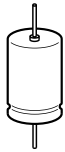
# Aluminum electrolytic capacitors

## Axial-lead capacitors

**Series/Type:** **B43699**

Date: December 2010

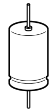


**Applications**
- Electronic ballasts

**Features**
- Very long useful life
- High ripple current capability
- Very high voltage capability
  550 V DC/85 °C/2000 h
  500 V DC/105 °C/6000 h
- Outstanding performance
- Very compact

**Construction**
- Charge/discharge-proof, polar
- Aluminum case with insulating sleeve
- Negative pole connected to case
- Axial leads, welded to ensure perfect electrical contact

**Taping and packing**
- Bulk
- Pallet package
- Capacitors with d × l ≤ 16 × 30 mm are also available taped on reel.



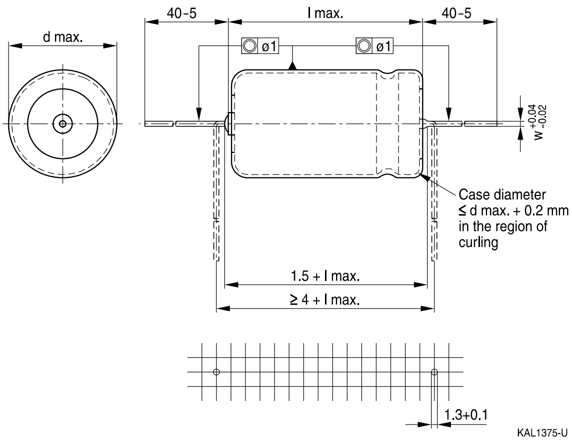
## Specifications and characteristics in brief

| | | | | | | |
|---|---|---|---|---|---|---|
| Rated voltage $V_R$<br>Surge voltage $V_S$ | 450 V DC<br>550 V DC at 90 °C | | | | | |
| Rated capacitance $C_R$<br>Capacitance tolerance | 10 ... 47 µF<br>−10/+30% ≙ Q | | | | | |
| Leakage current $I_{leak}$<br>(5 min, 20 °C) | $I_{leak} \le 0.3\,\mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{V_R}{V}\right)^{0.7} + 4\,\mu A$ | | | | | |
| Self-inductance ESL[1] | Diameter d (mm) | 12 | 13.3 | 14 | 16 | 18 |
| | Length l (mm) | Approx. ESL (nH) | | | | |
| | 30 | 21 | – | 24 | 29 | 34 |
| | 39 | 23 | 28 | – | 33 | 38 |
| Useful life<br>105 °C; $V_R$; $I_{AC,R}$<br>105 °C; 500 V DC; $I_{AC,R}$<br>90 °C; $V_R$; $I_{AC,R}$<br>85 °C; 500 V DC; $I_{AC,R}$<br>40 °C; $V_R$; 2.0 · $I_{AC,R}$<br>40 °C; 500 V DC;<br>1.95 · $I_{AC,R}$ | <br>> 12500 h<br>> 6000 h<br>> 40000 h<br>> 30000 h<br>> 500000 h<br><br>> 250000 h | Requirements:<br>ΔC/C ≤ ±30% of initial value<br>ESR ≤ 3 times initial specified limit<br>$I_{leak}$ ≤ initial specified limit | | | | |
| Voltage endurance test<br>105 °C; $V_R$ | <br>6000 h | Post test requirements:<br>ΔC/C ≤ ±10% of initial value<br>ESR ≤ 1.3 times initial specified limit<br>$I_{leak}$ ≤ initial specified limit | | | | |
| Vibration resistance test | To IEC 60068-2-6, test Fc:<br>Frequency range 10 Hz ... 55 Hz, displacement amplitude 0.75 mm, acceleration max. 10 *g*, duration 3 × 2 h.<br>Capacitor mounted by its wire leads at a distance of (6 ±1) mm from the case and additionally clamped by the case. | | | | | |
| IEC climatic category | To IEC 60068-1:<br>40/105/56 (−40 °C/+105 °C/56 days damp heat test) | | | | | |
| Detail specification<br>Sectional specification | Similar to CECC 30301-801<br>IEC 60384-4 | | | | | |

1) If optimum circuit design is used, the values are lower by 30%.

