

# DATA SHEET

116 RLL

**Aluminum electrolytic capacitors**  
**Radial Long Life**

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

2001 Nov 05

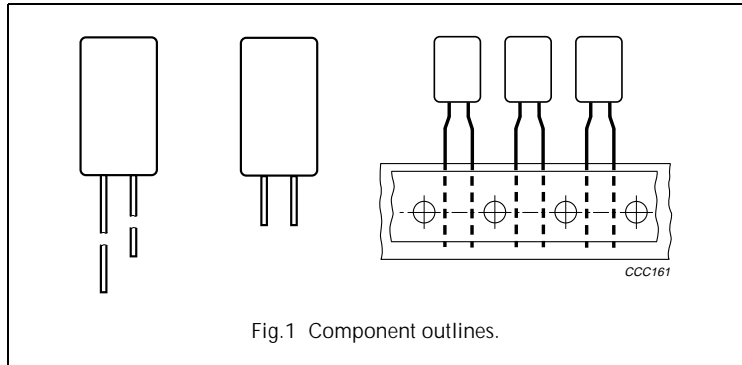
# Aluminum electrolytic capacitors

## Radial Long Life

116 RLL

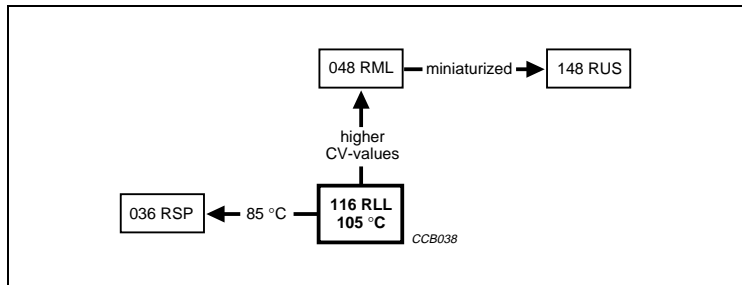
### FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, all-insulated (light blue)
- Natural pitch 2.5 mm and 5 mm
- Charge and discharge proof
- Miniaturized, high CV-product per unit volume
- Long useful life: 2000 hours at 105 °C, high reliability.



### APPLICATIONS

- Automotive, telecommunication, industrial and EDP
- Stand-by applications in audio and video equipment
- Coupling, decoupling, timing; smoothing, filtering and buffering in DC-DC converters
- Portable and mobile equipment (small size, low mass).



### QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ( $\varnothing D_{nom} \times L_{nom}$ in mm)	5 × 11 and 8.2 × 11
Rated capacitance range, $C_R$	0.47 to 470 $\mu\text{F}$
Tolerance on $C_R$	$\pm 20\%$
Rated voltage range, $U_R$	6.3 to 100 V
Category temperature range	-55 to +105 °C
Endurance test at 105 °C	1500 hours
Endurance test at 85 °C	5000 hours
Useful life at 105 °C	2000 hours
Useful life at 40 °C, $1.3 \times I_R$ applied	200000 hours
Shelf life at 0 V, 105 °C	1500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	55/105/56

# Aluminum electrolytic capacitors

## Radial Long Life

116 RLL

Selection chart for  $C_R$ ,  $U_R$  and relevant nominal case sizes ( $\varnothing D \times L$  in mm)

Preferred types in **bold**.

