

# DATA SHEET

O30/O31 AS  
**Aluminum electrolytic capacitors**  
**Axial Standard**

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

2000 Jan 18

# Aluminum electrolytic capacitors

## Axial Standard

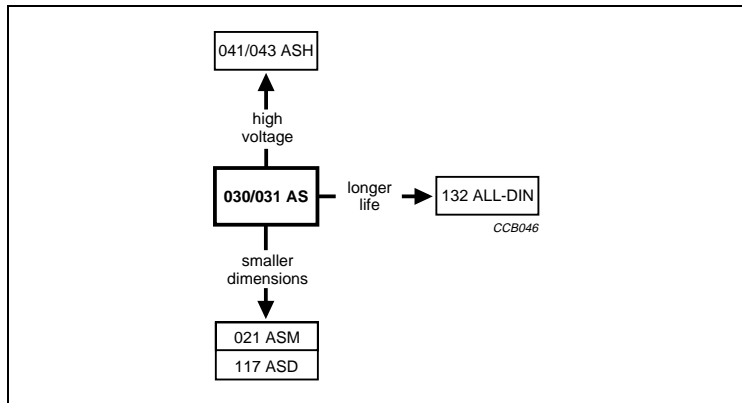
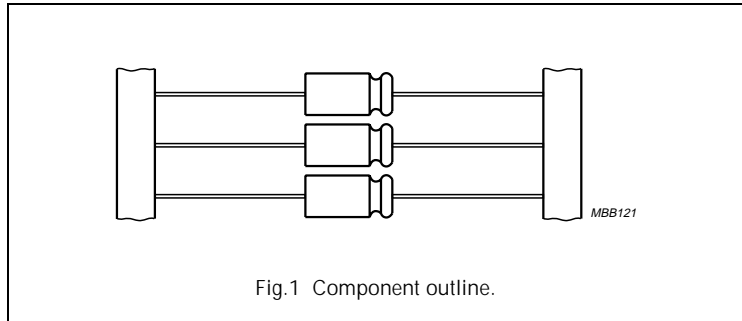
030/031 AS

### FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve
- Taped version available for automatic insertion
- Charge and discharge proof
- Useful life: 3000 hours at 85 °C (case ØD = 3.3 mm: 1500 hours)
- Standard dimensions.

### APPLICATIONS

- General purpose and industrial, automotive, telecommunication, audio-video
- Coupling, decoupling, timing, smoothing, filtering, buffering in SMPS
- Boards with restricted mounting height, vibration and shock resistant.



### QUICK REFERENCE DATA

DESCRIPTION	VALUE	
	Case sizes (ØD <sub>nom</sub> × L <sub>nom</sub> in mm)	3.3 × 11
Rated capacitance range, C <sub>R</sub>	0.47 to 1000 µF	
Tolerance on C <sub>R</sub>	-10 to +50%	
Rated voltage range, U <sub>R</sub>	6.3 to 100 V	
Category temperature range	-40 to +85 °C	
Endurance test at 85 °C	1000 hours	2000 hours
Useful life at 85 °C	1500 hours	3000 hours
Useful life at 40 °C, 1.4 × I <sub>R</sub> applied	40000 hours	80000 hours
Shelf life at 0 V, 85 °C	500 hours	
Based on sectional specification	IEC 60384-4/EN130300	
Climatic category IEC 60068	40/085/56	

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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**.

$C_R$ ( $\mu F$ )	$U_R$ (V)						
	6.3	10	16	25	40	63	100
0.47	–	–	–	–	–	–	4.5 × 10
1.0	–	–	–	–	–	<b>4.5 × 10</b>	4.5 × 10
	–	–	–	–	–	3.3 × 11	–
2.2	–	–	–	–	3.3 × 11	<b>4.5 × 10</b>	4.5 × 10
3.3	–	–	–	–	–	4.5 × 10	4.5 × 10
4.7	–	–	3.3 × 11	–	–	<b>4.5 × 10</b>	6 × 10
6.8	–	–	–	–	–	4.5 × 10	6 × 10
10	3.3 × 11	–	–	<b>4.5 × 10</b>	4.5 × 10	<b>6 × 10</b>	8 × 11
	–	–	–	–	–	–	6.5 × 18
15	–	–	–	–	4.5 × 10	6 × 10	–
22	–	–	–	<b>4.5 × 10</b>	<b>6 × 10</b>	8 × 11	<b>8 × 18</b>
	–	–	–	–	–	6.5 × 18	–
33	–	–	<b>4.5 × 10</b>	–	6 × 10	–	10 × 18
47	–	<b>4.5 × 10</b>	–	<b>6 × 10</b>	<b>8 × 11</b>	<b>8 × 18</b>	10 × 25
	–	–	–	–	6.5 × 18	–	–
68	4.5 × 10	–	<b>6 × 10</b>	–	–	10 × 18	–
100	–	<b>6 × 10</b>	–	<b>8 × 11</b>	<b>8 × 18</b>	<b>10 × 25</b>	–
	–	–	–	6.5 × 18	–	–	–
150	6 × 10	–	8 × 11	8 × 18	10 × 18	–	–
	–	–	6.5 × 18	–	–	–	–
220	–	8 × 11	8 × 18	<b>10 × 18</b>	<b>10 × 25</b>	–	–
	–	<b>6.5 × 18</b>	–	–	–	–	–
330	–	8 × 18	<b>10 × 18</b>	10 × 25	–	–	–
470	<b>8 × 18</b>	<b>10 × 18</b>	<b>10 × 25</b>	–	–	–	–
680	10 × 18	10 × 25	–	–	–	–	–
1000 <sup>(1)</sup>	<b>10 × 25</b>	–	–	–	–	–	–

