

# **Aluminum electrolytic capacitors**

## Capacitors with screw terminals

**Series/Type:**        **B41456, B41458**

**Date:**                December 2019

## Long-life grade capacitors

### Applications

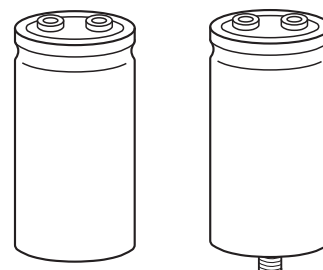
- General industrial electronics
- For switch-mode power supplies in professional equipment

### Features

- High ripple current capability
- Compact design
- High reliability
- Long useful life
- All-welded construction ensures reliable electrical contact
- Version with low-inductance design available
- RoHS-compatible

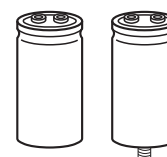
### Construction

- Charge-discharge proof, polar
- Aluminum case, insulated with PET sleeve
- Types with threaded stud are available with or without insulated base
- Versions with PVC insulation available upon request
- Poles with screw terminal connections
- Mounting with ring clips, clamps or threaded stud



B41456

B41458



## Specifications and characteristics in brief

|                                                                                               |                                                                                                                                                                                                                                     |                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rated voltage $V_R$                                                                           | 16 ... 100 V DC                                                                                                                                                                                                                     |                                                                                                                                                                        |
| Surge voltage $V_S$                                                                           | $1.15 \cdot V_R$                                                                                                                                                                                                                    |                                                                                                                                                                        |
| Rated capacitance $C_R$                                                                       | 10000 ... 680000 $\mu\text{F}$                                                                                                                                                                                                      |                                                                                                                                                                        |
| Capacitance tolerance                                                                         | $\pm 20\% \triangleq M$                                                                                                                                                                                                             |                                                                                                                                                                        |
| Leakage current $I_{\text{leak}}$<br>(20 °C, 5 min)                                           | $I_{\text{leak}} \leq 0.020 \mu\text{A} \cdot \left( \frac{C_R}{\mu\text{F}} \cdot \frac{V_R}{V} \right)^{0.85} + 4 \mu\text{A}$                                                                                                    |                                                                                                                                                                        |
| Self-inductance ESL                                                                           | Approx. 20 nH<br>Capacitors with low-inductance design:<br>$d \geq 64.3 \text{ mm}$ : approx. 13 nH                                                                                                                                 |                                                                                                                                                                        |
| Useful life <sup>1)</sup><br>85 °C; $V_R$ ; $I_{AC,R}$<br>40 °C; $V_R$ ; $2.9 \cdot I_{AC,R}$ | > 12000 h<br>> 200000 h                                                                                                                                                                                                             | Requirements:<br>$ \Delta C/C  \leq 45\%$ of initial value<br>ESR $\leq 3$ times initial specified limit<br>$I_{\text{leak}} \leq$ initial specified limit             |
| Voltage endurance test<br>85 °C; $V_R$                                                        | 2000 h                                                                                                                                                                                                                              | Post test requirements:<br>$ \Delta C/C  \leq 15\%$ of initial value<br>ESR $\leq 1.3$ times initial specified limit<br>$I_{\text{leak}} \leq$ initial specified limit |
| Vibration resistance test                                                                     | To IEC 60068-2-6, test Fc:<br>Frequency range 10 ... 55 Hz, displacement amplitude 0.75 mm,<br>acceleration max. 10 g, duration $3 \times 2 \text{ h}$ .<br>Capacitor rigidly clamped by the case, e.g. using our standard fixture. |                                                                                                                                                                        |
| IEC climatic category                                                                         | To IEC 60068-1:<br>40/085/56 (–40 °C/+85 °C/56 days damp heat test)                                                                                                                                                                 |                                                                                                                                                                        |
| Sectional specification                                                                       | IEC 60384-4                                                                                                                                                                                                                         |                                                                                                                                                                        |

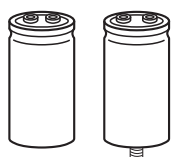
## Ripple current capability

Due to the ripple current capability of the capacitor contact elements, the following current upper limits must not be exceeded in case of the absence of any forced cooling around the capacitor and its contact elements:

|                    |         |         |         |
|--------------------|---------|---------|---------|
| Capacitor diameter | 51.6 mm | 64.3 mm | 76.9 mm |
| $I_{AC,max}$       | 34 A    | 45 A    | 57 A    |

In the event of the availability of cooling (e.g. forced air around the capacitor body, forced air around the contact elements, capacitor base cooling by a heat sink) however above limits may be exceeded depending on the cooling conditions. For details please contact our sales offices.

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



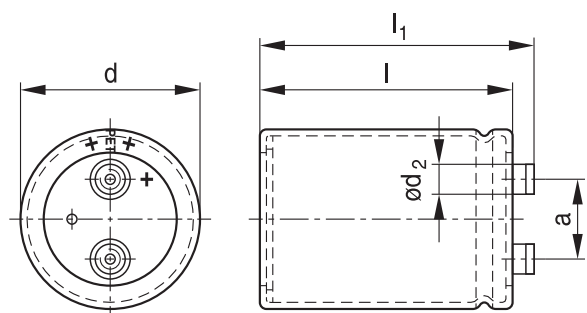
**B41456, B41458**

**85 °C**

## Dimensional drawings

### B41456

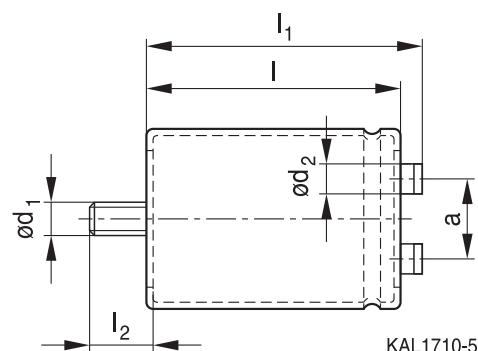
Ring clip/clamp mounting



Positive pole marking: +

### B41458

Threaded stud mounting



For standard types with threaded stud the base is not insulated. Also refer to the mounting instructions in chapter "Capacitors with screw terminals – accessories" on page 15.

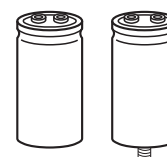
Screw terminals with UNF threads are available upon request.

For information regarding dimensions and weights, packing, special designs and design options, refer to chapter "Capacitors with screw terminals – general information" on page 8.

## Overview of available types

The capacitance and voltage ratings listed below are available in different case sizes upon request. Other voltage and capacitance ratings are also available upon request.

| $V_R$ (V DC) | 16                                | 25           | 40           | 63           | 100          |
|--------------|-----------------------------------|--------------|--------------|--------------|--------------|
|              | Case dimensions $d \times l$ (mm) |              |              |              |              |
| $C_R$ (μF)   |                                   |              |              |              |              |
| 10000        |                                   |              |              |              | 51.6 × 80.7  |
| 15000        |                                   |              |              |              | 51.6 × 105.7 |
| 22000        |                                   |              |              | 51.6 × 80.7  | 64.3 × 105.7 |
| 33000        |                                   |              |              | 51.6 × 105.7 | 76.9 × 105.7 |
| 47000        |                                   |              | 51.6 × 80.7  | 64.3 × 105.7 | 76.9 × 143.2 |
| 68000        |                                   | 51.6 × 80.7  | 51.6 × 105.7 | 76.9 × 105.7 |              |
| 100000       | 51.6 × 80.7                       | 51.6 × 105.7 | 64.3 × 105.7 | 76.9 × 143.2 |              |
| 150000       | 51.6 × 80.7                       | 64.3 × 105.7 | 76.9 × 105.7 | 76.9 × 220.7 |              |
| 220000       | 64.3 × 105.7                      | 64.3 × 105.7 | 76.9 × 143.2 |              |              |
| 330000       | 64.3 × 105.7                      | 76.9 × 143.2 |              |              |              |
| 470000       | 76.9 × 143.2                      | 76.9 × 220.7 |              |              |              |
| 680000       | 76.9 × 143.2                      |              |              |              |              |


