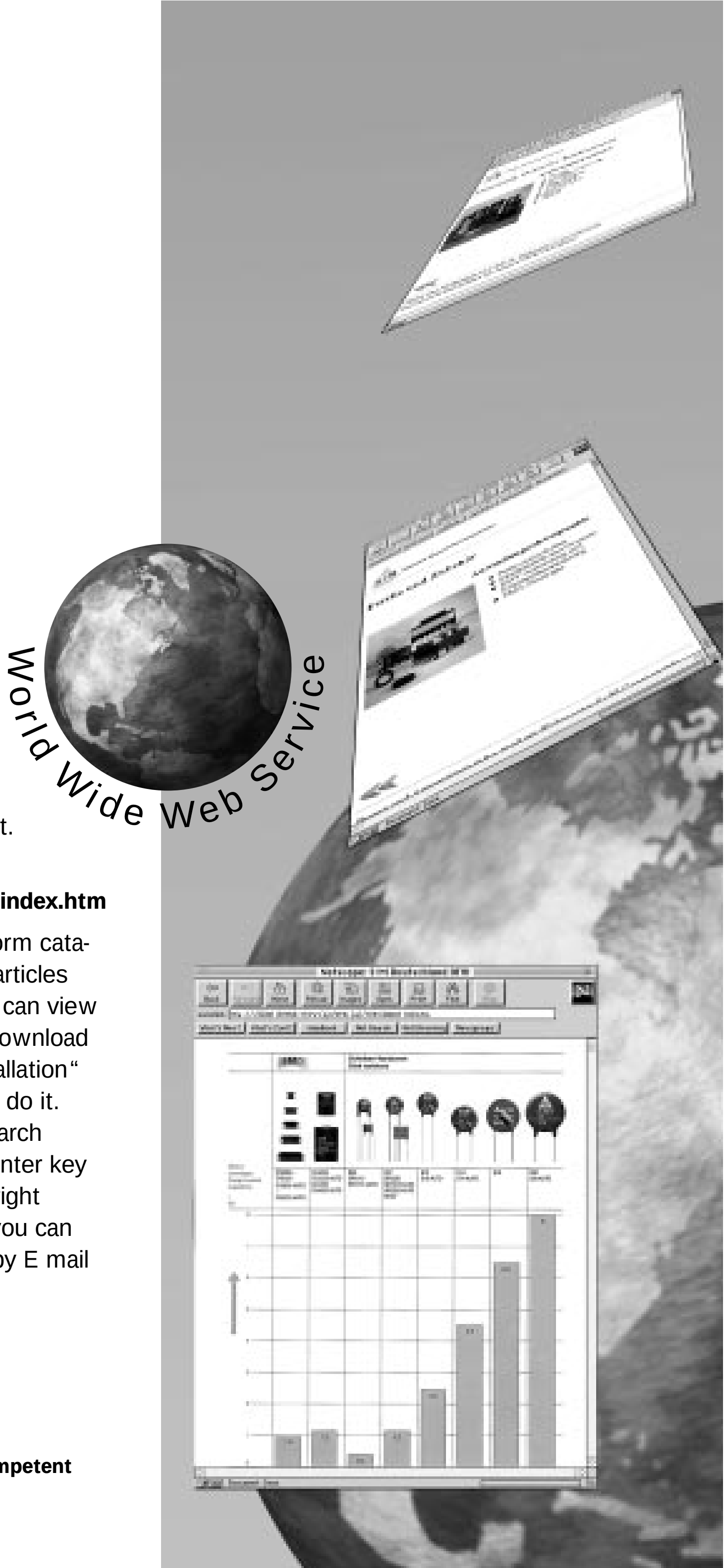
SIEMENS

SCS on the Internet

Creating new links



As of now you can tie up with Passive Components and Electron Tubes Group plus Siemens Matsushita Components on the Internet. On our home page under

http://www.siemens.de/pr/index.htm

you'll find the latest short form catalogs, data books, technical articles and more subjects too. You can view the documents on-line, or download them to your PC. The "Installation" menu item tells you how to do it. Thanks to the integrated search function, you only have to enter key terms to go straight to the right document. And of course, you can get in touch with us direct by E mail at any time.

SCS – dependable, fast and competent

Aluminum Electrolytic Capacitors

Siemens Matsushita Components

New lab assortments in film capacitors

Five at a stroke

To save you the trouble of inquiring for individual ratings to put into your design, there are now five practical sets of film capacitors:

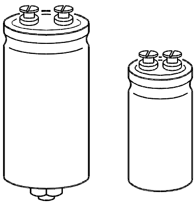
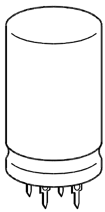
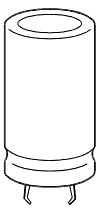
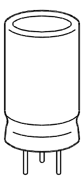
- ▶ Lead spacing 5: 525 types, 50 to 400 V, 1 nF to 3.3 µF
- ▶ SilverCaps: the lowest-cost models, low in volume, 63 to 400 V, 1 nF to 10 µF
- ▶ MKPs in wound technology: for RF applications, 250 to 2000 V, 1.5 nF to 0.68 µF
- ▶ MKPs in stacked-film technology: 382 types, 160 to 1000 V, 1.5 nF to 1 µF
- ▶ Interference suppression: 140 types with a wide choice of ratings for different applications – X2 capacitors with small dimensions or for maximum security against active flammability (Safe-X) and Y2 capacitors for suppressing commonmode interference

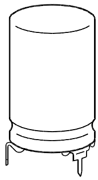
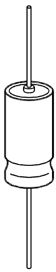
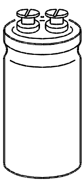
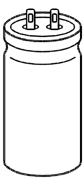
SCS – dependable, fast and competent

Contents

Contents

Overview of Terminals and Quality Grades

Terminal style	Quality grade	Rated voltage U_R V–	Rated capacitance C_R µF	Temperature range °C	Page
Screw terminals  KAL0272-T	GP	160 … 500	100 … 33 000	– 25 … + 85	61
	LL	16 … 500	100 … 680 000	– 40 … + 85 – 25 … + 85	
	SIKOREL®	5 … 100	1 000 … 150 000	– 55 … + 125 – 55 … + 105	
	High performance	160 … 400	150 … 15 000	– 40 … + 105 – 25 … + 105	
	High ripple current	350, 400	850 … 5 300	– 25 … + 105	
Solder pins  KAL0273-2	GP	16 … 500	33 … 47 000	– 40 … + 85 – 25 … + 85	147
	LL	10 … 450	68 … 100 000	– 40 … + 85 – 25 … + 85	
Snap-in  KAL0274-A	GP	10 … 550	15 … 47 000	– 40 … + 85 – 25 … + 85	167
	LL	10 … 500	15 … 33 000	– 40 … + 105 – 25 … + 105 – 40 … + 85 – 25 … + 85	
3-pin  KAL0275-I	LL	6,3 … 385	47 … 33 000	– 55 … + 105 – 40 … + 85	209

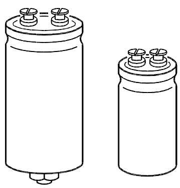
Terminal style	Quality grade	Rated voltage U_R V–	Rated capacitance C_R µF	Temperature range °C	Page
Soldering star  KAL0276-R	GP	10 … 385	10 … 4 700	– 40 … + 85 (+ 105)	229
	LL	10 … 350	10 … 4 700	– 40 … + 85 (+ 105)	
	SIKOREL®	10 … 100	47 … 4 700	– 55 … + 125 (+ 145)	
	High performance	160 … 350	10 … 220	– 40 … + 105	
Axial wire leads  KAL0277-Z	GP	6,3 … 100	4,7 … 10 000	– 40 … + 85 (+ 105)	267
	LL	10 … 350 (450)	1 … 4 700	– 40 … + 85 (+ 105)	
	SIKOREL®	10 … 100	4,7 … 4 700	– 55 … + 125 (+ 145)	
	High performance	160 … 350	2,2 … 220	– 40 … + 105	
Capacitors for photoflash applications					
Screw terminals Solder lugs  KAL0272  KAL0287	–	310 … 500	120 … 17 000	– 25 … + 60	307

GP = Standard types, GP grade
LL = Professional types, LL grade
SIKOREL® = SIKOREL types, LL grade (SIemens KOndensatoren with high RELiability)
High performance = High-performance versions, LL grade
High ripple current = Type with high ripple current capability (up to 100 A), LL grade

List of Type Numbers

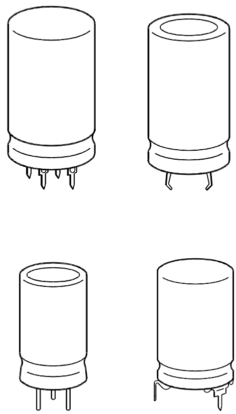
Terminal styles

Screw terminals



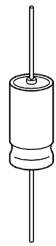
- Industrial electronics
  - Power supplies
  - Switch-mode power supplies
  - Converters
- Photoflash applications

Snap-in
Solder pin
3-pin
Soldering star



- Industrial electronics
- Telecommunications
- Data systems engineering
- Control engineering
- Automotive electronics
- Consumer electronics
- Entertainment electronics

Axial-lead



- Industrial electronics
- Automotive electronics
- Entertainment electronics
- Electronic lamp ballasts

Siemens Matsushita Components

Inductive ferrite components
from SCS stock

Transformation at its best

Not just one-off solutions but complete ones designed precisely to a requirements profile are more in demand than ever. So we are offering surface-mount transformers for power and broadband applications straight from SCS stock:

- **E 6,3** with small dimensions, low leakage inductance and high electric strength
- **ER 11** flat and with low leakage inductance
- **RM 4 LP** for high DC biasing
- **S interface transformer RM 5** for precise pulse transmission in ISDN terminals
- **U interface transformer RM 6** for ISDN applications

SCS – dependable, fast and competent

1 Basic construction of aluminum electrolytic capacitors

Aluminum electrolytic capacitors, which will be abbreviated to “Al electrolytic capacitors” in the following, assume a special position among the various types of capacitors since their principle of operation relies, in part, on electrochemical processes.

The advantages of Al electrolytic capacitors that have led to their wide application range are their high volumetric efficiency (i.e. capacitance per unit volume), which enables the production of capacitors with up to one Farad capacitance, and the fact that an Al electrolytic capacitor provides a high ripple current capability together with a high reliability and an excellent price/performance ratio.

As is the case with all capacitors, an Al electrolytic capacitor comprises two electrically conductive material layers that are separated by a dielectric layer. One electrode (the anode) is formed by an aluminum foil with an enlarged surface area. The oxide layer (Al_2O_3) that is built up on this is used as the dielectric. In contrast to other capacitors, the counter electrode (the cathode) of Al electrolytic capacitors is a conductive liquid, the operating electrolyte. A second aluminum foil, the so-called cathode foil, serves as a large-surfaced contact area for passing current to the operating electrolyte.

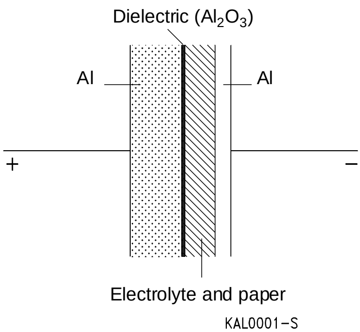


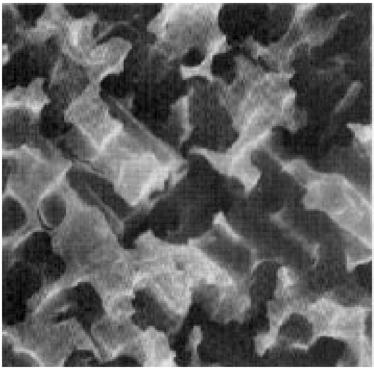
Figure 1 Basic construction of an aluminum electrolytic capacitor

$$C = \varepsilon_0 \cdot \varepsilon_r \cdot \frac{A}{d}$$

C	Capacitance	F
ε_0	Absolute permittivity	As/Vm
ε_r	Relative dielectric constant	(9,5 for Al_2O_3)
A	Capacitor electrode surface area	m^2
d	Electrode spacing	m

The anode of an Al electrolytic capacitor is an aluminum foil of extreme purity. The effective surface area of this foil is greatly enlarged (by a factor of up to 200) by electrochemical etching in order to achieve the maximum possible capacitance values. The type of etch pattern and the degree of etching is matched to the respective requirements by applying specific etching processes.

Etched foils enable very compact Al electrolytic capacitor dimensions to be achieved and are the form used almost exclusively nowadays. The electrical characteristics of Al electrolytic capacitors with plain (not etched) foils are, in part, better, but these capacitors are considerably larger and are only used for special applications nowadays.



KAL0286-Y

Figure 2 Etched aluminum foil as seen through a scanning electron microscope (Enlarged 2500 times)

The dielectric layer of an Al electrolytic capacitor is created by anodic oxidation (forming) to generate an aluminum oxide layer on the foil. The layer thickness increases in proportion to the forming voltage at a rate of approximately 1,2 nm/V. Even for capacitors for very high voltages, layer thicknesses of less than 1 µm are attained, thus enabling very small electrode spacings. This is one reason for the high volumetric efficiency achieved (e.g. in comparison to the minimum thickness of a paper dielectric, 6 to 8 µm).

During the forming process the very fine pits of the etched foils will encrust partially in proportion to the forming voltage and thus also to the achieved layer thickness. Due to this effect, the final operating voltage range must already be taken into account when the foils are etched.

The oxide layer constitutes a voltage-dependent resistance that causes the current to increase more steeply as the voltage increases. A characteristic curve as shown in figure 3 is obtained.

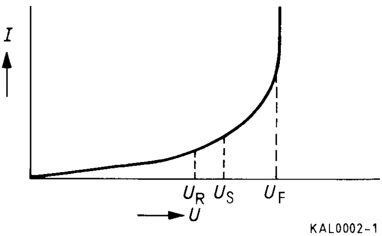


Figure 3 Current-voltage characteristic of an Al electrolytic capacitor

When the forming voltage U_F is exceeded, the forming process starts anew and large amounts of gas and heat are generated. The same effect, yet on a smaller scale, can already be observed in the knee of the curve. In order to achieve a high degree of operating safety of the capacitor, the rated voltage U_R is defined as being on the quasi-linear part of the curve. As the capacitor is subjected to surge voltages U_S for short periods only, this range lies between the rated voltage and the forming voltage. The difference between forming voltage and operating voltage, the so-called over-anodization, thus has a substantial effect on the operating reliability of the capacitor. High over-anodization offers the possibity of producing especially reliable capacitors designated as long-life grade “LL” capacitors in accordance with IEC 384–1.

Since the electrolytic capacitors have a liquid as a cathode, they are also designated as “wet” or “non-solid” capacitors. The liquid has the advantage that it fills the fine etching pits, therefore optimally fitting into the anode structure.

The two aluminum foils are separated by paper spacers. The paper serves various purposes, it serves as a container for the electrolyte – the electrolyte is stored in the pores of the absorbent paper – and also as a spacer to prevent electric short-circuits, as well as ensuring the required dielectric strength between the anode and cathode foils.

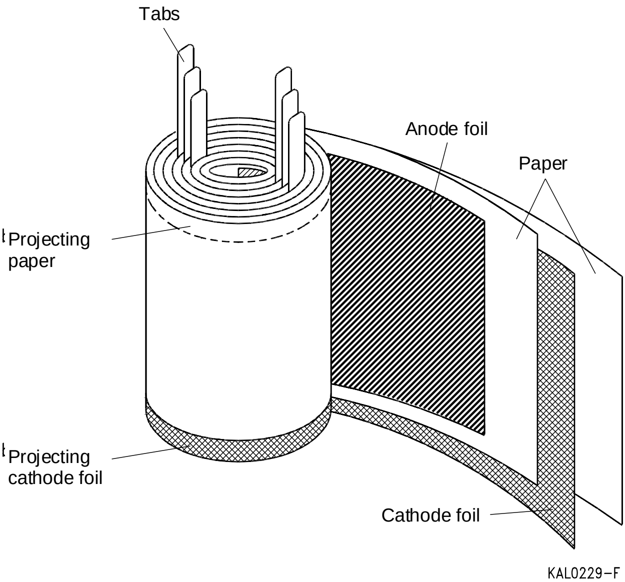


Figure 4 Winding construction of an Al electrolytic capacitor

An Al electrolytic capacitor constructed in the way described above will only operate correctly if the positive pole is connected to the formed Al foil (or anode), and the negative pole to the cathode foil. If the opposite polarity were to be applied, this would cause an electrolytic process resulting in the formation of a dielectric layer on the cathode foil. In this case strong internal heat generation and gas emission may occur and destroy the capacitor. Secondly, the cathode capacitance, which will progressively decrease as the oxide layer thickness increases, and which is connected in series with the anode capacitance, would reduce the overall capacitance considerably.

An electrolytic capacitor of the basic design described here is therefore only suitable for dc operation. The dc voltage may also be a ripple voltage, i.e. a dc voltage with a superimposed alternating voltage; the positive pole must be connected to the anode. Capacitors with this configuration are polar versions that can be used for most applications.

As already pointed out, polar capacitors do not tolerate a voltage reversal. Incorrect polarities of up to 1,5 V are, however, permissible for short periods of time as the formation of a damaging oxide layer on the cathode only starts at voltages of this magnitude. (This is because the cathode foil is covered by an air-oxide layer that corresponds to an anodized dielectric layer with a breakdown voltage of approximately 1,5 V.)

Bipolar Al electrolytic capacitors are also available. In bipolar designs, not only the anode foil but also the cathode foil is anodized in the production process. The cathode foil has the same capacitance rating as the anode foil. This construction allows for operation at direct voltage of either polarity, as well as operation at purely alternating voltages. Since it causes internal heating, the applied alternating voltage must be kept considerably below the direct voltage rating.

Due to series connection of the two capacitor elements the total capacitance amounts to only half the individual capacitance values. In comparison to a polar capacitor, a bipolar electrolytic capacitor of similar construction thus requires up to twice the volume for the same total capacitance. Moreover, twice the leakage current must be expected.

2 Standards and specifications

2.1 GP grade and LL grade

Al electrolytic capacitors are generally divided into two basic reliability categories: capacitors for high-reliability applications and capacitors for general-purpose applications. This differentiation has also been adopted in the relevant standards (IEC and CECC internationally and DIN in Germany).

In IEC publications Al electrolytic capacitors for high-reliability applications are identified as “Long-Life Grade” capacitors (formerly Type I). The abbreviation LL is stamped on the capacitors. In addition to the over-anodization as described in chapter 1, further measures are taken to enhance the reliability. Generally, the materials used for Al electrolytic capacitors must meet strict purity requirements, and those used for producing LL grade capacitors must be specially selected. The design effort required for such capacitors affects both the case size and the price.

This kind of effort is not justified for general-purpose requirements, since a lower degree of reliability is adequate. In these applications, the main demand is for smaller dimensions. In the past few years, the case sizes have been continually reduced, this being achieved mainly by increasing the roughness of the etched foil surfaces. However, this procedure cannot be intensified indefinitely, since the accompanying reduction of the foil leads to increasing losses. Up to a point it has been possible to compensate for this disadvantage, e.g. by using electrolytes with very high conductivity. Al electrolytic capacitors for general applications are called “General-Purpose Grade” (abbreviated “GP”, formerly Type II) in IEC publications.

2.2 Applicable standards

The international standard for aluminum electrolytic capacitors is IEC 384-4, which is also available in German as DIN IEC 384, part 4. In future, German specifications will be adapted to these IEC specifications or will be brought into line with CECC 30 300, which has the same technical contents as the IEC standard.

The sectional specifications mentioned above are complemented by a set of detail specifications that apply to specific design types (e.g. electrolytic capacitors with axial wire leads). Frequently these detail specifications state better electrical ratings than the sectional specifications. The detail specifications also include maximum permissible dimensions in relation to capacitance and rated voltage.

The capacitance ratings given in recent specifications are in accordance with the E3 or E6 series. The rated voltage values are standardized according to the R5 series, in exceptional cases the voltage ratings have been chosen to meet specific requirements.

There are no standards governing bipolar Al electrolytic capacitors, since there is only little demand for these types. Photoflash electrolytic capacitors are produced in large quantities, however they are at present not subject to standardization due to the large variety of types required.

The following standards are applicable to aluminum electrolytic capacitors with a non-solid electrolyte:

IEC 384-1 (identical with DIN IEC 384, part 1, CECC 30 300):
Generic specification:
Fixed capacitors for use in electronic equipment

IEC 384-4 (identical with DIN IEC 384, part 4, CECC 30 300):
Sectional specification:
Aluminum electrolytic capacitors with solid or non-solid electrolyte

IEC 384-4-1 (identical with DIN IEC 384, part 4-1, CECC 30 300):
Blank detail specification
Aluminum electrolytic capacitors with non-solid electrolyte

DIN 57 560, part 15 / VDE 0560, part 15 (draft, only available in German):
Capacitors. Aluminum and tantalum electrolytic capacitors (VDE regulations)

The technical specifications given for Al electrolytic capacitors produced by Siemens Matsushita are in line with the CECC detail specifications (if available). The individual type series can be roughly assigned as follows. The standards given in parantheses are no longer valid. Nevertheless they are stated in the data sheets to facilitate comparsion for a transitional period.

CECC detail specifications (and former DIN and CECC detail specifications)	Comparable S + M type series and design types derived from these
CECC 30 301-044 (DIN 45 910 part 126, formerly: DIN 41 316)	B 41 010, B 41 283
CECC 30 301-047 (DIN 45 910 part 129, formerly: DIN 41 238)	B 41 306, B 43 306
CECC 30 301-048 (DIN 45 910 part 1210, formerly: DIN 41 253)	B 41 293, B 43 293
CECC 30 301-049 (DIN 45 910 part 1211, formerly: DIN 41 267)	B 41 593, B 43 593, B 43 592
CECC 30 301-801 (CECC 30 301-003, DIN 45 910 part 123, formerly: DIN 41 257)	B 41 588, B 43 588, B 43 590
CECC 30 301-802	B 41 590, B 41 592
CECC 30 301-803 CECC 30 301-807 (CECC 30 301-046, DIN 45 910 part 128, formerly: DIN 41 248)	B 43 455/B 43 457 B 43 564/B 43 584 B 43 456/B 43 458 B 43 566/B 43 586 B 43 550/B 43 570
CECC 30 301-804 (CECC 30 301-050, DIN 45 910 part 1212)	B 41 554, B 41 550/B 41 570
CECC 30 301-805 (CECC 30 301-057, DIN 45 910 part 1213, formerly: DIN 41 268)	B 41 507, B 43 507
CECC 30 301-806	B 41 303, B 43 303 B 43 501, B 43 502
CECC 30 301-809	B 41 503, B 43 503
CECC 30 301-810	B 41 456/B 41 458

3 Electrical ratings

3.1 Voltages

3.1.1 Rated voltage U_R

The rated voltage U_R is the direct voltage value for which the capacitor has been designed and which is indicated upon it. For Al electrolytic capacitors, rated voltages of ≤ 100 V are usually designated as “low voltage” and rated voltages ≥ 150 V as “high voltage” (cf. chapter 13).

3.1.2 Operating voltage U_{op}

The capacitors can be operated continuously at full rated voltage (including superimposed ac voltage) within the entire operating temperature range.

The permissible voltage range for continuous operation lies between the rated voltage and 0 V. For short periods of time, the capacitors can also handle voltages up to – 1,5 V (see paragraph 3.1.6 “Reverse voltage”).

3.1.3 Surge voltage U_S

The surge voltage is the maximum voltage which may be applied to the capacitor for short periods of time, i.e. up to 5 times for 1 minute per hour. IEC 384-4 specifies the surge voltage as follows:

for $U_R \leq 315$ V: $U_s = 1{,}15 \cdot U_R$
for $U_R > 315$ V: $U_s = 1{,}10 \cdot U_R$

3.1.4 Transient voltage

Some capacitor types produced by S + M Components can withstand voltage pulses exceeding the surge voltage U_S. As the requirements differ largely depending on the individual applications, we do not state general ratings but match the overvoltage capability to customer requirements.

3.1.5 Superimposed AC, ripple voltage

A superimposed alternating voltage, or ripple voltage, may be applied to Al electrolytic capacitors, provided that:

– the sum of the direct voltage and superimposed alternating voltage does not exceed the rated voltage, and
– the rated ripple current is not exceeded (cf. chapter 4, “ripple current considerations”) and that no polarity reversal will occur.

3.1.6 Reverse voltage

Aluminum electrolytic capacitors are polar capacitors. Where necessary, voltages of opposite polarity should be prevented by connecting a diode. The diode’s conducting-state voltage of approximately 0,8 V is permissible. Reverse voltages ≤ 1,5 V are tolerable for a duration of less than 1 second, but not in continuous or repetitive operation.

3.2 Capacitance

3.2.1 AC and DC capacitance

The capacitance of a capacitor can be determined by measuring its ac impedance (taking into account amplitude and phase) or by measuring the charge it will hold when a direct voltage is applied. The two methods produce slightly different results. As a general rule, it can be said that dc-voltage based measurements (DC capacitance) yield higher values (DC capacitance) than the alternating current method (AC capacitance). The factors are approximately 1,1 to 1,5 and maximum deviations occur with capacitors of low voltage ratings.

Corresponding to the most common applications (e.g. smoothing and coupling), it is most usual to determine the AC capacitance of aluminum electrolytic capacitors.

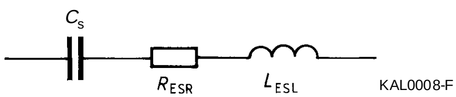


Figure 5 Simplified equivalent circuit diagram of an electrolytic capacitor

For this purpose, the capacitive component of the equivalent series circuit (the series capacitance C_S) is determined by applying an alternating voltage of ≤ 0,5 V. As the AC capacitance depends on frequency and temperature, IEC 384-1 and 384-4 prescribe a measuring frequency of 100 Hz or 120 Hz and a temperature of 20 °C (other reference values by special request).

There are also applications (e.g. discharge circuits and timing elements) in which the DC capacitance is decisive. In spite of this fact, capacitors for which the capacitance has been determined by the ac method are also used in such applications, whereby allowances are made to compensate for the difference between the two measuring methods.

However, in exceptional cases it may be necessary to determine the DC capacitance. The IEC publications do not provide any corresponding specifications. Because of this, a separate DIN standard has been defined. This standard, DIN 41 328, part 4, describes a measuring method involving one-time, non-recurrent charging and discharging of the capacitor.

3.2.2 Rated capacitance C_R

The rated capacitance is the ac capacitance value for which the capacitor has been designed and which is indicated upon it. C_R is determined by specific measurement methods described in the relevant standards (IEC 384-1 and 384-4). Preferred capacitance values are taken from the E3 or E6 series.

S + M Components specifies C_R in µF as the AC capacitance measured at 100 Hz and 20 °C, in accordance with IEC 384-4.

3.2.3 Capacitance tolerance

The capacitance tolerance is the range within which the actual capacitance may deviate from the specific rated capacitance. Where the capacitance tolerances are to be indicated on the components themselves, Siemens Matsushita uses code letters in accordance with IEC 62; this code letter is also part of the ordering code (cf. chapters 10 and 13).

3.2.4 Temperature dependence of the capacitance

The capacitance of an electrolytic capacitor is not a constant quantity that retains its value under all operating conditions. The temperature has a considerable effect on the capacitance. With decreasing temperature, the viscosity of the electrolyte increases, thus reducing its conductivity. The resulting typical behavior is shown in figure 6.

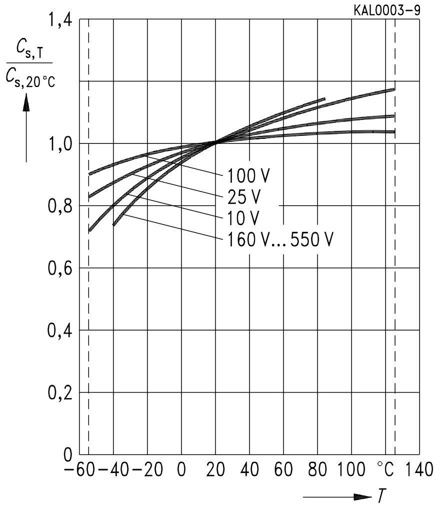


Figure 6 Temperature dependence of series capacitance C_S (typical behavior)
Reference value: AC capacitance at 20 °C and 100 Hz

As a general rule, the characteristic curves are steeper for lower rated voltages and increasing anode surface roughness (deeper etching).

The most favorable flat shape of the curves shown in figure 6 is obtained by using special electrolytes which ensure that the capacitors can be operated at temperatures far below zero.

The shape of the curves varies widely, depending on whether the temperature relationship of the AC or of the DC capacitance is determined. The DC capacitance has a flatter temperature characteristic.

3.2.5 Frequency dependence of the capacitance

The AC capacitance depends not only on the temperature but also on the measuring frequency. Figure 7 shows the typical behavior. Typical values of the effective capacitance can be derived from the impedance curve, as long as the impedance is still in the range where the capacitive component is dominant.

$$C = \frac{1}{2 \cdot \pi \cdot f \cdot Z}$$

C	Capacitance	F
f	Frequency	Hz
Z	Impedance	Ω

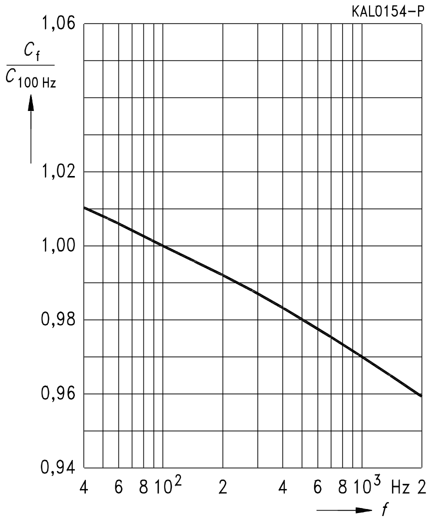


Figure 7 Capacitance C versus frequency f
Typical behavior

3.2.6 Charge-discharge proof

Frequent charging/discharging cycles lead to a decrease in capacitance. Due to their special design aluminum electrolytic capacitors produced by Siemens Matsushita are charge-discharge proof. This means that 10^6 switching cycles will cause a capacitance reduction of less than 10 %.

(Charge-discharge test in accordance with IEC 384-4).

3.3 Dissipation factor tan δ

The dissipation factor tan δ is the ratio of the equivalent series resistance to the capacitive reactance component in the equivalent series circuit, or the ratio of effective power (dissipated power) to reactive power for sinusoidal voltages.

It is measured using the same set-up as for the series capacitance C_s (refer to figure 5).

IEC 384-4 specifies the following maximum values:

Rated voltage	4 V < U_R ≤ 10 V	10 V < U_R ≤ 25 V	25 V < U_R ≤ 63 V	63 V < U_R
Maximum value for the 100 Hz dissipation factor, as specified by IEC	0,5	0,35	0,25	0,20

These values apply to capacitors with a maximum charge of 100 000 µC. Proportionally higher dissipation factors are permissible for capacitors with higher maximum charges.

3.3.1 Frequency and temperature dependence of the dissipation factor

The dissipation factor, like the capacitance, varies with frequency and temperature. Figure 8, figure 9 and figure 10 show some examples of commonly used low-voltage and high-voltage electrolytic capacitors.

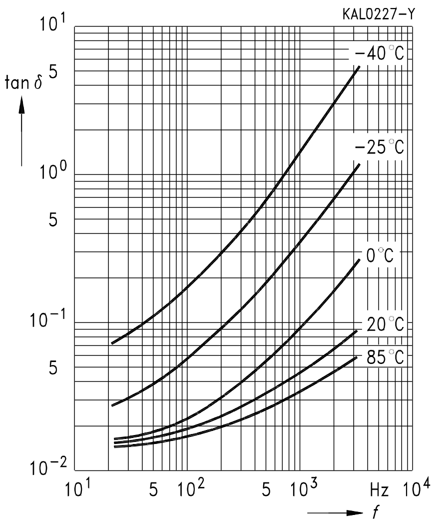


Figure 8 Low-voltage Al electrolytic capacitor (Example: 100 µF/63 V–)

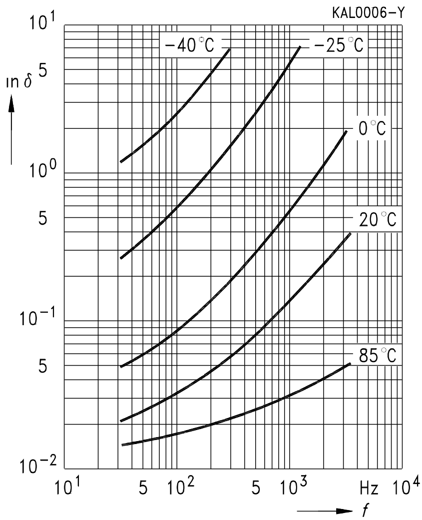


Figure 9 High-voltage Al electrolytic capacitor (Example 47 µF/350 V–)

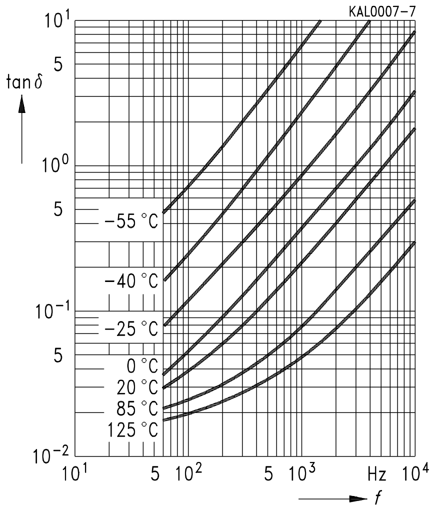


Figure 10 Low-voltage electrolytic capacitor "SIKOREL 125", B 41 590 (Example: 220 µF/40 V–)

3.4 Self-inductance L_{ESL}

The self-inductance or equivalent series inductance results from the terminal configuration and the internal design of the capacitor. It is defined by the equivalent series circuit shown in figure 11.

3.5 Equivalent series resistance R_{ESR}

The equivalent series resistance is the resistive component of the equivalent series circuit. The R_{ESR} value depends on frequency and temperature and is related to the dissipation factor by the following equation:

$$R_{ESR} = \frac{\tan\delta}{\omega \cdot C_s}$$

R_{ESR}	Equivalent series resistance	Ω
tan δ	Dissipation factor	
C_s	Series capacitance	F

The tolerance limits of the rated capacitance must be taken into account when calculating this value.

3.6 Impedance Z

The impedance of an electrolytic capacitor results primarily from the series circuit formed by the following índividual equivalent series components (figure 11):

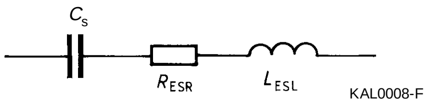


Figure 11 Simplified equivalent circuit diagram of an electrolytic capacitor

1) Capacitive reactance $1/\omega C_s$ of the capacitance C_s
2) Dielectric losses and ohmic resistance of the electrolyte and the terminals (R_{ESR})
3) Inductive reactance ωL_{ESL} of the capacitor winding and the terminals.

The inductive reactance ωL_{ESL} only depends on the frequency, whereas $1/\omega C_s$ and R_{ESR} depend on frequency and on temperature.

The characteristics of the individual resistive and reactive components determine the total impedance of the capacitor. Figures 12 and 13 show typical frequency and temperature characteristics of aluminum electrolytic capacitors.

– Capacitive reactance predominates at low frequencies.
– With increasing frequency, the capacitive reactance ($X_C = 1/\omega C_s$) decreases until it reaches the order of magnitude of the electrolyte resistance.
– At even higher frequencies and unchanged temperatures (see 20 °C curve), the resistance of the electrolyte predominates.
– When the capacitor's resonance frequency is reached, capacitive and inductive reactance mutually cancel each other.
– Above this frequency, the inductive resistance of the winding and its terminals ($X_L = \omega L$) becomes effective and leads to an increase in impedance.

The resistance of the electrolyte increases strongly with decreasing temperature. Figures 12 and 13 show that this component already has an effect at low frequencies for low temperature ranges.

Specific impedance values are given in the individual data sheets.

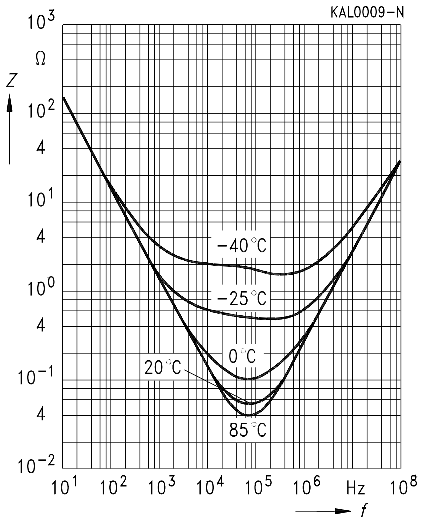


Figure 12 Impedance versus frequency and temperature
Example: 100 µF/63 V–
(simplified graph)

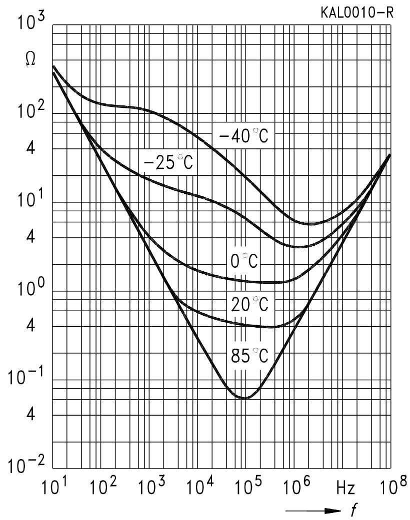


Figure 13 Impedance versus frequency and temperature
Example: 47 µF/350 V–
(simplified graph)

3.7 Leakage current

Due to the special properties of the aluminum oxide layer that serves as a dielectric, a small current will continue to flow even after a dc voltage has been applied for longer periods. This current is called the leakage current. A low leakage current is an indication that the dielectric is well designed.

3.7.1 Time and temperature dependence of the leakage current

As figure 14 shows, a high leakage current flows (inrush current) in the first minutes after applying a voltage to the capacitor, in particular after prolonged storage without any applied voltage. In the course of continuous operation, the leakage current will decrease and reach an almost constant "steady-state" value.

The temperature dependence of the leakage current is shown in figure 15, taking a capacitor of the 85 °C temperature category as an example.

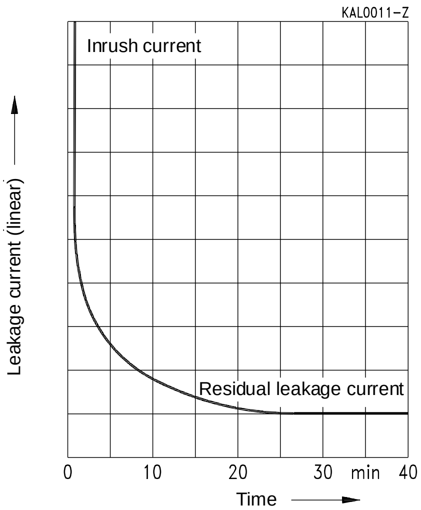


Figure 14 Leakage current versus time for which a voltage is applied

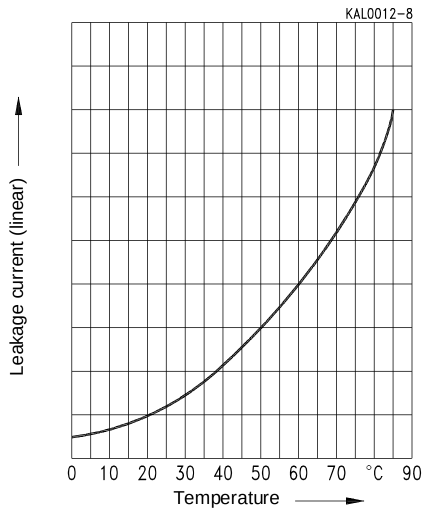


Figure 15 Leakage current versus temperature

3.7.2 Voltage dependence of the leakage current

The relationship between the leakage current and the voltage applied under constant temperature conditions is shown schematically in figure 16.

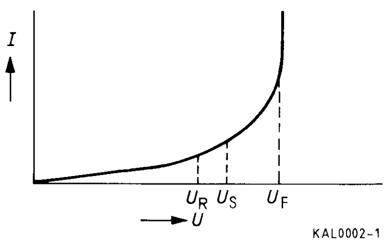


Figure 16 Voltage dependence of the leakage current

3.7.3 Operating leakage current I_{lkop}

The operational leakage current is the steady-state current that is attained during continuous operation. The I_{lkop} of Al electrolytic capacitors made by Siemens Matsushita can be calculated using the following equation:

LL grade:

$$I_{lkop} = \frac{0{,}0005\ \mu A}{\mu F \cdot V} \cdot C_R \cdot U_R + 1\ \mu A$$

GP grade:

$$I_{lkop} = \frac{0{,}001\ \mu A}{\mu F \cdot V} \cdot C_R \cdot U_R + 3\ \mu A$$

I_{lkop} Operating leakage current
C_R Rated capacitance
U_R Rated voltage

(For bipolar capacitors, the values are doubled).

The results refer to the rated voltage U_R and a temperature of 20 °C.

In accordance with DIN 41 240 and DIN 41 332, the results obtained for 20 °C must be multiplied by the following factors, to allow for the temperature dependence of the operating leakage current of both GP and LL grade capacitors:

Temperature (°C)	0	20	50	60	70	85	125
Factor (typical value)	0,5	1	4	5	6	10	12,5

Siemens “SIKOREL” types are an exception to this rule. The following values apply to these:

Temperature (°C)	0	20	55	70	85	105	125
Factor (typical value)	0,7	1	2	3	4	5	8

When the actual operating voltage is below the rated voltage, the operating leakage current is substantially lower:

Operating voltage, in % of the rated voltage U_R	20	30	40	50	60	70	80	90	100
Typical values, in % of the operating leakage current I_{lkop} (GP grade)	3	6	9	14	18	25	40	50	100
Typical values, in % of the operating leakage current I_{lkop} (LL grade)	7	12	17	23	30	40	50	70	100

3.7.4 Leakage current for acceptance test I_{lka}

As the leakage current varies with time and temperature, it is necessary to define reference values for measuring time and temperature. According to the relevant standards the leakage current is to be measured at 20 °C, after the rated voltage has been applied for 5 minutes. The following equations apply:

GP grade:

$$I_{lka} \leq 0{,}3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)^{0{,}7} + 4\ \mu A$$

LL grade:

$C_R \cdot U_R \leq 1\,000\ \mu C$

$$I_{lka} \leq 0{,}01\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) \quad \text{or } 1\ \mu A$$

(the larger value applies)

$C_R \cdot U_R > 1\,000\ \mu C \ldots < 470\,000\ \mu C$

$$I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$$

$C_R \cdot U_R \geq 470\,000\ \mu C$

$$I_{lka} \leq 0{,}3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)^{0{,}7} + 4\ \mu A$$

Acceptance testing for leakage current can be carried out at any temperature between 15 and 35 °C. The permissible limit values are then multiplied by the following conversion factors, with reference to the 20 °C value:

Temperature (°C)	15	20	25	30	35
Factor (guideline value)	0,8	1	1,5	2	2,5

Referee tests are to be carried out at 20 °C.

3.7.5 Reforming

In accordance with IEC 384-4, Al electrolytic capacitors are to be subjected to a reforming process before acceptance testing. The purpose of this preconditioning is to ensure that the same initial conditions are maintained when comparing and assessing different products.

For this purpose, the rated voltage is applied to the capacitors via a series resistance of approximately 100 Ω for $U_R \leq 100$ V–, or 1000 Ω for $U_R > 100$ V–, for a period of one hour.

Subsequently, the capacitors are stored under no-voltage conditions for 12 to 48 hours at a temperature between 15 and 35 °C. The leakage current must then be measured, at the latest after 48 hours.

If the capacitors meet the leakage current requirements without preconditioning, this procedure can be omitted.

3.7.6 Leakage current behavior after voltage-free storage

The oxide layer may deteriorate when Al electrolytic capacitors are stored without an externally applied voltage, especially at higher temperatures. Since there is no leakage current to transport oxygen ions to the anode in this case, the oxide layer is not regenerated. The result is that a higher than normal leakage current will flow when a voltage is applied after prolonged storage. As the oxide layer is regenerated in use, however, the leakage current will gradually decrease to its normal level.

Al electrolytic capacitors can be stored voltage-free for at least 2 years, and capacitors of the SIKOREL series for as long as 10 years without any loss of reliability. Provided that these storage periods have not been exceeded, the capacitors can be operated at rated voltage directly after being taken out of storage. In this case, reforming as described under 3.7.5 is not required.

When designing application circuits, attention must be paid to the fact that the leakage current may be up to 100 times higher than normal during the first minutes following the application of power.

When the capacitors have been stored for more than two years, it is decisive whether the circuit will tolerate high initial leakage currents. A circuit that has been stored for more than two years with the capacitors incorporated, should be operated trouble-free for one hour. This will usually regenerate the capacitors so far that storage can be continued.

3.8 Breakdown strength and insulation resistance of insulating sleeves

Most Al electrolytic capacitors made by S+M Components are enveloped by an insulating sleeve. The minimum breakdown strength of the sleeve is 2 500 V~ or 3 500 V–. A test method for verifying the breakdown strength of the sleeves is described in IEC 384-4.

In order to ensure full breakdown strength, care must be taken not to damage the insulating sleeve, especially when ring clips are used for mounting.

The insulation resistance of the sleeve is at least 100 MΩ. IEC 384-4 specifies corresponding test methods.

4 Ripple current considerations

4.1 General

The term ripple current is used for the rms value of the alternating current that flows through the device as a result of any pulsating or ripple voltage. The maximum permissible ripple current value depends on the ambient temperature, the surface area of the capacitor (i.e. heat dissipation area), the dissipation factor tan δ (or R_{ESR}) and on the ac frequency.

As thermal stress has a decisive effect on the capacitor’s life expectancy, the dissipation heat generated by the ripple current is an important factor affecting the useful life. Diagrams showing the useful life as a function of the ambient temperature T_A are given in the individual data sheets (refer to section 5.3 for an explanation on how to use these diagrams).

These thermal considerations imply that, under certain circumstances, it may be necessary to select a capacitor with a higher voltage or capacitance rating than would normally be required by the respective application.

4.2 Frequency dependence of the ripple current

The dissipation factor (which is related to the equivalent series resistance) of Al electrolytic capacitors varies with the frequency of the applied voltage. As a result, the ripple current is also a function of the frequency. In the individual data sheets, the ripple current capability of the capacitors is generally referred to a frequency of 100 Hz, or in some cases to 20 kHz. Conversion factors for other operating frequencies are given for each type in the form of a graph.

4.3 Temperature dependence of the ripple current

The data sheets specify the maximum permissible ripple current for ambient temperatures of 40 °C as well as for the upper category temperature for each capacitor type. For all types with category temperature above 85 °C, the ripple current ratings for 85 °C have also been included for the purpose of comparison.

The data sheets for each capacitor type also include a diagram showing the limit values for continuous operation at other ambient temperatures and ripple currents. This diagram also permits the expected useful life to be estimated for given operating conditions.

4.4 Operation at non-clearly defined currents and frequencies

If the load on the capacitor cannot be clearly defined, measures must be taken to ensure that the surface temperature of the case does not exceed the sum of the category temperature and the permissible overtemperature (see table) at any point.

IEC 384-4 specifies the following permissible surface overtemperatures ΔT (self-heating, difference between surface temperature of the capacitor and the ambient temperature):

	Upper category temperature °C	Ambient temperature in °C									
		40	50	60	70	80	85	95	105	115	125
		Permissible overtemperature ΔT in K									
LL grade	85	10	9	7	5	4	3	—	—	—	—
	125	10	10	10	9	8	7	6	5	4	3
GP grade.	85	15	12	10	7	4	3	—	—	—	—

5 Useful life

Useful life (also termed service life or operational life) is defined as the life achieved by the capacitor without exceeding a specified failure rate. Total failure or failure due parametric variation is considered to constitute the end of the useful life (see also paragraph 4 of chapter "Quality Assurance").

Depending on the circuit design, device failure due to parametric variation does not necessarily imply equipment failure. This means that the actual life of a capacitor may be longer than the specified useful life. Data on useful life have been obtained from experience gained in the field and from accelerated tests.

The useful life can be prolonged by operating the capacitor at loads below the rating values (e.g. lower operating voltage, current or ambient temperature) and by appropriate cooling measures. In addition to the standard type series, Siemens Matsushita is able to offer types with useful life ratings specially matched to customer specifications.

5.1 Load conditions

CECC defines the useful life of capacitors with liquid electrolytes on the basis of the following load conditions:

– rated voltage
– rated ripple current
  (the peak value of the ac voltage superimposed on the dc voltage must not exceed the rated voltage)
– rated temperature.

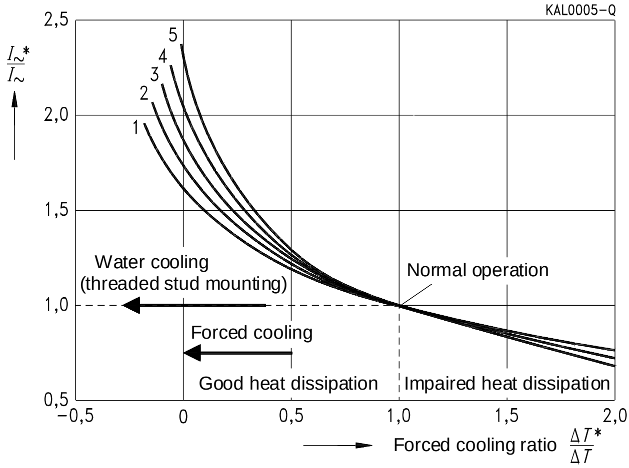
5.2 Cooling

The useful life values stated in these data sheets apply to Al electrolytic capacitors with natural cooling, i.e. the heat generated in the winding is dissipated through the casing and by natural convection. It is possible to increase the permissible ripple current and/or prolong the useful life by using additional cooling by heat sinks, water or forced ventilation. Conversely, impaired cooling (e.g. due to closely packed capacitor banks, thermally insulating sealing and vacuum) will reduce the useful life.

In order to lower the thermal resistance between winding and case, can-type capacitors produced by Siemens Matsushita have a thermal bridge between the capacitor winding and the base. 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 this reason some capacitor types are fitted with a threaded stud for mounting them on a heat sink.

Only the thermal resistance between the case and the surrounding air, which is greater than the thermal resistance between the capacitor winding and the case if forced cooling is not used, can be influenced by the mounting location. The thermal resistance is proportional to the temperature difference ΔT. The user can measure this temperature difference ($T_{case} - T_A$) under normal conditions and under forced-air conditions (ΔT^*) and constant ripple current load conditions, and then calculate the relative reduction or increase of the thermal resistance from the forced cooling ratio $\Delta T^*/\Delta T$. In turn, the forced cooling ratio can be used to determine the ripple current factor $I_{\sim}^*/I_{-}$. The latter is a measure of how much the ripple current load can be increased without reducing the useful life if forced cooling is used.

The diagram below (figure 17) shows the effect of the forced cooling ratio, as determined by measurement, on the ripple current factor *I*~*/*I*~ for various case sizes. In this diagram, the useful life of the capacitor with forced cooling (ripple current load: *I*~*) has been equated to the useful life rating of the Al electrolytic capacitor under normal operating conditions (ripple current load: *I*~).



Dimensions *d* × *l* (mm)

1 75 × 220, diameter = 90
2 75 × 145
3 50 × 105
4 35 × 80
5 18 × 30

ΔT Temperature difference $\Delta T = T_{case} - T_A$
I~ Permissible ripple current under normal conditions (natural convection cooling)
* Values for forced cooling

Figure 17 Effect of forced cooling on the ripple current capability

The following table gives typical values for the forced cooling ratios that can be achieved by forced convection with the respective air velocities.

Air velocity, approximate m/s	Forced cooling ratio $\Delta T^* / \Delta T$
approx. 0,5	0,55
approx. 1,0	0,45
approx. 1,5	0,39
approx. 2,0	0,35

Conversely, the ripple current capability *I**~ of Al electrolytic capacitors with impaired heat dissipation is lower than the rated value *I*~.

If a cooling fluid (e.g. water or oil) colder than the ambient temperature is used, the forced cooling ratio may be reduced to zero or may even attain negative values. Due to the limited thermal capacity of these media, the linear laws assumed for the use of pure thermal resistances no longer apply. In such cases the forced cooling ratio is also a function of the power dissipated in the capacitor itself. If such cooling measures are to be used, the maximum possible thermal load must be calculated. This is not necessary if only heat sinks and forced convection are used.

If the base of the capacitor is kept at a constant temperature by specific cooling measures, the current can be increased by the factors shown in the table below. To determine the corresponding useful life, replace the ambient temperature in the useful life graphs by the respective capacitor base temperature.

Capacitor length (mm)	Capacitor diameter (mm) 35,7	51,6	64,3	76,9	91,0
55 … 68	2,5				2,9
80	1,9	2,1	2,3	2,5	2,7
97 … 106	1,6	1,8	2,0	2,1	2,3
143 … 145		1,5	1,6	1,7	1,9
191 … 222				1,3	1,4

Choose the more favorable value from figure 17 or the table. Multiplication is not permissible.

5.3 Calculation of useful life

The tables in the individual data sheets list the rated ripple current for the upper category temperature (UCT = + 85 °C, + 105 °C or +125 °C) and for a frequency of 100 Hz (in some cases 20 kHz). The useful life for known ripple current loads and ambient temperatures is determined on the basis of the useful life graphs as follows:

Determine the quotient $\frac{I_\sim}{I_{\sim R,\,UC}}$ of the required ripple current at the given ambient temperature and the rated ripple current at the upper category temperature. The corresponding useful life value is given by the curve passing through the respective ambient temperature and the current quotient coordinates, or it can be interpolated if none of the useful life curves passes directly through these coordinates.

The frequency dependence of the ripple current has not been taken into account in the procedure described above. This must be introduced into the calculation in the form of an additional factor. The following table provides guide values for such factors. For more precise values, consult the characteristic curves shown in the individual data sheets.

Frequency f (Hz)	50	100	400	800	1000	≥ 2000
Conversion factor (guide value)	0,8	1,0	1,2	1,3	1,35	1,4

The following examples illustrate the calculation procedure, using the data of a capacitor of the B41550/B41570 series. For this type series, the upper category temperature is + 105 °C. As an example, a capacitor with the following ratings has been selected from the data sheets:

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR,max}$ 100 Hz 20 °C mΩ	Z_{max} 20 kHz 20°C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	$I_{\sim R}$ 100 Hz 105°C A	Ordering code Short code
40	4700	35,7 × 80,7	15	35	25	20	14	7,2	-A7478-Q

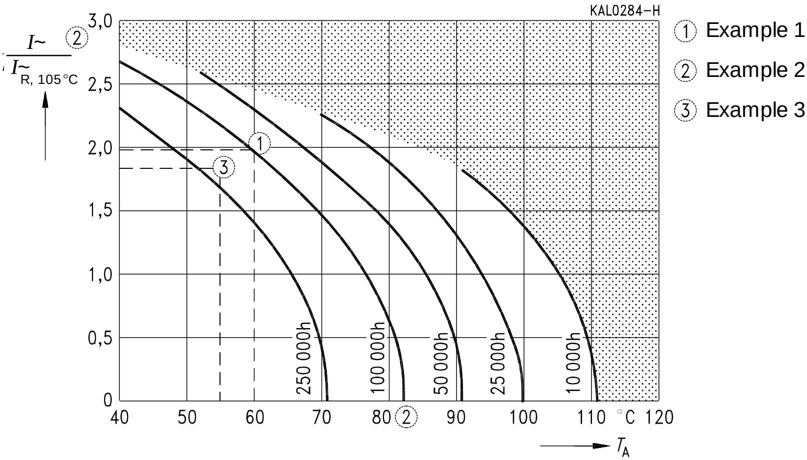


Figure 18 Useful life plotted versus ambient temperature T_A under ripple current operating conditions, SIKOREL type B41550/B41570, $d \leq 51{,}6$ mm

Example 1 – Calculating the useful life

The following values have been determined for capacitors to be used in a power supply. The corresponding useful life is to be calculated.