#### Note

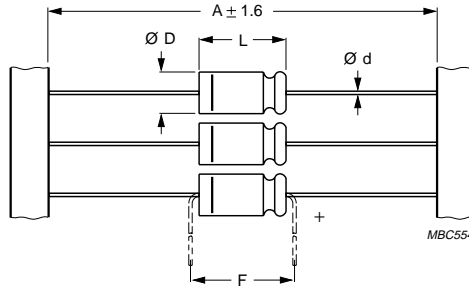
- For larger CV-values see data sheet "O21 ASM".

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**MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES**



Dimensions in mm.

**Form BR:** Taped on reel, **non-preferred**.

**Form BA:** Taped in box (ammopack), **preferred**.

**Case  $\varnothing D \times L = 3.3 \times 11$  to  $10 \times 25$  mm.**

For dimensions see Table 1.

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

Fig.2 Dimensional outline.

**Table 1 Axial:** Physical dimensions, mass and packaging quantities; see Fig. 2

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	AXIAL FORM BA and BR					MASS (g)	PACKAGING QUANTITIES	
		$\varnothing d$ (mm)	A (mm)	$\varnothing D_{max}$ (mm)	$L_{max}$ (mm)	$F_{min}$ (mm)		FORM BA	FORM BR
3.3 × 11	1	0.6	63.5 ± 1.5	3.5	12	17.5	≈ 0.35	1000	4000
4.5 × 10	2	0.6	63.5 ± 1.5	5.0	10.5	15	≈ 0.5	1000	3000
6 × 10	3	0.6	63.5 ± 1.5	6.3	10.5	15	≈ 0.7	1000	1000
8 × 11	5a	0.6	63.5 ± 1.5	8.5	11.5	15	≈ 1.1	500	500
6.5 × 18	4	0.8	73 ± 1.6	6.9	18.5	25	≈ 1.3	1000	1000
8 × 18	5	0.8	73 ± 1.6	8.5	18.5	25	≈ 1.7	500	500
10 × 18	6	0.8	73 ± 1.6	10.5	18.5	25	≈ 2.5	500	500
10 × 25	7	0.8	73 ± 1.6	10.5	25.0	30	≈ 3.3	500	500

**ELECTRICAL DATA AND ORDERING INFORMATION**

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

SYMBOL	DESCRIPTION
$C_R$	rated capacitance at 100 Hz, tolerance $-10$ to $+50\%$
$I_R$	rated RMS ripple current at 100 Hz, $85\text{ °C}$
$I_{L1}$	max. leakage current after 1 minute at $U_R$
$I_{L5}$	max. leakage current after 5 minutes at $U_R$
$\tan \delta$	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

**Ordering example**

Electrolytic capacitor 031 series

330  $\mu\text{F}/10\text{ V}$ ;  $-10/+50\%$

Nominal case size:  $\varnothing 8 \times 18\text{ mm}$ ; Form BA

Catalogue number: 2222 031 34331.

**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)	CASE CODE	$I_R$ 100 Hz $85\text{ °C}$ (mA)	$I_{L1}$ 1 min ( $\mu\text{A}$ )	$I_{L5}$ 5 min ( $\mu\text{A}$ )	$\tan \delta$ 100 Hz	ESR 100 Hz ( $\Omega$ )	Z 10 kHz ( $\Omega$ )	CATALOGUE NUMBER 2222 ... ..	
										TAPED ON REEL FORM BR	TAPED IN BOX FORM BA
6.3	10	$3.3 \times 11$	1	15	5	5	0.30	47.8	20	030 23109	030 33109
	68	$4.5 \times 10$	2	75	22	5.9	0.25	5.86	2.9	030 23689	030 33689
	150	$6 \times 10$	3	120	10	6.9	0.25	2.66	1.3	030 23151	030 33151
	<b>470</b>	<b><math>8 \times 18</math></b>	<b>5</b>	330	22	11	0.25	0.85	0.43	031 23471	<b>031 33471</b>
	680	$10 \times 18$	6	430	30	14	0.25	0.59	0.29	031 23681	031 33681
	<b>1000</b>	<b><math>10 \times 25</math></b>	<b>7</b>	560	42	18	0.25	0.40	0.20	031 23102	<b>031 33102</b>
	10	<b>47</b>	<b><math>4.5 \times 10</math></b>	<b>2</b>	70	24	5.9	0.20	6.78	3.4	030 24479
<b>100</b>		<b><math>6 \times 10</math></b>	<b>3</b>	10	110	7	0.20	3.19	1.6	030 24101	<b>030 34101</b>
220		$8 \times 11$	5a	210	18	9.4	0.20	1.45	0.73	030 24221	030 34221
<b>220</b>		<b><math>6.5 \times 18</math></b>	<b>4</b>	210	18	9.4	0.20	1.45	0.73	031 24221	<b>031 34221</b>
330		$8 \times 18$	5	310	24	12	0.20	0.97	0.48	031 24331	031 34331
<b>470</b>		<b><math>10 \times 18</math></b>	<b>6</b>	410	33	14	0.20	0.68	0.34	031 24471	<b>031 34471</b>
680		$10 \times 25$	7	510	45	19	0.20	0.47	0.24	031 24681	031 34681

