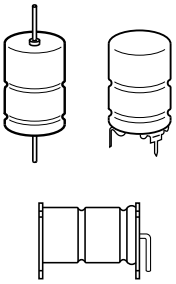
Aluminum electrolytic capacitors

Axial-lead and soldering star capacitors

Series/Type: **B43693, B43793**

Date: November 2012



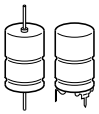
Applications
- Automotive electronics

Features
- High voltage design
- High ripple current capability
- Long useful life
- High vibration stability
- RoHS-compatible

Construction
- Charge/discharge-proof, polar
- Aluminum case with insulating sleeve
- Negative pole connected to case

Terminals
- Axial leads, welded to ensure perfect electrical contact
- Soldering star for upright mounting on PCB available
- Alternative axial-lead design with double-sided plates for horizontal mounting available upon request

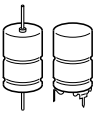
Taping and packing
- Axial-lead capacitors will be delivered in pallet package Capacitors with $d \times l \leq 16 \times 30$ mm are also available taped on reel
- Soldering star capacitors are packed in cardboard



Specifications and characteristics in brief

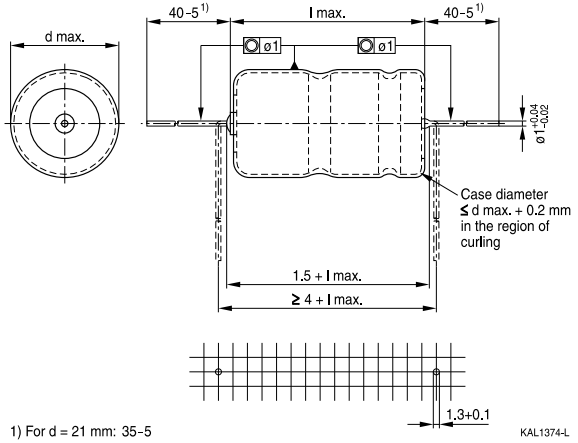
Rated voltage V_R	160 ... 250 V DC					
Surge voltage V_S	1.15 · V_R					
Rated capacitance C_R	22 ... 130 µF					
Capacitance tolerance	–10/+30% ≙ Q					
Leakage current I_{leak} (5 min, 20 °C)	$I_{leak} \leq 0.3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{V_R}{V}\right)^{0.7} + 4\ \mu A$					
Self-inductance ESL[1]	Diameter d (mm)		14	18	21	
	Terminals	Length l (mm)	Approx. ESL (nH)			
	axial	30	24	34	–	
		39	–	38	45	
		49	–	–	50	
	soldering star	30	7	10	–	
		39	–	11	13	
		49	–	–	14	
Useful life[2]			Requirements:			
125 °C; V_R; $I_{AC,R}$	> 2500 h		ΔC/C	≤ ±30% of initial value		
105 °C; V_R; $I_{AC,R}$	> 10000 h		ESR	≤ 3 times initial specified limit[3]		
85 °C; V_R; $I_{AC,max}$	> 4000 h		I_{leak}	≤ initial specified limit		
40 °C; V_R; 2 · $I_{AC,R}$	> 250000 h					
Voltage endurance test			Post test requirements:			
105 °C; V_R	5000 h		ΔC/C	≤ ±10% of initial value		
			ESR	≤ 1.3% of initial specified limit[3]		
			I_{leak}	≤ initial specified limit		
Vibration resistance test	To IEC 60068-2-6, test Fc: Frequency range 10 Hz ... 2 kHz, displacement amplitude max. 1.5 mm, acceleration max. 20 *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: 40/125/56 (–40 °C/+125 °C/56 days damp heat test)					
Detail specification Sectional specification	Similar to CECC 30301-802 IEC 60384-4					

1) If optimum circuit design is used, the values are lower by 30%.
2) Refer to chapter "General technical information, 5 Useful life" on how to interpret useful life.
3) ESR_{max} at 100 Hz, 20 °C



B43693, Axial-lead capacitors

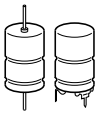
Dimensional drawing



1) For d = 21 mm: 35–5

Dimensions, weights and packing units

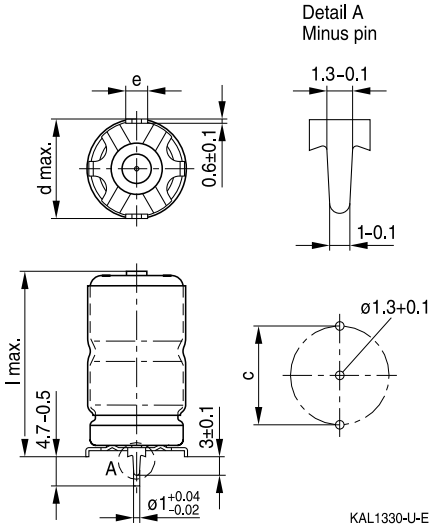
d × l	$d_{max} \times l_{max}$	Approx. weight	Packing units (pcs.)	
mm	mm	g	Pallet	Reel
14 × 30	14.5 × 30.5	6.8	200	350
18 × 30	18.5 × 30.5	11.1	160	–
18 × 39	18.5 × 40	14.7	160	–
21 × 39	21.5 × 40	20.0	140	–
21 × 49	21.5 × 50	25.0	110	–