$C_R$ ( $\mu\text{F}$ )	$U_R$ (V)								
	6.3	10	16	25	35	40	50	63	100
0.47	–	–	–	–	–	–	5 × 11	–	–
1.0	–	–	–	–	–	–	<b>5 × 11</b>	–	–
1.5	–	–	–	–	–	–	5 × 11	–	–
2.2	–	–	–	–	–	–	<b>5 × 11</b>	–	8.2 × 11
3.3	–	–	–	–	–	–	5 × 11	–	–
4.7	–	–	–	–	–	–	<b>5 × 11</b>	–	8.2 × 11
6.8	–	–	–	–	–	–	5 × 11	–	–
10	–	–	–	–	–	–	<b>5 × 11</b>	8.2 × 11	8.2 × 11
	–	–	–	–	–	–	8.2 × 11	–	–
15	–	–	–	–	–	–	5 × 11	–	–
22	–	–	–	–	–	–	<b>5 × 11</b>	8.2 × 11	–
	–	–	–	–	–	–	<b>8.2 × 11</b>	–	–
33	–	–	–	–	5 × 11	5 × 11	8.2 × 11	–	–
47	–	–	–	<b>5 × 11</b>	–	–	<b>8.2 × 11</b>	–	–
68	–	–	5 × 11	–	–	–	8.2 × 11	–	–
100	–	<b>5 × 11</b>	–	–	<b>8.2 × 11</b>	8.2 × 11	–	–	–
150	5 × 11	–	–	8.2 × 11	–	–	–	–	–
220	–	–	<b>8.2 × 11</b>	–	–	–	–	–	–
330	–	8.2 × 11	–	–	–	–	–	–	–
470 <sup>(1)</sup>	8.2 × 11	–	–	–	–	–	–	–	–

### Note

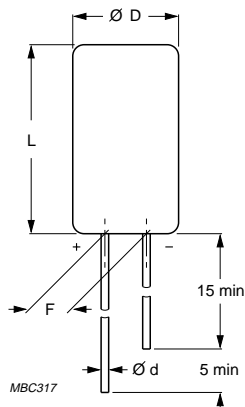
- For higher CV-values see data sheet "048 RML".

# Aluminum electrolytic capacitors

## Radial Long Life

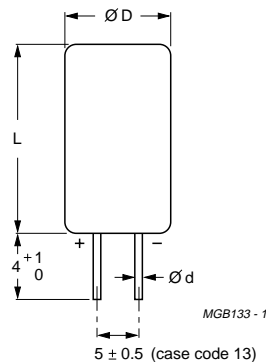
116 RLL

### MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Dimensions in mm.  
For dimensions see Table 1.

Fig.2 Form CA: Long leads.



Dimensions in mm.  
For dimensions see Table 1.

Fig.3 Form CB: Cut leads.

Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

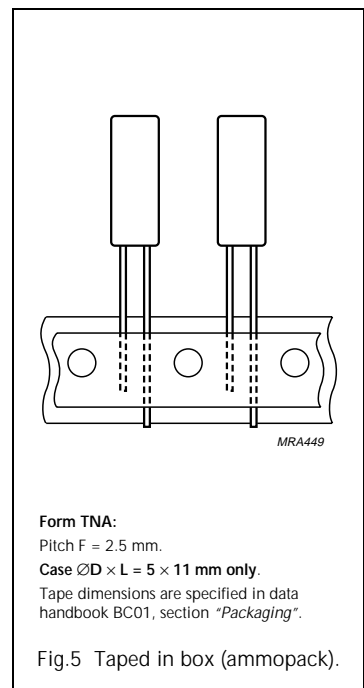
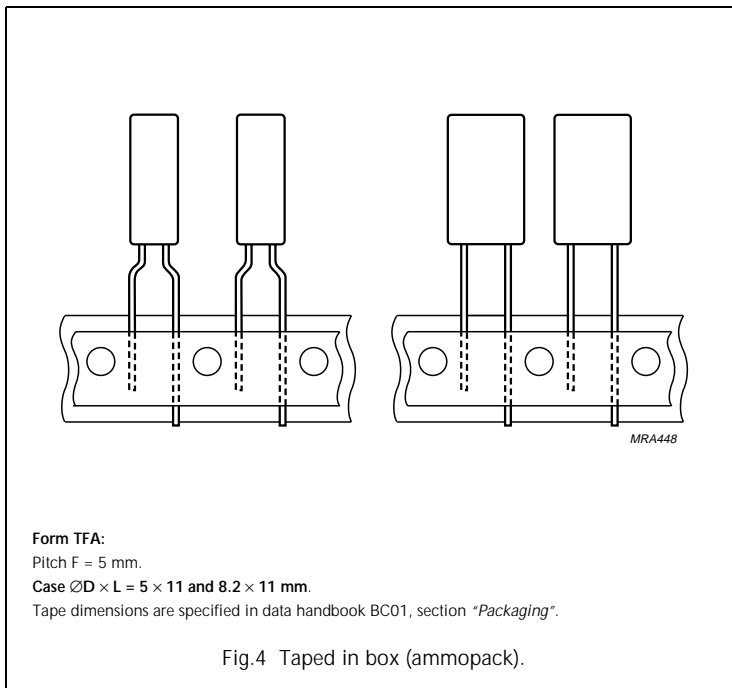
NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	$\varnothing d$ (mm)	$\varnothing D_{max}$ (mm)	$L_{max}$ (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES		
							FORM CA, CB	FORM TR+, TN+	FORM TFA, TNA
5 × 11	11	0.5	5.5	12	2.5 ± 0.5	≈ 0.4	1000	1000	2000
8.2 × 11	13	0.6	8.7	12	5 ± 0.5	≈ 1.1	1000	500	1000

