

Aluminum electrolytic capacitors

Single-ended capacitors

Series/Type: **B41859**
Date: November 2012

Long-life grade capacitors

Applications

- Automotive electronics
- For use in output circuits of switch-mode power supplies of compact design
- For professional industrial electronics, telecommunications and data processing equipment

Features

- Very low impedance at high frequency
- Very low ESR
- High ripple current capability
- RoHS-compatible

Construction

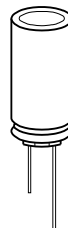
- Radial leads
- Charge-discharge proof, polar
- Aluminum case with insulating sleeve
- Minus pole marking on the insulating sleeve
- Case with safety vent

Delivery mode

Terminal configurations and packing:

- Bulk
- Taped, Ammo pack
- Cut
- Kinked
- PAPR (protection against polarity reversal):
crimped leads, J leads, bent leads

Refer to chapter "Single-ended capacitors – Taping, packing and lead configurations" for further details.





B41859

Very low impedance – 105 °C

Specifications and characteristics in brief

Rated voltage V_R	16 ... 50 V DC			
Surge voltage V_S	$1.15 \cdot V_R$			
Rated capacitance C_R	100 ... 3300 μ F			
Capacitance tolerance	$\pm 20\% \triangle M$			
Dissipation factor $\tan \delta$ (20 °C, 120 Hz)	For capacitance higher than 1000 μ F add 0.02 for every increase of 1000 μ F.			
	V_R (V DC)	16	25	35
	$\tan \delta$ (max.)	0.16	0.14	0.12
Leakage current I_{leak} (20 °C, 5 min)	$I_{leak} = 0.01 \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{V_R}{V} \right)$			
Self-inductance ESL	Diameter (mm)	8 ... 12.5	16	
	ESL (nH)	20	26	
Useful life ¹⁾ 105 °C; V_R ; $I_{AC,R}$	> 2000 h for d = 8 mm > 3000 h for d = 10 mm > 5000 h for d $\geq$ 12.5 mm			
Requirements	$\Delta C/C \leq \pm 40\%$ of initial value $\tan \delta \leq 3$ times initial specified limit $I_{leak} \leq$ initial specified limit			
Voltage endurance test 105 °C; V_R	2000 h for d = 8 mm 3000 h for d = 10 mm 5000 h for d $\geq$ 12.5 mm			
Post test requirements	$\Delta C/C \leq \pm 30\%$ of initial value $\tan \delta \leq 2$ times initial specified limit $I_{leak} \leq$ 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 rigidly clamped by the aluminum case.			
IEC climatic category	To IEC 60068-1: 40/105/56 (–40 °C/+105 °C/56 days damp heat test)			
Sectional specification	IEC 60384-4			

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



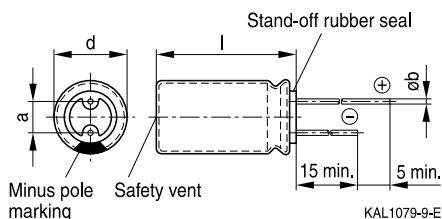
B41859

Very low impedance – 105 °C

Dimensional drawings

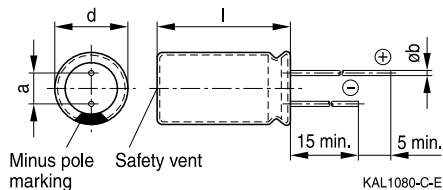
With stand-off rubber seal

Diameters (mm): 10, 12.5, 16



With flat rubber seal

Diameter (mm): 8



Dimensions and weights

Dimensions (mm)				Approx. weight
d +0.5	l	a ±0.5	b	g
8	11.5 +1.5	3.5	0.60 ±0.05	1.0
10	12.5 +1.0	5.0	0.60 ±0.05	1.6
10	16 +1.0	5.0	0.60 ±0.05	1.9
10	20 +2.0	5.0	0.60 ±0.05	2.6
12.5	20 +2.0	5.0	0.60 ±0.05	3.6
12.5	25 +2.0	5.0	0.60 ±0.05	4.5
16	20 +2.0	7.5	0.80 ±0.05	5.5
16	25 +2.0	7.5	0.80 ±0.05	7.5



