



Aluminum electrolytic capacitors

Axial-lead and soldering star capacitors

Series/Type: B41693, B41793

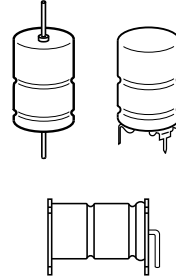
Date: November 2012

Applications

- Automotive electronics

Features

- High operating temperature capability up to 150 °C
- Rated voltage up to 100 V DC
- Low ESR
- High reliability
- Outstanding parametric stability
- High ripple current capability
- High vibration stability
- Long useful life
- Shelf life up to 15 years at storage temperatures up to 40 °C.
To ensure solderability, the capacitors should be built into the application within one year of delivery. After a total of two years' storage, the operating voltage must be applied for one hour to ensure the specified leakage current.
- 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	25 ... 100 V DC						
Surge voltage V_S	$1.15 \cdot V_R$						
Rated capacitance C_R	100 ... 4000 μF						
Capacitance tolerance	$-10/+30\% \triangle Q$						
Leakage current I_{leak} (5 min, 20 °C)	$I_{\text{leak}} \leq 0.006 \mu\text{A} \cdot \left(\frac{C_R}{\mu\text{F}} \cdot \frac{V_R}{V} \right) + 4 \mu\text{A}$						
Self-inductance ESL ¹⁾	Diameter d (mm)	12	14	16	18	20/21	
	Terminals	Length l (mm)	Approx. ESL (nH)				
	axial	25	–	22	–	30	–
		29	–	–	–	–	38
		30	21	24	29	34	–
		35	–	–	31	–	–
		39	–	–	33	38	45
		49	–	–	–	–	50
	soldering star	25	–	6	–	8	–
		30	6	7	8	10	–
		35	–	–	9	–	–
		39	–	–	9	11	13
		49	–	–	–	–	14
Useful life ²⁾ 150 °C; V_R ; $0.5 \cdot I_{AC,R}$ 125 °C; V_R ; $I_{AC,R}$ 85 °C; V_R ; $I_{AC,max}$ 40 °C; V_R ; $2.1 \cdot I_{AC,R}$	> 1000 h	Requirements: $\Delta C/C \leq \pm 30\%$ of initial value ESR ≤ 3 times initial specified limit ³⁾ $I_{\text{leak}} \leq$ initial specified limit					
	> 5000 h						
	> 15000 h						
	> 200000 h						
Voltage endurance test 125 °C; V_R	2000 h	Post test requirements: $\Delta C/C \leq \pm 10\%$ of initial value ESR $\leq 1.3\%$ of initial specified limit ³⁾ $I_{\text{leak}} \leq$ 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: 55/125/56 (-55 °C/ $+125$ °C/56 days damp heat test)						
Detail specification	Similar to CECC 30301-802						
Sectional specification	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

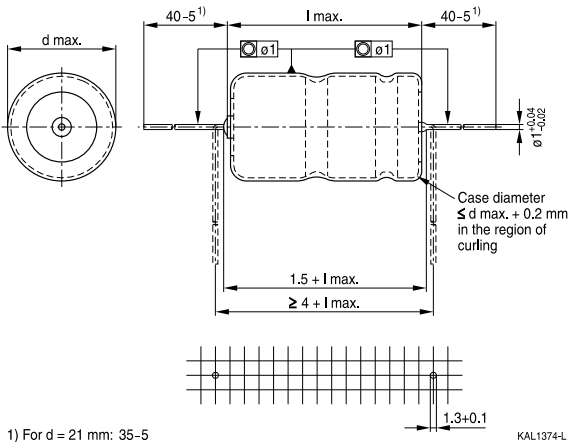


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High reliability – up to 150 °C