Ripple current	17,2	A
Frequency	400	Hz
Ambient temperature	60	°C

The equivalent ripple current for 100 Hz is calculated using the frequency-dependence conversion factor (see page 34):

$$\frac{17{,}2\ \text{A}}{1{,}2} = 14{,}33\ \text{A}$$

The ripple current factor is then calculated using the resulting equivalent 100 Hz ripple current.

$$\frac{I\sim}{I\sim_{\text{R, 105 °C}}} = \frac{14{,}33\ \text{A}}{7{,}2\ \text{A}} = 1{,}99$$

The useful life curve passing through the coordinates for the ripple current factor (1,99) and the ambient temperature (60 °C) indicates the useful life that can be expected:

100 000 h.

Example 2 – Determining the maximum permissible ambient temperature

The operating conditions listed below have been defined for a traction application. The maximum permissible ambient temperature is to be calculated:

Operating voltage	30	V–
Total ripple current	23	A
Frequency	50	Hz
Useful life	100 000	h

There are several methods of solving this problem:

First, the equivalent 100 Hz current value is determined (conversion factors given on page 34):

$$\frac{23\ \text{A}}{0{,}8} = 28{,}75\ \text{A}$$

The number of capacitors required is then determined for the respective ambient temperature by projecting the values along the 100 000 h curve:

$\frac{I\sim}{I\sim_{\text{R, 105 °C}}}$	Circuit	Ambient temperature
2,75	2 parallel	40 °C
2,0	2 parallel	59 °C
0,5	8 parallel	81 °C

Further value combinations can be determined in the same way.

Example 3 – Checking the ripple current load on an aluminum electrolytic capacitor

In many applications, Al electrolytic capacitors are subjected to ripple currents of varying frequency.

The equivalent total ripple current load shall be calculated for the following given rms values:

Current 1: $I\sim_{rms}$ at 400 Hz	8,5	A
Current 2: $I\sim_{rms}$ at 1 kHz	15	A
Ambient temperature	55	°C
Required useful life	150000	h

The first step is to calculate the equivalent 100 Hz values for the two current values (frequency-dependence conversion factors given on page 34) and the root-mean-square value of the two equivalent values:

Current I_1: $\frac{8{,}5\text{ A}}{1{,}2} \triangleq 7{,}1\text{ A at 100 Hz}$

Current I_2: $\frac{15\text{ A}}{1{,}35} \triangleq 11{,}1\text{ A at 100 Hz}$

$$I_{totalrms} = \sqrt{I_1^2 + I_2^2}$$

$$I_{totalrms} = \sqrt{(7{,}1\text{ A})^2 + (11{,}1\text{ A})^2} = 13{,}2\text{ A}$$

The ripple current factor can then be calculated:

$$\frac{I\sim}{I\sim_{R,\,105\,°C}} = \frac{13{,}2\text{ A}}{7{,}2\text{ A}} = 1{,}83$$

The useful life curve that coincides with the respective coordinates, 1,83 on the Y-axis (ripple current factor) and 55 °C on the X-axis (ambient temperature) indicates a **useful life of >200000 h**. The required useful life and a safety margin are thus achieved.

6 Climatic stress

Limits must be set for the climatic conditions to which electrolytic capacitors are subjected (in part for reasons of reliability and in part due to the variation of the electrical parameters with temperature). It is therefore important to observe the permissible minimum and maximum temperatures and the humidity conditions stated in coded form as IEC climatic category (see paragraph 6.4). The IEC categories are given for each type in the corresponding data sheet.

6.1 Maximum permissible operating temperature (upper category temperature)

The upper category temperature is the maximum permissible ambient temperature at which a capacitor may be continuously operated. It depends on the capacitor design and is stated in the respective IEC climatic category. If this limit is exceeded the capacitor may fail prematurely.

For some type series, however, operation at temperatures above the UCT is permissible for short periods of time. Details are given in the individual data sheets.

Useful life and reliability depend to a large extent on the capacitor's temperature. Operation at the lowest possible temperature will increase both useful life and reliability and is therefore recommended. For the same reason, it is advisable to select the coolest possible position within the equipment as a location for aluminum electrolytic capacitors.

6.2 Minimum permissible operating temperature (lower category temperature)

The conductivity of the electrolyte diminishes with decreasing temperature, causing an increase in electrolyte resistance. This, in turn, leads to increasing impedances and dissipation factors (or equivalent series resistances). For most applications, these increases are only permissible up to a certain maximum value. Therefore, minimum permissible operating temperatures are specified for Al electrolytic capacitors. These temperature limits are designated "lower category temperature" and are also part of the IEC climatic category.

It should be emphasized that operation below this temperature limit will not damage the capacitor. Especially when a ripple current flows through the device, the heat dissipated by the increased equivalent series resistance will raise the capacitor temperature so far above the ambient temperature that the capacitance will be adequate to maintain equipment operation.

6.3 Storage temperature

Al electrolytic capacitors can be stored voltage-free at temperatures up to the upper category temperature. (see paragraph 3.7.6 "Leakage current behavior after voltage-free storage".)

However, It must be taken into account that storage at elevated temperatures will reduce leakage current stability, useful life and reliability. In order not to impair these qualities unnecessarily, the storage temperature should not exceed + 40 °C and should preferably be below + 25 °C.

The standards for Al electrolytic capacitors specify a lower storage temperature that corresponds to the lower category temperature. Al electrolytic capacitors by S + M Components withstand the lowest specified storage temperature, i.e. – 65 °C, without being damaged.

6.4 IEC climatic category

The permissible climatic stress on an Al electrolytic capacitor is given by the respective IEC climatic category. In accordance with IEC 68-1, the climatic category comprises 3 groups of numbers, separated by slashes.

Example: 40/085/56

1st group:	Lower category temperature (limit temperature) denoting the test temperature for test A (cold) in accordance with IEC 68-2-1
2nd group:	Upper category temperature (limit temperature) denoting the test temperature for test B (dry heat) in accordance with IEC 68-2-2
3rd group:	Number of days denoting the duration of test Ca (damp heat, steady state) at 93 +2/–3 % relative humidity and 40 °C ambient temperature, in accordance with IEC 68-2-3

7 Mechanical stress resistance

7.1 Vibration resistance

The vibration resistance values are specifed in the individual data sheets.

7.2 Operating altitude

Al electrolytic capacitors can be used in high-altitude locations (in accordance with CECC 30 300 sub-clause 4.11.4). Continuous operation at extreme altitudes may decrease the useful life of some capacitor types.

7.3 Robustness of terminals

The mechanical strength of terminals and leads is defined in the respective detail specifications. Terminals of the capacitors in this book also meet the test conditions specified by IEC 68–2–21.

The following maximum tightening torques may not be exceeded when connecting screw terminals:

Thread	Maximum torque
M5	2 Nm
M6	2,5 Nm

8 Application notes

DIN 57 560, part 15/VDE 0560, part 15, draft 1983 (only available in German) provides general information on applications in which Al electrolytic capacitors are used. The most important subjects are: safety requirements and measures, installation in equipment with inherent heating, destruction by overpressure, fire hazards, parallel and series capacitor circuits.

8.1 Mounting positions (overpressure vent)

During operation Al electrolytic capacitors will always conduct a leakage current which causes electrolysis. On the one hand, the oxygen produced by electrolysis will regenerate the dielectric layer but, on the other hand, the hydrogen released may cause the internal pressure of the capacitor to increase.

An overpressure vent ensures that the gas can escape when the pressure reaches a certain level.

To prevent electrolyte from leaking out when the gas is “vented”, the capacitor should be mounted in the positions recommended by figure 19. All of these mounting positions are intended to avoid a vent-down installation of the capacitor.

Example:

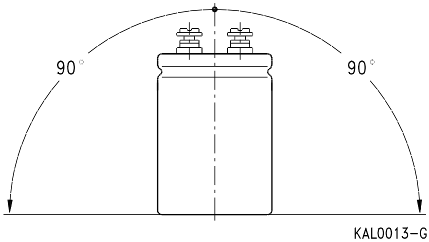


Figure 19 Recommended range of mounting positions

– Upright mounting is ideal, particularly when the capacitors are fixed by their terminals, by a threaded stud or mounted by their base.
– If the capacitor is horizontally mounted, the overpressure vent should be in a "12 o'clock" position.

Please note that other mounting positions will not cause any damage to the capacitor. However, minor contamination of the equipment may occur due to electrolyte leaking out of the overpressure vent.

8.2 Capacitor bank design

In some applications the required capacitance may not be achieved by using a single Al electrolytic capacitor. This may be the case if:

– the required electrical charge is too high to be stored in a single capacitor,
– the voltages that are to be applied are higher than can be attained by the permissible operating voltage ratings,
– charge-discharge and ripple current loads would generate more heat than could be safely dissipated by a single capacitor, and
– the requirements on the electrical characteristics (e.g. series resistance, dissipation factor or inductance) are so high that it would be too difficult or even impossible to implement them in a single capacitor.

In these cases, banks of capacitors connected in parallel or in series or in combined parallel and series circuits will be used. To prevent overloading of individual capacitors, the capacitance tolerance must be taken into account when determining the maximum ripple current. Furthermore, the individual capacitors must not be subjected to negative voltages when the bank is discharged. DIN 57 560, part 15, provides important information on the dimensioning and circuit configuration of capacitor banks. The following paragraphs explain and supplement this information.

8.2.1 Parallel connection of Al electrolytic capacitors

If one of the capacitors in a parallel circuit fails as a result of an internal short circuit, the entire bank is discharged through the defective capacitor. In the case of large banks with high energy content this may lead to extremely abrupt and severe discharge phenomena. It is therefore advisable to take measures to prevent or limit the short-circuit discharge current. In smoothing capacitor banks, for example, this is achieved by installing individual fuses; the principle is shown in figure 20.

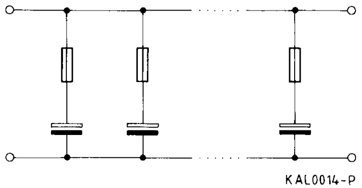


Figure 20 Individual fuses in smoothing capacitor banks

This principle is not suitable for capacitor banks designed for impulse discharges. Here, the capacitors should be protected during the charging process by means of appropriate resistors. The capacitors are then connected in parallel immediately before they are to be discharged. The principle is shown in figure 21.

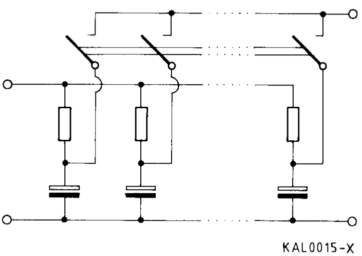


Figure 21 Protection by charging resistors

8.2.2 Series connection of Al electrolytic capacitors

When designing series circuits with Al electrolytic capacitors, care must be taken to ensure that the load on each individual capacitor does not exceed its maximum permissible voltage. Here, the fact that the total dc voltage applied is divided up among the individual capacitors in proportion to their individual dielectric insulation resistances (figure 22) must be taken into consideration.

Since the dielectric insulation resistance of the individual capacitors may differ quite strongly, the voltage distribution may also be non-uniform, which may lead to the permissible voltage of individual capacitors being exceeded. For this reason, forced balancing of the voltage distribution is recommended. The safest method of achieving this is to use electrically isolated voltage sources for the individual capacitors as shown in figure 23.

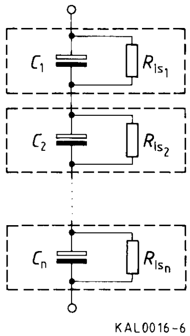


Figure 22 Series connection (with dielectric resistances)

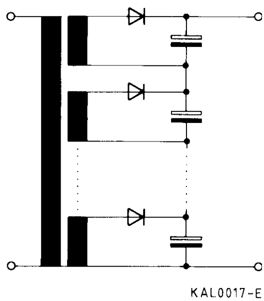


Figure 23 Series connection (forced voltage distribution balancing)

If this is not possible, external balancing resistors R_{Symm} (see figure 24) can be connected to the individual capacitors. The balancing resistances must be equal to one another, and must be substantially lower than the dielectric insulation resistance of the capacitor.

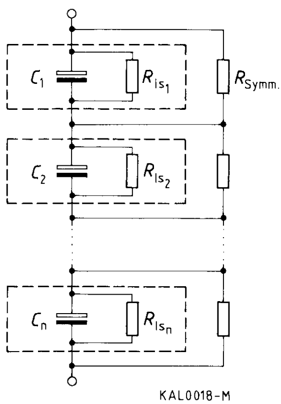


Figure 24 Series connection (external balancing resistors R_{Symm} connected to the individual capacitors)

Experience has shown that it is preferable to choose balancing resistance values that will cause a current of approximately 20 times the leakage current of the capacitor to flow through the resistors. The equation for calculating the resistance value is:

$$R_{Symm} = 50\ \mathrm{M\Omega} \cdot \mu\mathrm{F} \cdot \frac{1}{C_R}$$

The balancing measures described above may be omitted in cases where the total dc voltage to be applied is substantially lower than the sum of the rated voltages of the capacitors to be used.

Experience has shown that this is possible for n = 2 to 3 single capacitors in series without any considerable risk if the total voltage does not exceed $0{,}8 \cdot n \cdot U_R$. However, this solution can only be implemented if the series circuit consists of matching capacitors (same type, same capacitance), so that the dielectric insulation resistance of the capacitors, which is the only factor determining the voltage distribution in this case, will not vary too greatly from one capacitor to the next.

8.2.3 Combined parallel and series connection

The recommendations given above apply similarly to combinations of parallel and series circuits. If balancing resistors are to be used, it is advisable to allocate a separate resistor to each capacitor (figure 25).

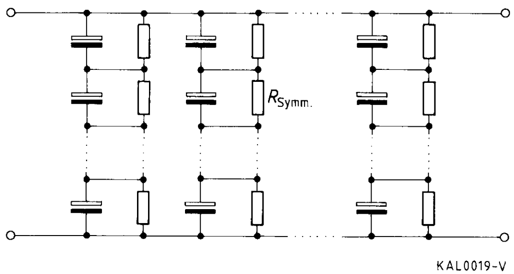


Figure 25 Combined parallel / series connection (voltage balancing by shunt resistors)

The alternative solution, parallel connection of the series capacitors in the individual branch and the use of one balancing resistor for each capacitor group, is shown in figure 26.

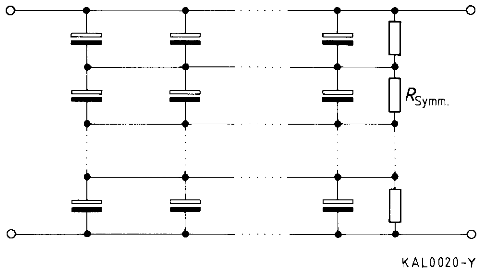


Figure 26 Combined parallel / series connection (group voltage balancing)

This solution is less complicated, but it has one serious disadvantage:

If a capacitor in one of the series branches fails and causes a short-circuit, the total voltage will be applied to the remaining capacitors. This will lead to a voltage overload and may destroy the remaining capacitors.

In the balancing arrangement shown in figure 25, only the series branch with the defective capacitor is subject to this risk, whereas in the more simple configuration shown in figure 26, the voltage overload affects all series branches due to the internal cross-connections, thus causing more severe damage. For the same reason, internal parallel connections should not be used in parallel groups connected in series without balancing resistors.

8.3 Mounting information

The maximum torques listed below should not be exceeded when tightening screw terminals or mounting stud nuts.

Thread	Maximum torque
M5	2 Nm
M6	2,5 Nm
M8	4 Nm
M12	10 Nm

8.4 Cleaning agents

Halogenated hydrocarbons may cause serious damage if allowed to come into contact with aluminum electrolytic capacitors. These solvents may dissolve or decompose the insulating film and reduce the insulating properties to below the permissible level. The capacitor seals may be affected and swell, and the solvents may even penetrate them. This will lead to premature component failure.

Because of this, measures must be taken to prevent electrolytic capacitors from coming into contact with the solvents when using halogenated hydrocarbon solvents to clean printed circuit boards after soldering the components, or to remove flux residues. If it is not possible to prevent the electrolytic capacitors from being wetted by the solvent, halogen-free solvents must be used in order to eliminate the possibility of damage.

Halogen-free solvents:

Ethanol (methylated spirits)
Propanol
Isopropanol
Isobutanol
Polypropylene-glycol-mano-methyl
Di-ethylene-glycol-dibutyl-ether

Critical solvents:

The following list contains a selection of critical halogenated hydrocarbons and other solvents frequently used, partially in pure form, partially in mixtures with other solvents, as cleaning agents in the electrical industry.

Trichlorotrifluoro-ethane (trade names e.g. Freon, Kaltron, Frigene)
Trichloroethylene
Trichloroethane (trade names e.g. Chlorothene, Wacker 3×1)
Tetrachloroethylene (trade name: Per)
Methylene chloride
Chloroform
Carbon tetrachloride
Acetone
Methyl ethyl ketone
Ethyl acetate
Butyl acetate

However, printed-circuit board cleaning equipment is available which uses halogenated solvents but is designed to enable thorough cleaning in a very short time (four-chamber ultrasonic cleaning process). Furthermore, the processes used ensure that virtually no solvent remains on the cleaned parts.

This means that the general warning against the use of halogenated cleaning solvents on Al electrolytic capacitors can be qualified if the following conditions are met:

1. The cleaning period in each chamber must not exceed 1 minute.
2. The final cleaning stage must use a solvent vapor only. The temperature must be 50 °C or lower.
3. Adequate drying must be ensured immediately after the cleaning process in order to evaporate any condensed residual solvent.
4. Contaminated cleaning agents must be regularly replaced as specified by the manufacturer and by legal regulations.

9 Electrolytes

The electrolytes used by S + M Components have not only been optimized with a view to the intended application, but also with regard to health and environmental compatibility. They do not contain any solvents that are detrimental to health, e.g. dimethyl formamide (DMF) or dimethyl acetamide (DMAC).

Furthermore, almost all high-voltage electrolytes used by Siemens Matsushita are self-extinguishing. They contain flame-retarding substances which will quickly extinguish any flame that may have been ignited.

As far as possible, S + M Components 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 properties because no safe substitute materials are currently known. However, the amount of dangerous materials used in our products has been limited to an absolute minimum. Nevertheless, the following rules should be observed when handling Al electrolytic capacitors:

- Any escaping electrolyte should not come into contact with eyes or skin.
- If electrolyte does come into contact with the skin, wash the affected parts immediately with running water. If the eyes are affected, rinse them for 10 minutes with plenty of water. If symptoms persist, seek medical treatment.
- Avoid breathing in electrolyte vapor or mists. Workplaces and other affected areas should be well ventilated.
- Clothing that has been contaminated by electrolyte must be changed and rinsed in water.

10 Marking of the capacitors

The example below shows how the capacitors are marked:

S+M COMPONENTS		Manufacturer (company logo)
	LL	Grade (only on LL grade capacitors)
B43507-B0108-M		Part number (ordering code)
1: 1000 µF (M)		Rated capacitance, tolerance (in coded form)
200 V–	40/085/56	Rated voltage, climatic category (in accordance with IEC or coded as explained below)
10.96	Made in Germany	Month and year of production, origin

Terminal identification (if required)

Capacitance tolerances are coded in accordance with IEC 62 using the codes shown below:

Code letter	Capacitance tolerance	Code letter	Capacitance tolerance
A	Tolerances to which no other code applies	S	– 20 %/+ 50 %
M	± 20 %	T	– 10 %/+ 50 %
N	± 30 %	V	– 10 %/+100 %
Q	– 10 %/+ 30 %	Y	0 %/+ 50 %
R	– 20 %/+ 30 %	Z	– 20 %/+ 80 %

The climatic category is specified in accordance with IEC 68–1 (see paragraph 6.4). If there is not enough space on the case, the following codes may be used:

E.g.: 40/085/56, in coded form, would read GPF

1st letter (lower category temperature)

Code letter	F	G	H
Temperature (°C)	– 55	– 40	– 25

2nd letter (upper category temperature)

Code letter	K	M	P	S	U
Temperature (°C)	+ 125	+ 105 (+ 100)	+ 85	+ 70	+ 60

3rd letter (humidity)

Letter F
withstands test Ca (damp heat, steady state), test duration 56 days, in accordance with IEC 68-2-3.

11 Packing

When packing our products, we naturally pay attention to environmental protection aspects. This means that only environmentally compatible materials are used for packing, and the amount of packing is kept to an absolute minimum.

In observing these rules, we are also complying with German packing regulations which came into force on the 1st December 1991.

In order to further comply with the aims of the regulations concerning the reduction of waste, we have implemented the following measures:

– The use of standardized "Euro"-pallets.
– Goods are secured on the pallets using straps and edge protectors made of environmentally compatible plastics (PE or PP). No stretch or shrink-wrap films are used.
– The shipping cartons (transport packing) qualify for and carry the RESY logo.
– Separating layers between pallets and cartons are of a single material type, preferably paper or cardboard.
– Styrofoam (expanded polystyrene foam) chips are used as filler and padding material. These can be re-used. They are expanded to a foam without using CFCs and halogens.
– The shipping cartons are sealed with paper adhesive tape in order to ensure that only a single, uniform material needs to be disposed of.
– We are prepared, on principle, to take back the packing material (especially product-specific plastic packages). However, we ask our customers to send cardboard cartons, corrugated cardboard, paper etc. to recycling or disposal companies in order to avoid unnecessary transportation of empty packing materials.

12 End of use and disposal

All Al electrolytic capacitors from S + M Components are of course free of PCB and do not contain any environmentally harmful substances such as DMF (dimethyl formamide) or DMAC (dimethyl acetamide).

These Al electrolytic capacitors are not specifically mentioned in the German waste materials classification regulations BGBI.IS.614, dated 03.04.1990. This would indicate that such capacitors need not be disposed of as "waste materials requiring special supervision" (special waste).

However, since our company is strongly committed to the principles of environmental protection, we would like to request our customers to treat aluminum electrolytic capacitors as "waste materials requiring special supervision" when disposing of them (e.g. to enable the aluminum to be recycled).

Separate disposal of the liquid electrolyte is not possible because this is absorbed by the paper in the capacitor winding. The German waste code possibly applicable to the disposal of aluminum capacitors is 353 04 "Aluminum scrap". In all cases, disposal should be planned in agreement with the disposal company responsible.

The relevant disposal regulations must also be complied with in all other countries. In the interest of the environment we would ask you to take every precaution when disposing of capacitors.

13 Structure of the ordering code (part number)

All technical products made by S + M Components are identified by a part number (which is identical to the ordering code). This number is the unique identifier for any respective specific component that can be supplied by us. The customer can speed up and facilitate processing of his order by quoting the part numbers. All components are supplied in accordance with the part numbers ordered.

A part number can consist of up to 15 digits and comprises three blocks of data separated by hyphens. Each of these blocks starts with a letter, all other positions are allocated to numerals.

Digit	1	2	3	4	5	6		7	8	9	10	11		12	13	14	15
	B						—						—				
	Block 1							Block 2						Block 3			

Digit	Meaning
1	B = Passive components
2	4 = Electrolytic capacitors
3	1 = Low-voltage range ≤ 100 Vdc 3 = High-voltage range ≥ 150 Vdc
4 bis 6	Type
7	Revision status
8	Rated voltage **Low-voltage range** 1 3 V– 2 6,3 V– 3 10 V–, 12 V– 4 15 V–, 16 V– 5 25 V– 6 30 V–, 50 V– 7 35 V–, 40 V– 8 63 V–, 70 V– 9 100 V– 0 special [1] **High-voltage range** 1 150 V–, 160 V– 2 200 V–*), 250 V– 3 300 V–, 385 V–*) 4 350 V– 5 450 V– 6 500 V– 7 510 V–, 520 V–, 550 V–*) 8 330 V–, 600 V–*) 9 360 V–*), 400 V–*) 0 special [1] *) Types already available with these voltages have the code number “0” (= special). Hence, there may be mixed designations.

1) “0” is omitted in the abbreviated form.

Digit	Meaning
9 to 11; 13	Capacitance The capacitance is given in coded form. Examples: Data digit 9 10 11 B 4 1 5 9 0 - A 7 $\boxed{2\ 2}$ $\boxed{6}$ –T = $\underline{22} \cdot 10^{\underline{6}}$ pF = 22 µF Data digit 9 10 11 13 B 4 1 5 9 0 - S 3 $\boxed{6\ 8}$ $\boxed{7}$ –T $\boxed{5}$ 01 = $\underline{68},\underline{5} \cdot 10^{\underline{7}}$ pF = 685 µF 1st and 2nd significant figure of the capacitance value Exponent 3rd significant figure of capacitance values with more than two significant figures, otherwise left vacant
12	Capacitance tolerance (Code according to IEC 62) 1) A Special tolerance M ± 20 % N ± 30 % Q – 10/+ 30 % R – 20/+ 30 % S – 20/+ 50 % T – 10/+ 50 % V – 10/+100 % Y 0/+ 50 % Z – 20/+ 80 %
14, 15	“Counters” for special versions or further information, e.g. type of packing or tape packaging

1) The article number can end after digit 12 (tolerance) if all following digits would only be occupied by “0”.

1 General

The high demands made on us by the world market for the quality of products and services mean that a thorough quality assurance system indispensable.

The quality assurance system for capacitors is certified in accordance with ISO 9001. It is based on quality directives which are binding at all company levels and departments. It is described in the quality assurance manual and takes into consideration:

– national and international standards,
– specifications harmonized with customers' requirements,
– S+M Components' own performance goals.

1.1 Total Quality Management and Zero Defect Concept

The strategic aim of Total Quality Management (TQM) is to satisfy the demands made by customers on products or services in terms of function, quality, punctuality and price/performance.

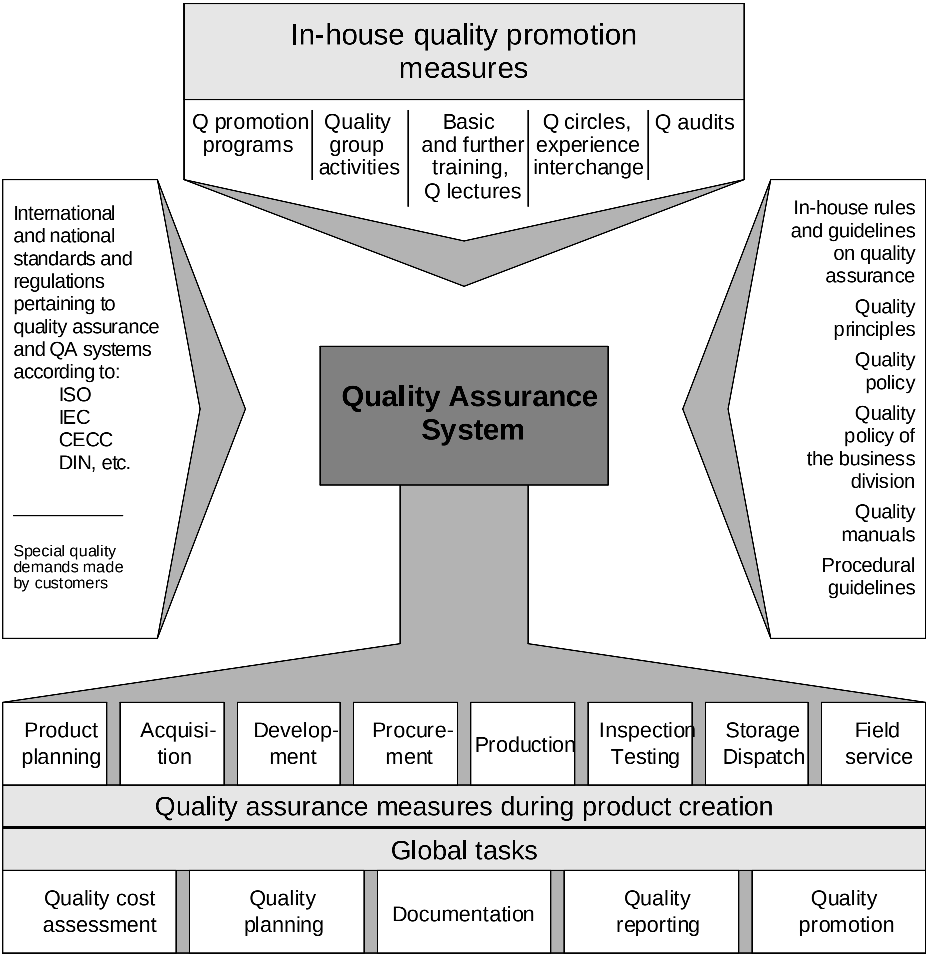
Based on the principle "quality from the very start", all instances and persons at S+M Components are involved in implementing this aim. Systematic planning, careful selection of suppliers and sure mastery of design and manufacturing processes are the major guarantees of a constantly high quality standard.

Internal quality promotion measures, such as training, quality groups, quality assurance circles and Q audits strengthen the feeling of responsibility in all employees, helping them to realize the significance of defects and thus avoid them.

Modern quality tools such as FMEA, SPC and Zero-Defect Programs with CEDAC[1)] diagrams supplement and support measures for quality assurance and enhancement.

1) FMEA Failure Mode and Effects Analyses
SPC Statistical Process Control
CEDAC-Diagramm Cause and Effect Diagram with Addition of Cards

1.2 Quality assurance system



2 Quality assurance procedure

The quality department examines capacitors and releases them for production according to the following criteria:

– compliance with type specifications
– process capability of equipment
– measuring and test technique.

The entire production process – from procurement of parts and materials, through the fabrication process to final inspection – is accompanied by quality assurance measures. The flow chart (cf. 2.5) shows the quality inspections stipulated for each individual step.

2.1 Material procurement

The high quality of parts and materials required in the manufacture of high-grade products is achieved through close co-operation with suppliers. Focal aspects of these quality assurance measures are the choice and qualification of suppliers, harmonization of specifications, incoming-goods inspection, quality assessment and problem management.

2.2 Product quality assurance

All essential manufacturing processes are subjected to permanent monitoring. Critical parameters, in particular, are subjected to statistical process control (SPC).

So-called “QC gates” are planned into the manufacturing process, i.e. there is an inspection for release at the end of the corresponding step. The continuous monitoring and evaluation of the test results are used to assess procedures and to determine how well the processes are mastered.

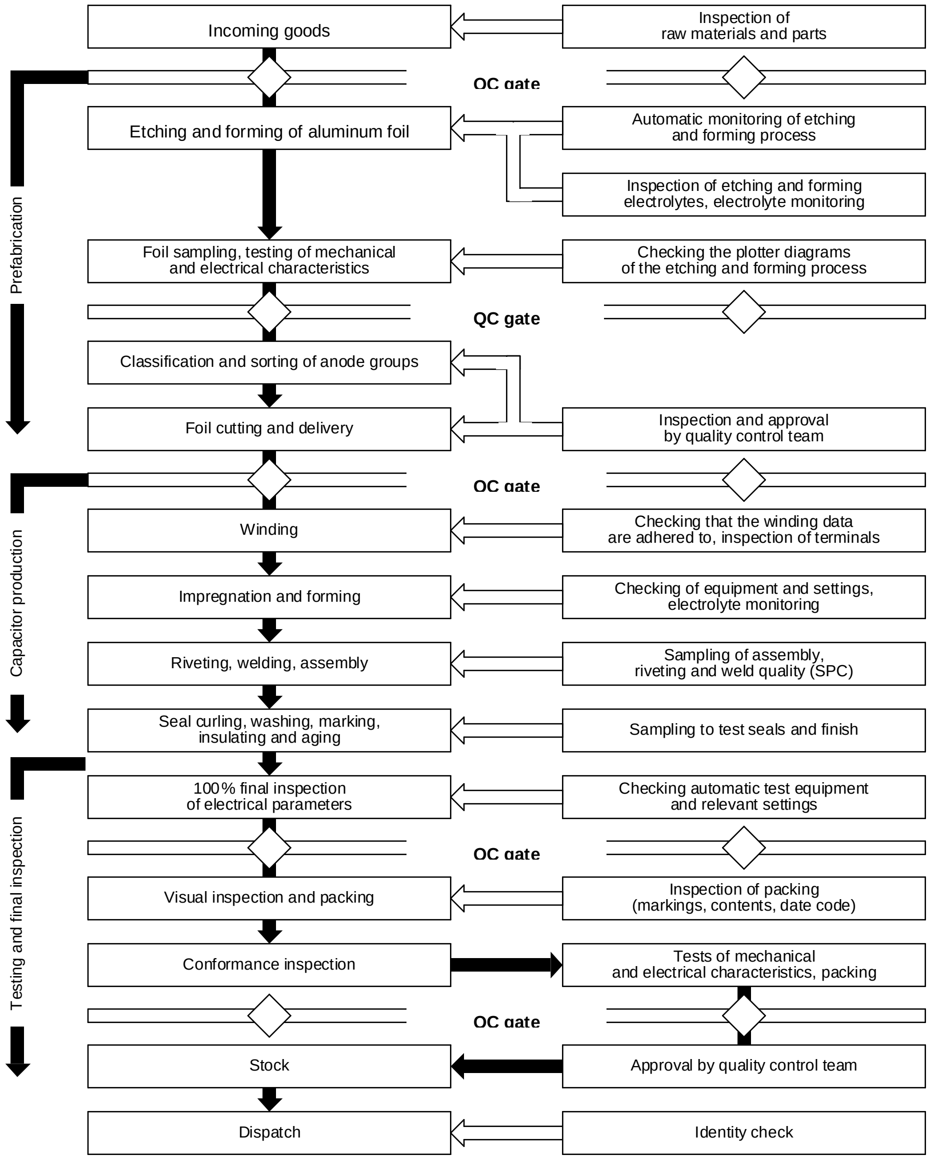
2.3 Final inspection

The capacitors are subjected to a specification-based final inspection. The parameters capacitance tolerance, dissipation factor / equivalent series resistance, impedance, leakage current and finish are checked.

2.4 Product monitoring

Our quality assurance department periodically carries out tests on random samples taken from current production lots to check climatic resistance, operational reliability, solderability and resistance to soldering heat in accordance with DIN, CECC and IEC specifications.

2.5 Manufacturing and quality assurance procedures for Al electrolytic capacitors



3 Delivery quality

The term “delivery quality” is used to indicate conformance with the mutually agreed specifications at the time of delivery.

3.1 Random sampling

The AQL (AQL = acceptable quality level) figures given in paragraph 3.3 are based on random sample inspection specification ISO 2859-1 single sampling plan for normal inspection, inspection level II. The contents of this standard correspond to MIL STD105 D and IEC 410.

The sampling instructions of this standard are such that a delivered lot will be accepted with a probability of ≥ 90 % if the percentage of non-conformancies does not exceed the stated AQL figure.

As a rule, the percentage of non-conformancies in deliveries from S+M Components is significantly below the AQL figure. The acceptance figure we apply to inoperatives, i.e. unusable components is $c = 0$.

3.2 Classification of inoperatives / non-conformancies

A non-conformancy exists if a component characteristic fails to meet the data sheet specifications or an agreed delivery specification. Inoperatives are totally unusable components.

Inoperatives (according to CECC(Sec)2874) for criteria 1) through 8):

1) Wrong or missing marking
(when specified, and provided the consequence can be misapplication)
2) Missing or useless terminals
3) Broken or missing encapsulation (if encapsulation is specified)
4) Short or open circuits
5) Capacitance outside three times the applicable tolerance
6) Marking: polarity, if missing
7) Leakage current more than 10 times the limiting value or ≥ 100 µA; whichever is greater
8) Impedance outside three times limit value
9) Alternating orientation of taped components
10) Mixing with other component types

Non-conformancies:

– non-conformancies in electrical characteristics
(electrical characteristics outside of specified limits)
– non-conformancies in mechanical properties
(e. g. wrong dimensions, damaged case, illegible marking, bent terminals).

3.3 AQL figures

The following AQL figures apply to the non-conformancies listed above:

– inoperatives (electrical and mechanical)	0,065
– sum of electrical non-conformancies	0,25
– sum of mechanical non-conformancies	0,25

3.4 Incoming goods inspection

We recommend the use of a random sampling plan according to ISO 2859-1 (the contents correspond to MIL STD 105 D and IEC 410) for incoming goods inspection.

The test methods to be used are laid down in the relevant standards. Deviations must be agreed by the customer and the supplier.

In case of complaints refer to section 7.

Single sampling plan for normal inspection – inspection level II

Excerpt from ISO 2859-1:

Sampling plan / N = Lot size	AQL 0,065	AQL 0,10	AQL 0,15	AQL 0,25
2 … 50	N-0	N-0	N-0	N-0
51 … 90	N-0	N-0	N or 80-0	50-0
91 … 150	N-0	N or 125-0	80-0	50-0
151 … 280	N or 200-0	125-0	80-0	50-0
281 … 500	200-0	125-0	80-0	50-0
501 … 1 200	200-0	125-0	80-0	50-0
1 201 … 3 200	200-0	125-0	80-0	200-1
3 201 … 10 000	200-0	125-0	315-1	200-1
10 001 … 35 000	200-0	500-1	315-1	315-2

Columns 2 to 5: Left-hand figure = sample size
Right-hand figure = acceptable non-conformancies

Non-conformancies classification: refer to paragraph 3.2

4 Useful life

Useful life is the period of time until a given failure percentage is reached. The failure percentage is the ratio of the number of failures to the total number of inspected capacitors. The useful life depends on the operating conditions, i.e. on the electrical and thermal stress to which the capacitor is subjected.

The useful life data given in this book have been determined by carrying out endurance tests, accelerated tests (e.g. increased temperature and ripple current load) and by experience gathered in actual applications.

The results obtained have been summarized in useful life diagrams for various operating conditions. These diagrams are included in the individual data sheets. The data always refer to operation at full rated voltage.

4.1 Failure criteria

– Short circuit or open circuit
– Capacitance change > 3 times the limit value of voltage endurance test, as prescribed by sectional specification, or 50% (whichever is lower)
– tan δ or equivalent series resistance > 3 times the initial limit value
– RF impedance > 3 times the initial limit value
– leakage current > initial limit value
– unusable terminals
– damaged insulation
– external short-circuiting of terminals by electrolyte
– open overpressure vent

4.2 Operating conditions

The useful life of electrolytic capacitors is mainly affected by the ambient temperature, the dc voltage load and the inherent heating caused by the ripple current.

5 Reliability

Data on long-term reliability under severe or moderate operating conditions are gained from endurance tests which are carried out continuously. The data are based on the failures registered for capacitors under a defined load, and long-term reliability of the individual types tested is based on a confidence level of 60 %. Our reliability data result from very large numbers of component operating hours.

5.1 Failure rate (long-term failure rate)

The failure rate is defined as the failure percentage divided by a specified operating period. The failure rate is expressed in fit (failures in 10^9 component hours) or as percentage of failures in 1000 hours.

1 fit = $1 \cdot 10^{-9}$/h (**fit** = **f**ailure **i**n **t**ime)

Example of a failure rate λ_{test} determined by a useful life test:

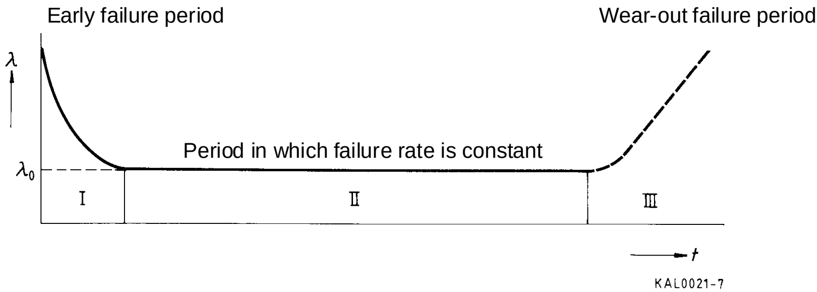
1) Number of components tested N = 8 000
2) Operating hours t_b = 25 000 h
3) Number of failures n = 2

$$\lambda_{test} = \frac{n}{N} \cdot \frac{1}{t_b} = \frac{2}{8000} \cdot \frac{1}{25000\,h} = 10 \text{ fit} = 0{,}001\ \%/1000\ h.$$

Failure rate specifications must include failure criteria, operating conditions and ambient conditions.

Usually the failure rate of components, when plotted against time, shows a characteristic curve with the following three periods:

I: early failure period, II: useful period, III: wear-out failure period



Unless otherwise specified, the failure rate refers to the useful period (II). During this period, an approximately constant failure rate λ_0 can be assumed.

5.2 Conversion factors for failure rates

The failure rate for each capacitor type is given in the individual data sheets.

The data sheet values are based on rated voltage load, negligible heating due to ripple currents and an ambient temperature of 40 °C.

The following conversion factors for different load conditions can be derived from IEC 56 (Sec) 411:

Load (as a percentage of the rated voltage)	Conversion factor
100 %	1
75 %	0,7
50 %	0,5
25 %	0,4
10 %	0,3

6 Supplementary information

The specification of quality data – which always refer to a fairly large number of components – does not constitute a guarantee of characteristics or properties in the legal sense. However, agreement on these specifications does not mean that the customer may not claim for replacement of individual defective capacitors within the terms of delivery. S+M Components cannot, however, assume any further liability beyond the replacement of defective components. This applies in particular to any further consequences of component failure.

Furthermore, it must be taken into consideration that the figures stated for useful life and failure rate refer to the average production status and are therefore to be understood as mean values (statistical expectations) for a large number of delivery lots of identical capacitors. These figures are based on application experience and on data obtained from preceding tests under normal conditions, or – for purposes of accelerated aging – more severe conditions.

7 Handling of claims and complaints

A main aim of our quality assurance system is to prevent any faults occurring. The following details will help us to respond quickly to any complaints which you may need to make:

a) Non-conformancies (inoperatives) in incoming goods

- Description of non-conformancy
- Test method / circuit
- Sample size
- Number of non-conforming units found
- Proof unit
- Packing slip

b) Non-conformancies (inoperatives) in production or operation

- Description of non-conformancy
- When and how was the non-conformancy detected
- Operating conditions
- Length of operation before non-conformancy occured
- Details as under a) if possible and applicable.

If transport damage has occurred, please describe it in detail and, if possible, mark it so that it can be distinguished from any other damage that may occur when the articles are returned. The original packing should also be examined and damage discovered should be described. To avoid further damage, please use the original packing, wherever possible, to return the articles being claimed for.

When packing capacitors, please note:

Capacitors may contain dangerous residual charges, so never handle them by the terminals! Before packing the capacitors, short-circuit the terminals.

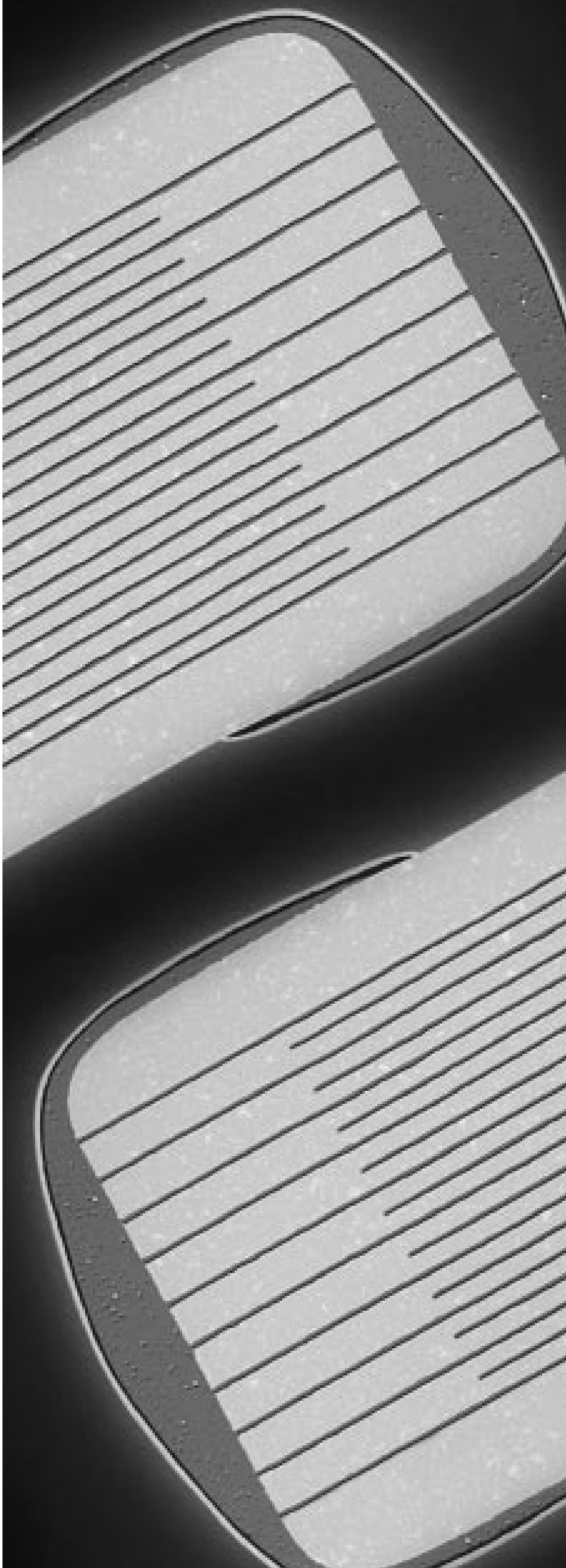
S+M COMPONENTS Siemens Matsushita Components

European technology center for
ceramic components

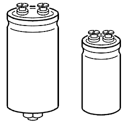
There when you need us

This is an organization that's proven its worth. Because it stands for more customer proximity and thus better service. Here you get information straight from the source, implementation of the latest technologies and products that match the market. Concentration of resources means that design engineers and production engineers are working side by side. And SCS warehousing directly at the plant ensures fastest possible delivery.

SCS – dependable, fast and competent



Capacitors with Screw Terminals

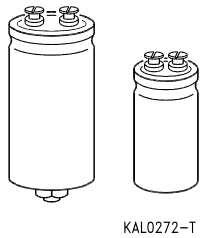


Overview

Quality grade	Type	Mounting *)	U_R V–	C_R µF	Temperature °C	Special features and fields of application	Page
GP	B 43 455 B 43 457	R C T	160 … 500	100 … 33 000	– 25 … + 85	High CU product High reliability and ripple current capability For professional and switch-mode power supplies in industrial electronics	62
LL	B 41 456 B 41 458	R C T	16 … 100	2 200 … 680 000	– 40 … + 85	High reliability Very good electrical characteristics with very small dimensions High ripple current capability For general industrial electronics, switch-mode power supplies in professional equipment, link circuits in converters	71
	B 43 456 B 43 458		350 … 450	1 000 … 18 000	– 40 … + 85 450 V: – 25 … + 85		79
	B 43 564 B 43 584		160 … 500	100 … 22 000	– 25 … + 85		86
	B 43 566 B 43 586		350 … 450	150 … 6 800	– 40 … + 85 ≥ 400 V: – 25 … + 85		94
SIKOREL	B 41 554	R C	16 … 100	1 000 … 150 000	– 55 … + 125	Maximum reliability Wide temperature range Excellent electrical data Long useful life Shelf life up to 10 years For highly professional power supplies	101
	B 41 550 B 41 570	R, C, T	16 … 100	1 000 … 150 000	– 55 … + 105		110
	B 41 431	R	5 … 55	2 800 … 46 000	– 55 … + 105		119
High performance	B 43 550 B 43 570	R C T	160 … 400	150 … 15 000	– 40 … + 105 400 V: – 25 … + 105	High reliability High ripple current capability For highly professional power supplies and power electronics (e. g. current converters)	125
High current	B 43 650 B 43 670	R C T	350 … 400	850 … 5 300	– 25 … + 105	Extremely high ripple current capability (up to 100 A) For power electronics and highly professional power supplies	133
Accessories (ring clips, clamps, insulating parts)							139

*) R = ring clip, C = clamp, T = threaded stud

For professional power supplies
High CU product
Rated voltage up to 500 V–



B 43 457 B 43 455

Construction

- Charge-discharge proof, polar
- Aluminum case with insulating sleeve
- Poles with screw terminal connections
- Mounting with ring clips, clamps or threaded stud
- The bases of types with threaded stud and $d \le 76{,}9$ mm are not insulated, types with $d = 91$ mm have fully insulated bases

Features

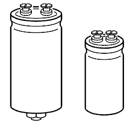
- Very compact, i. e. high CU product
- High reliability and ripple current capability
- All-welded construction ensures reliable electrical contact

Applications

- Power supplies
- For switch-mode power supplies in industrial electronics

Specifications and characteristics in brief

Rated voltage U_R Surge voltage U_S	160 to 500 V– $1{,}15 \cdot U_R$ (for $U_R \le 250$ V–) $1{,}10 \cdot U_R$ (for $U_R \ge 350$ V–)
Rated capacitance C_R Capacitance tolerance	100 to 33 000 µF ± 20 % ≙ M
Useful life 40 °C, U_R 85 °C, U_R, $I_{\sim R}$	 > 200 000 h (1,5 · $I_{\sim R,85\,°C}$) > 10 000 h
Failure percentage	≤ 1 % (during useful life)
Failure rate	≤ 40 fit ($\le 40 \cdot 10^{-9}$/h)
Voltage endurance test	2 000 h, 85 °C (at U_R)
Leakage current I_{lka} (5 min, 20 °C)	$I_{lka} \le 0{,}3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)^{0,7} + 4\ \mu A$
Self-inductance L_{ESL}	approx. 20 nH
IEC climatic category	in accordance with IEC 68-1 25/085/56 (–25 °C/+85 °C, 56 days damp heat test)



Specifications and characteristics in brief

Detail specifications	similar to CECC 30 301-803, CECC 30 301-807 (similar to CECC 30 301-046, similar to DIN 45 910 part 128)
Sectional specifications	IEC 384-4 (DIN 45 910 part 12)
Vibration resistance	in accordance with IEC 68-2–6, test Fc: displacement amplitude 0,75 mm, frequency range 10 to 55 Hz, acceleration max. 10 *g*, duration 3 × 2 h

Due to the current load capability of the contact elements, the following current limits must not be exceeded, even if the frequency and temperature factors have been taken into account:

Capacitor diameter	≤ 51,6 mm	64,3 mm	76,9 mm	91,0 mm
Maximum current	30 A	40 A	50 A	60 A

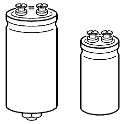
Accessories

The following items are included in the delivery package, but are not fastened to the capacitors:

	Thread	Toothed washers	Screws/Nuts	Maximum torque
For terminals	M 5	A 5,1 DIN 6797	Cylinder-head screw M 5 × 8 DIN 84-4.8	2 Nm
	M 6	A 6,4 DIN 6797	Cylinder-head screw M 6 × 12 DIN 85-4.8	2,5 Nm
For mounting	M 8	J 8,2 DIN 6797	Hex nut BM 8 DIN 439	4 Nm
	M 12	J 12,5 DIN 6797	Hex nut BM 12 DIN 439	10 Nm

The following must be ordered separately:

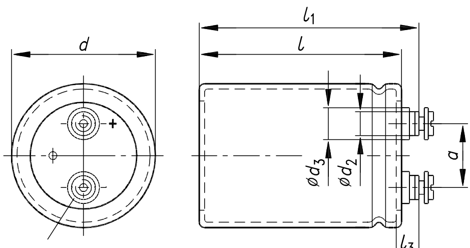
Ring clips B 44 030 (cf. page 142)
Clamps for capacitors with $d \geq$ 64,3 mm B 44 030 (cf. page 146)
Insulating parts B 44 020 (cf. page 139)



B 43 455
B 43 457

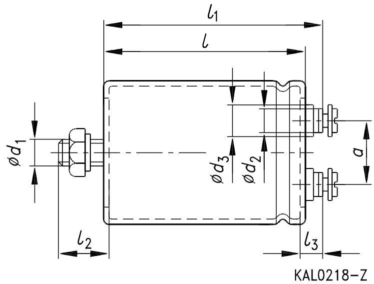
Outline drawings

Type B 43 455
Ring clip/clamp mounting



M5: min. reach of screw = 8 mm
M6: min. reach of screw = 12 mm

Type B 43 457
Threaded stud mounting



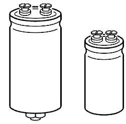
Positive pole marking: +

The base of all types with stud mounting and d = 91 mm is fully insulated (the lengths l and l_1 are increased by 0,5 mm in these cases). Also refer to the notes on mounting given on page 141. Screw terminals with UNF threads are available upon request.