# Aluminum electrolytic capacitors

## Radial Long Life

116 RLL

### Taped products



### MARKING

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

- Rated capacitance (in  $\mu\text{F}$ )
- Tolerance on rated capacitance, code letter in accordance with "IEC 60062"
- Rated voltage (in V)
- Group number (116)
- Name of manufacturer
- Date code in accordance with "IEC 60062"
- Code indicating factory of origin
- Minus-sign on top to identify the negative terminal.

# Aluminum electrolytic capacitors

## Radial Long Life

### 116 RLL

#### Ordering example

Electrolytic capacitor 116 series

220  $\mu\text{F}/16\text{ V}$ ;  $\pm 20\%$

Nominal case size:  $\varnothing 8.2 \times 11\text{ mm}$ ; Form TFA

Catalogue number: 2222 116 35221.

#### ELECTRICAL DATA

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

SYMBOL	DESCRIPTION
$C_R$	rated capacitance at 100 Hz, tolerance $\pm 20\%$
$I_R$	rated RMS ripple current at 100 kHz, $105\text{ }^\circ\text{C}$
$I_{L1}$	max. leakage current after 1 minute at $U_R$
Tan $\delta$	max. dissipation factor at 100 Hz
$Z_{100}$	max. impedance at 100 kHz and $20\text{ }^\circ\text{C}$

**Table 2** Electrical data: 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 kHz $105\text{ }^\circ\text{C}$ (mA)	$I_{L1}$ 1 min ( $\mu\text{A}$ )	Tan $\delta$ 100 Hz	$Z_{100}$ 100 kHz $20\text{ }^\circ\text{C}$ ( $\Omega$ )	CATALOGUE NUMBER 2222 116 .....							
							BULK PACKAGING				TAPED AMMOPACK			
							LONG LEADS		CUT LEADS		FORM TFA		FORM TNA	
							FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
6.3	150	$5 \times 11$	130	8.7	0.25	1.3	53151	2.5	–	–	33151	5.0	73151	2.5
	470	$8.2 \times 11$	300	21	0.25	0.45	53471	5.0	63471	5.0	33471	5.0	–	–
10	<b>100</b>	<b><math>5 \times 11</math></b>	130	9	0.2	1.4	<b>54101</b>	2.5	–	–	<b>34101</b>	5.0	74101	2.5
	330	$8.2 \times 11$	280	23	0.2	0.45	54331	5.0	64331	5.0	34331	5.0	–	–
16	68	$5 \times 11$	130	9.5	0.16	1.5	55689	2.5	–	–	35689	5.0	75689	2.5
	<b>220</b>	<b><math>8.2 \times 11</math></b>	280	24	0.16	0.5	<b>55221</b>	5.0	65221	5.0	<b>35221</b>	5.0	–	–
25	<b>47</b>	<b><math>5 \times 11</math></b>	120	10	0.14	1.6	<b>56479</b>	2.5	–	–	<b>36479</b>	5.0	76479	2.5
	150	$8.2 \times 11$	260	26	0.14	0.5	56151	5.0	66151	5.0	36151	5.0	–	–
35	33	$5 \times 11$	110	9.9	0.12	1.7	50339	2.5	–	–	30339	5.0	70339	2.5
	<b>100</b>	<b><math>8.2 \times 11</math></b>	240	24	0.12	0.55	<b>50101</b>	5.0	60101	5.0	<b>30101</b>	5.0	–	–
40	33	$5 \times 11$	110	10.9	0.12	1.7	57339	2.5	–	–	37339	5.0	77339	2.5
	100	$8.2 \times 11$	240	27	0.12	0.55	57101	5.0	67101	5.0	37101	5.0	–	–