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U <sub>R</sub> (V)	C <sub>R</sub> 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I <sub>R</sub> 100 Hz 85 °C (mA)	I <sub>L1</sub> 1 min (μA)	I <sub>L5</sub> 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	CATALOGUE NUMBER 2222 ... ..	
										TAPED ON REEL FORM BR	TAPED IN BOX FORM BA
16	4.7	3.3 × 11	1	15	5	5	0.20	67.8	26	030 25478	030 35478
	<b>33</b>	<b>4.5 × 10</b>	<b>2</b>	65	27	6.1	0.16	7.72	3.6	030 25339	<b>030 35339</b>
	<b>68</b>	<b>6 × 10</b>	<b>3</b>	110	11	7.2	0.16	3.75	1.8	030 25689	<b>030 35689</b>
	150	8 × 11	5a	200	19	9.8	0.16	1.70	0.80	030 25151	030 35151
	150	6.5 × 18	4	200	19	9.8	0.16	1.70	0.80	031 25151	031 35151
	220	8 × 18	5	270	26	12	0.16	1.16	0.55	031 25221	031 35221
	<b>330</b>	<b>10 × 18</b>	<b>6</b>	410	36	16	0.16	0.78	0.36	031 25331	<b>031 35331</b>
	<b>470</b>	<b>10 × 25</b>	<b>7</b>	480	49	20	0.16	0.55	0.26	031 25471	<b>031 35471</b>
25	<b>10</b>	<b>4.5 × 10</b>	<b>2</b>	50	13	5.5	0.14	22.3	9	030 26109	<b>030 36109</b>
	<b>22</b>	<b>4.5 × 10</b>	<b>2</b>	60	28	6.1	0.14	10.2	4.1	030 26229	<b>030 36229</b>
	<b>47</b>	<b>6 × 10</b>	<b>3</b>	100	12	7.4	0.14	4.8	1.9	030 26479	<b>030 36479</b>
	<b>100</b>	<b>8 × 11</b>	<b>5a</b>	160	19	10	0.14	2.23	0.90	030 26101	<b>030 36101</b>
	100	6.5 × 18	4	160	19	10	0.14	2.23	0.90	031 26101	031 36101
	150	8 × 18	5	240	27	13	0.14	1.49	0.60	031 26151	031 36151
	<b>220</b>	<b>10 × 18</b>	<b>6</b>	350	37	16	0.14	1.02	0.41	031 26221	<b>031 36221</b>
	330	10 × 25	7	460	54	22	0.14	0.68	0.27	031 26331	031 36331
40	2.2	3.3 × 11	1	15	5	5	0.15	109	32	030 27228	030 37228
	10	4.5 × 10	2	50	20	5.8	0.11	17.6	7	030 27109	030 37109
	15	4.5 × 10	2	55	30	6.2	0.11	11.7	4.7	030 27159	030 37159
	<b>22</b>	<b>6 × 10</b>	<b>3</b>	75	9	6.8	0.11	8.0	3.2	030 27229	<b>030 37229</b>
	33	6 × 10	3	95	12	7.7	0.11	5.31	2.1	030 27339	030 37339
	<b>47</b>	<b>8 × 11</b>	<b>5a</b>	150	16	8.8	0.11	3.73	1.5	030 27479	<b>030 37479</b>
	47	6.5 × 18	4	150	16	8.8	0.11	3.73	1.5	031 27479	031 37479
	<b>100</b>	<b>8 × 18</b>	<b>5</b>	220	28	13	0.11	1.75	0.70	031 27101	<b>031 37101</b>
	150	10 × 18	6	300	40	17	0.11	1.17	0.47	031 27151	031 37151
	<b>220</b>	<b>10 × 25</b>	<b>7</b>	430	57	23	0.11	0.80	0.32	031 27221	<b>031 37221</b>