Overview of available types

V _R (V DC)	16	25	35	50
	Case dimensions d × l (mm)			
C _R (μF)				
100			8 × 11.5	8 × 11.5
120			8 × 11.5	
150			8 × 11.5	10 × 12.5
180		8 × 11.5	10 × 12.5	
220		8 × 11.5	10 × 12.5	10 × 16
270	8 × 11.5	10 × 12.5		10 × 20
330	8 × 11.5	10 × 12.5	10 × 16	10 × 20
470	10 × 12.5	10 × 16	10 × 20	12.5 × 20
560	10 × 16	10 × 16	10 × 20	12.5 × 25
680	10 × 16	10 × 20	12.5 × 20	16 × 20
820		10 × 20		16 × 20
1000	10 × 20	12.5 × 20	12.5 × 25 16 × 20	16 × 25
1200	10 × 20		16 × 20	
1500	12.5 × 20	12.5 × 25	16 × 25	
1800	12.5 × 25	16 × 20		
2200	12.5 × 25	16 × 25		
2700	16 × 20			
3300	16 × 25			

Other voltage and capacitance ratings are available upon request.



B41859

Very low impedance – 105 °C

Technical data and ordering codes

C_R	Case dimensions	Z_{max}	Z_{max}	$I_{AC,R}$	Ordering code
120 Hz	$d \times l$	100 kHz	100 kHz	100 kHz	(composition see below)
20 °C	mm	– 10 °C	20 °C	105 °C	
μF		Ω	Ω	mA	

$V_R = 16 \text{ V DC}$

270	8 × 11.5	0.190	0.056	945	B41859C4277M***
330	8 × 11.5	0.190	0.056	945	B41859C4337M***
470	10 × 12.5	0.140	0.039	1330	B41859C4477M***
560	10 × 16	0.100	0.028	1760	B41859C4567M***
680	10 × 16	0.100	0.028	1760	B41859C4687M***
1000	10 × 20	0.060	0.020	1960	B41859C4108M***
1200	10 × 20	0.060	0.020	1960	B41859C4128M***
1500	12.5 × 20	0.043	0.017	2480	B41859C4158M***
1800	12.5 × 25	0.038	0.015	2900	B41859C4188M***
2200	12.5 × 25	0.038	0.015	2900	B41859C4228M***
2700	16 × 20	0.038	0.015	3250	B41859C4278M***
3300	16 × 25	0.035	0.013	3630	B41859C4338M***

$V_R = 25 \text{ V DC}$

180	8 × 11.5	0.190	0.056	945	B41859C5187M***
220	8 × 11.5	0.190	0.056	945	B41859C5227M***
270	10 × 12.5	0.140	0.039	1330	B41859C5277M***
330	10 × 12.5	0.140	0.039	1330	B41859C5337M***
470	10 × 16	0.100	0.028	1760	B41859C5477M***
560	10 × 16	0.100	0.028	1760	B41859C5567M***
680	10 × 20	0.060	0.020	1960	B41859C5687M***
820	10 × 20	0.060	0.020	1960	B41859C5827M***
1000	12.5 × 20	0.043	0.017	2480	B41859C5108M***
1500	12.5 × 25	0.038	0.015	2900	B41859C5158M***
1800	16 × 20	0.038	0.015	3250	B41859C5188M***
2200	16 × 25	0.035	0.013	3630	B41859C5228M***

Composition of ordering code

*** = Version

- 000 = for standard leads, bulk
- 001 = for kinked leads, bulk (for $d \times l = 10 \times 20 \text{ mm}$ and $\varnothing 12.5 \dots 16 \text{ mm}$)
- 002 = for cut leads, bulk (for $\varnothing 10 \dots 16 \text{ mm}$)
- 003 = for crimped leads, blister (for $\varnothing 16 \text{ mm}$)
- 004 = for J leads, blister (for $\varnothing 10 \dots 16 \text{ mm}$)
- 006 = for taped leads, Ammo pack, lead spacing $F = 3.5 \text{ mm}$ (for $\varnothing 8 \text{ mm}$)
- 008 = for taped leads, Ammo pack, lead spacing $F = 5.0 \text{ mm}$ (for $\varnothing 8 \dots 12.5 \text{ mm}$)
- 009 = for taped leads, Ammo pack, lead spacing $F = 7.5 \text{ mm}$ (for $\varnothing 16 \text{ mm}$)
- 012 = for bent 90° leads, blister (for $\varnothing 16 \text{ mm}$)


