

# DATA SHEET

## **198 PHR-SI**

Aluminum electrolytic capacitors  
Power High Ripple Current Snap-in

Product specification  
Supersedes data of April 1999  
File under BC Components, BC01

2000 Jan 18

# Aluminum electrolytic capacitors Power High Ripple Current Snap-in

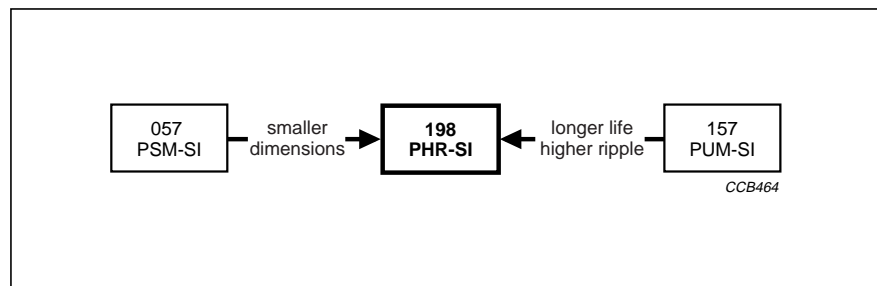
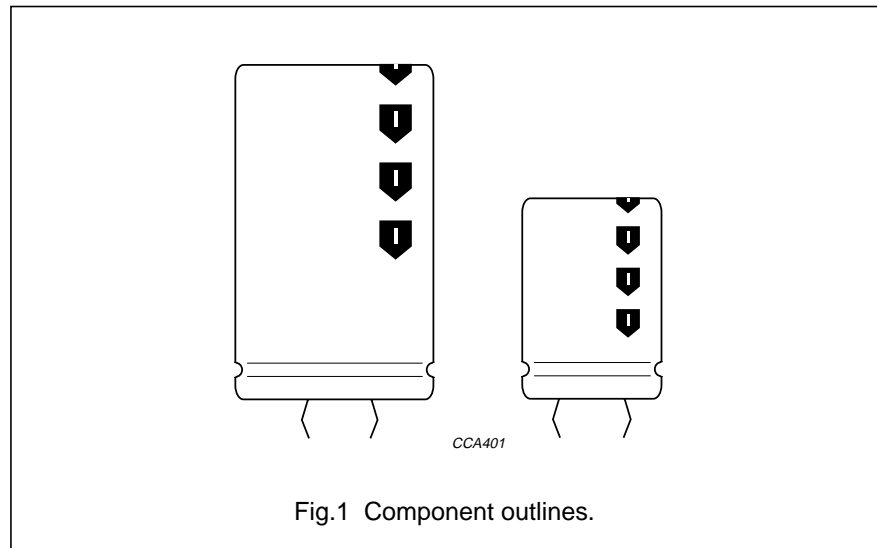
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**FEATURES**

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, miniaturized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief on the side of the aluminum case
- Charge and discharge proof
- Very high ripple current capability
- Keyed polarity version available.

**APPLICATIONS**

- Motor control and industrial systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems.



**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 680 $\mu$ F
Tolerance on $C_R$	$\pm 20\%$
Rated voltage range, $U_R$	400 and 450 V
Category temperature range	-25 to +85 °C
Endurance test at 85 °C	7000 hours
Useful life at 85 °C	15000 hours
Shelf life at 0 V, 85 °C	1000 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	25/085/56

# Aluminum electrolytic capacitors

## Power High Ripple Current Snap-in

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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**.