# Aluminum electrolytic capacitors

## Radial Long Life

### 116 RLL

U <sub>R</sub> (V)	C <sub>R</sub> 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	I <sub>R</sub> 100 kHz 105 °C (mA)	I <sub>L1</sub> 1 min (μA)	Tan δ 100 Hz	Z <sub>100</sub> 100 kHz 20 °C (Ω)	CATALOGUE NUMBER 2222 116 .....							
							BULK PACKAGING				TAPED AMMOPACK			
							LONG LEADS		CUT LEADS					
							FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
50	0.47	5 × 11	30	3.1	0.09	10	51477	2.5	–	5.0	31477	5.0	71477	2.5
	<b>1.0</b>	<b>5 × 11</b>	40	3.3	0.09	6	<b>51108</b>	2.5	–	5.0	<b>31108</b>	5.0	71108	2.5
	1.5	5 × 11	50	3.5	0.09	4	51158	2.5	–	5.0	31158	5.0	71158	2.5
	<b>2.2</b>	<b>5 × 11</b>	60	3.7	0.09	3.5	<b>51228</b>	2.5	–	5.0	<b>31228</b>	5.0	71228	2.5
	3.3	5 × 11	65	4	0.09	3.1	51338	2.5	–	5.0	31338	5.0	71338	2.5
	<b>4.7</b>	<b>5 × 11</b>	70	4.4	0.09	2.8	<b>51478</b>	2.5	–	5.0	<b>31478</b>	5.0	71478	2.5
	6.8	5 × 11	75	5	0.09	2.5	51688	2.5	–	5.0	31688	5.0	71688	2.5
	<b>10</b>	<b>5 × 11</b>	80	6	0.09	2.2	<b>51109</b>	2.5	–	5.0	<b>31109</b>	5.0	71109	2.5
	10	8.2 × 11	160	6	0.05	1.0	90084	5.0	90085	5.0	90036	5.0	–	–
	15	5 × 11	90	7.5	0.09	2.0	51159	2.5	–	5.0	31159	5.0	71159	2.5
	<b>22</b>	<b>5 × 11</b>	110	9.6	0.09	1.9	<b>51229</b>	2.5	–	5.0	<b>31229</b>	5.0	71229	2.5
	<b>22</b>	<b>8.2 × 11</b>	190	9.6	0.06	0.9	<b>90025</b>	5.0	90086	5.0	<b>90039</b>	5.0	–	–
	33	8.2 × 11	190	13	0.09	0.77	51339	5.0	61339	5.0	31339	5.0	–	–
	<b>47</b>	<b>8.2 × 11</b>	210	17	0.09	0.65	<b>51479</b>	5.0	61479	5.0	<b>31479</b>	5.0	–	–
68	8.2 × 11	240	23	0.09	0.55	51689	5.0	61689	5.0	31689	5.0	–	–	
63	10	8.2 × 11	160	7	0.06	1.3	58109	5.0	68109	5.0	38109	5.0	–	–
	22	8.2 × 11	190	11	0.06	0.9	58229	5.0	68229	5.0	38229	5.0	–	–
100	2.2	8.2 × 11	60	4.3	0.06	4	59228	5.0	69228	5.0	39228	5.0	–	–
	4.7	8.2 × 11	75	5.8	0.07	3.5	59478	5.0	69478	5.0	39478	5.0	–	–
	10	8.2 × 11	100	9	0.08	3	59109	5.0	69109	5.0	39109	5.0	–	–