## Axial-lead capacitors

### Dimensional drawing




### Dimensions, weights and packing units

| d × l | $d_{max} \times l_{max}$ | Wire w | Approx. weight | Packing units (pcs.) | | |
|---|---|---|---|---|---|---|
| mm | mm | mm | g | Bulk | Pallet | Reel |
| 12 × 30 | 12.5 × 30.5 | 0.8 | 5.1 | 600 | 288 | 450 |
| 12 × 39 | 12.5 × 40 | 0.8 | 6.5 | 500 | 288 | – |
| 13.3 × 39 | 14.0 × 40 | 0.8 | 8.0 | 400 | 200 | – |
| 14 × 30 | 14.5 × 30.5 | 0.8 | 6.8 | 400 | 200 | 350 |
| 16 × 30 | 16.5 × 30.5 | 0.8 | 8.9 | 350 | 180 | 250 |
| 16 × 39 | 16.5 × 40 | 0.8 | 11.7 | 300 | 180 | – |
| 18 × 30 | 18.5 × 30.5 | 1.0 | 11.1 | 300 | 160 | – |
| 18 × 39 | 18.5 × 40 | 1.0 | 14.7 | 250 | 160 | – |

## Case dimensions and ordering codes

| $V_R$<br><br><br>V DC | $C_R$<br>100 Hz<br>20 °C<br>µF | Case dimensions<br>d × l<br>mm | Ordering code<br>Bulk | Ordering code<br>Pallet package | Ordering code<br>Reel |
|---|---|---|---|---|---|
| 450 | 10 | 12 × 30 | B43699B5106Q000 | B43699B5106Q007 | B43699B5106Q009 |
| | 15 | 12 × 39 | B43699B5156Q000 | B43699B5156Q007 | |
| | 15 ∇ | 14 × 30 | B43699C5156Q000 | B43699C5156Q007 | B43699C5156Q009 |
| | 22 | 13.3 × 39 | B43699B5226Q000 | B43699B5226Q007 | |
| | 22 ∇ | 16 × 30 | B43699C5226Q000 | B43699C5226Q007 | B43699C5226Q009 |
| | 33 | 16 × 39 | B43699B5336Q000 | B43699B5336Q007 | |
| | 33 ∇ | 18 × 30 | B43699C5336Q000 | B43699C5336Q007 | |
| | 47 | 18 × 39 | B43699B5476Q000 | B43699B5476Q007 | |

∇ Variant with different case dimensions

## Technical data

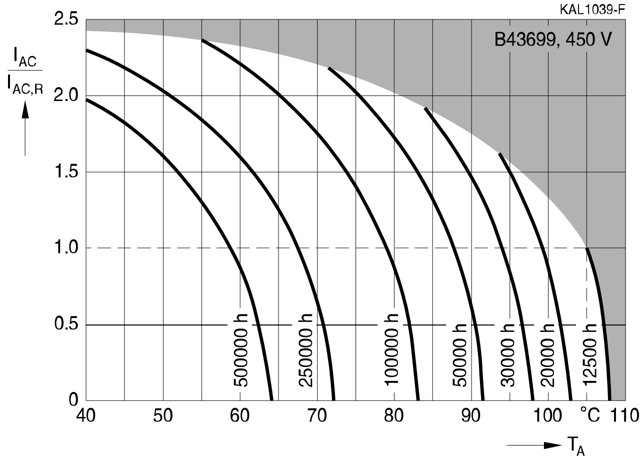
| $C_R$<br>100 Hz<br>20 °C<br>µF | $ESR_{typ}$<br>100 Hz<br>20 °C<br>Ω | $ESR_{max}$<br>100 Hz<br>20 °C<br>Ω | $ESR_{max}$<br>100 Hz<br>−25 °C<br>Ω | $ESR_{max}$<br>10 kHz<br>20 °C<br>Ω | $Z_{max}$<br>100 kHz<br>20 °C<br>Ω | $I_{AC,max}$<br>10 kHz<br>60 °C<br>A | $I_{AC,max}$<br>10 kHz<br>85 °C<br>A | $I_{AC,R}$<br>10 kHz<br>105 °C<br>A |
|---|---|---|---|---|---|---|---|---|
| $V_R$ = 450 V DC | | | | | | | | |
| 10 | 6.1 | 10.1 | 200 | 4.7 | 4.6 | 1.15 | 0.94 | 0.49 |
| 15 | 4.1 | 6.8 | 130 | 3.1 | 3.0 | 1.60 | 1.31 | 0.69 |
| 15 ∇ | 4.1 | 6.8 | 130 | 3.1 | 3.0 | 1.51 | 1.23 | 0.65 |
| 22 | 2.8 | 4.6 | 90 | 2.2 | 2.0 | 2.03 | 1.66 | 0.87 |
| 22 ∇ | 2.8 | 4.6 | 90 | 2.2 | 2.0 | 1.94 | 1.58 | 0.83 |
| 33 | 1.9 | 3.1 | 60 | 1.4 | 1.3 | 2.70 | 2.20 | 1.16 |
| 33 ∇ | 1.9 | 3.1 | 60 | 1.4 | 1.3 | 2.47 | 2.01 | 1.06 |
| 47 | 1.3 | 2.1 | 40 | 1.1 | 1.0 | 3.35 | 2.73 | 1.44 |