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U <sub>R</sub> (V)	C <sub>R</sub> 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I <sub>R</sub> 100 Hz 85 °C (mA)	I <sub>L1</sub> 1 min (μA)	I <sub>L5</sub> 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	CATALOGUE NUMBER 2222 ... ..	
										TAPED ON REEL FORM BR	TAPED IN BOX FORM BA
63	1.0	3.3 × 11	1	10	5	5	0.12	191	55	030 90067	030 90068
	<b>1.0</b>	<b>4.5 × 10</b>	<b>2</b>	13	5	5	0.09	143	55	030 28108	<b>030 38108</b>
	<b>2.2</b>	<b>4.5 × 10</b>	<b>2</b>	25	7	5.3	0.09	65.2	25	030 28228	<b>030 38228</b>
	3.3	4.5 × 10	2	35	11	5.4	0.09	46.5	17	030 28338	030 38338
	<b>4.7</b>	<b>4.5 × 10</b>	<b>2</b>	40	15	5.6	0.09	30.5	12	030 28478	<b>030 38478</b>
	6.8	4.5 × 10	2	46	22	5.9	0.09	21.1	8.1	030 28688	030 38688
	<b>10</b>	<b>6 × 10</b>	<b>3</b>	70	7	6.3	0.08	12.8	5.5	030 28109	<b>030 38109</b>
	15	6 × 10	3	79	10	6.9	0.08	8.5	3.7	030 28159	030 38159
	22	8 × 11	5a	110	13	7.8	0.08	5.79	2.5	030 28229	030 38229
	22	6.5 × 18	4	110	13	7.8	0.08	5.79	2.5	031 28229	031 38229
	<b>47</b>	<b>8 × 18</b>	<b>5</b>	190	22	11	0.08	2.71	1.2	031 28479	<b>031 38479</b>
	68	10 × 18	6	250	30	14	0.08	1.88	0.81	031 28689	031 38689
	<b>100</b>	<b>10 × 25</b>	<b>7</b>	300	42	18	0.08	1.28	0.55	031 28101	<b>031 38101</b>
100	0.47	4.5 × 10	2	9	5	5	0.08	271	96	030 29477	030 39477
	1.0	4.5 × 10	2	20	5	5	0.08	128	45	030 29108	030 39108
	2.2	4.5 × 10	2	30	11	11	0.08	57.9	21	030 29228	030 39228
	3.3	4.5 × 10	2	40	17	17	0.08	38.6	14	030 29338	030 39338
	4.7	6 × 10	3	50	22	22	0.07	23.7	9.6	030 29478	030 39478
	6.8	6 × 10	3	70	34	34	0.07	16.4	6.6	030 29688	030 39688
	10	8 × 11	5a	90	50	50	0.07	11.2	4.5	030 29109	030 39109
	10	6.5 × 18	4	90	50	50	0.07	11.2	4.5	031 29109	031 39109
	<b>22</b>	<b>8 × 18</b>	<b>5</b>	120	80	80	0.07	5.07	2.1	031 29229	<b>031 39229</b>
	33	10 × 18	6	200	119	119	0.07	3.38	1.4	031 29339	031 39339
47	10 × 25	7	260	33	33	0.07	2.37	0.96	031 29479	031 39479	

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#### Additional electrical data

PARAMETER	CONDITIONS	VALUE
<b>Voltage</b>		
Surge voltage		$U_S \leq 1.15 \times U_R$
Reverse voltage		$U_{REV} \leq 1 \text{ V}$
<b>Current</b>		
Leakage current	after 1 minute at $U_R$ : case $\varnothing D \times L = 3.3 \times 11$ and $4.5 \times 10$ mm case $\varnothing D \times L = 6 \times 10$ to $10 \times 25$ mm	$I_{L1} \leq 0.05C_R \times U_R$ or $5 \mu\text{A}$ , whichever is greater $I_{L1}$ for $CV \leq 1000 \mu\text{C}$ : $\leq 0.01C_R \times U_R$ or $1 \mu\text{A}$ , whichever is greater $I_{L1}$ for $CV > 1000 \mu\text{C}$ : $\leq 0.006C_R \times U_R + 4 \mu\text{A}$
	after 5 minutes: $U_R = 6.3$ to $63 \text{ V}$ $U_R = 100 \text{ V}$	$I_{L5} \leq 0.002C_R \times U_R + 5 \mu\text{A}$ $I_{L5} \leq 0.006C_R \times U_R + 4 \mu\text{A}$
<b>Inductance</b>		
Equivalent series inductance (ESL)	case $\varnothing D \times L$ mm:	
	$3.3 \times 11$	typ. 11 nH
	$4.5 \times 10$	typ. 10 nH
	$6 \times 10$	typ. 22 nH
	$8 \times 11$	typ. 85 nH
	$6.5 \times 18$	typ. 25 nH
	$8 \times 18$	typ. 40 nH
	$10 \times 18$	typ. 61 nH
$10 \times 25$	typ. 38 nH	

#### 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" (not for case code 1)
- Rated voltage (in V)
- Group number (030 or 031)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Band to identify the negative terminal
- '+' sign to indicate the positive terminal (not for case sizes  $L < 18$  mm).

