# DATA SHEET

116 RLL

## Aluminum electrolytic capacitors
## Radial Long Life

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

2000 Jan 18

BC COMPONENTS

# Aluminum electrolytic capacitors Radial Long Life

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## 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.

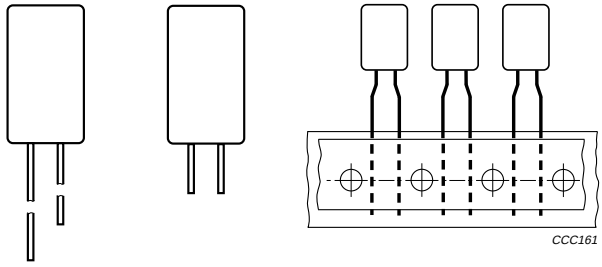
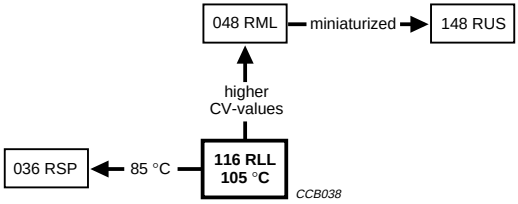



Fig.1 Component outlines.

## 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) | $5 \times 11$ and $8.2 \times 11$ |
| Rated capacitance range, $C_R$ | 0.47 to 470 μF |
| Tolerance on $C_R$ | ±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 |

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**Selection chart for $C_R$, $U_R$ and relevant nominal case sizes (∅D × L in mm)**

Preferred types in **bold.**

| $C_R$ (μF) | $U_R$ (V) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **6.3** | **10** | **16** | **25** | **35** | **40** | **50** | **63** | **100** |
| 0.47 | – | – | – | – | – | – | 5 × 11 | – | – |
| 1.0 | – | – | – | – | – | – | **5 × 11** | – | – |
| 1.5 | – | – | – | – | – | – | 5 × 11 | – | – |
| 2.2 | – | – | – | – | – | – | **5 × 11** | – | 8.2 × 11 |
| 3.3 | – | – | – | – | – | – | 5 × 11 | – | – |
| 4.7 | – | – | – | – | – | – | **5 × 11** | – | 8.2 × 11 |
| 6.8 | – | – | – | – | – | – | 5 × 11 | – | – |
| 10 | – | – | – | – | – | – | **5 × 11** | 8.2 × 11 | 8.2 × 11 |
| | – | – | – | – | – | – | 8.2 × 11 | – | – |
| 15 | – | – | – | – | – | – | 5 × 11 | – | – |
| 22 | – | – | – | – | – | – | **5 × 11** | 8.2 × 11 | – |
| | – | – | – | – | – | – | **8.2 × 11** | – | – |
| 33 | – | – | – | – | 5 × 11 | 5 × 11 | 8.2 × 11 | – | – |
| 47 | – | – | – | **5 × 11** | – | – | **8.2 × 11** | – | – |
| 68 | – | – | 5 × 11 | – | – | – | 8.2 × 11 | – | – |
| 100 | – | **5 × 11** | – | – | **8.2 × 11** | 8.2 × 11 | – | – | – |
| 150 | 5 × 11 | – | – | 8.2 × 11 | – | – | – | – | – |
| 220 | – | – | **8.2 × 11** | – | – | – | – | – | – |
| 330 | – | 8.2 × 11 | – | – | – | – | – | – | – |
| 470[1] | 8.2 × 11 | – | – | – | – | – | – | – | – |

**Note**

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

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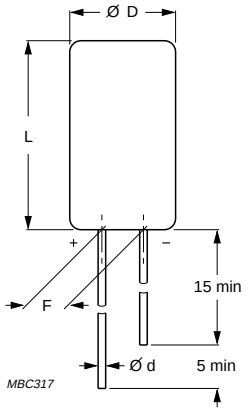
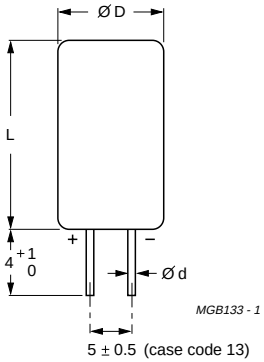
## MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES




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.