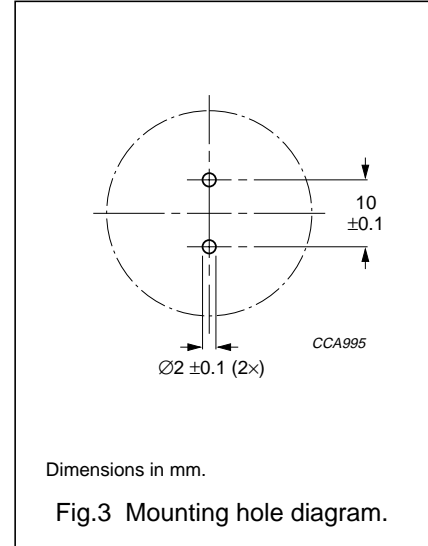
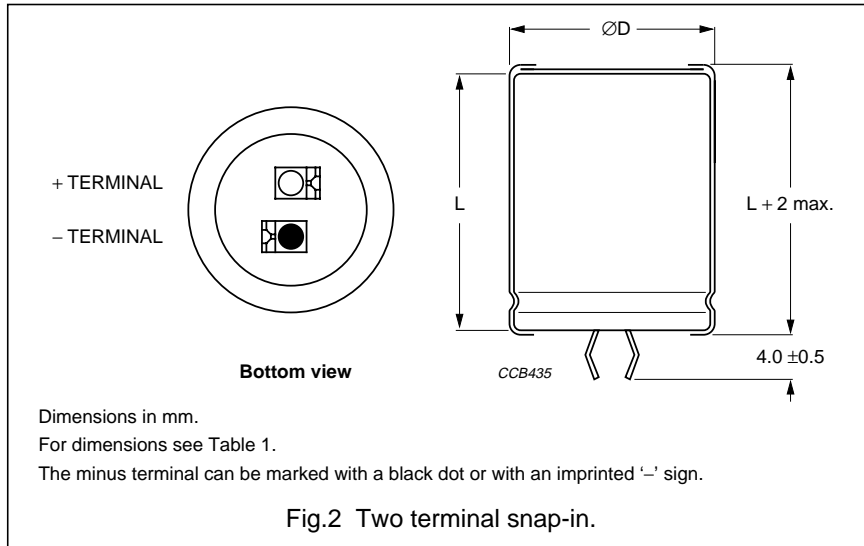
$C_R$ ( $\mu F$ )	$U_R$ (V)	
	400	450
56	22 × 25	22 × 25
<b>68</b>	22 × 25	<b>22 × 30</b>
82	–	22 × 30
	–	25 × 25
<b>100</b>	<b>22 × 30</b>	<b>22 × 35</b>
	–	25 × 30
120	22 × 35	22 × 40
	25 × 30	25 × 30
	–	30 × 25
<b>150</b>	<b>22 × 40</b>	<b>25 × 40</b>
	25 × 35	30 × 30
180	25 × 40	25 × 40
	30 × 30	30 × 35
	35 × 25	35 × 25
<b>220</b>	<b>25 × 45</b>	25 × 50
	30 × 35	<b>30 × 40</b>
	35 × 30	35 × 30
270	30 × 40	30 × 45
	35 × 30	35 × 35
<b>330</b>	<b>30 × 45</b>	<b>30 × 50</b>
	35 × 35	35 × 40
390	30 × 50	35 × 45
	35 × 40	–
<b>470</b>	<b>35 × 45</b>	<b>35 × 50</b>
560	35 × 50	35 × 60
<b>680</b>	<b>35 × 60</b>	<b>35 × 60</b>