B41859
Very low impedance – 105 °C
Technical data and ordering codes

C_R 120 Hz 20 °C μF	Case dimensions $d \times l$ mm	Z_{max} 100 kHz –10 °C Ω	Z_{max} 100 kHz 20 °C Ω	$I_{AC,R}$ 100 kHz 105 °C mA	Ordering code (composition see below)
$V_R = 35 V DC$					
100	8 × 11.5	0.190	0.056	945	B41859C7107M***
120	8 × 11.5	0.190	0.056	945	B41859C7127M***
150	8 × 11.5	0.190	0.056	945	B41859C7157M***
180	10 × 12.5	0.140	0.039	1330	B41859C7187M***
220	10 × 12.5	0.140	0.039	1330	B41859C7227M***
330	10 × 16	0.100	0.028	1760	B41859C7337M***
470	10 × 20	0.060	0.020	1960	B41859C7477M***
560	10 × 20	0.060	0.020	1960	B41859C7567M***
680	12.5 × 20	0.043	0.017	2480	B41859C7687M***
1000	12.5 × 25	0.038	0.015	2900	B41859C7108M***
1000	16 × 20	0.038	0.015	3250	B41859D7108M***
1200	16 × 20	0.038	0.015	3250	B41859C7128M***
1500	16 × 25	0.035	0.013	3630	B41859C7158M***
$V_R = 50 V DC$					
100	8 × 11.5	0.220	0.074	724	B41859C6107M***
150	10 × 12.5	0.180	0.061	979	B41859C6157M***
220	10 × 16	0.120	0.042	1370	B41859C6227M***
270	10 × 20	0.090	0.030	1580	B41859C6277M***
330	10 × 20	0.090	0.030	1580	B41859C6337M***
470	12.5 × 20	0.068	0.027	2050	B41859C6477M***
560	12.5 × 25	0.059	0.023	2410	B41859C6567M***
680	16 × 20	0.059	0.023	2730	B41859C6687M***
820	16 × 20	0.059	0.023	2730	B41859C6827M***
1000	16 × 25	0.056	0.021	3010	B41859C6108M***

Composition of ordering code

*** = Version

- 000 = for standard leads, bulk
- 001 = for kinked leads, bulk (for $d \times l = 10 \times 20$ mm and $\varnothing 12.5 \dots 16$ mm)
- 002 = for cut leads, bulk (for $\varnothing 10 \dots 16$ mm)
- 003 = for crimped leads, blister (for $\varnothing 16$ mm)
- 004 = for J leads, blister (for $\varnothing 10 \dots 16$ mm)
- 006 = for taped leads, Ammo pack, lead spacing $F = 3.5$ mm (for $\varnothing 8$ mm)
- 008 = for taped leads, Ammo pack, lead spacing $F = 5.0$ mm (for $\varnothing 8 \dots 12.5$ mm)
- 009 = for taped leads, Ammo pack, lead spacing $F = 7.5$ mm (for $\varnothing 16$ mm)
- 012 = for bent 90° leads, blister (for $\varnothing 16$ mm)