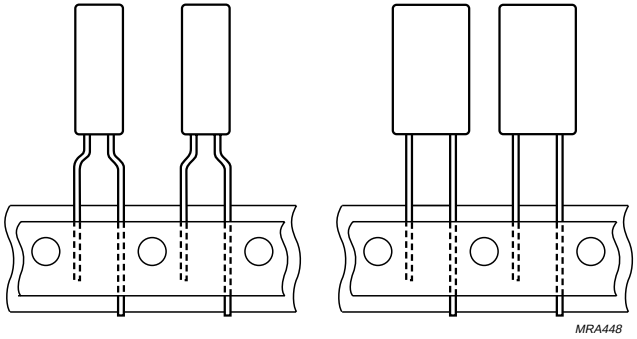
**Table 1** Physical dimensions, mass and packaging quantities; see Figs 2 and 3

| NOMINAL CASE SIZE ∅D × L (mm) | CASE CODE | ∅d (mm) | $∅D_{max}$ (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

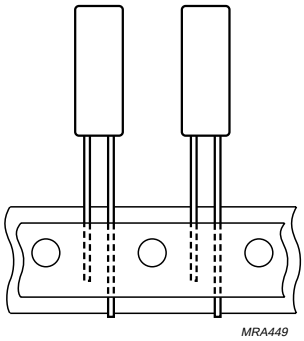


**Taped products**




**Form TFA:**
Pitch F = 5 mm.
**Case ∅D × L = 5 × 11 and 8.2 × 11 mm**.
Tape dimensions are specified in this handbook, section *"Packaging"*.

Fig.4 Taped in box (ammopack).




**Form TNA:**
Pitch F = 2.5 mm.
**Case ∅D × L = 5 × 11 mm only**.
Tape dimensions are specified in this handbook, section *"Packaging"*.

Fig.5 Taped in box (ammopack).

## 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 (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



## ELECTRICAL DATA

Unless otherwise specified, all electrical values in Tables 2 and 4 apply at $T_{amb}$ = 20 °C, P = 86 to 106 kPa, RH = 45 to 75%.

| SYMBOL | DESCRIPTION |
|---|---|
| $C_R$ | rated capacitance at 100 Hz, tolerance ±20% |
| $I_R$ | rated RMS ripple current at 100 kHz, 105 °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 $\delta_{max}$ and $C_R$) |
| $Z_{10}$ | max. impedance at 10 kHz and 20 or –40 °C |
| $Z_{100}$ | max. impedance at 100 kHz and 20 °C |

**Table 2** Electrical data; preferred types in **bold**

| $U_R$ (V) | $C_R$ 100 Hz (μF) | NOMINAL CASE SIZE ∅D × L (mm) | CASE CODE | $I_R$ 100 kHz 105 °C (mA) | $I_{L1}$ 1 min (μA) | $I_{L5}$ 5 min (μA) | Tan δ 100 Hz | ESR 100 Hz (Ω) | $Z_{10}$ 10 kHz 20 °C (Ω) | $Z_{100}$ 100 kHz 20 °C (Ω) | $Z_{10}$ 10 kHz –40 °C (Ω) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6.3 | 150 | 5 × 11 | 11 | 130 | 8.7 | 3.9 | 0.25 | 2.7 | 2 | 1.3 | 32 |
| | 470 | 8.2 × 11 | 13 | 300 | 21 | 6 | 0.25 | 0.8 | 0.64 | 0.45 | 10 |
| 10 | **100** | **5 × 11** | **11** | 130 | 9 | 4 | 0.2 | 3.2 | 2 | 1.4 | 32 |
| | 330 | 8.2 × 11 | 13 | 280 | 23 | 6.3 | 0.2 | 1.0 | 0.61 | 0.45 | 9.7 |
| 16 | 68 | 5 × 11 | 11 | 130 | 9.5 | 4.1 | 0.16 | 3.7 | 2.4 | 1.5 | 29 |
| | **220** | **8.2 × 11** | **13** | 280 | 24 | 6.5 | 0.16 | 1.2 | 0.73 | 0.5 | 9.1 |
| 25 | **47** | **5 × 11** | **11** | 120 | 10 | 4.2 | 0.14 | 4.7 | 2.6 | 1.6 | 32 |
| | 150 | 8.2 × 11 | 13 | 260 | 26 | 6.8 | 0.14 | 1.5 | 0.8 | 0.5 | 10 |
| 35 | 33 | 5 × 11 | 11 | 110 | 9.9 | 4.2 | 0.12 | 5.8 | 2.7 | 1.7 | 33 |
| | **100** | **8.2 × 11** | **13** | 240 | 24 | 6.5 | 0.12 | 1.9 | 0.9 | 0.55 | 11 |
| 40 | 33 | 5 × 11 | 11 | 110 | 10.9 | 4.3 | 0.12 | 5.8 | 2.7 | 1.7 | 33 |
| | 100 | 8.2 × 11 | 13 | 240 | 27 | 7 | 0.12 | 1.9 | 0.9 | 0.55 | 11 |

