Aluminum electrolytic capacitors

Axial-lead capacitors

Series/Type: **B43698**

Date: November 2008

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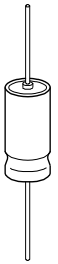


Applications
- Electronic ballasts

Features
- Extremely long useful life
- Very high ripple current capability
- Very high voltage capability
  550 V DC/85 °C/5000 h
  500 V DC/105 °C/10000 h
- Outstanding performance

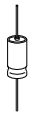
Construction
- Charge/discharge-proof, polar
- Aluminum case with insulating sleeve
- Negative pole connected to case
- Axial leads, welded to ensure perfect electrical contact

Taping and packing
- Bulk
- Pallet package
- Capacitors with $d \times l \leq 16 \times 30$ mm are also available taped on reel.

Specifications and characteristics in brief

Rated voltage V_R	450 V DC					
Surge voltage V_S	550 V DC at 105 °C					
Rated capacitance C_R	6.8 ... 33 µF					
Capacitance tolerance	−10/+30% ≙ Q					
Leakage current I_{leak} (5 min, 20 °C)	$I_{leak} \leq 0.3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{V_R}{V}\right)^{0.7} + 4\ \mu A$					
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		Requirements:				
105 °C; V_R; $I_{AC,R}$	> 15000 h	ΔC/C	≤ ±30% of initial value			
105 °C; 500 V DC; $I_{AC,R}$	> 10000 h	ESR	≤ 3 times initial specified limit			
90 °C; V_R; $I_{AC,R}$	> 50000 h	I_{leak}	≤ initial specified limit			
85 °C; 500 V DC; $I_{AC,R}$	> 50000 h					
40 °C; V_R; 2.1 · $I_{AC,R}$	> 500000 h					
40 °C; 500 V DC; 2.2 · $I_{AC,R}$	> 250000 h					
Voltage endurance test		Post test requirements:				
105 °C; V_R	7500 h	ΔC/C	≤ ±10% of initial value			
		ESR	≤ 1.3 times initial specified limit			
		I_{leak}	≤ initial specified limit			
Vibration resistance test	To IEC 60068-2-6, test Fc: Displacement amplitude 0.75 mm, frequency range 10 Hz ... 55 Hz, acceleration max. 10 *g*, duration 3 × 2 h. 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: 40/105/56 (−40 °C/+105 °C/56 days damp heat test)					
Detail specification Sectional specification	Similar to CECC 30301-801 IEC 60384-4					

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



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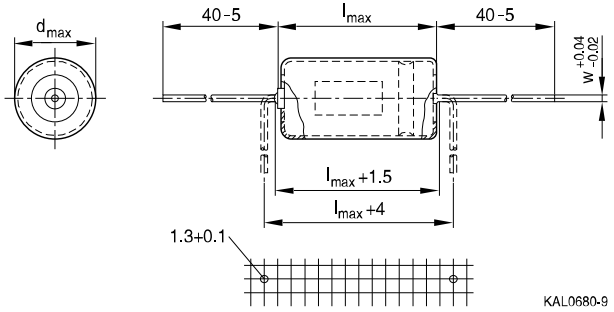
High performance – 105 °C

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	C_R 100 Hz 20 °C	Case dimensions d × l	Ordering code Bulk	Ordering code Pallet package	Ordering code Reel
V DC	µF	mm			
450	6.8	12 × 30	B43698A5685Q000	B43698A5685Q007	B43698A5685Q009
	10	12 × 39	B43698B5106Q000	B43698B5106Q007	
	10 ∇	14 × 30	B43698A5106Q000	B43698A5106Q007	B43698A5106Q009
	15	13.3 × 39	B43698B5156Q000	B43698B5156Q007	
	15 ∇	16 × 30	B43698A5156Q000	B43698A5156Q007	B43698A5156Q009
	22	16 × 39	B43698A5226Q000	B43698A5226Q007	
	22 ∇	18 × 30	B43698B5226Q000	B43698B5226Q007	
	33	18 × 39	B43698A5336Q000	B43698A5336Q007	