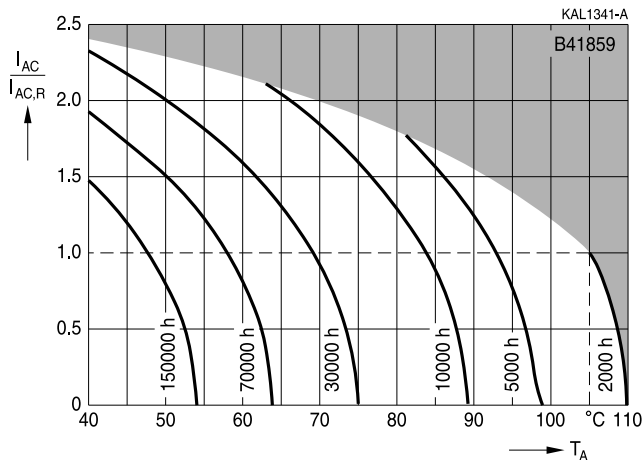
B41859

Very low impedance – 105 °C

Useful life¹⁾

depending on ambient temperature T_A under ripple current operating conditions

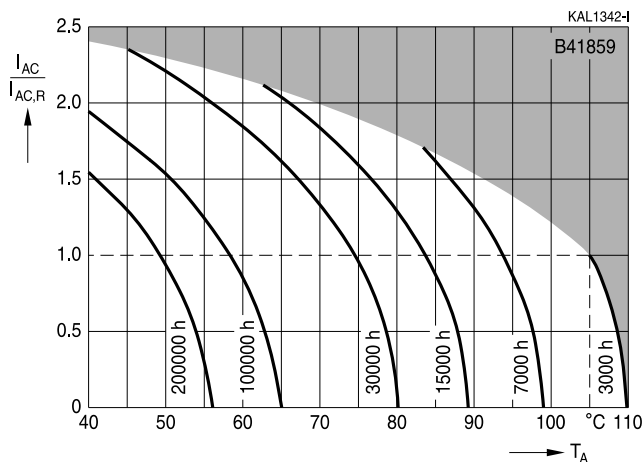
$d = 8 \text{ mm}$



Useful life¹⁾

depending on ambient temperature T_A under ripple current operating conditions

$d = 10 \text{ mm}$



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



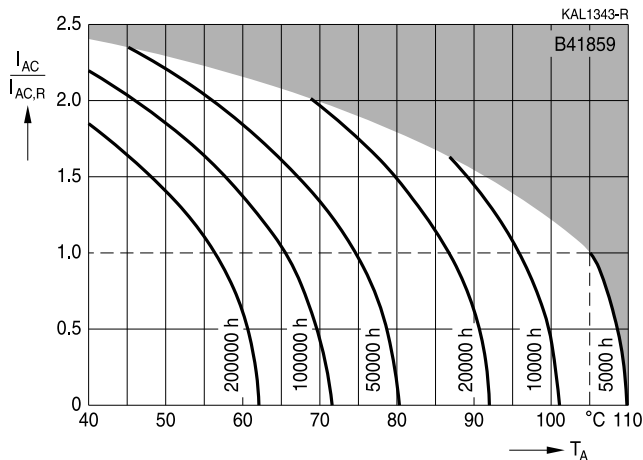
B41859

Very low impedance – 105 °C

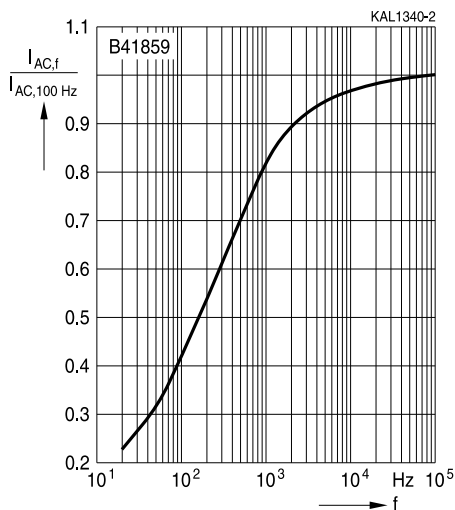
Useful life¹⁾

depending on ambient temperature T_A under ripple current operating conditions

$d \geq 12.5$ mm



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



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



B41859

Very low impedance – 105 °C

Taping, packing and lead configurations

Taping

Single-ended capacitors are available taped in Ammo pack from diameter 8 to 18 mm as follows:

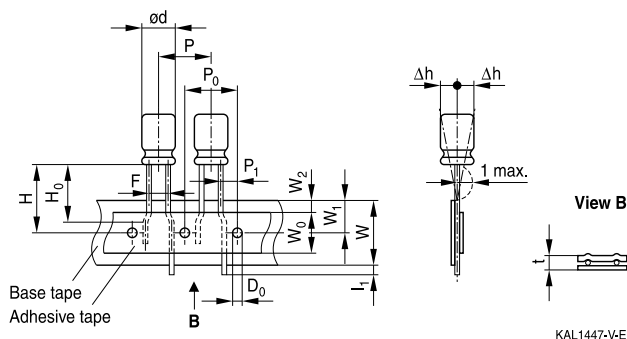
Lead spacing $F = 3.5$ mm ($\varnothing d = 8$ mm)

Lead spacing $F = 5.0$ mm ($\varnothing d = 8 \dots 12.5$ mm)

Lead spacing $F = 7.5$ mm ($\varnothing d = 16 \dots 18$ mm).