Terminal	Dimensions (mm) with insulating sleeve									Approx. wt. (g)
	d	$l \pm 1$	$l_1 \pm 1$	$l_2\ ^{+0}_{-1}$	l_3	d_1	d_2 max	d_3 max	$a\ ^{+0,2}_{-0,4}$	
M 5	35,7 +0/–0,8	55,7	62,2	13	7,0 +0,2/– 1	M 8	8,2	13,5	12,7	65
M 5	35,7 +0/–0,8	80,7	87,2	13	7,0 +0,2/– 1	M 8	8,2	13,5	12,7	105
M 5	35,7 +0/–0,8	105,7	112,2	13	7,0 +0,2/– 1	M 8	8,2	13,5	12,7	135
M 5	51,6 +0/–0,8	80,7	87,2	17	7,0 +0,2/– 1	M 12	8,2	13,5	22,2	220
M 5	51,6 +0/–0,8	105,7	112,2	17	7,0 +0,2/– 1	M 12	8,2	13,5	22,2	280
M 5	64,3 +0/–0,8	80,7	87,2	17	7,0 +0,2/– 1	M 12	8,2	13,5	28,5	345
M 5	64,3 +0/–0,8	105,7	112,2	17	7,0 +0,2/– 1	M 12	8,2	13,5	28,5	440
M 6	76,9 +0/–0,7	105,7	111,5	17	6,4 +1,1/– 0,8	M 12	17,7	17,7	31,7	540
M 6	76,9 +0/–0,7	143,2	149,0	17	6,4 +1,1/– 0,8	M 12	17,7	17,7	31,7	840
M 6	76,9 +0/–0,7	220,7	226,5	17	6,4 +1,1/– 0,8	M 12	17,7	17,7	31,7	1300
M 6	91,0 +0/–2	97,0	103,3	17	6,4 +1,1/– 0,8	M 12	17,7	17,7	31,7	750
M 6	91,0 +0/–2	144,5	149,8	17	6,4 +1,1/– 0,8	M 12	17,7	17,7	31,7	1200
M 6	91,0 +0/–2	191,0	196,3	17	6,4 +1,1/– 0,8	M 12	17,7	17,7	31,7	1700
M 6	91,0 +0/–2	221,0	226,3	17	6,4 +1,1/– 0,8	M 12	17,7	17,7	31,7	1900

Packing units

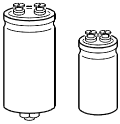
Capacitor diameter d	Packing units (pieces)
35,7 mm	72
51,6 mm	36
64,3 mm	20
76,9 mm	16
91,0 mm	8



Overview of available types

U_R (V–)	160	250	350	400	450	500
C_R (µF)	Case dimensions $d \times l$ (mm)					
100						35,7 × 55,7
150					35,7 × 55,7	35,7 × 80,7
220		35,7 × 55,7	35,7 × 80,7	35,7 × 55,7	35,7 × 80,7	35,7 × 80,7
330						35,7 × 105,7
470	35,7 × 55,7	35,7 × 55,7	35,7 × 80,7	35,7 × 80,7	51,6 × 80,7	51,6 × 80,7
680						51,6 × 105,7
1 000	35,7 × 80,7	35,7 × 80,7	51,6 × 80,7	51,6 × 80,7	51,6 × 105,7	64,3 × 105,7
1 500	35,7 × 80,7	51,6 × 80,7	51,6 × 105,7	64,3 × 105,7	64,3 × 105,7	76,9 × 105,7
2 200	51,6 × 80,7	51,6 × 80,7	64,3 × 105,7	64,3 × 105,7	76,9 × 105,7	76,9 × 143,2
3 300	51,6 × 80,7	51,6 × 105,7	76,9 × 105,7	76,9 × 105,7	76,9 × 143,2	76,9 × 220,7
4 700	51,6 × 105,7	64,3 × 105,7	76,9 × 143,2	76,9 × 143,2 91,0 × 97,0	76,9 × 220,7 91,0 × 144,5	91,0 × 221,0
5 600						91,0 × 221,0
6 000			76,9 × 143,2	76,9 × 220,7	76,9 × 220,7	
6 800	64,3 × 105,7	76,9 × 105,7		91,0 × 144,5		
8 200			91,0 × 144,5		91,0 × 221,0	
10 000	76,9 × 105,7	76,9 × 143,2	76,9 × 220,7	91,0 × 191,0		
12 000			91,0 × 191,0	91,0 × 221,0		
15 000	76,9 × 143,2	76,9 × 220,7 91,0 × 144,5				
22 000	76,9 × 220,7 91,0 × 144,5	91,0 × 221,0				
33 000	91,0 × 221,0					

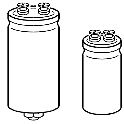
The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR,\ typ}$ 100 Hz 20 °C mΩ	$R_{ESR,\ max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	$I_{\sim max}$ 100 Hz 85 °C A	Ordering code[1)] Short code
B43455-, B43457-									
160	470	35,7 × 55,7	260	520	420	4,4	2,0	2,4	-A1477-M
	1 000	35,7 × 80,7	130	260	220	6,9	3,1	3,8	-A1108-M
	1 500	35,7 × 80,7	85	170	140	8,5	3,9	4,6	-A1158-M
	2 200	51,6 × 80,7	57	120	100	12	5,3	6,3	-A1228-M
	3 300	51,6 × 80,7	40	80	69	14	6,3	7,6	-A1338-M
	4 700	51,6 × 105,7	31	62	55	17	7,9	9,4	-A1478-M
	6 800	64,3 × 105,7	23	46	42	22	10	12	-A1688-M
	10 000	76,9 × 105,7	17	34	32	24	11	13	-A1109-M
	15 000	76,9 × 143,2	12	24	24	30	14	17	-A1159-M
	22 000	76,9 × 220,7	9	18	18	42	19	23	-A1229-M
	22 000	91,0 × 144,5	8	18	18	42	19	23	-J1229-M
	33 000	91,0 × 221,0	6	14	14	57	26	31	-A1339-M
250	220	35,7 × 55,7	370	740	580	3,7	1,7	2,0	-A2227-M
	470	35,7 × 55,7	170	340	280	5,4	2,5	3,0	-A2477-M
	1 000	35,7 × 80,7	93	190	160	8,1	3,7	4,4	-A2108-M
	1 500	51,6 × 80,7	71	150	130	10	4,7	5,7	-A2158-M
	2 200	51,6 × 80,7	51	100	85	12	5,6	6,7	-A2228-M
	3 300	51,6 × 105,7	36	72	63	16	7,3	8,7	-A2338-M
	4 700	64,3 × 105,7	27	54	48	21	9,4	11	-A2478-M
	6 800	76,9 × 105,7	20	40	37	21	10	11	-A2688-M
	10 000	76,9 × 143,2	15	30	29	27	12	15	-A2109-M
	15 000	76,9 × 220,7	14	28	27	33	15	18	-A2159-M
	15 000	91,0 × 144,5	12	28	27	33	15	18	-J2159-M
	22 000	91,0 × 221,0	9	20	20	47	21	25	-A2229-M

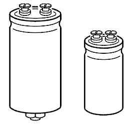
1) For instructions on how to determine ordering codes, refer to page 68.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	$I_{\sim max}$ 100 Hz 85 °C A	Ordering code[1)] Short code
B43455-, B43457-									
350	220	35,7 × 80,7	310	620	500	4,4	2,0	2,4	-A4227-M
	470	35,7 × 80,7	150	300	250	6,4	2,9	3,5	-A4477-M
	1 000	51,6 × 80,7	86	170	140	9,4	4,3	5,2	-A4108-M
	1 500	51,6 × 105,7	62	130	110	12	5,6	6,7	-A4158-M
	2 200	64,3 × 105,7	48	96	82	15	7,0	8,4	-A4228-M
	3 300	76,9 × 105,7	32	64	56	16	7,5	9,0	-A4338-M
	4 700	76,9 × 143,2	25	50	45	21	10	12	-A4478-M
	6 000	76,9 × 143,2	21	42	39	23	10	13	-A4608-M
	8 200	91,0 × 144,5	13	30	29	33	15	18	-A4828-M
	10 000	76,9 × 220,7	13	26	26	35	16	19	-A4109-M
	12 000	91,0 × 191,0	10	22	22	46	20	24	-A4129-M
400	220	35,7 × 55,7	310	620	500	4,0	1,8	2,2	-A227-M
	470	35,7 × 80,7	150	300	250	6,4	1,9	3,5	-A477-M
	1 000	51,6 × 80,7	86	170	140	9,4	4,3	5,2	-A108-M
	1 500	64,3 × 105,7	62	130	110	14	6,2	7,4	-A158-M
	2 200	64,3 × 105,7	48	96	82	15	7,0	8,4	-A228-M
	3 300	76,9 × 105,7	36	72	63	16	7,1	8,5	-A338-M
	4 700	76,9 × 143,2	27	54	48	20	9,2	11	-A478-M
	4 700	91,0 × 97,0	23	54	48	22	9,8	12	-K478-M
	6 000	76,9 × 220,7	21	42	39	27	12	15	-A608-M
	6 800	91,0 × 144,5	16	38	35	30	13	16	-A688-M
	10 000	91,0 × 191,0	13	26	26	35	16	19	-A109-M
	12 000	91,0 × 221,0	10	22	22	46	20	24	-A129-M

1) For instructions on how to determine ordering codes, refer to page 68.

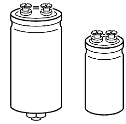


B 43 455
B 43 457

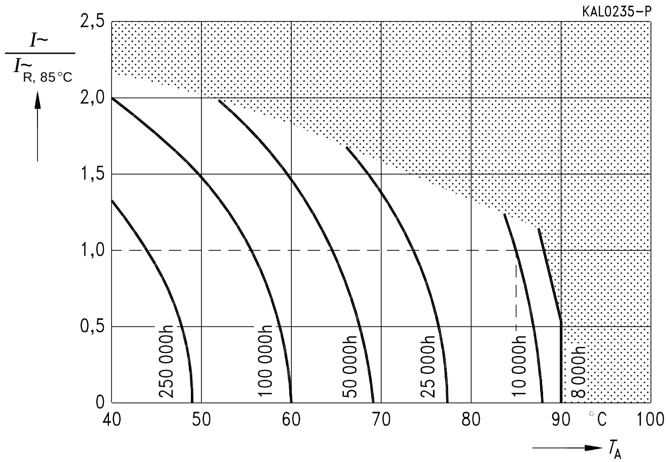
Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	$I_{\sim max}$ 100 Hz 85 °C A	Ordering code[1)] Short code
B43455-, B43457-									
450	150	35,7 × 55,7	800	1600	1300	2,5	1,1	1,4	-A5157-M
	220	35,7 × 80,7	540	1100	890	3,4	1,5	1,8	-A5227-M
	470	51,6 × 80,7	260	520	420	5,4	2,5	3,0	-A5477-M
	1 000	51,6 × 105,7	120	240	200	8,7	4,0	4,8	-A5108-M
	1 500	64,3 × 105,7	80	160	130	12	5,5	6,5	-A5158-M
	2 200	76,9 × 105,7	54	110	93	13	5,8	7,0	-A5228-M
	3 300	76,9 × 143,2	36	72	63	18	8,0	9,6	-A5338-M
	4 700	76,9 × 220,7	28	56	50	24	11	13	-A5478-M
	4 700	91,0 × 144,5	24	56	50	24	11	13	-J5478-M
	6 000	76,9 × 220,7	22	44	40	27	12	15	-A5608-M
	8 200	91,0 × 221,0	14	32	31	38	17	20	-A5828-M
500	100	35,7 × 55,7	880	1760	1420	2,1	0,94	1,1	-A6107-M
	150	35,7 × 80,7	590	1180	950	2,8	1,3	1,5	-A6157-M
	220	35,7 × 80,7	400	800	650	3,4	1,5	1,9	-A6227-M
	330	35,7 × 105,7	270	540	440	4,6	2,1	2,5	-A6337-M
	470	51,6 × 80,7	190	380	310	5,5	2,5	3,0	-A6477-M
	680	51,6 × 105,7	130	260	220	7,3	3,3	4,0	-A6687-M
	1 000	64,3 × 105,7	90	180	150	9,8	4,5	5,3	-A6108-M
	1 500	76,9 × 105,7	62	130	110	12	5,4	6,5	-A6158-M
	2 200	76,9 × 143,2	42	84	72	16	7,4	8,9	-A6228-M
	3 300	76,9 × 220,7	28	56	50	24	11	13	-J6338-M
	4 700	91,0 × 221,0	17	40	37	33	15	18	-A6478-M
	5 600	91,0 × 221,0	15	34	32	36	16	20	-A6568-M

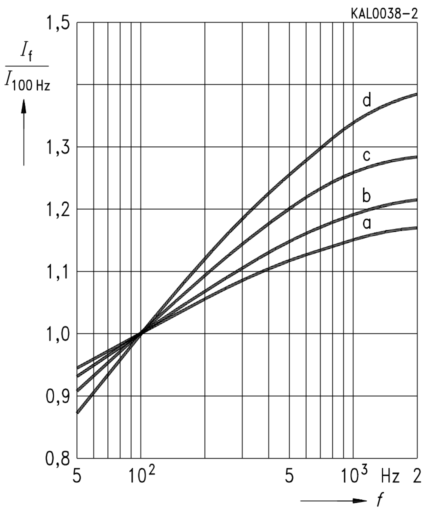
1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B43457-A5157-M
B43455-… (ring clip/clamp mounting)
B43457-… (with threaded stud)



Useful life
versus ambient temperature T_A under ripple current operating conditions[1)]



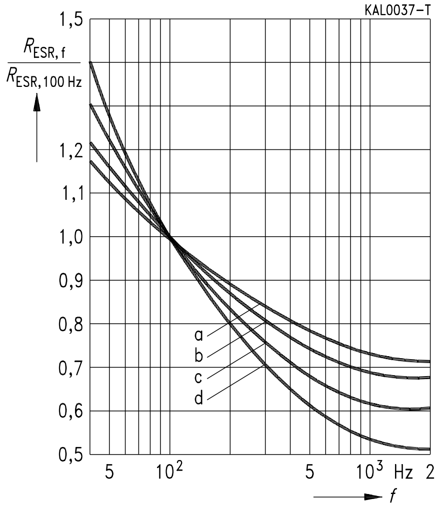
Permissible ripple current *I*~
versus frequency *f*



d (mm)	35,7	51,6	64,3	76,9	91,0
Curve	d	c	b	a	c

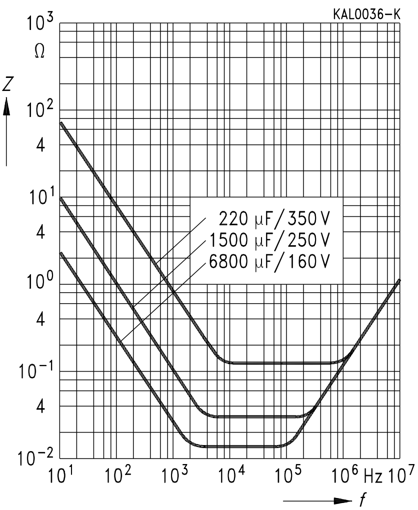
1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

Equivalent series resistance R_{ESR}
versus frequency f
Typical behavior

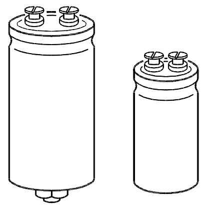


d (mm)	35,7	51,6	64,3	76,9	91,0
Curve	d	c	b	a	a

Impedance Z
versus frequency f
Typical behavior



Compact low-voltage type
For professional power supplies



B 41 458 B 41 456

Construction

- Charge-discharge proof, polar
- Aluminum case with insulating sleeve
- Poles with screw terminal connections
- Mounting with ring clips, clamps or threaded stud
- The bases of types with threaded stud are not insulated

Features

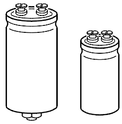
- High reliability
- Extremely good electrical characteristics and small dimensions
- High ripple current capability
- All-welded construction ensures reliable electrical contact

Applications

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

Specifications and characteristics in brief

Rated voltage U_R Surge voltage U_S	16 to 100 V– $1{,}15 \cdot U_R$
Rated capacitance C_R Capacitance tolerance	2 200 to 680 000 µF ± 20 % ≙ M
Useful life 85 °C, U_R, $I_{\sim R}$	 > 12 000 h
Failure percentage	≤ 1 % (during useful life)
Failure rate	≤ 40 fit ($\leq 40 \cdot 10^{-9}$/h)
Voltage endurance test	2 000 h, 85 °C (at U_R)
Leakage current I_{lka} (5 min, 20 °C)	$1\,000\ \mu C \leq C_R \cdot U_R < 470\,000\ \mu C$: $I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$ $C_R \cdot U_R \geq 470\,000\ \mu C$: $I_{lka} \leq 0{,}3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)^{0{,}7} + 4\ \mu A$



B 41 456
B 41 458

Specifications and characteristics in brief

Self-inductance L_{ESL}	approx. 20 nH
IEC climatic category	in accordance with IEC 68-1 40/085/56 (–40 °C/+85 °C, 56 days damp heat test)
Detail specifications Sectional specifications	similar to CECC 30 301-810 IEC 384-4 (DIN 45 910 part 12)
Vibration resistance	in accordance with IEC 68-2–6, test Fc: displacement amplitude 0,75 mm, frequency range 10 to 55 Hz, acceleration max. 10 *g*, duration 3 × 2 h

Due to the current load capability of the contact elements, the following current limits must not be exceeded, even if the frequency and temperature factors have been taken into account:

Capacitor diameter	≤ 51,6 mm	64,3 mm	76,9 mm
Maximum current	30 A	40 A	50 A

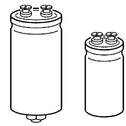
Accessories

The following items are included in the delivery package, but are not fastened to the capacitors:

	Thread	Toothed washers	Screws/Nuts	Maximum torque
For terminals	M 5	A 5,1 DIN 6797	Cylinder-head screw M 5 × 8 DIN 84-4.8	2 Nm
	M 6	A 6,4 DIN 6797	Cylinder-head screw M 6 × 12 DIN 85-4.8	2,5 Nm
For mounting	M 8	J 8,2 DIN 6797	Hex nut BM 8 DIN 439	4 Nm
	M 12	J 12,5 DIN 6797	Hex nut BM 12 DIN 439	10 Nm

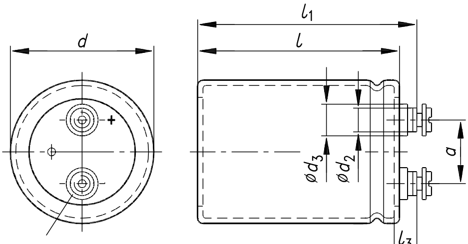
The following must be ordered separately:

Ring clips — B 44 030 (cf. page 142)
Clamps for capacitors with $d \geq 64{,}3$ mm — B 44 030 (cf. page 146)
Insulating parts — B 44 020 (cf. page 139)



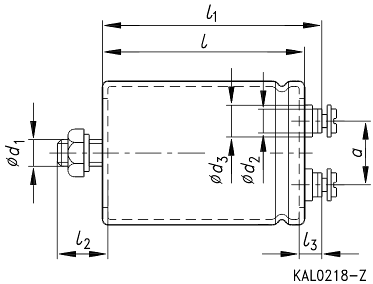
Outline drawings

Type B 41 456
Ring clip/clamp mounting



M5: min. reach of screw =   8 mm
M6: min. reach of screw = 12 mm

Type B 41 458
Threaded stud mounting



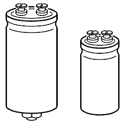
Positive pole marking: +

Screw terminals with UNF threads are available upon request.

Ter-minal	Dimensions (mm) with insulating sleeve									Approx. wt. (g)
	d	$l \pm 1$	$l_1 \pm 1$	$l_2\,^{+0}_{-1}$	l_3	d_1	d_2 max	d_3 max	$a\,^{+0,2}_{-0,4}$	
M 5	35,7 $^{+0/-0,8}$	55,7	62,2	13	7,0 $^{+0,2/-1}$	M 8	8,2	13,5	12,7	65
M 5	35,7 $^{+0/-0,8}$	80,7	87,2	13	7,0 $^{+0,2/-1}$	M 8	8,2	13,5	12,7	105
M 5	35,7 $^{+0/-0,8}$	105,7	112,2	13	7,0 $^{+0,2/-1}$	M 8	8,2	13,5	12,7	135
M 5	51,6 $^{+0/-0,8}$	80,7	87,2	17	7,0 $^{+0,2/-1}$	M 12	8,2	13,5	22,2	220
M 5	51,6 $^{+0/-0,8}$	105,7	112,2	17	7,0 $^{+0,2/-1}$	M 12	8,2	13,5	22,2	280
M 5	64,3 $^{+0/-0,8}$	105,7	112,2	17	7,0 $^{+0,2/-1}$	M 12	8,2	13,5	28,5	440
M 6	76,9 $^{+0/-0,7}$	105,7	111,5	17	6,4 $^{+1,1/-0,8}$	M 12	17,7	17,7	31,7	540
M 6	76,9 $^{+0/-0,7}$	143,2	149,0	17	6,4 $^{+1,1/-0,8}$	M 12	17,7	17,7	31,7	840
M 6	76,9 $^{+0/-0,7}$	220,7	226,5	17	6,4 $^{+1,1/-0,8}$	M 12	17,7	17,7	31,7	1300

Packing units

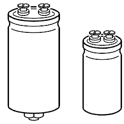
Capacitor diameter *d*	Packing units (pieces)
35,7 mm	72
51,6 mm	36
64,3 mm	20
76,9 mm	16



Overview of available types

U_R (V–)	16	25	40	63	100
C_R (µF)	Case dimensions $d \times l$ (mm)				
2 200					35,7 × 55,7
3 300					35,7 × 80,7
4 700				35,7 × 55,7	35,7 × 80,7
6 800				35,7 × 55,7	35,7 × 105,7
10 000			35,7 × 55,7	35,7 × 80,7	51,6 × 80,7
15 000			35,7 × 80,7	35,7 × 105,7	51,6 × 105,7
22 000	35,7 × 55,7	35,7 × 55,7	35,7 × 80,7	51,6 × 80,7	64,3 × 105,7
33 000	35,7 × 55,7	35,7 × 80,7	35,7 × 105,7	51,6 × 105,7	76,9 × 105,7
47 000	35,7 × 80,7	35,7 × 105,7	51,6 × 80,7	64,3 × 105,7	76,9 × 143,2
68 000	35,7 × 105,7	51,6 × 80,7	51,6 × 105,7	76,9 × 105,7	
100 000	51,6 × 80,7	51,6 × 105,7	64,3 × 105,7	76,9 × 143,2	
150 000	51,6 × 80,7	64,3 × 105,7	76,9 × 105,7	76,9 × 220,7	
220 000	64,3 × 105,7	64,3 × 105,7	76,9 × 143,2		
330 000	64,3 × 105,7	76,9 × 143,2			
470 000	76,9 × 143,2	76,9 × 220,7			
680 000	76,9 × 143,2				

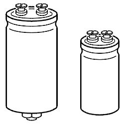
The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR,\ typ}$ 100 Hz 20 °C mΩ	$R_{ESR,\ max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code[1)] Short code
B41456-, B41458-								
16	22 000	35,7 × 55,7	14,1	28	23	21	7,1	-B4229-M
	33 000	35,7 × 55,7	10	21	17	24	8,3	-B4339-M
	47 000	35,7 × 80,7	7,9	16	13	30	11	-B4479-M
	68 000	35,7 × 105,7	6,3	13	10	30	13	-B4689-M
	100 000	51,6 × 80,7	5,1	10	8,2	30	14	-B4100-M
	150 000	51,6 × 80,7	4,2	8,4	6,8	30	15	-B4150-M
	220 000	64,3 × 105,7	3,7	7,3	5,9	40	20	-B4220-M
	330 000	64,3 × 105,7	3,3	6,6	5,3	50	21	-B4330-M
	470 000	76,9 × 143,2	3,0	6,1	4,9	50	25	-B4470-M
	680 000	76,9 × 143,2	2,9	5,8	4,6	50	26	-B4680-M
25	22 000	35,7 × 55,7	13	25	20	22	7,7	-B5229-M
	33 000	35,7 × 80,7	9,3	19	15	29	10	-B5339-M
	47 000	35,7 × 105,7	7,3	15	12	30	12	-B5479-M
	68 000	51,6 × 80,7	5,8	12	9,3	30	13	-B5689-M
	100 000	51,6 × 105,7	4,7	9,5	7,6	48	16	-B5100-M
	150 000	64,3 × 105,7	4,0	8,0	6,4	40	20	-B5150-M
	220 000	64,3 × 105,7	3,5	7,0	5,6	50	21	-B5220-M
	330 000	76,9 × 143,2	3,2	6,4	5,1	50	25	-B5330-M
	470 000	76,9 × 220,7	3,0	6,0	4,8	50	31	-B5470-M
40	10 000	35,7 × 55,7	19	37	34	18	6,3	-B7109-M
	15 000	35,7 × 80,7	13	27	24	24	8,3	-B7159-M
	22 000	35,7 × 80,7	10	20	18	28	9,6	-B7229-M
	33 000	35,7 × 105,7	7,4	15	13	30	12	-B7339-M
	47 000	51,6 × 80,7	5,9	12	10	30	13	-B7479-M
	68 000	51,6 × 105,7	4,9	10	8,4	30	16	-B7689-M
	100 000	64,3 × 105,7	4,1	8,2	7,0	40	19	-B7100-M
	150 000	76,9 × 105,7	3,6	7,2	6,0	50	21	-B7150-M
	220 000	76,9 × 143,2	3,2	6,5	5,4	50	25	-B7220-M

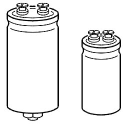
1) For instructions on how to determine ordering codes, refer to page 76.



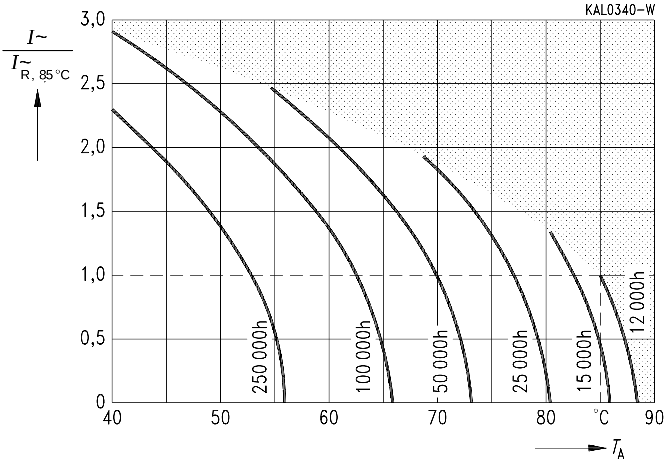
Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code[1) Short code
B41456-, B41458-								
63	4 700	35,7 × 55,7	30	60	58	14	4,9	-B8478-M
	6 800	35,7 × 55,7	22	43	42	17	5,9	-B8688-M
	10 000	35,7 × 80,7	15	31	30	23	7,7	-B8109-M
	15 000	35,7 × 105,7	11	22	21	30	10	-B8159-M
	22 000	51,6 × 80,7	8,0	16	16	30	11	-B8229-M
	33 000	51,6 × 105,7	6,0	12	12	30	14	-B8339-M
	47 000	64,3 × 105,7	4,8	10	9,4	40	18	-B8479-M
	68 000	76,9 × 105,7	4,0	7,9	7,8	50	20	-B8689-M
	100 000	76,9 × 143,2	3,3	6,7	6,6	50	25	-B8100-M
	150 000	76,9 × 220,7	2,9	5,8	5,7	50	31	-B8150-M
100	2 200	35,7× 55,7	32	80	70	13	4,3	-B9228-M
	3 300	35,7 × 80,7	22	55	48	17	5,8	-B9338-M
	4 700	35,7 × 80,7	16	40	35	20	6,7	-B9478-M
	6 800	35,7 × 105,7	12	29	25	25	8,7	-B9688-M
	10 000	51,6 × 80,7	8,6	22	18	30	10	-B9109-M
	15 000	51,6 × 105,7	6,4	16	14	38	13	-B9159-M
	22 000	64,3 × 105,7	5,0	13	11	40	17	-B9229-M
	33 000	76,9 × 105,7	4,0	10	8,4	50	19	-B9339-M
	47 000	76,9 × 143,2	3,4	8,5	7,1	50	24	-B9479-M

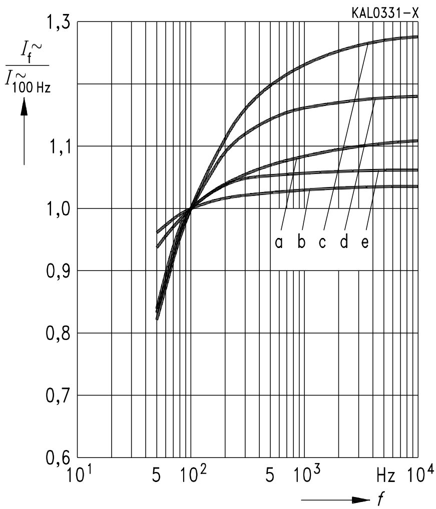
1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B41456-B8478-M
B41456-... (ring clip/clamp mounting)
B41458-... (with threaded stud)



Useful life
versus ambient temperature T_A under ripple current operating conditions[1)]

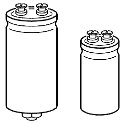


Permissible ripple current *I*~
versus frequency *f*

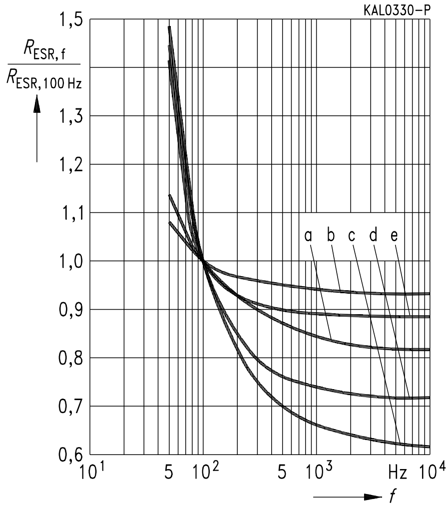


d (mm)	35,7	51,6	64,3	76,9
≤63 V–	a	a	a	b
100 V–	c	d	d	e

1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

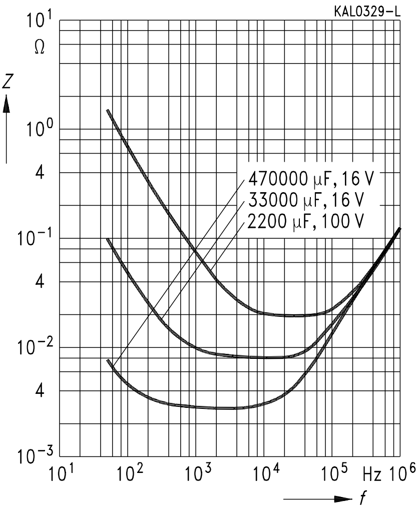


Equivalent series resistance R_{ESR}
versus frequency f
Typical behavior

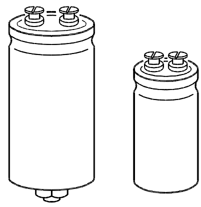


d (mm)	35,7	51,6	64,3	76,9
≤63 V–	a	a	a	b
100 V–	c	d	d	e

Impedance Z
versus frequency f
Typical behavior



Compact high-voltage type
For professional power supplies



B 43 458 B 43 456

Construction

- Charge-discharge proof, polar
- Aluminum case with insulating sleeve
- Poles with screw terminal connections
- Mounting with ring clips, clamps or threaded stud
- The bases of types with threaded stud and $d \leq 76{,}9$ mm are not insulated, types with $d = 91$ mm have fully insulated bases

Features

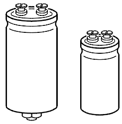
- Very compact, i. e. high CU product
- High reliability and ripple current capability
- All-welded construction ensures reliable electrical contact

Applications

- Power supplies
- For switch-mode power supplies in industrial electronics

Specifications and characteristics in brief

Rated voltage U_R Surge voltage U_S	350 to 450 V– $1{,}10 \cdot U_R$
Rated capacitance C_R Capacitance tolerance	1 000 to 18 000 µF ± 20 % ≙ M
Useful life 40 °C, U_R 85 °C, U_R, $I_{\sim R}$	 > 250 000 h (1,5 · $I_{\sim R,85\,°C}$) > 12 000 h
Failure percentage	≤ 1 % (during useful life)
Failure rate	≤ 40 fit (≤ 40 · 10^{-9}/h)
Voltage endurance test	2 000 h, 85 °C (at U_R)
Leakage current I_{lka} (5 min, 20 °C)	$I_{lka} \leq 0{,}3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)^{0{,}7} + 4\ \mu A$
Self-inductance L_{ESL}	approx. 20 nH



B 43 456
B 43 458

Specifications and characteristics in brief

IEC climatic category	in accordance with IEC 68-1 ≤ 400 V–: 40/085/56 (–40 °C/+85 °C, 56 days damp heat test) 450 V–: 25/085/56 (–25 °C/+85 °C, 56 days damp heat test)
Detail specifications	similar to CECC 30 301-803, CECC 30 301-807 (similar to CECC 30 301-046, similar to DIN 45 910 part 128)
Sectional specifications	IEC 384-4 (DIN 45 910 part 12)
Vibration resistance	in accordance with IEC 68-2–6, test Fc: displacement amplitude 0,75 mm, frequency range 10 to 55 Hz, acceleration max. 10 *g*, duration 3 × 2 h

Due to the current load capability of the contact elements, the following current limits must not be exceeded, even if the frequency and temperature factors have been taken into account:

Capacitor diameter	51,6 mm	64,3 mm	76,9 mm	91,0 mm
Maximum current	30 A	40 A	50 A	60 A

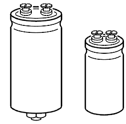
Accessories

The following items are included in the delivery package, but are not fastened to the capacitors:

	Thread	Toothed washers	Screws/Nuts	Maximum torque
For terminals	M 5	A 5,1 DIN 6797	Cylinder-head screw M 5 × 8 DIN 84-4.8	2 Nm
	M 6	A 6,4 DIN 6797	Cylinder-head screw M 6 × 12 DIN 85-4.8	2,5 Nm
For mounting	M 8	J 8,2 DIN 6797	Hex nut BM 8 DIN 439	4 Nm
	M 12	J 12,5 DIN 6797	Hex nut BM 12 DIN 439	10 Nm

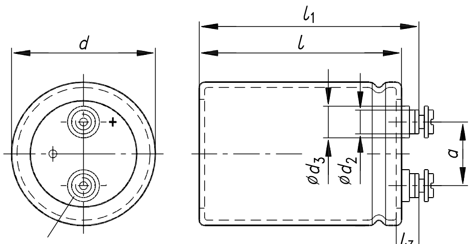
The following must be ordered separately:

Ring clips	B 44 030 (cf. page 142)
Clamps for capacitors with $d \geq 64{,}3$ mm	B 44 030 (cf. page 146)
Insulating parts	B 44 020 (cf. page 139)



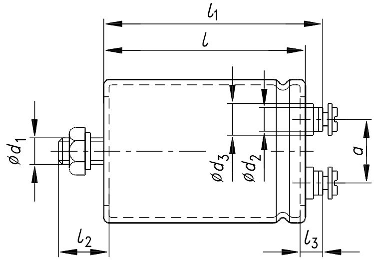
Outline drawings

Type B 43 456
Ring clip/clamp mounting



M5: min. reach of screw = 8 mm
M6: min. reach of screw = 12 mm

Type B 43 458
Threaded stud mounting



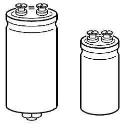
Positive pole marking: +

The base of all types with stud mounting and d = 91 mm is fully insulated (the lengths l and l_1 are increased by 0,5 mm in these cases). Also refer to the notes on mounting given on page 141.
Screw terminals with UNF threads are available upon request.

Terminal	Dimensions (mm) with insulating sleeve									Approx. wt. (g)
	d	$l \pm 1$	$l_1 \pm 1$	$l_2\ ^{+0}_{-1}$	l_3	d_1	d_2 max	d_3 max	$a\ ^{+0,2}_{-0,4}$	
M 5	51,6 +0/–0,8	80,7	87,2	17	7,0 +0,2/– 1	M 12	8,2	13,5	22,2	220
M 5	51,6 +0/–0,8	105,7	112,2	17	7,0 +0,2/– 1	M 12	8,2	13,5	22,2	280
M 5	64,3 +0/–0,8	105,7	112,2	17	7,0 +0,2/– 1	M 12	8,2	13,5	28,5	440
M 6	76,9 +0/–0,7	105,7	111,5	17	6,4 +1,1/– 0,8	M 12	17,7	17,7	31,7	540
M 6	76,9 +0/–0,7	143,2	149,0	17	6,4 +1,1/– 0,8	M 12	17,7	17,7	31,7	840
M 6	76,9 +0/–0,7	220,7	226,5	17	6,4 +1,1/– 0,8	M 12	17,7	17,7	31,7	1300
M 6	91,0 +0/–2	144,5	149,8	17	6,4 +1,1/– 0,8	M 12	17,7	17,7	31,7	1200
M 6	91,0 +0/–2	221,0	226,3	17	6,4 +1,1/– 0,8	M 12	17,7	17,7	31,7	1900

Packing units

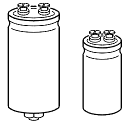
Capacitor diameter d	Packing units (pieces)
51,6 mm	36
64,3 mm	20
76,9 mm	16
91,0 mm	8



Overview of available types

U_R (V–)	350	400	450
C_R (µF)	Case dimensions $d \times l$ (mm)		
1 000			51,6 × 80,7
1 500	51,6 × 80,7	51,6 × 80,7	51,6 × 105,7
2 200	51,6 × 105,7	51,6 × 105,7	64,3 × 105,7
3 300		64,3 × 105,7	76,9 × 105,7
3 900	64,3 × 105,7		
4 700		76,9 × 105,7	
5 600	76,9 × 105,7		76,9 × 143,2
6 800		76,9 × 143,2	91,0 × 144,5
8 200	76,9 × 143,2		76,9 × 220,7
10 000		91,0 × 144,5	
12 000	91,0 × 144,5	76,9 × 220,7	91,0 × 221,0
15 000	76,9 × 220,7	91,0 × 221,0	
18 000	91,0 × 221,0		

The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.

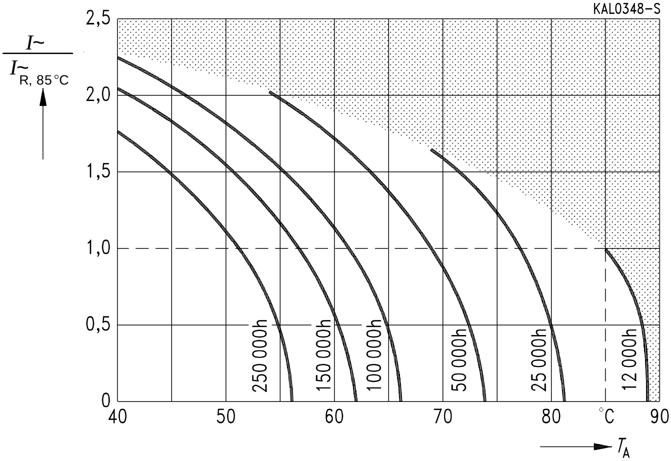


Technical data and ordering codes

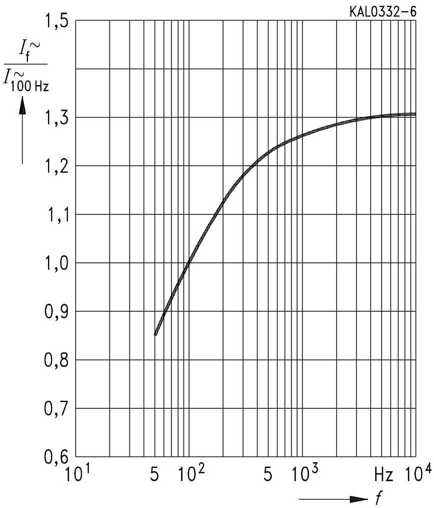
U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code[1)] Short code
B43456-, B43458-								
350	1 500	51,6 × 80,7	54	110	93	13	5,6	-A4158-M
	2 200	51,6 × 105,7	37	73	63	17	7,6	-A4228-M
	3 900	64,3 × 105,7	21	41	38	25	11	-A4398-M
	5 600	76,9 × 105,7	15	29	28	31	14	-A4568-M
	8 200	76,9 × 143,2	10	20	20	42	18	-A4828-M
	12 000	91,0 × 144,5	7	14	14	56	25	-A4129-M
	15 000	76,9 × 220,7	6	11	11	50	30	-A4159-M
	18 000	91,0 × 221,0	5	9	9	60	36	-A4189-M
400	1 500	51,6 × 80,7	53	110	93	13	5,6	-A9158-M
	2 200	51,6 × 105,7	36	73	63	17	7,6	-A9228-M
	3 300	64,3 × 105,7	24	49	44	23	10	-A9338-M
	4 700	76,9 × 105,7	17	34	32	28	12	-A9478-M
	6 800	76,9 × 143,2	12	24	24	38	17	-A9688-M
	10 000	91,0 × 144,5	8	16	16	51	23	-A9109-M
	12 000	76,9 × 220,7	7	14	14	50	27	-A9129-M
	15 000	91,0 × 221,0	5	11	11	60	33	-A9159-M
450	1 000	51,6 × 80,7	110	220	190	10	4,6	-A5108-M
	1 500	51,6 × 105,7	71	150	130	14	6,3	-A5158-M
	2 200	64,3 × 105,7	48	100	85	19	8,3	-A5228-M
	3 300	76,9 × 105,7	32	66	57	24	10	-A5338-M
	5 600	76,9 × 143,2	19	38	35	35	15	-A5568-M
	6 800	91,0 × 144,5	16	32	31	50	22	-A5688-M
	8 200	76,9 × 220,7	13	26	26	42	19	-A5828-M
	12 000	91,0 × 221,0	9	18	18	60	29	-A5129-M

1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B43456-A4158-M
B43456-… (ring clip/clamp mounting)
B43458-… (with threaded stud)

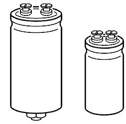
Useful life
versus ambient temperature T_A under ripple current operating conditions[1)]



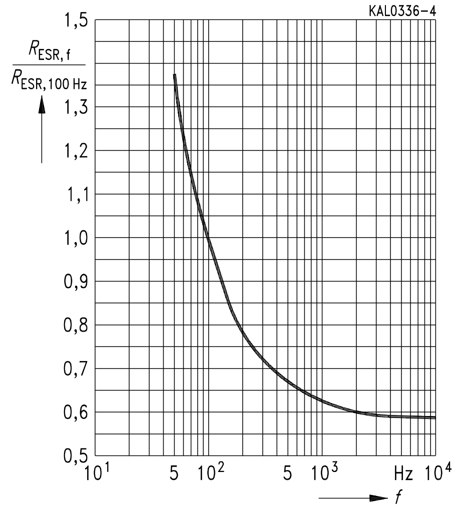
Permissible ripple current *I*~
versus frequency *f*



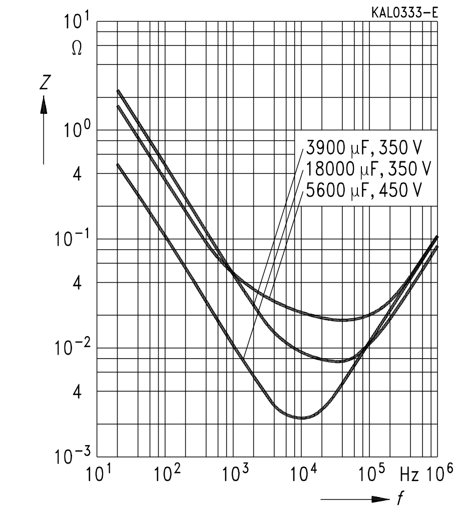
1) Refer to page 34 for an explanation on how to interpret the useful life graphs.



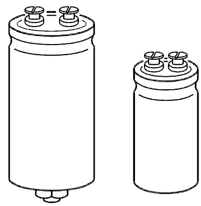
Equivalent series resistance R_{ESR}
versus frequency f
Typical behavior



Impedance Z
versus frequency f
Typical behavior



For professional current converter technology
Rated voltage up to 500 V–



KAL0272-T

B 43 584 B 43 564

Construction

- Charge-discharge proof, polar
- Aluminum case with insulating sleeve
- Poles with screw terminal connections
- Mounting with ring clips, clamps or threaded stud
- The bases of types with threaded stud and $d \leq$ 76,9 mm are not insulated, types with d = 91 mm have fully insulated bases

Features

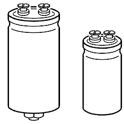
- High reliability
- Extremely good electrical characteristics and small dimensions
- High ripple current capability
- All-welded construction ensures reliable electrical contact

Applications

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

Specifications and characteristics in brief

Rated voltage U_R Surge voltage U_S	160 to 500 V– 1,15 · U_R (for $U_R \leq$ 250 V–) 1,10 · U_R (for $U_R \geq$ 350 V–)
Rated capacitance C_R Capacitance tolerance	100 to 22 000 µF ± 20 % ≙ M
Useful life 40 °C, U_R 85 °C, U_R, $I_{\sim R}$	 > 200 000 h (1,6 · $I_{\sim R,85\,°C}$) > 15 000 h
Failure percentage	≤ 1 % (during useful life)
Failure rate	≤ 40 fit (≤ 40 · 10^{-9}/h)
Voltage endurance test	2 000 h, 85 °C (at U_R, $I_{\sim R}$)



Specifications and characteristics in brief

Leakage current I_{lka} (5 min, 20 °C)	$1\,000\ \mu C \le C_R \cdot U_R < 470\,000\ \mu C$: $I_{lka} \le 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$ $C_R \cdot U_R \ge 470\,000\ \mu C$: $I_{lka} \le 0{,}3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)^{0{,}7} + 4\ \mu A$
Self-inductance L_{ESL}	approx. 20 nH
IEC climatic category	in accordance with IEC 68-1 25/085/56 (–25 °C/+85 °C, 56 days damp heat test)
Detail specifications Sectional specifications	similar to CECC 30 301-803, CECC 30 301-807 (similar to CECC 30 301-046, similar to DIN 45 910 part 128) IEC 384-4 (DIN 45 910 part 12)
Vibration resistance	in accordance with IEC 68-2–6, test Fc: displacement amplitude 0,75 mm, frequency range 10 to 55 Hz, acceleration max. 10 *g*, duration 3 × 2 h

Due to the current load capability of the contact elements, the following current limits must not be exceeded, even if the frequency and temperature factors have been taken into account:

Capacitor diameter	≤ 51,6 mm	64,3 mm	76,9 mm	91,0 mm
Maximum current	30 A	40 A	50 A	60 A

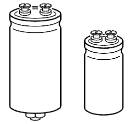
Accessories

The following items are included in the delivery package, but are not fastened to the capacitors:

	Thread	Toothed washers	Screws/Nuts	Maximum torque
For terminals	M 5	A 5,1 DIN 6797	Cylinder-head screw M 5 × 8 DIN 84-4.8	2 Nm
	M 6	A 6,4 DIN 6797	Cylinder-head screw M 6 × 12 DIN 85-4.8	2,5 Nm
For mounting	M 8	J 8,2 DIN 6797	Hex nut BM 8 DIN 439	4 Nm
	M 12	J 12,5 DIN 6797	Hex nut BM 12 DIN 439	10 Nm

The following must be ordered separately:

Ring clips — B 44 030 (cf. page 142)
Clamps for capacitors with $d \ge 64{,}3$ mm — B 44 030 (cf. page 146)
Insulating parts — B 44 020 (cf. page 139)

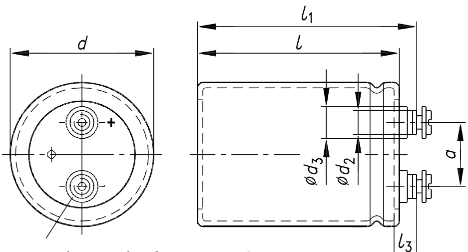


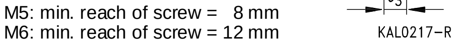
B 43 564
B 43 584

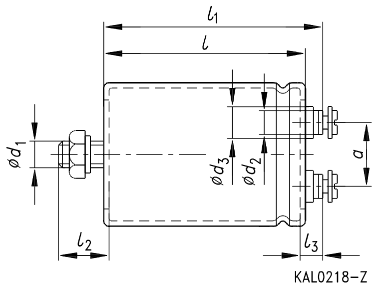
Outline drawings

Type B 43 564
Ring clip/clamp mounting

Type B 43 584
Threaded stud mounting







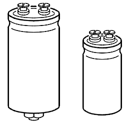
Positive pole marking: +

The base of all types with stud mounting and d = 91 mm is fully insulated (the lengths l and l_1 are increased by 0,5 mm in these cases). Also refer to the notes on mounting given on page 141.

Terminal	Dimensions (mm) with insulating sleeve									Approx. wt. (g)
	d	$l \pm 1$	$l_1 \pm 1$	$l_2\,^{+0}_{-1}$	l_3	d_1	d_2 max	d_3 max	$a\,^{+0,2}_{-0,4}$	
M 5	35,7 +0/–0,8	55,7	62,2	13	7,0 +0,2/–1	M 8	8,2	13,5	12,7	65
M 5	35,7 +0/–0,8	80,7	87,2	13	7,0 +0,2/–1	M 8	8,2	13,5	12,7	105
M 5	35,7 +0/–0,8	105,7	112,2	13	7,0 +0,2/–1	M 8	8,2	13,5	12,7	135
M 5	51,6 +0/–0,8	80,7	87,2	17	7,0 +0,2/–1	M 12	8,2	13,5	22,2	220
M 5	51,6 +0/–0,8	105,7	112,2	17	7,0 +0,2/–1	M 12	8,2	13,5	22,2	280
M 5	64,3 +0/–0,8	105,7	112,2	17	7,0 +0,2/–1	M 12	8,2	13,5	28,5	440
M 6	76,9 +0/–0,7	105,7	111,5	17	6,4 +1,1/–0,8	M 12	17,7	17,7	31,7	540
M 6	76,9 +0/–0,7	143,2	149,0	17	6,4 +1,1/–0,8	M 12	17,7	17,7	31,7	840
M 6	76,9 +0/–0,7	220,7	226,5	17	6,4 +1,1/–0,8	M 12	17,7	17,7	31,7	1300
M 6	91,0 +0/–2	97,0	103,3	17	6,4 +1,1/–0,8	M 12	17,7	17,7	31,7	750
M 6	91,0 +0/–2	144,5	149,8	17	6,4 +1,1/–0,8	M 12	17,7	17,7	31,7	1200
M 6	91,0 +0/–2	221,0	226,3	17	6,4 +1,1/–0,8	M 12	17,7	17,7	31,7	1900

Packing units

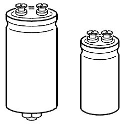
Capacitor diameter *d*	Packing units (pieces)
35,7 mm	72
51,6 mm	36
64,3 mm	20
76,9 mm	16
91,0 mm	8



Overview of available types

U_R (V–)	160	250	350	400	450	500
C_R (µF)	Case dimensions $d \times l$ (mm)					
100						35,7 × 55,7
150						35,7 × 80,7
220			35,7 × 55,7	35,7 × 55,7	35,7 × 80,7	35,7 × 80,7
330						35,7 × 105,7
470	35,7 × 55,7	35,7 × 55,7	35,7 × 80,7	35,7 × 80,7	35,7 × 105,7	51,6 × 80,7
680						51,6 × 105,7
1 000	35,7 × 80,7	35,7 × 80,7	51,6 × 80,7	51,6 × 80,7	51,6 × 105,7	64,3 × 105,7
1 500	35,7 × 105,7	51,6 × 80,7	51,6 × 105,7	51,6 × 105,7	64,3 × 105,7	76,9 × 105,7
2 200	51,6 × 80,7	51,6 × 80,7	64,3 × 105,7	64,3 × 105,7	76,9 × 105,7	76,9 × 143,2
3 300	51,6 × 105,7	51,6 × 105,7	76,9 × 105,7	76,9 × 143,2	76,9 × 143,2	76,9 × 220,7
4 700	64,3 × 105,7	64,3 × 105,7	76,9 × 143,2	91,0 × 97,0	76,9 × 220,7 91,0 × 144,5	91,0 × 221,0
5 600						91,0 × 221,0
6 000			76,9 × 143,2	76,9 × 220,7	76,9 × 220,7	
6 800	64,3 × 105,7	76,9 × 143,2		91,0 × 144,5		
8 200			91,0 × 144,5			
10 000	76,9 × 105,7	76,9 × 143,2	76,9 × 220,7			
15 000	76,9 × 143,2	91,0 × 144,5				
22 000	76,9 × 220,7 91,0 × 144,5					

The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.

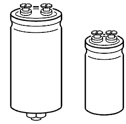


B 43 564
B 43 584

Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	$I_{\sim max}$ 100 Hz 85 °C A	Ordering code[1)] Short code
B43564-, B43584-									
160	470	35,7 × 55,7	260	410	370	4,8	2,2	2,6	-A1477-M
	1 000	35,7 × 80,7	130	200	180	7,5	3,4	4,1	-A1108-M
	1 500	35,7 × 105,7	85	130	120	10	4,7	5,6	-A1158-M
	2 200	51,6 × 80,7	57	86	79	13	5,8	6,9	-A1228-M
	3 300	51,6 × 105,7	40	60	56	17	7,6	9,1	-A1338-M
	4 700	64,3 × 105,7	31	47	44	21	10	12	-A1478-M
	6 800	64,3 × 105,7	23	35	35	25	11	13	-A1688-M
	10 000	76,9 × 105,7	17	26	26	29	13	16	-A1109-M
	15 000	76,9 × 143,2	12	18	18	35	16	19	-A1159-M
	22 000	76,9 × 220,7	9	14	14	48	22	26	-A1229-M
	22 000	91,0 × 144,5	8	14	14	48	22	26	-J1229-M
250	470	35,7 × 55,7	170	260	230	5,9	2,7	3,2	-A2477-M
	1 000	35,7 × 80,7	93	140	130	8,9	4,1	4,9	-A2108-M
	1 500	51,6 × 80,7	71	110	100	11	5,2	6,2	-A2158-M
	2 200	51,6 × 80,7	51	77	74	13	6,1	7,3	-A2228-M
	3 300	51,6 × 105,7	36	54	52	18	8,0	9,6	-A2338-M
	4 700	64,3 × 105,7	27	41	41	23	10	12	-A2478-M
	6 800	76,9 × 143,2	20	30	30	30	14	16	-A2688-M
	10 000	76,9 × 143,2	15	23	23	34	16	19	-A2109-M
	15 000	91,0 × 144,5	10	18	18	46	21	25	-A2159-M
350	220	35,7 × 55,7	310	470	400	4,4	2,0	2,4	-A4227-M
	470	35,7 × 80,7	150	230	200	7,0	3,2	3,8	-A4477-M
	1 000	51,6 × 80,7	86	130	120	10	4,7	5,6	-A4108-M
	1 500	51,6 × 105,7	62	93	93	13	6,1	7,3	-A4158-M
	2 200	64,3 × 105,7	48	72	66	17	8,0	9,3	-A4228-M
	3 300	76,9 × 105,7	32	48	47	21	10	11	-A4338-M
	4 700	76,9 × 143,2	25	38	38	27	12	15	-A4478-M
	6 000	76,9 × 143,2	21	32	32	29	13	16	-A4608-M
	8 200	91,0 × 144,5	13	23	23	41	18	22	-A4828-M
	10 000	76,9 × 220,7	13	20	20	44	20	24	-A4109-M

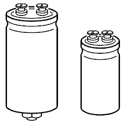
1) For instructions on how to determine ordering codes, refer to page 91.