# Aluminum electrolytic capacitors Power High Ripple Current Snap-in

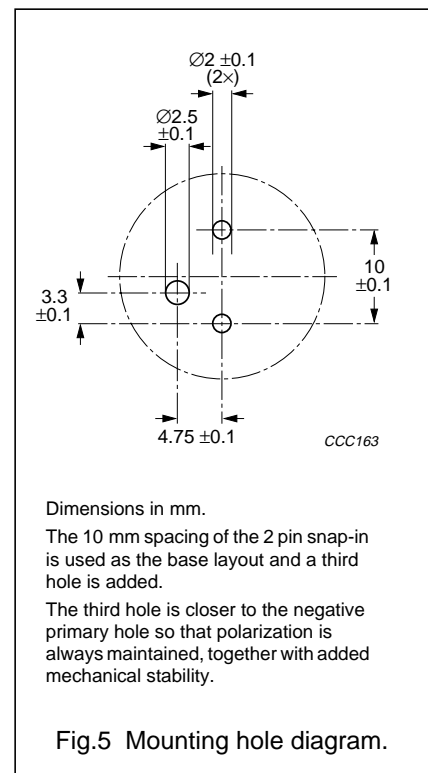
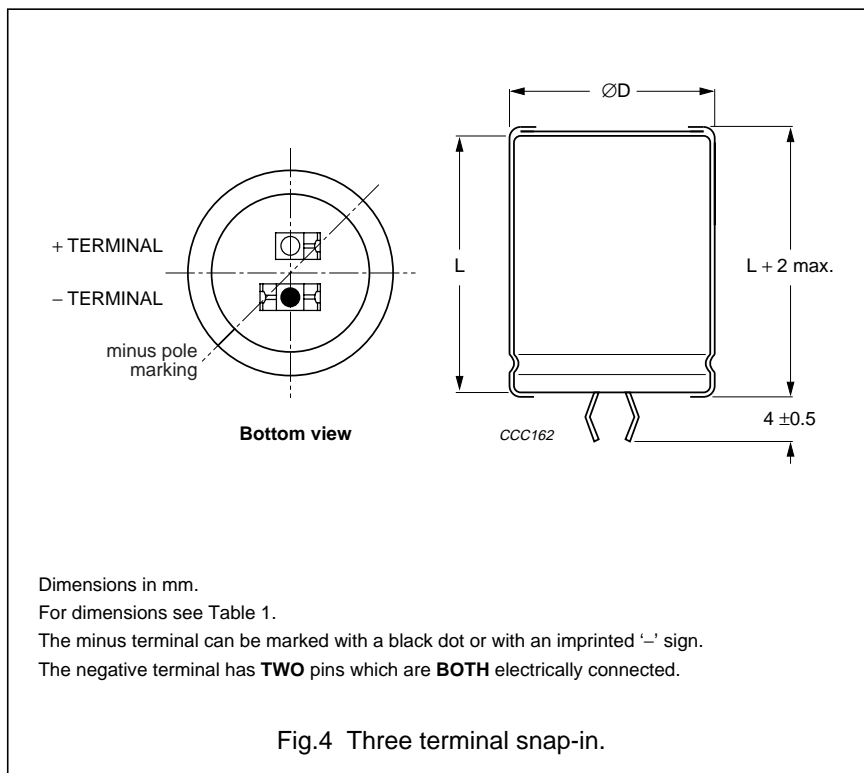
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## MECHANICAL DATA AND PACKAGING QUANTITIES

### Two terminal snap-in



### Three terminal snap-in (available on request)



## Aluminum electrolytic capacitors Power High Ripple Current 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	≈87	50	390 × 198 × 74

**MARKING**

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

- Rated capacitance (in  $\mu\text{F}$ )
- 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 specification in accordance with "IEC 60384-4-1" and "CECC 30301".

# Aluminum electrolytic capacitors

## Power High Ripple Current Snap-in

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**ELECTRICAL DATA AND ORDERING INFORMATION**

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

SYMBOL	DESCRIPTION
$C_R$	rated capacitance at 100 Hz
$I_R$	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 $U_R$
ESR	typ./max. equivalent series resistance at 100 Hz
Z	typ./max. impedance at 10 kHz

**Ordering example**

Electrolytic capacitor 198 PHR-SI

470  $\mu\text{F}$ /450 V;  $\pm 20\%$ Nominal case size:  $\varnothing 35 \times 50\text{ mm}$   
2-terminal snap-in

Catalogue number: 2222 198 57471.

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

$U_R$ (V)	$C_R$ 100 Hz ( $\mu\text{F}$ )	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$I_R$ 100 Hz 85 °C (A)	$I_{L1}$ 1 min ( $\mu\text{A}$ )	$I_{L5}$ 5 min ( $\mu\text{A}$ )	TYP. ESR 100 Hz (m $\Omega$ )	MAX. ESR 100 Hz (m $\Omega$ )	TYP. Z 10 kHz (m $\Omega$ )	MAX. Z 10 kHz (m $\Omega$ )	CATALOGUE NUMBER <sup>(1)(2)</sup> 2222 ... ..
400	56	22 × 25	0.72	138	49	1530	4265	869	2170	198 56569
	68	22 × 25	0.79	167	59	1270	3513	724	1810	198 56689
	<b>100</b>	<b>22 × 30</b>	1.00	244	84	866	2389	495	1220	<b>198 56101</b>
	120	22 × 35	1.14	292	100	722	1990	412	900	198 46121
	<b>150</b>	25 × 30	1.14	292	100	730	1990	420	900	198 36121
		<b>22 × 40</b>	1.33	364	124	580	1592	332	725	<b>198 66151</b>
180		25 × 35	1.33	364	124	585	1592	337	725	198 36151
		25 × 40	1.51	436	148	489	1327	282	590	198 36181
	<b>220</b>	30 × 30	1.49	436	148	508	1327	300	590	198 66181
		35 × 25	1.56	436	148	545	1327	334	590	198 26181
270		<b>25 × 45</b>	1.75	532	180	402	1086	232	560	<b>198 36221</b>
		30 × 35	1.56	532	180	416	1086	245	560	198 26221
	<b>330</b>	35 × 30	1.81	532	180	431	1086	259	560	198 16221
		30 × 40	1.95	652	220	341	885	202	525	198 36271
390		35 × 30	1.93	652	220	370	885	229	525	198 66271
		<b>30 × 45</b>	2.22	796	268	282	724	168	420	<b>198 36331</b>
	<b>470</b>	35 × 35	2.18	796	268	302	724	187	420	198 66331
		30 × 50	2.50	940	316	241	612	144	350	198 36391
560		35 × 40	2.44	940	316	256	612	158	350	198 66391
		<b>35 × 45</b>	2.72	1132	380	215	508	134	305	<b>198 36471</b>
	<b>680</b>	35 × 50	3.03	1348	452	184	427	116	265	198 46561
		<b>35 × 60</b>	3.53	1636	548	151	351	95	220	<b>198 46681</b>