# Aluminum electrolytic capacitors Radial Long Life



## ORDERING INFORMATION

**Ordering example**

Electrolytic capacitor 116 series

220 μF/16 V; ±20%

Nominal case size: ∅8.2 × 11 mm; Form TFA

Catalogue number: 2222 116 35221.

**Table 3** Ordering information; 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) |
| 6.3 | 150 | 11 | 116 53151 | 2.5 | – | – | 116 33151 | 5.0 | 116 73151 | 2.5 |
| | 470 | 13 | 116 53471 | 5.0 | 116 63471 | 5.0 | 116 33471 | 5.0 | – | – |
| 10 | **100** | **11** | **116 54101** | 2.5 | – | – | **116 34101** | 5.0 | 116 74101 | 2.5 |
| | 330 | 13 | 116 54331 | 5.0 | 116 64331 | 5.0 | 116 34331 | 5.0 | – | – |
| 16 | 68 | 11 | 116 55689 | 2.5 | – | – | 116 35689 | 5.0 | 116 75689 | 2.5 |
| | **220** | **13** | **116 55221** | 5.0 | 116 65221 | 5.0 | **116 35221** | 5.0 | – | – |
| 25 | **47** | **11** | **116 56479** | 2.5 | – | – | **116 36479** | 5.0 | 116 76479 | 2.5 |
| | 150 | 13 | 116 56151 | 5.0 | 116 66151 | 5.0 | 116 36151 | 5.0 | – | – |
| 35 | 33 | 11 | 116 50339 | 2.5 | – | – | 116 30339 | 5.0 | 116 70339 | 2.5 |
| | **100** | **13** | **116 50101** | 5.0 | 116 60101 | 5.0 | **116 30101** | 5.0 | – | – |
| 40 | 33 | 11 | 116 57339 | 2.5 | – | – | 116 37339 | 5.0 | 116 77339 | 2.5 |
| | 100 | 13 | 116 57101 | 5.0 | 116 67101 | 5.0 | 116 37101 | 5.0 | – | – |

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**ELECTRICAL DATA (continued)**