Lead spacing 3.5 mm ($\varnothing d = 8$ mm)

Last 3 digits of ordering code: 006



KAL1447-V-E

Dimensions in mm

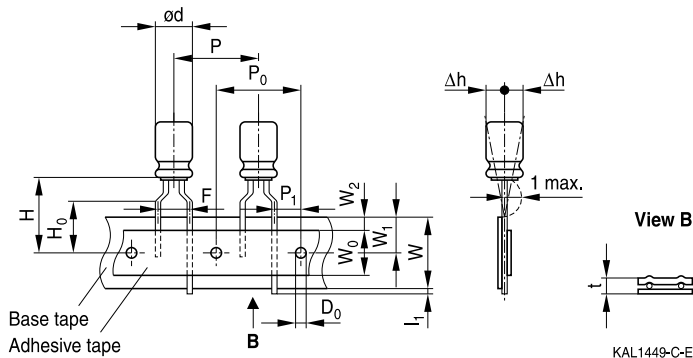
$\varnothing d$	F	H	W	W_0	W_1	W_2	P	P_0	P_1	L_1	t	Δh	D_0
8	3.5	18.5	18.0	9.5	9.0	3.0	12.7	12.7	4.6	1.0	0.7	1.0	4.0
Tolerance	+0.8 -0.2	±1.0	±0.5	min.	±0.5	max.	±1.0	±0.3	±0.6	max.	±0.2	max.	±0.2

Leads can also run straight through the taping area.



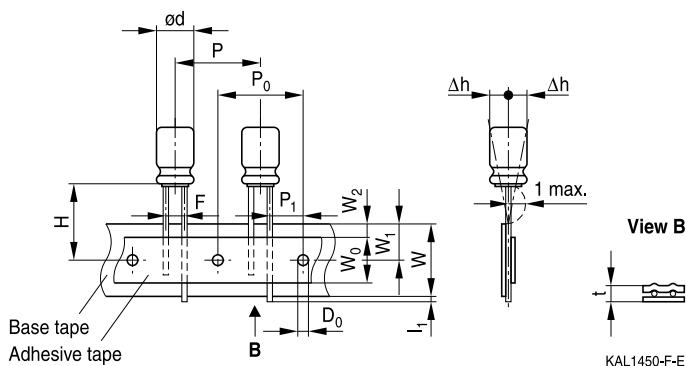
Lead spacing 5.0 mm (Ø d = 8 mm)

Last 3 digits of ordering code: 008



Lead spacing 5.0 mm (Ø d = 10 ... 12.5 mm)

Last 3 digits of ordering code: 008



Dimensions in mm

Ø d	F	H	W	W ₀	W ₁	W ₂	H ₀	P	P ₀	P ₁	l ₁	t	Δh	D ₀
4 ... 6.3	5.0	18.5	18.0	5.5	9.0	1.5	16.0	12.7	12.7	3.85	1.0	0.6	1.0	4.0
8	5.0	20.0	18.0	9.5	9.0	1.5	16.0	12.7	12.7	3.85	1.0	0.6	1.0	4.0
10		19.0		9.5			—	12.7	12.7	3.85				
12.5		19.0		11.5			—	15.0	15.0	5.0				
Tolerance	+0.8 -0.2	±0.75	±0.5	min.	±0.5	max.	±0.5	±1.0	±0.2	±0.5	max.	+0.3 -0.2	max.	±0.2

Taping is available up to dimensions d × l = 12.5 × 25 mm.

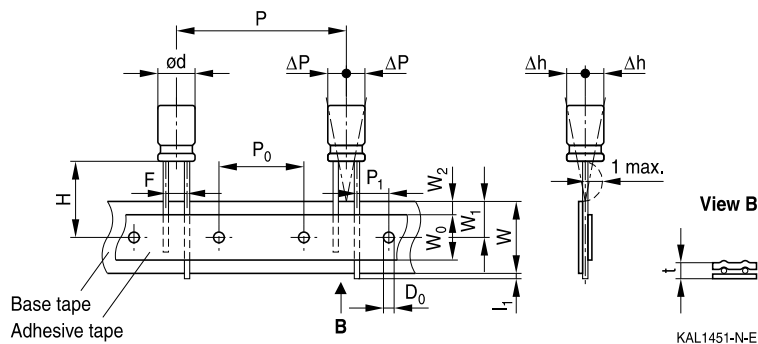


B41859

Very low impedance – 105 °C

Lead spacing 7.5 mm ($\varnothing d = 16 \dots 18$ mm)

Last 3 digits of ordering code: 009



Dimensions in mm

$\varnothing d$	F	H	W	W_0	W_1	W_2	P	P_0	P_1	L_1	t	ΔP	Δh	D_0
16	7.5	18.5	18.0	12.5	9.0	1.5	30.0	15.0	3.75	1.0	0.7	0	0	4.0
18														
Tolerance	± 0.8	-0.5 $+0.75$	± 0.5	min.	± 0.5	max.	± 1.0	± 0.2	± 0.5	max.	± 0.2	± 1.0	± 1.0	± 0.2

Taping is available up to dimensions $d \times l = 16 \times 31.5$ mm and 18×31.5 mm.