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$U_R$ (V)	$C_R$ 100 Hz ( $\mu$ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$I_R$ 100 Hz 85 °C (A)	$I_{L1}$ 1 min ( $\mu$ A)	$I_{L5}$ 5 min ( $\mu$ A)	TYP. ESR 100 Hz (m $\Omega$ )	MAX. ESR 100 Hz (m $\Omega$ )	TYP. Z 10 kHz (m $\Omega$ )	MAX. Z 10 kHz (m $\Omega$ )	CATALOGUE NUMBER <sup>(1)(2)</sup> 2222 ... ..
450	56	22 × 25	0.71	155	54.4	1441	4265	799	1880	198 57569
	<b>68</b>	<b>22 × 30</b>	0.82	188	65.2	1182	3513	654	1530	<b>198 57689</b>
	82	22 × 30	0.89	225	77.8	987	2913	548	1290	198 47829
	<b>100</b>	25 × 25	0.91	225	77.8	1006	2913	565	1290	198 57829
		<b>22 × 35</b>	1.02	274	94	809	2389	450	1050	<b>198 47101</b>
	120	25 × 30	1.05	274	94	818	2389	457	1050	198 57101
		22 × 40	1.14	328	112	676	1990	375	885	198 47121
	<b>150</b>	25 × 30	1.13	328	112	691	1990	389	885	198 57121
		30 × 25	1.16	328	112	718	1990	414	885	198 67121
		<b>25 × 40</b>	1.36	409	139	547	1592	306	705	<b>198 47151</b>
	180	30 × 30	1.36	409	139	566	1592	323	705	198 57151
		25 × 40	1.47	490	166	462	1327	261	605	198 47181
	<b>220</b>	30 × 35	1.54	490	166	470	1327	268	605	198 57181
		35 × 25	1.46	490	166	527	1327	319	605	198 67181
		25 × 50	1.71	598	202	377	1086	212	525	198 47221
		<b>30 × 40</b>	1.75	598	202	387	1086	221	525	<b>198 57221</b>
	270	35 × 30	1.72	598	202	414	1086	246	525	198 67221
		30 × 45	1.98	733	247	318	885	183	450	198 47271
	<b>330</b>	35 × 35	1.96	733	247	337	885	200	450	198 57271
		<b>30 × 50</b>	2.22	895	301	264	724	152	390	<b>198 47331</b>
390	35 × 40	2.22	895	301	278	724	166	390	198 57331	
	<b>35 × 45</b>	2.46	1057	355	237	612	142	340	198 57391	
<b>470</b>	<b>35 × 50</b>	2.73	1273	427	200	508	121	290	<b>198 57471</b>	
	560	35 × 60	3.10	1516	508	167	427	100	240	198 57561
<b>680</b>	<b>35 × 60</b>	3.30	1840	616	147	351	91	220	<b>198 57681</b>	

**Notes**

1. All catalogue numbers refer to 2-terminal snap-in products.
2. 3-terminal snap-ins are available on request.

**Customized products**

If you are unable to find the capacitor you require, please contact your local BC Components sales organization; we are able to design and manufacture customized capacitors to meet your specific requirements.