**Table 4** Electrical data continued; preferred types in **bold**

| $U_R$ (V) | $C_R$ 100 Hz (μF) | NOMINAL CASE SIZE ∅D × L (mm) | CASE CODE | $I_R$ 100 kHz 105 °C (mA) | $I_{L1}$ 1 min (μA) | $I_{L5}$ 5 min (μA) | Tan δ 100 Hz | ESR 100 Hz (Ω) | $Z_{10}$ 10 kHz 20 °C (Ω) | $Z_{100}$ 100 kHz 20 °C (Ω) | $Z_{10}$ 10 kHz −40 °C (Ω) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0.47 | 5 × 11 | 11 | 30 | 3.1 | 3 | 0.09 | 300 | 150 | 10 | 1900 |
| | **1.0** | **5 × 11** | **11** | 40 | 3.3 | 3.1 | 0.09 | 140 | 70 | 6 | 900 |
| | 1.5 | 5 × 11 | 11 | 50 | 3.5 | 3.1 | 0.09 | 95 | 47 | 4 | 600 |
| | **2.2** | **5 × 11** | **11** | 60 | 3.7 | 3.1 | 0.09 | 65 | 32 | 3.5 | 410 |
| | 3.3 | 5 × 11 | 11 | 65 | 4 | 3.2 | 0.09 | 43 | 21 | 3.1 | 270 |
| | **4.7** | **5 × 11** | **11** | 70 | 4.4 | 3.2 | 0.09 | 30 | 15 | 2.8 | 190 |
| | 6.8 | 5 × 11 | 11 | 75 | 5 | 3.3 | 0.09 | 21 | 10 | 2.5 | 130 |
| | **10** | **5 × 11** | **11** | 80 | 6 | 3.5 | 0.09 | 14 | 7 | 2.2 | 90 |
| | 10 | 8.2 × 11 | 13 | 160 | 6 | 3.5 | 0.05 | 8.0 | 3.6 | 1.0 | 40 |
| | 15 | 5 × 11 | 11 | 90 | 7.5 | 3.8 | 0.09 | 9.5 | 4.7 | 2.0 | 60 |
| | **22** | **5 × 11** | **11** | 110 | 9.6 | 4.1 | 0.09 | 6.5 | 3.2 | 1.9 | 41 |
| | **22** | **8.2 × 11** | **13** | 190 | 9.6 | 4.1 | 0.06 | 4.4 | 2.2 | 0.9 | 29 |
| | 33 | 8.2 × 11 | 13 | 190 | 13 | 4.7 | 0.09 | 4.3 | 2.1 | 0.77 | 27 |
| | **47** | **8.2 × 11** | **13** | 210 | 17 | 5.4 | 0.09 | 3.0 | 1.5 | 0.65 | 19 |
| | 68 | 8.2 × 11 | 13 | 240 | 23 | 6.4 | 0.09 | 2.1 | 1.0 | 0.55 | 13 |
| 63 | 10 | 8.2 × 11 | 13 | 160 | 7 | 3.6 | 0.06 | 9.5 | 3.5 | 1.3 | 45 |
| | 22 | 8.2 × 11 | 13 | 190 | 11 | 4.4 | 0.06 | 4.4 | 1.8 | 0.9 | 23 |
| 100 | 2.2 | 8.2 × 11 | 13 | 60 | 4.3 | 3.2 | 0.06 | 43 | 18 | 4 | 190 |
| | 4.7 | 8.2 × 11 | 13 | 75 | 5.8 | 3.5 | 0.07 | 24 | 12 | 3.5 | 170 |
| | 10 | 8.2 × 11 | 13 | 100 | 9 | 4 | 0.08 | 13 | 4.5 | 3 | 70 |

**Additional electrical data**

| PARAMETER | CONDITIONS | VALUE |
|---|---|---|
| **Voltage** | | |
| Surge voltage | | $U_s \leq 1.3\ U_R$ |
| Reverse voltage | | $U_{rev} \leq 1$ V |
| **Current** | | |
| Leakage current | after 1 minute at $U_R$ | $I_{L1} \leq 0.006C_R \times U_R + 3$ μA |
| | after 5 minutes at $U_R$ | $I_{L5} \leq 0.001C_R \times U_R + 3$ μA |
| **Inductance** | | |
| Equivalent series inductance (ESL) | case ∅D × L = 5 × 11 mm | typ. 13 nH |
| | case ∅D × L = 8.2 × 11 mm | typ. 16 nH |

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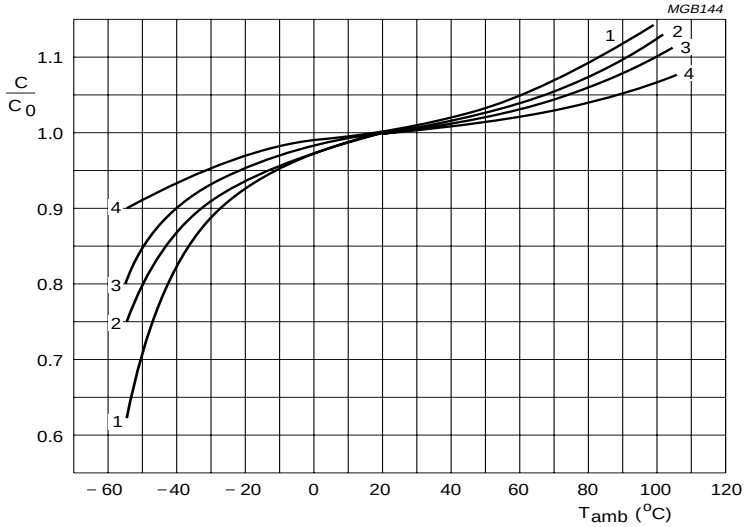
**ORDERING INFORMATION (continued)**