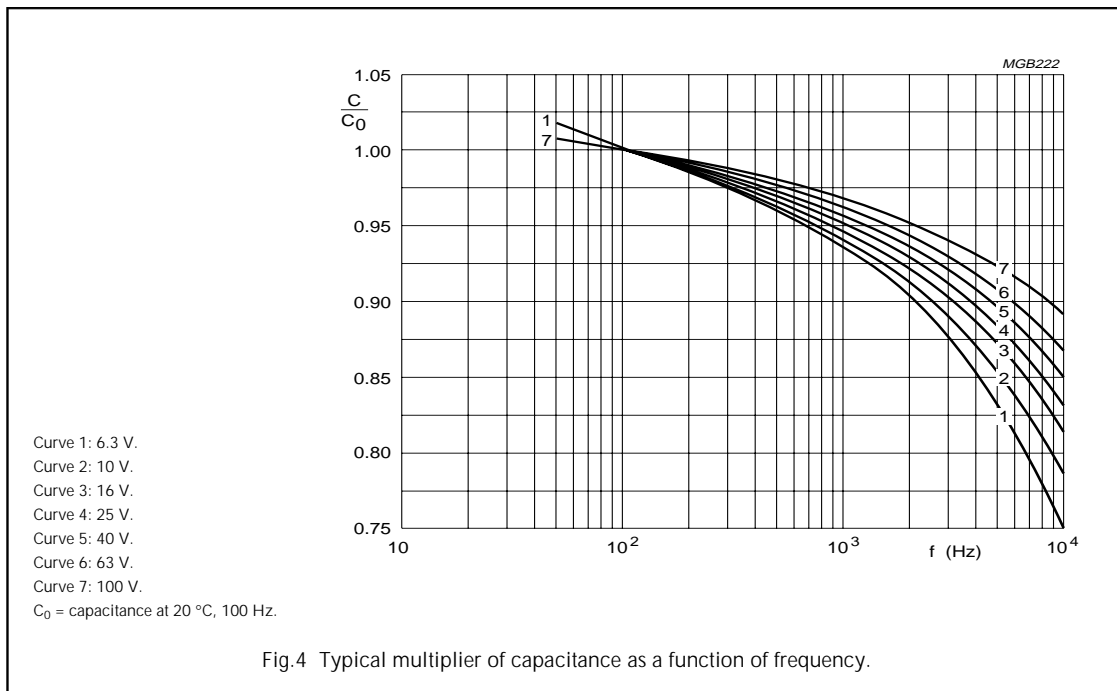
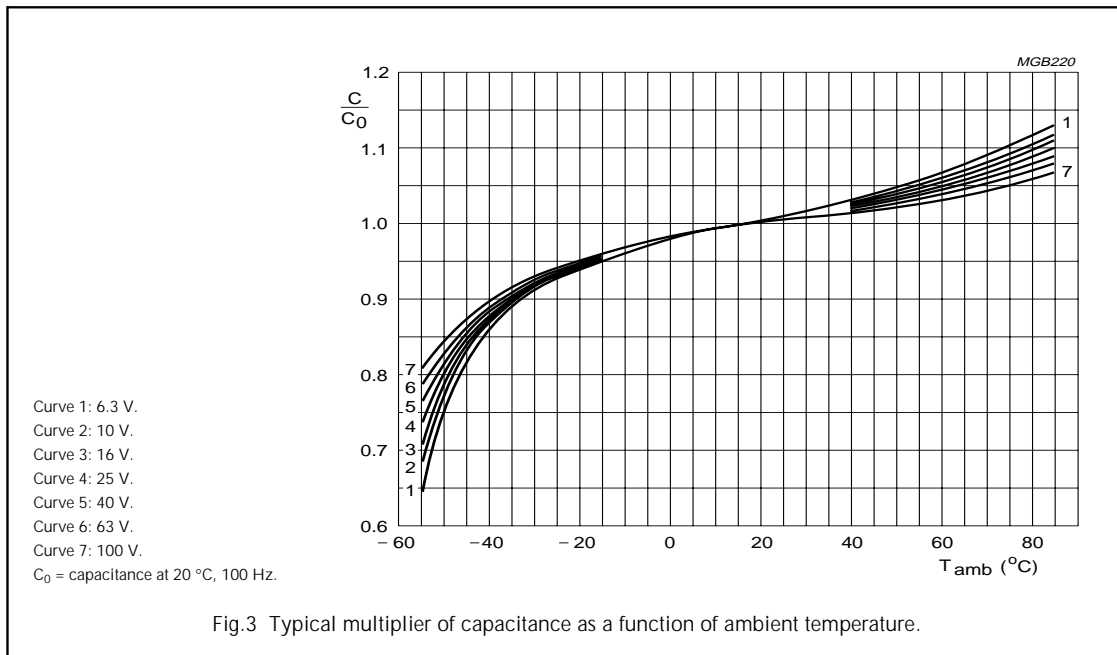