∇ Variant with different case dimensions

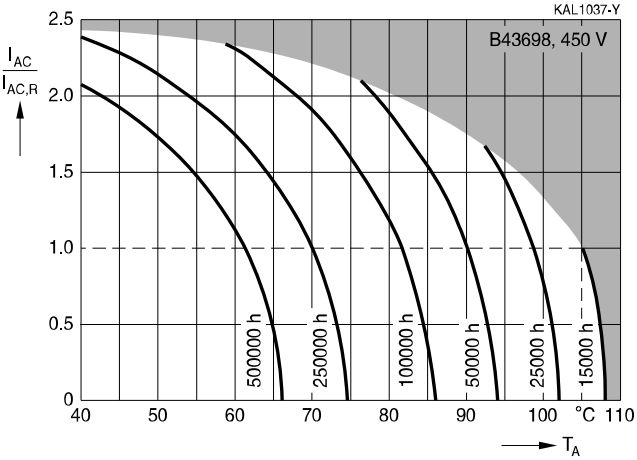
Technical data

C_R 100 Hz 20 °C	ESR_{typ} 100 Hz 20 °C	ESR_{max} 100 Hz 20 °C	ESR_{max} 100 Hz −25 °C	ESR_{max} 10 kHz 20 °C	Z_{max} 100 kHz 20 °C	$I_{AC,max}$ 10 kHz 60 °C	$I_{AC,max}$ 10 kHz 85 °C	$I_{AC,R}$ 10 kHz 105 °C
µF	Ω	Ω	Ω	Ω	Ω	A	A	A
V_R = 450 V DC								
6.8	7.2	12.0	180	5.5	5.4	1.26	1.03	0.54
10	4.9	8.1	120	3.8	3.7	1.74	1.42	0.75
10 ∇	4.9	8.1	120	3.8	3.7	1.65	1.34	0.71
15	3.2	5.4	80	2.5	2.4	2.24	1.82	0.96
15 ∇	3.2	5.4	80	2.5	2.4	2.13	1.74	0.92
22	2.2	3.7	50	1.7	1.6	2.94	2.40	1.26
22 ∇	2.2	3.7	50	1.7	1.6	2.68	2.19	1.15
33	1.5	2.5	40	1.2	1.1	3.73	3.04	1.60

∇ Variant with different case dimensions

Useful life

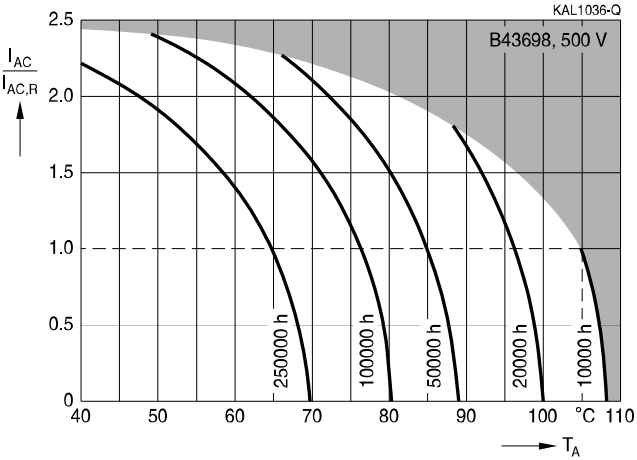
depending on ambient temperature T_A under ripple current operating conditions at V_R[1)]



Useful life

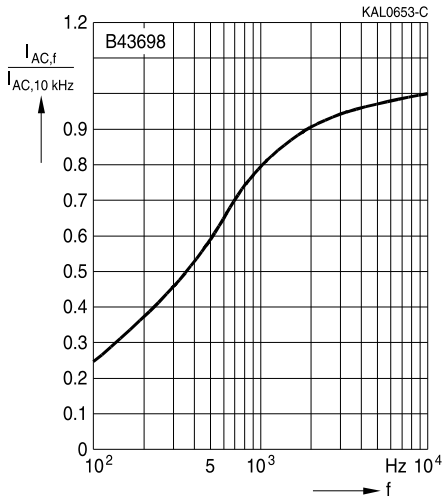
depending on ambient temperature T_A under ripple current operating conditions at V_{op}[1)]