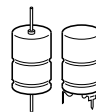
B41693, Axial-lead capacitors

Dimensional drawing

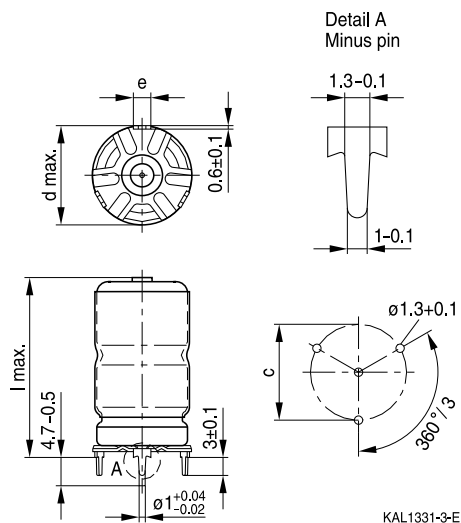
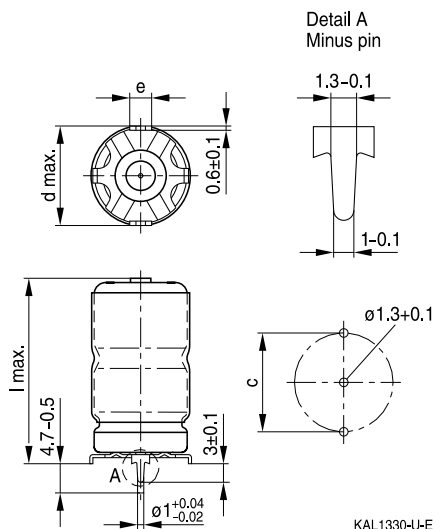


Dimensions, weights and packing units

$d \times l$ mm	$d_{max} \times l_{max}$ mm	Approx. weight g	Packing units (pcs.)	
			Pallet	Reel
12 × 30	12.5 × 30.5	5.1	288	450
14 × 25	14.5 × 25.5	5.7	200	350
14 × 30	14.5 × 30.5	6.8	200	350
16 × 30	16.5 × 30.5	8.9	180	250
16 × 35	16.5 × 35.5	10.4	180	—
16 × 39	16.5 × 40	11.7	180	—
18 × 25	18.5 × 25.5	9.3	160	—
18 × 30	18.5 × 30.5	11.1	160	—
18 × 39	18.5 × 40	14.7	160	—
20 × 29	20.5 × 29.5	13.5	140	—
21 × 39	21.5 × 40	20.0	140	—
21 × 49	21.5 × 50	25.0	110	—


B41793, Soldering star capacitors
Dimensional drawings

 Mounting holes $d = 12 \text{ mm} \dots 14 \text{ mm}$

 Mounting holes $d = 16 \text{ mm} \dots 21 \text{ mm}$

Dimensions, weights and packing units

$d \times l$ mm	$d_{\max} \times l_{\max}$ mm	$c \pm 0.1$ mm	$e \pm 0.1$ mm	Approx. weight g	Packing units pcs.
12 × 30	13.5 × 32	12.5	3.0	5.4	480
14 × 25	15.5 × 27	14.5	3.0	6.1	480
14 × 30	15.5 × 32	14.5	3.0	7.2	480
16 × 30	17.5 × 32	16.5	3.0	9.4	300
16 × 35	17.5 × 37	16.5	3.0	10.9	200
16 × 39	17.5 × 41.5	16.5	3.0	12.2	200
18 × 25	19.5 × 27	18.5	3.0	9.9	300
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



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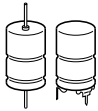
High reliability – up to 150 °C

Overview of available types

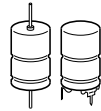
V_R (V DC)	25	40	63	75	100
	Case dimensions $d \times l$ (mm)				
C_R (μF)					
100			12 × 30	12 × 30	12 × 30
150					14 × 30
220			14 × 30	16 × 30	16 × 30
330		12 × 30	16 × 30 18 × 25	16 × 35	
470	14 × 25	14 × 30	16 × 39	18 × 39 20 × 29	18 × 39 20 × 29
560			20 × 29		
680		16 × 30 18 × 25	18 × 39	21 × 39	21 × 39
820		16 × 35			
1000	16 × 30 18 × 25	16 × 39 18 × 30	21 × 39	21 × 49	21 × 49
1200		20 × 29	21 × 49		
1500	16 × 39	18 × 39			
1800	20 × 29				
2000	18 × 39				
2200		21 × 39			
2700		21 × 49			
3000	21 × 39				
4000	21 × 49				