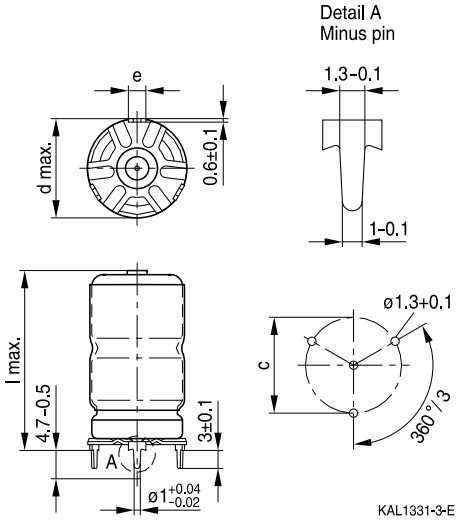
B43793, Soldering star capacitors

Dimensional drawings

Mounting holes d = 14 mm

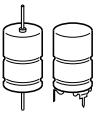


Mounting holes d = 16 mm ... 21 mm



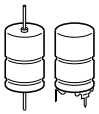
Dimensions, weights and packing units

d × l mm	$d_{max} \times l_{max}$ mm	c ±0.1 mm	e ±0.1 mm	Approx. weight g	Packing units pcs.
14 × 30	15.5 × 32	14.5	3.0	7.2	480
18 × 30	19.5 × 32	18.5	3.0	11.8	300
18 × 39	19.5 × 41.5	18.5	3.0	15.4	200
21 × 39	22.5 × 41.5	21.5	3.5	21.0	324
21 × 49	22.5 × 51.5	21.5	3.5	26.0	264



Case dimensions and ordering codes

V_R	C_R 100 Hz 20 °C	Case dimensions d × l	Ordering code Axial pallet	Ordering code Axial reel	Ordering code Soldering star
V DC	µF	mm			
160	68	14 × 30	B43693A1686Q001	B43693A1686Q003	B43793A1686Q001
	130	18 × 30	B43693A1137Q001		B43793A1137Q001
	200	18 × 39	B43693A1207Q001		B43793A1207Q001
	300	21 × 39	B43693A1307Q001		B43793A1307Q001
	400	21 × 49	B43693A1407Q001		B43793A1407Q001
200	47	14 × 30	B43693B2476Q001	B43693B2476Q003	B43793B2476Q001
	100	18 × 30	B43693B2107Q001		B43793B2107Q001
	150	18 × 39	B43693A2157Q001		B43793A2157Q001
	200	21 × 39	B43693A2207Q001		B43793A2207Q001
	270	21 × 49	B43693A2307Q001		B43793A2307Q001
250	22	14 × 30	B43693A2226Q001	B43693A2226Q003	B43793A2226Q001
	47	18 × 30	B43693A2476Q001		B43793A2476Q001
	68	18 × 39	B43693A2686Q001		B43793A2686Q001
	100	21 × 39	B43693A2107Q001		B43793A2107Q001
	130	21 × 49	B43693A2137Q001		B43793A2137Q001