**Technical data and ordering codes**

| $C_R$<br>100 Hz<br>20 °C<br>$\mu\text{F}$  | Case<br>dimensions<br>$d \times l$<br>mm | $\text{ESR}_{\text{typ}}$<br>100 Hz<br>20 °C<br>$\text{m}\Omega$ | $\text{ESR}_{\text{max}}$<br>100 Hz<br>20 °C<br>$\text{m}\Omega$ | $Z_{\text{max}}$<br>10 kHz<br>20 °C<br>$\text{m}\Omega$ | $I_{\text{AC,max}}$<br>100 Hz<br>40 °C<br>A | $I_{\text{AC,R}}$<br>100 Hz<br>85 °C<br>A | Ordering code<br>(composition see<br>below) |
|--------------------------------------------|------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------|---------------------------------------------------------|---------------------------------------------|-------------------------------------------|---------------------------------------------|
| <b><math>V_R = 16 \text{ V DC}</math></b>  |                                          |                                                                  |                                                                  |                                                         |                                             |                                           |                                             |
| 100000                                     | 51.6 × 80.7                              | 5.0                                                              | 10                                                               | 8.2                                                     | 34                                          | 14                                        | B4145*B4100M60#                             |
| 150000                                     | 51.6 × 80.7                              | 4.2                                                              | 8.4                                                              | 6.8                                                     | 34                                          | 15                                        | B4145*B4150M60#                             |
| 220000                                     | 64.3 × 105.7                             | 3.7                                                              | 7.3                                                              | 5.9                                                     | 45                                          | 20                                        | B4145*B4220M60#                             |
| 330000                                     | 64.3 × 105.7                             | 3.3                                                              | 6.6                                                              | 5.3                                                     | 45                                          | 21                                        | B4145*B4330M60#                             |
| 470000                                     | 76.9 × 143.2                             | 3.0                                                              | 6.1                                                              | 4.9                                                     | 57                                          | 25                                        | B4145*B4470M60#                             |
| 680000                                     | 76.9 × 143.2                             | 3.0                                                              | 5.8                                                              | 4.6                                                     | 57                                          | 26                                        | B4145*B4680M60#                             |
| <b><math>V_R = 25 \text{ V DC}</math></b>  |                                          |                                                                  |                                                                  |                                                         |                                             |                                           |                                             |
| 68000                                      | 51.6 × 80.7                              | 6.0                                                              | 12                                                               | 9.3                                                     | 34                                          | 13                                        | B4145*B5689M60#                             |
| 100000                                     | 51.6 × 105.7                             | 5.0                                                              | 9.5                                                              | 7.6                                                     | 34                                          | 16                                        | B4145*B5100M60#                             |
| 150000                                     | 64.3 × 105.7                             | 4.0                                                              | 8.0                                                              | 6.4                                                     | 45                                          | 20                                        | B4145*B5150M60#                             |
| 220000                                     | 64.3 × 105.7                             | 3.5                                                              | 7.0                                                              | 5.6                                                     | 45                                          | 21                                        | B4145*B5220M60#                             |
| 330000                                     | 76.9 × 143.2                             | 3.2                                                              | 6.4                                                              | 5.1                                                     | 57                                          | 25                                        | B4145*B5330M60#                             |
| 470000                                     | 76.9 × 220.7                             | 3.0                                                              | 4.0                                                              | 4.8                                                     | 57                                          | 31                                        | B4145*B5470M60#                             |
| <b><math>V_R = 40 \text{ V DC}</math></b>  |                                          |                                                                  |                                                                  |                                                         |                                             |                                           |                                             |
| 47000                                      | 51.6 × 80.7                              | 6.0                                                              | 12                                                               | 10                                                      | 34                                          | 13                                        | B4145*B7479M60#                             |
| 68000                                      | 51.6 × 105.7                             | 5.0                                                              | 10                                                               | 8.4                                                     | 34                                          | 16                                        | B4145*B7689M60#                             |
| 100000                                     | 64.3 × 105.7                             | 4.1                                                              | 8.2                                                              | 7.0                                                     | 45                                          | 19                                        | B4145*B7100M60#                             |
| 150000                                     | 76.9 × 105.7                             | 3.0                                                              | 5.5                                                              | 6.0                                                     | 57                                          | 21                                        | B4145*B7150M60#                             |
| 220000                                     | 76.9 × 143.2                             | 3.0                                                              | 5.0                                                              | 5.4                                                     | 57                                          | 25                                        | B4145*B7220M60#                             |
| <b><math>V_R = 63 \text{ V DC}</math></b>  |                                          |                                                                  |                                                                  |                                                         |                                             |                                           |                                             |
| 22000                                      | 51.6 × 80.7                              | 8.0                                                              | 16                                                               | 16                                                      | 33                                          | 11                                        | B4145*B8229M60#                             |
| 33000                                      | 51.6 × 105.7                             | 6.0                                                              | 12                                                               | 12                                                      | 34                                          | 14                                        | B4145*B8339M60#                             |
| 47000                                      | 64.3 × 105.7                             | 5.0                                                              | 10                                                               | 9.4                                                     | 45                                          | 18                                        | B4145*B8479M60#                             |
| 68000                                      | 76.9 × 105.7                             | 3.0                                                              | 5.0                                                              | 6.5                                                     | 57                                          | 20                                        | B4145*B8689M60#                             |
| 100000                                     | 76.9 × 143.2                             | 3.0                                                              | 4.0                                                              | 6.0                                                     | 57                                          | 25                                        | B4145*B8100M60#                             |
| 150000                                     | 76.9 × 220.7                             | 3.0                                                              | 4.0                                                              | 5.0                                                     | 57                                          | 31                                        | B4145*B8150M60#                             |
| <b><math>V_R = 100 \text{ V DC}</math></b> |                                          |                                                                  |                                                                  |                                                         |                                             |                                           |                                             |
| 10000                                      | 51.6 × 80.7                              | 9.0                                                              | 18                                                               | 14                                                      | 30                                          | 10                                        | B4145*B9109M60#                             |
| 15000                                      | 51.6 × 105.7                             | 8.0                                                              | 15                                                               | 12                                                      | 34                                          | 13                                        | B4145*B9159M60#                             |
| 22000                                      | 64.3 × 105.7                             | 5.0                                                              | 10                                                               | 10                                                      | 45                                          | 17                                        | B4145*B9229M60#                             |
| 33000                                      | 76.9 × 105.7                             | 3.0                                                              | 6.0                                                              | 7.0                                                     | 56                                          | 19                                        | B4145*B9339M60#                             |
| 47000                                      | 76.9 × 143.2                             | 3.0                                                              | 5.0                                                              | 6.0                                                     | 57                                          | 24                                        | B4145*B9479M60#                             |

**Composition of ordering code**

\* = Mounting style

6 = for capacitors with ring clip/clamp mounting

8 = for capacitors with threaded stud

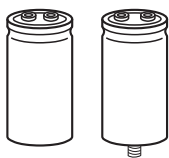
# = Design

0 = standard

3 = low inductance (13 nH)

8 = insulated base

For details refer to "Design options" on page 11.