# Aluminum electrolytic capacitors

## Radial Long Life

116 RLL

### Additional electrical data

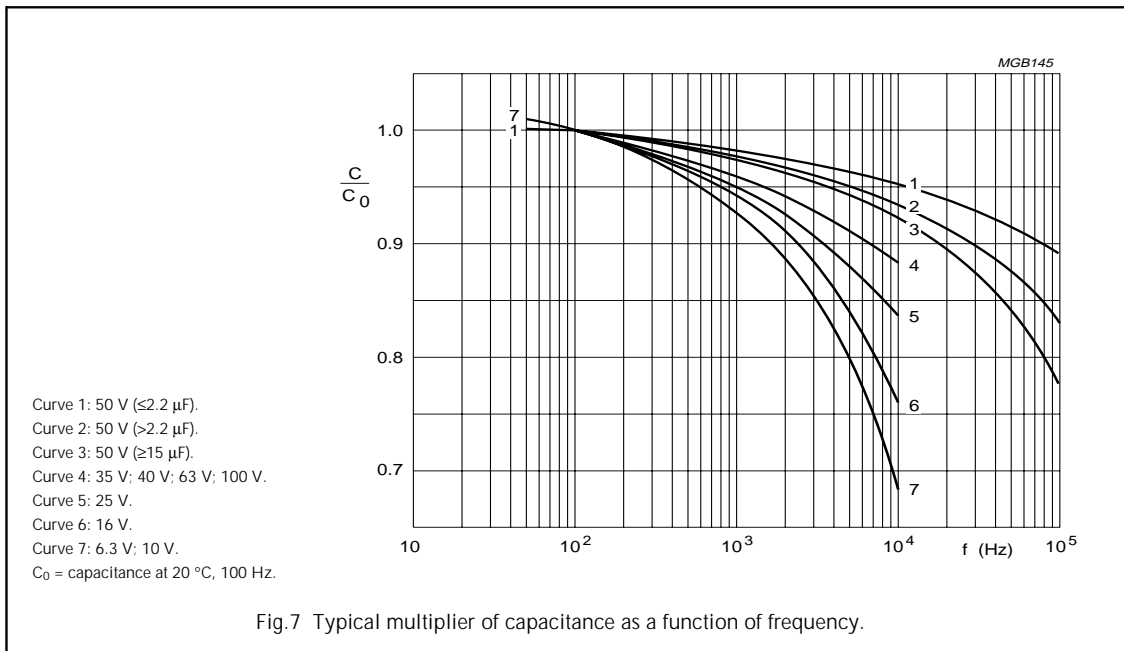
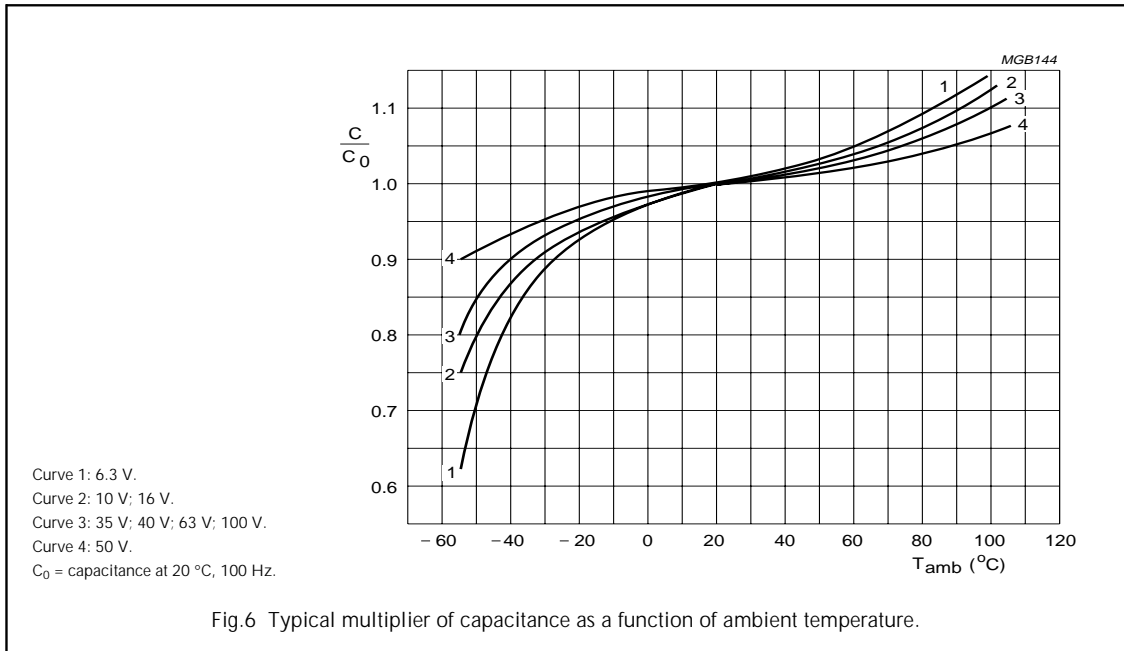
PARAMETER	CONDITIONS	VALUE
<b>Voltage</b>		
Surge voltage		$U_s \leq 1.3 U_R$
Reverse voltage		$U_{rev} \leq 1 V$
<b>Current</b>		
Leakage current	after 1 minute at $U_R$	$I_{L1} \leq 0.006 C_R \times U_R + 3 \mu A$
	after 5 minutes at $U_R$	$I_{L5} \leq 0.001 C_R \times U_R + 3 \mu A$
<b>Inductance</b>		
Equivalent series inductance (ESL)	case $\varnothing D \times L = 5 \times 11 \text{ mm}$	typ. 13 nH
	case $\varnothing D \times L = 8.2 \times 11 \text{ mm}$	typ. 16 nH
<b>Resistance</b>		
Equivalent series resistance (ESR)	calculated from $\tan \delta_{max}$ and $C_R$ (see Table 2)	$ESR = \tan \delta / 2\pi f C_R$