V_{op} = 500 V



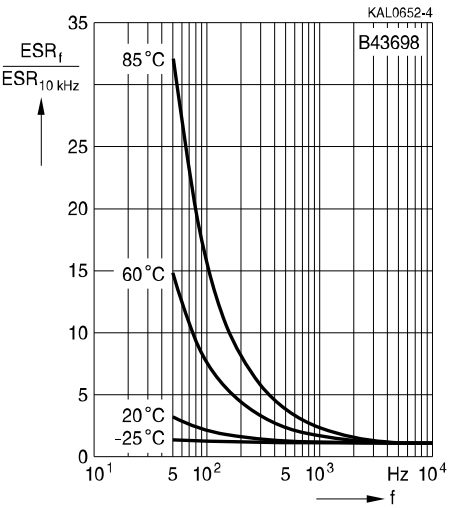
1) Refer to chapter "General technical information, 5.3 Calculation of useful life" for an explanation on how to interpret the useful life graphs.

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



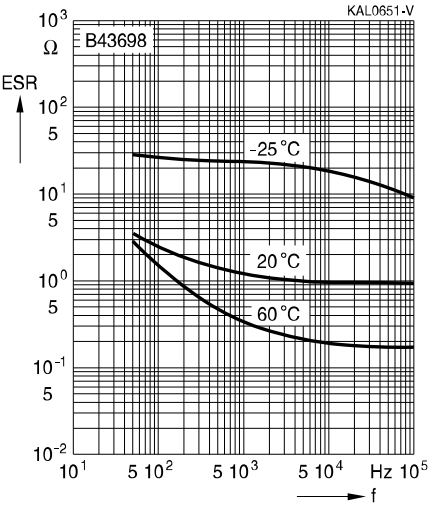
Frequency characteristics of ESR

Typical behavior



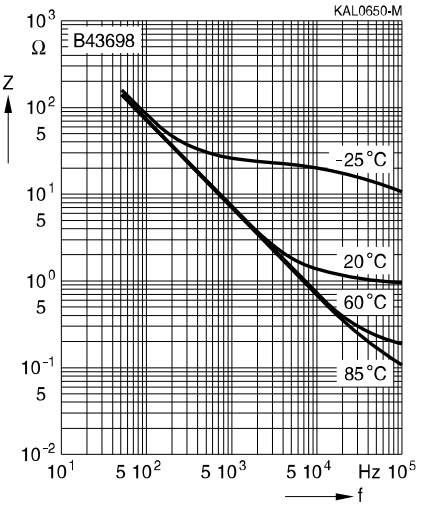
Equivalent series resistance ESR versus frequency f

Typical behavior for 22 µF/450 V



Impedance Z versus frequency f

Typical behavior for 22 µF/450 V



Cautions and warnings

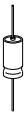
Personal safety

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

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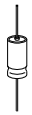
High performance – 105 °C

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	Ableitstrom
$I_{leak,op}$	Operating leakage current	Ableitstrom bei Betrieb
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
ΔT	Temperature difference	Temperaturdifferenz
T_A	Ambient temperature	Umgebungstemperatur
T_C	Case temperature	Gehäusetemperatur
T_B	Capacitor base temperature	Temperatur des Becherbodens
t	Time	Zeit
Δt	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 δ	Dissipation factor	Verlustfaktor
λ	Failure rate	Ausfallrate
ε_0	Absolute permittivity	Elektrische Feldkonstante
ε_r	Relative permittivity	Dielektrizitätszahl
ω	Angular velocity; $2 \cdot \pi \cdot f$	Kreisfrequenz; $2 \cdot \pi \cdot f$

Notes

All dimensions are given in mm.

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