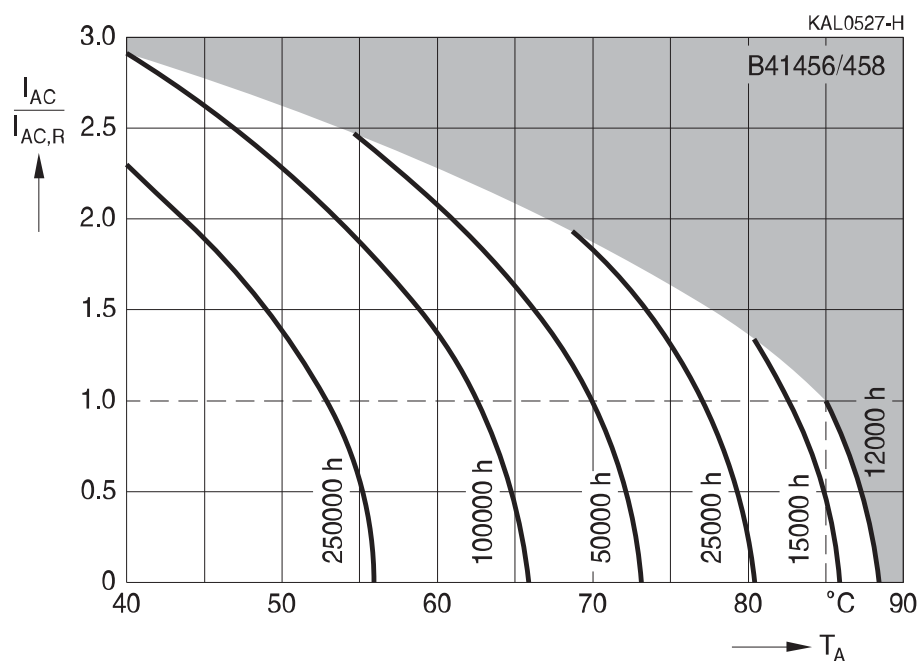


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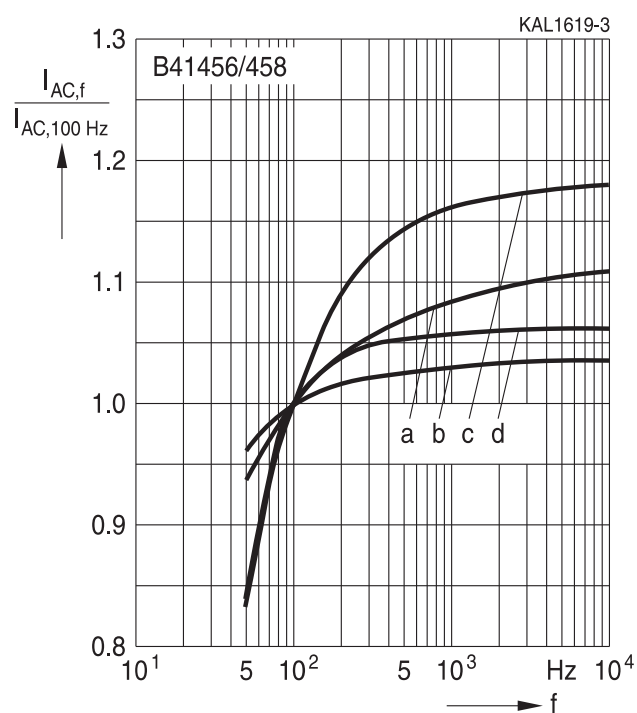
**85 °C**

### Useful life<sup>1)</sup>

depending on ambient temperature  $T_A$  under ripple current operating conditions

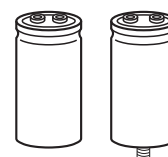


### Frequency factor of permissible ripple current $I_{AC}$ versus frequency $f$



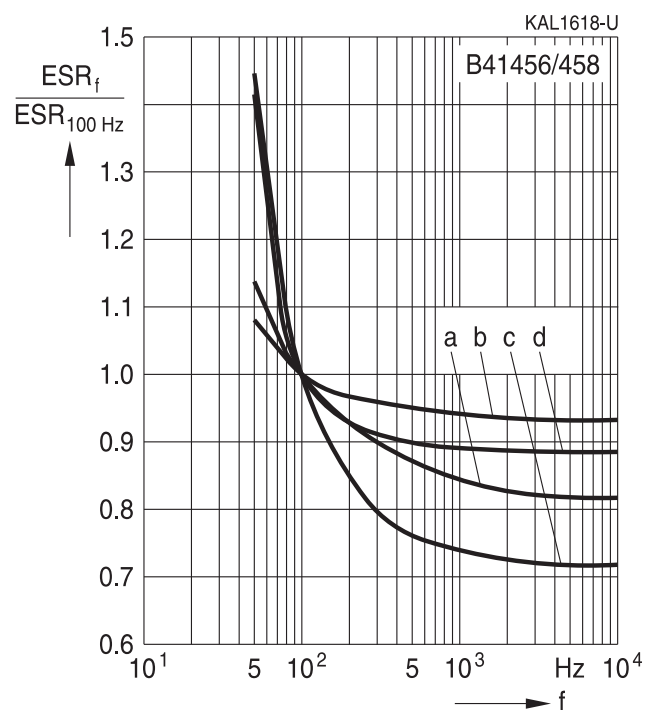
| $V_R$ (V DC)          | $\leq 63$ | 100 |
|-----------------------|-----------|-----|
| $d = 51.6 \text{ mm}$ | a         | c   |
| $d = 64.3 \text{ mm}$ | a         | c   |
| $d = 76.9 \text{ mm}$ | b         | d   |

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



## Frequency characteristics of ESR

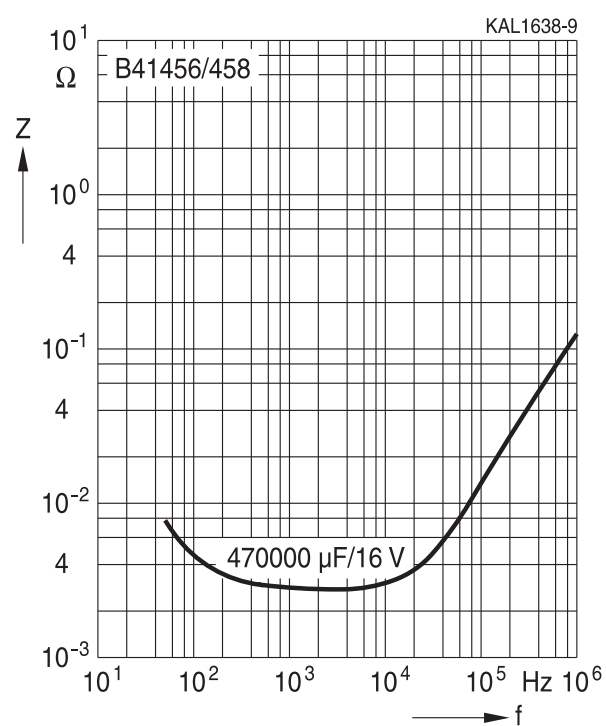
Typical behavior

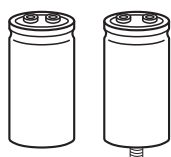


| V <sub>R</sub> (V DC) | ≤ 63 | 100 |
|-----------------------|------|-----|
| d = 51.6 mm           | a    | c   |
| d = 64.3 mm           | a    | c   |
| d = 76.9 mm           | b    | d   |

## Impedance Z versus frequency f

Typical behavior at 20 °C





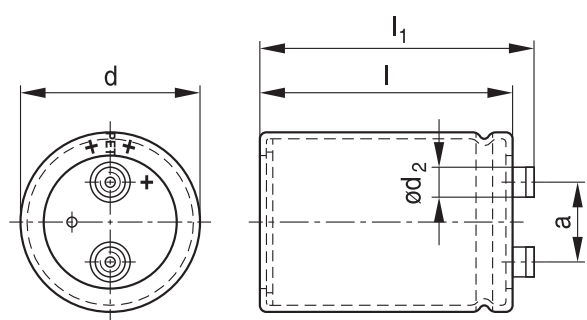
B41456, B41458

85 °C

## Capacitors with screw terminals – general information

### 1 Dimensional drawings

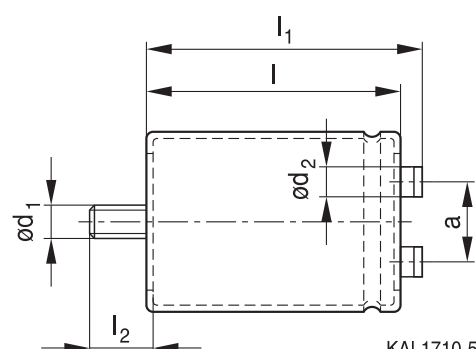
Ring clip/clamp mounting



Positive pole marking: +

KAL1760-6

Threaded stud mounting



KAL1710-5

For standard types with threaded stud the base is not insulated. Also refer to the mounting instructions in chapter "Capacitors with screw terminals – accessories" on page 15.  
Screw terminals with UNF threads are available upon request.