# Aluminum electrolytic capacitors

## Radial Long Life

116 RLL

### Capacitance (C)

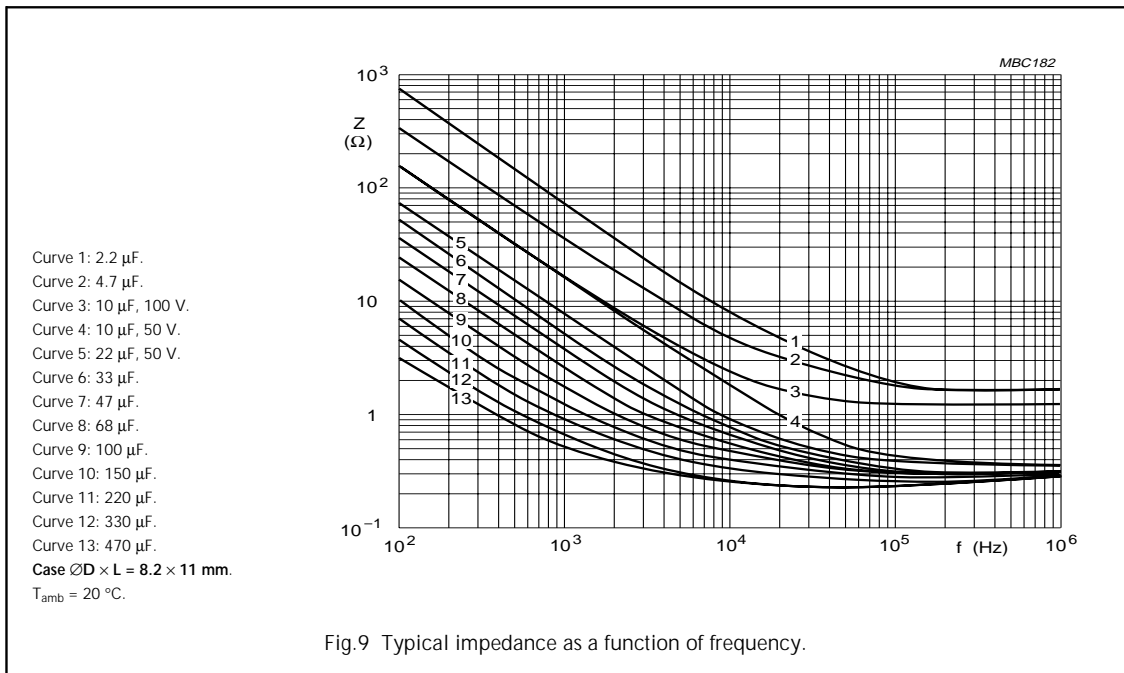
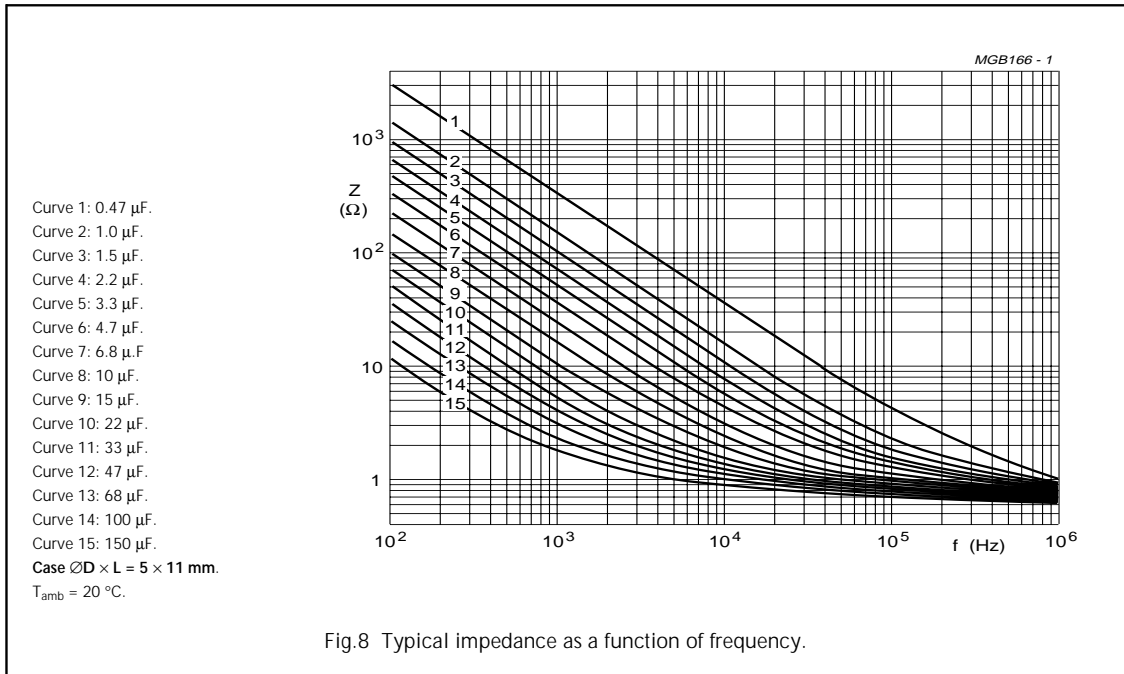