∇ Variant with different case dimensions

**Useful life**

depending on ambient temperature $T_A$ under ripple current operating conditions at $V_R$ 1)

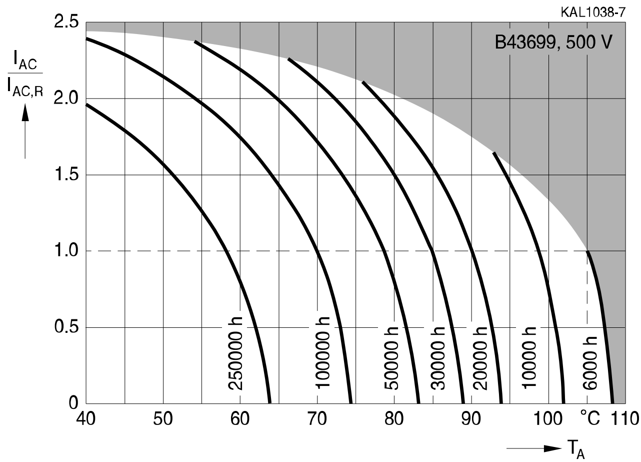
$V_R$ = 450 V



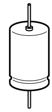

**Useful life**

depending on ambient temperature $T_A$ under ripple current operating conditions at $V_{op}$ 1)

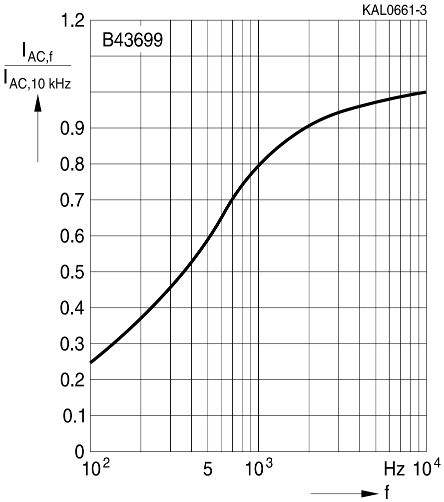
$V_{op}$ = 500 V




1) Refer to chapter "General technical information, 5.3 Calculation of useful life" for an explanation on how to interpret the useful life graphs.