### 2 Dimensions and weights (Standard capacitors, without heat sink, M600)

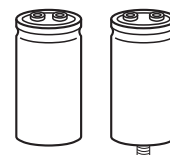
#### 2.1 Capacitors with screw terminals series B43701, B43721

| Ter-<br>minal | Dimensions (mm) with insulating sleeve |       |                   |                      |                |                     |             | Approx.<br>weight (g) |
|---------------|----------------------------------------|-------|-------------------|----------------------|----------------|---------------------|-------------|-----------------------|
|               | d                                      | l ±1  | l <sub>1</sub> ±1 | l <sub>2</sub> +0/-1 | d <sub>1</sub> | d <sub>2</sub> max. | a +0.2/-0.4 |                       |
| M5            | 51.6 +0.5/-1                           | 80.7  | 87.2              | 17                   | M12            | 10.2                | 22.2        | 220                   |
| M5            | 51.6 +0.5/-1                           | 96.7  | 103.2             | 17                   | M12            | 10.2                | 22.2        | 250                   |
| M5            | 51.6 +0.5/-1                           | 105.7 | 112.2             | 17                   | M12            | 10.2                | 22.2        | 280                   |
| M5            | 51.6 +0.5/-1                           | 118.2 | 124.7             | 17                   | M12            | 10.2                | 22.2        | 320                   |
| M5            | 51.6 +0.5/-1                           | 130.7 | 137.2             | 17                   | M12            | 10.2                | 22.2        | 350                   |
| M5            | 64.3 +0.5/-1                           | 80.7  | 87.2              | 17                   | M12            | 13.2                | 28.5        | 370                   |
| M5            | 64.3 +0.5/-1                           | 96.7  | 103.2             | 17                   | M12            | 13.2                | 28.5        | 400                   |
| M5            | 64.3 +0.5/-1                           | 105.7 | 112.2             | 17                   | M12            | 13.2                | 28.5        | 440                   |
| M5            | 64.3 +0.5/-1                           | 118.2 | 124.7             | 17                   | M12            | 13.2                | 28.5        | 510                   |
| M5            | 64.3 +0.5/-1                           | 130.7 | 137.2             | 17                   | M12            | 13.2                | 28.5        | 600                   |
| M5            | 64.3 +0.5/-1                           | 143.2 | 149.7             | 17                   | M12            | 13.2                | 28.5        | 630                   |
| M5            | 76.9 +0.5/-1                           | 96.7  | 103.2             | 17                   | M12            | 13.2                | 31.7        | 570                   |
| M5            | 76.9 +0.5/-1                           | 105.7 | 112.2             | 17                   | M12            | 13.2                | 31.7        | 620                   |
| M5            | 76.9 +0.5/-1                           | 130.7 | 137.2             | 17                   | M12            | 13.2                | 31.7        | 800                   |
| M5            | 76.9 +0.5/-1                           | 156.2 | 162.7             | 17                   | M12            | 13.2                | 31.7        | 920                   |
| M5            | 76.9 +0.5/-1                           | 168.7 | 175.2             | 17                   | M12            | 13.2                | 31.7        | 1000                  |
| M5            | 76.9 +0.5/-1                           | 190.7 | 197.2             | 17                   | M12            | 13.2                | 31.7        | 1150                  |

Min. reach of screw = 9.5 mm

Tolerances of terminal thread respectively stud thread:

- Terminal thread M5: 6H
- Stud thread M12: 6g



## 2.2 Capacitors with screw terminals series

| Ter-<br>minal | Dimensions (mm) with insulating sleeve |       |                   |                      |                |                     |             | Approx.<br>weight (g) |
|---------------|----------------------------------------|-------|-------------------|----------------------|----------------|---------------------|-------------|-----------------------|
|               | d                                      | l ±1  | l <sub>1</sub> ±1 | l <sub>2</sub> +0/-1 | d <sub>1</sub> | d <sub>2</sub> max. | a +0.2/-0.4 |                       |
| M5            | 51.6 +0.5/-1                           | 80.7  | 87.2              | 17                   | M12            | 10.2                | 22.2        | 220                   |
| M5            | 51.6 +0.5/-1                           | 96.7  | 103.2             | 17                   | M12            | 10.2                | 22.2        | 250                   |
| M5            | 51.6 +0.5/-1                           | 105.7 | 112.2             | 17                   | M12            | 10.2                | 22.2        | 280                   |
| M5            | 51.6 +0.5/-1                           | 118.2 | 124.7             | 17                   | M12            | 10.2                | 22.2        | 320                   |
| M5            | 51.6 +0.5/-1                           | 130.7 | 137.2             | 17                   | M12            | 10.2                | 22.2        | 350                   |
| M5            | 64.3 +0.5/-1                           | 80.7  | 87.2              | 17                   | M12            | 13.2                | 28.5        | 370                   |
| M5            | 64.3 +0.5/-1                           | 96.7  | 103.2             | 17                   | M12            | 13.2                | 28.5        | 400                   |
| M5            | 64.3 +0.5/-1                           | 105.7 | 112.2             | 17                   | M12            | 13.2                | 28.5        | 440                   |
| M5            | 64.3 +0.5/-1                           | 118.2 | 124.7             | 17                   | M12            | 13.2                | 28.5        | 510                   |
| M5            | 64.3 +0.5/-1                           | 130.7 | 137.2             | 17                   | M12            | 13.2                | 28.5        | 600                   |
| M5            | 64.3 +0.5/-1                           | 143.2 | 149.7             | 17                   | M12            | 13.2                | 28.5        | 630                   |
| M6            | 76.9 +0.5/-1                           | 96.7  | 102.5             | 17                   | M12            | 17.7                | 31.7        | 570                   |
| M6            | 76.9 +0.5/-1                           | 105.7 | 111.5             | 17                   | M12            | 17.7                | 31.7        | 620                   |
| M6            | 76.9 +0.5/-1                           | 118.2 | 124.0             | 17                   | M12            | 17.7                | 31.7        | 700                   |
| M6            | 76.9 +0.5/-1                           | 130.7 | 136.5             | 17                   | M12            | 17.7                | 31.7        | 800                   |
| M6            | 76.9 +0.5/-1                           | 143.2 | 149.0             | 17                   | M12            | 17.7                | 31.7        | 840                   |
| M6            | 76.9 +0.5/-1                           | 156.2 | 162.0             | 17                   | M12            | 17.7                | 31.7        | 920                   |
| M6            | 76.9 +0.5/-1                           | 168.7 | 174.5             | 17                   | M12            | 17.7                | 31.7        | 1000                  |
| M6            | 76.9 +0.5/-1                           | 190.7 | 196.5             | 17                   | M12            | 17.7                | 31.7        | 1150                  |
| M6            | 76.9 +0.5/-1                           | 220.7 | 226.5             | 17                   | M12            | 17.7                | 31.7        | 1300                  |
| M6            | 90.0 +0.5/-1.5                         | 97.0  | 102.3             | 17                   | M12            | 17.7                | 31.7        | 770                   |
| M6            | 90.0 +0.5/-1.5                         | 120.0 | 125.3             | 17                   | M12            | 17.7                | 31.7        | 1000                  |
| M6            | 90.0 +0.5/-1.5                         | 144.5 | 149.8             | 17                   | M12            | 17.7                | 31.7        | 1200                  |
| M6            | 90.0 +0.5/-1.5                         | 170.0 | 175.3             | 17                   | M12            | 17.7                | 31.7        | 1400                  |
| M6            | 90.0 +0.5/-1.5                         | 191.0 | 196.3             | 17                   | M12            | 17.7                | 31.7        | 1650                  |
| M6            | 90.0 +0.5/-1.5                         | 197.0 | 202.3             | 17                   | M12            | 17.7                | 31.7        | 1700                  |
| M6            | 90.0 +0.5/-1.5                         | 221.0 | 226.3             | 17                   | M12            | 17.7                | 31.7        | 1900                  |

For low-inductance design the following deviation applies:

d = 64.3 mm: l<sub>1</sub> -0.7 mm

d = 90.0 mm: l<sub>1</sub> -1.7 mm

M5: Min. reach of screw = 9.5 mm

9 mm for low inductance design

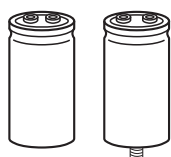
M6: Min. reach of screw = 12.0 mm

9.5 mm for low inductance design

Tolerances of terminal thread respectively stud thread:

– Terminal thread M5 and M6: 6H

– Stud thread M12: 6g



**B41456, B41458**

**85 °C**

### 3 Accessories

All accessories for connecting (screws M5 and M6) as well as for mounting the capacitors must be ordered separately. For details refer to chapter "Capacitors with screw terminals – accessories" on page 15.