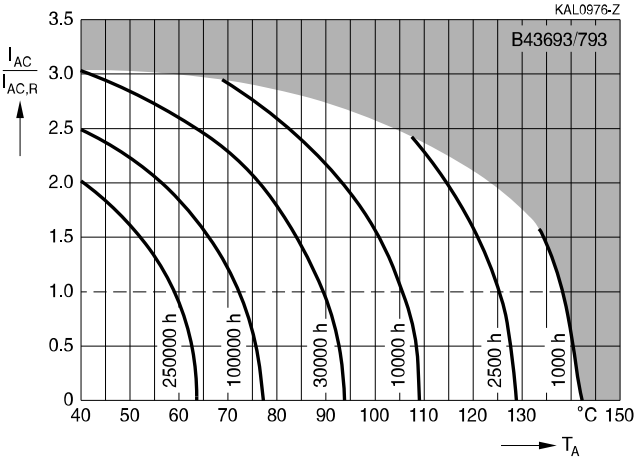


Technical data

C_R 100 Hz 20 °C µF	Case dimensions d × l mm	ESR_{max} 100 Hz 20 °C mΩ	ESR_{max} 100 Hz −40 °C Ω	ESR_{max} 10 kHz 20 °C mΩ	Z_{max} 100 kHz 20 °C mΩ	$I_{AC,max}$ 10 kHz 40 °C A	$I_{AC,max}$ 10 kHz 105 °C A	$I_{AC,R}$ 10 kHz 105 °C A	$I_{AC,max}$ 10 kHz 125 °C A
V_R = 160 V DC									
68	14 × 30	1050	25	440	450	3.68	2.95	1.2	2.3
130	18 × 30	570	13	240	250	5.2	4.15	1.7	3.25
200	18 × 39	370	8	160	165	7.2	5.75	2.35	4.5
300	21 × 39	250	6	105	110	10.05	8.10	3.3	6.25
400	21 × 49	190	4	77	80	12.9	10.40	4.25	8.0
V_R = 200 V DC									
47	14 × 30	1400	32	500	510	3.4	2.72	1.12	2.13
100	18 × 30	680	15	240	250	5.05	4.00	1.65	3.15
150	18 × 39	450	10	160	165	6.95	5.60	2.30	4.33
200	21 × 39	330	7.5	120	123	9.3	7.45	3.05	5.8
270	21 × 49	250	5.5	90	93	12.0	9.60	3.95	7.5
V_R = 250 V DC									
22	14 × 30	2300	34.0	454	510	3.65	2.90	1.20	2.27
47	18 × 30	1100	16.0	222	246	5.43	4.35	1.78	3.38
68	18 × 39	750	11.0	154	171	7.36	5.90	2.41	4.58
100	21 × 39	520	7.5	102	114	10.16	8.15	3.33	6.33
130	21 × 49	400	6.0	79	88	12.89	10.35	4.23	8.03

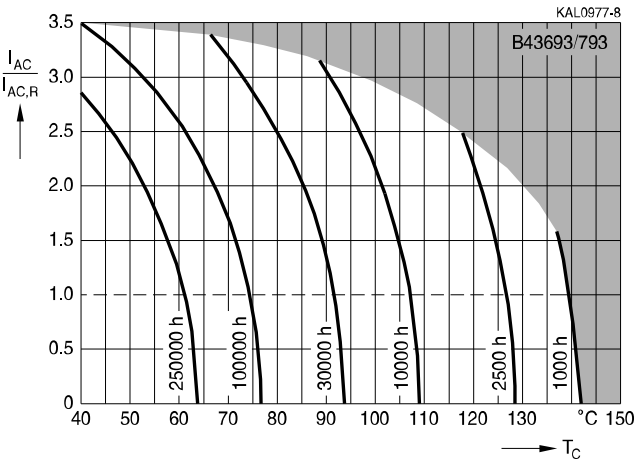
Useful life[1)]

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

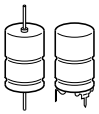


Useful life[1)]

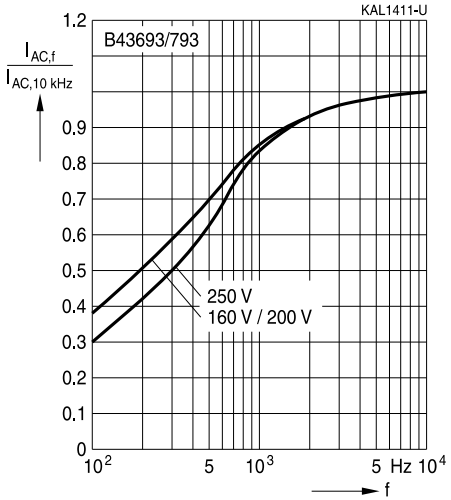
depending on case temperature T_C under ripple current operating conditions at V_R[1)]



1) Refer to chapter "General technical information, 5 Useful life" on how to interpret useful life.

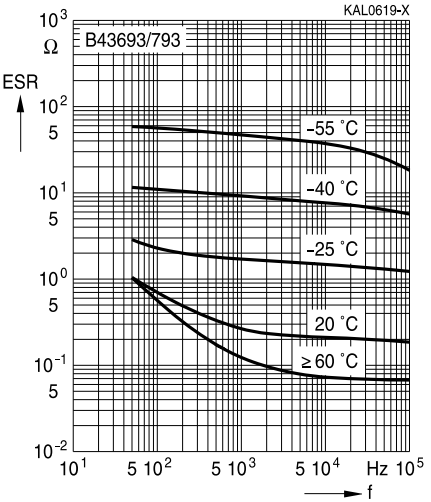


Frequency factor of permissible ripple current I_{AC} versus frequency f



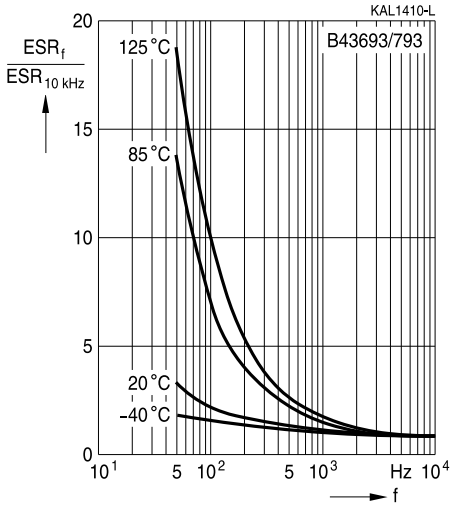
Equivalent series resistance ESR versus frequency f