Technical data and ordering codes

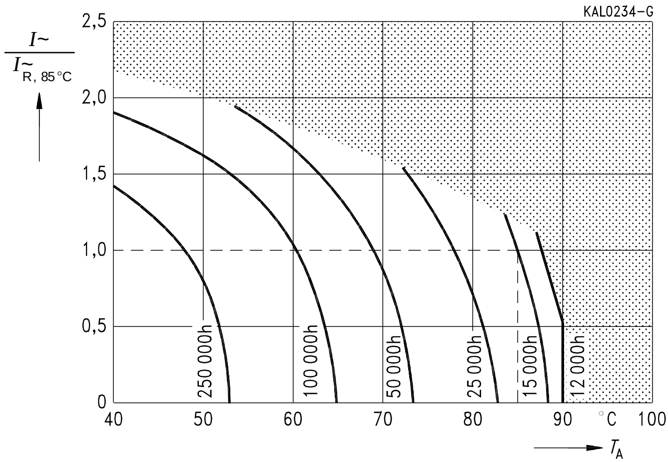
U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	$I_{\sim max}$ 100 Hz 85 °C A	Ordering code[1)] Short code
B43564-, B43584-									
400	220	35,7 × 55,7	310	470	400	4,4	2,0	2,4	-A227-M
	470	35,7 × 80,7	150	230	210	7,0	3,2	3,8	-A477-M
	1 000	51,6 × 80,7	86	130	120	10	4,7	5,6	-A108-M
	1 500	51,6 × 105,7	62	93	84	13	6,1	7,3	-A158-M
	2 200	64,3 × 105,7	48	72	65	17	7,7	9,3	-A228-M
	3 300	76,9 × 143,2	36	54	51	22	10	12	-A338-M
	4 700	91,0 × 97,0	23	41	41	27	12	15	-B478-M
	6 000	76,9 × 220,7	21	32	32	35	16	19	-A608-M
	6 800	91,0 × 144,5	15	27	27	38	17	21	-A688-M
450	220	35,7 × 80,7	360	540	460	4,5	2,1	2,5	-A5227-M
	470	35,7 × 105,7	170	260	240	7,3	3,3	4,0	-A5477-M
	1 000	51,6 × 105,7	93	140	130	11	5,0	6,0	-A5108-M
	1 500	64,3 × 105,7	66	99	89	14	6,6	7,9	-A5158-M
	2 200	76,9 × 105,7	48	72	65	17	7,8	9,3	-A5228-M
	3 300	76,9 × 143,2	34	51	49	23	10	12	-A5338-M
	4 700	76,9 × 220,7	25	38	38	32	14	17	-A5478-M
	4 700	91,0 × 144,5	25	38	38	32	15	17	-J5478-M
	6 000	76,9 × 220,7	21	32	32	35	16	19	-A5608-M
500	100	35,7 × 55,7	800	1200	1100	2,7	1,2	1,5	-A6107-M
	150	35,7 × 80,7	540	810	730	3,7	1,7	2,0	-A6157-M
	220	35,7 × 80,7	370	560	500	4,5	2,0	2,4	-A6227-M
	330	35,7 × 105,7	250	380	340	6,0	2,7	3,3	-A6337-M
	470	51,6 × 80,7	180	270	250	7,2	3,3	3,9	-A6477-M
	680	51,6 × 105,7	120	180	180	9,6	4,4	5,2	-A6687-M
	1 000	64,3 × 105,7	85	130	130	13	5,8	7,0	-A6108-M
	1 500	76,9 × 105,7	57	86	86	16	7,1	8,6	-A6158-M
	2 200	76,9 × 143,2	39	59	59	21	9,7	12	-A6228-M
	3 300	76,9 × 220,7	26	39	39	31	14	17	-A6338-M
	4 700	91,0 × 221,0	15	27	27	45	20	25	-A6478-M
	5 600	91,0 × 221,0	14	24	24	47	21	25	-A6568-M

1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B43564-A227-M
B43564-... (ring clip/clamp mounting)
B43584-... (with threaded stud)

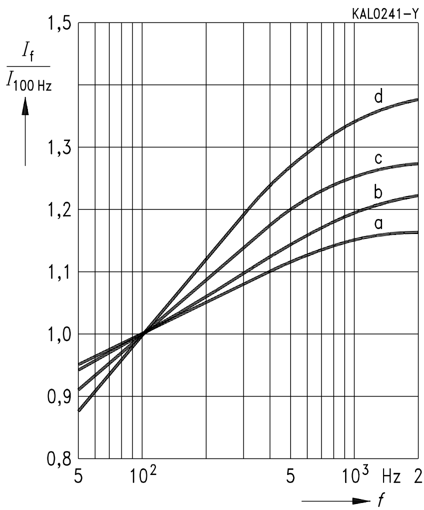


Useful life

versus ambient temperature T_A under ripple current operating conditions[1)]

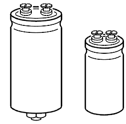


Permissible ripple current *I~*
versus frequency *f*

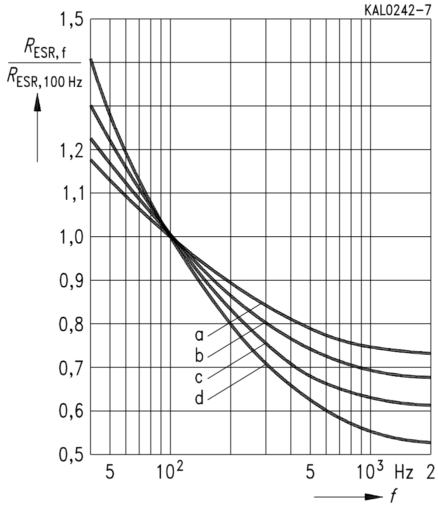


d (mm)	35,7	51,6	64,3	76,9	91,0
Curve	d	c	b	a	c

1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

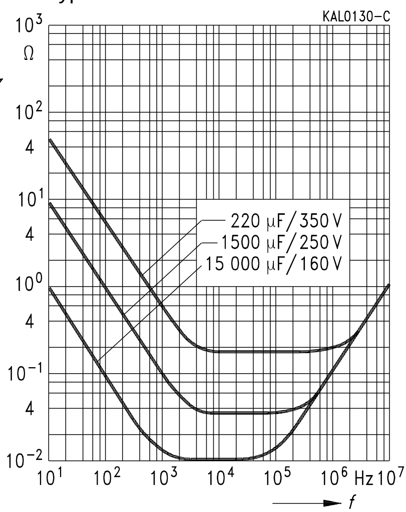


Equivalent series resistance R_{ESR}
versus frequency f
Typical behavior

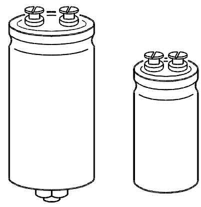


d (mm)	35,7	51,6	64,3	76,9	91,0
Curve	d	c	b	a	a

Impedance Z
versus frequency f
Typical behavior



Extremely high ripple current capability



B 43 586 B 43 566

Construction

- Charge-discharge proof, polar
- Aluminum case with insulating sleeve
- Poles with screw terminal connections
- Mounting with ring clips, clamps or threaded stud
- The bases of types with threaded stud and $d \leq 76{,}9$ mm are not insulated, types with $d = 91$ mm have fully insulated bases

Features

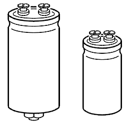
- High reliability
- Long useful life
- Good electrical characteristics and small dimensions
- Extremely high ripple current capability
- All-welded construction ensures reliable electrical contact

Applications

- General industrial electronics
- For link circuits in converters

Specifications and characteristics in brief

Rated voltage U_R Surge voltage U_S	350 to 450 V– $1{,}10 \cdot U_R$
Rated capacitance C_R Capacitance tolerance	150 to 6 800 µF – 10/+ 30 % ≙ Q
Useful life 40 °C, U_R 85 °C, U_R, $I_{\sim R}$	 > 200 000 h ($2{,}1 \cdot I_{\sim R,85\,°C}$) > 24 000 h
Failure percentage	≤ 1 % (during useful life)
Failure rate	≤ 30 fit ($\leq 30 \cdot 10^{-9}$/h)
Voltage endurance test	5 000 h, 85 °C (at U_R, $I_{\sim R}$)
Leakage current I_{lka} (5 min, 20 °C)	$1\,000\ \mu C \leq C_R \cdot U_R < 470\,000\ \mu C$: $I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$ $C_R \cdot U_R \geq 470\,000\ \mu C$: $I_{lka} \leq 0{,}3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)^{0{,}7} + 4\ \mu A$



Specifications and characteristics in brief

Self-inductance L_{ESL}	d = 35,7 mm: approx. 10 nH d = 51,6 mm: approx. 15 nH d = 76,9 mm: approx. 20 nH d = 91,0 mm: approx. 20 nH
IEC climatic category	in accordance with IEC 68-1 350 V–: 40/085/56 (–40 °C/+85 °C, 56 days damp heat test)[1] ≥ 400 V–: 25/085/56 (–25 °C/+85 °C, 56 days damp heat test)
Detail specifications	similar to CECC 30 301-803, CECC 30 301-807 (similar to CECC 30 301-046, similar to DIN 45 910 part 128)
Sectional specifications	IEC 384-4 (DIN 45 910 part 12)
Vibration resistance	in accordance with IEC 68-2–6, test Fc: displacement amplitude 0,75 mm, frequency range 10 to 55 Hz, acceleration max. 10 g, duration 3 × 2 h

Due to the current load capability of the contact elements, the following current limits must not be exceeded, even if the frequency and temperature factors have been taken into account:

Capacitor diameter	≤ 51,6 mm	64,3 mm	76,9 mm	91,0 mm
Maximum current	30 A	40 A	50 A	60 A

Accessories

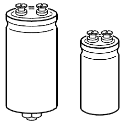
The following items are included in the delivery package, but are not fastened to the capacitors:

	Thread	Toothed washers	Screws/Nuts	Maximum torque
For terminals	M 5	A 5,1 DIN 6797	Cylinder-head screw M 5 × 8 DIN 84-4.8	2 Nm
	M 6	A 6,4 DIN 6797	Cylinder-head screw M 6 × 12 DIN 85-4.8	2,5 Nm
For mounting	M 8	J 8,2 DIN 6797	Hex nut BM 8 DIN 439	4 Nm
	M 12	J 12,5 DIN 6797	Hex nut BM 12 DIN 439	10 Nm

The following must be ordered separately:

Ring clips B 44 030 (cf. page 142)
Clamps for capacitors with $d \geq$ 64,3 mm B 44 030 (cf. page 146)
Insulating parts B 44 020 (cf. page 139)

1) For case dimensions 76,9 mm × 220,7 mm: IEC climatic category 25/085/56

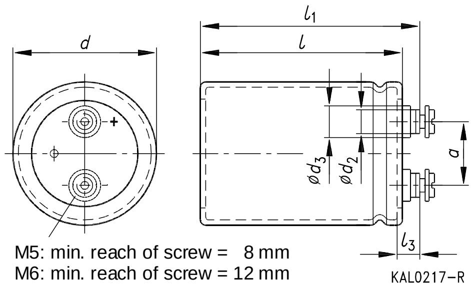


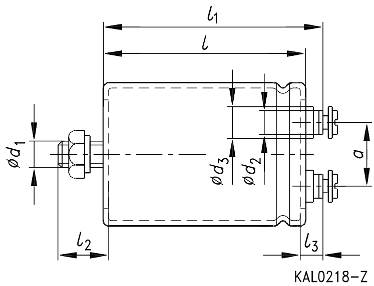
B 43 566
B 43 586

Outline drawings

Type B 43 566
Ring clip/clamp mounting

Type B 43 586
Threaded stud mounting





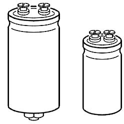
Positive pole marking: +

The base of all types with stud mounting and d = 91 mm is fully insulated (the lengths l and l_1 are increased by 0,5 mm in these cases). Also refer to the notes on mounting given on page 141.

Ter-minal	Dimensions (mm) with insulating sleeve									Approx. wt. (g)
	d	$l \pm 1$	$l_1 \pm 1$	$l_2\,^{+0}_{-1}$	l_3	d_1	d_2 max	d_3 max	$a\,^{+0,2}_{-0,4}$	
M 5	35,7 + 0/– 0,8	55,7	62,2	13	7,0 + 0,2/– 1	M 8	8,2	13,5	12,7	65
M 5	35,7 + 0/– 0,8	80,7	87,2	13	7,0 + 0,2/– 1	M 8	8,2	13,5	12,7	105
M 5	35,7 + 0/– 0,8	105,7	112,2	13	7,0 + 0,2/– 1	M 8	8,2	13,5	12,7	135
M 5	51,6 + 0/– 0,8	80,7	87,2	17	7,0 + 0,2/– 1	M 12	8,2	13,5	22,2	220
M 5	51,6 + 0/– 0,8	105,7	112,2	17	7,0 + 0,2/– 1	M 12	8,2	13,5	22,2	280
M 5	64,3 + 0/– 0,8	105,7	112,2	17	7,0 + 0,2/– 1	M 12	8,2	13,5	28,5	440
M 6	76,9 + 0/– 0,7	105,7	111,5	17	6,4 + 1,1/– 0,8	M 12	17,7	17,7	31,7	540
M 6	76,9 + 0/– 0,7	143,2	149,0	17	6,4 + 1,1/– 0,8	M 12	17,7	17,7	31,7	840
M 6	76,9 + 0/– 0,7	220,7	226,5	17	6,4 + 1,1/– 0,8	M 12	17,7	17,7	31,7	1300
M 6	91,0 + 0/– 2	144,5	149,8	17	6,4 + 1,1/– 0,8	M 12	17,7	17,7	31,7	1200

Packing units

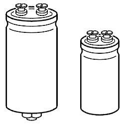
Capacitor diameter d	Packing units (pieces)
35,7 mm	72
51,6 mm	36
64,3 mm	20
76,9 mm	16
91,0 mm	8



Overview of available types

U_R (V–)	350	400	450
C_R (µF)	Case dimensions $d \times l$ (mm)		
150		35,7 × 55,7	35,7 × 80,7
220	35,7 × 55,7	35,7 × 80,7	35,7 × 105,7
330	35,7 × 80,7	35,7 × 80,7	51,6 × 80,7
470	35,7 × 80,7	51,6 × 80,7	51,6 × 80,7
680	51,6 × 80,7	51,6 × 80,7	51,6 × 105,7
1 000	51,6 × 105,7	51,6 × 105,7	64,3 × 105,7
1 500	64,3 × 105,7	64,3 × 105,7	76,9 × 105,7
2 200	64,3 × 105,7	76,9 × 105,7	76,9 × 143,2
2 700			91,0 × 144,5
3 300	76,9 × 105,7 76,9 × 143,2	76,9 × 143,2	76,9 × 220,7
4 700	76,9 × 143,2	76,9 × 220,7 91,0 × 144,5	
6 000	76,9 × 220,7 91,0 × 144,5	76,9 × 220,7	
6 800	76,9 × 220,7		

The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.

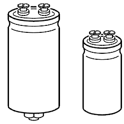


B 43 566
B 43 586

Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	$I_{\sim max}$ 100 Hz 85 °C A	Ordering code[1)] Short code
B43566-, B43586-									
350	220	35,7 × 55,7	140	350	300	4,7	2,0	2,4	-A4227-Q
	330	35,7 × 80,7	95	240	200	6,3	2,7	3,2	-A4337-Q
	470	35,7 × 80,7	67	170	150	7,5	3,2	3,8	-J4477-Q
	680	51,6 × 80,7	48	120	100	9,9	4,2	5,0	-A4687-Q
	1 000	51,6 × 105,7	34	84	73	13	5,5	6,6	-A4108-Q
	1 500	64,3 × 105,7	24	59	52	17	7,3	8,7	-A4158-Q
	2 200	64,3 × 105,7	17	43	39	20	8,7	10	-A4228-Q
	3 300	76,9 × 105,7	13	32	29	23	10	12	-A4338-Q
	3 300	76,9 × 143,2	13	32	29	26	11	13	-J4338-Q
	4 700	76,9 × 143,2	10	25	23	30	13	15	-A4478-Q
	6 000	76,9 × 220,7	9	22	21	38	16	19	-B4608-Q
	6 000	91,0 × 144,5	8	23	22	38	16	19	-J4608-Q
	6 800	76,9 × 220,7	8	20	19	40	17	21	-B4688-Q
400	150	35,7 × 55,7	400	1000	830	3,7	1,6	1,9	-A157-Q
	220	35,7 × 80,7	270	680	560	5,0	2,1	2,6	-A227-Q
	330	35,7 × 80,7	180	450	370	6,1	2,6	3,1	-A337-Q
	470	51,6 × 80,7	130	330	290	8,0	3,4	4,1	-A477-Q
	680	51,6 × 80,7	90	230	200	9,7	4,1	4,9	-A687-Q
	1 000	51,6 × 105,7	65	160	140	12	5,3	6,4	-A108-Q
	1 500	64,3 × 105,7	45	100	92	17	7,1	8,6	-A158-Q
	2 200	76,9 × 105,7	33	83	65	20	8,4	10	-A228-Q
	3 300	76,9 × 143,2	23	58	47	27	11	14	-A338-Q
	4 700	76,9 × 220,7	17	43	40	37	16	19	-A478-Q
	4 700	91,0 × 144,5	15	43	40	37	16	19	-J478-Q
	6 000	76,9 × 220,7	14	35	33	41	17	21	-A608-Q

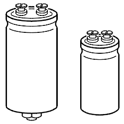
1) For instructions on how to determine ordering codes, refer to page 99.



Technical data and ordering codes

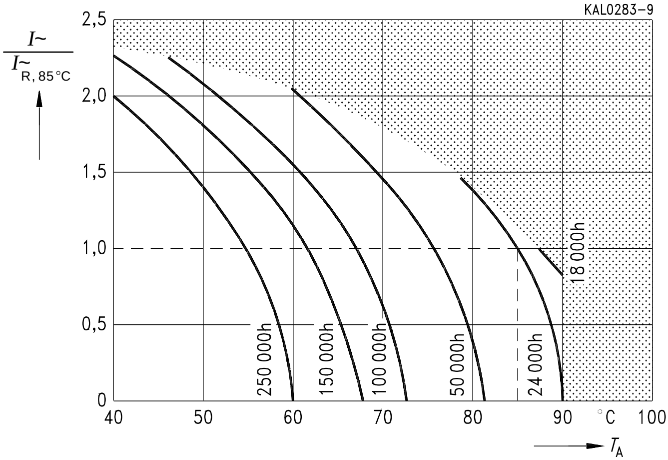
U_R	C_R	Case dimensions	$R_{ESR,\ typ}$	$R_{ESR,\ max}$	Z_{max}	$I_{\sim max}$	$I_{\sim R}$	$I_{\sim max}$	Ordering code[1)]
		$d \times l$	100 Hz	100 Hz	10 kHz	100 Hz	100 Hz	100 Hz	
			20 °C	20 °C	20 °C	40 °C	85 °C	85 °C	
V–	µF	mm	mΩ	mΩ	mΩ	A	A	A	Short code
B43566-, B43586-									
450	150	35,7 × 80,7	400	1000	830	4,1	1,8	2,1	-A5157-Q
	220	35,7 × 105,7	270	675	560	5,5	2,4	2,8	-A5227-Q
	330	51,6 × 80,7	180	450	400	6,8	2,9	3,5	-A5337-Q
	470	51,6 × 80,7	140	350	310	7,7	3,3	4,0	-A5477-Q
	680	51,6 × 105,7	100	250	220	10	4,3	5,1	-A5687-Q
	1 000	64,3 × 105,7	75	190	180	13	5,5	6,6	-A5108-Q
	1 500	76,9 × 105,7	50	130	120	16	6,8	8,2	-A5158-Q
	2 200	76,9 × 143,2	38	95	90	21	8,8	11	-A5228-Q
	2 700	91,0 × 144,5	30	88	83	26	11	13	-A5278-Q
	3 300	76,9 × 220,7	28	70	67	29	12	15	-A5338-Q

1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B43566-A5157-Q
B43566-.... (ring clip/clamp mounting)
B43586-.... (with threaded stud)

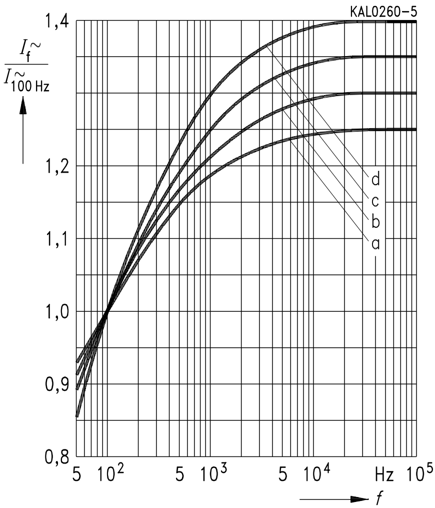


Useful life

versus ambient temperature T_A under ripple current operating conditions[1]

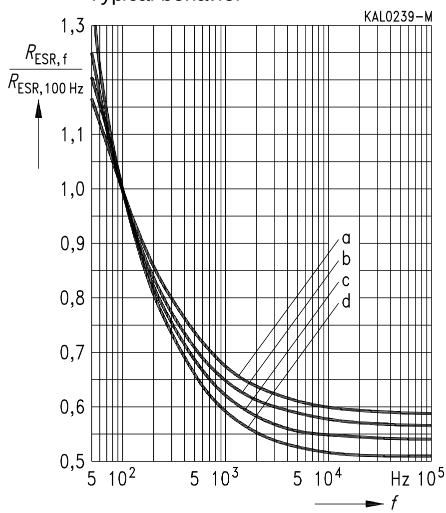


Permissible ripple current *I~*
versus frequency *f*



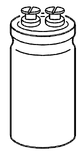
d (mm)	35,7	51,6	64,3	76,9	91,0
Curve	d	c	b	a	c

Equivalent series resistance R_{ESR}
versus frequency *f*
Typical behavior



d (mm)	35,7	51,6	64,3	76,9	91,0
Curve	d	c	b	a	a

1) Refer to page 34 for an explanation on how to interpret the useful life graphs.



KAL0272-T

Maximum reliability
For highly professional switch-mode power supplies and capacitor banks
Operating temperature up to 125 °C

Construction

- Charge-discharge proof, polar
- Aluminum case with insulating sleeve
- Poles with screw terminal connections
- Mounting with ring clips or clamps

Features

- Maximum reliability
- Wide temperature range
- Good thermal characteristics and high ripple current capability
- Long useful life
- Shelf life up to 10 years
- All-welded construction ensures reliable electrical contact

Applications

- Highly professional power supplies
- Power electronics (e. g. capacitor banks in current converters)

Specifications and characteristics in brief

Rated voltage U_R	16 to 100 V–	
Surge voltage U_S	1,15 · U_R	
Rated capacitance C_R	1 000 to 150 000 µF	
Capacitance tolerance	– 10/+ 30 % ≙ Q	
Useful life	$d \leq$ 51,6 mm	$d \geq$ 64,3 mm
40 °C, U_R	> 200 000 h (3,4 · $I_{\sim R,125\,°C}$)	> 200 000 h (3,8 · $I_{\sim R,125\,°C}$)
85 °C, U_R, $I_{\sim max}$	> 15 000 h	> 25 000 h
125 °C, U_R, $I_{\sim R}$	> 2 500 h	> 5 000 h
Failure percentage	≤ 1 % (during useful life)	
Failure rate	≤ 20 fit ($\leq 20 \cdot 10^{-9}$/h)	
Voltage endurance test	2 000 h, 125 °C (at U_R, $I_{\sim R}$)	

Specifications and characteristics in brief

Leakage current I_{lka} (5 min, 20 °C)	1 000 µC ≤ $C_R \cdot U_R$ < 470 000 µC: $I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$ $C_R \cdot U_R \geq 470\,000\ \mu C$: $I_{lka} \leq 0{,}3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)^{0,7} + 4\ \mu A$
Self-inductance L_{ESL}	d = 35,7 mm: approx. 10 nH d = 51,6 mm: approx. 15 nH d ≥ 64,3 mm: approx. 20 nH
IEC climatic category	in accordance with IEC 68-1 55/125/56 (–55 °C/+125 °C, 56 days damp heat test)
Detail specifications Sectional specifications	similar to CECC 30 301-804 (similar to CECC 30 301-050, similar to DIN 45 910 part 1212) IEC 384-4 (DIN 45 910 part 12)
Vibration resistance	in accordance with IEC 68-2–6, test Fc: displacement amplitude 0,75 mm, frequency range 10 to 55 Hz, acceleration max. 10 *g*, duration 3 × 2 h

Due to the current load capability of the contact elements, the following current limits must not be exceeded, even if the frequency and temperature factors have been taken into account:

Capacitor diameter	≤ 51,6 mm	> 51,6 mm
Maximum current	30 A	40 A

Accessories

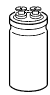
The following items are included in the delivery package, but are not fastened to the capacitors:

	Thread	Toothed washers	Screws/Nuts	Maximum torque
For terminals	M 5	A 5,1 DIN 6797	Cylinder-head screw M 5 × 8 DIN 84-4.8	2 Nm

The following must be ordered separately:

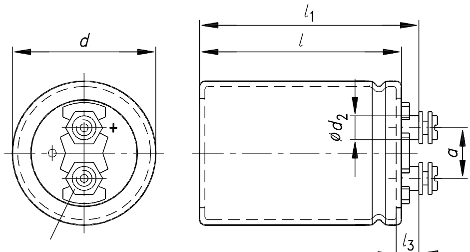
Ring clips — B 44 030 (cf. page 142)

Clamps for capacitors with d ≥ 64,3 mm — B 44 030 (cf. page 146)



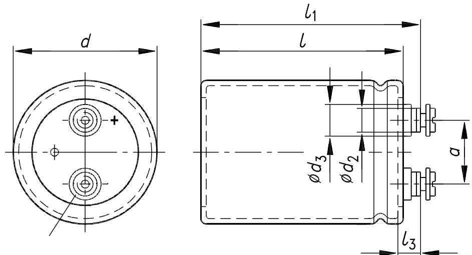
Outline drawings

Outline drawing
for *d* = 35,7 mm



Min. reach of screw = 8 mm

Outline drawing
for *d* ≥ 51,6 mm



M5: min. reach of screw = 8 m

Positive pole marking: +

Terminal	Dimensions (mm) with insulating sleeve						Approx. wt. (g)
	d	$l \pm 1$	$l_1 \pm 1$	l_3	d_2 max	$a\ ^{+0,2}_{-0,4}$	
M 5	35,7+ 0/– 0,8	55,7	62,0	7,0+ 0,2/– 1	8,2	12,7	65
M 5	35,7+ 0/– 0,8	80,7	87,0	7,0+ 0,2/– 1	8,2	12,7	105
M 5	35,7+ 0/– 0,8	105,7	112,0	7,0+ 0,2/– 1	8,2	12,7	135
M 5	51,6+ 0/– 0,8	80,7	87,0	7,0+ 0,2/– 1	8,2	22,2	220
M 5	51,6+ 0/– 0,8	105,7	112,0	7,0+ 0,2/– 1	8,2	22,2	280
M 5	64,3+ 0/– 0,8	105,7	112,0	7,0+ 0,2/– 1	8,2	28,5	440
M 5	76,9+ 0/– 0,7	105,7	112,0	7,0+ 0,2/– 1	8,2	31,7	540
M 5	76,9+ 0/– 0,7	143,2	149,5	7,0+ 0,2/– 1	8,2	31,7	840

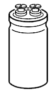
Packing units

Capacitor diameter *d*	Packing units (pieces)
35,7 mm	72
51,6 mm	36
64,3 mm	20
76,9 mm	16

Overview of available types

U_R (V–)	16	25	40	63	100
C_R (µF)	Case dimensions $d \times l$ (mm)				
1 000					35,7 × 55,7
2 200				35,7 × 55,7	35,7 × 80,7
3 300				35,7 × 80,7	51,6 × 80,7
4 700		35,7 × 55,7	35,7 × 80,7	35,7 × 105,7	51,6 × 105,7
6 800				51,6 × 80,7	64,3 × 105,7
10 000	35,7 × 55,7	35,7 × 80,7	35,7 × 105,7	51,6 × 105,7	76,9 × 105,7
15 000	35,7 × 80,7	35,7 × 105,7	51,6 × 80,7	64,3 × 105,7	76,9 × 143,2
22 000	35,7 × 105,7	51,6 × 80,7	51,6 × 105,7	76,9 × 105,7	
33 000	51,6 × 80,7	51,6 × 105,7	64,3 × 105,7	76,9 × 143,2	
47 000	51,6 × 105,7	64,3 × 105,7	76,9 × 105,7		
68 000	64,3 × 105,7	76,9 × 105,7	76,9 × 143,2		
100 000	76,9 × 105,7	76,9 × 143,2			
150 000	76,9 × 143,2				

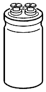
The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR,\,typ}$ 100 Hz 20 °C mΩ	$R_{ESR,\,max}$ 100 Hz 20 °C mΩ	Z_{max} 20 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	$I_{\sim R}$ 100 Hz 125 °C A	Ordering code[1)] Short code
16	10 000	35,7 × 55,7	15	38	26	17	12	4,5	-B4109-Q
	15 000	35,7 × 80,7	12	26	21	23	16	5,8	-B4159-Q
	22 000	35,7 × 105,7	9	21	18	29	21	7,5	-B4229-Q
	33 000	51,6 × 80,7	7	17	15	30	24	8,7	-B4339-Q
	47 000	51,6 × 105,7	5	13	13	30	30	11	-B4479-Q
	68 000	64,3 × 105,7	5	13	11	40	38	14	-B4689-Q
	100 000	76,9 × 105,7	4	10	9	40	39	14	-B4100-Q
	150 000	76,9 × 143,2	4	10	8	40	40	16	-B4150-Q
25	4 700	35,7 × 55,7	22	40	31	14	10	3,7	-B5478-Q
	10 000	35,7 × 80,7	14	28	21	21	15	5,4	-B5109-Q
	15 000	35,7 × 105,7	11	24	17	26	19	6,8	-B5159-Q
	22 000	51,6 × 80,7	8	20	15	30	22	8,1	-B5229-Q
	33 000	51,6 × 105,7	6	15	12	30	29	10	-B5339-Q
	47 000	64,3 × 105,7	5	13	11	40	34	12	-B5479-Q
	68 000	76,9 × 105,7	5	11	9	40	35	13	-B5689-Q
	100 000	76,9 × 143,2	4	9	8	40	39	15	-B5100-Q
40	4 700	35,7 × 80,7	15	35	25	20	14	5,2	-B7478-Q
	10 000	35,7 × 105,7	11	27	17	26	19	6,8	-B7109-Q
	15 000	51,6 × 80,7	8	20	14	30	22	8,1	-B7159-Q
	22 000	51,6 × 105,7	6	15	12	30	29	10	-B7229-Q
	33 000	64,3 × 105,7	5	13	10	40	34	12	-B7339-Q
	47 000	76,9 × 105,7	5	12	9	40	35	13	-B7479-Q
	68 000	76,9 × 143,2	4	9	8	40	39	15	-B7689-Q
63	2 200	35,7 × 55,7	26	60	30	13	9,4	3,4	-B8228-Q
	3 300	35,7 × 80,7	17	39	24	19	14	4,9	-B8338-Q
	4 700	35,7 × 105,7	13	31	20	24	17	6,2	-B8478-Q
	6 800	51,6 × 80,7	10	23	17	28	20	7,2	-B8688-Q
	10 000	51,6 × 105,7	7	18	14	30	27	9,6	-B8109-Q
	15 000	64,3 × 105,7	6	15	11	40	31	11	-B8159-Q
	22 000	76,9 × 105,7	5	12	9	40	35	13	-B8229-Q
	33 000	76,9 × 143,2	4	9	8	40	39	15	-B8339-Q

1) For instructions on how to determine ordering codes, refer to page 106.



Technical data and ordering codes

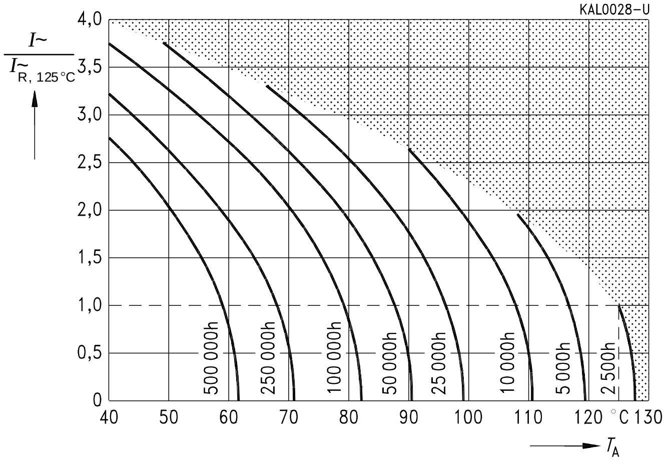
U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 20 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	$I_{\sim R}$ 100 Hz 125 °C A	Ordering code[1)] Short code
100	1 000	35,7 × 55,7	55	120	48	9,9	6,9	2,5	-B9108-Q
	2 200	35,7 × 80,7	26	57	30	17	12	4,2	-B9228-Q
	3 300	51,6 × 80,7	17	37	24	21	15	5,4	-B9338-Q
	4 700	51,6 × 105,7	13	29	20	29	20	7,2	-B9478-Q
	6 800	64,3 × 105,7	8	22	17	36	25	9,1	-B9688-Q
	10 000	76,9 × 105,7	7	15	14	40	30	11	-B9109-Q
	15 000	76,9 × 143,2	6	13	11	40	36	13	-B9159-Q

1) To obtain the required ordering code, prefix the type number to the short code.
E. g.: B41554-B9108-Q

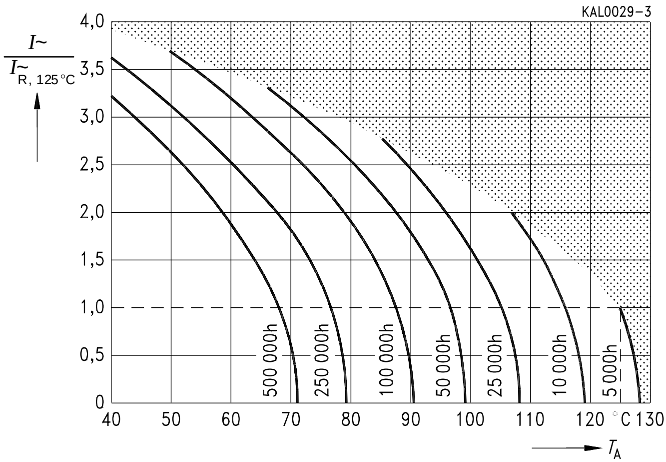
Useful life

versus ambient temperature T_A under ripple current operating conditions[1)]

$d \leq 51,6$ mm

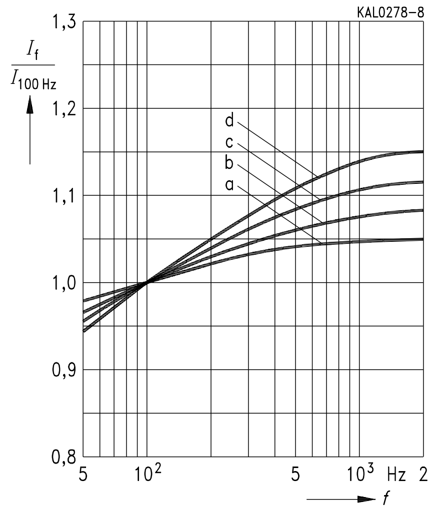


$d \geq 64,3$ mm



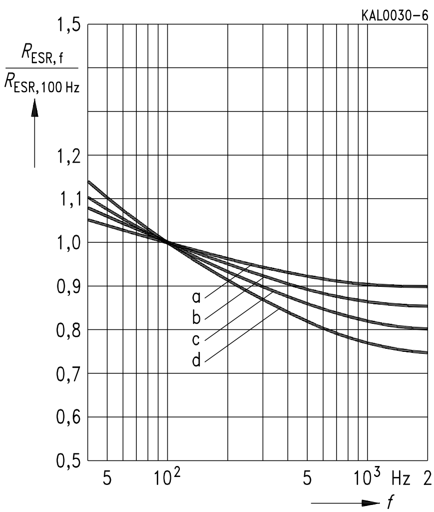
1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

Permissible ripple current *I~*
versus frequency *f*

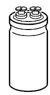


U_R (V–)	16; 25	40	63	100
d = 35,7 mm	b	c	d	d
d = 51,6 mm	a	b	c	c
d = 64,3 mm	a	a	c	c
d = 76,9 mm	a	a	b	c

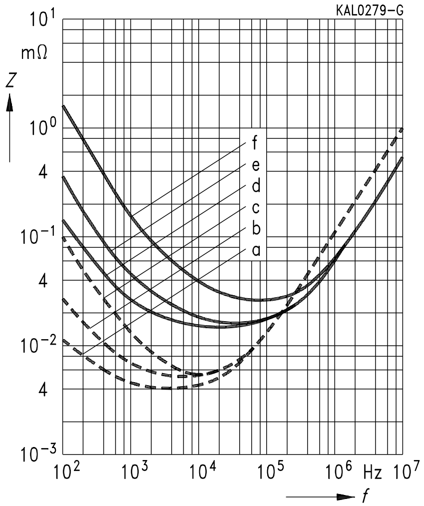
Equivalent series resistance R_{ESR}
versus frequency *f*
Typical behavior



U_R (V–)	16; 25	40	63	100
d = 35,7 mm	b	c	d	d
d = 51,6 mm	a	b	c	c
d = 64,3 mm	a	a	c	c
d = 76,9 mm	a	a	b	c

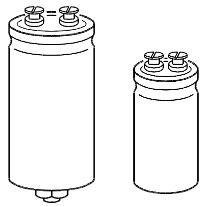


Impedance ***Z***
versus frequency *f*
Typical behavior



C_R µF	U_R V–	*d* mm	Curve
150 000	16		a
68 000	40	76,9	b
15 000	100		c
10 000	16		d
4 700	40	35,7	e
1 000	100		f

Maximum reliability
For highly professional switch-mode power supplies
Operating temperature up to 105 °C



KAL0272-T

B 41 570   B 41 550

Construction

- Charge-discharge proof, polar
- Aluminum case with insulating sleeve
- Poles with screw terminal connections
- Mounting with ring clips, clamps or threaded stud
- The bases of types with threaded stud are not insulated

Features

- Maximum reliability
- Operation at temperatures up to 125 °C permissible without insulating sleeve[1)]
- High ripple current capability
- Long useful life
- Shelf life up to 10 years
- All-welded construction ensures reliable electrical contact

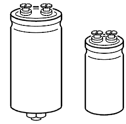
Applications

- Highly professional power supplies
- Power electronics (e. g. capacitor banks in current converters)

Specifications and characteristics in brief

Rated voltage U_R	16 to 100 V–	
Surge voltage U_S	1,15 · U_R	
Rated capacitance C_R	1 000 to 150 000 µF	
Capacitance tolerance	– 10/+ 30 % ≙ Q	
Useful life	$d \leq$ 51,6 mm	$d \geq$ 64,3 mm
40 °C, U_R	> 200 000 h (2,4 · $I_{\sim R,105\,°C}$)	> 200 000 h (2,7 · $I_{\sim R,105\,°C}$)
85 °C, U_R, $I_{\sim max}$	> 15 000 h	> 25 000 h
105 °C, U_R, $I_{\sim R}$	> 10 000 h	> 20 000 h
Failure percentage	≤ 1 % (during useful life)	
Failure rate	≤ 20 fit ($\leq 20 \cdot 10^{-9}$/h)	
Voltage endurance test	5 000 h, 105 °C (at U_R, $I_{\sim R}$)	

1) For ∅ ≤ 51,6 mm: 2500 h, for ∅ ≥ 64,3 mm: 5000 h



Specifications and characteristics in brief

Leakage current I_{lka} (5 min, 20 °C)	$1\,000\ \mu C \le C_R \cdot U_R < 470\,000\ \mu C$: $I_{\mathrm{lka}} \le 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$ $C_R \cdot U_R \ge 470\,000\ \mu C$: $I_{\mathrm{lka}} \le 0{,}3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)^{0{,}7} + 4\ \mu A$
Self-inductance L_{ESL}	d = 35,7 mm: approx. 10 nH d = 51,6 mm: approx. 15 nH $d \ge$ 64,3 mm: approx. 20 nH
IEC climatic category	in accordance with IEC 68-1 55/105/56 (–55 °C/+105 °C, 56 days damp heat test)
Detail specifications Sectional specifications	similar to CECC 30 301-804 (similar to CECC 30 301-050, similar to DIN 45 910 part 1212) IEC 384-4 (DIN 45 910 part 12)
Vibration resistance	in accordance with IEC 68-2–6, test Fc: displacement amplitude 0,75 mm, frequency range 10 to 55 Hz, acceleration max. 10 g, duration 3 × 2 h

Due to the current load capability of the contact elements, the following current limits must not be exceeded, even if the frequency and temperature factors have been taken into account:

Capacitor diameter	≤ 51,6 mm	> 51,6 mm
Maximum current	30 A	40 A

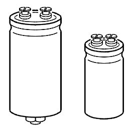
Accessories

The following items are included in the delivery package, but are not fastened to the capacitors:

	Thread	Toothed washers	Screws/Nuts	Maximum torque
For terminals	M 5	A 5,1 DIN 6797	Cylinder-head screw M 5 × 8 DIN 84-4.8	2 Nm
For mounting	M 8	J 8,2 DIN 6797	Hex nut BM 8 DIN 439	4 Nm
	M 12	J 12,5 DIN 6797	Hex nut BM 12 DIN 439	10 Nm

The following must be ordered separately:

Ring clips — B 44 030 (cf. page 142)
Clamps for capacitors with $d \ge$ 64,3 mm — B 44 030 (cf. page 146)
Insulating parts — B 44 020 (cf. page 139)



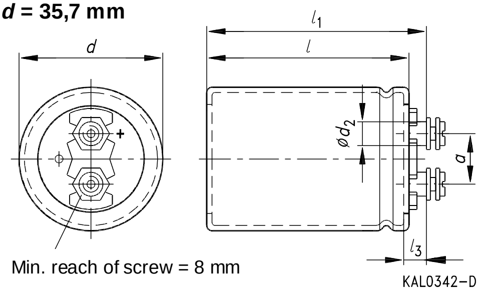
B 41 550
B 41 570

Outline drawings

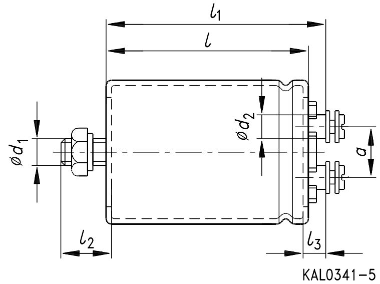
Type B 41 550
Ring clip/clamp mounting

Type B 41 570
Threaded stud mounting

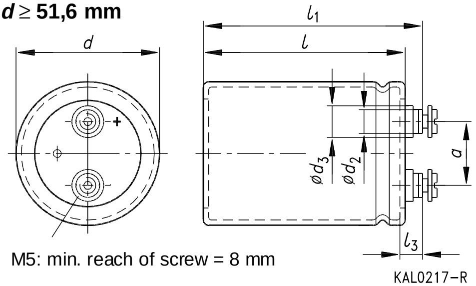
***d* = 35,7 mm**



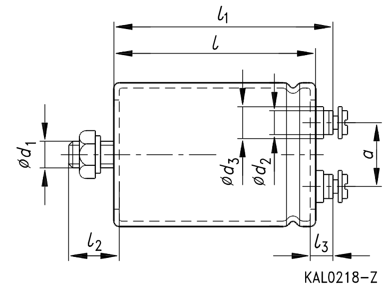
Min. reach of screw = 8 mm



***d* ≥ 51,6 mm**



M5: min. reach of screw = 8 mm



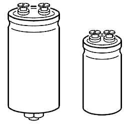
Positive pole marking: +

Ter-minal	Dimensions (mm) with insulating sleeve									Approx. wt. (g)
	d	$l \pm 1$	$l_1 \pm 1$	$l_2\ ^{+0}_{-1}$	l_3	d_1	d_2 max	d_3 max	$a\ ^{+0,2}_{-0,4}$	
M 5	35,7+ 0/– 0,8	55,7	62,0	13	7,0+ 0,2/– 1	M 8	8,2	13,5	12,7	65
M 5	35,7+ 0/– 0,8	80,7	88,0	13	7,0+ 0,2/– 1	M 8	8,2	13,5	12,7	105
M 5	35,7+ 0/– 0,8	105,7	113,0	13	7,0+ 0,2/– 1	M 8	8,2	13,5	12,7	135
M 5	51,6+ 0/– 0,8	80,7	88,0	17	7,0+ 0,2/– 1	M 12	8,2	13,5	22,2	220
M 5	51,6+ 0/– 0,8	105,7	113,0	17	7,0+ 0,2/– 1	M 12	8,2	13,5	22,2	280
M 5	64,3+ 0/– 0,8	105,7	113,0	17	7,0+ 0,2/– 1	M 12	8,2	13,5	28,5	440
M 5	76,9+ 0/– 0,7	105,7	113,0	17	7,0+ 0,2/– 1	M 12	8,2	13,5	31,7	540
M 5	76,9+ 0/– 0,7	143,2	150,5	17	7,0+ 0,2/– 1	M 12	8,2	13,5	31,7	840

Packing units

Capacitor diameter *d*	Packing units (pieces)
35,7 mm	72
51,6 mm	36

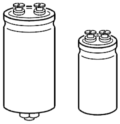
Capacitor diameter *d*	Packing units (pieces)
64,3 mm	20
76,9 mm	16



Overview of available types

U_R (V–)	16	25	40	63	100
C_R (µF)	Case dimensions $d \times l$ (mm)				
1 000					35,7 × 55,7
2 200				35,7 × 55,7	35,7 × 80,7
3 300				35,7 × 80,7	51,6 × 80,7
4 700		35,7 × 55,7	35,7 × 80,7	35,7 × 105,7	51,6 × 105,7
6 800				51,6 × 80,7	64,3 × 105,7
10 000	35,7 × 55,7	35,7 × 80,7	35,7 × 105,7	51,6 × 105,7	76,9 × 105,7
15 000	35,7 × 80,7	35,7 × 105,7	51,6 × 80,7	64,3 × 105,7	76,9 × 143,2
22 000	35,7 × 105,7	51,6 × 80,7	51,6 × 105,7	76,9 × 105,7	
33 000	51,6 × 80,7	51,6 × 105,7	64,3 × 105,7	76,9 × 143,2	
47 000	51,6 × 105,7	64,3 × 105,7	76,9 × 105,7		
68 000	64,3 × 105,7	76,9 × 105,7	76,9 × 143,2		
100 000	76,9 × 105,7	76,9 × 143,2			
150 000	76,9 × 143,2				

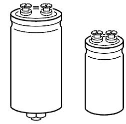
The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 20 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	$I_{\sim R}$ 100 Hz 105 °C A	Ordering code[1)] Short code
B41550-, B41570-									
16	10 000	35,7 × 55,7	15	38	26	17	12	6,2	-A4109-Q
	15 000	35,7 × 80,7	12	26	21	23	16	8,1	-A4159-Q
	22 000	35,7 × 105,7	9	21	18	29	21	10	-A4229-Q
	33 000	51,6 × 80,7	7	17	15	30	24	12	-A4339-Q
	47 000	51,6 × 105,7	5	13	13	30	30	16	-A4479-Q
	68 000	64,3 × 105,7	5	13	11	40	34	17	-A4689-Q
	100 000	76,9 × 105,7	4	10	9	40	39	19	-A4100-Q
	150 000	76,9 × 143,2	4	10	8	40	40	22	-A4150-Q
25	4 700	35,7 × 55,7	22	40	31	14	10	5,2	-A5478-Q
	10 000	35,7 × 80,7	14	28	21	21	15	7,5	-A5109-Q
	15 000	35,7 × 105,7	11	24	17	26	19	9,4	-A5159-Q
	22 000	51,6 × 80,7	8	20	15	30	22	11	-A5229-Q
	33 000	51,6 × 105,7	6	15	12	30	29	15	-A5339-Q
	47 000	64,3 × 105,7	5	13	11	40	34	17	-A5479-Q
	68 000	76,9 × 105,7	5	11	9	40	35	17	-A5689-Q
	100 000	76,9 × 143,2	4	9	8	40	39	21	-A5100-Q
40	4 700	35,7 × 80,7	15	35	25	20	14	7,2	-A7478-Q
	10 000	35,7 × 105,7	11	27	17	26	19	9,4	-A7109-Q
	15 000	51,6 × 80,7	8	20	14	30	22	11	-A7159-Q
	22 000	51,6 × 105,7	6	15	12	30	29	15	-A7229-Q
	33 000	64,3 × 105,7	5	13	10	40	34	17	-A7339-Q
	47 000	76,9 × 105,7	5	12	9	40	35	17	-A7479-Q
	68 000	76,9 × 143,2	4	9	8	40	39	21	-A7689-Q
63	2 200	35,7 × 55,7	26	60	30	13	9,4	4,7	-A8228-Q
	3 300	35,7 × 80,7	17	39	24	19	14	6,8	-A8338-Q
	4 700	35,7 × 105,7	13	31	20	24	17	8,7	-A8478-Q
	6 800	51,6 × 80,7	10	23	17	28	20	10	-A8688-Q
	10 000	51,6 × 105,7	7	18	14	30	27	13	-A8109-Q
	15 000	64,3 × 105,7	6	15	11	40	31	15	-A8159-Q
	22 000	76,9 × 105,7	5	12	9	40	35	17	-A8229-Q
	33 000	76,9 × 143,2	4	9	8	40	39	21	-A8339-Q

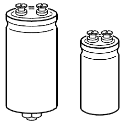
1) For instructions on how to determine ordering codes, refer to page 115.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 20 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	$I_{\sim R}$ 100 Hz 105 °C A	Ordering code[1)] Short code
B41550-, B41570-									
100	1 000	35,7 × 55,7	55	120	48	9,8	7	3,5	-A9108-Q
	2 200	35,7 × 80,7	26	57	30	16	12	5,9	-A9228-Q
	3 300	51,6 × 80,7	17	37	24	22	16	8,0	-A9338-Q
	4 700	51,6 × 105,7	13	29	20	28	20	10	-A9478-Q
	6 800	64,3 × 105,7	10	22	17	36	26	13	-A9688-Q
	10 000	76,9 × 105,7	7	15	14	40	32	16	-A9109-Q
	15 000	76,9 × 143,2	6	13	11	40	36	18	-A9159-Q

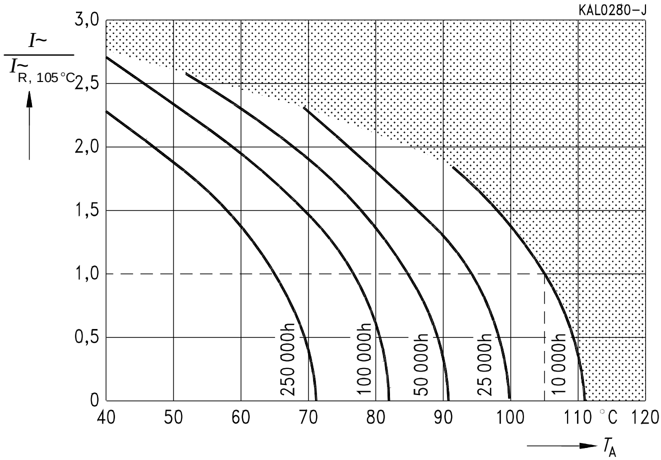
1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B41550-A9108-Q
B41550-.... (ring clip/clamp mounting)
B41570-.... (with threaded stud)



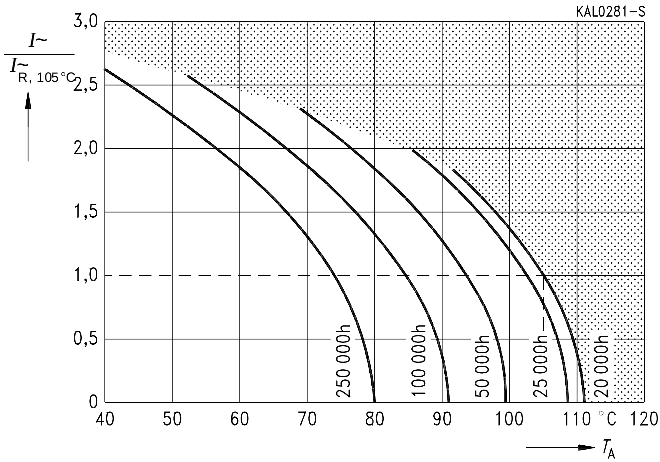
Useful life

versus ambient temperature T_A under ripple current operating conditions[1)]

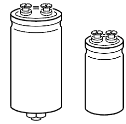
$d \leq$ 51,6 mm



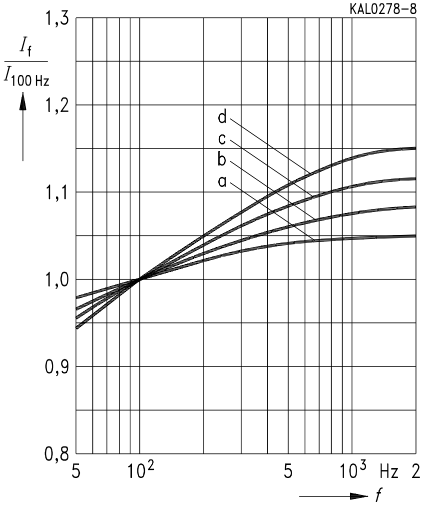
$d \geq$ 64,3 mm



1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

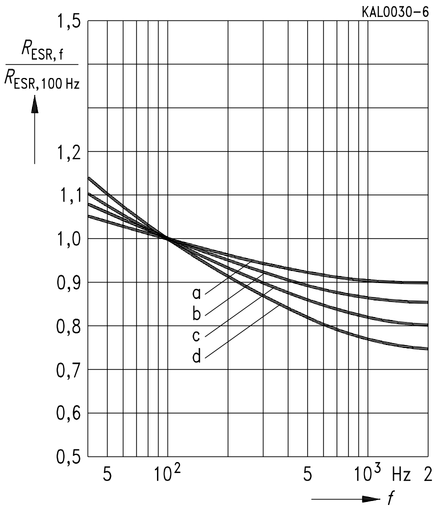


Permissible ripple current *I*~
versus frequency *f*

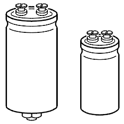


U_R (V–)	16; 25	40	63	100
d = 35,7 mm	b	c	d	d
d = 51,6 mm	a	b	c	c
d = 64,3 mm	a	a	c	c
d = 76,9 mm	a	a	b	c

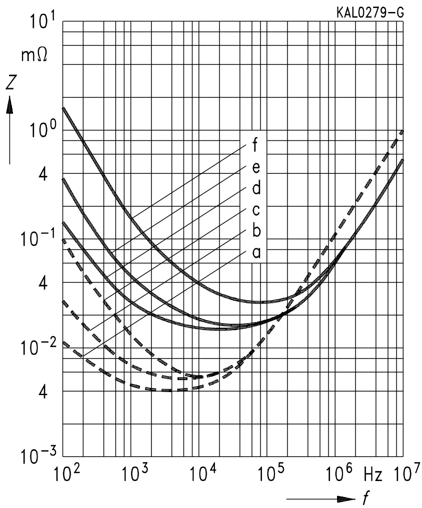
Equivalent series resistance R_{ESR}
versus frequency *f*
Typical behavior



U_R (V–)	16; 25	40	63	100
d = 35,7 mm	b	c	d	d
d = 51,6 mm	a	b	c	c
d = 64,3 mm	a	a	c	c
d = 76,9 mm	a	a	b	c

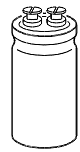


Impedance *Z*
versus frequency *f*
Typical behavior



C_R µF	U_R V–	*d* mm	Curve
150 000	16		a
68 000	40	76,9	b
15 000	100		c
10 000	16		d
4 700	40	35,7	e
1 000	100		f

For professional switch-mode power supplies
with high clock frequencies
Terminals with UNF thread



KAL0272-T

Construction

- Charge-discharge proof, polar
- Aluminum case with insulating sleeve
- Poles with sturdy UNF thread screw terminal connections
- Mounting with ring clips or clamps

Features

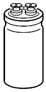
- Very low impedance over a wide range of temperatures
- Good thermal characteristics and high ripple current capability
- Low ohmic loss
- Long useful life
- Shelf life up to 10 years
- All-welded construction ensures reliable electrical contact

Applications

- For professional switch-mode power supplies with high clock frequencies

Specifications and characteristics in brief

Rated voltage U_R Surge voltage U_S	5 to 55 V– $1{,}15 \cdot U_R$
Rated capacitance C_R Capacitance tolerance	2 800 to 46 000 µF ± 20 % ≙ M
Useful life 40 °C, U_R 85 °C, U_R, $I_{\sim max}$ 105 °C, U_R, $I_{\sim R}$	 > 200 000 h (2,4 · $I_{\sim R,105\,°C}$) > 9 000 h > 4 000 h
Failure percentage	≤ 1 % (during useful life)
Failure rate	≤ 40 fit (≤ $40 \cdot 10^{-9}$/h)
Voltage endurance test	2 000 h, 105 °C (at U_R, $I_{\sim R}$)
Leakage current I_{lka} (5 min, 20 °C)	$I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$
Self-inductance L_{ESL}	approx. 10 nH
IEC climatic category	in accordance with IEC 68-1 55/105/56 (–55 °C/+105 °C, 56 days damp heat test)



B 41 431

Specifications and characteristics in brief

Sectional specifications	IEC 384-4 (DIN 45 910 part 12)
Vibration resistance	in accordance with IEC 68-2–6, test Fc: displacement amplitude 0,75 mm, frequency range 10 to 55 Hz, acceleration max. 10 *g*, duration 3 × 2 h

Due to the current load capability of the contact elements, the maximum current limit of 30 A must not be exceeded, even if the frequency and temperature factors have been taken into account.