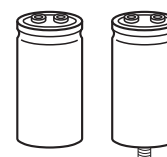
| Item                                        | Type   |
|---------------------------------------------|--------|
| Screws M5 and M6                            | B44020 |
| Ring clips                                  | B44030 |
| Clamps for capacitors with $d \geq 64.3$ mm | B44030 |
| Insulating parts                            | B44020 |

### 4 Packing

| Capacitor diameter d (mm) | Length l (mm) | Packing units (pcs.) |
|---------------------------|---------------|----------------------|
| 51.6                      | all           | 36                   |
| 64.3                      | all           | 25                   |
| 76.9                      | $\leq 168.7$  | 16                   |
|                           | $> 168.7$     | 12                   |
| 90.0                      | all           | 9                    |



For ecological reasons the packing is pure cardboard.



## 5 Special designs

### 5.1 Design options

| Design options               | Identification in third block of ordering code | Remark                                                                                                                                                 |
|------------------------------|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Standard                     | M600                                           | Standard version without threaded stud: fully insulated with PET<br>Standard version with threaded stud: insulated with PET sleeve, base not insulated |
| Low inductance (13 nH)       | M603                                           | For capacitors with diameter $d \geq 64.3$ mm                                                                                                          |
| Heat sink mounting           | M607                                           | For capacitors with diameter $d \geq 64.3$ mm and without threaded stud                                                                                |
| Insulated base               | M608                                           | For capacitors with threaded stud, fully insulated with PET sleeve and PP disk                                                                         |
| PAPR terminal style          | M650                                           | Not for low inductance                                                                                                                                 |
| PAPR with heat sink mounting | M657                                           | For capacitors with diameter $d \geq 64.3$ mm and without threaded stud, not for low inductance                                                        |
| PAPR with insulated base     | M658                                           | For capacitors with threaded stud, fully insulated with PET sleeve and PP disk, not for low inductance                                                 |

Version with low inductance (13 nH) in combination with insulated base (threaded stud) available upon request.

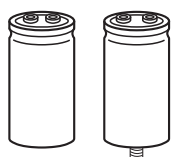
Please note that there are design options which might not be available for each series. For further information refer to series data sheets.

### 5.2 Low-inductance design (M603)

Low-inductance aluminum electrolytic capacitors offer numerous advantages for frequency converter design:

- Voltage peaks caused by steep-edged pulses are significantly reduced.
- Power semiconductors of a lower voltage class can be used.
- Capacitor banks require fewer capacitors, which reduces the cost, weight and space requirements of frequency converters accordingly.

The low inductance of the aluminum electrolytic capacitor with screw terminals is the result of various design improvements.



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85 °C

Many of the data book types with diameter  $\geq 64.3$  mm can be ordered in low-inductance design with inductance approx.  $L = 13$  nH.

For low-inductance design the following deviation regarding case dimensions applies:

$d = 64.3$  mm:  $l_1 - 0.7$  mm

$d = 90.0$  mm:  $l_1 - 1.7$  mm

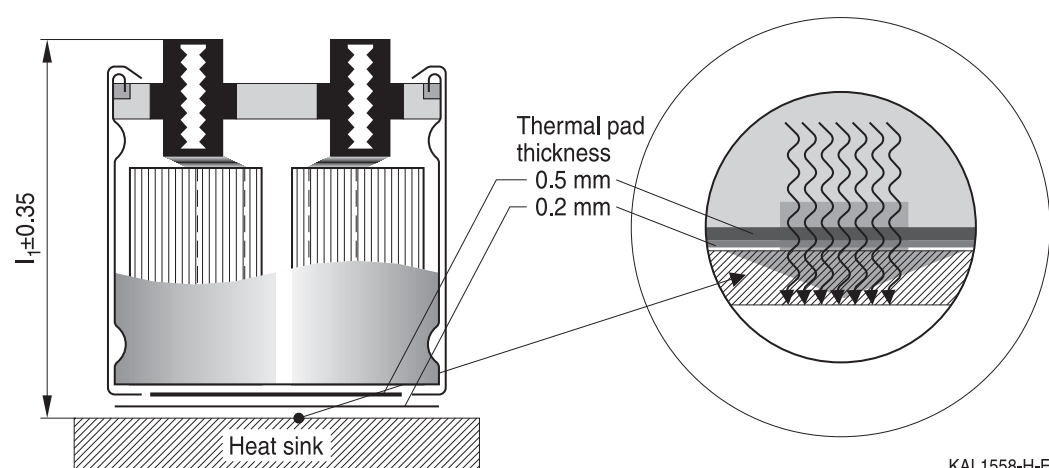
M5: Min. reach of screw = 9.0 mm

M6: Min. reach of screw = 9.5 mm

### 5.3 Capacitors with heat sink mounting (M607, M657)

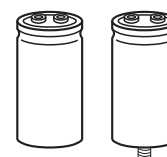
As a large amount of heat is dissipated through the base of the case, the use of a heat sink connected to the capacitor base is the most efficient cooling method. For heat-sink mounting we offer a special optimized version of high-voltage capacitors with screw terminals in order to ensure an optimal heat transfer between the base of the case and the heat sink. The special design comprises:

- Two thermal pads at the base. The first one (thickness 0.5 mm) closes the air gap at the base in the area which is not covered by the insulating sleeve and the second one (thickness 0.2 mm) ensures the electrical insulation of the case.
- Minimized tolerance ( $\pm 0.35$  mm) of the overall length  $l_1$  of the capacitor to avoid unwanted mechanical forces on the terminals particularly when several capacitors are mounted between heat sink and bus bar.
- Case with extra groove near the base for ring clamp mounting (recommended accessory B44030A0165-A0190B). The clamp ensures an optimal pressing of the case to the heat sink.
- Most of the high-voltage data book types without threaded stud and for diameters  $\geq 64.3$  mm can be ordered in heat-sink mounting design.



KAL1558-H-E

Please refer to chapter "General technical information, 5.2.2 Base cooling with heat sink". Regarding ripple current and useful life, please refer to chapter "General technical information, 5 Useful life".



Dimensions and weights for heat sink mounting:

| Terminal | Dimensions (mm) with insulating sleeve |           |                |                    |                   | Approx. weight<br>g |
|----------|----------------------------------------|-----------|----------------|--------------------|-------------------|---------------------|
|          | d                                      | $l \pm 1$ | $l_1 \pm 0.35$ | $d_2 \text{ max.}$ | $a + 0.2 / - 0.4$ |                     |
| M5       | $64.3 + 0.5 / - 1$                     | 80.7      | 86.3           | 13.2               | 28.5              | 370                 |
| M5       | $64.3 + 0.5 / - 1$                     | 96.7      | 102.3          | 13.2               | 28.5              | 400                 |
| M5       | $64.3 + 0.5 / - 1$                     | 105.7     | 111.3          | 13.2               | 28.5              | 440                 |
| M6       | $76.9 + 0.5 / - 1$                     | 96.7      | 101.6          | 17.7               | 31.7              | 570                 |
| M6       | $76.9 + 0.5 / - 1$                     | 105.7     | 110.6          | 17.7               | 31.7              | 620                 |
| M6       | $76.9 + 0.5 / - 1$                     | 118.2     | 123.1          | 17.7               | 31.7              | 700                 |
| M6       | $90.0 + 0.5 / - 1.5$                   | 97.0      | 101.4          | 17.7               | 31.7              | 770                 |
| M6       | $90.0 + 0.5 / - 1.5$                   | 120.0     | 124.4          | 17.7               | 31.7              | 1000                |
| M6       | $90.0 + 0.5 / - 1.5$                   | 144.5     | 148.9          | 17.7               | 31.7              | 1200                |

M5: Min. reach of screw = 7.5 mm

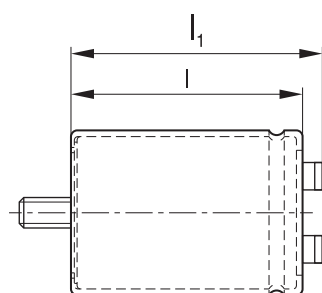
M6: Min. reach of screw = 10.0 mm

Tolerances of terminal thread M5 and M6: 6H

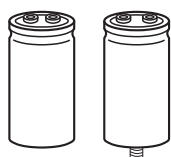
Dimensions for other sizes are available upon request.

#### 5.4 Insulated base (M608, M658)

Length  $l$  and  $l_1$  increase by +0.5 mm for types with threaded stud and insulated base. All other dimensions of the capacitor are identical with those of standard capacitors. Please refer to the table "Dimensions and weights".