# Aluminum electrolytic capacitors

## Radial Long Life

116 RLL

### Impedance (Z)



# Aluminum electrolytic capacitors

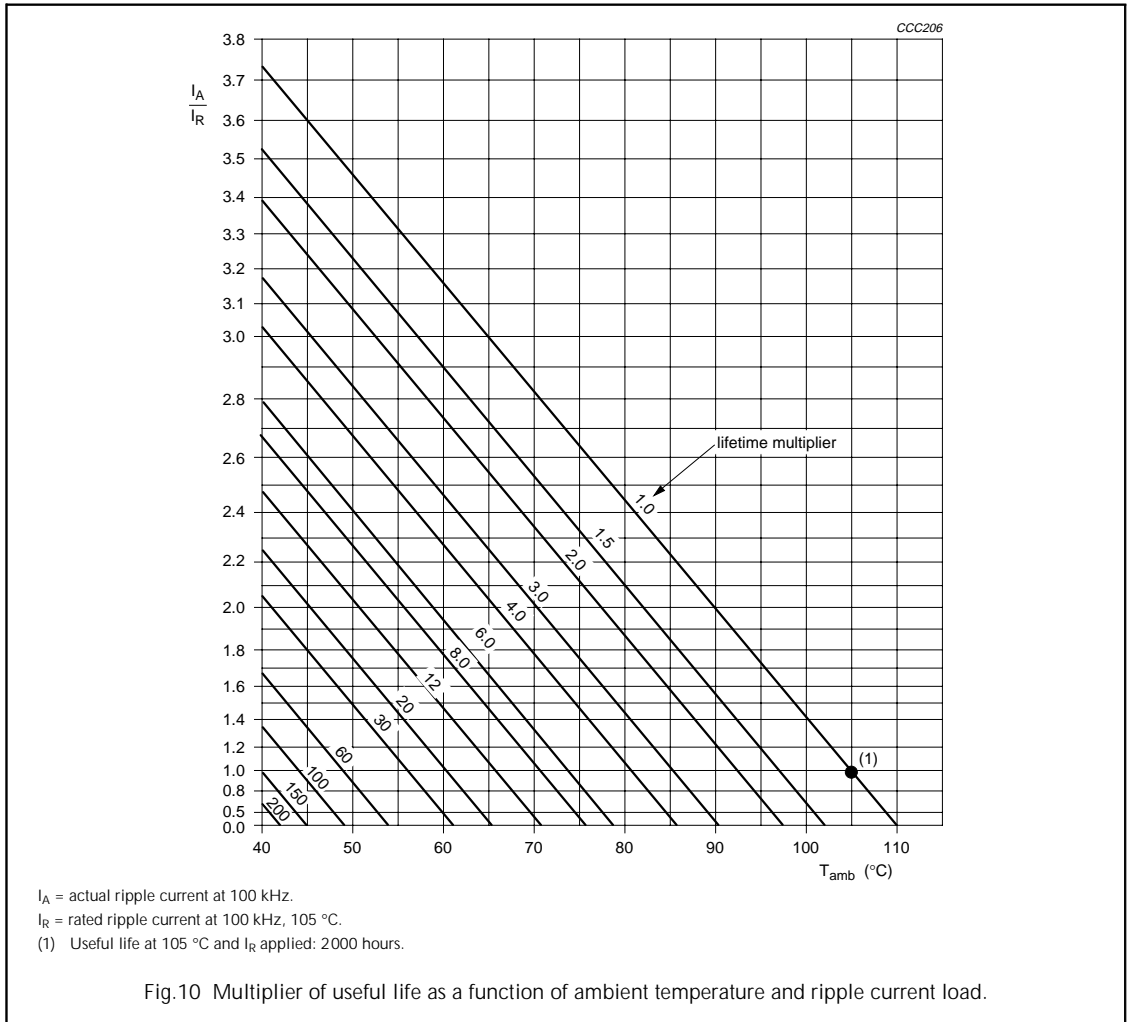
## Radial Long Life

116 RLL

### RIPPLE CURRENT AND USEFUL LIFE

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

FREQUENCY (Hz)	$I_R$ MULTIPLIER		
	$U_R = 6.3$ to $10$ V	$U_R = 16$ to $35$ V	$U_R = 40$ to $100$ V ( $C_R \geq 10 \mu\text{F}$ )
50	0.7	0.6	0.5
100	0.77	0.71	0.63
300	0.86	0.85	0.78
1000	0.92	0.93	0.88
3000	0.96	0.96	0.94
10 to 100 k	1.0	1.0	1.0



# Aluminum electrolytic capacitors

## Radial Long Life

116 RLL

### SPECIFIC TESTS AND REQUIREMENTS

General tests and requirements are specified in data handbook BC01, 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	$T_{amb} = 105\text{ }^{\circ}\text{C}$ ; $U_R$ applied; 1500 hours	$U_R \leq 6.3\text{ V}$ ; $\Delta C/C$ : +15/–30% $U_R > 6.3\text{ V}$ ; $\Delta C/C$ : $\pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z_{10} \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied; 2000 hours	$U_R \leq 6.3\text{ V}$ ; $\Delta C/C$ : +45/–50% $U_R > 6.3\text{ V}$ ; $\Delta C/C$ : $\pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z_{10} \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105\text{ }^{\circ}\text{C}$ ; no voltage applied; 1500 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 $I_{L5} \leq 2 \times \text{spec. limit}$