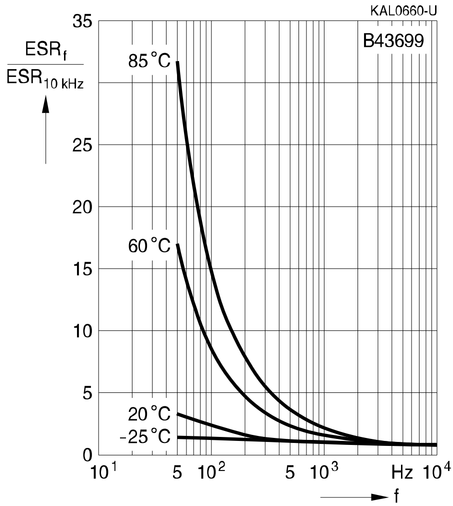


## Frequency factor of permissible ripple current $I_{AC}$ versus frequency f



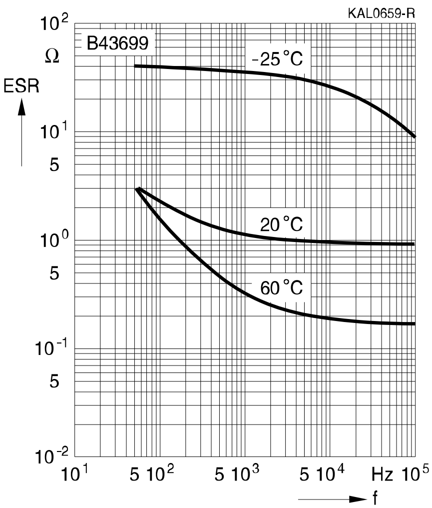

## Frequency characteristics of ESR

Typical behavior



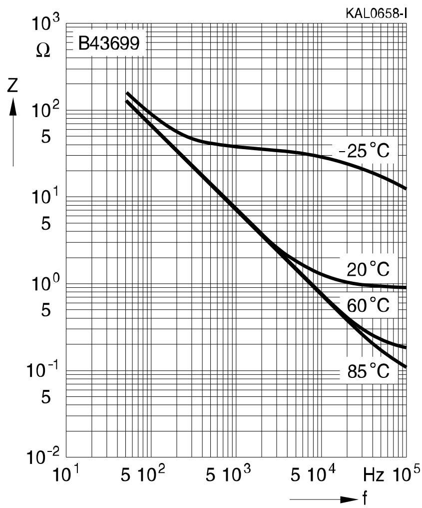

## Equivalent series resistance ESR versus frequency f

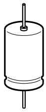
Typical behavior for 22 µF/450 V




## Impedance Z versus frequency f

Typical behavior for 22 µF/450 V







## Cautions and warnings

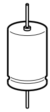
### Personal safety

The electrolytes used by EPCOS have not only been optimized with a view to the intended application, but also with regard to health and environmental compatibility. They do not contain any solvents that are detrimental to health, e.g. dimethyl formamide (DMF) or dimethyl acetamide (DMAC).

Furthermore, part of the high-voltage electrolytes used by EPCOS are self-extinguishing. They contain flame-retarding substances which will quickly extinguish any flame that may have been ignited.

As far as possible, EPCOS does not use any dangerous chemicals or compounds to produce operating electrolytes. However, in exceptional cases, such materials must be used in order to achieve specific physical and electrical properties because no safe substitute materials are currently known. However, the amount of dangerous materials used in our products has been limited to an absolute minimum. Nevertheless, the following rules should be observed when handling aluminum electrolytic capacitors:

- Any escaping electrolyte should not come into contact with eyes or skin.
- If electrolyte does come into contact with the skin, wash the affected parts immediately with running water. If the eyes are affected, rinse them for 10 minutes with plenty of water. If symptoms persist, seek medical treatment.
- Avoid breathing in electrolyte vapor or mists. Workplaces and other affected areas should be well ventilated. Clothing that has been contaminated by electrolyte must be changed and rinsed in water.



**Product safety**

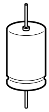
The table below summarizes the safety instructions that must be observed without fail. A detailed description can be found in the relevant sections of chapter "General technical information".

| Topic | Safety information | Reference chapter "General technical information" |
|---|---|---|
| Polarity | Make sure that polar capacitors are connected with the right polarity. | 1<br>"Basic construction of aluminum electrolytic capacitors" |
| Reverse voltage | Voltages polarity classes should be prevented by connecting a diode. | 3.1.6<br>"Reverse voltage" |
| Upper category temperature | Do not exceed the upper category temperature. | 7.2<br>"Maximum permissible operating temperature" |
| Maintenance | Make periodic inspections of the capacitors.<br>Before the inspection, make sure that the power supply is turned off and carefully discharge the electricity of the capacitors.<br>Do not apply any mechanical stress to the capacitor terminals. | 10<br>"Maintenance" |
| Mounting position of screw-terminal capacitors | Do not mount the capacitor with the terminals (safety vent) upside down. | 11.1.<br>"Mounting positions of capacitors with screw terminals" |
| Mounting of single-ended capacitors | The internal structure of single-ended capacitors might be damaged if excessive force is applied to the lead wires.<br>Avoid any compressive, tensile or flexural stress.<br>Do not move the capacitor after soldering to PC board.<br>Do not pick up the PC board by the soldered capacitor.<br>Do not insert the capacitor on the PC board with a hole space different to the lead space specified. | 11.4<br>"Mounting considerations for single-ended capacitors" |
| Robustness of terminals | The following maximum tightening torques must not be exceeded when connecting screw terminals:<br>M5: 2 Nm<br>M6: 2.5 Nm | 11.3<br>"Mounting torques" |
| Soldering | Do not exceed the specified time or temperature limits during soldering. | 11.5<br>"Soldering" |

| Topic | Safety information | Reference chapter "General technical information" |
|---|---|---|
| Soldering, cleaning agents | Do not allow halogenated hydrocarbons to come into contact with aluminum electrolytic capacitors. | 11.6 "Cleaning agents" |
| Passive flammability | Avoid external energy, such as fire or electricity. | 8.1 "Passive flammability" |
| Active flammability | Avoid overload of the capacitors. | 8.2 "Active flammability" |
| | | Reference chapter "Capacitors with screw terminals" |
| Breakdown strength of insulating sleeves | Do not damage the insulating sleeve, especially when ring clips are used for mounting. | "Screw terminals − accessories" |