KAL1711-D



**B41456, B41458**

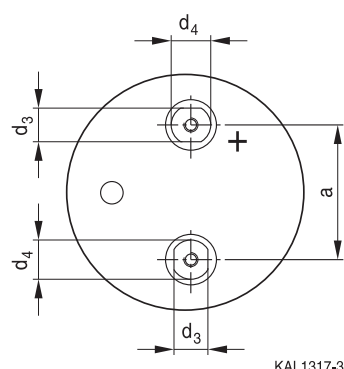
**85 °C**

## 5.5 PAPR terminal style (M650, M657, M658)

An aluminum electrolytic capacitor is a polar component that needs strictly to be mounted under correct polarity. With our PAPR terminal style (**P**rotection **A**gainst **P**olarity **R**eversal) we offer an optional mechanical feature in addition to the visual polarity marking on the cover disk and the sleeve, which prevents from mounting in reverse polarity.

The non-circular shape of the terminals and their arrangement perpendicular to each other enables the user to definitely prevent wrong mounting with respect to polarity (Poka Yoke).

Dimensional drawing of PAPR terminal configuration:



Dimensions for PAPR terminal style (mm):

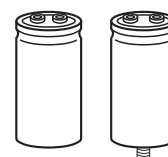
| Capacitor diameter d | Terminal | $d_3 \pm 0.1$ | $d_4 \pm 0.1$ | $a + 0.2 / - 0.4$ |
|----------------------|----------|---------------|---------------|-------------------|
| 51.6                 | M5       | 10            | 13            | 22.2              |
| 64.3                 | M5       | 13            | 15            | 28.5              |
| 76.9                 | M6       | 13            | 15            | 31.7              |
| 90.0                 | M6       | 13            | 15            | 31.7              |

M5: Min. reach of screw = 9.5 mm

M6: Min. reach of screw = 12.0 mm

Tolerances of terminal thread M5 and M6: 6H

All other dimensions of the capacitor such as diameter d, case length l and overall length  $l_1$  are identical with those of standard capacitors of this series. Please refer to the tables "Dimensions and weights" (standard types) on page 9 and "Dimensions and weights for heat sink mounting" (special designs) on page 13.



## Capacitors with screw terminals – accessories

### Basic accessories

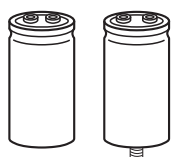
One packing unit contains accessories for 16 capacitors.

| For terminals |  |  | Screw | Washer for screw |
|---------------|--|--|-------|------------------|
|               |  |  |       |                  |
|               |  |  |       | KAL1712-L-E      |

| Thread | d2<br>mm | Toothed<br>washers | Screws                                            | Maximum<br>torque                    | Ordering code   |
|--------|----------|--------------------|---------------------------------------------------|--------------------------------------|-----------------|
| M5     | 5.3      | A 5.1 DIN 6797     | DIN 7985 /<br>ISO 7045-M5 x 10-5.6-Z<br>l = 10 mm | 2.5 Nm<br>thread depth<br>t ≥ 8 mm   | B44020J0500B000 |
| M6     | 6.4      | A 6.4 DIN 6797     | DIN 7985 /<br>ISO 7045-M6 x 12-5.6-Z<br>l = 12 mm | 4.0 Nm<br>thread depth<br>t ≥ 9.5 mm | B44020J0600B000 |

| For threaded stud |  |  | Nut | Washer for nut |
|-------------------|--|--|-----|----------------|
|                   |  |  |     |                |
|                   |  |  |     | KAL1713-U-E    |

| Thread | For<br>terminal | Toothed<br>washers | Nuts                  | Maximum<br>torque | Ordering code   |
|--------|-----------------|--------------------|-----------------------|-------------------|-----------------|
| M12    | M5              | J 12.5 DIN 6797    | Hex nut BM 12 DIN 439 | 10 Nm             | B44020J0500B012 |
| M12    | M6              | J 12.5 DIN 6797    | Hex nut BM 12 DIN 439 | 10 Nm             | B44020J0600B012 |



B41456, B41458

85 °C

### Additional accessories for capacitors with mounting stud on capacitor base

#### Insulating washer made of hostalen

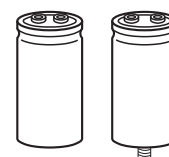
| Capacitor diameter | Thread size | Dimensional drawing | Diameter d mm                                                                          | Ordering code   |
|--------------------|-------------|---------------------|----------------------------------------------------------------------------------------|-----------------|
| 51.6 mm            | M12         |                     | $d_1 - 0.5 = 51$<br>$d_2 - 0.5 = 31$<br>$d_3 \pm 0.3 = 21.5$<br>$d_4 \pm 0.2 = 13$     | B44020B0006B051 |
| 64.2 mm            | M12         |                     | $d_1 - 0.5 = 63.5$<br>$d_2 - 0.5 = 43.5$<br>$d_3 \pm 0.3 = 21.5$<br>$d_4 \pm 0.2 = 13$ | B44020B0006B064 |
| 76.9 mm            | M12         |                     | $d_1 - 0.5 = 76$<br>$d_2 - 0.5 = 56$<br>$d_3 \pm 0.3 = 21.5$<br>$d_4 \pm 0.2 = 13$     | B44020B0006B076 |
| 90.0 mm            | M12         |                     | $d_1 - 0.5 = 89$<br>$d_2 - 0.5 = 69$<br>$d_3 \pm 0.3 = 21.5$<br>$d_4 \pm 0.2 = 13$     | B44020B0006B090 |

Only for capacitors with threaded stud and without insulated base

#### Reinforced nylon cap nut

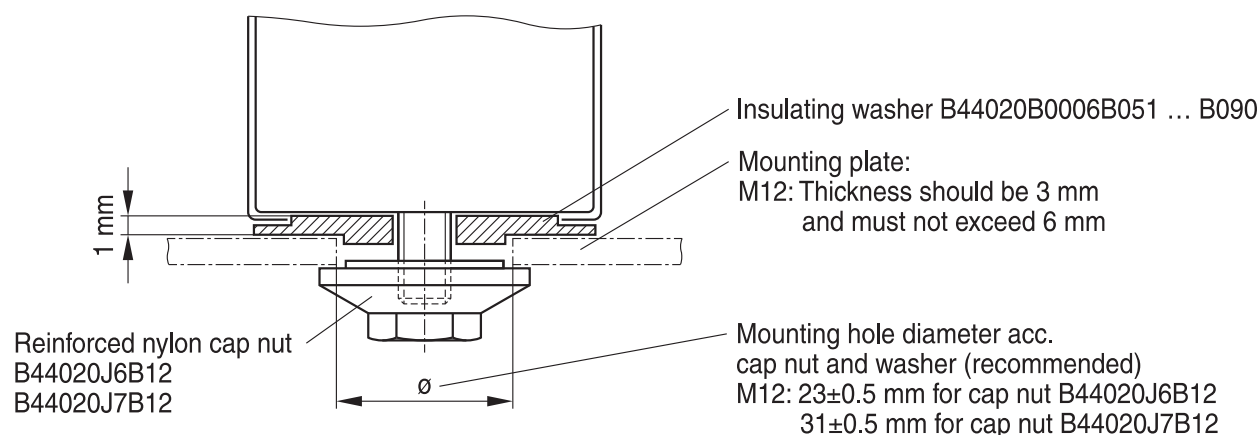
| Capacitor diameter | Thread size                                   | Dimensional drawing | Ordering code   |
|--------------------|-----------------------------------------------|---------------------|-----------------|
| > 40 mm            | M12 <sup>1)</sup><br>width across flats 19 mm |                     | B44020J0006B012 |
|                    |                                               |                     | B44020J0007B012 |

1) Maximum torque M12: 7.0 Nm for mounting thread length ≥ 13 mm; 5.0 Nm for mounting thread length ≥ 10 mm



## Mounting instructions

Insulated mounting with washer and cap nut (for capacitors with threaded stud and without insulated base):



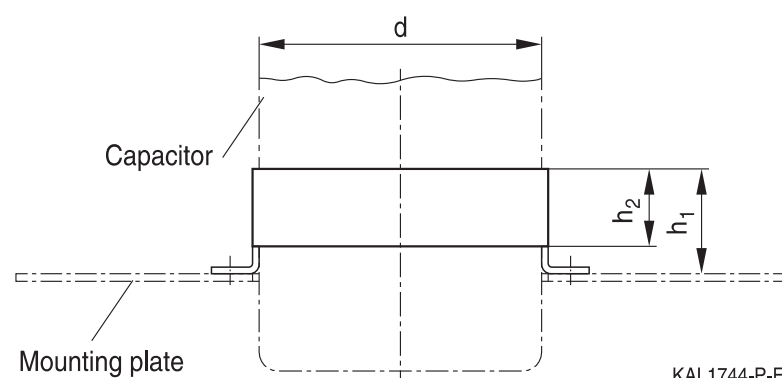
KAL1752-F-E

Mounting stud has the same potential as the negative terminal.