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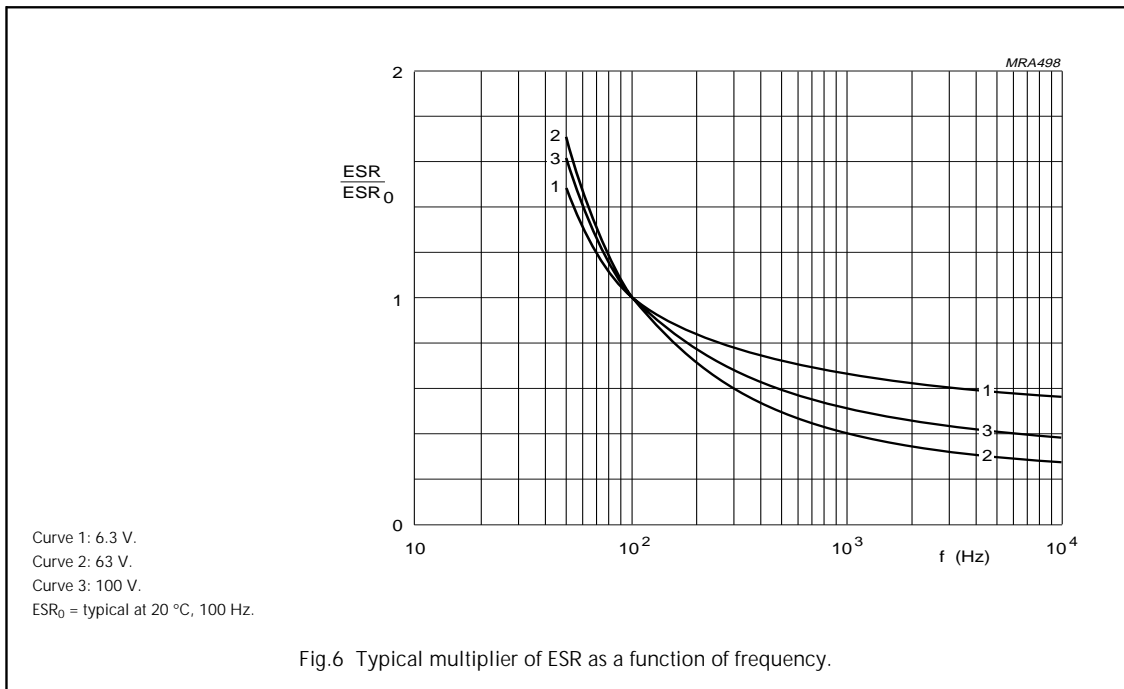
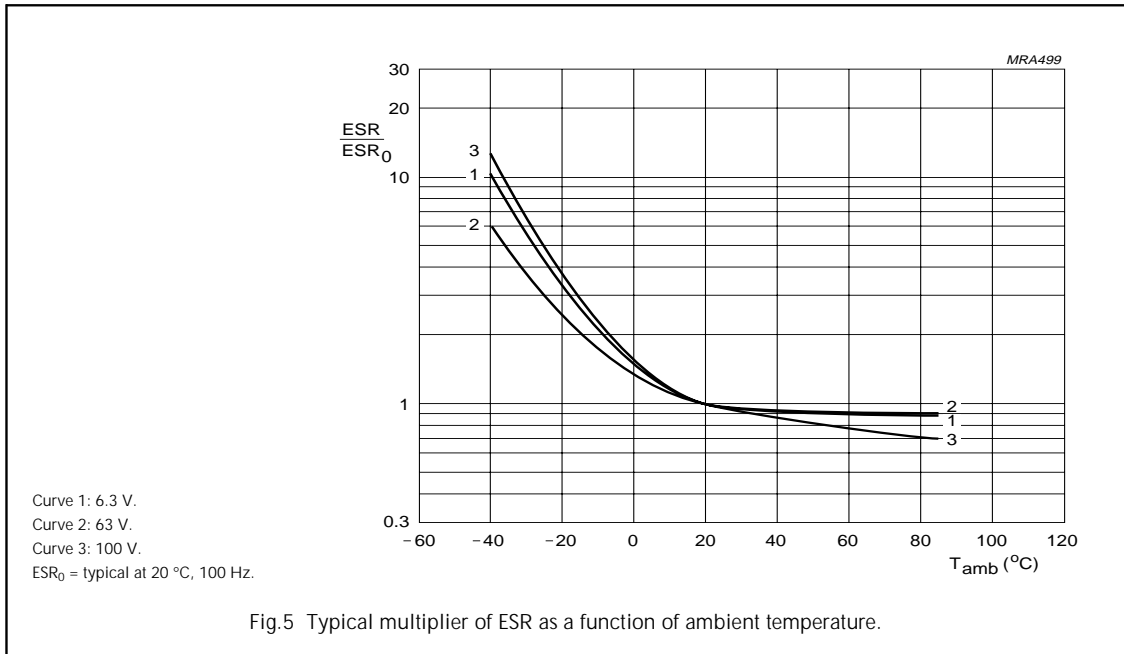
### Capacitance (C)