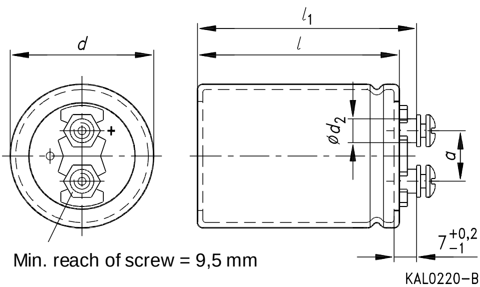
Accessories

The following items are included in the delivery package, but are not fastened to the capacitors:

	Thread	Toothed washers	Screws/Nuts	Maximum torque
For terminals	UNF	A 5,1 DIN 6797	10-32 UNF-2A × 9,5	2 Nm

The following must be ordered separately:
Ring clips B 44 030 (cf. page 142)

Outline drawing

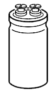


Positive pole marking: +

Terminal	Dimensions (mm) with insulating sleeve					Approx. wt. (g)
	d	*l* ± 0,8	l_1 ± 1	d_2 max	$a\ ^{+0,2}_{-0,4}$	
10-32 UNF	35,7+ 0/– 0,8	55,7	62,0	8,2	12,7	60
10-32 UNF	35,7+ 0/– 0,8	80,7	87,0	8,2	12,7	95
10-32 UNF	35,7+ 0/– 0,8	105,7	112,0	8,2	12,7	120

Packing units

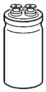
Capacitor diameter *d*	Packing units (pieces)
35,7 mm	72



Overview of available types

U_R (V–)	5	7,5	16	20	28	35	55
C_R (µF)	Case dimensions $d \times l$ (mm)						
2 800							35,7 × 55,7
4 500						35,7 × 55,7	
5 000							35,7 × 80,7
6 300					35,7 × 55,7		
7 300							35,7 × 05,7
8 100						35,7 × 80,7	
8 800				35,7 × 55,7			
10 000			35,7 × 55,7				
11 000					35,7 × 80,7		
12 000						35,7×105,7	
15 000		35,7 × 55,7					
16 000				35,7 × 80,7	35,7×105,7		
18 000	35,7 × 55,7		35,7 × 80,7				
22 000				35,7×105,7			
26 000			35,7×105,7				
27 000		35,7 ×8 0,7					
32 000	35,7 × 80,7						
39 000		35,7×105,7					
46 000	35,7×105,7						

The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.

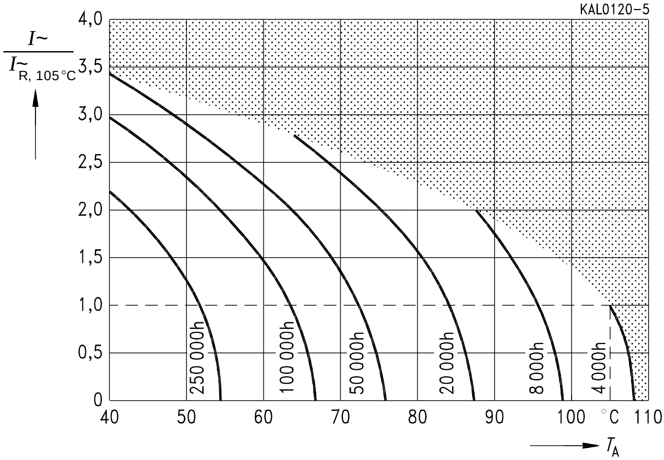


Technical data and ordering codes

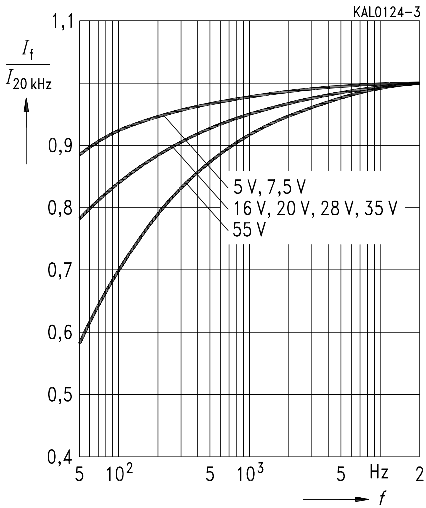
U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 20 kHz 20 °C mΩ	$R_{ESR, max}$ 20 kHz 20 °C mΩ	$I_{\sim max}$ 20 kHz 40 °C A	$I_{\sim max}$ 20 kHz 85 °C A	$I_{\sim R}$ 20 kHz 105 °C A	Ordering code[1)] Short code
5	18 000	35,7 × 55,7	5,8	7,6	26,6	16,1	7,7	-A189-M
	32 000	35,7 × 80,7	4,5	5,9	30,0	21,2	10,2	-A329-M
	46 000	35,7 × 105,7	3,8	5,0	30,0	25,8	12,4	-A469-M
7,5	15 000	35,7 × 55,7	6,0	7,8	26,2	15,8	7,6	-D159-M
	27 000	35,7 × 80,7	4,6	6,0	30,0	20,9	10,1	-D279-M
	39 000	35,7 × 105,7	3,9	5,1	30,0	25,4	12,2	-D399-M
16	10 000	35,7 × 55,7	6,4	8,4	25,3	15,3	7,4	-A4109-M
	18 000	35,7 × 80,7	4,9	6,4	30,0	20,3	9,7	-A4189-M
	26 000	35,7 × 105,7	4,0	5,2	30,0	25,1	12,1	-A4269-M
20	8 800	35,7 × 55,7	6,6	8,6	25,0	15,1	7,3	-G888-M
	16 000	35,7 × 80,7	5,0	6,5	30,0	20,1	9,7	-G169-M
	22 000	35,7 × 105,7	4,1	5,4	30,0	24,8	11,9	-G229-M
28	6 300	35,7 × 55,7	7,1	9,3	24,1	14,5	7,0	-K638-M
	11 000	35,7 × 80,7	5,3	6,9	30,0	19,4	9,4	-K119-M
	16 000	35,7 × 105,7	4,3	5,6	30,0	24,2	11,7	-K169-M
35	4 500	35,7 × 55,7	7,5	9,8	23,1	14,0	6,7	-A7458-M
	8 100	35,7 × 80,7	5,5	7,2	30,0	19,1	9,2	-A7818-M
	12 000	35,7 × 105,7	4,5	5,9	30,0	23,7	11,4	-A7129-M
55	2 800	35,7 × 55,7	8,7	11,3	21,7	13,1	6,3	-N288-M
	5 000	35,7 × 80,7	6,3	8,2	29,6	17,9	8,6	-N508-M
	7 300	35,7 × 105,7	5,0	6,5	30,0	22,5	10,8	-N738-M

1) To obtain the required ordering code, prefix the type number to the short code.
E. g.: B41431-A189-M

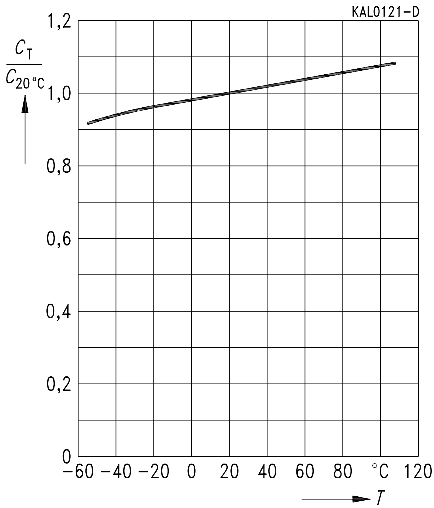
Useful life
versus ambient temperature T_A under ripple current operating conditions[1)]



Permissible ripple current *I~*
versus frequency *f*

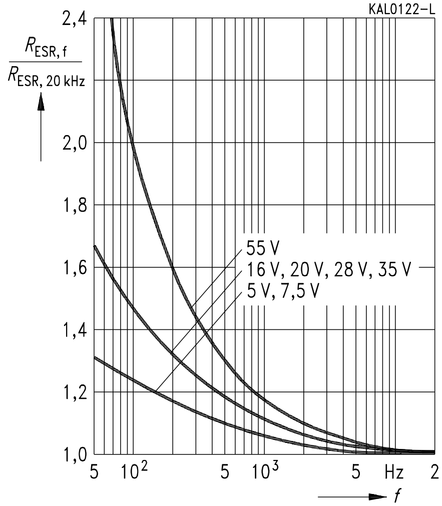


Series capacitance C_S at f = 100 Hz
versus temperature T
Typical behavior

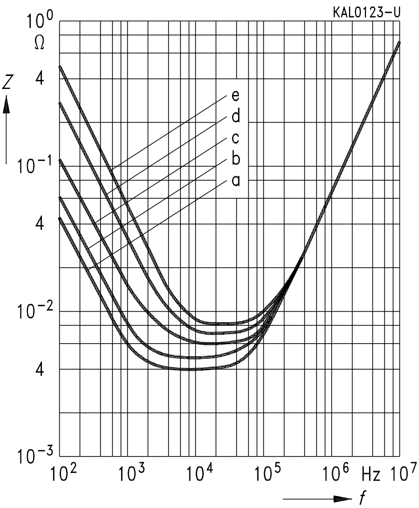


1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

Equivalent series resistance R_{ESR}
versus frequency f
Typical behavior

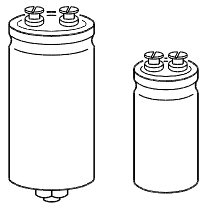


Impedance Z
versus frequency f
Typical behavior



C_R µF	U_R V–	Curve
39 000	7,5	a
27 000	7,5	b
15 000	7,5	c
5 000	55	d
2 800	55	e

Maximum reliability and long useful life
Operating temperature up to 105 °C



B 43 570 B 43 550

Construction

- Charge-discharge proof, polar
- Aluminum case with insulating sleeve
- Poles with screw terminal connections
- Mounting with ring clips, clamps or threaded stud
- The bases of types with threaded stud and $d \le 76{,}9$ mm are not insulated, types with $d = 91$ mm have fully insulated bases

Features

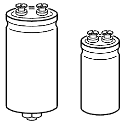
- Maximum reliability
- Good thermal characteristics and high ripple current characteristics
- Long useful life
- Wide temperature range
- All-welded construction ensures reliable electrical contact

Applications

- Highly professional power supplies
- Power electronics, e. g. capacitor banks in current converters

Specifications and characteristics in brief

Rated voltage U_R Surge voltage U_S	160 to 400 V– $1{,}15 \cdot U_R$ (for $U_R \le 250$ V–) $1{,}10 \cdot U_R$ (for $U_R \ge 350$ V–)
Rated capacitance C_R Capacitance tolerance	150 to 15 000 µF – 10/+ 30 % ≙ Q
Useful life 40 °C, U_R 85 °C, U_R, $I_{\sim max}$ 105 °C, U_R, $I_{\sim R}$	 > 200 000 h ($3 \cdot I_{\sim R,105\,°C}$) > 15 000 h > 6 000 h
Failure percentage	≤ 1 % (during useful life)
Failure rate	≤ 20 fit ($\le 20 \cdot 10^{-9}$/h)
Voltage endurance test	2 000 h, 105 °C (at U_R, $I_{\sim R}$)
Leakage current I_{lka} (5 min, 20 °C)	$1\,000\ \mu C \le C_R \cdot U_R < 470\,000\ \mu C$: $I_{lka} \le 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$



Specifications and characteristics in brief

Leakage current I_{lka} (5 min, 20 °C)	$C_R \cdot U_R \geq 470\,000\ \mu C$: $I_{lka} \leq 0{,}3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)^{0,7} + 4\ \mu A$
Self-inductance L_{ESL}	d = 35,7 mm: approx. 10 nH d = 51,6 mm: approx. 15 nH $d \geq$ 64,3 mm: approx. 20 nH
IEC climatic category	in accordance with IEC 68-1 ≤ 350 V–: 40/105/56 (–40 °C/+105 °C, 56 days damp heat test)[1)] 400 V–: 25/105/56 (–25 °C/+105 °C, 56 days damp heat test)
Detail specifications	similar to CECC 30 301-803, CECC 30 301-807, (similar to CECC 30 301-046, similar to DIN 45 910 part 128)
Sectional specifications	IEC 384-4 (DIN 45 910 part 12)
Vibration resistance	in accordance with IEC 68-2–6, test Fc: displacement amplitude 0,75 mm, frequency range 10 to 55 Hz, acceleration max. 10 *g*, duration 3 × 2 h

Due to the current load capability of the contact elements, the following current limits must not be exceeded, even if the frequency and temperature factors have been taken into account:

Capacitor diameter	≤ 51,6 mm	64,3 mm	76,9 mm	91,0 mm
Maximum current	30 A	40 A	50 A	60 A

Accessories

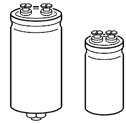
The following items are included in the delivery package, but are not fastened to the capacitors:

	Thread	Toothed washers	Screws/Nuts	Maximum torque
For terminals	M 5	A 5,1 DIN 6797	Cylinder-head screw M 5 × 8 DIN 84-4.8	2 Nm
	M 6	A 6,4 DIN 6797	Cylinder-head screw M 6 × 12 DIN 85-4.8	2,5 Nm
For mounting	M 8	J 8,2 DIN 6797	Hex nut BM 8 DIN 439	4 Nm
	M 12	J 12,5 DIN 6797	Hex nut BM 12 DIN 439	10 Nm

The following must be ordered separately:

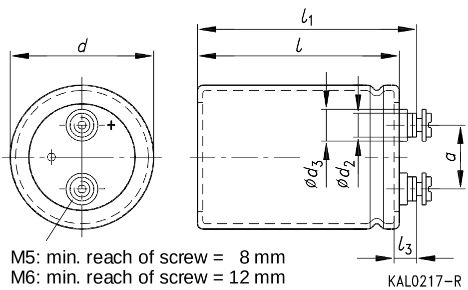
Ring clips — B 44 030 (cf. page 142)
Clamps for capacitors with $d \geq$ 64,3 mm — B 44 030 (cf. page 146)
Insulating parts — B 44 020 (cf. page 139)

1) For case size 76,9 mm × 220,7 mm and ∅ 91 mm: IEC climatic category 25/105/56

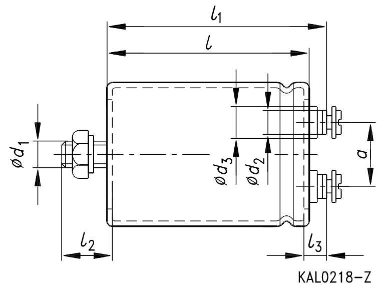


Outline drawings

Type B 43 550
Ring clip/clamp mounting



Type B 43 570
Threaded stud mounting



Positive pole marking: +

The base of all types with stud mounting and d = 91 mm is fully insulated (the lengths l and l_1 are increased by 0,5 mm in these cases). Also refer to the notes on mounting given on page 141.

Ter-minal	Dimensions (mm) with insulating sleeve									Approx. wt. (g)
	d	$l \pm 1$	$l_1 \pm 1$	$l_2\ ^{+0}_{-1}$	l_3	d_1	d_2 max	d_3 max	$a\ ^{+0,2}_{-0,4}$	
M 5	35,7+ 0/– 0,8	55,7	62,2	13	7,0+ 0,2/– 1	M 8	8,2	13,5	12,7	65
M 5	35,7+ 0/– 0,8	80,7	87,2	13	7,0+ 0,2/– 1	M 8	8,2	13,5	12,7	105
M 5	35,7+ 0/– 0,8	105,7	112,2	13	7,0+ 0,2/– 1	M 8	8,2	13,5	12,7	135
M 5	51,6+ 0/– 0,8	80,7	87,2	17	7,0+ 0,2/– 1	M 12	8,2	13,5	22,2	220
M 5	51,6+ 0/– 0,8	105,7	112,2	17	7,0+ 0,2/– 1	M 12	8,2	13,5	22,2	280
M 5	64,3+ 0/– 0,8	105,7	112,2	17	7,0+ 0,2/– 1	M 12	8,2	13,5	28,5	440
M 6	76,9+ 0/– 0,7	97,0	103,3	17	6,4+ 1,1/– 0,8	M 12	17,7	17,7	31,7	540
M 6	76,9+ 0/– 0,7	143,2	149,0	17	6,4+ 1,1/– 0,8	M 12	17,7	17,7	31,7	840
M 6	76,9+ 0/– 0,7	220,7	226,5	17	6,4+ 1,1/– 0,8	M 12	17,7	17,7	31,7	1300
M 6	91,0+ 0/– 2	144,5	149,8	17	6,4+ 1,1/– 0,8	M 12	17,7	17,7	31,7	1200

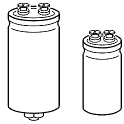
Packing units

Capacitor diameter d	Packing units (pieces)
35,7 mm	72
51,6 mm	36
64,3 mm	20
76,9 mm	16
91,0 mm	8

Overview of available types

U_R (V–)	160	250	350	400
C_R (µF)	Case dimensions $d \times l$ (mm)			
150			35,7 × 55,7	35,7 × 55,7
220		35,7 × 55,7	35,7 × 80,7	35,7 × 80,7
330	35,7 × 55,7	35,7 × 55,7	35,7 × 105,7	35,7 × 105,7
470	35,7 × 55,7	35,7 × 80,7	51,6 × 80,7	51,6 × 80,7
680	35,7 × 80,7	51,6 × 80,7	51,6 × 105,7	51,6 × 105,7
1 000	35,7 × 80,7	51,6 × 80,7	51,6 × 105,7	64,3 × 105,7
1 500	51,6 × 80,7	51,6 × 80,7	64,3 × 105,7	76,9 × 105,7
2 200	51,6 × 80,7	64,3 × 105,7	76,9 × 105,7	76,9 × 143,2
3 300	64,3 × 105,7	76,9 × 105,7	76,9 × 143,2	76,9 × 220,7 91,0 × 144,5
4 700	64,3 × 105,7	76,9 × 143,2	76,9 × 220,7 91,0 × 144,5	76,9 × 220,7
6 000			76,9 × 220,7	
6 800	76,9 × 105,7	76,9 × 143,2		
10 000	76,9 × 143,2	76,9 × 220,7 91,0 × 144,5		
15 000	76,9 × 220,7 91,0 × 144,5			

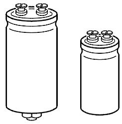
The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	$I_{\sim R}$ 100 Hz 105 °C A	Ordering code[1)] Short code
B43550-, B43570-									
160	330	35,7 × 55,7	210	450	290	5,1	3,1	1,5	-A1337-Q
	470	35,7 × 55,7	150	240	200	6,0	3,7	1,8	-A1477-Q
	680	35,7 × 80,7	100	140	130	8,2	5,0	2,4	-A1687-Q
	1 000	35,7 × 80,7	70	100	98	9,8	6,0	2,9	-C1108-Q
	1 500	51,6 × 80,7	47	68	67	13	8,1	3,9	-A1158-Q
	2 200	51,6 × 80,7	33	50	49	16	9,7	4,7	-C1228-Q
	3 300	64,3 × 105,7	22	35	34	24	15	7,0	-A1338-Q
	4 700	64,3 × 105,7	16	27	26	28	17	8,2	-A1478-Q
	6 800	76,9 × 105,7	12	24	23	33	20	9,5	-B1688-Q
	10 000	76,9 × 143,2	9	18	17	43	26	12	-B1109-Q
	15 000	76,9 × 220,7	7	17	16	58	35	17	-C1159-Q
	15 000	91,0 × 144,5	7	17	16	58	35	17	-J1159-Q
250	220	35,7 × 55,7	220	440	330	5,0	3,0	1,5	-A2227-Q
	330	35,7 × 55,7	150	300	220	6,0	3,7	1,8	-C2337-Q
	470	35,7 × 80,7	100	190	160	8,2	5,0	2,4	-C2477-Q
	680	51,6 × 80,7	73	140	110	11	6,5	3,1	-A2687-Q
	1 000	51,6 × 80,7	50	100	82	13	7,9	3,8	-C2108-Q
	1 500	51,6 × 80,7	34	62	59	16	9,5	4,6	-J2158-Q
	2 200	64,3 × 105,7	24	45	44	23	14	6,7	-A2228-Q
	3 300	76,9 × 105,7	17	33	32	28	17	8,0	-B2338-Q
	4 700	76,9 × 143,2	12	27	26	37	22	11	-B2478-Q
	6 800	76,9 × 143,2	9	23	22	43	26	12	-E2688-Q
	10 000	76,9 × 220,7	9	23	22	50	31	15	-A2109-Q
	10 000	91,0 × 144,5	8	23	22	50	31	15	-J2109-Q

1) For instructions on how to determine ordering codes, refer to page 130.

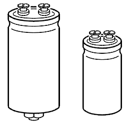


B 43 550
B 43 570

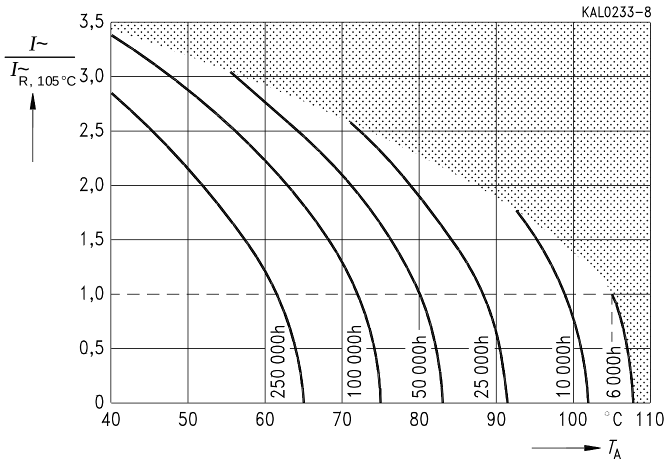
Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	$I_{\sim R}$ 100 Hz 105 °C A	Ordering code[1) Short code
B43550-, B43570-									
350	150	35,7 × 55,7	270	600	410	4,5	2,7	1,3	-A4157-Q
	220	35,7 × 80,7	180	420	290	6,1	3,7	1,8	-A4227-Q
	330	35,7 × 105,7	120	280	190	8,3	5,0	2,4	-A4337-Q
	470	51,6 × 80,7	87	190	140	9,9	6,0	2,9	-A4477-Q
	680	51,6 × 105,7	60	130	100	13	7,9	3,8	-A4687-Q
	1 000	51,6 × 105,7	42	90	72	16	9,4	4,5	-J4108-Q
	1 500	64,3 × 105,7	29	60	52	21	13	6,1	-A4158-Q
	2 200	76,9 × 105,7	20	45	40	25	15	7,4	-B4228-Q
	3 300	76,9 × 143,2	14	30	29	34	21	9,9	-B4338-Q
	4 700	76,9 × 220,7	18	24	23	46	28	14	-C4478-Q
	4 700	91,0 × 144,5	18	24	23	46	28	14	-J4478-Q
	6 000	76,9 × 220,7	14	20	19	50	32	15	-C4608-Q
400	150	35,7 × 55,7	410	820	660	4,5	2,7	1,3	-F157-Q
	220	35,7 × 80,7	280	560	430	6,1	3,7	1,8	-F227-Q
	330	35,7 × 105,7	190	380	290	8,2	5,0	2,4	-F337-Q
	470	51,6 × 80,7	140	280	230	9,6	5,8	2,8	-F477-Q
	680	51,6 × 105,7	100	200	160	13	7,6	3,6	-F687-Q
	1 000	64,3 × 105,7	75	150	120	16	10	4,7	-F108-Q
	1 500	76,9 × 105,7	50	100	80	20	12	5,8	-J158-Q
	2 200	76,9 × 143,2	36	72	60	26	16	7,7	-J228-Q
	3 300	76,9 × 220,7	26	52	45	37	22	11	-J338-Q
	3 300	91,0 × 144,5	22	52	45	37	22	11	-L338-Q
	4 700	76,9 × 220,7	20	40	36	42	26	12	-H478-Q

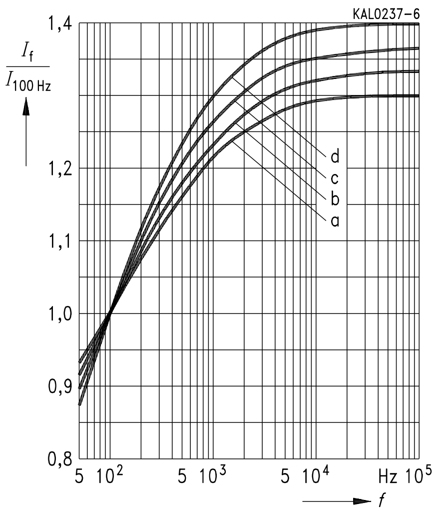
1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B43550-A4157-Q
B43550-.... (ring clip/clamp mounting)
B43570-.... (with threaded stud)



Useful life
versus ambient temperature T_A under ripple current operating conditions[1)]

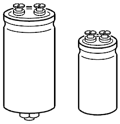


Permissible ripple current *I*~
versus frequency *f*

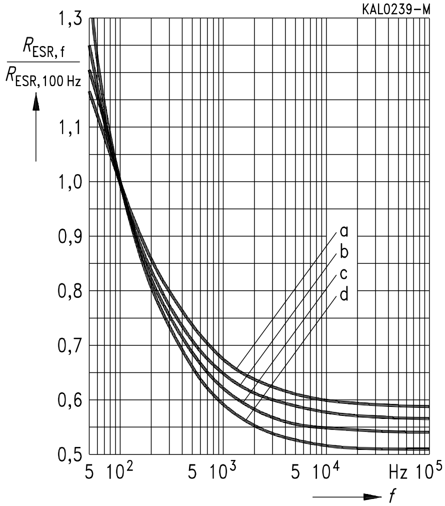


d (mm)	35,7	51,6	64,3	76,9	91,0
Curve	d	c	b	a	c

1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

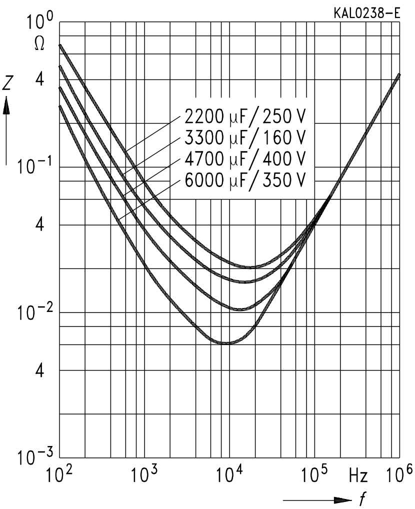


Equivalent series resistance R_{ESR}
versus frequency f
Typical behavior

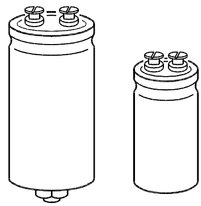


d (mm)	35,7	51,6	64,3	76,9	91,0
Curve	d	c	b	a	a

Impedance Z
versus frequency f
Typical behavior



Extremely high ripple current capability (up to 100 A)



KAL0272-T

B 43 670 B 43 650

Construction

- Charge-discharge proof, polar
- Aluminum case with insulating sleeve
- Poles with screw terminal connections
- Mounting with ring clips, clamps or threaded stud

Features

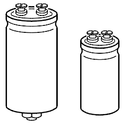
- High ripple current capability (up to 100 A)
- High reliability
- Wide temperature range
- All-welded construction ensures reliable electrical contact

Applications

- Highly professional power supplies with clock frequencies as high as several kHz
- Power electronics, e. g. capacitor banks in current converters

Specifications and characteristics in brief

Rated voltage U_R Surge voltage U_S	350 V– and 400 V– $1{,}1 \cdot U_R$
Rated capacitance C_R Capacitance tolerance	850 to 5 300 µF + 20 % ≙ M
Useful life 40 °C, U_R 85 °C, U_R, $I_{\sim R}$ 85 °C, U_R, $I_{\sim max}$ 105 °C, U_R, $I_{\sim R}$	 > 200 000 h ($2{,}6 \cdot I_{\sim R,105\,°C}$) > 20 000 h > 4 000 h > 4 000 h
Failure percentage	≤ 1 % (during useful life)
Failure rate	≤ 20 fit ($\leq 20 \cdot 10^{-9}$/h)
Voltage endurance test	2000 h, 105 °C (at U_R, $I_{\sim R}$)
Leakage current I_{lka} (5 min, 20 °C)	$1\,000\ \mu C \leq C_R \cdot U_R < 470\,000\ \mu C$: $I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$ $C_R \cdot U_R \geq 470\,000\ \mu C$: $I_{lka} \leq 0{,}3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)^{0{,}7} + 4\ \mu A$



Specifications and characteristics in brief

Self-inductance L_{ESL}	d = 64,3 mm: approx. 14 nH d = 76,9 mm: approx. 18 nH
IEC climatic category	in accordance with IEC 68-1 25/105/56 (–25 °C/+105 °C, 56 days damp heat test)
Detail specifications Sectional specifications	– IEC 384-4 (DIN 45 910 part 12)
Vibration resistance	in accordance with IEC 68-2–6, test Fc: displacement amplitude 0,75 mm, frequency range 10 to 55 Hz, acceleration max. 10 g, duration 3 × 2 h

Due to the current load capability of the contact elements, the following current limits must not be exceeded, even if the frequency and temperature factors have been taken into account:

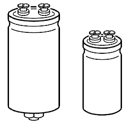
Capacitor diameter	Capacitor base cooling	Terminal and capacitor base cooling
64,3 mm	62 A	75 A
76,9 mm	80 A	100 A
91,0 mm	80 A	100 A

Accessories

The following items are included in the delivery package, but are not fastened to the capacitors:

	Thread	Toothed washers	Screws/Nuts	Maximum torque
For terminals	M 6	A 6,4 DIN 6797	Cylinder-head screw M 6 × 12 DIN 85-4.8	2,5 Nm
For mounting	M 12	J 12,5 DIN 6797	Hex nut BM 12 DIN 439	10 Nm

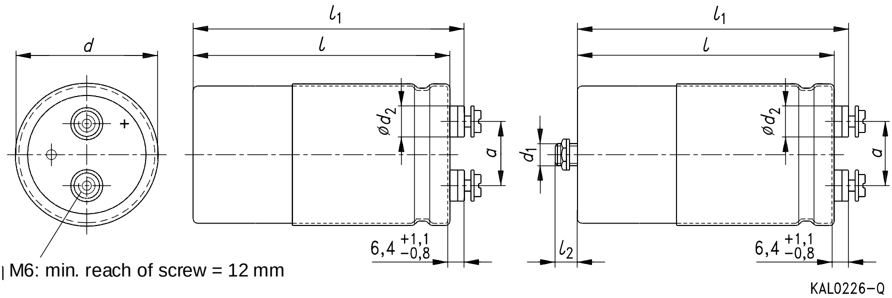
The following must be ordered separately:
Ring clips B 44 030 (cf. page 142)
Clamps B 44 030 (cf. page 146)
Insulating parts B 44 020 (cf. page 139)



Outline drawings

Type B 43 650
Ring clip/clamp mounting

Type B 43 670
Threaded stud mounting



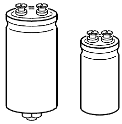
Positive pole marking: +

Terminal	Dimensions (mm) without insulating sleeve[1]							Approx. wt. (g)
	d	$l \pm 0{,}8$	$l_1 \pm 0{,}8$	$l_2\,^{+0}_{-1}$	d_1	d_2 max	$a\,^{+0,2}_{-0,4}$	
M 6	64,3+ 0/– 0,8	80,3	86,0	17	M 12	17,7	28,5	350
M 6	64,3+ 0/– 0,8	105,3	111,0	17	M 12	17,7	28,5	450
M 6	76,9+ 0/– 0,7	105,3	111,0	17	M 12	17,7	31,7	550
M 6	76,9+ 0/– 0,7	142,8	148,5	17	M 12	17,7	31,7	850
M 6	91,0+ 0/– 2	67,1	72,4	17	M 12	17,1	31,7	600
M 6	91,0+ 0/– 2	96,6	101,6	17	M 12	17,7	31,7	800
M 6	91,0+ 0/– 2	144,1	149,4	17	M 12	17,7	31,7	1300

Packing units

Capacitor diameter d	Packing units (pieces)
64,3 mm	20
76,9 mm	16
91,0 mm	8

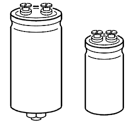
1) Fully insulated versions available upon request



Technical data and ordering codes

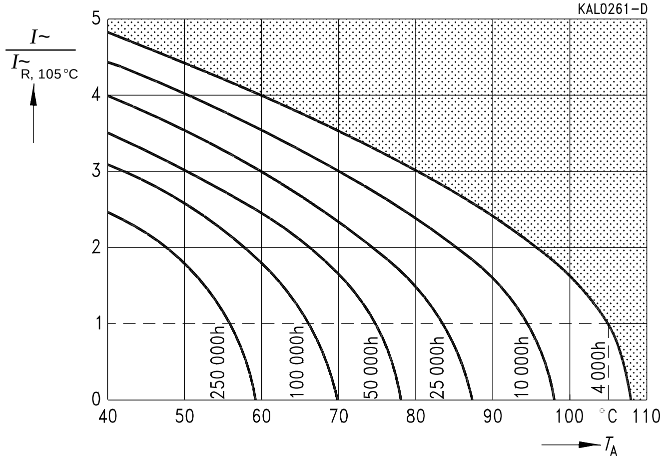
C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 1) 10 kHz 40 °C A	$I_{\sim max}$ 1) 10 kHz 85 °C A	$I_{\sim max}$ 2) 10 kHz 85 °C A	$I_{\sim R}$ 1) 10 kHz 105 °C A	Ordering code 3) Short code
U_R = 350 V–									
1 200	64,3 × 80,3	35	70	32	45	26	70	9,5	-A4128-M
1 500	91,0 × 67,1	28	56	26	49	28	85	10	-A4158-M
1 800	64,3 × 105,3	23	46	21	56	32	75	12	-A4188-M
2 700	76,9 × 105,3	15	30	13	75	43	100	16	-A4278-M
3 900	76,9 × 142,8	10	21	9	80	55	100	20	-A4398-M
5 300	91,0 × 144,1	8	16	8	80	71	100	26	-A4538-M
U_R = 400 V–									
850	64,3 × 80,3	70	140	110	45	26	70	9,5	-A9857-M
1 200	91,0 × 67,1	50	100	80	49	28	85	10	-A9128-M
1 300	64,3 × 105,3	46	92	74	56	32	75	12	-A9138-M
1 900	76,9 × 105,3	32	64	51	75	43	100	16	-A9198-M
2 900	76,9 × 142,8	21	42	34	80	55	100	20	-A9298-M
3 900	91,0 × 144,1	15	30	24	80	71	100	26	-A9398-M

1) Ripple current capabilities without forced cooling
2) With forced cooling of the terminals and the case base (≤ 85°C)
3) To obtain the required ordering code, prefix the type number to the short code. E. g.: B43650-A4128-M
B43650-... (ring clip/clamp mounting)
B43670-... (with threaded stud)



Useful life

versus ambient temperature T_A under ripple current operating conditions (without forced cooling)[1)]



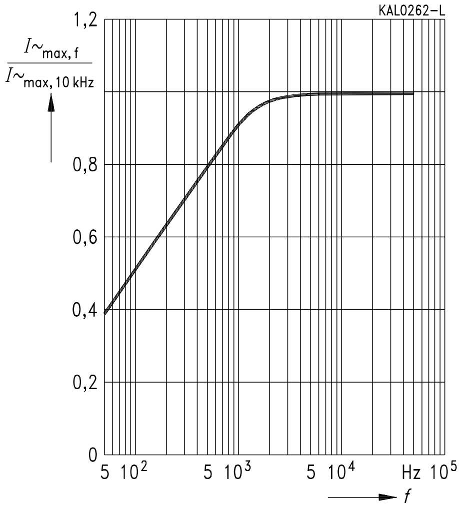
Forced cooling

With forced cooling, the case temperature T_C is used as a reference temperature instead of the ambient temperature T_A in the useful life curves.
Current factors for forced cooling of the capacitor case surface:

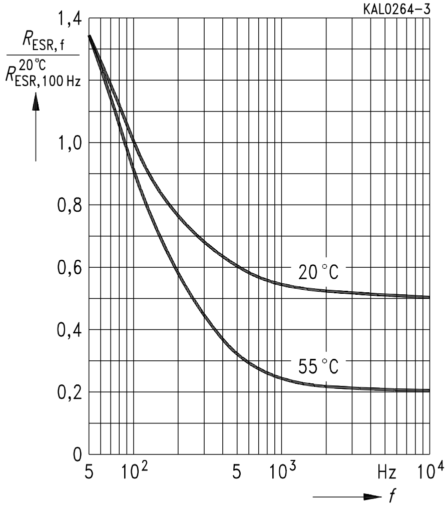
U_R V–	C_R µF	Without forced cooling (T_A)	With forced cooling (T_C)	Cooling of the terminals and capacitor base (T_C)
350	1 200	1	2,3	2,7
	1 500	1	2,7	3,0
	1 800	1	1,9	2,4
	2 700	1	2,1	2,6
	3 900	1	1,7	2,3
	5 300	1	1,8	2,3
400	850	1	2,3	2,7
	1 200	1	2,7	3,0
	1 300	1	1,9	2,4
	1 900	1	2,1	2,6
	2 900	1	1,7	2,3
	3 900	1	1,8	2,3

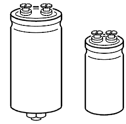
1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

Permissible ripple current *I~*
versus frequency *f*

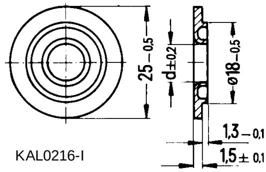
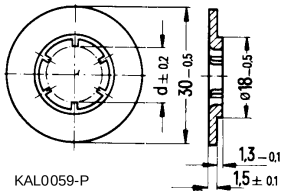
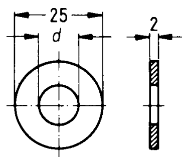
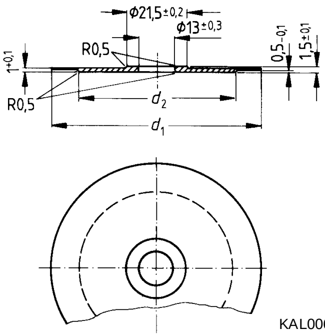


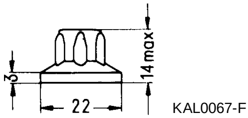
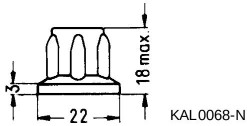
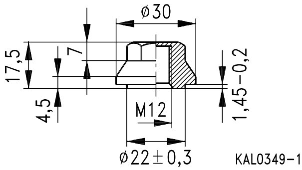
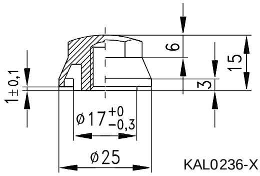
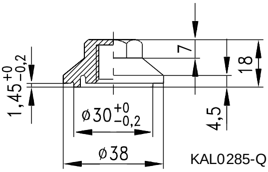
Equivalent series resistance R_{ESR}
versus frequency *f*
Typical behavior



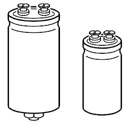


Accessories for capacitors with mounting stud on capacitor base

Capacitor diameter	Outline drawing	Diameter *d* (mm)	Ordering code
Insulating plastic shoulder washer "P" similar to DIN 41 331 specifications			
≤ 40 mm	for M 8 thread  KAL0216-I	8,4	B44020-B1-B25
> 40 mm	for M 12 thread  KAL0059-P	12,5	B44020-B2-B30
Insulating washer "N" made of laminated paper			
≤ 40 mm	for M 8 / M 12 thread  KAL0066-7	8,4	B44020-A1-B25
> 40 mm		13	B44020-A2-B25
Insulating washer made of Hostalen			
51,6 mm 76,9 mm	 KAL0061-1	$d_{1-0,5}$ / $d_{2-0,5}$ 51 / 31 76 / 56	B44020-B6-B51 B44020-B6-B76

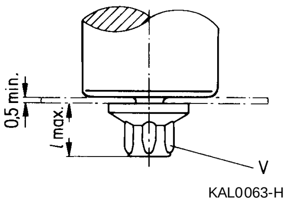
Capacitor diameter	Outline drawing	Ordering code
	Plastic cap nut “V”	
≤ 40 mm	for M 8 thread width across flats 13 mm 	B44020-B5-B8
> 40 mm	for M 12 thread width across flats 17 mm 	B44020-A5-B12
	Reinforced nylon cap nut	
> 40 mm	for M 12 thread width across flats 19 mm 	B44020-J6-B12
≤ 40 mm	for M 8 thread width across flats 17 mm 	B44020-J6-B8
> 40 mm	for M 12 thread *) width across flats 19 mm 	B44020-J7-B12

*) For achieving larger clearances.

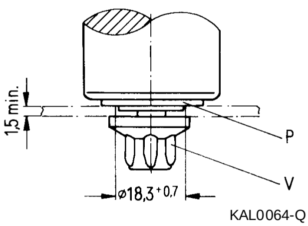


Mounting instructions

For maximum tightening torques, refer to “General Technical Information”, section 8.3, page 44



Non-insulated mounting
with cap nut

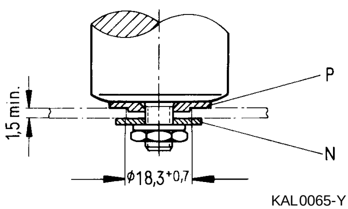


Mounting hole diameter

Insulated mounting
with cap nut

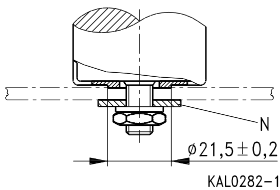
Insulated mounting with DIN 439 hex nut

d ≤ 76,9 mm

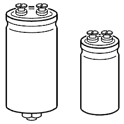


Mounting hole diameter

d = 91 mm

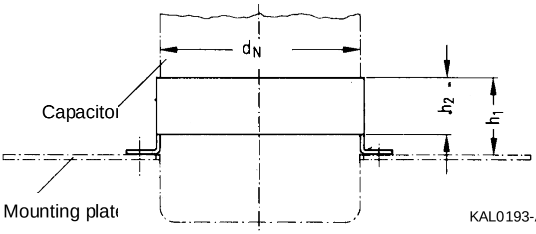


Mounting hole diameter



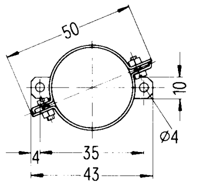
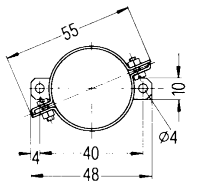
Ring clip mounting

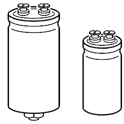
Ring clips are primarily used for upright mounting of screw-terminal and photoflash capacitors. The clip surfaces are specially treated and corrosion-protected.

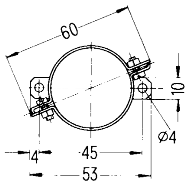
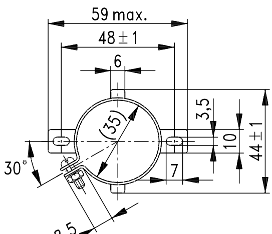
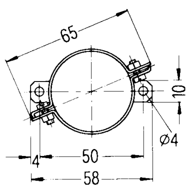


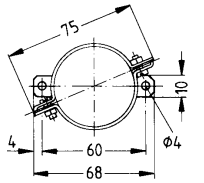
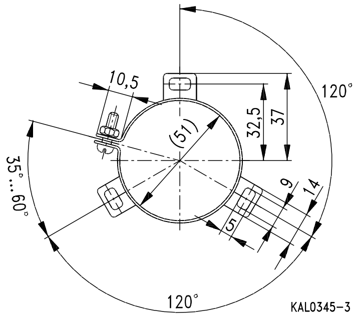
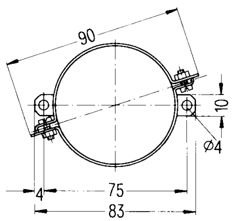
KAL0193-A

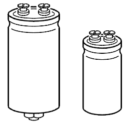
A variety of ring clip versions is available for Al electrolytic capacitors. Some versions are supplied with AM 3 × 10 DIN 84 clamping screws and DIN 934 nuts included. Additional insulation can be achieved by inserting a 30 mm-wide insulating strip between the capacitor and the ring clip. In such cases, attention must be paid to any relevant regulations (e. g. VDE, BSA or UL regulations).

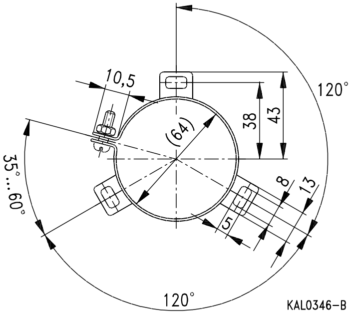
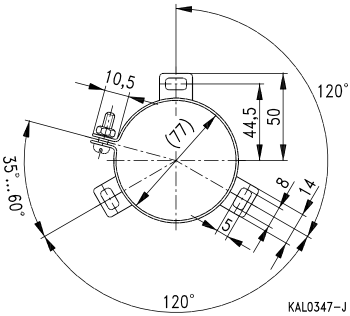
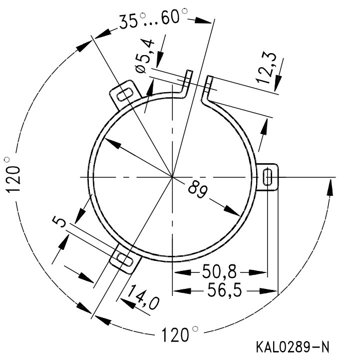
d_N (mm)	h_1 (mm)	h_2 (mm)	Ring clip version	Ordering code without insulating strip	Ordering code with insulating strip
25	19	15	 KAL0198-G Clamping screws and nuts are included in delivery package.	B44030-A25	B44030-J25 (insulating strip length: 170 mm)
30	19	15	 KAL0199-P Clamping screws and nuts are included in delivery package.	B44030-A30	B44030-J30 (insulating strip length: 200 mm)

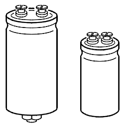


d_N	h_1	h_2	Ring clip version	Ordering code without insulating strip	Ordering code with insulating strip
mm					
35	19	15	KAL0201-5 Clamping screws and nuts are included in delivery package.	B44030-A35	B44030-J35 (insulating strip length: 230 mm)
35	15	10	KAL0344-U	B44030-A36	B44030-J36 (insulating strip length: 230 mm)
40	19	15	KAL0200-W Clamping screws and nuts are included in delivery package.	B44030-A40	B44030-J40 (insulating strip length: 260 mm)

d_N	h_1	h_2	Ring clip version	Ordering code without	 with
mm				insulating strip	
50	19	15	 Clamping screws and nuts are included in delivery package.	B44030-A50	B44030-J50 (insulating strip length: 325 mm)
	22	15		B44030-A51	B44030-J51 (insulating strip length: 325 mm)
65	26	22	 Clamping screws and nuts are included in delivery package.	B44030-A65	B44030-J65 (insulating strip length: 420 mm)



d_N	h_1	h_2	Ring clip version	Ordering code without insulating strip	Ordering code with insulating strip
mm	mm	mm			
65	29	19		B44030-A64	B44030-J64 (insulating strip length: 420 mm)
75	29	19		B44030-A75	B44030-J75 (insulating strip length: 495 mm)
90	29	19		B44030-A90	B44030-J90 (insulating strip length: 590 mm)



B 44 030
Accessories

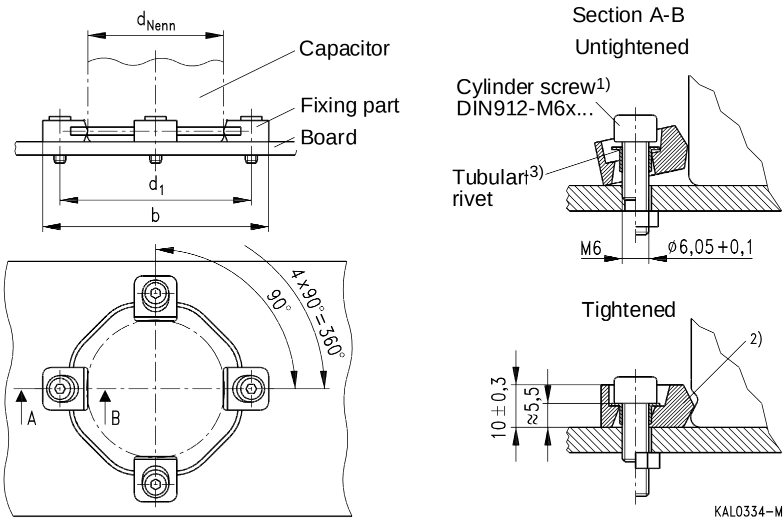
Clamp mounting

Screw-terminal capacitors without threaded stud and with a diameter ≥ 64,3 mm can also be mounted with 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

Outline drawing

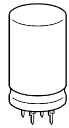


1) Lenght depends on application.
2) The screws have to be tightened uniformly and crosswise until the fixing part rests flatly on the board.
3) Tubular rivets included in delivery package.

Dimensions and ordering codes

Capacitor diameter d_N	$d_1 \pm 0{,}2$ mm	b mm	Ordering code
65 mm	87	104	B44030-A165
75 mm	99	116	B44030-A175
90 mm	112	130	B44030-A190

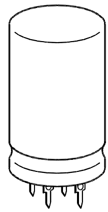
Capacitors with Solder Pins



Overview

Quality grade	Type	U_R V–	C_R µF	Temperature °C	Special features and fields of application	Page
GP	B 41 306 B 43 306	16 … 100 250 … 500	470 … 47 000 33 … 1 000	– 40 … + 85 ≥ 400 V–: – 25 … + 85	Standard type with high ripple current capability Low series resistance and low self-inductance Pinning ensures correct insertion For consumer electronics and for control electronics	148
LL	B 41 507 B 43 507	10… 100 200 … 450	1 000 … 100 000 68 … 2 200	– 40 … + 85 ≥ 400 V–: – 25 … + 85	Especially high volumetric efficiency High reliability Low series resistance and low self-inductance Pinning ensures correct insertion For professional switch-mode power supplies in industrial and consumer electronics	157

Standard type with high ripple current capability
Rated voltage up to 500 V–



KAL0273-2

Construction

- Charge-discharge proof, polar
- Aluminum case, fully insulated
- Overload protection by preset break point in case
- Solder pin mounting on printed circuit boards, pins fit standardized spacings on PCB
- Negative pole brought out to solder pin, but not insulated from case

Features

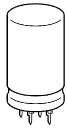
- Standard type with high ripple current capability
- Welded terminal connections ensure secure contacts and high reliability
- Low series resistance and low self-inductance
- Pinning ensures correct insertion

Applications

- Preferred components for switch-mode power supplies in consumer electronics
- Industrial applications, e.g. control systems

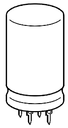
Specifications and characteristics in brief

	B 41 306	B 43 306
Rated voltage U_R Spitzenspannung U_S	16 … 100 V– $1{,}15 \cdot U_R$	250 … 500 V– $1{,}15 \cdot U_R$ (for $U_R \leq 250$ V–) $1{,}10 \cdot U_R$ (for $U_R \geq 385$ V–)
Rated capacitance C_R Capacitance tolerance	470 … 47 000 µF – 10/+ 50 % ≙ T	33 … 1 000 µF – 10/+ 50 % ≙ T
Useful life 40 °C, U_R 85 °C, U_R; $I_{\sim R}$	 > 200 000 h ($1{,}5 \cdot I_{\sim R,85°C}$) > 4 000 h	 > 200 000 h ($1{,}7 \cdot I_{\sim R,85°C}$) > 5 000 h
Failure percentage	≤ 1 % (during useful life)	≤ 1 % (during useful life)
Failure rate	≤ 40 fit ($\leq 40 \cdot 10^{-9}$/h)	≤ 40 fit ($\leq 40 \cdot 10^{-9}$/h)
Voltage endurance test	2 000 h, 85 °C (at U_R)	2 000 h, 85 °C (at U_R)
Leakage current I_{lka} (5 min, 20 °C)	$I_{lka} \leq 0{,}3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)^{0{,}7} + 4\ \mu A$	



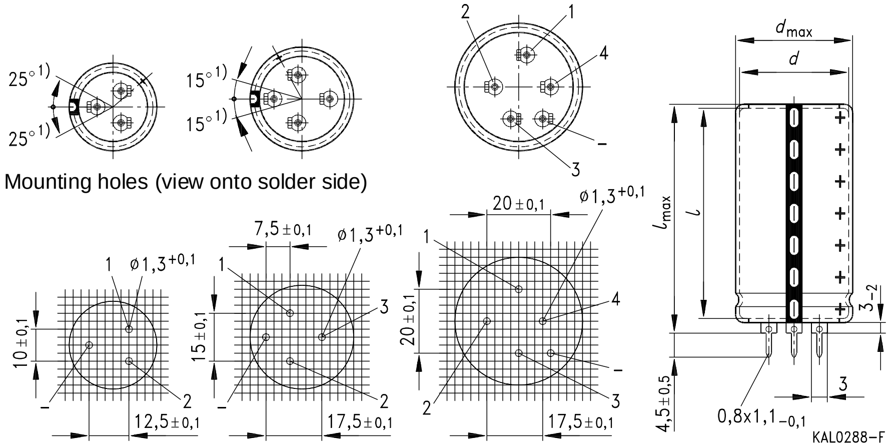
Specifications and characteristics in brief

	B 41 306	B 43 306
Self-inductance L_{ESL}	approx. 10 nH	
IEC climatic category	in accordance with IEC 68–1 ≤ 385 V–: 40/085/56 (–40 °C/+85 °C, 56 days damp heat test) ≥ 400 V–: 25/085/56 (–25 °C/+85 °C, 56 days damp heat test)	
Detail specifications	similar to CECC 30 301-047 (similar to DIN 45 910 part 129)	
Sectional specifications	IEC 384–4 (DIN 45 910 part 12)	
Vibration resistance	in accordance with IEC 68–2–6, test Fc: frequency range 10 … 55 Hz, duration 3 × 2 h for d = 25 mm: displacement amplitude 0,75 mm, acceleration max. 10 g for d ≥ 30 mm: displacement amplitude 0,35 mm, acceleration max. 5 g	



B 41 306
B 43 306

d = 25 mm *d* = 30 and 35 mm *d* = 40 mm

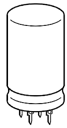


No plus and minus pole markings on the shrunk-on insulating sleeve for *d* = 35 and 40 mm.
Pole markings: Plus: 1; Minus: –

All pin holes must be drilled into the PC-board, since the unconnected pins serve as mountings. These pins must be soldered to isolated pads or pads with the same potential as the negative pole.

Dimensions (mm) *d* × *l*	$d_{max} \times l_{max}$	Approximate weight (g)	Packing units Pieces
25 × 30	25,8 × 34	22	384
25 × 35	25,8 × 39	22	256
25 × 40	25,8 × 44	29	256
30 × 35	30,8 × 39	32	240
30 × 40	30,8 × 44	36	160
30 × 45	30,8 × 49	36	160
30 × 50	30,8 × 54	42	160
30 × 55	30,8 × 59	46	160
30 × 70	30,8 × 74	58	80
35 × 45	35,8 × 49	53	144
35 × 50	35,8 × 54	59	144
40 × 50	40,8 × 54	76	96
40 × 55	40,8 × 59	83	96
40 × 70	40,8 × 74	103	48
40 × 100	40,8 × 104	153	48
40 × 105	40,8 × 109	160	48

1) Permissible range of positions for pole identification marks.