Case dimensions and ordering codes

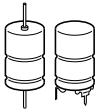
V_R	C_R	Case dimensions d × l mm	Ordering code Axial pallet	Ordering code Axial reel	Ordering code Soldering star
	100 Hz 20 °C μF				
25	470	14 × 25	B41693A5477Q001	B41693A5477Q003	B41793A5477Q001
	1000	16 × 30	B41693A5108Q001	B41693A5108Q003	B41793A5108Q001
	1000	18 × 25	B41693B5108Q001		B41793B5108Q001
	1500	16 × 39	B41693A5158Q001		B41793A5158Q001
	1800	20 × 29	B41693A5188Q001		
	2000	18 × 39	B41693A5208Q001		B41793A5208Q001
	3000	21 × 39	B41693A5308Q001		B41793A5308Q001
	4000	21 × 49	B41693A5408Q001		B41793A5408Q001
40	330	12 × 30	B41693A7337Q001	B41693A7337Q003	B41793A7337Q001
	470	14 × 30	B41693A7477Q001	B41693A7477Q003	B41793A7477Q001
	680	16 × 30	B41693A7687Q001	B41693A7687Q003	B41793A7687Q001
	680	18 × 25	B41693B7687Q001		B41793B7687Q001
	820	16 × 35	B41693A7827Q001		B41793A7827Q001
	1000	16 × 39	B41693B7108Q001		B41793B7108Q001
	1000	18 × 30	B41693A7108Q001		B41793A7108Q001
	1200	20 × 29	B41693A7128Q001		
	1500	18 × 39	B41693A7158Q001		B41793A7158Q001
	2200	21 × 39	B41693A7228Q001		B41793A7228Q001
	2700	21 × 49	B41693A7278Q001		B41793A7278Q001
	63	100	12 × 30	B41693A8107Q001	B41693A8107Q003
220		14 × 30	B41693A8227Q001	B41693A8227Q003	B41793A8227Q001
330		16 × 30	B41693A8337Q001	B41693A8337Q003	B41793A8337Q001
330		18 × 25	B41693B8337Q001		B41793B8337Q001
470		16 × 39	B41693A8477Q001		B41793A8477Q001
560		20 × 29	B41693A8567Q001		
680		18 × 39	B41693A8687Q001		B41793A8687Q001
1000		21 × 39	B41693A8108Q001		B41793A8108Q001
1200		21 × 49	B41693A8128Q001		B41793A8128Q001


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High reliability – up to 150 °C

V_R	C_R 100 Hz 20 °C	Case dimensions d × l mm	Ordering code Axial pallet	Ordering code Axial reel	Ordering code Soldering star	
V DC	μF					
75	100	12 × 30	B41693A0107Q001	B41693A0107Q003	B41793A0107Q001	
	220	16 × 30	B41693A0227Q001		B41793A0227Q001	
	330	16 × 35	B41693A0337Q001		B41793A0337Q001	
	470	18 × 39	B41693A0477Q001		B41793A0477Q001	
	470	20 × 29	B41693B0477Q001			
	680	21 × 39	B41693A0687Q001		B41793A0687Q001	
	1000	21 × 49	B41693A0108Q001		B41793A0108Q001	
100	100	12 × 30	B41693B9107Q001	B41693B9107Q003	B41793B9107Q001	
	150	14 × 30	B41693B9157Q001	B41693B9157Q003	B41793B9157Q001	
	220	16 × 30	B41693A9227Q001	B41693A9227Q003	B41793A9227Q001	
	470	18 × 39	B41693A9477Q001		B41793A9477Q001	
	470	20 × 29	B41693B9477Q001			
	680	21 × 39	B41693A9687Q001		B41793A9687Q001	
	1000	21 × 49	B41693A9108Q001			B41793A9108Q001