Typical behavior for 47 µF/250 V



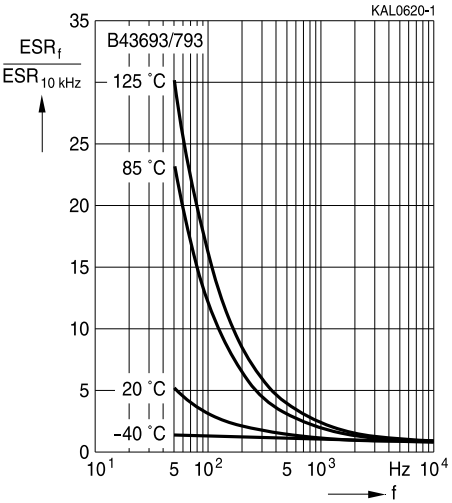
Frequency characteristics of ESR

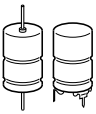
Typical behavior for 160 and 200 V



Frequency characteristics of ESR

Typical behavior for 250 V





Cautions and warnings

Personal safety

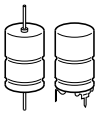
The electrolytes used by EPCOS have been optimized both with a view to the intended application and with regard to health and environmental compatibility. They do not contain any solvents that are detrimental to health, e.g. dimethyl formamide (DMF) or dimethyl acetamide (DMAC).
Furthermore, some of the high-voltage electrolytes used by EPCOS are self-extinguishing.

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 alternative materials are currently known. However, the amount of dangerous materials used in our products is limited to an absolute minimum.

Materials and chemicals used in EPCOS aluminum electrolytic capacitors are continuously adapted in compliance with the EPCOS Corporate Environmental Policy and the latest EU regulations and guidelines such as RoHS, REACH/SVHC, GADSL, and ELV.

MDS (Material Data Sheets) are available on the EPCOS website for all types listed in the data book. MDS for customer specific capacitors are available upon request.
MSDS (Material Safety Data Sheets) are available for all of our electrolytes upon request.

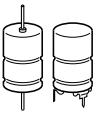
Nevertheless, the following rules should be observed when handling aluminum electrolytic capacitors: No electrolyte should come into contact with eyes or skin. If electrolyte does come into contact with the skin, wash the affected areas immediately with running water. If the eyes are affected, rinse them for 10 minutes with plenty of water. If symptoms persist, seek medical treatment. Avoid inhaling 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".

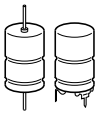
Topic	Safety information	Reference chapter "General technical information"
Polarity	Make sure that polar capacitors are connected with the right polarity.	1 "Basic construction of aluminum electrolytic capacitors"
Reverse voltage	Voltages polarity classes should be prevented by connecting a diode.	3.1.6 "Reverse voltage"
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"
Robustness of terminals	The following maximum tightening torques must not be exceeded when connecting screw terminals: M5: 2.5 Nm M6: 4.0 Nm	11.3 "Mounting torques"
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"
Soldering	Do not exceed the specified time or temperature limits during soldering.	11.5 "Soldering"
Soldering, cleaning agents	Do not allow halogenated hydrocarbons to come into contact with aluminum electrolytic capacitors.	11.6 "Cleaning agents"
Upper category temperature	Do not exceed the upper category temperature.	7.2 "Maximum permissible operating temperature"
Passive flammability	Avoid external energy, such as fire or electricity.	8.1 "Passive flammability"



B43693, B43793

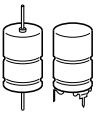
High voltage – 125 °C

Topic	Safety information	Reference chapter "General technical information"
Active flammability	Avoid overload of the capacitors.	8.2 "Active flammability"
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"
Storage	Do not store capacitors at high temperatures or high humidity. Capacitors should be stored at +5 to +35 °C and a relative humidity of ≤ 75%.	7.3 Storage conditions
		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
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; $2 \cdot \pi \cdot f$

Note

All dimensions are given in mm.

Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application**. As a rule, EPCOS is either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an EPCOS product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified**. In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or lifesaving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
3. **The warnings, cautions and product-specific notes must be observed.**
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