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**Additional electrical data**

PARAMETER	CONDITIONS	VALUE
<b>Voltage</b>		
Surge voltage	$\geq 400$ V versions	$U_S = 1.1 \times U_R$
Reverse voltage		$\leq 1$ V
<b>Current</b>		
Leakage current	after 1 minute at $U_R$	$I_{L1} \leq 0.006C_R \times U_R + 4 \mu\text{A}$
	after 5 minutes at $U_R$	$I_{L5} \leq 0.002C_R \times U_R + 4 \mu\text{A}$
<b>Inductance</b>		
Equivalent series inductance (ESL)	all case sizes	typ. 19 nH
		max. 25 nH



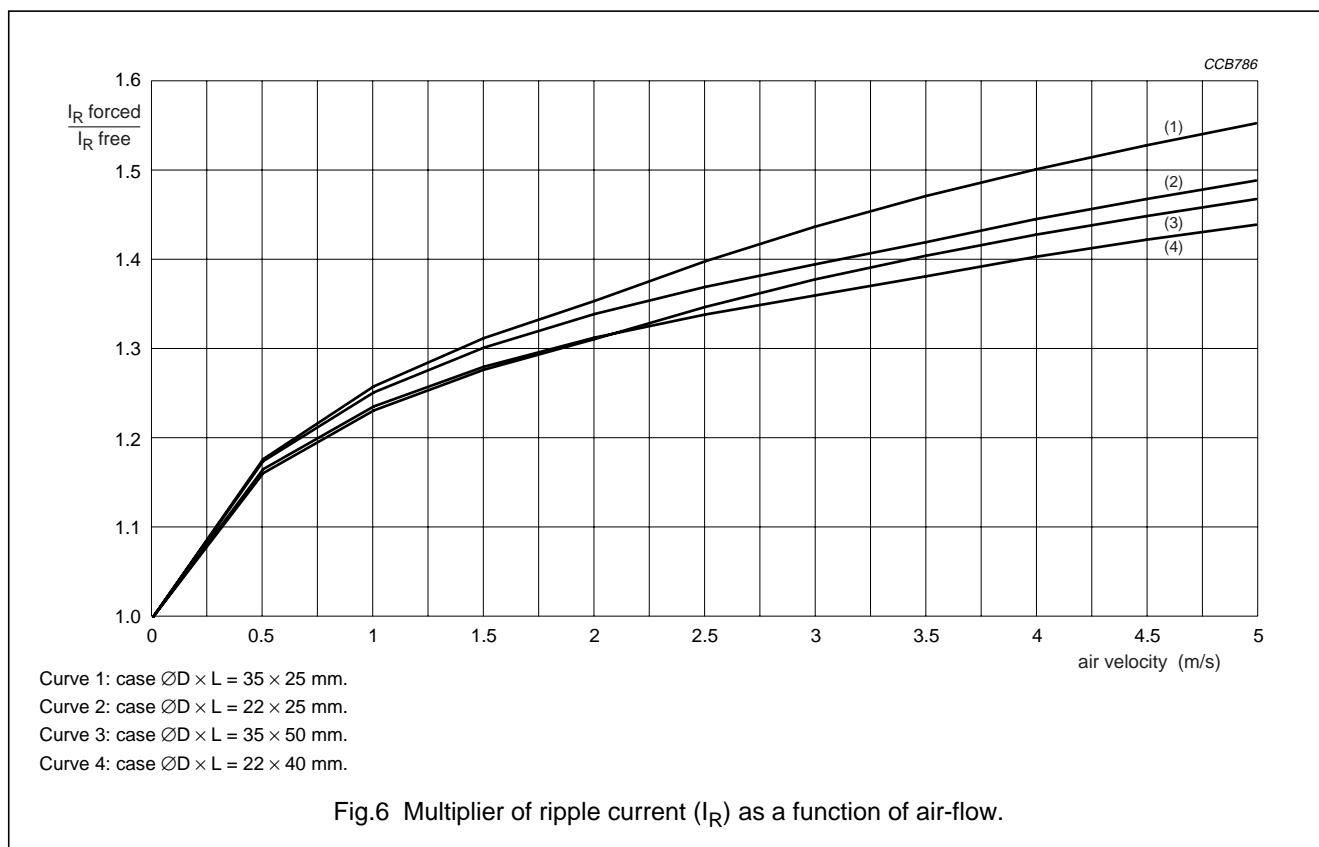
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**RIPPLE CURRENT AND USEFUL LIFE**