**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) |
| 50 | 0.47 | 11 | 116 51477 | 2.5 | – | 5.0 | 116 31477 | 5.0 | 116 71477 | 2.5 |
| | **1.0** | **11** | **116 51108** | 2.5 | – | 5.0 | **116 31108** | 5.0 | 116 71108 | 2.5 |
| | 1.5 | 11 | 116 51158 | 2.5 | – | 5.0 | 116 31158 | 5.0 | 116 71158 | 2.5 |
| | **2.2** | **11** | **116 51228** | 2.5 | – | 5.0 | **116 31228** | 5.0 | 116 71228 | 2.5 |
| | 3.3 | 11 | 116 51338 | 2.5 | – | 5.0 | 116 31338 | 5.0 | 116 71338 | 2.5 |
| | **4.7** | **11** | **116 51478** | 2.5 | – | 5.0 | **116 31478** | 5.0 | 116 71478 | 2.5 |
| | 6.8 | 11 | 116 51688 | 2.5 | – | 5.0 | 116 31688 | 5.0 | 116 71688 | 2.5 |
| | **10** | **11** | **116 51109** | 2.5 | – | 5.0 | **116 31109** | 5.0 | 116 71109 | 2.5 |
| | 10 | 13 | 116 90084 | 5.0 | 116 90085 | 5.0 | 116 90036 | 5.0 | – | – |
| | 15 | 11 | 116 51159 | 2.5 | – | 5.0 | 116 31159 | 5.0 | 116 71159 | 2.5 |
| | **22** | **11** | **116 51229** | 2.5 | – | 5.0 | **116 31229** | 5.0 | 116 71229 | 2.5 |
| | **22** | **13** | **116 90025** | 5.0 | 116 90086 | 5.0 | **116 90039** | 5.0 | – | – |
| | 33 | 13 | 116 51339 | 5.0 | 116 61339 | 5.0 | 116 31339 | 5.0 | – | – |
| | **47** | **13** | **116 51479** | 5.0 | 116 61479 | 5.0 | **116 31479** | 5.0 | – | – |
| | 68 | 13 | 116 51689 | 5.0 | 116 61689 | 5.0 | 116 31689 | 5.0 | – | – |
| 63 | 10 | 13 | 116 58109 | 5.0 | 116 68109 | 5.0 | 116 38109 | 5.0 | – | – |
| | 22 | 13 | 116 58229 | 5.0 | 116 68229 | 5.0 | 116 38229 | 5.0 | – | – |
| 100 | 2.2 | 13 | 116 59228 | 5.0 | 116 69228 | 5.0 | 116 39228 | 5.0 | – | – |
| | 4.7 | 13 | 116 59478 | 5.0 | 116 69478 | 5.0 | 116 39478 | 5.0 | – | – |
| | 10 | 13 | 116 59109 | 5.0 | 116 69109 | 5.0 | 116 39109 | 5.0 | – | – |