Attention must be paid on any relevant regulations (e.g. VDE, BSA or UL).

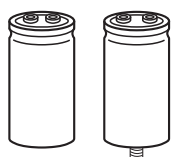
## Ring clip mounting

Ring clips are primarily used for upright mounting of screw terminal and photoflash capacitors. The ring clips are corrosion protected and are RoHS-compatible.



KAL1744-P-E

It is recommended to insert an additional insulating strip between capacitor and ring clip to avoid any risk of damage due to edges from the clip. The strip is included in delivery. For ordering code, see the following table. Attention must be paid to any relevant regulations (e.g. VDE, BSA or UL).



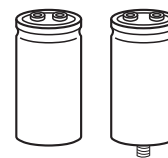
B41456, B41458

85 °C

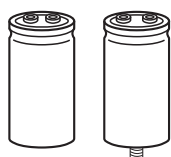
| d    | h <sub>1</sub><br>mm | h <sub>2</sub> | Ring clip version | Ordering code<br>with insulating strip                              |
|------|----------------------|----------------|-------------------|---------------------------------------------------------------------|
| 51.6 | 22                   | 15             |                   | <p>B44030J0051B000</p> <p>(insulating strip<br/>length: 325 mm)</p> |
| 64.3 | 29                   | 19             |                   | <p>B44030J0064B000</p> <p>(insulating strip<br/>length: 420 mm)</p> |
| 76.9 | 29                   | 19             |                   | <p>B44030J0075B000</p> <p>(insulating strip<br/>length: 495 mm)</p> |

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85 °C



| d    | h <sub>1</sub><br>mm | h <sub>2</sub> | Ring clip version | Ordering code<br>with insulating strip                              |
|------|----------------------|----------------|-------------------|---------------------------------------------------------------------|
| 90.0 | 29                   | 19             |                   | <p>B44030J0090B000</p> <p>(insulating strip<br/>length: 585 mm)</p> |



**B41456, B41458**

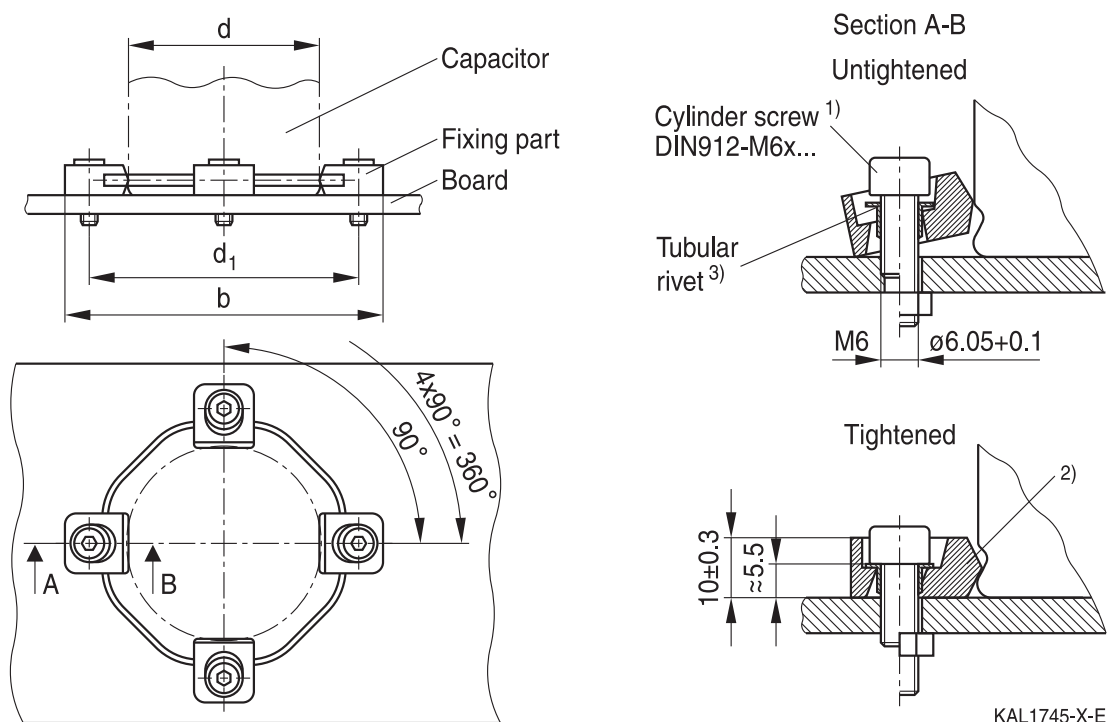
**85 °C**

## Clamp mounting

Screw terminal capacitors without threaded stud and with a diameter  $\geq 64.3$  mm can also be mounted with ring clamps. Clamp mounting offers the following advantages:

- Optimum heat transfer between capacitor base and board due to pressure contact
- High vibration resistance
- Electrically insulated material

## Dimensional drawing



<sup>1)</sup> Length of screw depends on application.

<sup>2)</sup> The screws have to be tightened uniformly and crosswise until the fixing part rests flatly on the board.

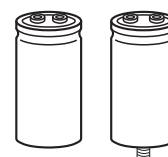
<sup>3)</sup> Tubular rivets included in delivery package.

General hints for mounting: If required, the four fixation parts can be cut out from the common carrier ring and mounted separately.

## Dimensions and ordering codes

| Capacitor diameter d<br>mm | $d_1 \pm 0.2$<br>mm | b<br>mm | Ordering code   |
|----------------------------|---------------------|---------|-----------------|
| 64.3                       | 87.0                | 104.0   | B44030A0165B000 |
| 76.9                       | 99.0                | 116.0   | B44030A0175B000 |
| 90.0                       | 112.0               | 130.0   | B44030A0190B000 |

Screws are not included in the delivery package.