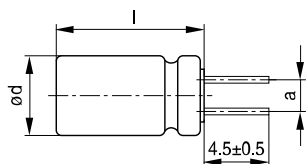
Cut or kinked leads

Single-ended capacitors are available with cut or kinked leads. Other lead configurations also available upon request.

Cut leads

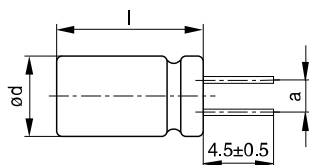
Last 3 digits of ordering code: 002

With stand-off rubber seal



KAL1085-I

With flat rubber seal



KAL1086-R

Case size $d \times l$ (mm)	Dimensions (mm) $a \pm 0.5$
10 × 12.5	5.0
10 × 16	5.0
10 × 20	5.0
12.5 × 20	5.0
12.5 × 25	5.0
16 × 20	7.5
16 × 25	7.5
16 × 31.5	7.5
16 × 35.5	7.5
18 × 20	7.5
18 × 25	7.5
18 × 31.5	7.5
18 × 35	7.5
18 × 40	7.5



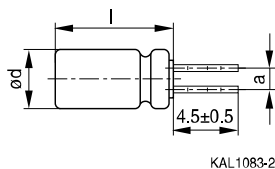
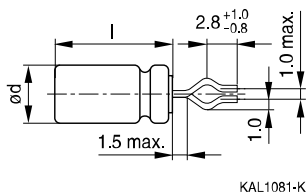
B41859

Very low impedance – 105 °C

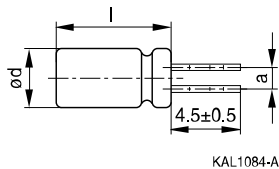
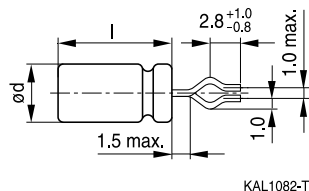
Kinked leads

Last 3 digits of ordering code: 001

With stand-off rubber seal



With flat rubber seal



Case size d × l (mm)	Dimensions (mm) a ±0.5
10 × 20	5.0
12.5 × 20	5.0
12.5 × 25	5.0
16 × 20	7.5
16 × 25	7.5
16 × 31.5	7.5
16 × 35.5	7.5
18 × 20	7.5
18 × 25	7.5
18 × 31.5	7.5
18 × 35	7.5
18 × 40	7.5



PAPR leads (Protection Against Polarity Reversal)

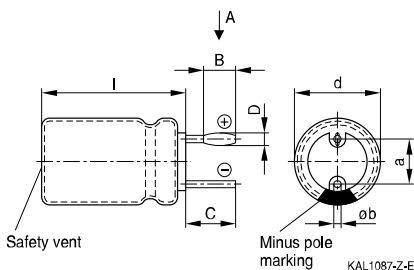
These lead configurations ensure correct placement of the capacitor on the PCB with regard to polarity. PAPR leads are available for diameters from 10 mm up to 18 mm (excluding $d \times l = 12.5 \times 30/35/40$ mm).

There are three configurations available: Crimped leads, J leads, bent 90° leads

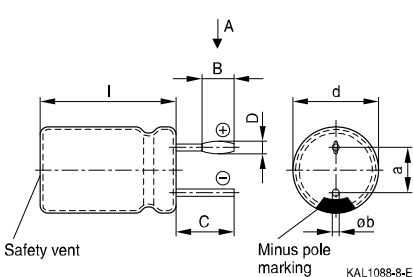
Crimped leads

Last 3 digits of ordering code: 003

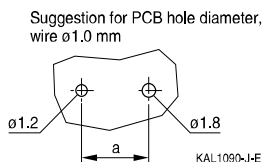
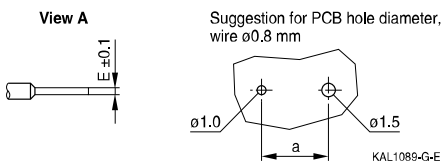
With stand-off rubber seal