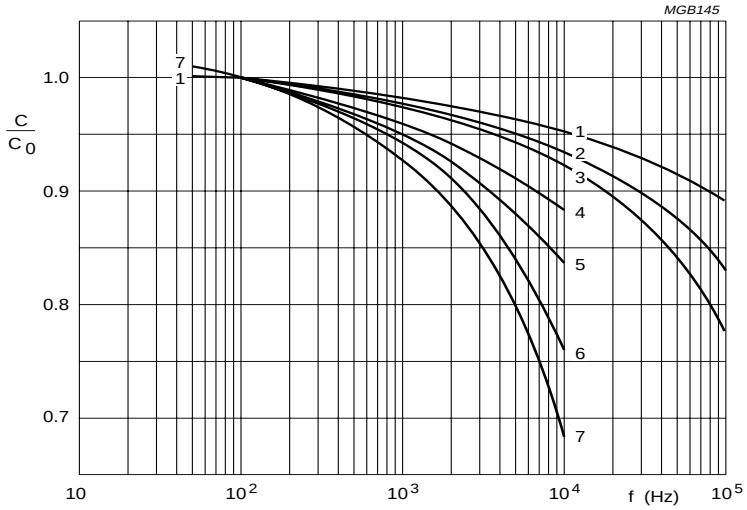
**ELECTRICAL DATA (continued)**

**Capacitance (C)**




Curve 1: 6.3 V.
Curve 2: 10 V; 16 V.
Curve 3: 35 V; 40 V; 63 V; 100 V.
Curve 4: 50 V.
$C_0$ = capacitance at 20 °C, 100 Hz.

Fig.6 Typical multiplier of capacitance as a function of ambient temperature.




Curve 1: 50 V (≤2.2 μF).
Curve 2: 50 V (>2.2 μF).
Curve 3: 50 V (≥15 μF).
Curve 4: 35 V; 40 V; 63 V; 100 V.
Curve 5: 25 V.
Curve 6: 16 V.
Curve 7: 6.3 V; 10 V.
$C_0$ = capacitance at 20 °C, 100 Hz.

Fig.7 Typical multiplier of capacitance as a function of frequency.

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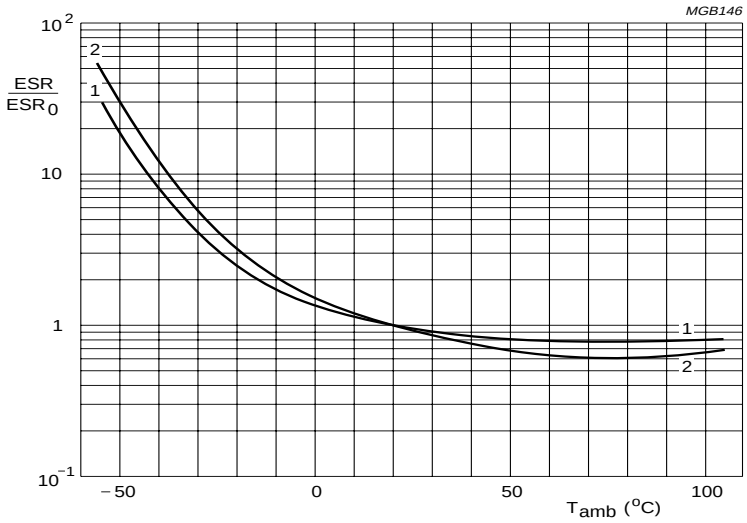
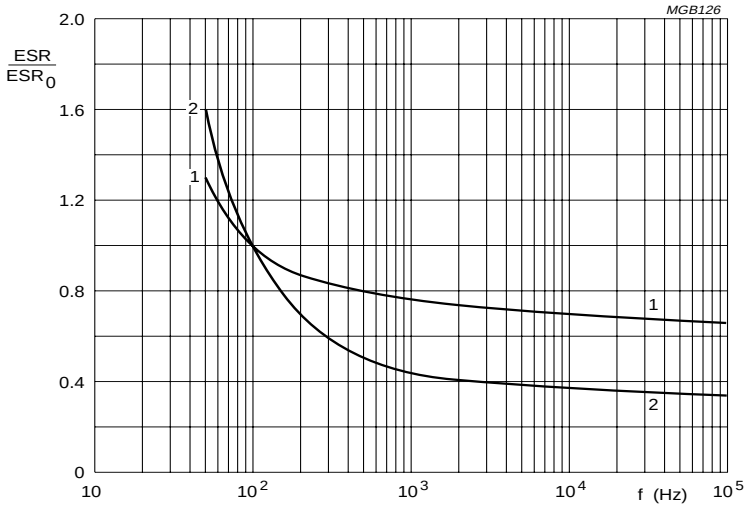
**Equivalent series resistance (ESR)**




Curve 1: 50 V (≥10 μF).
Curve 2: 6.3 V; 63 V; 100 V.
$ESR_0$ = typical at 20 °C, 100 Hz.