Technical data

C_R	Case dimensions	ESR_{max} 100 Hz 20 °C	ESR_{max} 100 Hz -40 °C	ESR_{max} 10 kHz 20 °C	Z_{max} 100 kHz 20 °C	$I_{AC,max}$ 10 kHz 105 °C	$I_{AC,max}$ 10 kHz 125 °C	$I_{AC,R}$ 10 kHz 125 °C	$I_{AC,max}$ 10 kHz 150 °C
μF	mm	m Ω	m Ω	m Ω	m Ω	A	A	A	A
$V_R = 25 V DC$									
470	14 × 25	260	1900	140	102	3.6	2.8	1.95	1.0
1000	16 × 30	130	900	75	55	5.3	4.2	2.9	1.4
1000	18 × 25	120	900	70	50	5.8	4.6	3.15	1.6
1500	16 × 39	85	600	50	39	7.4	5.8	4.0	2.0
1800	20 × 29	70	600	40	30	8.2	6.4	4.45	2.2
2000	18 × 39	70	500	42	26	7.9	6.2	4.3	4.1
3000	21 × 39	43	450	25	21	11.8	9.2	6.4	3.2
4000	21 × 49	33	320	20	16	14.9	11.7	8.0	4.0
$V_R = 40 V DC$									
330	12 × 30	320	2500	150	140	3.7	2.9	2.0	1.0
470	14 × 30	220	1700	110	102	4.5	3.5	2.45	1.2
680	16 × 30	160	1200	80	75	5.2	4.1	2.85	1.4
680	18 × 25	150	1200	75	70	5.6	4.4	3.05	1.5
820	16 × 35	130	900	69	65	6.2	4.9	3.4	1.7
1000	16 × 39	110	700	57	55	7.2	5.7	3.9	1.9
1000	18 × 30	115	700	65	62	5.7	4.5	3.1	1.5
1200	20 × 29	85	600	45	44	8.0	6.3	4.35	2.2
1500	18 × 39	75	500	45	43	7.9	6.2	4.3	2.1
2200	21 × 39	50	450	26	26	11.7	9.2	6.3	6.1
2700	21 × 49	40	330	21	21	14.7	11.5	7.9	3.9
$V_R = 63 V DC$									
100	12 × 30	700	3300	230	215	3.2	2.5	1.7	0.85
220	14 × 30	320	1700	110	102	4.6	3.6	2.5	1.25
330	16 × 30	220	1200	80	75	5.3	4.2	2.9	1.45
330	18 × 25	210	1200	74	70	5.9	4.6	3.2	1.6
470	16 × 39	150	900	55	52	7.3	5.7	4.0	2.0
560	20 × 29	120	630	45	44	8.1	6.4	4.4	2.2
680	18 × 39	110	550	45	44	7.9	6.2	4.3	2.1
1000	21 × 39	70	440	27	27	11.8	9.2	6.4	3.2
1200	21 × 49	58	380	22	22	14.7	11.5	8.0	4.0

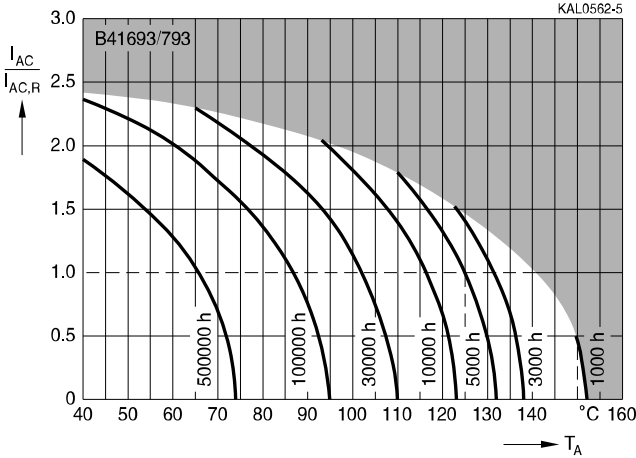

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High reliability – up to 150 °C