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## Equivalent series resistance (ESR)



# Aluminum electrolytic capacitors

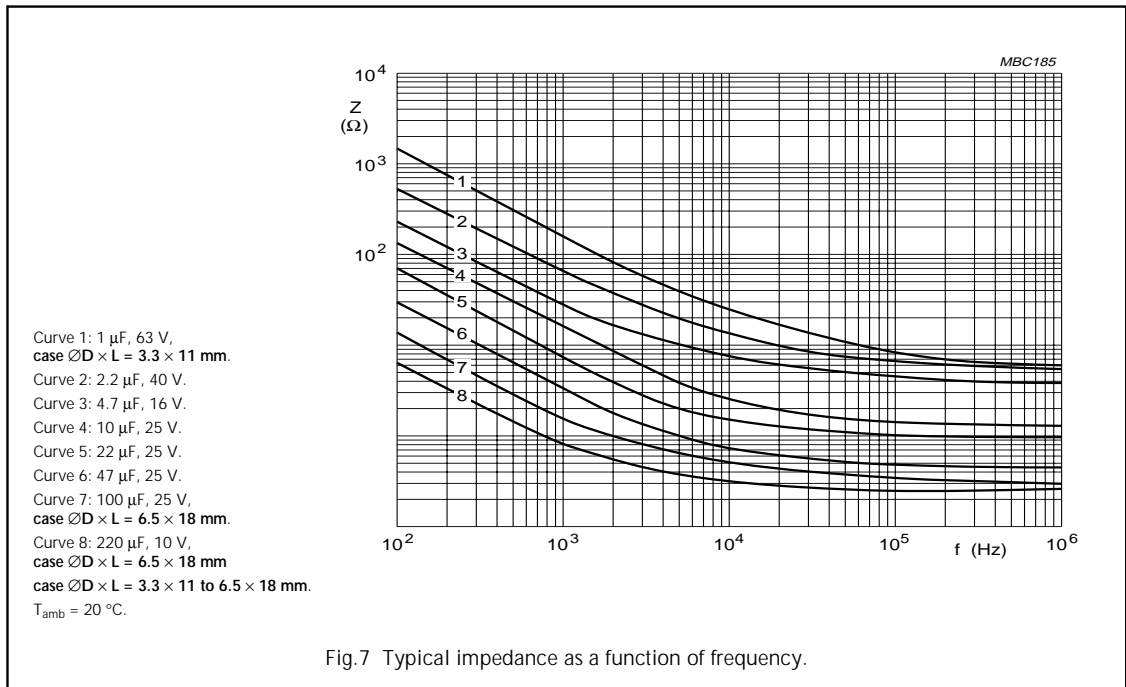
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#### Impedance (Z)

**Table 3** Impedance  $\times$  capacitance values at 10 kHz

$T_{amb}$	$Z \times C_R (\Omega \times \mu F)$ at 10 kHz						
	6.3 V	10 V	16 V	25 V	40 V	63 V	100 V
+20 °C	$\leq 200$	$\leq 160$	$\leq 120$	$\leq 90$	$\leq 70$	$\leq 55$	$\leq 45$
-25 °C	$\leq 1200$	$\leq 750$	$\leq 560$	$\leq 400$	$\leq 300$	$\leq 180$	$\leq 130$
-40 °C	$\leq 3200$	$\leq 2000$	$\leq 1500$	$\leq 1100$	$\leq 900$	$\leq 500$	$\leq 350$



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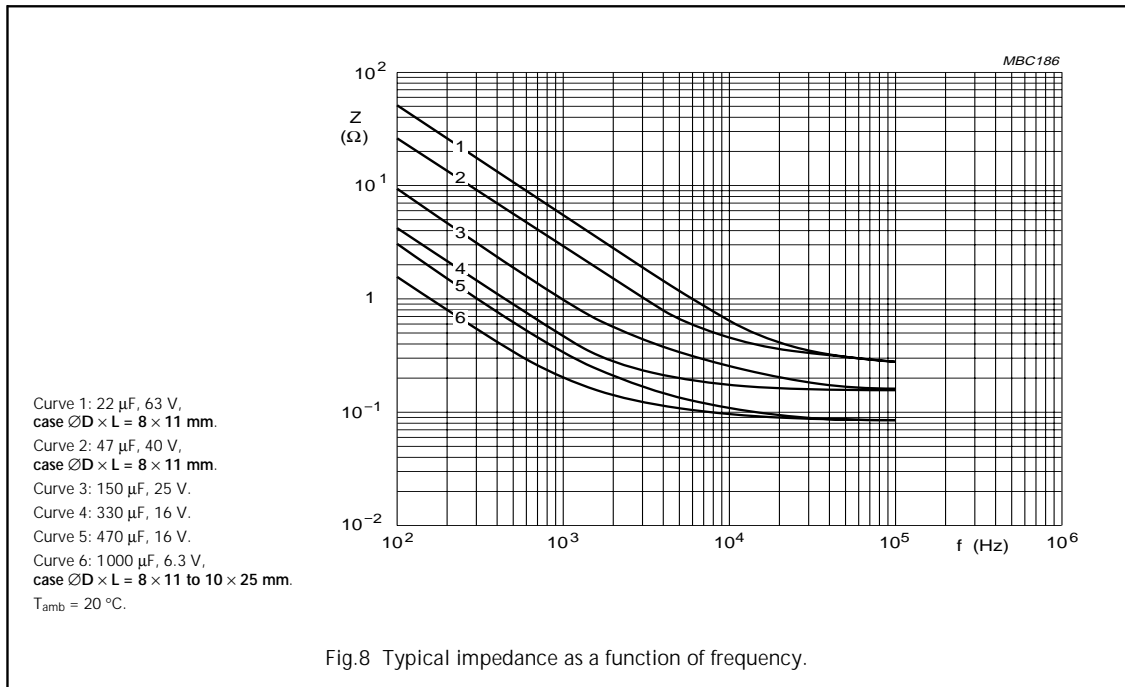
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Fig.8 Typical impedance as a function of frequency.