Overview of available types

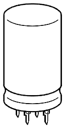
Type B 41 306

U_R (V–)	16	25	40	63	100
C_R (µF)	Case dimensions $d \times l$ (mm)				
470					25 × 40
1 000				25 × 40	30 × 40
2 200		25 × 30	30 × 40	30 × 40	35 × 50
4 700	25 × 30	30 × 40	30 × 40	35 × 50	40 × 70
10 000	30 × 40	30 × 50	30 × 50	40 × 70	
22 000	30 × 70	40 × 70			
47 000	40 × 70				

Type B 43 306

U_R (V–)	250	385	400	450	500
C_R (µF)	Case dimensions $d \times l$ (mm)				
33					25 × 35
47					30 × 35
68				30 × 35	30 × 40
100	25 × 40	30 × 40	30 × 35	30 × 40	30 × 55
150		30 × 40	30 × 35	30 × 45	35 × 50
220	30 × 40	30 × 40 30 × 50	30 × 45	30 × 55	40 × 50
330		35 × 45			40 × 70
470	30 × 50	40 × 70	40 × 50	40 × 55	40 × 100
1 000	40 × 70	40 × 100	40 × 100	40 × 105	

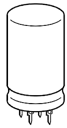
The capacitance and voltage ratings listed above are available in smaller cases upon request. Other capacitance and voltage ratings are also available upon request.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code [1)] Short code
B41306-								
16	4 700	25 × 30	48	95	81	5,5	1,9	-F4478-T
	10 000	30 × 40	34	63	54	7,5	2,6	-E4109-T
	22 000	30 × 70	24	41	36	11	3,7	-E4229-T
	47 000	40 × 70	17	30	27	15	5,0	-E4479-T
25	2 200	25 × 30	60	112	90	4,9	1,7	-F5228-T
	4 700	30 × 40	39	68	54	7,0	2,4	-E5478-T
	10 000	30 × 70	26	47	36	9,3	3,2	-E5109-T
	22 000	40 × 70	19	32	27	14	4,7	-E5229-T
40	2 200	30 × 40	48	86	72	6,4	2,2	-E7228-T
	4 700	30 × 40	30	54	45	8,1	2,8	-E7478-T
	10 000	30 × 50	20	36	31	12	3,2	-F7109-T
63	1 000	25 × 40	75	135	83	4,6	1,6	-E8108-T
	2 200	30 × 40	44	77	54	6,7	2,3	-E8228-T
	4 700	35 × 50	27	49	36	9,9	3,4	-E8478-T
	10 000	40 × 70	19	32	27	15	4,4	-F8109-T
100	470	25 × 40	110	234	108	3,8	1,3	-E9477-T
	1 000	30 × 40	67	126	63	5,2	1,8	-E9108-T
	2 200	35 × 50	38	72	40	8,4	2,9	-E9228-T
	4 700	40 × 70	24	45	27	12	4,2	-E9478-T
B43306-								
250	100	25 × 30	540	1350	1100	1,7	0,6	-E2107-T
	220	30 × 40	250	630	500	2,9	1,0	-E2227-T
	470	30 × 50	120	300	240	3,8	1,3	-F2477-T
	1 000	40 × 70	54	160	120	8,1	2,8	-E2108-T
385	100	30 × 40	470	1180	900	2,0	0,7	-E107-T
	150	30 × 40	320	800	600	2,3	0,8	-E157-T
	220	30 × 40	220	550	410	3,2	1,1	-G227-T
	220	30 × 50	220	550	410	3,2	1,1	-E227-T
	330	35 × 45	140	370	280	4,1	1,4	-E337-T
	470	40 × 70	100	250	190	5,8	2,0	-E477-T
	1 000	40 × 100	47	120	90	9,6	3,3	-E108-T

1) For instructions on how to determine ordering codes, refer to page 153.



Technical data and ordering codes

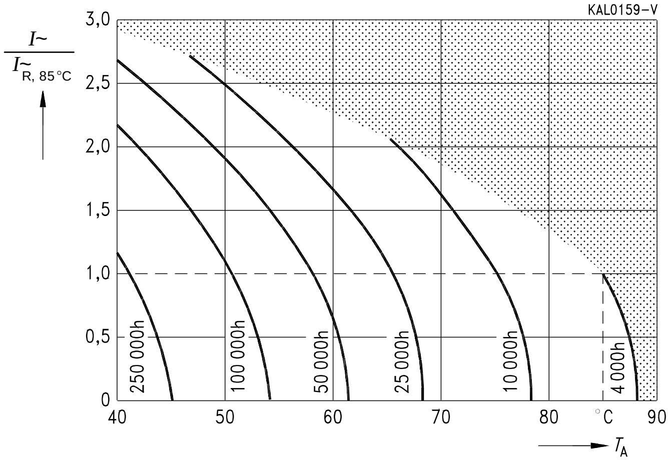
U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code 1) Short code
B43306-								
400	100	30 × 35	890	1500	1250	1,8	0,61	-F107-T
	150	30 × 35	590	980	820	2,2	0,75	-F157-T
	220	30 × 45	400	670	560	2,8	0,99	-F227-T
	470	40 × 50	190	320	270	5,1	1,8	-F477-T
	1 000	40 × 100	88	150	130	9,7	3,4	-F108-T
450	68	30 × 35	1400	3300	2750	1,5	0,50	-A5686-T
	100	30 × 40	960	2200	1830	1,9	0,64	-B5107-T
	150	30 × 45	640	1500	1250	2,4	0,82	-A5157-T
	220	30 × 55	440	1000	830	3,1	1,1	-B5227-T
	470	40 × 55	210	470	390	6,3	1,8	-A5477-T
	1 000	40 × 105	96	220	180	9,9	3,4	-A5108-T
500	33	25 × 35	2900	6500	5400	0,89	0,31	-A6336-T
	47	30 × 35	2100	4700	3900	1,2	0,40	-A6476-T
	68	30 × 40	1400	3300	2700	1,5	0,51	-A6686-T
	100	30 × 55	960	2200	1800	2,0	0,69	-A6107-T
	150	35 × 50	640	1500	1300	2,6	0,90	-A6157-T
	220	40 × 50	440	1000	830	3,3	1,1	-A6227-T
	330	40 × 70	290	650	540	4,6	1,6	-A6337-T
	470	40 × 100	210	470	390	6,4	2,2	-A6477-T

1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B43306-F107-T
B41306-... (U_R = 16 … 100 V–)
B43306-... (U_R = 250 … 500 V–)

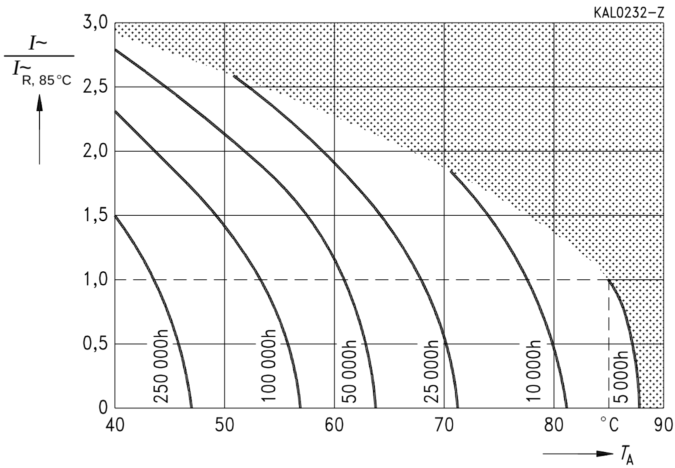
Useful life

versus ambient temperature T_A under ripple current operating conditions [1)]

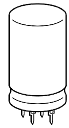
U_R = 16 … 100 V–



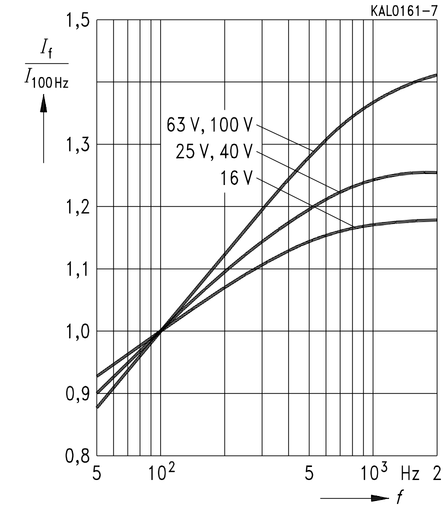
U_R = 250 … 500 V–



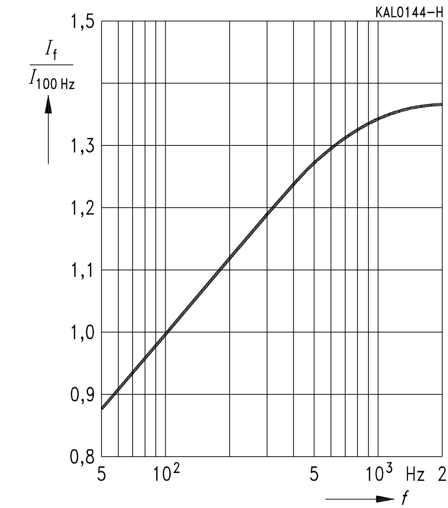
1) Refer to page 34 for an explanation on how to interpret the useful life graphs.



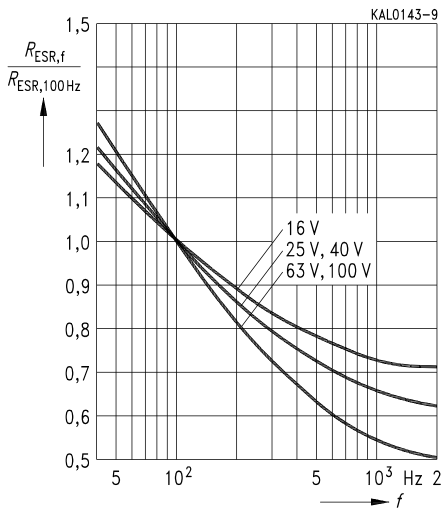
Permissible ripple current *I*~
versus frequency *f*
$U_R \leq 100$ V–



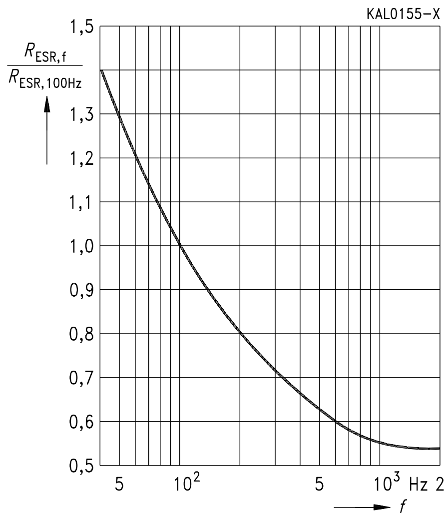
Permissible ripple current *I*~
versus frequency *f*
$U_R \geq 250$ V–



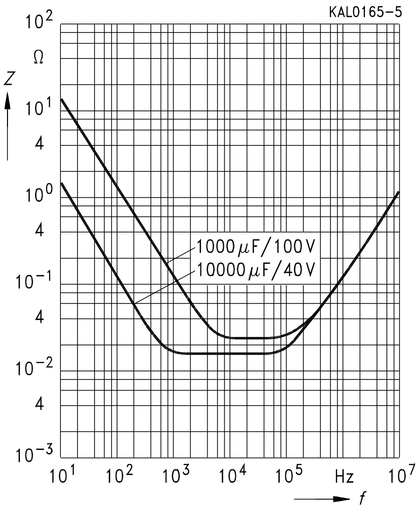
Equivalent series resistance R_{ESR}
versus frequency *f*
Typical behavior
$U_R \leq 100$ V–



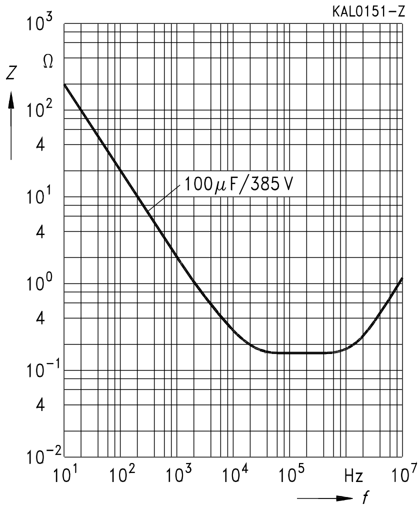
Equivalent series resistance R_{ESR}
versus frequency *f*
Typical behavior
$U_R \geq 250$ V–



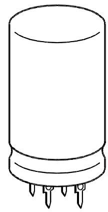
Impedance *Z*
versus frequency *f*
Typical behavior
$U_R \leq 100$ V–



Impedance *Z*
versus frequency *f*
Typical behavior
$U_R \geq 250$ V–



Especially high volumetric efficiency



KAL0273-2

Construction

- Charge-discharge proof, polar
- Aluminum case, fully insulated
- Overload protection by preset break point in case
- Solder pin mounting on printed circuit boards, pins fit standardized spacings on PCB
- Negative pole brought out to solder pin, but not insulated from case

Features

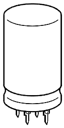
- High reliability and high ripple current capability
- Extremely small dimensions, i.e. especially high volumetric efficiency
- Low equivalent series resistance and low self-inductance
- Pinning ensures correct insertion

Applications

- For switch-mode power supplies in industrial and consumer electronics
- For professional, long-life switch-mode power supplies

Specifications and characteristics in brief

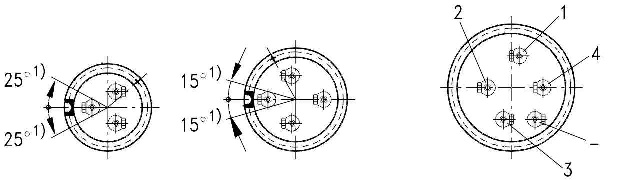
	B 41 507		B 43 507
Rated voltage U_R	10 … 100 V–		200 … 450 V–
Surge voltage U_S	1,15 · U_R		1,15 · U_R (for $U_R \leq$ 200 V–) 1,10 · U_R (for $U_R \geq$ 385 V–)
Rated capacitance C_R	1 000 … 100 000 µF		68 … 2 200 µF
Capacitance tolerance	± 20 % ≙ M		± 20 % ≙ M
Useful life	≤ 63 V–	100 V–	
40 °C, U_R	> 200 000 h (1,6 · $I_{\sim R,85°C}$)	> 200 000 h ($I_{\sim R,85°C}$)	> 200 000 h (1,7 · $I_{\sim R,85°C}$)
85 °C, U_R; $I_{\sim R}$	> 10 000 h	> 5 000 h	> 8 000 h
Failure percentage	≤ 1 % (during useful life)		≤ 1 % (during useful life)
Failure rate	≤ 40 fit (≤ 40 · 10^{-9}/h)		≤ 40 fit (≤ 40 · 10^{-9}/h)
Voltage endurance test	3 000 h, 85 °C (at U_R)		3 000 h, 85 °C (at U_R)



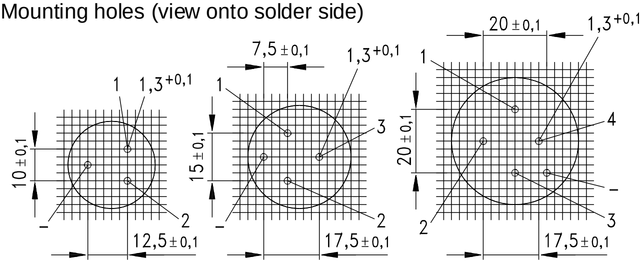
Specifications and characteristics in brief

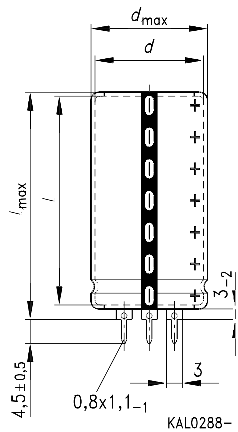
	B 41 507	B 43 507
Leakage current I_{lka} (5 min, 20 °C)	$1\,000\ \mu C \le C_R \cdot U_R < 470\,000\ \mu C$: $I_{lka} \le 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$ $C_R \cdot U_R \ge 470\,000\ \mu C$: $I_{lka} \le 0{,}3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)^{0,7} + 4\ \mu A$	
Self-inductance L_{ESL}	approx. 10 nH	
IEC climatic category	in accordance with IEC 68–1 ≤ 385 V–: 40/085/56 (–40 °C/+85 °C, 56 days damp heat test) ≥ 400 V–: 25/085/56 (–25 °C/+85 °C, 56 days damp heat test)	
Detail specifications	similar to CECC 30 301-805 (or CECC 30 301-057) (similar to DIN 45 910 part 1213)	
Sectional specifications	IEC 384–4 (DIN 45 910 part 12)	
Vibration resistance	in accordance with IEC 68–2–6, test Fc: frequency range 10 … 55 Hz, duration 3 × 2 h for d = 25 mm: displacement amplitude 0,75 mm, acceleration max. 10 g for $d \ge$ 30 mm: displacement amplitude 0,35 mm, acceleration max. 5 g	

d = 25 mm   *d* = 30 and 35 mm   *d* = 40 mm



Mounting holes (view onto solder side)





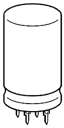
Pole markings: Plus: 1; Minus: –

No plus and minus pole markings on the shrunk-on insulating sleeve for *d* = 35 and 40 mm.

All pin holes must be drilled into the PC-board, since the unconnected pins serve as mountings. These pins must be soldered to isolated pads or pads with the same potential as the negative pole.

Dimensions (mm) *d* × *l*	$d_{max} \times l_{max}$	Approximate weight (g)	Packing units (Pieces)
25 × 30	25,8 × 34	22	384
25 × 35	25,8 × 39	22	256
25 × 40	25,8 × 44	29	256
30 × 35	30,8 × 39	32	240
30 × 40	30,8 × 44	36	160
30 × 45	30,8 × 49	36	160
30 × 50	30,8 × 54	42	160
35 × 40	35,8 × 44	48	144
35 × 50	35,8 × 54	59	144
40 × 50	40,8 × 54	76	96
40 × 70	40,8 × 74	103	48
40 × 100	40,8 × 104	153	48
40 × 105	40,8 × 109	160	48

1) Permissible range of positions for pole identification marks



B 41 507
B 43 507

Overview of available types

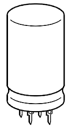
Type B 41 507

U_R (V–)	10	16	25	40	63	100
C_R (µF)	Case dimensions $d \times l$ (mm)					
1 000						25 × 40
2 200					25 × 35	30 × 40 35 × 40
4 700			25 × 30	25 × 40	30 × 45	40 × 50
10 000	25 × 30	25 × 40	30 × 40	30 × 50 35 × 40	35 × 50	40 × 100
22 000	30 × 40	30 × 50 35 × 40	35 × 50	40 × 50	40 × 100	
47 000	35 × 50	40 × 50	40 × 70	40 × 100		
100 000	40 × 70	40 × 100				

Type B 43 507

U_R (V–)	200	385	400	450
C_R (µF)	Case dimensions $d \times l$ (mm)			
68				30 × 35
100		25 × 40	30 × 35	30 × 40
150		30 × 40	30 × 35	30 × 45
220	25 × 40	30 × 40 35 × 40	30 × 45	30 × 50
470	30 × 40 35 × 40	40 × 50	40 × 50	40 × 50
680	35 × 50	40 × 70	40 × 70	40 × 70
1 000	40 × 50	40 × 100	40 × 100	40 × 105
2 200	40 × 100			

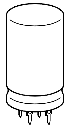
The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	$I_{\sim max}$ 100 Hz 85 °C A	Ordering code 1) Short code
B41507-									
10	10 000	25 × 30	46	98	81	6,5	2,5	4,0	-B3109-M
	22 000	30 × 40	30	51	46	9,4	3,6	5,8	-B3229-M
	47 000	35 × 50	20	35	32	13	5,1	8,2	-B3479-M
	100 000	40 × 70	17	34	21	17	6,4	10	-B3100-M
16	10 000	25 × 40	36	62	56	7,8	3,0	4,8	-B4109-M
	22 000	30 × 50	24	44	42	12	4,6	7,4	-J4229-M
	22 000	35 × 40	24	44	42	12	4,6	7,4	-B4229-M
	47 000	40 × 50	17	35	28	15	5,8	9,3	-B4479-M
	100 000	40 × 100	13	20	16	22	8,4	13	-B4100-M
25	4 700	25 × 30	46	87	84	6,5	2,5	4,0	-B5478-M
	10 000	30 × 40	28	48	46	9,6	3,7	5,9	-B5109-M
	22 000	35 × 50	20	33	32	13	5,1	8,2	-B5229-M
	47 000	40 × 70	14	24	23	18	7,0	11	-B5479-M
40	4 700	25 × 40	36	60	59	7,8	3,0	4,8	-B7478-M
	10 000	30 × 50	24	42	41	12	4,6	7,4	-J7109-M
	10 000	35 × 40	24	42	41	12	4,6	7,4	-B7109-M
	22 000	40 × 50	18	35	34	15	5,6	9,0	-B7229-M
	47 000	40 × 100	13	20	19	22	8,4	13	-B7479-M
63	2 200	25 × 35	45	87	84	6,5	2,5	4,0	-A8228-M
	4 700	30 × 45	30	50	49	9,4	3,6	5,8	-A8478-M
	10 000	35 × 50	20	36	33	13	5,1	8,2	-B8109-M
	22 000	40 × 100	13	20	18	22	8,4	13	-B8229-M
100	1 000	25 × 40	58	110	88	7,2	2,4	3,3	-B9108-M
	2 200	30 × 40	31	60	48	12	4,1	5,3	-J9228-M
	2 200	35 × 40	31	60	48	12	4,1	5,3	-B9228-M
	4 700	40 × 50	20	36	31	16	5,3	7,6	-B9478-M
	10 000	40 × 100	13	25	22	24	8,1	12	-B9109-M

1) For instructions on how to determine ordering codes, refer to page 162.



Technical data and ordering codes

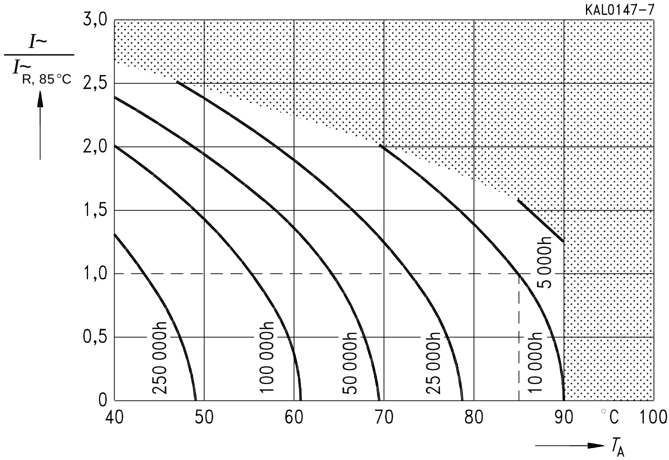
U_R V–	C_R μF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	$I_{\sim max}$ 100 Hz 85 °C A	Ordering code 1) Short code
B43507-									
200	220	25 × 40	300	660	530	2,7	0,9	1,2	-C227-M
	470	30 × 40	140	310	250	5,4	1,8	2,3	-K477-M
	470	35 × 40	140	310	250	5,4	1,8	2,3	-C477-M
	680	35 × 50	100	220	180	6,0	2,0	2,6	-C687-M
	1 000	40 × 50	66	150	120	7,5	2,5	3,3	-C108-M
	2 200	40 × 100	30	75	60	12	4,1	5,3	-C228-M
385	100	25 × 40	480	890	750	1,8	0,6	0,8	-F107-M
	150	30 × 40	320	600	500	2,4	0,8	1,0	-F157-M
	220	30 × 40	220	410	350	3,6	1,2	1,6	-G227-M
	220	35 × 40	220	410	350	3,6	1,2	1,6	-F227-M
	470	40 × 50	100	200	170	5,4	1,8	2,3	-F477-M
	680	40 × 70	77	140	120	6,9	2,3	3,0	-F687-M
	1 000	40 × 100	55	100	88	9,0	3,0	3,9	-F108-M
400	100	30 × 35	1000	1700	1420	1,7	0,60	0,60	-J107-M
	150	30 × 35	670	1100	920	2,1	0,72	0,72	-J157-M
	220	30 × 45	450	750	630	2,8	0,95	0,95	-J227-M
	470	40 × 50	210	350	290	4,9	1,7	1,7	-J477-M
	680	40 × 70	150	250	210	6,6	2,3	2,3	-J687-M
	1 000	40 × 100	100	170	140	9,3	3,2	3,2	-J108-M
450	68	30 × 35	1600	3700	3080	1,4	0,50	0,50	-A5686-M
	100	30 × 40	1100	2500	2080	1,8	0,61	0,61	-A5107-M
	150	30 × 45	720	1700	1420	2,3	0,78	0,78	-A5157-M
	220	30 × 50	490	1200	1000	2,9	0,99	0,99	-A5227-M
	470	40 × 50	230	530	440	4,9	1,7	1,7	-A5477-M
	680	40 × 70	160	370	310	6,6	2,3	2,3	-A5687-M
	1 000	40 × 105	110	250	210	9,5	3,3	3,3	-A5108-M

1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B43507-C227-M
B41507-... (U_R = 10 … 100 V–)
B43507-... (U_R = 200 … 450 V–)

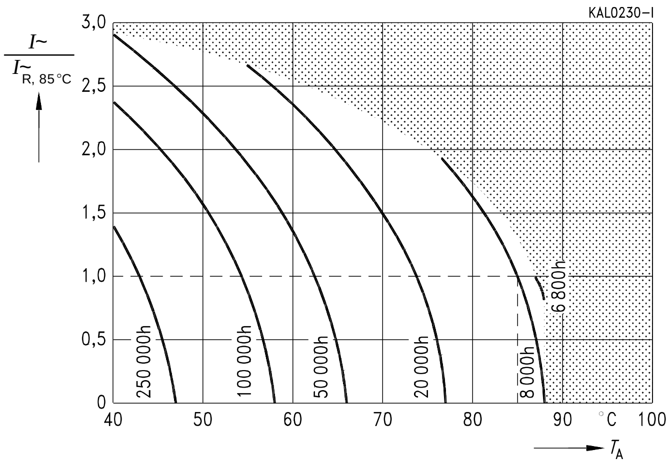
Useful life

versus ambient temperature T_A under ripple current operating conditions [1)]

$U_R \leq 63$ V–

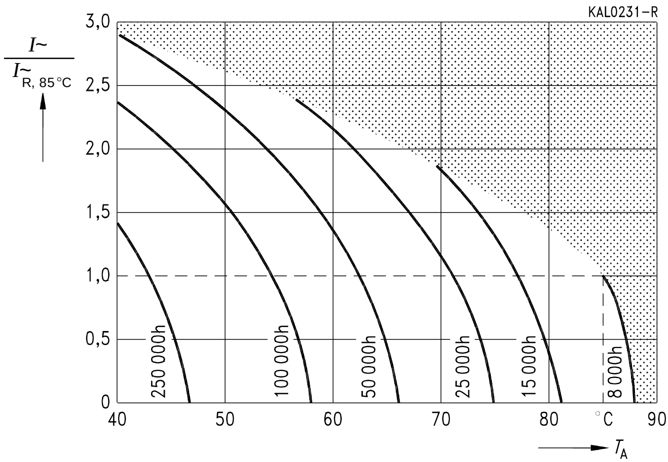


U_R = 100 V– … 385 V–

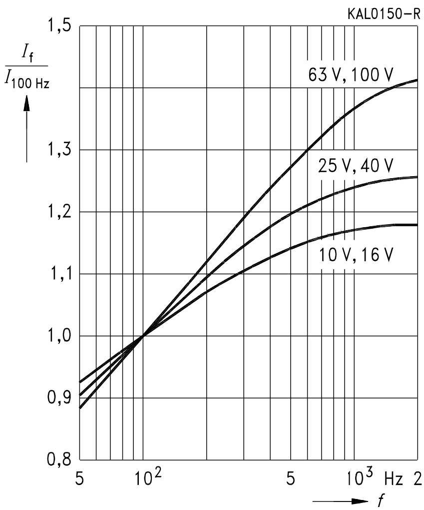


1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

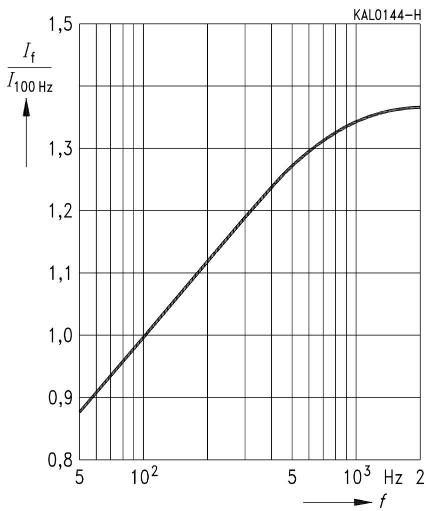
Useful life
versus ambient temperature T_A under ripple current operating conditions [1)]
U_R = 400 and 450 V–



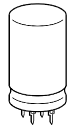
Permissible ripple current *I*~
versus frequency *f*
$U_R \leq$ 100 V–



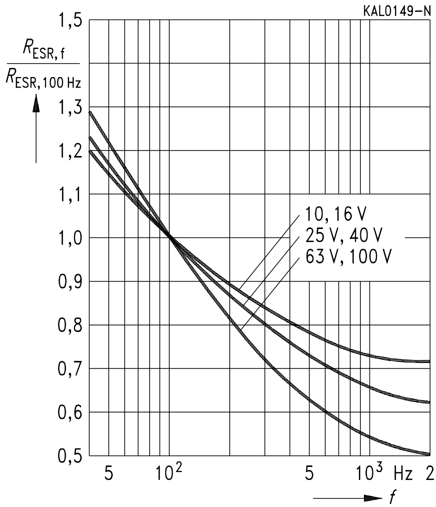
Permissible ripple current *I*~
versus frequency *f*
$U_R \geq$ 200 V–



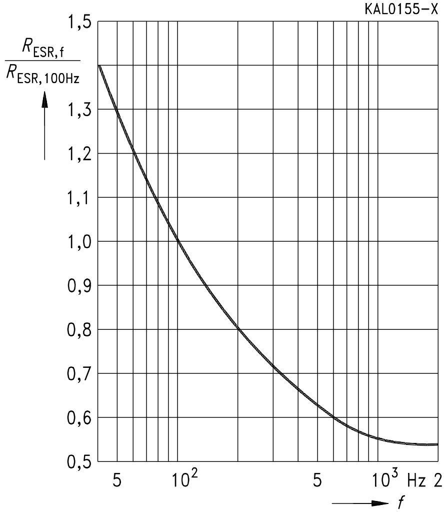
1) Refer to page 34 for an explanation on how to interpret the useful life graphs.



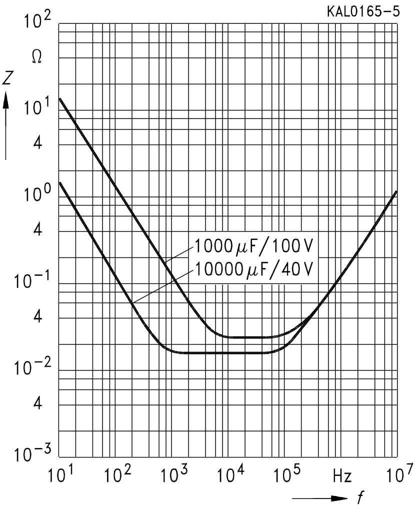
Equivalent series resistance R_{ESR}
versus frequency f
Typical behavior
$U_R \leq 100$ V–



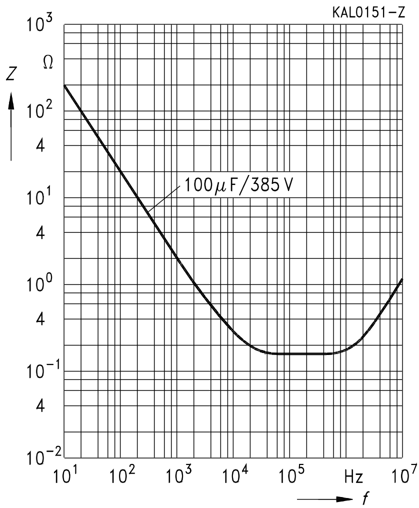
Equivalent series resistance R_{ESR}
versus frequency f
Typical behavior
$U_R \geq 200$ V–



Impedance Z
versus frequency f
Typical behavior
$U_R \leq 100$ V–



Impedance Z
versus frequency f
Typical behavior
$U_R \geq 200$ V–

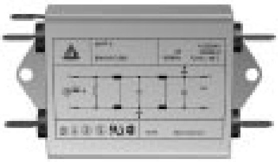


Siemens Matsushita Components

Siemens filters from stock

Ready, steady, go

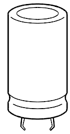
SCS has 100,000 SIFI filters in stock, ready to go as soon as your order arrives. We offer a big selection through all the many variants, ie



building-block system, different attenuation characteristics and packages, various kinds of leads and current ratings from 1 through 20 A.

SCS – dependable, fast and competent

Snap-In Capacitors



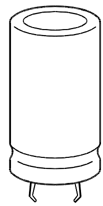
Overview

Quality grade	Type	U_R V–	C_R µF	Temperature °C	Special features and fields of application	Page
GP	B 41 303 B 43 303	10 … 100 200 … 550	680 … 47 000 15 … 1 500	– 40 … + 85 – 25 … + 85	High ripple current capability For switch-mode power supplies in industrial and entertainment electronics	168
LL	B 43 501	160 … 450	47 … 2 200	≤ 400 V–: – 40 … + 85 450 V–: – 25 … + 85	High ripple current capability High CU product, i.e. extremely compact Low equivalent series resistance For switch-mode power supplies in industrial and entertainment electronics	180
LL	B 43 502	200 … 450	47 … 1 500	– 40 … + 85	Long useful life For professional switch-mode power supplies in industrial and data processing electronics, as well as for entertainment electronics	187
LL	B 41 503 B 43 503	10… 100 200 … 500	470 … 33 000 15 … 1 500	– 40 … + 105 – 25 … + 105	High reliability High ripple current capability and small dimensions For professional switch-mode power supplies in industrial and data processing electronics	195
Packing						206

ICOTRON — Siemens Brazil

Snap-in capacitors with Ø 35 mm are manufactured by Icotron, Brazil.

Icotron is a subsidiary of Siemens AG, Passive Components and Electron Tubes Group, and has ISO 9001 qualification.



KAL0274-A

For universal application

Construction

- Charge-discharge proof, polar
- Aluminum case, fully insulated
- Snap-in solder pins to hold component in place on PC-board
- Minus pole marking on case surface
- Minus pole not insulated from case
- All-welded construction
- Standard 10 mm lead spacing

Features

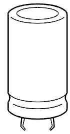
- High ripple current capability
- High *CU* product, i. e. extremely compact
- Different case sizes available for each capacitance value

Applications

- Switch-mode power supplies in industrial and entertainment electronics

Specifications and characteristics in brief

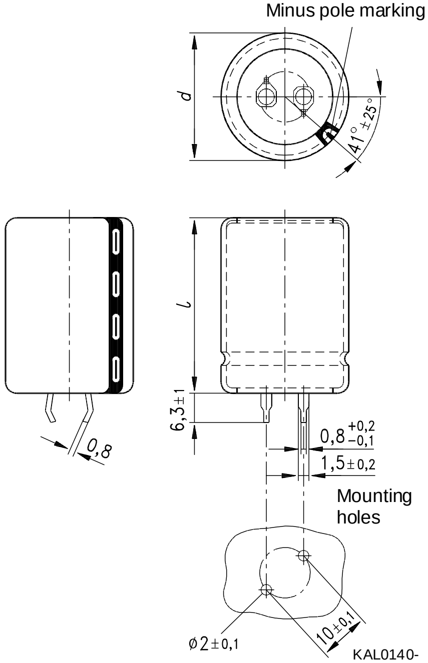
	B 41 303	B 43 303
Rated voltage U_R Surge voltage U_S	10 … 100 V– $1{,}15 \cdot U_R$	200 … 550 V– $1{,}15 \cdot U_R$ (for $U_R \leq 250$ V–) $1{,}10 \cdot U_R$ (for $U_R \geq 385$ V–)
Rated capacitance C_R Capacitance tolerance	680 … 47 000 µF ± 20 % ≙ M	15 … 1 500 µF ± 20 % ≙ M
Useful life 40 °C, U_R 85 °C, U_R; $I_{\sim R}$	 > 100 000 h ($1{,}3 \cdot I_{\sim R,85°C}$) > 2 000 h	 > 100 000 h ($1{,}3 \cdot I_{\sim R,85°C}$) > 2 000 h
Failure percentage	≤ 1 % (during useful life)	≤ 1 % (during useful life)
Failure rate	≤ 100 fit ($\leq 100 \cdot 10^{-9}$/h)	≤ 100 fit ($\leq 100 \cdot 10^{-9}$/h)
Voltage endurance test	2 000 h, 85 °C (at U_R)	2 000 h, 85 °C (at U_R)
Leakage current I_{lka} (5 min, 20 °C)	$I_{lka} \leq 0{,}3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)^{0{,}7} + 4\ \mu A$	
Self-inductance L_{ESL}	approx. 20 nH	



Specifications and characteristics in brief

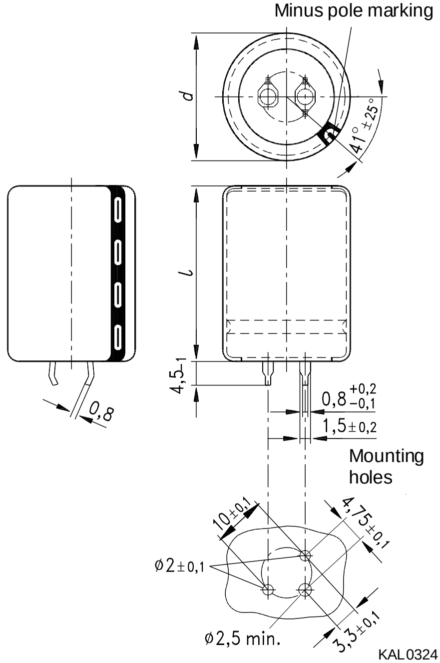
	B 41 303	B 43 303
IEC climatic category	in accordance with IEC 68–1	
	40/085/56 (–40 °C/+85 °C, 56 days damp heat test)	25/085/56 (–25 °C/+85 °C, 56 days damp heat test)
Detail specification	similar to CECC 30 301-806	
Sectional specifications	IEC 384–4 (DIN 45 910 part 12)	
Vibration resistance	in accordance with IEC 68–2–6, test Fc: displacement amplitude 0,35 mm, frequency range 10 … 55 Hz, acceleration max. 5 *g*, duration 3 × 2 h	

Outline drawings



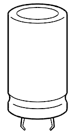
Snap-in claws, standard (length 6,3 ± 1 mm). Also available in a shorter version with a length of 4,5 – 1 mm. For packing modes and ordering example see page 206.

Dimensions (mm) $d + 1$	$l \pm 2$	Approx. weight (g)	Packing units (pieces)
22	25	9	384
22	30	12	384
22	35	15	384
22	40	18	256
22	45	20	256
25	25	13	384
25	30	17	384
25	35	19	384
25	40	22	256
25	45	25	256
30	25	17	240



Snap-in capacitors are also available with 3 claws.
For packing modes and ordering example see page 206.

Dimensions (mm) $d + 1$	$l \pm 2$	Approx. weight (g)	Packing units (pieces)
30	30	23	240
30	35	29	240
30	40	36	240
30	45	41	160
30	50	46	160
35	20	19	100
35	40	44	100
35	45	52	100
35	50	59	100
35	55	66	100

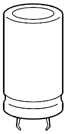


Overview of available types

Type B 41 303

U_R (V–)	10	16	25	40	63	100
C_R (μF)	Case dimensions $d \times l$ (mm)					
680						22 × 30 25 × 25
1 000						22 × 35 25 × 30
1 500					22 × 30 25 × 25	25 × 35 30 × 30
2 200					22 × 35 25 × 30	30 × 35
3 300				22 × 30 25 × 25	25 × 35 30 × 30	30 × 45
4 700			22 × 30 25 × 25	22 × 35 25 × 30	30 × 35	
6 800		22 × 30 25 × 25	22 × 35 25 × 30	25 × 40 30 × 30	30 × 45	
10 000	22 × 30 25 × 25	22 × 35 25 × 30	25 × 35 30 × 30	30 × 35		
15 000	22 × 35 25 × 30	25 × 40 30 × 30	30 × 35	30 × 50		
22 000	25 × 40 30 × 30	30 × 35	30 × 45			
33 000	30 × 35	30 × 45				
47 000	30 × 45					

The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.

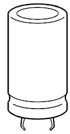


Overview of available types

Type B 43 303

U_R (V–)	200	250	385	400	450	500	550
C_R (µF)	Case dimensions $d \times l$ (mm)						
15							22 × 25
22						22 × 25	22 × 30
33						22 × 30	22 × 40 25 × 30
47						22 × 40	25 × 40
68			22 × 25	22 × 30	22 × 35	25 × 40	30 × 40
100			22 × 30 25 × 25	22 × 35 25 × 30	25 × 40 35 × 20	30 × 40	30 × 50
150		22 × 25	22 × 40 25 × 30	22 × 45 25 × 35 35 × 20	30 × 35	30 × 50	
220	22 × 25	22 × 30 25 × 25	25 × 40 30 × 35	25 × 45 30 × 35	30 × 50		
330	22 × 30 25 × 25	22 × 40 25 × 35	30 × 45	30 × 45	35 × 40		
390				35 × 40	35 × 45		
470	22 × 40 30 × 25	25 × 40 30 × 30	35 × 40	35 × 45	35 × 50		
560			35 × 45	35 × 50			
680	25 × 40 30 × 35	30 × 40		35 × 55			
1 000	30 × 45 35 × 40	35 × 45					
1 200	35 × 45	35 × 50					
1 500	35 × 50						

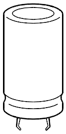
The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR,\ typ}$ 100 Hz 20 °C mΩ	$R_{ESR,\ max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code [1) Short code
B41303-								
10	10 000	22 × 30	44	66	59	4,7	1,8	-A3109-M
	10 000	25 × 25	44	66	59	4,7	1,8	-J3109-M
	15 000	22 × 35	36	54	49	5,6	2,2	-B3159-M
	15 000	25 × 30	36	54	49	5,6	2,2	-J3159-M
	22 000	25 × 40	31	46	43	6,7	2,6	-A3229-M
	22 000	30 × 30	31	46	43	6,7	2,6	-J3229-M
	33 000	30 × 35	27	41	39	7,3	2,8	-B3339-M
	47 000	30 × 45	25	38	36	8,3	3,2	-B3479-M
16	6 800	22 × 30	47	71	59	4,5	1,8	-A4688-M
	6 800	25 × 25	47	71	59	4,5	1,8	-J4688-M
	10 000	22 × 35	39	58	52	5,2	2,0	-B4109-M
	10 000	25 × 30	39	58	52	5,2	2,0	-J4109-M
	15 000	25 × 40	32	49	45	6,4	2,5	-A4159-M
	15 000	30 × 30	32	49	45	6,4	2,5	-J4159-M
	22 000	30 × 35	28	43	40	7,3	2,8	-B4229-M
	33 000	30 × 45	26	39	37	8,1	3,1	-B4339-M
25	4 700	22 × 30	51	77	67	4,4	1,7	-A5478-M
	4 700	25 × 25	51	77	67	4,4	1,7	-J5478-M
	6 800	22 × 35	42	62	56	4,9	1,9	-B5688-M
	6 800	25 × 30	42	62	56	4,9	1,9	-J5688-M
	10 000	25 × 35	35	52	48	5,5	2,3	-B5109-M
	10 000	30 × 30	35	52	48	5,5	2,3	-J5109-M
	15 000	30 × 35	30	45	42	7,0	2,7	-B5159-M
	22 000	30 × 45	27	40	38	8,1	3,1	-B5229-M
40	3 300	22 × 30	54	77	71	4,4	1,7	-A7338-M
	3 300	25 × 25	54	77	71	4,4	1,7	-J7338-M
	4 700	22 × 35	44	66	59	4,9	1,9	-B7478-M
	4 700	25 × 30	44	66	59	4,9	1,9	-J7478-M
	6 800	25 × 40	37	55	50	6,1	2,4	-A7688-M
	6 800	30 × 30	37	55	50	6,1	2,4	-J7688-M
	10 000	30 × 35	31	47	44	6,8	2,6	-B7109-M
	15 000	30 × 50	28	41	39	8,4	3,3	-A7159-M

1) For instructions on how to determine ordering codes, refer to page 176.

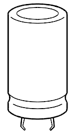


B 41 303
B 43 303

Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR,\,typ}$ 100 Hz 20 °C mΩ	$R_{ESR,\,max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code [1)] Short code
B41303-								
63	1 500	22 × 30	78	120	100	3,5	1,4	-A8158-M
	1 500	25 × 25	78	120	100	3,5	1,4	-J8158-M
	2 200	22 × 35	59	89	77	4,2	1,6	-B8228-M
	2 200	25 × 30	59	89	77	4,2	1,6	-J8228-M
	3 300	25 × 35	46	69	62	5,2	2,0	-B8338-M
	3 300	30 × 30	46	69	62	5,2	2,0	-J8338-M
	4 700	30 × 35	38	58	52	6,2	2,4	-B8478-M
	6 800	30 × 45	33	49	45	7,3	2,8	-B8688-M
100	680	22 × 30	120	180	150	2,9	1,1	-A9687-M
	680	25 × 25	120	180	150	2,9	1,1	-J9687-M
	1 000	22 × 35	87	130	110	3,4	1,3	-B9108-M
	1 000	25 × 30	87	130	110	3,4	1,3	-J9108-M
	1 500	25 × 35	64	97	83	4,4	1,7	-B9158-M
	1 500	30 × 30	64	97	83	4,4	1,7	-J9158-M
	2 200	30 × 35	50	75	66	5,5	2,1	-B9228-M
	3 300	30 × 45	40	60	54	6,5	2,5	-B9338-M
B43303-								
200	220	22 × 25	610	920	740	1,7	0,77	-D227-M
	330	22 × 30	410	620	500	2,2	1,0	-D337-M
	330	25 × 25	410	620	500	2,3	1,0	-M337-M
	470	22 × 40	290	440	360	2,9	1,3	-D477-M
	470	30 × 25	290	440	360	3,0	1,3	-M477-M
	680	25 × 40	200	300	240	3,8	1,7	-D687-M
	680	30 × 35	200	300	240	4,0	1,8	-M687-M
	1 000	30 × 45	140	210	170	5,3	2,4	-D108-M
	1 000	35 × 40	90	160	120	4,8	2,2	-A108-M90
	1 200	35 × 45	100	170	100	5,5	2,5	-A128-M90
	1 500	35 × 50	130	200	90	6,0	2,7	-A158-M90

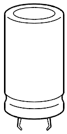
1) For instructions on how to determine ordering codes, refer to page 176.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR,\ typ}$ 100 Hz 20 °C mΩ	$R_{ESR,\ max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code [1] Short code
B43303-								
250	150	22 × 25	890	1400	1200	1,4	0,63	-C2157-M
	220	22 × 30	610	920	740	1,8	0,82	-C2227-M
	220	25 × 25	610	920	740	1,8	0,84	-L2227-M
	330	22 × 40	410	620	500	2,5	1,1	-C2337-M
	330	25 × 35	410	620	500	2,5	1,2	-L2337-M
	470	25 × 40	290	440	360	3,2	1,4	-C2477-M
	470	30 × 30	290	440	360	3,1	1,4	-L2477-M
	680	30 × 40	200	300	240	4,2	1,9	-C2687-M
	1 000	35 × 45	90	160	120	5,0	2,3	-A2108-M90
	1 200	35 × 50	100	170	100	5,7	2,6	-A2128-M90
385	68	22 × 25	1800	2700	2200	1,0	0,45	-H686-M
	100	22 × 30	1200	1800	1500	1,3	0,58	-H107-M
	100	25 × 25	1200	1800	1500	1,3	0,59	-R107-M
	150	22 × 40	780	1200	940	1,7	0,79	-H157-M
	150	25 × 30	780	1200	940	1,7	0,77	-R157-M
	220	25 × 40	530	800	640	2,3	1,0	-H227-M
	220	30 × 35	530	800	640	2,4	1,1	-P227-M
	330	30 × 45	360	540	440	3,2	1,4	-H337-M
	470	35 × 40	370	630	300	3,7	1,7	-A477-M90
	560	35 × 45	350	530	270	4,2	1,9	-A567-M90
400	68	22 × 30	1500	2400	2000	1,0	0,48	-G686-M
	100	22 × 35	1000	1600	1420	1,3	0,61	-G107-M
	100	25 × 30	1000	1600	1420	1,4	0,63	-Q107-M
	150	22 × 45	670	1100	920	1,8	0,82	-G157-M
	150	25 × 35	670	1100	920	1,8	0,81	-Q157-M
	150	35 × 20	670	1100	920	1,7	0,77	-A157-M90
	220	25 × 45	450	700	630	2,4	1,1	-G227-M
	220	30 × 35	450	700	630	2,4	1,1	-Q227-M
	330	30 × 45	300	450	420	3,2	1,4	-G337-M
	390	35 × 40	450	770	360	3,4	1,5	-A397-M90
	470	35 × 45	370	630	300	3,9	1,8	-F477-M90
	560	35 × 50	310	530	250	4,4	2,0	-F567-M90
	680	35 × 55	260	440	200	5,0	2,3	-A687-M90

1) For instructions on how to determine ordering codes, refer to page 176.



Technical data and ordering codes

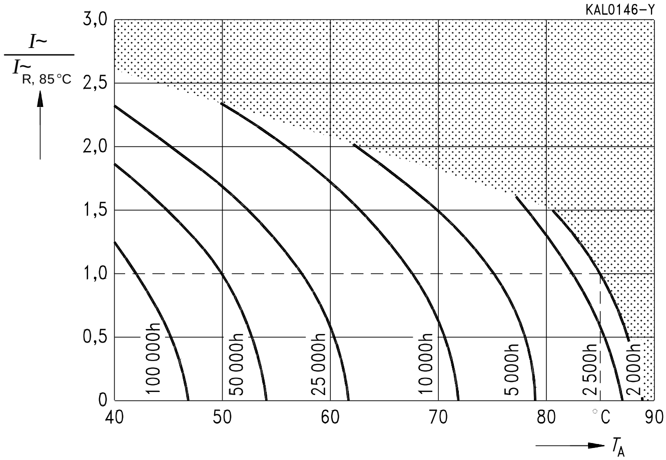
U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code 1) Short code
B43303-								
450	68	22 × 35	1590	3700	3080	1,1	0,50	-A5686-M
	100	25 × 40	1080	2500	2080	1,5	0,70	-A5107-M
	100	35 × 20	1100	2500	2080	1,4	0,63	-A5107-M90
	150	30 × 35	720	1700	1420	1,9	0,88	-A5157-M
	220	30 × 50	490	1200	1000	2,7	1,2	-A5227-M
	330	35 × 40	560	900	630	3,1	1,4	-A5337-M90
	390	35 × 45	500	770	540	3,5	1,6	-A5397-M90
	470	35 × 50	420	630	450	4,1	1,8	-A5477-M90
500	22	22 × 25	6100	9200	7700	0,52	0,24	-A6226-M
	33	22 × 30	4100	6200	5200	0,68	0,31	-A6336-M
	47	22 × 40	2900	4400	3700	0,91	0,41	-A6476-M
	68	25 × 40	2000	3000	2500	1,2	0,54	-A6686-M
	100	30 × 40	1400	2100	1800	1,6	0,71	-A6107-M
	150	30 × 50	890	1400	1200	2,1	0,94	-A6157-M
550	15	22 × 25	8900	14000	12000	0,43	0,20	-A7156-M
	22	22 × 30	6100	9200	7700	0,56	0,25	-A7226-M
	33	22 × 40	4100	6200	5200	0,76	0,35	-A7336-M
	33	25 × 30	4100	6200	5200	0,74	0,34	-J7336-M
	47	25 × 40	2900	4400	3700	0,98	0,45	-A7476-M
	68	30 × 40	2000	3000	2500	1,3	0,58	-A7686-M
	100	30 × 50	1400	2100	1800	1,7	0,77	-A7107-M

1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B43303-A5686-M
B41303-... (U_R = 10 … 100 V–)
B43303-... (U_R = 200 … 550 V–)

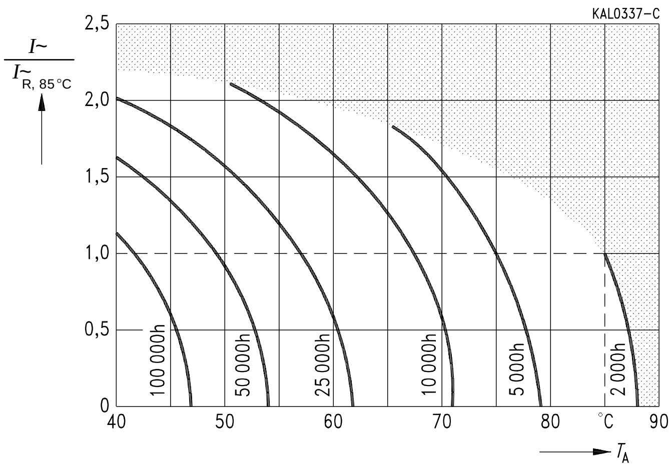
Useful life

versus ambient temperature T_A under ripple current operating conditions [1)]

$U_R \leq 100$ V–

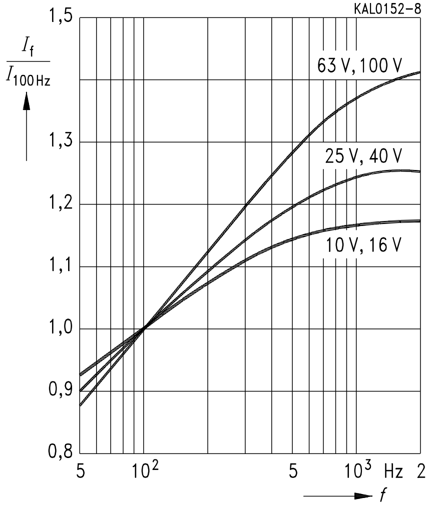


$U_R \geq 200$ V–

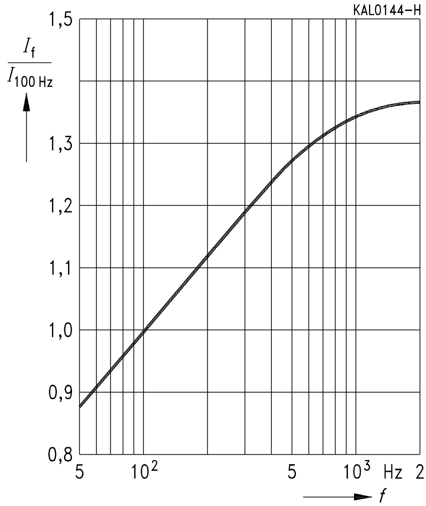


1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

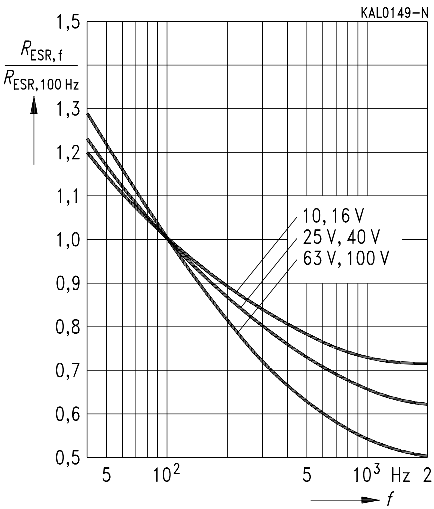
Permissible ripple current *I~*
versus frequency *f*
$U_R \leq 100$ V–



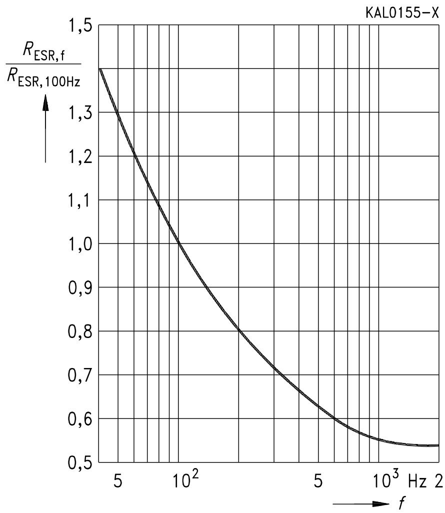
Permissible ripple current *I~*
versus frequency *f*
$U_R \geq 200$ V–

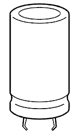


Equivalent series resistance R_{ESR}
versus frequency *f*
Typical behavior
$U_R \leq 100$ V–

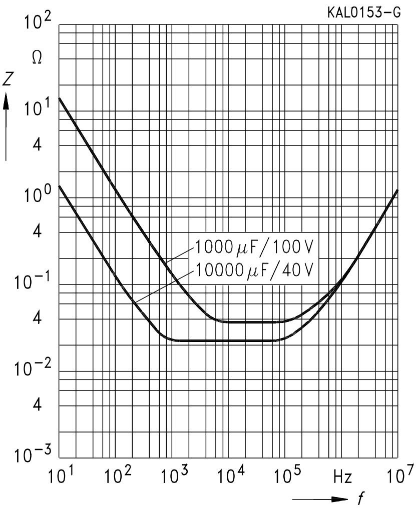


Equivalent series resistance R_{ESR}
versus frequency *f*
Typical behavior
$U_R \geq 200$ V–

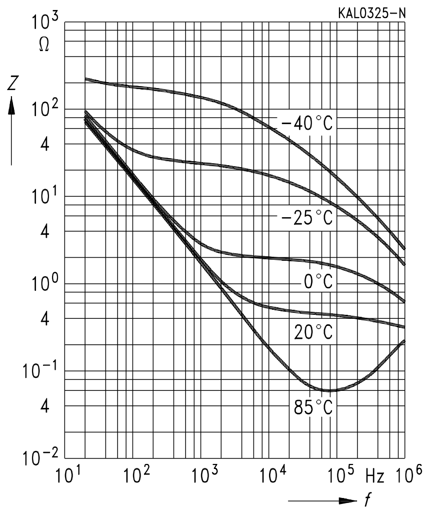




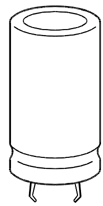
Impedance *Z*
versus frequency *f*
Typical behavior
$U_R \leq 100$ V–



Impedance *Z*
versus frequency *f*
and temperature *T* for 100 µF/400 V–
Typical behavior



For universal application


KAL0274-A

Construction

- Charge-discharge proof, polar
- Aluminum case, fully insulated
- Snap-in solder pins to hold component in place on PC-board
- Minus pole marking on case surface
- Minus pole not insulated from case
- All-welded construction
- Standard 10 mm lead spacing

Features

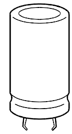
- High reliability and high ripple current capability
- Low equivalent series resistance R_{ESR}
- High *CU* product, i. e. extremely compact
- Different case sizes available for each capacitance value

Applications

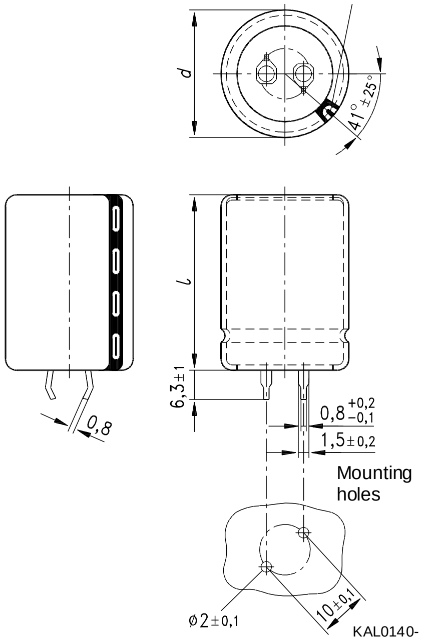
- Switch-mode power supplies in industrial and entertainment electronics

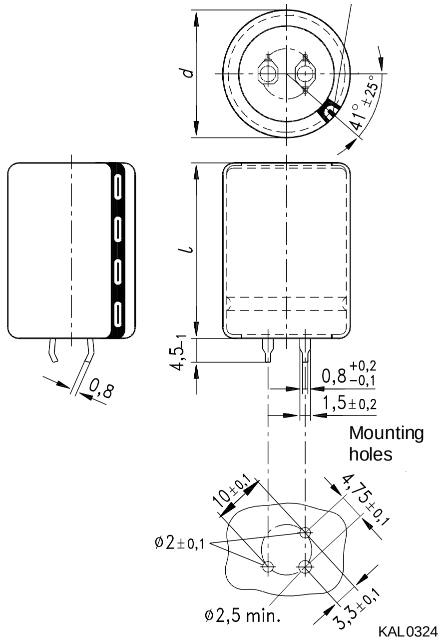
Specifications and characteristics in brief

Rated voltage U_R	160 … 450 V–
Surge voltage U_S	1,15 · U_R (for $U_R \leq$ 250 V–) 1,10 · U_R (for $U_R \geq$ 385 V–)
Rated capacitance C_R	47 … 2 200 µF
Capacitance tolerance	± 20 % ≙ M
Useful life 40 °C, U_R 85 °C, U_R; $I_{\sim R}$	 > 100 000 h (1,75 · $I_{\sim R,85°C}$) > 5 000 h
Failure percentage	≤ 1 % (during useful life)
Failure rate	≤ 100 fit (≤ 100 · 10^{-9}/h)
Voltage endurance test	2 000 h, 85 °C (at U_R)
Leakage current I_{lka} (5 min, 20 °C)	$I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$
Self-inductance L_{ESL}	approx. 20 nH
IEC climatic category	in accordance with IEC 68–1 ≤ 400 V–: 40/085/56 (–40 °C/+85 °C, 56 days damp heat test) 450 V–: 25/085/56 (–25 °C/+85 °C, 56 days damp heat test)
Detail specification	similar to CECC 30 301-806
Sectional specifications	IEC 384–4 (DIN 45 910 part 12)
Vibration resistance	in accordance with IEC 68–2–6, test Fc: displacement amplitude 0,35 mm, frequency range 10 … 55 Hz, acceleration max. 5 *g*, duration 3 × 2 h



Outline drawings





Snap-in claws, standard (length 6,3 ± 1 mm). Also available in a shorter version with a length of 4,5 – 1 mm. For packing modes and ordering example see page 206.