C_R	Case dimensions	ESR_{max} 100 Hz 20 °C μF	ESR_{max} 100 Hz -40 °C $m\Omega$	ESR_{max} 10 kHz 20 °C $m\Omega$	Z_{max} 100 kHz 20 °C $m\Omega$	$I_{AC,max}$ 10 kHz 105 °C A	$I_{AC,max}$ 10 kHz 125 °C A	$I_{AC,R}$ 10 kHz 125 °C A	$I_{AC,max}$ 10 kHz 150 °C A
$V_R = 75 V DC$									
100	12 × 30	600	3000	200	190	3.5	2.7	1.85	0.9
220	16 × 30	300	1500	100	95	5.1	4.0	2.8	1.4
330	16 × 35	210	1050	75	72	6.3	5.0	3.4	1.7
470	18 × 39	140	700	50	48	7.9	6.2	4.3	2.1
470	20 × 29	135	720	45	44	8.2	6.4	4.4	2.2
680	21 × 39	95	500	30	30	11.5	9.0	6.2	3.1
1000	21 × 49	65	350	22	22	14.8	11.6	8.0	4.0
$V_R = 100 V DC$									
100	12 × 30	750	4000	320	310	2.3	1.8	1.3	0.6
150	14 × 30	550	2900	230	225	3.0	2.4	1.7	0.8
220	16 × 30	350	1900	160	157	3.7	2.9	2.0	1.0
470	18 × 39	170	900	75	73	6.9	5.4	3.7	1.8
470	20 × 29	175	900	78	76	6.0	4.7	3.2	1.6
680	21 × 39	120	670	58	56	8.5	6.7	4.6	2.3
1000	21 × 49	85	500	44	43	11.2	8.8	6.1	3.0



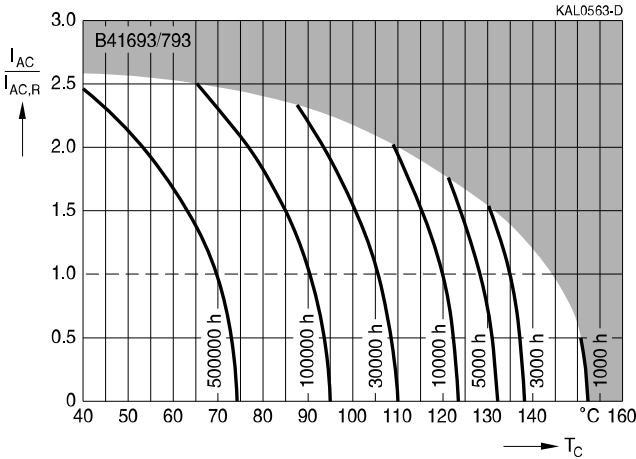
Useful life¹⁾

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

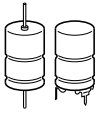


Useful life¹⁾

depending on case temperature T_C under ripple current operating conditions at V_R



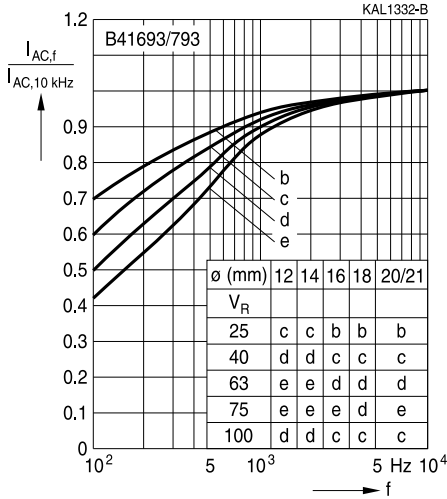
1) Refer to chapter "General technical information, 5 Useful life" on how to interpret useful life.