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

FREQUENCY (Hz)	$I_R$ MULTIPLIER
50	0.86
100	1.00
300	1.17
600	1.24
1000	1.29
$\geq 10000$	1.40



**Maximum ripple current multiplier**

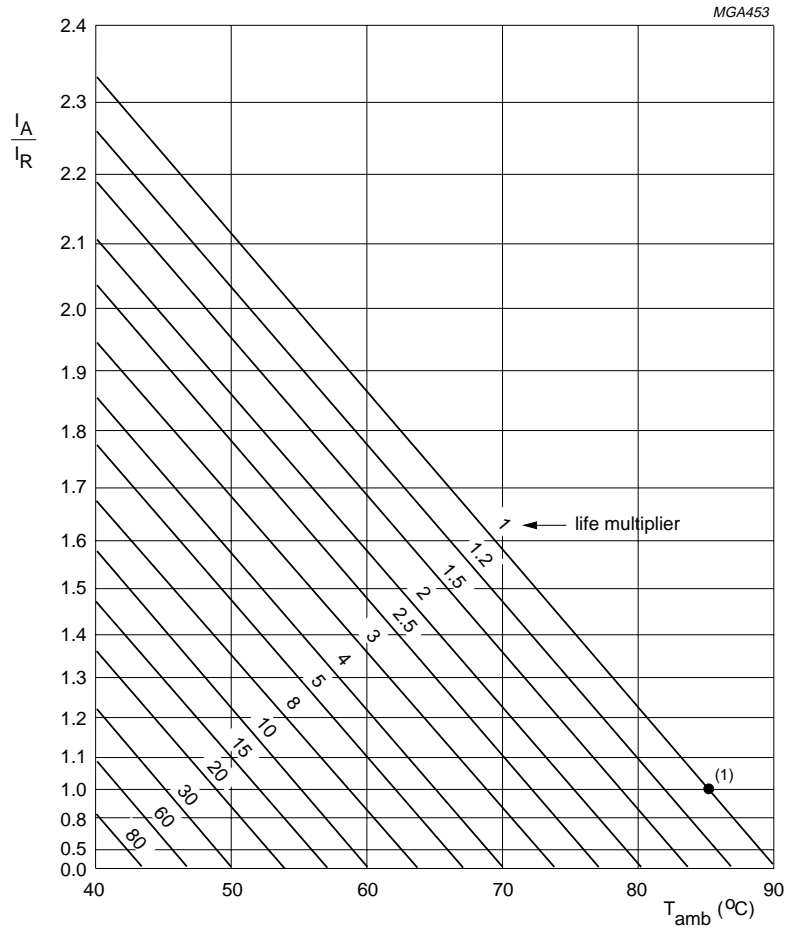
CALCULATION EXAMPLE FOR CASE  $\varnothing D \times L = 35 \times 25$  mm

PARAMETER	CONDITION	MAXIMUM RIPPLE CURRENT MULTIPLIER	VALUE
Ambient temperature ( $T_{amb}$ )	70 °C	from nomogram; see Fig.7	1.57
Operating frequency (f)	300 Hz	from frequency table; see Table 3	1.17
Air-flow	2 m/s	from air-flow; see Fig.6	1.35

Therefore the maximum ripple current multiplier at 70 °C, 300 Hz and 2 m/s air-flow =  $1.57 \times 1.17 \times 1.35 = 2.48$ .

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$I_A$  = actual ripple current at 100 Hz and 85 °C.  
 $I_R$  = rated ripple current at 100 Hz and 85 °C.  
(1) Useful life at 85 °C and  $U_R$  applied: 15000 hours.

Fig.7 Multiplier of useful life as a function of ambient temperature and ripple current load.

# Aluminum electrolytic capacitors

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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	$T_{amb} = 85\text{ °C}$ ; $U_R$ applied; 7000 hours	$\Delta C/C: \pm 10\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ °C}$ ; $U_R$ and $I_R$ applied; 15000 hours	$\Delta C/C: \pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
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	$\Delta C/C: \pm 15\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$