Dimensions (mm) *d* + 1	*l* ± 2	Approx. weight (g)	Packing units (pieces)
22	25	9	384
22	30	12	384
22	35	15	384
22	40	18	256
25	25	13	384
25	30	17	384
25	35	19	384
25	40	22	256
30	25	17	240

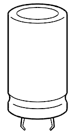
Snap-in capacitors are also available with 3 claws.
For packing modes and ordering example see page 206.

Dimensions (mm) *d* + 1	*l* ± 2	Approx. weight (g)	Packing units (pieces)
30	30	23	240
30	35	29	240
30	40	36	240
30	45	41	160
35	35	36	100
35	40	41	100
35	45	57	100
35	50	72	100

Overview of available types

U_R (V–)	160	200	250	385	400	450
C_R (µF)	Case dimensions $d \times l$ (mm)					
47						22 × 25
68				22 × 25	22 × 25	22 × 30 22 × 25
100				22 × 30 25 × 25	22 × 30 25 × 25	22 × 40 25 × 30
150			22 × 25	22 × 40 25 × 30	22 × 40 30 × 25	25 × 40 30 × 30
220	22 × 25	22 × 25	22 × 30 25 × 25	25 × 40 30 × 30	25 × 40 30 × 35	30 × 40
330	22 × 30	22 × 30 25 × 25	22 × 40 25 × 30	30 × 40	30 × 45	35 × 40
470	22 × 35	22 × 40 30 × 25	25 × 40 30 × 30	35 × 40	35 × 45	35 × 50
560				35 × 45	35 × 50	
680	25 × 35	25 × 40 30 × 30	30 × 40			
1 000	30 × 35	30 × 40 35 × 35	35 × 40			
1 500	30 × 45	35 × 45				
2 200	35 × 50					

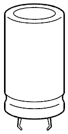
The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code [1] Short code
160	220	22 × 25	530	910	730	2,4	1,1	-A1227-M
	330	22 × 30	360	610	490	3,2	1,4	-A1337-M
	470	22 × 35	250	430	350	4,0	1,8	-A1477-M
	680	25 × 35	180	300	240	5,2	2,4	-A1687-M
	1 000	30 × 35	120	200	160	6,9	3,1	-A1108-M
	1 500	30 × 45	80	140	120	9,2	4,2	-A1158-M
	2 200	35 × 50	60	91	80	13	5,8	-A1228-M
200	220	22 × 25	380	610	490	2,4	1,1	-A2227-M
	330	22 × 30	260	410	330	3,2	1,4	-A2337-M
	330	25 × 25	260	410	330	3,2	1,5	-J2337-M
	470	22 × 40	180	290	240	4,2	1,9	-A2477-M
	470	30 × 25	180	290	350	4,2	1,9	-J2477-M
	680	25 × 40	130	200	160	5,5	2,5	-A2687-M
	680	30 × 30	130	200	160	5,4	2,4	-J2687-M
	1 000	30 × 40	83	140	120	7,2	3,3	-A2108-M
	1 000	35 × 35	83	140	120	7,6	3,5	-J2108-M
	1 500	35 × 45	56	90	80	10	4,6	-A2158-M
250	150	22 × 25	560	890	800	2,0	0,91	-B2157-M
	220	22 × 30	380	610	500	2,6	1,2	-B2227-M
	220	25 × 25	380	610	490	2,6	1,2	-K2227-M
	330	22 × 40	260	410	330	3,5	1,6	-B2337-M
	330	25 × 30	260	410	330	3,4	1,6	-K2337-M
	470	25 × 40	180	290	240	4,5	2,1	-B2477-M
	470	30 × 30	180	290	240	4,5	2,0	-K2477-M
	680	30 × 40	130	200	160	5,9	2,7	-B2687-M
	1 000	35 × 40	83	140	120	8,0	3,6	-B2108-M

1) For instructions on how to determine ordering codes, refer to page 184.

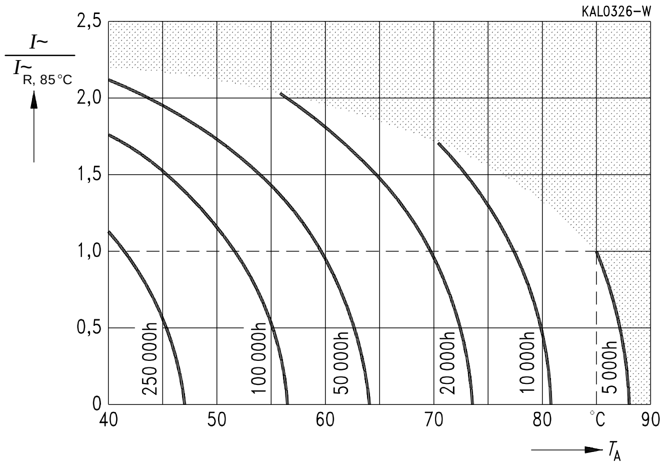


Technical data and ordering codes

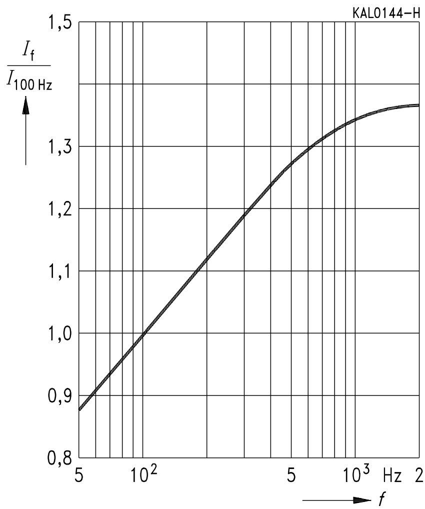
U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code [1)] Short code
385	68	22 × 25	980	1960	1570	1,3	0,61	-A3686-M
	100	22 × 30	670	1330	1070	1,7	0,79	-A3107-M
	100	25 × 25	670	1330	1070	1,8	0,80	-B3107-M
	150	22 × 40	450	890	720	2,4	1,1	-A3157-M
	150	25 × 30	450	890	720	2,3	1,0	-B3157-M
	220	25 × 40	310	610	490	3,1	1,4	-A3227-M
	220	30 × 30	310	610	490	3,1	1,4	-B3227-M
	330	30 × 40	210	410	330	4,1	1,9	-A3337-M
	470	35 × 40	150	290	240	5,5	2,5	-A3477-M
	560	35 × 45	120	240	200	6,2	2,8	-A3567-M
400	68	22 × 25	980	1960	1570	1,3	0,61	-A9686-M
	100	22 × 30	670	1330	1070	1,7	0,79	-A9107-M
	100	25 × 25	670	1330	1070	1,8	0,80	-B9107-M
	150	22 × 40	450	890	720	2,4	1,1	-A9157-M
	150	30 × 25	450	890	720	2,4	1,1	-B9157-M
	220	25 × 40	310	610	490	3,1	1,4	-A9227-M
	220	30 × 35	310	610	490	3,2	1,5	-B9227-M
	330	30 × 45	210	410	330	4,3	2,0	-A9337-M
	470	35 × 45	150	290	240	5,7	2,6	-A9477-M
	560	35 × 50	120	240	200	6,4	2,9	-A9567-M
450	47	22 × 25	2830	4240	3400	1,1	0,51	-A5476-M
	68	22 × 30	1960	2930	2350	1,4	0,65	-A5686-M
	68	25 × 25	1960	2930	2350	1,5	0,66	-B5686-M
	100	22 × 40	1330	1990	1600	1,9	0,88	-A5107-M
	100	25 × 30	1330	1990	1600	1,9	0,86	-B5107-M
	150	25 × 40	890	1330	1070	2,6	1,2	-A5157-M
	150	30 × 30	890	1330	1070	2,5	1,1	-B5157-M
	220	30 × 40	610	910	730	3,4	1,5	-A5227-M
	330	35 × 40	410	610	490	4,6	2,1	-A5337-M
	470	35 × 50	290	430	350	5,9	2,7	-A5477-M

1) To obtain the required ordering code, prefix the type number to the short code.
E. g.: B43501-A3686-M

Useful life
versus ambient temperature T_A under ripple current operating conditions [1)]

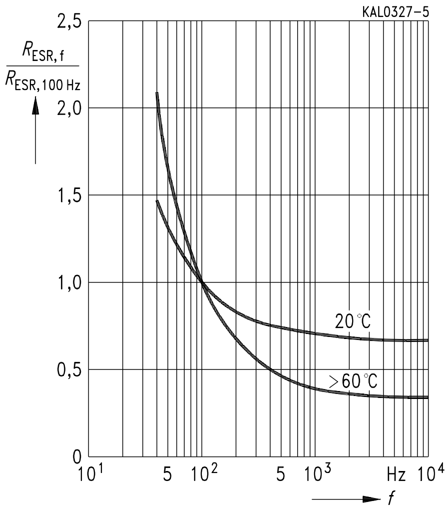


Permissible ripple current *I~*
versus frequency *f*

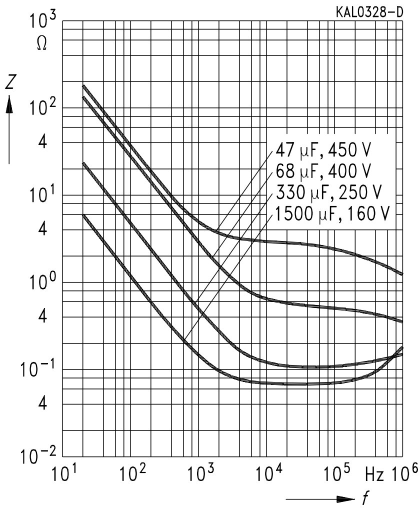


1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

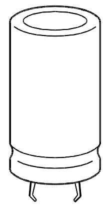
Equivalent series resistance R_{ESR}
versus frequency f
Typical behavior



Impedance Z
versus frequency f
Typical behavior



Long useful life
Operation at temperatures up to 85 °C



Construction

- Charge-discharge proof, polar
- Aluminum case, fully insulated
- Snap-in solder pins to hold component in place on PC-board
- Minus pole marking on case surface
- Minus pole not insulated from case
- All-welded construction
- Standard 10 mm lead spacing

Features

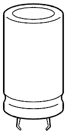
- High reliability
- High ripple current capability and small dimensions
- Low equivalent series resistance R_{ESR}
- Different case sizes available for each capacitance value

Applications

- Professional switch-mode power supplies in industrial electronics and in data processing equipment
- Switch-mode power supplies in entertainment electronics

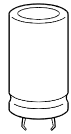
Specifications and characteristics in brief

Rated voltage U_R Surge voltage U_S	200 … 450 V– $1{,}15 \cdot U_R$ (for $U_R \leq 250$ V–) $1{,}10 \cdot U_R$ (for $U_R \geq 385$ V–)
Rated capacitance C_R Capacitance tolerance	47 … 1 500 µF ± 20 % ≙ M
Useful life 40 °C, U_R 85 °C, U_R; $I_{\sim R}$	 > 200 000 h ($1{,}3 \cdot I_{\sim R,85°C}$) > 10 000 h
Failure percentage	≤ 1 % (during useful life)
Failure rate	≤ 40 fit ($\leq 40 \cdot 10^{-9}$/h)
Voltage endurance test	5 000 h, 85 °C (at U_R)
Leakage current I_{lka} (5 min, 20 °C)	$I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$

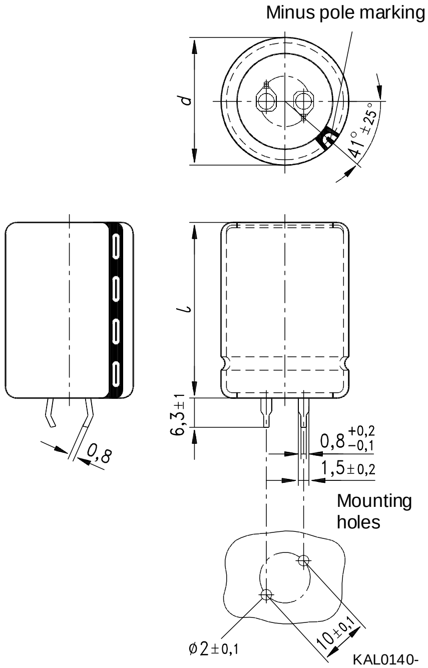


Specifications and characteristics in brief

Self-inductance L_{ESL}	approx. 20 nH
IEC climatic category	in accordance with IEC 68–1 25/085/56 (–25 °C/+85 °C, 56 days damp heat test)
Detail specification	similar to CECC 30 301-806
Sectional specifications	IEC 384–4 (DIN 45 910 part 12)
Vibration resistance	in accordance with IEC 68–2–6, test Fc: displacement amplitude 0,35 mm, frequency range 10 … 55 Hz, acceleration max. 5 *g*, duration 3 × 2 h

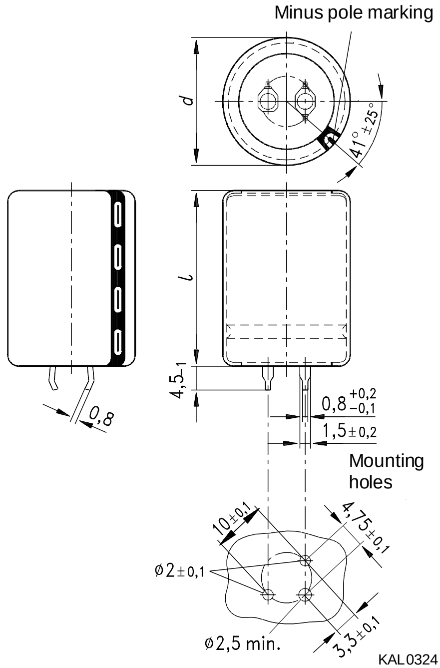


Outline drawings



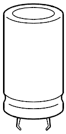
Snap-in claws, standard (length 6,3 ± 1 mm). Also available in a shorter version with a length of 4,5 – 1 mm. For packing modes and ordering example see page 206.

Dimensions (mm) d + 1	l ± 2	Approx. weight (g)	Packing units (pieces)
22	25	9	384
22	30	12	384
22	35	15	384
22	40	18	256
25	25	13	384
25	30	17	384
25	35	19	384
25	40	22	256
25	45	25	256
25	50	28	256



Snap-in capacitors are also available with 3 claws.
For packing modes and ordering example see page 206.

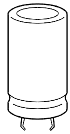
Dimensions (mm) d + 1	l ± 2	Approx. weight (g)	Packing units (pieces)
30	30	23	240
30	35	29	240
30	40	36	240
30	45	41	160
30	50	46	160
35	35	37	100
35	40	44	100
35	45	52	100
35	50	59	100



Overview of available types

U_R (V–)	200	250	385	400	450
C_R (µF)	Case dimensions $d \times l$ (mm)				
47			22 × 25	22 × 25	22 × 25
68			22 × 30 25 × 25	22 × 30 25 × 25	22 × 30 25 × 25
100		22 × 25	22 × 35 25 × 30	22 × 35 25 × 30	22 × 40 25 × 35
150	22 × 25	22 × 30 25 × 25	25 × 40 30 × 30	25 × 40 30 × 30	25 × 45 30 × 35
220	22 × 30 25 × 25	22 × 40 25 × 30	25 × 50 30 × 35	25 × 50 30 × 35	30 × 45 35 × 35
270					35 × 40
330	22 × 40 25 × 30	25 × 40 30 × 30	30 × 45	30 × 50 35 × 40	35 × 45
390				35 × 45	35 × 50
470	25 × 40 30 × 30	25 × 50 30 × 40	35 × 45	35 × 50	
680	25 × 50 30 × 40	30 × 50			
1 000	30 × 50 35 × 40	35 × 45			
1 200	35 × 45				
1 500	35 × 50				

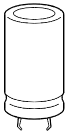
The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code [1] Short code
200	150	22 × 25	890	1400	1200	1,7	0,84	-B157-M
	220	22 × 30	610	920	740	2,2	1,1	-B227-M
	220	25 × 25	610	920	740	2,3	1,1	-K227-M
	330	22 × 40	410	620	500	3,0	1,5	-B337-M
	330	25 × 30	410	620	500	3,0	1,4	-K337-M
	470	25 × 40	290	440	360	3,9	1,9	-B477-M
	470	30 × 30	290	440	360	3,9	1,9	-K477-M
	680	25 × 50	200	300	240	5,1	2,5	-B687-M
	680	30 × 40	200	300	240	5,1	2,5	-K687-M
	1 000	30 × 50	140	210	170	6,8	3,3	-B108-M
	1 000	35 × 40	70	150	110	6,4	3,1	-A108-M90
	1 200	35 × 45	100	170	130	6,7	3,3	-A128-M90
	1 500	35 × 50	80	130	105	7,4	3,6	-A158-M90
250	100	22 × 25	1400	2100	1700	1,5	0,72	-B2107-M
	150	22 × 30	890	1400	1200	1,9	0,96	-B2157-M
	150	25 × 25	890	1400	1100	2,0	0,97	-K2157-M
	220	22 × 40	610	920	740	2,6	1,3	-B2227-M
	220	25 × 30	610	920	740	2,6	1,2	-K2227-M
	330	25 × 40	410	620	500	3,5	1,7	-B2337-M
	330	30 × 30	410	620	500	3,4	1,7	-K2337-M
	470	25 × 50	290	440	360	4,5	2,2	-B2477-M
	470	30 × 40	290	440	360	4,5	2,2	-K2477-M
	680	30 × 50	200	300	240	5,9	2,9	-B2687-M
	1 000	35 × 45	120	200	105	6,3	3,1	-A2108-M90
385	47	22 × 25	2500	3800	3100	1,1	0,53	-D476-M
	68	22 × 30	1800	2700	2200	1,4	0,68	-D686-M
	68	25 × 25	1800	2700	2200	1,4	0,69	-M686-M
	100	22 × 35	1200	1800	1500	1,8	0,87	-D107-M
	100	25 × 30	1200	1800	1500	1,8	0,89	-M107-M
	150	25 × 40	780	1200	960	2,5	1,2	-D157-M
	150	30 × 30	780	1200	960	2,5	1,2	-M157-M

1) For instructions on how to determine ordering codes, refer to page 192.

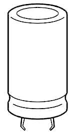


B 43 502

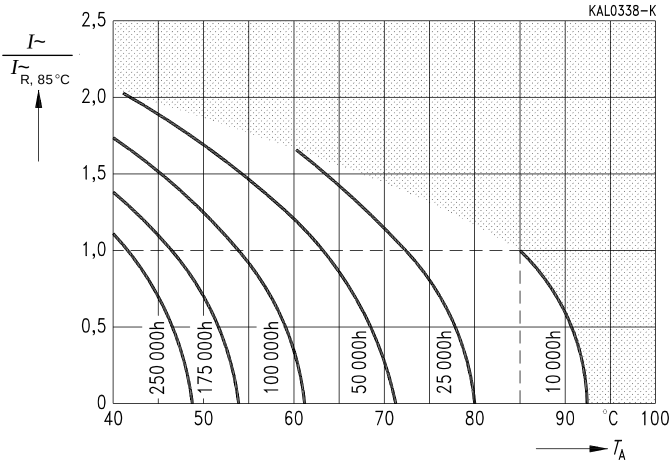
Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code [1)] Short code
385	220	25 × 50	530	800	640	3,3	1,6	-D227-M
	220	30 × 35	530	800	640	3,1	1,5	-M227-M
	330	30 × 45	360	540	440	4,2	2,0	-D337-M
	470	35 × 45	370	630	300	4,7	2,3	-A477-M90
400	47	22 × 25	2100	3000	1400	1,0	0,51	-F476-M
	68	22 × 30	1500	2100	1000	1,3	0,66	-F686-M
	68	25 × 25	1500	2100	1000	1,4	0,67	-P686-M
	100	22 × 35	1000	1400	780	1,7	0,85	-F107-M
	100	25 × 30	1000	1400	780	1,8	0,87	-P107-M
	150	25 × 40	670	950	520	2,4	1,2	-F157-M
	150	30 × 30	670	950	520	2,4	1,2	-P157-M
	220	25 × 50	450	650	400	3,2	1,6	-F227-M
	220	30 × 35	450	650	400	3,0	1,5	-P227-M
	330	30 × 50	300	480	280	4,2	2,1	-F337-M
	330	35 × 40	300	450	420	4,1	2,0	-A337-M90
	390	35 × 45	450	680	610	4,7	2,3	-A397-M90
	470	35 × 50	370	630	300	5,4	2,6	-B477-M90
450	47	22 × 25	2800	5600	4400	0,8	0,39	-A5476-M
	68	22 × 30	1900	3900	3100	1,0	0,50	-A5686-M
	68	25 × 25	1900	3900	3100	1,0	0,51	-J5686-M
	100	22 × 40	1300	2600	2100	1,4	0,67	-A5107-M
	100	25 × 35	1300	2600	2100	1,4	0,69	-J5107-M
	150	25 × 45	800	1600	1300	1,9	0,93	-A5157-M
	150	30 × 35	800	1600	1300	1,9	0,92	-J5157-M
	220	30 × 45	600	1100	900	2,5	1,2	-A5227-M
	220	35 × 35	880	1360	950	1,8	0,90	-A5227-M90
	270	35 × 40	680	1100	790	2,0	1,0	-A5277-M90
	330	35 × 45	590	900	630	2,5	1,2	-A5337-M90
	390	35 × 50	500	770	540	2,8	1,4	-A5397-M90

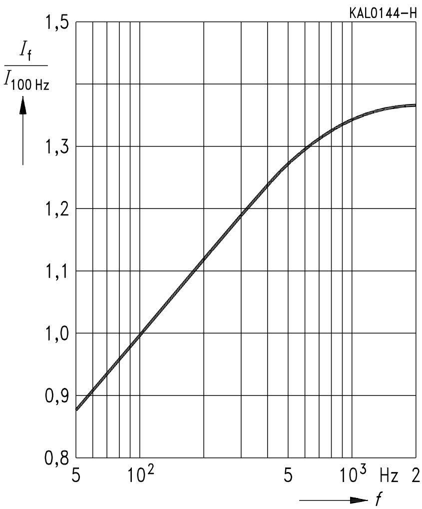
1) To obtain the required ordering code, prefix the type number to the short code.
E. g.: B43502-D227-M



Useful life
versus ambient temperature T_A under ripple current operating conditions [1)]

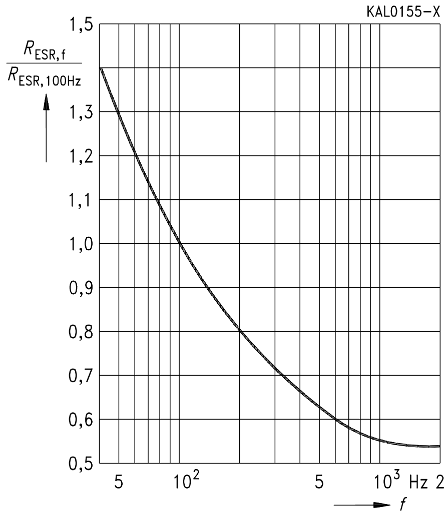


Permissible ripple current *I~*
versus frequency *f*

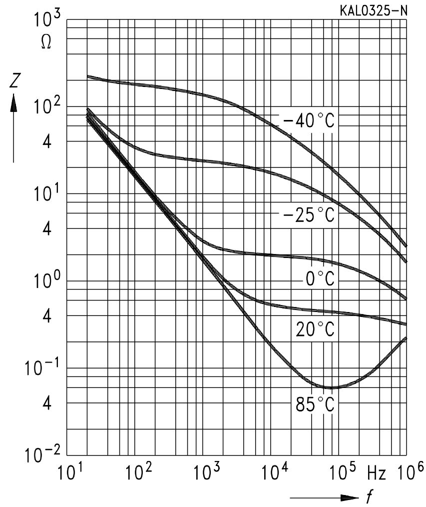


1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

Equivalent series resistance R_{ESR}
versus frequency f
Typical behavior

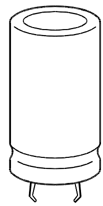


Impedance Z
versus frequency f
and temperature T for 100 µF/400 V–
Typical behavior



Snap-In Capacitors B 41 503
LL Grade B 43 503

For professional switch-mode power supplies
Operation at temperatures up to 105 °C



KAL0274-A

Construction

- Charge-discharge proof, polar
- Aluminum case, fully insulated
- Snap-in solder pins to hold component in place on PC-board
- Minus pole marking on case surface
- Minus pole not insulated from case
- All-welded construction
- Standard 10 mm lead spacing

Features

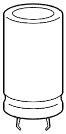
- High reliability
- High ripple current capability and small dimensions
- Wide temperature range
- Low equivalent series resistance R_{ESR}
- Different case sizes available for each capacitance value

Applications

- Professional switch-mode power supplies in industrial electronics and in data processing equipment
- Switch-mode power supplies in entertainment electronics

Specifications and characteristics in brief

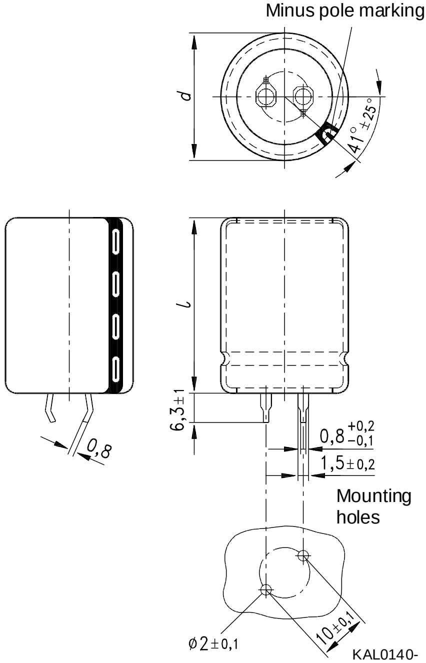
	B 41 503	B 43 503
Rated voltage U_R	10 … 100 V–	200 … 500 V–
Surge voltage U_S	1,15 · U_R	1,15 · U_R (for $U_R \leq$ 250 V–) 1,10 · U_R (for $U_R \geq$ 350 V–)
Rated capacitance C_R	470 … 33 000 µF	15 … 1 500 µF
Capacitance tolerance	± 20 % ≙ M	± 20 % ≙ M
Useful life		
40 °C, U_R	> 200 000 h (2,1 · $I_{\sim R,105°C}$)	> 200 000 h (2,7 · $I_{\sim R,105°C}$)
85 °C, U_R; $I_{\sim max}$	> 4 000 h	> 12 000 h
105 °C, U_R; $I_{\sim R}$	> 2 500 h	> 5 000 h
Failure percentage	≤ 1 % (during useful life)	≤ 1 % (during useful life)
Failure rate	≤ 40 fit (≤ 40 · 10^{-9}/h)	≤ 40 fit (≤ 40 · 10^{-9}/h)
Voltage endurance test	2 000 h, 105 °C (at U_R)	2 000 h, 105 °C (at U_R)

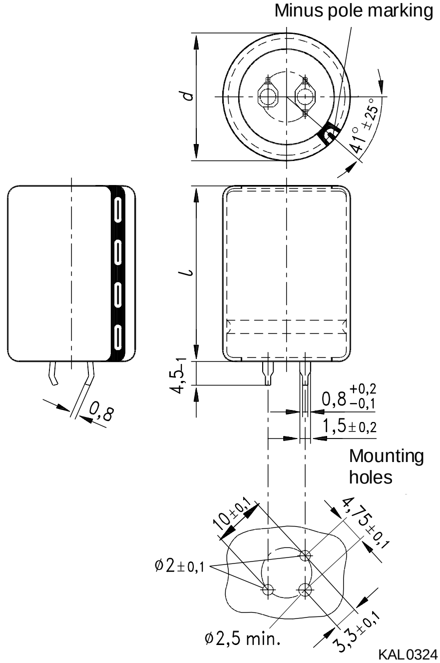


Specifications and characteristics in brief

Leakage current I_{lka} (5 min, 20 °C)	$I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$	
Self-inductance L_{ESL}	approx. 20 nH	
	B 41 503	B 43 503
IEC climatic category	in accordance with IEC 68–1 40/105/56 (–40 °C/+105 °C, 56 days damp heat test)	 25/105/56 (–25 °C/+105 °C, 56 days damp heat test)
Detail specification Sectional specifications	similar to CECC 30 301-806 IEC 384–4 (DIN 45 910 part 12)	
Vibration resistance	in accordance with IEC 68–2–6, test Fc: displacement amplitude 0,35 mm, frequency range 10 … 55 Hz, acceleration max. 5 *g*, duration 3 × 2 h	

Outline drawings



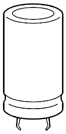


Snap-in claws, standard (length 6,3 ± 1 mm). Also available in a shorter version with a length of 4,5 – 1 mm. For packing modes and ordering example see page 206.

Dimensions (mm) *d* + 1	*l* ± 2	Approx. weight (g)	Packing units (pieces)
22	25	9	384
22	30	12	384
22	35	15	384
22	40	18	256
25	25	13	384
25	30	17	384
25	35	19	384
25	40	22	256
25	45	25	256
30	30	23	240
30	35	29	240

Snap-in capacitors are also available with 3 claws.
For packing modes and ordering example see page 206.

Dimensions (mm) *d* + 1	*l* ± 2	Approx. weight (g)	Packing units (pieces)
30	40	36	240
30	45	41	160
30	50	46	160
35	25	25	100
35	30	31	100
35	35	37	100
35	40	44	100
35	45	52	100
35	50	59	100
35	55	66	100

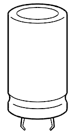


Overview of available types

Type B 41 503

U_R (V–)	10	16	25	40	63	100
C_R (µF)	Case dimensions $d \times l$ (mm)					
470						22 × 30 25 × 25
680						22 × 35 25 × 30
1 000					22 × 30 25 × 25	25 × 35 30 × 30
1 500					22 × 35 25 × 30	30 × 35
2 200				22 × 30 25 × 25	25 × 35 30 × 30	30 × 45
3 300			22 × 30 25 × 25	22 × 40 25 × 30	30 × 40	
4 700		22 × 30 25 × 25	22 × 35 25 × 30	25 × 40 30 × 30	30 × 45	
6 800	22 × 30 25 × 25	22 × 35 25 × 30	25 × 35 30 × 30	30 × 35		
10 000	22 × 35 25 × 30	25 × 35 30 × 30	30 × 35	30 × 50		
15 000	25 × 35 30 × 30	30 × 35	30 × 45			
22 000	30 × 35	30 × 45				
33 000	30 × 45					

The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.

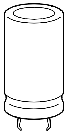


Overview of available types

Type B 43 503

U_R (V–)	200	250	400	450	500
C_R (µF)	Case dimensions $d \times l$ (mm)				
15					22 × 25
22					22 × 30
33					22 × 35
47			22 × 25	22 × 35 25 × 30	25 × 35
68			22 × 30 25 × 25	25 × 35	25 × 45
100			22 × 35 25 × 30	30 × 35	30 × 45
150	22 × 25	22 × 30 25 × 25	25 × 40 30 × 30	30 × 45 35 × 25	
220	22 × 30 25 × 25	25 × 30 22 × 35	30 × 40 35 × 30	35 × 40	
330	22 × 35 25 × 30	25 × 35 30 × 30	30 × 50 35 × 35	35 × 50	
470	25 × 40 30 × 30	30 × 35	35 × 50		
560			35 × 55		
680	30 × 35	30 × 45			
1 000	35 × 45	35 × 45			
1 200	35 × 50				
1 500	35 × 55				

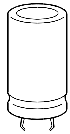
The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	$I_{\sim R}$ 100 Hz 105 °C A	Ordering code [1)] Short code
B41503-									
10	6 800	22 × 30	55	83	72	4,9	3,5	1,6	-A3688-M
	6 800	25 × 25	55	83	72	4,9	3,5	1,6	-J3688-M
	10 000	22 × 35	44	66	59	5,9	4,2	1,9	-B3109-M
	10 000	25 × 30	44	66	59	5,9	4,2	1,9	-J3109-M
	15 000	25 × 35	36	54	49	6,8	4,8	2,2	-B3159-M
	15 000	30 × 30	36	54	49	6,8	4,8	2,2	-J3159-M
	22 000	30 × 35	31	46	43	8,1	5,7	2,6	-B3229-M
	33 000	30 × 45	27	41	39	9,6	6,8	3,1	-B3339-M
16	4 700	22 × 30	60	90	78	4,7	3,5	1,6	-A4478-M
	4 700	25 × 25	60	90	78	4,7	3,5	1,6	-J4478-M
	6 800	22 × 35	47	71	63	5,6	4,0	1,8	-B4688-M
	6 800	25 × 30	47	71	63	5,6	4,0	1,8	-J4688-M
	10 000	25 × 35	39	58	52	6,8	4,8	2,2	-B4109-M
	10 000	30 × 30	39	58	52	6,8	4,8	2,2	-J4109-M
	15 000	30 × 35	32	49	45	8,1	5,7	2,6	-B4159-M
	22 000	30 × 45	28	43	40	9,3	6,6	3,0	-B4229-M
25	3 300	22 × 30	64	97	83	4,6	3,3	1,5	-A5338-M
	3 300	25 × 25	64	97	83	4,6	3,3	1,5	-J5338-M
	4 700	22 × 35	51	77	67	5,3	3,7	1,7	-B5478-M
	4 700	25 × 30	51	77	67	5,3	3,7	1,7	-J5478-M
	6 800	25 × 35	42	62	56	6,5	4,6	2,1	-B5688-M
	6 800	30 × 30	42	62	56	6,5	4,6	2,1	-J5688-M
	10 000	30 × 35	35	52	48	7,8	5,5	2,5	-B5109-M
	15 000	30 × 45	30	45	42	9,0	6,4	2,9	-B5159-M
40	2 200	22 × 30	72	110	92	4,3	3,1	1,4	-A7228-M
	2 200	25 × 25	72	110	92	4,3	3,1	1,4	-J7228-M
	3 300	22 × 40	54	82	71	5,4	3,9	1,8	-A7338-M
	3 300	25 × 30	54	82	71	5,4	3,9	1,8	-J7338-M
	4 700	25 × 40	44	66	59	6,2	4,8	2,2	-A7478-M
	4 700	30 × 30	44	66	59	6,2	4,8	2,2	-J7478-M
	6 800	30 × 35	37	55	50	7,4	5,3	2,4	-B7688-M
	10 000	30 × 50	31	47	44	9,2	6,5	3,0	-A7109-M

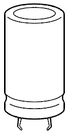
1) For instructions on how to determine ordering codes, refer to page 202.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	$I_{\sim R}$ 100 Hz 105 °C A	Ordering code 1) Short code
B41503-									
63	1 000	22 × 30	110	160	130	3,6	2,6	1,2	-A8108-M
	1 000	25 × 25	110	160	130	3,6	2,6	1,2	-J8108-M
	1 500	22 × 35	78	120	100	4,3	3,1	1,4	-B8158-M
	1 500	25 × 30	78	120	100	4,3	3,1	1,4	-J8158-M
	2 200	25 × 35	59	89	77	5,6	4,0	1,8	-B8228-M
	2 200	30 × 30	59	89	77	5,6	4,0	1,8	-J8228-M
	3 300	30 × 40	46	69	62	7,0	5,0	2,3	-A8338-M
	4 700	30 × 45	38	58	52	8,1	5,7	2,6	-B8478-M
100	470	22 × 30	160	240	200	2,9	2,1	0,96	-A9477-M
	470	25 × 25	160	240	200	2,9	2,1	0,96	-J9477-M
	680	22 × 35	120	180	150	3,4	2,4	1,1	-B9687-M
	680	25 × 30	120	180	150	3,4	2,4	1,1	-J9687-M
	1 000	25 × 35	87	130	110	4,6	3,1	1,4	-B9108-M
	1 000	30 × 30	87	130	110	4,6	3,1	1,4	-J9108-M
	1 500	30 × 35	64	97	83	5,6	4,0	1,8	-B9158-M
	2 200	30 × 45	50	75	66	7,1	5,1	2,3	-B9228-M
B43503-									
200	150	22 × 25	790	1400	1100	1,8	1,2	0,61	-D157-M
	220	22 × 30	540	900	750	2,4	1,6	0,79	-D227-M
	220	25 × 25	540	900	750	2,4	1,6	0,81	-M227-M
	330	22 × 35	360	600	500	3,0	2,0	1,0	-D337-M
	330	25 × 30	360	600	500	3,3	2,2	1,1	-M337-M
	470	25 × 40	250	420	350	4,2	2,8	1,4	-D477-M
	470	30 × 30	250	420	350	4,2	2,8	1,4	-L477-M
	680	30 × 35	170	280	230	5,1	3,4	1,7	-D687-M
	1 000	35 × 45	120	300	96	6,6	4,4	2,2	-A108-M90
	1 200	35 × 50	110	250	110	7,2	4,8	2,4	-A128-M90
	1 500	35 × 55	100	200	120	7,6	5,0	2,5	-A158-M90
250	150	22 × 30	790	1320	1100	2,1	1,4	0,69	-C2157-M
	150	25 × 25	790	1320	1100	2,1	1,4	0,70	-L2157-M
	220	25 × 30	540	900	750	2,7	1,8	0,91	-L2227-M
	220	22 × 35	540	900	750	2,7	1,8	0,89	-C2227-M

1) For instructions on how to determine ordering codes, refer to page 202.



Technical data and ordering codes

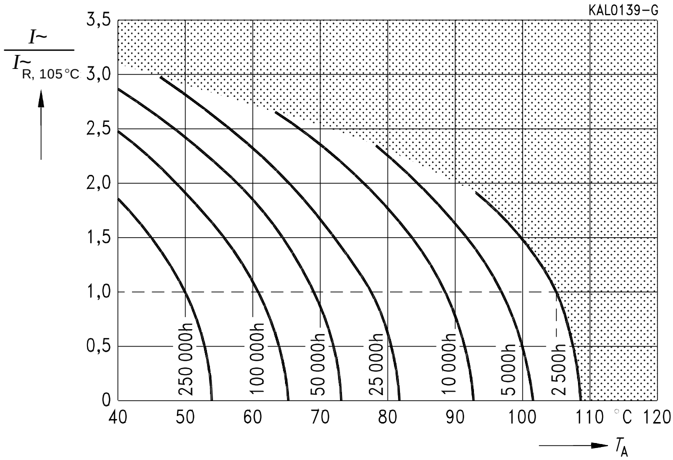
U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	$I_{\sim R}$ 100 Hz 105 °C A	Ordering code 1) Short code
B43503-									
250	330	25 × 35	360	600	500	3,6	2,4	1,2	-C2337-M
	330	30 × 30	360	600	500	3,6	2,4	1,2	-L2337-M
	470	30 × 35	250	420	350	4,5	3,0	1,5	-C2477-M
	680	30 × 45	170	280	230	6,0	4,0	2,0	-C2687-M
	1 000	35 × 45	120	300	96	6,6	4,4	2,2	-A2108-M90
400	47	22 × 25	1900	3200	2700	1,1	0,74	0,37	-G476-M
	68	22 × 30	1300	2200	1810	1,4	0,94	0,47	-G686-M
	68	25 × 25	1300	2200	1900	1,4	0,96	0,48	-Q686-M
	100	22 × 35	1000	1600	1500	1,8	1,2	0,61	-G107-M
	100	25 × 30	1000	1600	1500	1,9	1,2	0,62	-Q107-M
	150	25 × 40	670	1100	920	2,5	1,7	0,84	-G157-M
	150	30 × 30	670	1100	920	2,5	1,7	0,83	-P157-M
	220	30 × 40	450	700	630	3,3	2,2	1,1	-G227-M
	220	35 × 30	630	1360	630	3,3	2,2	1,1	-A227-M90
	330	30 × 50	300	450	420	4,5	3,0	1,5	-F337-M
	330	35 × 35	360	900	420	4,2	2,8	1,4	-A337-M90
	470	35 × 50	250	630	300	5,4	3,6	1,8	-A477-M90
	560	35 × 55	210	530	250	6,3	4,2	2,1	-A567-M90
450	47	22 × 35	2300	5300	4300	1,1	0,72	0,36	-A5476-M
	47	25 × 30	2300	5300	4300	1,1	0,74	0,37	-J5476-M
	68	25 × 35	1600	3700	3100	1,4	0,94	0,47	-A5686-M
	100	30 × 35	1100	2500	2100	1,9	1,2	0,62	-A5107-M
	150	30 × 45	720	1700	1400	2,5	1,7	0,83	-A5157-M
	150	35 × 25	930	1700	1420	2,5	1,6	0,81	-A5157-M90
	220	35 × 40	880	1360	950	3,4	2,2	1,1	-A5227-M90
	330	35 × 50	590	900	630	4,0	2,7	1,3	-A5337-M90
500	15	22 × 25	5900	9900	8300	0,54	0,36	0,18	-A6156-M
	22	22 × 30	4000	6700	5600	0,70	0,46	0,23	-A6226-M
	33	22 × 35	2700	4500	3800	0,91	0,60	0,30	-A6336-M
	47	25 × 35	1900	3200	2700	1,2	0,78	0,39	-A6476-M
	68	25 × 45	1300	2200	1800	1,6	1,0	0,52	-A6686-M
	100	30 × 45	880	1500	1300	2,0	1,4	0,68	-A6107-M

1) To obtain the required ordering code, prefix the type number to the short code. E. g: B43503-C2337-M
B41503-... (U_R = 10 … 100 V–); B43503-... (U_R = 200 … 500 V–)

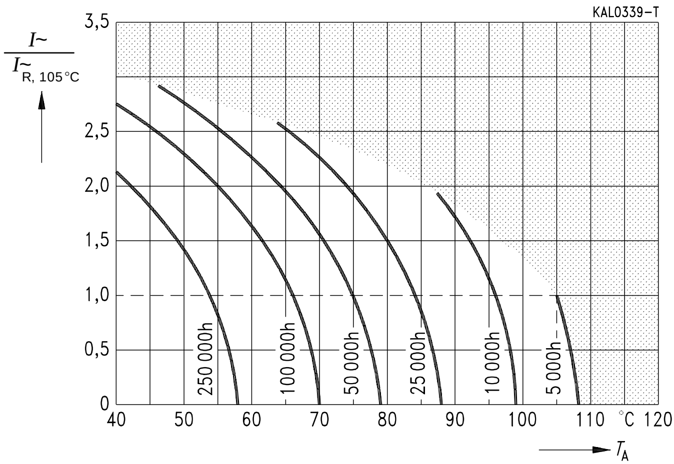
Useful life

versus ambient temperature T_A under ripple current operating conditions [1)]

U_R = 10 … 100 V–

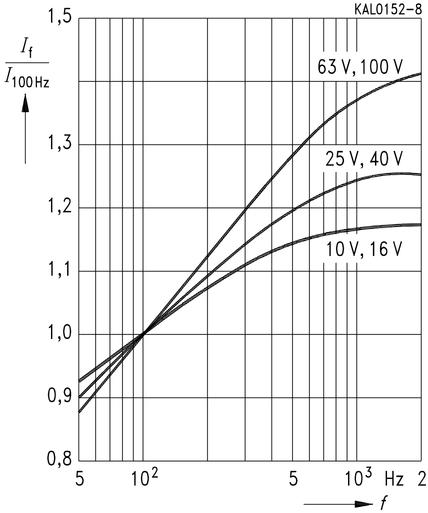


U_R = 200 … 500 V–

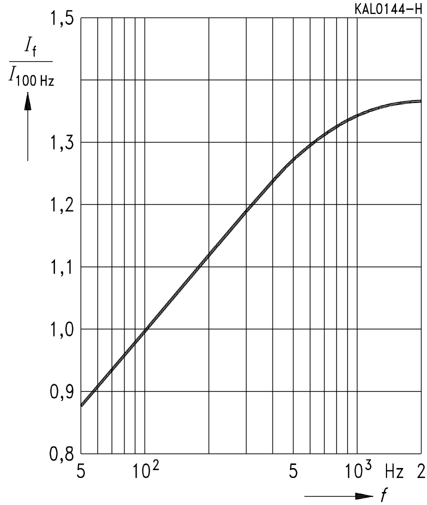


1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

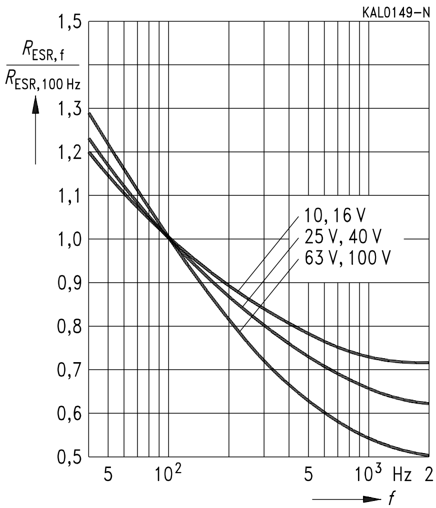
Permissible ripple current *I*~
versus frequency *f*
$U_R \leq 100$ V–



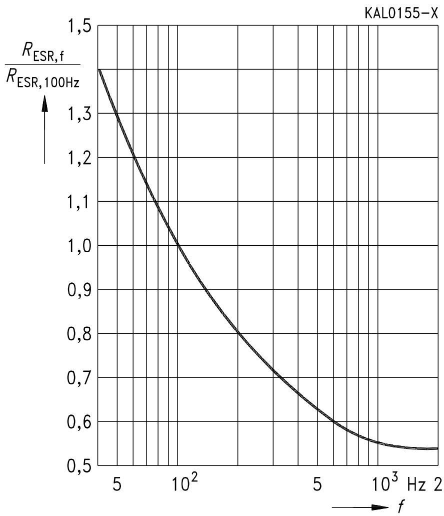
Permissible ripple current *I*~
versus frequency *f*
$U_R \geq 200$ V–

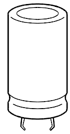


Equivalent series resistance R_{ESR}
versus frequency *f*
Typical behavior
$U_R \leq 100$ V–

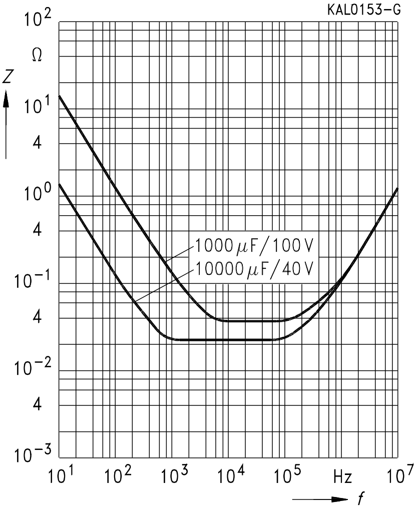


Equivalent series resistance R_{ESR}
versus frequency *f*
Typical behavior
$U_R \geq 200$ V–

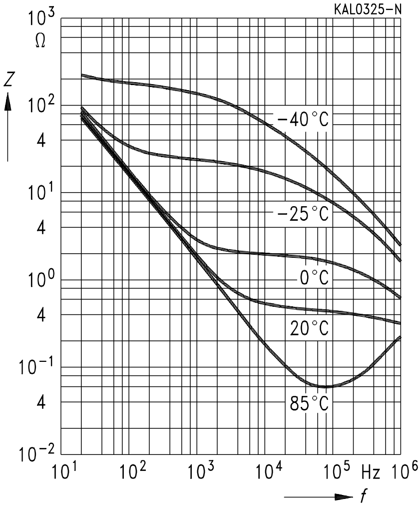




Impedance *Z*
versus frequency *f*
Typical behavior
$U_R \leq 100$ V–



Impedance *Z*
versus frequency *f*
and temperature *T* for 100 µF/400 V–
Typical behavior

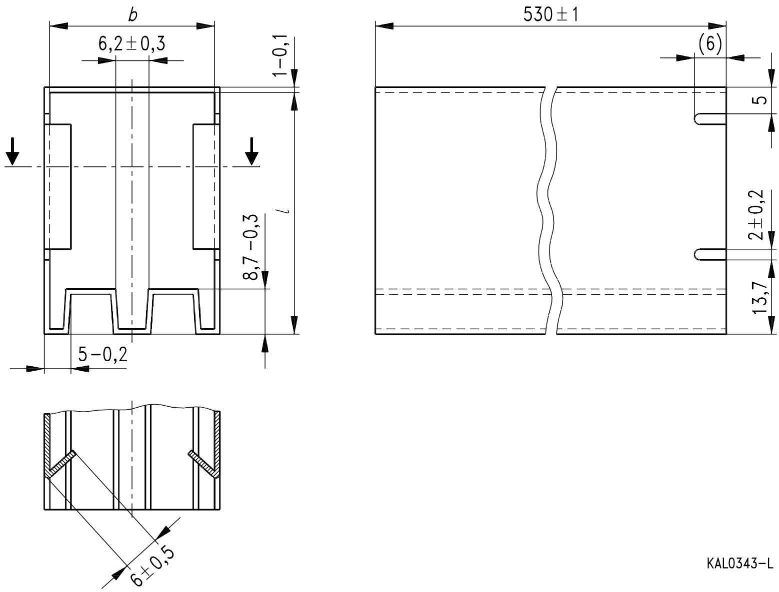


Packing

Packing of snap-in capacitors

Snap-in capacitors are supplied bulk-packed in cartons, or in stick magazines. The individual versions and the packing mode are identified by a code in the 3rd block of the ordering code (see table).