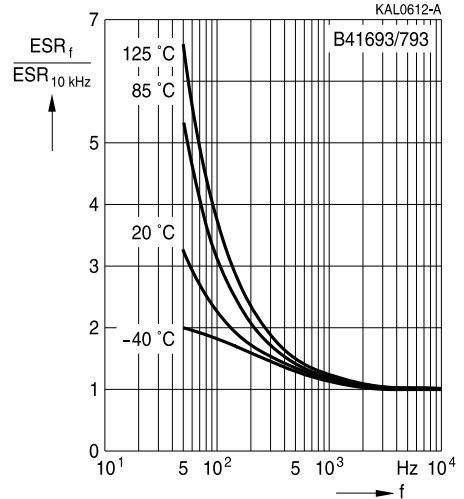
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High reliability – up to 150 °C

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

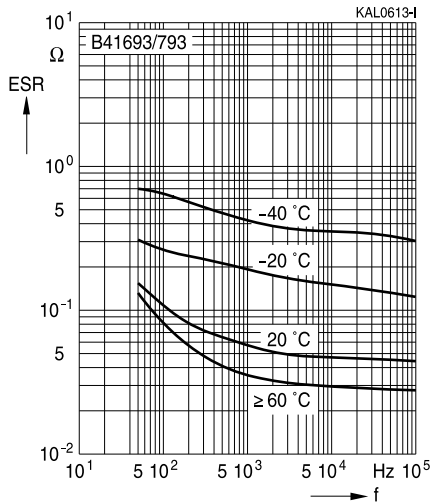


Frequency characteristics of ESR
Typical behavior



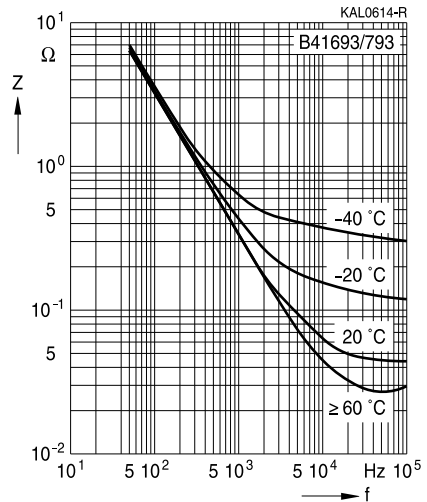
Equivalent series resistance ESR versus frequency f

Typical behavior for 470 μ F/63V



Impedance Z versus frequency f

Typical behavior for 470 μ F/63V





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.

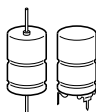
As far as possible, EPCOS does not use any dangerous chemicals or compounds to produce operating electrolytes. However, in exceptional cases, such materials must be used in order to achieve specific physical and electrical properties because no alternative materials are currently known. However, the 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.

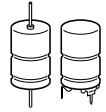
Nevertheless, the following rules should be observed when handling aluminum electrolytic capacitors: No electrolyte should come into contact with eyes or skin. If electrolyte does come into contact with the skin, wash the affected areas immediately with running water. If the eyes are affected, rinse 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"



Topic	Safety information	Reference chapter "General technical information"
Active flammability	Avoid overload of the capacitors.	8.2 "Active flammability"
Maintenance	<p>Make periodic inspections of the capacitors.</p> <p>Before the inspection, make sure that the power supply is turned off and carefully discharge the electricity of the capacitors.</p> <p>Do not apply any mechanical stress to the capacitor terminals.</p>	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 $\leq 75\%$.	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"

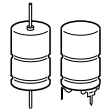


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High reliability – up to 150 °C

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 · π · f	Kreisfrequenz; 2 · π · f

Note

All dimensions are given in mm.

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