	77151
	150	35 × 25	0.91	0.67	600	1200	420	705	67151	87151
	180	25 × 45	1.07	0.81	500	1000	360	605	47181	27181
	180	30 × 35	1.06	0.81	500	1000	360	605	57181	77181
	220	30 × 40	1.21	0.99	370	740	310	525	47221	27221
	220	35 × 30	1.14	0.99	370	740	310	525	57221	77221
	270	30 × 45	1.37	1.21	350	700	270	450	47271	27271
	270	35 × 35	1.32	1.21	350	700	270	450	57271	77271
	330	30 × 50	1.54	1.48	300	600	230	390	47331	27331
	330	35 × 40	1.49	1.48	300	600	230	390	57331	77331
	390	35 × 45	1.61	1.75	250	500	200	340	57391	77391
470	35 × 50	1.72	2.11	210	420	170	290	57471	77471	
560	35 × 60	2.11	2.52	190	380	140	240	57561	77561	

Note

1. ESR at 120 Hz is approximately $0.95 \times$ ESR 100 Hz.

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Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≥400 V versions	$U_S = 1.1 \times U_R$
	≤250 V versions	$U_S = 1.15 \times U_R$
Reverse voltage		≤1 V
Current		
Leakage current	after 5 minutes at U_R	$I_{L5} \leq 0.01 C_R \times U_R$
Inductance		
Equivalent series inductance (ESL)	all case sizes	typ. 19 nH
		max. 25 nH

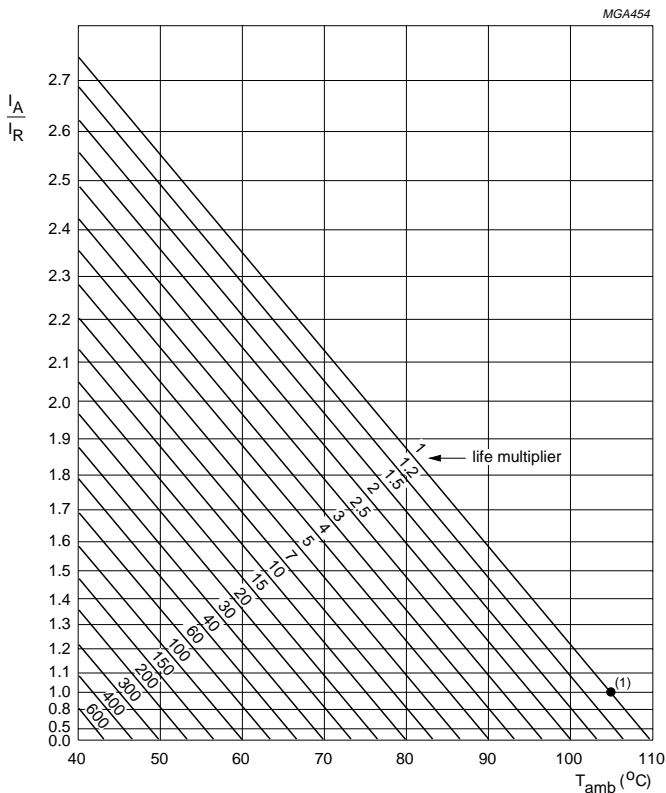
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RIPPLE CURRENT AND USEFUL LIFE

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
50	0.9
100	0.95
120	1.0
200	1.15
1000	1.3
≥ 10000	1.4



I_A = actual ripple current at 120 Hz and 105 °C.
 I_R = rated ripple current at 120 Hz and 105 °C.
 (1) Useful life at 105 °C and I_R applied: 5000 hours.

Fig.6 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 4 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ °C}$; U_R applied; 2000 hours	$\Delta C/C: \pm 15\%$ $ESR \leq 1.3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Load life		$T_{amb} = 105\text{ °C}$; U_R and I_R applied; 2000 hours	$\Delta C/C: \pm 20\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ °C}$; U_R and I_R applied; 5000 hours	$\Delta C/C: \pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105\text{ °C}$; no voltage applied; 1000 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 15\%$ $ESR \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$