## Symbols and terms

| Symbol | English | German |
|---|---|---|
| C | Capacitance | Kapazität |
| $C_R$ | Rated capacitance | Nennkapazität |
| $C_S$ | Series capacitance | Serienkapazität |
| $C_{S,T}$ | Series capacitance at temperature T | Serienkapazität bei Temperatur T |
| $C_f$ | Capacitance at frequency f | Kapazität bei Frequenz f |
| d | Case diameter, nominal dimension | Gehäusedurchmesser, Nennmaß |
| $d_{max}$ | Maximum case diameter | Maximaler Gehäusedurchmesser |
| ESL | Self-inductance | Eigeninduktivität |
| ESR | Equivalent series resistance | Ersatzserienwiderstand |
| $ESR_f$ | Equivalent series resistance at frequency f | Ersatzserienwiderstand bei Frequenz f |
| $ESR_T$ | Equivalent series resistance at temperature T | Ersatzserienwiderstand bei Temperatur T |
| f | Frequency | Frequenz |
| I | Current | Strom |
| $I_{AC}$ | Alternating current (ripple current) | Wechselstrom |
| $I_{AC,rms}$ | Root-mean-square value of alternating current | Wechselstrom, Effektivwert |
| $I_{AC,f}$ | Ripple current at frequency f | Wechselstrom bei Frequenz f |
| $I_{AC,max}$ | Maximum permissible ripple current | Maximal zulässiger Wechselstrom |
| $I_{AC,R}$ | Rated ripple current | Nennwechselstrom |
| $I_{AC,R}$ (B) | Rated ripple current for base cooling | Nennwechselstromstrom für Bodenkühlung |
| $I_{leak}$ | Leakage current | Reststrom |
| $I_{leak,op}$ | Operating leakage current | Betriebsreststrom |
| l | Case length, nominal dimension | Gehäuselänge, Nennmaß |
| $l_{max}$ | Maximum case length (without terminals and mounting stud) | Maximale Gehäuselänge (ohne Anschlüsse und Gewindebolzen) |
| R | Resistance | Widerstand |
| $R_{ins}$ | Insulation resistance | Isolationswiderstand |
| $R_{symm}$ | Balancing resistance | Symmetrierwiderstand |
| T | Temperature | Temperatur |
| $\Delta T$ | Temperature difference | Temperaturdifferenz |
| $T_A$ | Ambient temperature | Umgebungstemperatur |
| $T_C$ | Case temperature | Gehäusetemperatur |
| $T_B$ | Capacitor base temperature | Temperatur des Becherbodens |
| t | Time | Zeit |
| $\Delta t$ | Period | Zeitraum |
| $t_b$ | Service life (operating hours) | Brauchbarkeitsdauer (Betriebszeit) |





| Symbol | English | German |
|---|---|---|
| $V$ | Voltage | Spannung |
| $V_F$ | Forming voltage | Formierspannung |
| $V_{op}$ | Operating voltage | Betriebsspannung |
| $V_R$ | Rated voltage, DC voltage | Nennspannung, Gleichspannung |
| $V_S$ | Surge voltage | Spitzenspannung |
| $X_C$ | Capacitive reactance | Kapazitiver Blindwiderstand |
| $X_L$ | Inductive reactance | Induktiver Blindwiderstand |
| $Z$ | Impedance | Scheinwiderstand |
| $Z_T$ | Impedance at temperature T | Scheinwiderstand bei Temperatur T |
| $\tan \delta$ | Dissipation factor | Verlustfaktor |
| $\lambda$ | Failure rate | Ausfallrate |
| $\varepsilon_0$ | Absolute permittivity | Elektrische Feldkonstante |
| $\varepsilon_r$ | Relative permittivity | Dielektrizitätszahl |
| $\omega$ | Angular velocity; $2 \cdot \pi \cdot f$ | Kreisfrequenz; $2 \cdot \pi \cdot f$ |

**Note**

All dimensions are given in mm.

EPCOS

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The following applies to all products named in this publication:

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