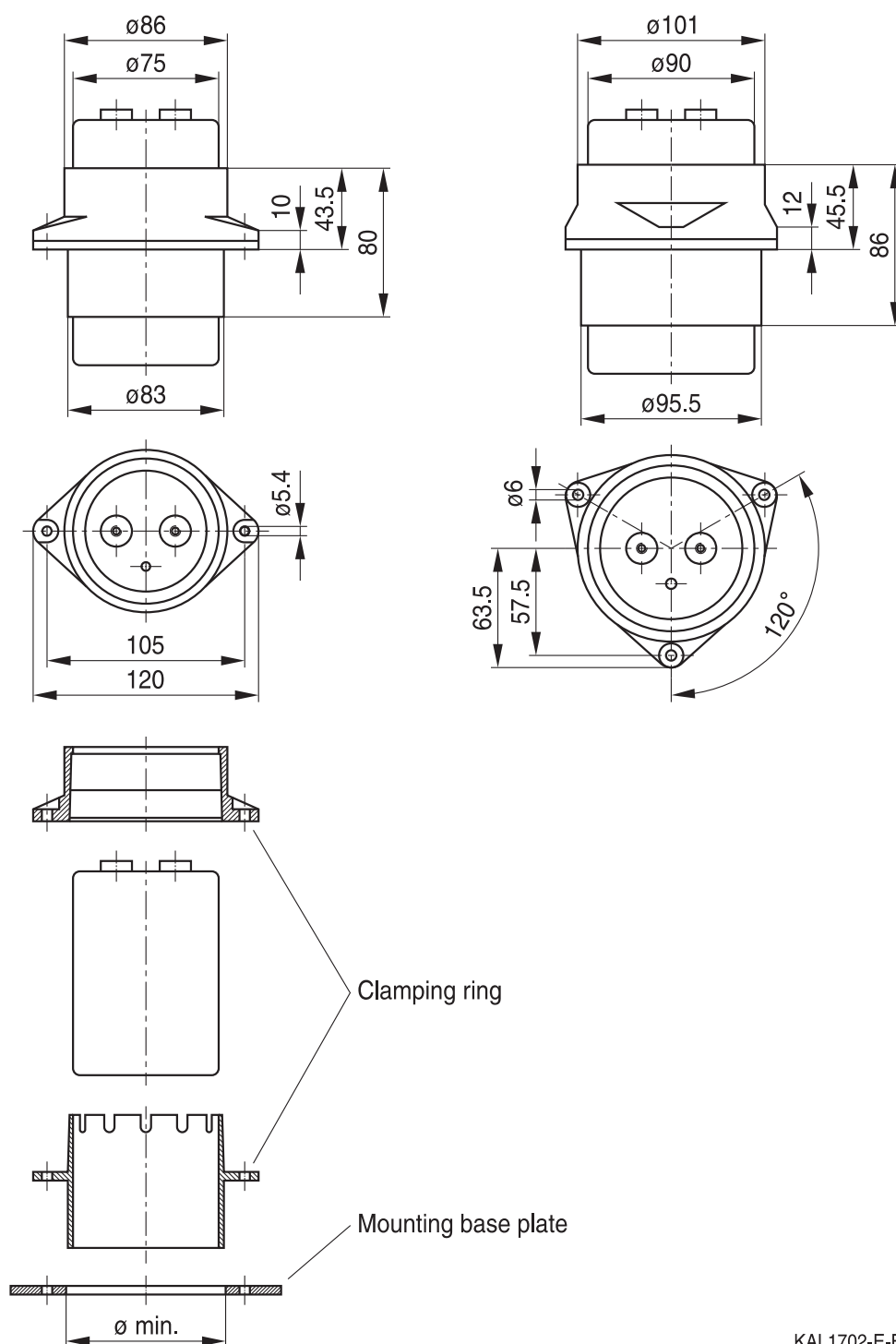
## Mounting set (ring clamps)

- Protects the capacitor against tilt and the terminals from mechanical stress
- Fits for different capacitor length
- Electrically insulated clamping material

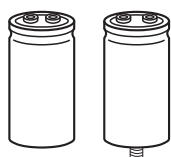
## Dimensions and ordering codes

| Capacitor diameter d | $\varnothing_{\min}$ | Ordering code   |
|----------------------|----------------------|-----------------|
| 76.9 mm              | 84 mm                | B44030A0375B000 |
| 90.0 mm              | 96.5 mm              | B44030A0390B000 |

## Dimensional drawing



KAL1702-E-E



B41456, B41458

85 °C

## Cautions and warnings

### Personal safety

The electrolytes used 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 are self-extinguishing.

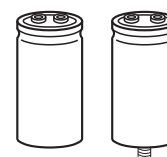
As far as possible, we do not use any dangerous chemicals or compounds to produce operating electrolytes, although in exceptional cases, such materials must be used in order to achieve specific physical and electrical properties because no alternative materials are currently known. We do, however, restrict the amount of dangerous materials used in our products to an absolute minimum.

Materials and chemicals used in our aluminum electrolytic capacitors are continuously adapted in compliance with the TDK Electronics 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 our 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 our electrolytes upon request.

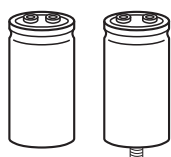
Nevertheless, the following rules should be observed when handling aluminum electrolytic capacitors: No electrolyte should come into contact with eyes or skin. If electrolyte does come into contact with the skin, wash the affected areas immediately with running water. If the eyes are affected, rinse 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 separate file 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 of opposite polarity should be prevented by connecting a diode.                                                                                                                                                                                                                                                                                                                              | 3.1.6<br>"Reverse voltage"                                       |
| Mounting position of screw-terminal capacitors | Screw terminal capacitors must not be mounted with terminals facing down unless otherwise specified.                                                                                                                                                                                                                                                                                                  | 11.1.<br>"Mounting positions of capacitors with screw terminals" |
| Robustness of terminals                        | The following maximum tightening torques must not be exceeded when connecting screw terminals:<br>M5: 2.5 Nm<br>M6: 4.0 Nm                                                                                                                                                                                                                                                                            | 11.3<br>"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.<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"    |
| Soldering                                      | Do not exceed the specified time or temperature limits during soldering.                                                                                                                                                                                                                                                                                                                              | 11.5<br>"Soldering"                                              |
| Soldering, cleaning agents                     | Do not allow halogenated hydrocarbons to come into contact with aluminum electrolytic capacitors.                                                                                                                                                                                                                                                                                                     | 11.6<br>"Cleaning agents"                                        |
| Upper category temperature                     | Do not exceed the upper category temperature.                                                                                                                                                                                                                                                                                                                                                         | 7.2<br>"Maximum permissible operating temperature"               |
| Passive flammability                           | Avoid external energy, e.g. fire.                                                                                                                                                                                                                                                                                                                                                                     | 8.1<br>"Passive flammability"                                    |



**B41456, B41458**

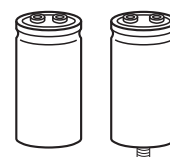
**85 °C**

| Topic                                          | Safety information                                                                                                                                                                                                                                 | Reference<br>chapter "General<br>technical information"   |
|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Active<br>flammability                         | Avoid overload of the capacitors.                                                                                                                                                                                                                  | 8.2<br>"Active flammability"                              |
| Maintenance                                    | Make periodic inspections of the capacitors.<br>Before the inspection, make sure that the power supply is turned off and carefully discharge the capacitors.<br>Do not apply excessive mechanical stress to the capacitor terminals when mounting. | 10<br>"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<br>"Shelf life and storage conditions"                |
|                                                |                                                                                                                                                                                                                                                    | Reference<br>chapter "Capacitors with<br>screw terminals" |
| Breakdown strength<br>of insulating<br>sleeves | Do not damage the insulating sleeve, especially when ring clips are used for mounting.                                                                                                                                                             | "Screw terminals –<br>accessories"                        |

### Display of ordering codes for TDK Electronics products

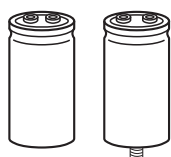
The ordering code for one and the same product can be represented differently in data sheets, data books, other publications, on the company website, or in order-related documents such as shipping notes, order confirmations and product labels. The varying representations of the ordering codes are due to different processes employed and do not affect the specifications of the respective products.

Detailed information can be found on the Internet under  
[www.tdk-electronics.tdk.com/orderingcodes](http://www.tdk-electronics.tdk.com/orderingcodes).



## 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                                          |
| $I_{leak}$    | 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 Gehäusebodens                              |
| t             | Time                                                      | Zeit                                                      |
| $\Delta t$    | Period                                                    | Zeitraum                                                  |
| $t_b$         | Service life (operating hours)                            | Brauchbarkeitsdauer (Betriebszeit)                        |



**B41456, B41458**

**85 °C**

| 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                          |
| $\epsilon_0$  | Absolute permittivity                   | Elektrische Feldkonstante            |
| $\epsilon_r$  | Relative permittivity                   | Dielektrizitätszahl                  |
| $\omega$      | Angular velocity; $2 \cdot \pi \cdot f$ | Kreisfrequenz; $2 \cdot \pi \cdot f$ |

## Note

All dimensions are given in mm.

## 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, we are 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 a 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.**
4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous)**. Useful information on this will be found in our Material Data Sheets on the Internet ([www.tdk-electronics.tdk.com/material](http://www.tdk-electronics.tdk.com/material)). Should you have any more detailed questions, please contact our sales offices.
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## Important notes

7. **Our manufacturing sites serving the automotive business apply the IATF 16949 standard.** The IATF certifications confirm our compliance with requirements regarding the quality management system in the automotive industry. Referring to customer requirements and customer specific requirements ("CSR") TDK always has and will continue to have the policy of respecting individual agreements. Even if IATF 16949 may appear to support the acceptance of unilateral requirements, we hereby like to emphasize that **only requirements mutually agreed upon can and will be implemented in our Quality Management System.** For clarification purposes we like to point out that obligations from IATF 16949 shall only become legally binding if individually agreed upon.
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