# Aluminum electrolytic capacitors

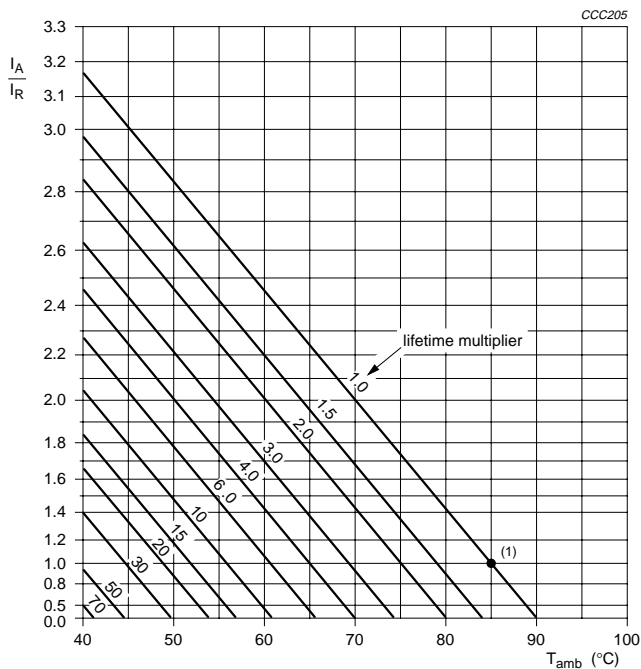
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### RIPPLE CURRENT AND USEFUL LIFE

**Table 4** 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 $25$ V	$U_R = 40$ to $100$ V
50	0.95	0.9	0.85
100	1.0	1.0	1.0
300	1.07	1.12	1.2
1000	1.12	1.2	1.3
3000	1.15	1.25	1.35
$\geq 10000$	1.2	1.3	1.4



$I_A$  = 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:  
 case  $\varnothing D \times L = 3.3 \times 11$  mm: 1500 hours  
 case  $\varnothing D \times L = 4.5 \times 10$  to  $10 \times 25$  mm: 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 5** Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
<b>Case <math>\varnothing D \times L = 3.3 \times 11</math> mm</b>			
Endurance	IEC 384-4/ EN130300 subclause 4.13	$T_{amb} = 85$ °C; $U_R$ applied; 1000 hours	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times$ spec. limit $Z \leq 3 \times$ spec. limit $I_{L5} \leq$ spec. limit
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85$ °C; $U_R$ and $I_R$ applied; 1500 hours	$\Delta C/C: \pm 50\%$ $\tan \delta \leq 3 \times$ spec. limit $Z \leq 3 \times$ spec. limit $I_{L5} \leq$ spec. limit no short or open circuit total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 384-4/ EN130300 subclause 4.17	$T_{amb} = 85$ °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 $I_{L5} \leq 2 \times$ spec. limit
<b>Case <math>\varnothing D \times L = 4.5 \times 10</math> to <math>10 \times 25</math> mm</b>			
Endurance	IEC 384-4/ EN130300 subclause 4.13	$T_{amb} = 85$ °C; $U_R$ applied; 2000 hours	$U_R \leq 6.3$ V; $\Delta C/C: +15/-30\%$ $U_R > 6.3$ V; $\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times$ spec. limit $Z \leq 2 \times$ spec. limit $I_{L5} \leq$ spec. limit
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85$ °C; $U_R$ and $I_R$ applied; 3000 hours	$U_R \leq 6.3$ V; $\Delta C/C: +45/-50\%$ $U_R > 6.3$ V; $\Delta C/C: \pm 45\%$ $\tan \delta \leq 3 \times$ spec. limit $Z \leq 3 \times$ spec. limit $I_{L5} \leq$ spec. limit no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 384-4/ EN130300 subclause 4.17	$T_{amb} = 85$ °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 $I_{L5} \leq 2 \times$ spec. limit