Fig.8 Typical multiplier of ESR as a function of ambient temperature.




Curve 1: 6.3 V.
Curve 2: 50 V (≥10 μF); 63 V; 100 V.
$ESR_0$ = typical at 20 °C, 100 Hz.

Fig.9 Typical multiplier of ESR as a function of frequency.

# Aluminum electrolytic capacitors Radial Long Life



## Impedance (Z)

Curve 1: 0.47 µF.
Curve 2: 1.0 µF.
Curve 3: 1.5 µF.
Curve 4: 2.2 µF.
Curve 5: 3.3 µF.
Curve 6: 4.7 µF.
Curve 7: 6.8 µ.F
Curve 8: 10 µF.
Curve 9: 15 µF.
Curve 10: 22 µF.
Curve 11: 33 µF.
Curve 12: 47 µF.
Curve 13: 68 µF.
Curve 14: 100 µF.
Curve 15: 150 µF.
**Case ∅D × L = 5 × 11 mm**.
$T_{amb}$ = 20 °C.

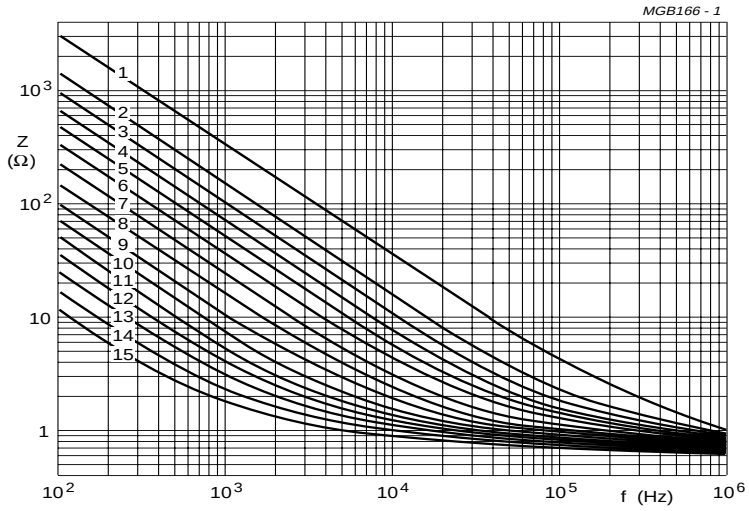



Fig.10 Typical impedance as a function of frequency.

Curve 1: 2.2 µF.
Curve 2: 4.7 µF.
Curve 3: 10 µF, 100 V.
Curve 4: 10 µF, 50 V.
Curve 5: 22 µF, 50 V.
Curve 6: 33 µF.
Curve 7: 47 µF.
Curve 8: 68 µF.
Curve 9: 100 µF.
Curve 10: 150 µF.
Curve 11: 220 µF.
Curve 12: 330 µF.
Curve 13: 470 µF.
**Case ∅D × L = 8.2 × 11 mm**.
$T_{amb}$ = 20 °C.

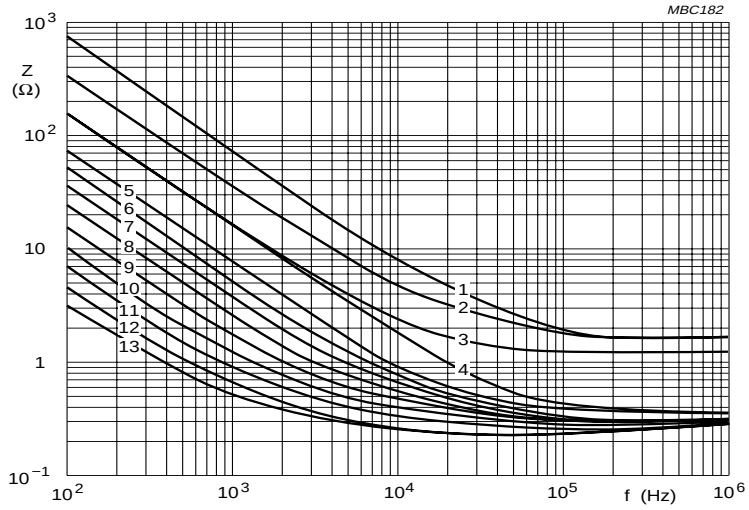



Fig.11 Typical impedance as a function of frequency.