With flat rubber seal



Suggestion for PCB hole diameter



Case size $d \times l$ (mm)	Dimensions (mm)					
	B ± 0.2	C ± 0.5	D ± 0.1	E ± 0.1	a ± 0.5	$\varnothing b$
16 $\times$ 20	1.5	3.0	1.3	0.3	7.5	0.8 ± 0.05
16 $\times$ 25	1.5	3.0	1.3	0.3	7.5	0.8 ± 0.05
16 $\times$ 31.5	1.5	3.0	1.3	0.3	7.5	0.8 ± 0.05
16 $\times$ 35.5	1.5	3.0	1.3	0.3	7.5	0.8 ± 0.05
18 $\times$ 20	1.5	3.0	1.3	0.3	7.5	0.8 ± 0.1
18 $\times$ 25	1.5	3.0	1.3	0.3	7.5	0.8 ± 0.1
18 $\times$ 31.5	1.5	3.0	1.3	0.3	7.5	0.8 ± 0.1
18 $\times$ 35	1.5	3.0	1.3	0.3	7.5	0.8 ± 0.1
18 $\times$ 40	1.5	3.0	1.3	0.3	7.5	0.8 ± 0.1

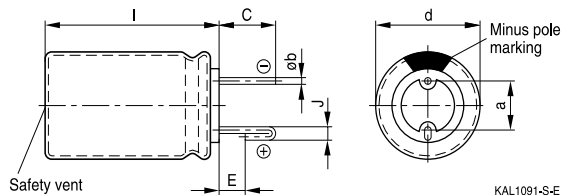


B41859

Very low impedance – 105 °C

J leads

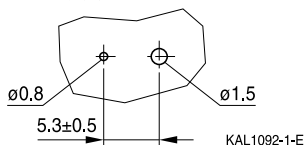
Last 3 digits of ordering code: 004



KAL1091-S-E

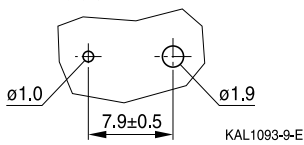
Suggestion for PCB hole diameter

Suggestion for PCB hole diameter,
wire $\varnothing 0.6$ mm



KAL1092-1-E

Suggestion for PCB hole diameter,
wire $\varnothing 0.8$ mm



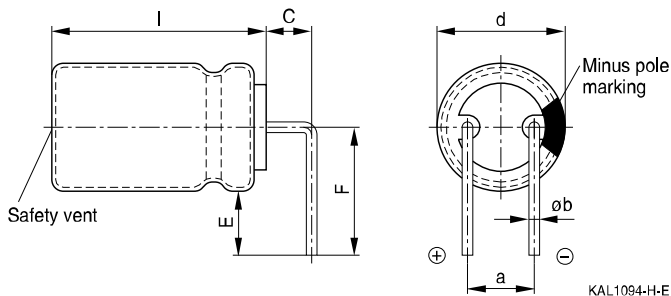
KAL1093-9-E

Case size $d \times l$ (mm)	Dimensions (mm)				
	$C \pm 0.5$	$E \pm 0.5$	$J \pm 0.2$	$a \pm 0.5$	$\varnothing b$
10×12.5	3.2	0.7	1.2	5.0	0.6 ± 0.05
10×16	3.2	0.7	1.2	5.0	0.6 ± 0.05
10×20	3.2	0.7	1.2	5.0	0.6 ± 0.05
12.5×20	3.2	0.7	1.2	5.0	0.6 ± 0.05
12.5×25	3.2	0.7	1.2	5.0	0.6 ± 0.05
16×20	3.5	0.7	1.6	7.5	0.8 ± 0.05
16×25	3.5	0.7	1.6	7.5	0.8 ± 0.05
16×31.5	3.5	0.7	1.6	7.5	0.8 ± 0.05
16×35.5	3.5	0.7	1.6	7.5	0.8 ± 0.05
18×20	3.5	0.7	1.6	7.5	0.8 ± 0.1
18×25	3.5	0.7	1.6	7.5	0.8 ± 0.1
18×31.5	3.5	0.7	1.6	7.5	0.8 ± 0.1
18×35	3.5	0.7	1.6	7.5	0.8 ± 0.1



Bent 90° leads for horizontal mounting pinning

Last 3 digits of ordering code: 012



Case size d × l (mm)	Dimensions (mm)				
	C ±0.5	E ±0.5	F ±0.5	a ±0.5	Øb
16 × 20	4.0	4.0	12.0	7.5	0.8 ±0.05
16 × 25	4.0	4.0	12.0	7.5	0.8 ±0.05
16 × 31.5	4.0	4.0	12.0	7.5	0.8 ±0.05
16 × 35.5	4.0	4.0	12.0	7.5	0.8 ±0.05
18 × 20	4.0	4.0	13.0	7.5	0.8 ±0.1
18 × 25	4.0	4.0	13.0	7.5	0.8 ±0.1
18 × 31.5	4.0	4.0	13.0	7.5	0.8 ±0.1
18 × 35	4.0	4.0	13.0	7.5	0.8 ±0.1
18 × 40	4.0	4.0	13.0	7.5	0.8 ±0.1

Bent leads for diameter 12.5 mm available upon request.

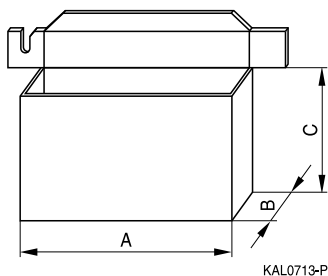


B41859

Very low impedance – 105 °C

Packing units and box dimensions

Ammo pack



Case size $d \times l$ mm	Dimensions (mm)			Packing units pcs.
	$A_{\max}$	$B_{\max}$	$C_{\max}$	
8×11.5	345	55	240	1000
10×12.5	345	55	280	750
10×16	345	60	200	500
10×20	345	60	200	500
12.5×20	345	65	280	500
12.5×25	345	65	280	500
16×20	315	65	275	300
16×25	315	65	275	300
16×31.5	315	65	275	300
18×20	315	65	275	250
18×25	315	65	275	250
18×31.5	315	65	275	250



Overview of packing units and code numbers for case sizes 8 × 11.5 ... 16 × 35.5

						PAPR			
Case size d × l	Stan- dard, bulk	Taped, Ammo pack			Kinked leads, bulk	Cut leads, bulk	Crimped leads, blister	J leads, blister	Bent 90° leads, blister
mm	pcs.	pcs.			pcs.	pcs.	pcs.	pcs.	pcs.
8 × 11.5	1000	1000			—	—	—	—	
10 × 12.5	1000	750			—	1000	—	675	
10 × 16	1000	500			—	1000	—	675	
10 × 20	500	500			500	500	—	500	
12.5 × 20	350	500			350	350	—	300	1)
12.5 × 25	250	500			500	500	—	225	1)
12.5 × 30	200	—			—	—	—	—	
12.5 × 35	175	—			—	—	—	—	
12.5 × 40	175	—			—	—	—	—	
16 × 20	250	300			200	200	200	200	120
16 × 25	250	300			200	200	200	200	216
16 × 31.5	200	300			250	250	344	344	180
16 × 35.5	100	—			100	100	150	150	150
The last three digits of the complete ordering code state the lead configuration	000	Code	F (mm)	d (mm)	001	002	003	004	012
		006	3.5	8					
		008	5	8...12.5					
		009	7.5	16...18					

1) Available upon request



B41859

Very low impedance – 105 °C

Overview of packing units and code numbers for case sizes 18 × 20 ... 18 × 40

						PAPR			
Case size d × l mm	Stan- dard, bulk pcs.	Taped, Ammo pack pcs.			Kinked leads, bulk pcs.	Cut leads, bulk pcs.	Crimped leads, blister pcs.	J leads, blister pcs.	Bent 90° leads, blister pcs.
18 × 20	175	250			175	175	200	200	120
18 × 25	150	250			150	150	200	200	120
18 × 31.5	100	250			100	100	150	150	120
18 × 35	100	—			100	100	150	150	150
18 × 40	125	—			100	100	120	—	72
The last three digits of the complete ordering code state the lead configuration	000	Code	F (mm)	d (mm)	001	002	003	004	012
		009	7.5	16...18					



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.


B41859
Very low impedance – 105 °C

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"



B41859

Very low impedance – 105 °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 $\leq 75\%$.	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"



B41859

Very low impedance – 105 °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.

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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