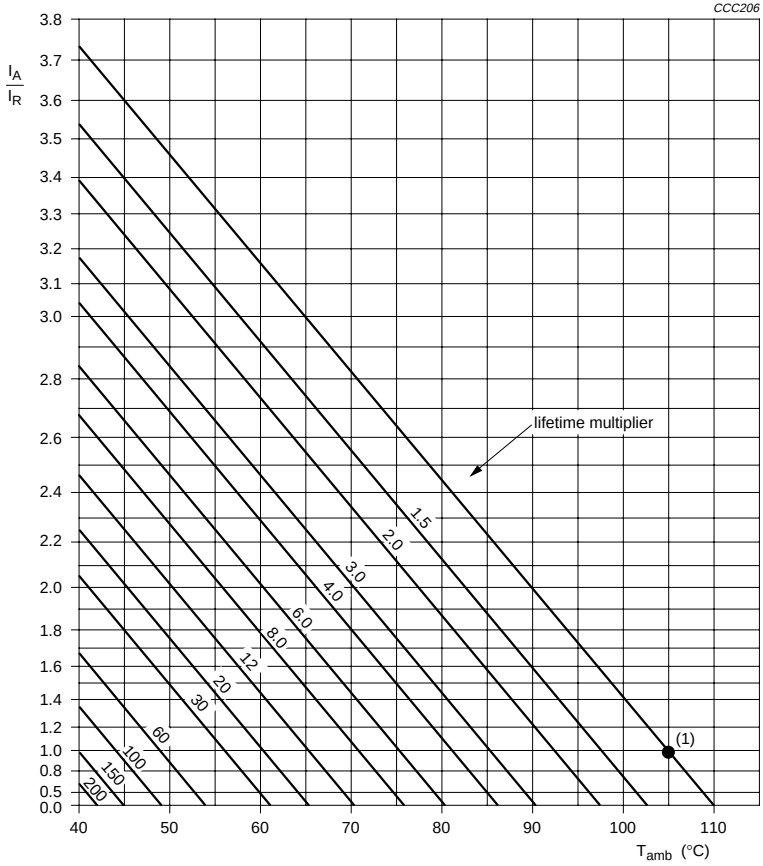
# Aluminum electrolytic capacitors Radial Long Life



## RIPPLE CURRENT AND USEFUL LIFE

**Table 6** 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 ($C_R \geq 10$ μF) |
| 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 |




$I_A$ = actual ripple current at 100 kHz.

$I_R$ = rated ripple current at 100 kHz, 105 °C.

(1) Useful life at 105 °C and $I_R$ applied: 2000 hours.

Fig.12 Multiplier of useful life as a function of ambient temperature and ripple current load.

## 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 | $T_{amb}$ = 105 °C; $U_R$ applied; 1500 hours | $U_R \leq 6.3$ V; ΔC/C: +15/–30%<br>$U_R > 6.3$ V; ΔC/C: ±15%<br>tan δ ≤ 1.3 × spec. limit<br>$Z_{10} \leq 2 \times$ spec. limit<br>$I_{L5} \leq$ spec. limit |
| Useful life | CECC 30301 subclause 1.8.1 | $T_{amb}$ = 105 °C; $U_R$ and $I_R$ applied; 2000 hours | $U_R \leq 6.3$ V; ΔC/C: +45/–50%<br>$U_R > 6.3$ V; ΔC/C: ±45%<br>tan δ ≤ 3 × spec. limit<br>$Z_{10} \leq 3 \times$ spec. limit<br>$I_{L5} \leq$ spec. limit<br>no short or open circuit<br>total failure percentage: ≤1% |
| Shelf life (storage at high temperature) | IEC 60384-4/ EN130300 subclause 4.17 | $T_{amb}$ = 105 °C; no voltage applied; 1500 hours<br>after test: $U_R$ to be applied for 30 minutes, 24 to 48 hours before measurement | ΔC/C, tan δ, Z: for requirements see 'Endurance test' above<br>$I_{L5} \leq 2 \times$ spec. limit |