Outline drawing of stick magazine



Ordering codes

Snap-in claw Version	Packing	Identifcation in 3rd block of ordering code	
Standard claws (6,3 ± 1)	Bulk-packed in carton	-M	-M90
	Stick magazine	-M1	-M91
Short claws (4,5 –1)	Bulk-packed in carton	-M7	-M97
	Stick magazine	-M8	-M98
3 claws	Bulk-packed in carton	-M2	-M92

Ordering example:

B41303-A3109-M
B43502-A2108-M90 } standard claws, capacitors bulk-packed in carton

B41303-A3109-M8
B43502-A2108-M98 } short claws, capacitors packed in stick magazine

Packing units

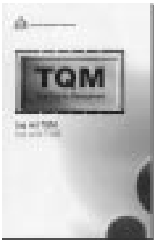
Capacitor diameter mm	Magazine dimensions $b \times l$ mm	Pieces per magazine
22	25 × 40	23
	25 × 50	23
25	25 × 40	20
	25 × 50	20
30	30 × 35	16
35	35 × 35	14

S+M
COMPONENTS
Siemens Matsushita Components

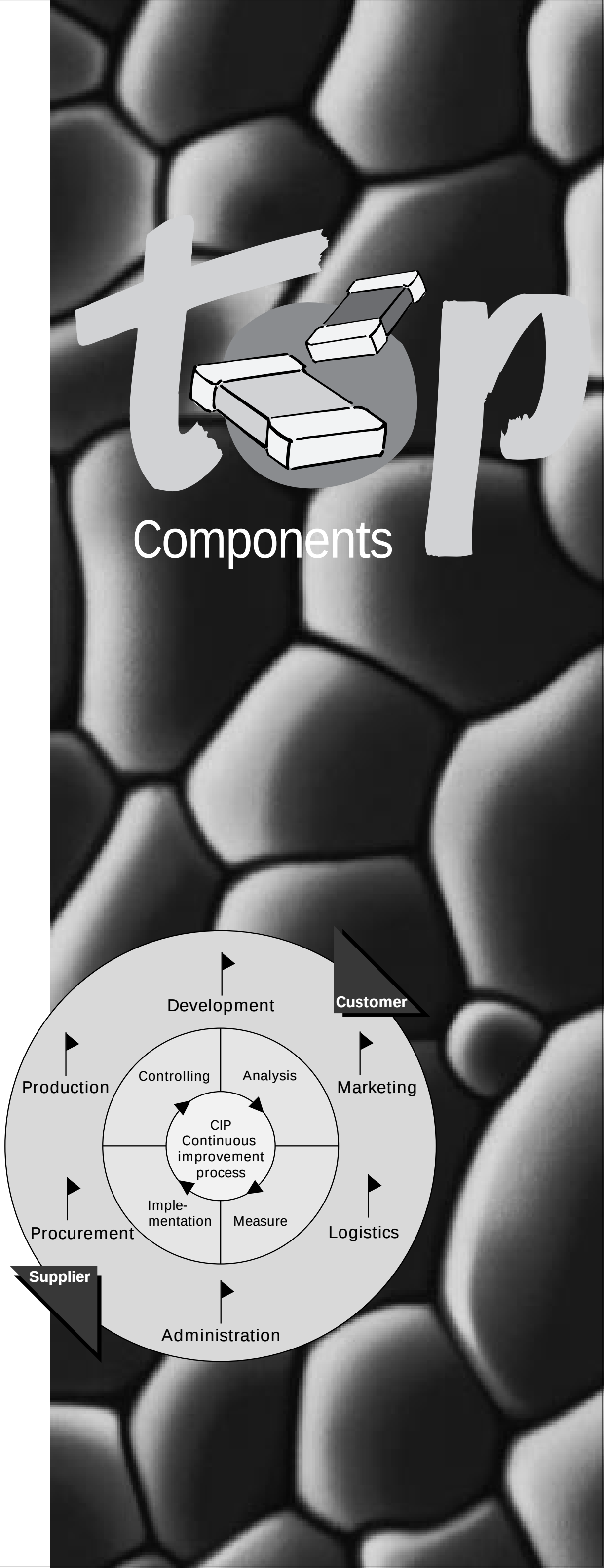
Quality without compromises

top with TQM

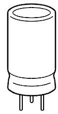
We're not satisfied until you are. So our quality demands are quite tough. And they don't start in production, they span the whole field from development to despatch. To watch over it all we implemented Total Quality Management, a system aimed at continuous improvement – in everything. That includes true-to-schedule delivery and service readiness, ISO 9000 for all plants, modern QA, commitment to the environment in manufacturing, materials and packing plus constant training of employees. All embedded in *top*, the worldwide quality campaign of the Siemens organization.



More about "top with TQM" in this brochure!



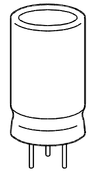
SCS – dependable, fast and competent



Overview

Quality grade	Type	U_R V–	C_R µF	Temperature °C	Special features and fields of application	Page
LL	B 41 336	6,3 … 100	100 … 15 000	– 40 … + 85	Very low equivalent series resistance Very low self-inductance Pinning ensures correct insertion Optimally suited for switch-mode power supplies and high-frequency apparatus	210
LL	B 41 534 B 43 534	6,3 … 100 200 … 385	100 … 15 000 47 … 220	– 40 … + 85	High reliability and ripple current capability Long useful life Pinning ensures correct insertion For professional switch-mode power supplies For industrial electronics, telecommunications and data processing equipment	216
LL	B 41 538	6,3 … 63	1 000 … 33 000	– 55 … + 105	Very high ripple current capability and long useful life Low equivalent series resistance High capacitance per unit volume Pinning ensures correct insertion Specially suitable for use in switch-mode power supply output circuits For industrial and automotive electronics, telecommunications and data processing equipment	223

Product series with very low self-inductance



KAL0275-I

Construction

- Charge-discharge proof, polar
- Aluminum case with insulating sleeve
- Solder pin terminals brought out at one end to fit standardized PCB spacings
- Negative potential can be applied to third pin; this pin does not serve as a minus pole, however

Features

- Very low self-inductance
- Very low equivalent series resistance R_{ESR}
- High ripple current capability and small dimensions
- Long useful life
- Operation at temperatures up to 105 °C [1)]
- Pinning ensures correct insertion

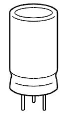
Applications

- Best suited for switch-mode power supplies with high clock frequencies
- For all types of equipment with high operating frequencies

Specifications and characteristics in brief

Rated voltage U_R Surge voltage U_S	6,3 … 100 V– $1{,}15 \cdot U_R$
Rated capacitance C_R Capacitance tolerance	100 … 15 000 µF – 10/+ 50 % ≙ T
Useful life 40 °C, U_R 85 °C, U_R; $I_{\sim max}$	 > 200 000 h (1,8 · $I_{\sim R,85°C}$) > 8 000 h
Failure percentage	≤ 0,5 % (during useful life)
Failure rate	≤ 20 fit (≤ 20 · 10^{-9}/h)
Voltage endurance test	3 000 h, 85 °C (at U_R)
Leakage current I_{lka} (5 min, 20 °C)	$I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$
Self-inductance L_{ESL}	approx. 5 nH

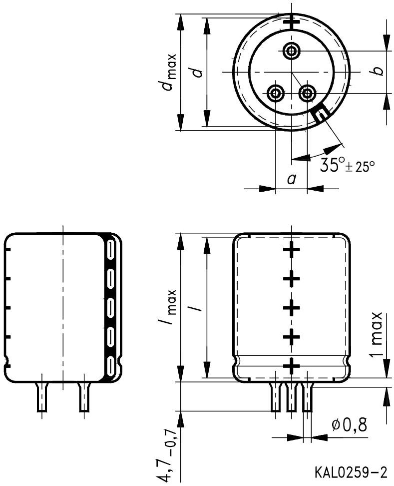
1) Up to a total of 500 h operation at 105°C permissible.



Specifications and characteristics in brief

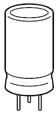
IEC climatic category	in accordance with IEC 68–1 40/085/56 (– 40 °C/+ 85 °C, 56 days damp heat test)
Detail specification Sectional specifications	– IEC 384–4 (DIN 45 910 part 12)
Vibration resistance	in accordance with IEC 68–2–6, test Fc: displacement amplitude 0,35 mm, frequency range 10 … 55 Hz, acceleration max. 5 *g*, duration 3 × 2 h

Outline drawing



Dimensions (mm)				Approximate weight (g)	Packing units (pieces)
$d \times l$	$d_{max} \times l_{max}$	$a^{+0,4}_{-0,2}$	$b^{+0,4}_{-0,2}$		
18 × 30	18,8 × 30,5	5	7,5	11	600
18 × 40 1)	18,8 × 40,5	5	7,5	14	600
22 × 40 2)	22,8 × 40,5	7,5	10	18	256
25 × 40	25,8 × 40,5	7,5	10	26	256

1) Also available with *d* x *l* = 22 × 30 mm; ordering code: B41336-J★★★★-T
2) Also available with *d* x *l* = 25 × 30 mm; ordering code: B41336-J★★★★-T
The electrical values may differ slightly from the ones specified above.

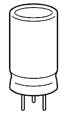


B 41 336

Overview of available types

U_R (V–)	6,3	10	16	25	40	63	100
C_R (µF)	Case dimensions $d \times l$ (mm)						
100							18 × 30
150							18 × 30
220						18 × 30	18 × 40
330						18 × 30	22 × 40
470					18 × 30	18 × 40	25 × 40
680					18 × 30	22 × 40	
1 000				18 × 30	18 × 40	25 × 40	
1 500			18 × 30	18 × 40	22 × 40		
2 200			18 × 30	22 × 40	25 × 40		
3 300		18 × 30	18 × 40	25 × 40			
4 700	18 × 30	18 × 40	22 × 40	25 × 40			
6 800	18 × 40	22 × 40	25 × 40				
10 000	22 × 40	25 × 40					
15 000	25 × 40						

The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.



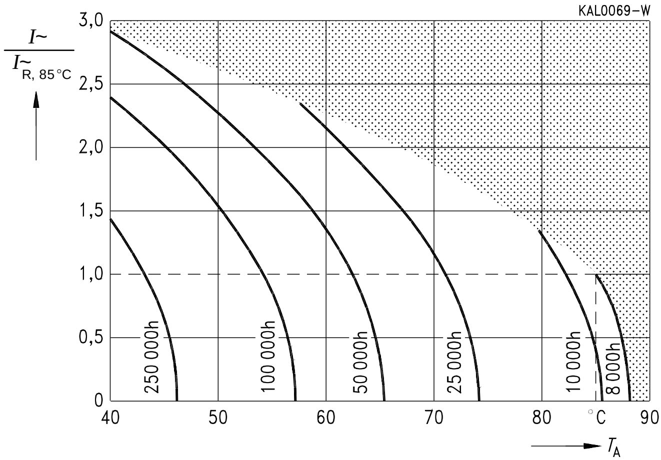
Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR,\,typ}$ 20 kHz 20 °C mΩ	$R_{ESR,\,max}$ 20 kHz 20 °C mΩ	Z_{max} 200 kHz 20 °C mΩ	$I_{\sim max}$ 20 kHz 40 °C A	$I_{\sim R}$ 20 kHz 85 °C A	Ordering code [1)] Short code
6,3	4 700	18 × 30	26	30	30	6,7	2,3	-A2478-T
	6 800	18 × 40	22	25	25	7,9	2,7	-A2688-T
	10 000	22 × 40	18	20	22	9,7	3,3	-A2109-T
	15 000	25 × 40	16	18	20	11,0	3,8	-A2159-T
10	3 300	18 × 30	26	31	30	6,4	2,2	-A3338-T
	4 700	18 × 40	23	26	25	7,7	2,6	-A3478-T
	6 800	22 × 40	18	21	22	9,4	3,2	-A3688-T
	10 000	25 × 40	17	19	20	10,7	3,7	-A3109-T
16	1 500	18 × 30	34	40	36	5,8	2,0	-A4158-T
	2 200	18 × 30	27	32	30	6,4	2,2	-A4228-T
	3 300	18 × 40	23	27	25	7,6	2,6	-A4338-T
	4 700	22 × 40	19	22	22	9,2	3,2	-A4478-T
	6 800	25 × 40	17	19	20	10,7	3,7	-A4688-T
25	1 000	18 × 30	31	36	35	6,1	2,1	-A5108-T
	1 500	18 × 40	25	29	26	7,3	2,5	-A5158-T
	2 200	22 × 40	20	23	22	9,0	3,1	-A5228-T
	3 300	25 × 40	18	22	22	9,9	3,4	-A5338-T
	4 700	25 × 40	16	20	21	10,4	3,6	-A5478-T
40	470	18 × 30	43	49	43	5,2	1,8	-A7477-T
	680	18 × 30	33	38	35	5,8	2,0	-A7687-T
	1 000	18 × 40	27	31	26	7,1	2,4	-A7108-T
	1 500	22 × 40	22	25	23	8,6	3,0	-A7158-T
	2 200	25 × 40	19	22	21	9,9	3,4	-A7228-T
63	220	18 × 30	56	64	53	4,4	1,5	-A8227-T
	330	18 × 30	41	47	40	5,2	1,8	-A8337-T
	470	18 × 40	33	38	30	6,4	2,2	-A8477-T
	680	22 × 40	27	30	26	7,9	2,7	-A8687-T
	1 000	25 × 40	22	26	25	9,1	3,1	-A8108-T
100	100	18 × 30	98	220	180	2,8	0,95	-A9107-T
	150	18 × 30	69	160	130	3,2	1,1	-A9157-T
	220	18 × 40	53	120	100	4,1	1,4	-A9227-T
	330	22 × 40	39	88	78	5,2	1,8	-A9337-T
	470	25 × 40	31	71	66	6,4	2,2	-A9477-T

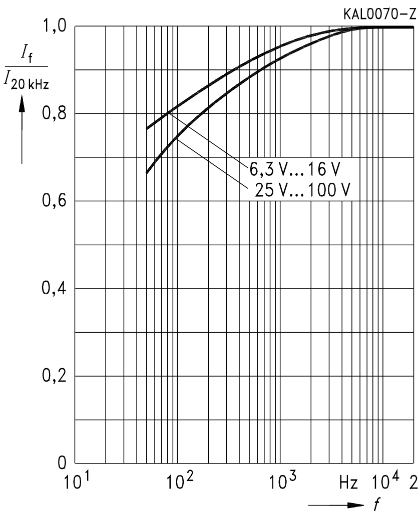
1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B41336-A2478-T

Useful life

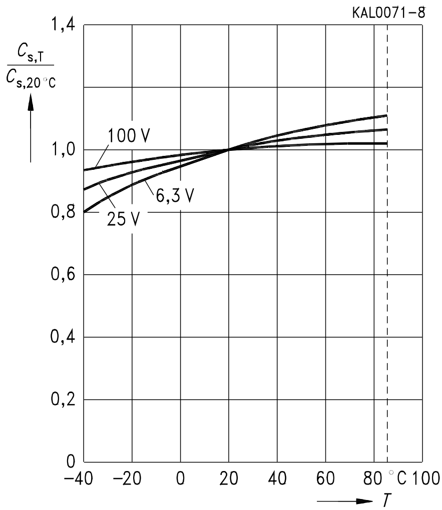
versus ambient temperature T_A under ripple current operating conditions [1)]



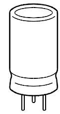
Permissible ripple current *I~*
versus frequency *f*
Typical behavior



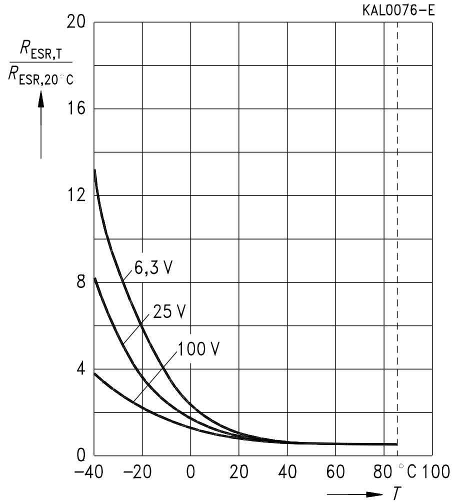
Series capacitänce C_S at f = 100 Hz
versus temperature *T*
Typical behavior



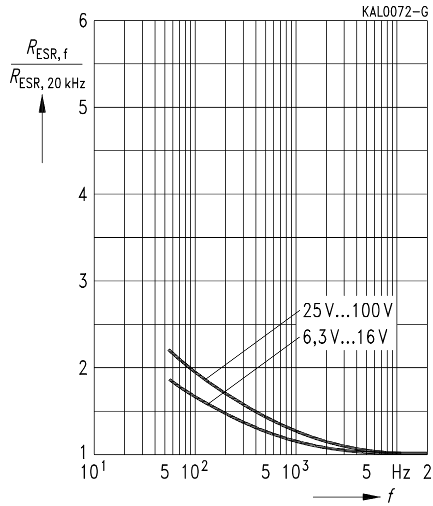
1) Refer to page 34 for an explanation on how to interpret the useful life graphs.



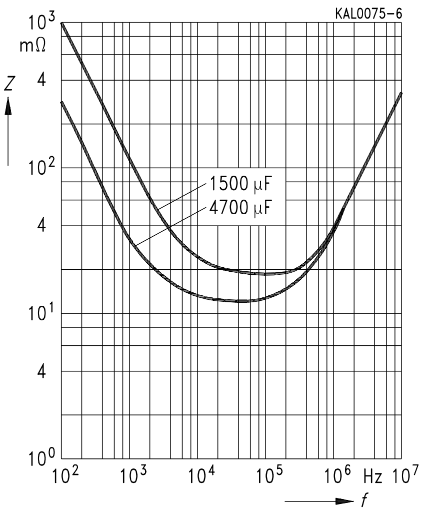
Equivalent series resistance R_{ESR}
at 100 Hz versus temperature T
Typical behavior



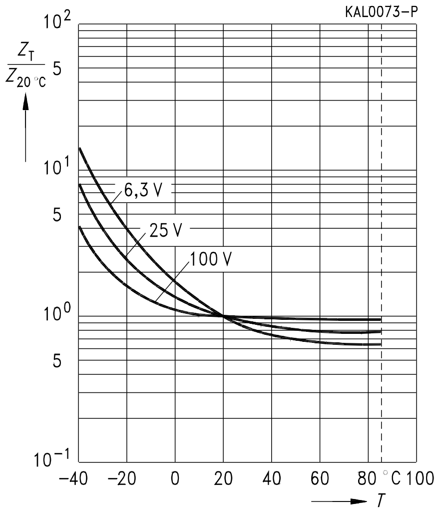
Equivalent series resistance R_{ESR}
versus frequency f
Typical behavior



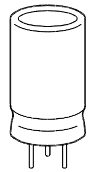
Impedance Z
versus frequency f
for U_R = 25 V– at 20 °C
Typical behavior



Impedance Z at 20 kHz
versus temperature T
Typical behavior



For professional switch-mode power supplies of compact design



Construction

- Charge-discharge proof, polar
- Aluminum case with insulating sleeve
- Solder pin terminals brought out at one end to fit standardized PCB spacings
- Negative potential can be applied to third pin; this pin does not serve as a minus pole, however

Features

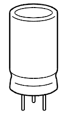
- Low equivalent series resistance R_{ESR}
- High reliability, high ripple current capability and small dimensions
- Long useful life
- Pinning ensures correct insertion

Applications

- For professional switch-mode power supplies of compact design
- General industrial electronics, telecommunications and data processing equipment

Specifications and characteristics in brief

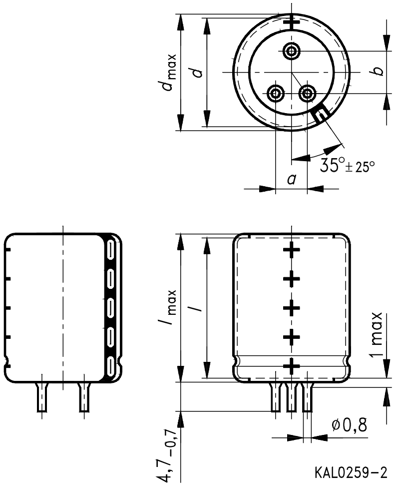
	B 41 534	B 43 534
Rated voltage U_R Surge voltage U_S	6,3 … 100 V– 1,15 · U_R	200 and 385 V– 1,15 · U_R (for $U_R \leq$ 200 V–) 1,10 · U_R (for U_R = 385 V–)
Rated capacitance C_R Capacitance tolerance	100 … 15 000 µF ± 20 % ≙ M	47 … 220 µF ± 20 % ≙ M
Useful life 40 °C, U_R 85 °C, U_R; $I_{\sim R}$	 > 200 000 h (1,8 · $I_{\sim R,85°C}$) > 8 000 h	 > 200 000 h (1,8 · $I_{\sim R,85°C}$) > 8 000 h
Failure percentage	≤ 0,5 % (during useful life)	≤ 0,5 % (during useful life)
Failure rate	≤ 20 fit (≤ 20 · 10^{-9}/h)	≤ 20 fit (≤ 20 · 10^{-9}/h)
Voltage endurance test	3 000 h, 85 °C (at U_R)	3 000 h, 85 °C (at U_R)
Leakage current I_{lka} (5 min, 20 °C)	$I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$	
Self-inductance L_{ESL}	approx. 10 nH	
IEC climatic category	in accordance with IEC 68–1 40/085/56 (– 40 °C/+ 85 °C, 56 days damp heat test)	



Specifications and characteristics in brief

	B 41 534	B 43 534
Detail specification	–	
Sectional specifications	IEC 384–4 (DIN 45 910 part 12)	
Vibration resistance	in accordance with IEC 68–2–6, test Fc: displacement amplitude 0,35 mm, frequency range 10 … 55 Hz, acceleration max. 5 *g*, duration 3 × 2 h	

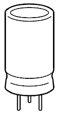
Outline drawing



Dimensions (mm)				Approximate weight	Packing units
$d \times l$	$d_{max} \times l_{max}$	$a\ ^{+0,4}_{-0,2}$	$b\ ^{+0,4}_{-0,2}$	(g)	(pieces)
18 × 30	18,8 × 30,5	5	7,5	11	600
18 × 40 [1)]	18,8 × 40,5	5	7,5	14	600
22 × 40 [2)]	22,8 × 40,5	7,5	10	18	256
25 × 40	25,8 × 40,5	7,5	10	26	256

1) Also available with *d* x *l* = 22 × 30 mm
2) Also available with *d* x *l* = 25 × 30 mm

Ordering code: B41534-J★★★★-M (6,3 … 100 V–)
B43534-J★★★-M (200 V–)
B43534-N★★★-M (385 V–)



B 41 534
B 43 534

Overview of available types

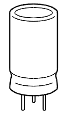
Type B 41 534

U_R (V–)	6,3	10	16	25	40	63	100
C_R (µF)	Case dimensions $d \times l$ (mm)						
100							18 × 30
150							18 × 30
220						18 × 30	18 × 40
330						18 × 30	22 × 40
470					18 × 30	18 × 40	25 × 40
680					18 × 30	22 × 40	
1 000				18 × 30	18 × 40	25 × 40	
1 500			18 × 30	18 × 40	22 × 40		
2 200			18 × 30	22 × 40	25 × 40		
3 300		18 × 30	18 × 40	25 × 40			
4 700	18 × 30	18 × 40	22 × 40	25 × 40			
6 800	18 × 40	22 × 40	25 × 40				
10 000	22 × 40	25 × 40					
15 000	25 × 40						

Type B 43 534

U_R (V–)	200	385
C_R (µF)	Case dimensions $d \times l$ (mm)	
47	18 × 30	18 × 40
68	18 × 40	22 × 40
100	22 × 40	25 × 40
150	22 × 40	25 × 40
220	25 × 40	

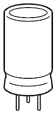
The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 20 kHz 20 °C mΩ	$R_{ESR, max}$ 20 kHz 20 °C mΩ	Z_{max} 200 kHz 20 °C mΩ	$I_{\sim max}$ 20 kHz 40 °C A	$I_{\sim R}$ 20 kHz 85 °C A	Ordering code [1] Short code
B41534-								
6,3	4 700	18 × 30	27	31	30	6,3	2,2	-A2478-M
	6 800	18 × 40	22	26	26	7,7	2,6	-A2688-M
	10 000	22 × 40	19	23	24	9,0	3,1	-A2109-M
	15 000	25 × 40	17	20	22	10,0	3,6	-A2159-M
10	3 300	18 × 30	27	32	30	6,2	2,1	-A3338-M
	4 700	18 × 40	23	27	27	7,6	2,6	-A3478-M
	6 800	22 × 40	19	23	24	9,0	3,1	-A3688-M
	10 000	25 × 40	17	21	22	10,0	3,5	-A3109-M
16	1 500	18 × 30	35	41	37	5,5	1,8	-A4158-M
	2 200	18 × 30	28	33	31	6,1	2,1	-A4228-M
	3 300	18 × 40	23	27	26	7,6	2,6	-A4338-M
	4 700	22 × 40	19	23	24	9,0	3,1	-A4478-M
	6 800	25 × 40	17	21	22	10,0	3,5	-A4688-M
25	1 000	18 × 30	32	37	36	5,8	2,0	-A5108-M
	1 500	18 × 40	25	30	30	7,2	2,4	-A5158-M
	2 200	22 × 40	21	25	26	8,6	3,0	-A5228-M
	3 300	25 × 40	18	22	23	9,9	3,4	-A5338-M
	4 700	25 × 40	16	20	22	10,0	3,6	-A5478-M
40	470	18 × 30	44	50	44	5,0	1,7	-A7477-M
	680	18 × 30	34	39	36	5,6	1,9	-A7687-M
	1 000	18 × 40	27	32	30	7,0	2,4	-A7108-M
	1 500	22 × 40	22	26	26	8,5	2,9	-A7158-M
	2 200	25 × 40	19	23	23	9,7	3,3	-A7228-M
63	220	18 × 30	57	65	54	4,4	1,5	-A8227-M
	330	18 × 30	42	48	42	5,1	1,7	-A8337-M
	470	18 × 40	33	38	35	6,4	2,2	-A8477-M
	680	22 × 40	27	31	30	7,7	2,7	-A8687-M
	1 000	25 × 40	22	26	26	9,1	3,1	-A8108-M

1) For instructions on how to determine ordering codes, refer to page 220.

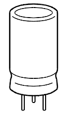


B 41 534
B 43 534

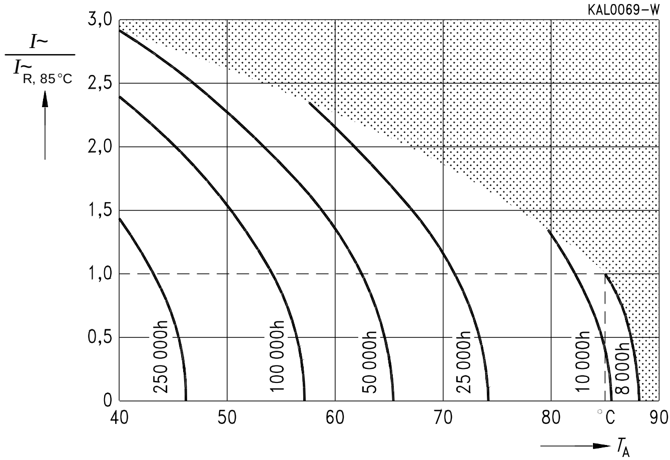
Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 20 kHz 20 °C mΩ	$R_{ESR, max}$ 20 kHz 20 °C mΩ	Z_{max} 200 kHz 20 °C mΩ	$I_{\sim max}$ 20 kHz 40 °C A	$I_{\sim R}$ 20 kHz 85 °C A	Ordering code [1)] Short code
B41534								
100	100	18 × 30	90	115	85	2,9	1,0	-A9107-M
	150	18 × 30	65	77	62	3,5	1,2	-A9157-M
	220	18 × 40	48	55	48	4,4	1,5	-A9227-M
	330	22 × 40	36	40	37	5,2	1,8	-A9337-M
	470	25 × 40	28	32	31	7,0	2,4	-A9477-M
B43534-								
200	47	18 × 30	520	1300	1100	1,1	0,36	-A476-M
	68	18 × 40	360	900	780	1,6	0,55	-A686-M
	100	22 × 40	250	630	540	2,1	0,71	-A107-M
	150	22 × 40	170	430	360	2,5	0,86	-A157-M
	220	25 × 40	120	300	250	3,5	1,2	-A227-M
385	47	18 × 40	440	1100	950	1,5	0,51	-E476-M
	68	22 × 40	310	780	670	1,9	0,63	-E686-M
	100	25 × 40	210	530	460	2,6	0,89	-E107-M
	150	25 × 40	150	380	310	3,1	1,1	-E157-M

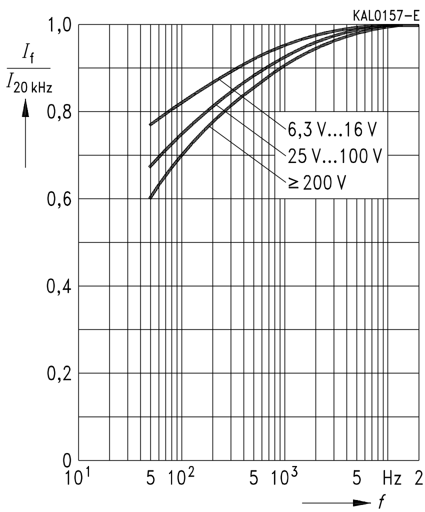
1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B43534-A9107-M
B41534-… (U_R = 6,3 … 100 V–);
B43534-… (U_R = 200 … 385 V–)



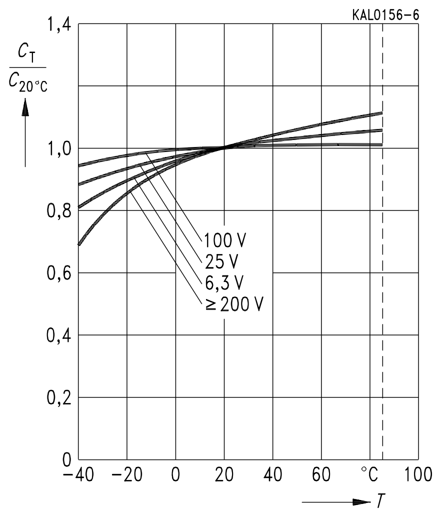
Useful life
versus ambient temperature T_A under ripple current operating conditions [1)]



Permissible ripple current *I~*
versus frequency *f*
Typical behavior

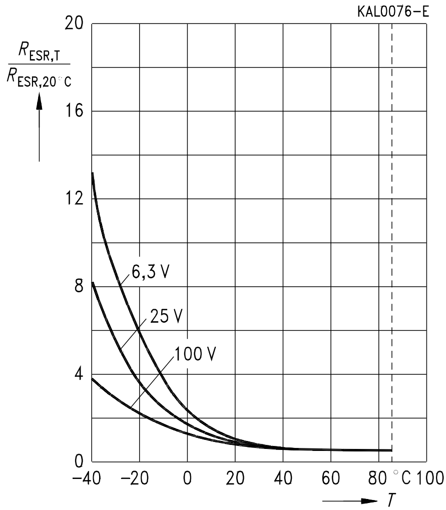


Series capacitance C_S at f = 100 Hz
versus temperature *T*
Typical behavior

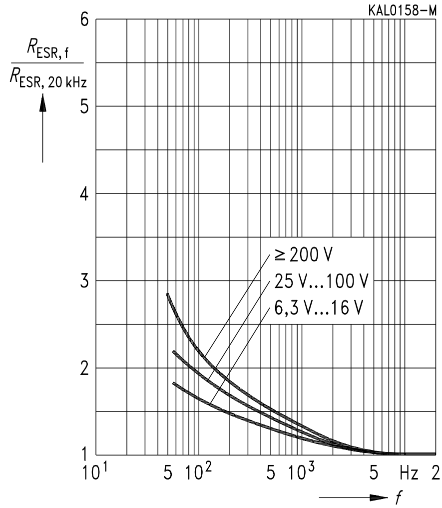


1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

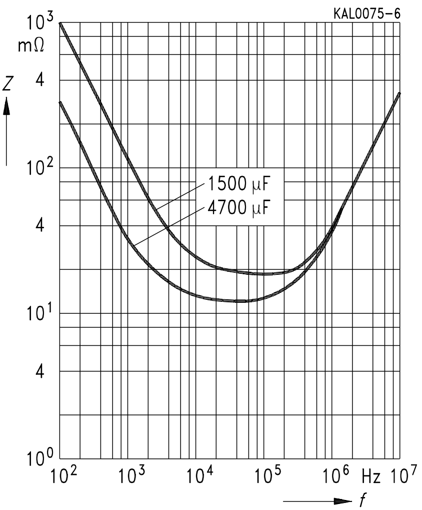
Equivalent series resistance R_{ESR}
at 100 Hz versus temperature T
Typical behavior



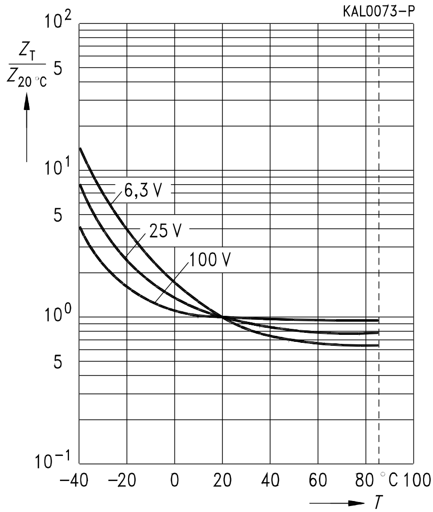
Equivalent series resistance R_{ESR}
versus frequency f
Typical behavior



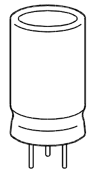
Impedance Z
versus frequency f
for U_R = 25 V– at 20 °C
Typical behavior



Impedance Z at 20 kHz
versus temperature T
Typical behavior



Especially long useful life
High volumetric efficiency
Operation at temperatures up to 105 °C



KAL0275-I

Construction

- Charge-discharge proof, polar
- Aluminum case with insulating sleeve
- Solder pin terminals brought out at one end to fit standardized PCB spacings
- Negative potential can be applied to third pin; this pin does not serve as a minus pole, however

Construction

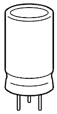
- Low equivalent series resistance R_{ESR}
- Very high ripple current capability
- Very long useful life
- Wide temperature range
- Pinning ensures correct insertion

Applications

- Specially suitable for use in output circuits of switch-mode power supplies
- General industrial electronics, telecommunications and data processing equipment

Specifications and characteristics in brief

Rated voltage U_R Surge voltage U_S	6,3 … 63 V– $1{,}15 \cdot U_R$
Rated capacitance C_R Capacitance tolerance	1 000 … 33 000 µF ± 20 % ≙ M
Useful life 40 °C, U_R 85 °C, U_R; $I_{\sim max}$ 105 °C, U_R; $I_{\sim R}$	 > 200 000 h (2,9 · $I_{\sim R,105°C}$) > 12 000 h ≥ 5 000 h
Failure percentage	≤ 1 % (during useful life)
Failure rate	≤ 20 fit ($\leq 20 \cdot 10^{-9}$/h)
Voltage endurance test	2 000 h, 105 °C (at U_R)
Leakage current I_{lka} (5 min, 20 °C)	$I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$
Self-inductance L_{ESL}	approx. 10 nH

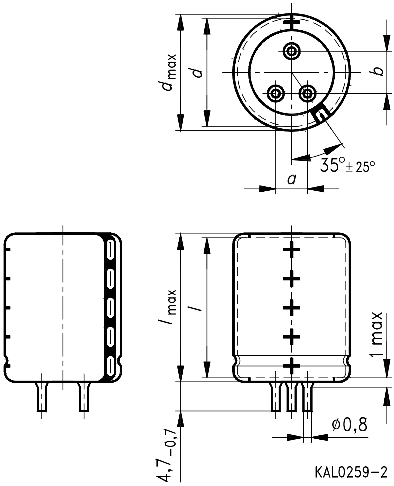


B 41 538

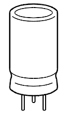
Specifications and characteristics in brief

IEC climatic category	in accordance with IEC 68–1 55/105/56 (– 55 °C/+ 105 °C, 56 days damp heat test)
Detail specification Sectional specifications	– IEC 384–4 (DIN 45 910 part 12)
Vibration resistance	in accordance with IEC 68–2–6, test Fc: displacement amplitude 0,35 mm, frequency range 10 … 55 Hz, acceleration max. 5 *g*, duration 3 × 2 h

Outline drawing



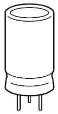
Dimensions (mm)				Approximate weight	Packing units
$d \times l$	$d_{max} \times l_{max}$	$a^{+0,4}_{-0,2}$	$b^{+0,4}_{-0,2}$	(g)	(pieces)
18 × 30	18,8 × 30,5	5	7,5	11	600
18 × 40	18,8 × 40,5	5	7,5	14	600
22 × 30	22,8 × 30,5	7,5	10	14	384
22 × 40	22,8 × 40,5	7,5	10	18	256
25 × 30	25,8 × 30,5	7,5	10	18	384
25 × 40	25,8 × 40,5	7,5	10	26	256



Overview of available types

U_R (V–)	6,3	10	16	25	40	63
C_R (µF)	Case dimensions $d \times l$ (mm)					
1 000						18 × 30
1 500						18 × 40 22 × 30
2 200					18 × 30	22 × 40 25 × 30
3 300				18 × 30	18 × 40 22 × 30	25 × 40
4 700			18 × 30	18 × 40 22 × 30	22 × 40 25 × 30	
6 800		18 × 30	18 × 40 22 × 30	22 × 40 25 × 30	25 × 40	
10 000	18 × 30	18 × 40 22 × 30	22 × 40 25 × 30	25 × 40		
15 000	18 × 40 22 × 30	22 × 40 25 × 30	25 × 40			
22 000	22 × 40 25 × 30	25 × 40				
33 000	25 × 40					

The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.

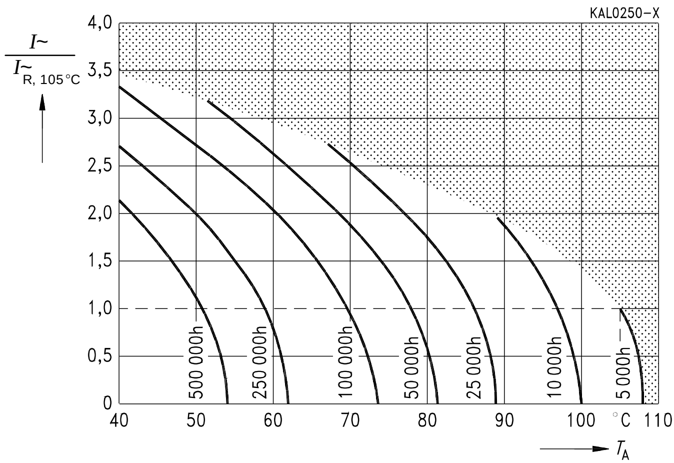


Technical data and ordering codes

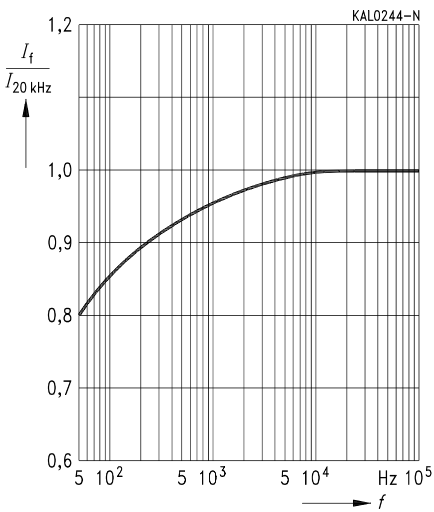
U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 20 kHz 20 °C mΩ	$R_{ESR, max}$ 20 kHz 20 °C mΩ	Z_{max} 200 kHz 20 °C mΩ	$I_{\sim max}$ 20 kHz 40 °C A	$I_{\sim max}$ 20 kHz 85 °C A	$I_{\sim R}$ 20 kHz 105 °C A	Ordering code 1) Short code
6,3	10 000	18 × 30	22	33	32	7,4	4,5	2,2	-A2109-M
	15 000	18 × 40	19	29	28	8,8	5,3	2,6	-A2159-M
	15 000	22 × 30	19	29	28	8,8	5,3	2,6	-J2159-M
	22 000	22 × 40	17	26	25	10	6,2	3,0	-A2229-M
	22 000	25 × 30	17	26	25	10	6,2	3,0	-J2229-M
	33 000	25 × 40	15	23	24	12	7,5	3,6	-A2339-M
10	6 800	18 × 30	22	33	32	7,4	4,5	2,2	-A3688-M
	10 000	18 × 40	19	29	28	8,8	5,3	2,6	-A3109-M
	10 000	22 × 30	19	29	28	8,8	5,3	2,6	-J3109-M
	15 000	22 × 40	16	24	25	11	6,4	3,1	-A3159-M
	15 000	25 × 30	16	24	25	11	6,4	3,1	-J3159-M
	22 000	25 × 40	15	23	24	12	7,5	3,6	-A3229-M
16	4 700	18 × 30	22	33	32	7,4	4,5	2,2	-A4478-M
	6 800	18 × 40	19	29	28	8,8	5,3	2,6	-A4688-M
	6 800	22 × 30	19	29	28	8,8	5,3	2,6	-J4688-M
	10 000	22 × 40	16	24	25	11	6,4	3,1	-A4109-M
	10 000	25 × 30	16	24	25	11	6,4	3,1	-J4109-M
	15 000	25 × 40	15	23	24	12	7,5	3,6	-A4159-M
25	3 300	18 × 30	21	32	31	7,6	4,6	2,2	-A5338-M
	4 700	18 × 40	18	27	27	9,1	5,5	2,6	-A5478-M
	4 700	22 × 30	18	27	27	9,1	5,5	2,6	-J5478-M
	6 800	22 × 40	16	24	25	11	6,4	3,1	-A5688-M
	6 800	25 × 30	16	24	25	11	6,4	3,1	-J5688-M
	10 000	25 × 40	15	23	24	12	7,5	3,6	-A5109-M
40	2 200	18 × 30	21	32	31	7,6	4,6	2,2	-A7228-M
	3 300	18 × 40	18	27	27	9,1	5,5	2,6	-A7338-M
	3 300	22 × 30	18	27	27	9,1	5,5	2,6	-J7338-M
	4 700	22 × 40	16	24	25	11	6,4	3,1	-A7478-M
	4 700	25 × 30	16	24	25	11	6,4	3,1	-J7478-M
	6 800	25 × 40	15	22	24	12	7,5	3,6	-A7688-M
63	1 000	18 × 30	50	75	75	4,9	3,0	1,4	-A8108-M
	1 500	18 × 40	35	53	53	6,5	3,9	1,9	-A8158-M
	1 500	22 × 30	35	53	53	6,5	3,9	1,9	-J8158-M
	2 200	22 × 40	25	38	38	8,8	5,1	2,5	-A8228-M
	2 200	25 × 30	25	38	38	8,8	5,1	2,5	-J8228-M
	3 300	25 × 40	19	28	28	11	6,7	3,2	-A8338-M

1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B41538-A2109-M

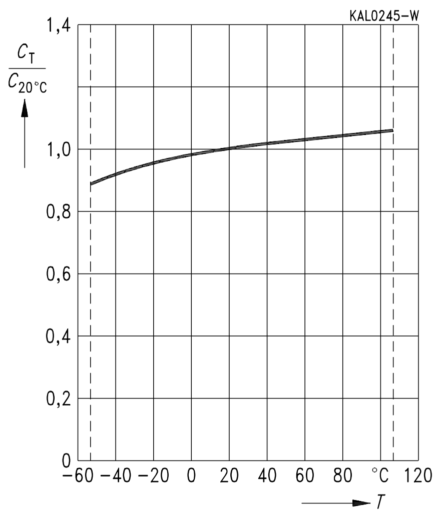
Useful life
versus ambient temperature T_A under ripple current operating conditions [1]



Permissible ripple current *I*~
versus frequency *f*
Typical behavior

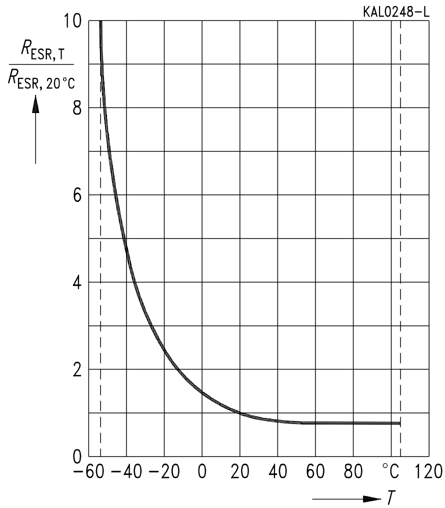


Series capacitance C_S at f = 100 Hz
versus temperature T
Typical behavior

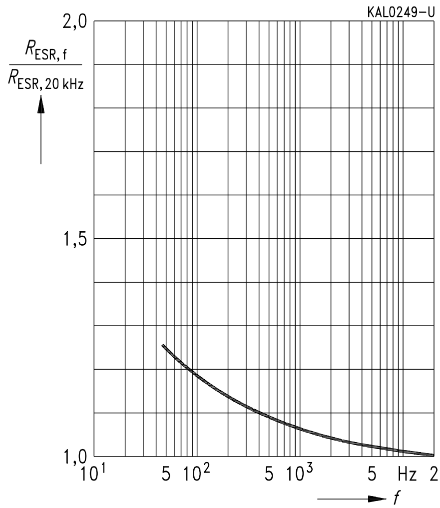


1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

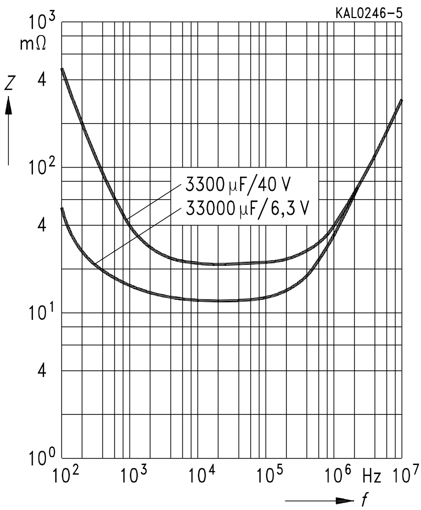
Equivalent series resistance R_{ESR}
at 100 Hz versus temperature T
Typical behavior



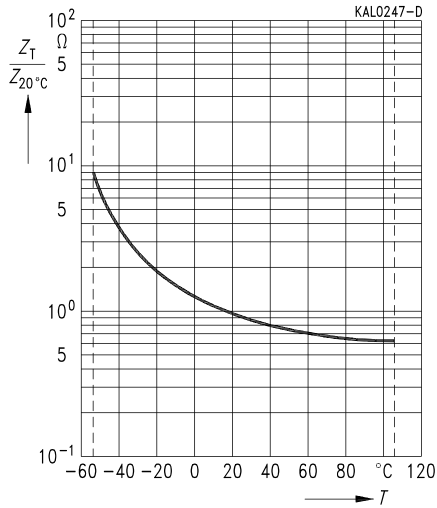
Equivalent series resistance R_{ESR}
versus frequency f
Typical behavior

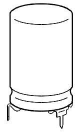


Impedance Z
versus frequency f at 20 °C
Typical behavior



Impedance Z at 20 kHz
versus temperature T
Typical behavior



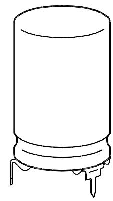


Overview

Quality grade	Type	U_R V–	C_R µF	Temperature [1] °C	Special features and fields of application	Page
GP	B 41 293 B 43 293	10 … 100 160 … 385	100 … 4 700 10 … 220	– 40 … + 85 (+ 105)	Good mounting stability and high vibration resistance Pinning ensures correct insertion Standard version for entertainment and industrial electronics, also for automotive electronics	230
LL	B 41 593 B 43 593	10… 100 160 … 350	47 … 4 700 10 … 220	– 40 … + 85 (+ 105)	High reliability and long useful life High vibration resistance Pinning ensures correct insertion For filter, coupling and pulse circuits For automotive electronics	241
SIKOREL	B 41 592	10 … 100	47 … 4 700	– 55 … + 125 (+ 145)	Very high reliability and long useful life Shelf life up to 10 years Pinning ensures correct insertion For high-reliability equipment in industrial and automotive electronics	252
High performance	B 43 592	160 … 350	10 … 220	– 40 … + 105	High ripple current capability High vibration resistance Pinning ensures correct insertion For high-reliability equipment in industrial and automotive electronics	260

1) The temperature specified in brackets applies to operation at reduced voltage and current.

Standard type for entertainment and industrial electronics


KAL0276-R

Construction

- Charge-discharge proof, polar
- Aluminum case, partially insulated
- Solder pins on mounting base that is securely welded to the case, ensuring perfect electrical contact
- Positive pole connection brought out axially at center
- Negative pole connected to two or three solder pins of the mounting base

Features

- Good stability and vibration resistance
- Operation at temperatures up to 105 °C [1) permissible
- High parametric stability
- Pinning ensures correct insertion

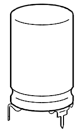
Applications

- Standard type for entertainment and industrial electronics
- Filtering, coupling and pulse circuits
- Automotive electronics

Specifications and characteristics in brief

	B 41 293	B 43 293
Rated voltage U_R Surge voltage U_S	10 … 100 V– 1,15 · U_R	160 … 385 V– 1,15 · U_R (for $U_R \leq$ 250 V–) 1,10 · U_R (for $U_R \geq$ 350 V–)
Rated capacitance C_R Capacitance tolerance	100 … 4 700 µF – 10/+ 50 % ≙ T	10 … 220 µF – 10/+ 50 % ≙ T
Useful life 40 °C, U_R 85 °C, U_R; $I_{\sim R}$	 > 200 000 h (1,5 · $I_{\sim R,85°C}$) > 4 000 h	 > 200 000 h ($I_{\sim R,85°C}$) > 3 000 h
Failure percentage	≤ 1 % (during useful life)	≤ 1 % (during useful life)
Failure rate	≤ 100 fit (≤ 100 · 10^{-9}/h)	≤ 100 fit (≤ 100 · 10^{-9}/h)
Voltage endurance test	2 000 h, 85 °C (at U_R)	2 000 h, 85 °C (at U_R)
Leakage current I_{lka} (5 min, 20 °C)	$I_{lka} \leq 0{,}3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)^{0,7} + 4\ \mu A$	

1) Operation at 105 °C and 0,6 $I_{\sim max,85\,°C}$ permissible for a total of 500 h.

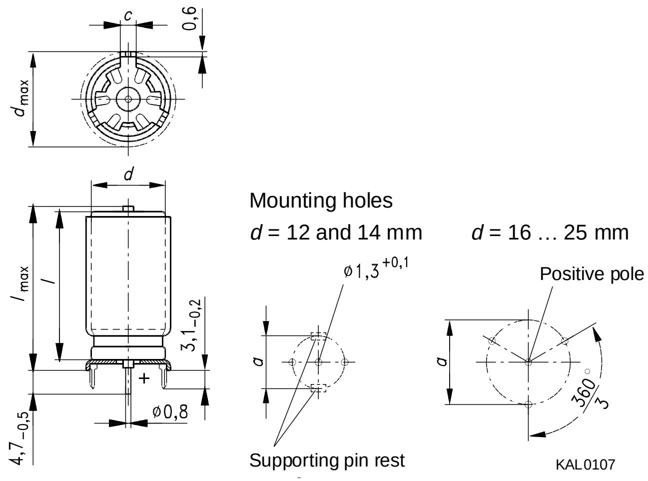


Specifications and characteristics in brief

	B 41 293			B 43 293				
Self-inductance L_{ESL}	*d* (mm)	12	14	16	18	21	25	25
	l (mm)	30	30	30	39,5	40	40	45
	L_{ESL} approx. (nH)	23	38	38	37	17	17	40
IEC climatic category	in accordance with IEC 68–1 40/085/56 (– 40 °C/+ 85 °C, 56 days damp heat test)							
Detail specifications Sectional specifications	similar to CECC 30 301-048 (similar to DIN 45 910 part 1210) IEC 384–4 1) (DIN 45 910 part 12)							
Vibration resistance	in accordance with IEC 68–2–6, test Fc: displacement amplitude 0,75 mm, frequency range 10 … 55 Hz, acceleration max. 10 *g*, duration 3 × 2 h							

1) These capacitors comply with the requirements for “Long-Life Grade” (LL).

Outline drawing

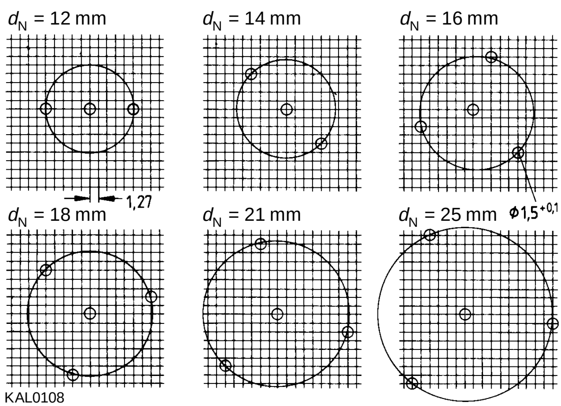


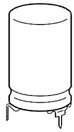
Soldering star and supports are connected to the negative pole

Dimensions (mm) $d \times l$	$d_{max} \times l_{max}$	$a \pm 0,1$	$c \pm 0,1$	Approx weight (g)	Packing units (pieces)
12 × 30	13,5 × 33	12,5	3,0	5,7	480
14 × 30	15,5 × 33	14,5		7,9	480
16 × 30	17,5 × 33	16,5		9,8	300
18 × 39,5	19,5 × 40,8	18,5		15	200
21 × 40	22,5 × 42	21,5	3,5	19	128
25 × 40	26,5 × 42	25,5		27	128
25 × 45	26,5 × 47	25,5		27	128

The PC-board hole arrangement specified above is based on circular arcs.

If, however, the mounting holes have to be matched to a standard drilling raster, a spacing of 1,27 mm ($^1/_{20}$″) has proved to be sufficiently accurate if the following arrangements are used:





Overview of available types

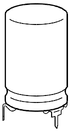
Type B 41 293

U_R (V–)	10	16	25	40	63	100
C_R (µF)	Case dimensions $d \times l$ (mm)					
100						12 × 30
220					12 × 30	16 × 30
470			12 × 30	12 × 30	16 × 30	21 × 40
1 000	12 × 30	12 × 30	14 × 30	16 × 30	21 × 40	
2 200	14 × 30	16 × 30	18 × 39,5	21 × 40		
4 700	18 × 39,5	21 × 40	25 × 40			

Type B 43 293

U_R (V–)	160	250	350	385
C_R (µF)	Case dimensions $d \times l$ (mm)			
10			12 × 30	
22	12 × 30	12 × 30	14 × 30	
47	14 × 30	16 × 30	18 × 39,5	
100	18 × 39,5	21 × 40	25 × 40	25 × 40
150				25 × 45
220	25 × 40			

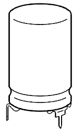
The above capacitance and voltage ratings are available in smaller cases upon request. Other capacitance and voltage ratings are also available upon request.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C Ω	$R_{ESR, max}$ 100 Hz 20 °C Ω	Z_{max} 10 kHz 20 °C Ω	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code [1)] Short code
B41293-								
10	1 000	12 × 30	0,18	0,32	0,16	1,7	0,57	-A3108-T
	2 200	14 × 30	0,10	0,18	0,08	2,3	0,81	-J3228-T
	4 700	18 × 39,5	0,06	0,10	0,05	4,1	1,4	-J3478-T
16	1 000	12 × 30	0,15	0,28	0,13	1,8	0,63	-J4108-T
	2 200	16 × 30	0,09	0,16	0,06	2,7	0,93	-B4228-T
	4 700	21 × 40	0,06	0,09	0,05	4,4	1,5	-A4478-T
25	470	12 × 30	0,21	0,53	0,19	1,5	0,53	-A5477-T
	1 000	14 × 30	0,12	0,25	0,09	2,1	0,74	-J5108-T
	2 200	18 × 39,5	0,07	0,14	0,05	3,8	1,3	-J5228-T
	4 700	25 × 40	0,05	0,09	0,05	5,2	1,8	-B5478-T
40	470	12 × 30	0,18	0,38	0,15	1,7	0,57	-J7477-T
	1 000	16 × 30	0,10	0,18	0,08	2,6	0,88	-B7108-T
	2 200	21 × 40	0,07	0,11	0,05	4,1	1,4	-B7228-T
63	220	12 × 30	0,30	0,64	0,25	1,3	0,44	-J8227-T
	470	16 × 30	0,14	0,30	0,12	2,1	0,74	-B8477-T
	1 000	21 × 40	0,08	0,14	0,06	3,8	1,3	-A8108-T
100	100	12 × 30	0,40	1,0	0,45	1,1	0,38	-B9107-T
	220	16 × 30	0,22	0,55	0,20	1,7	0,59	-B9227-T
	470	21 × 40	0,12	0,26	0,10	2,9	1,0	-B9477-T

1) For instructions on how to determine ordering codes, refer to page 235.



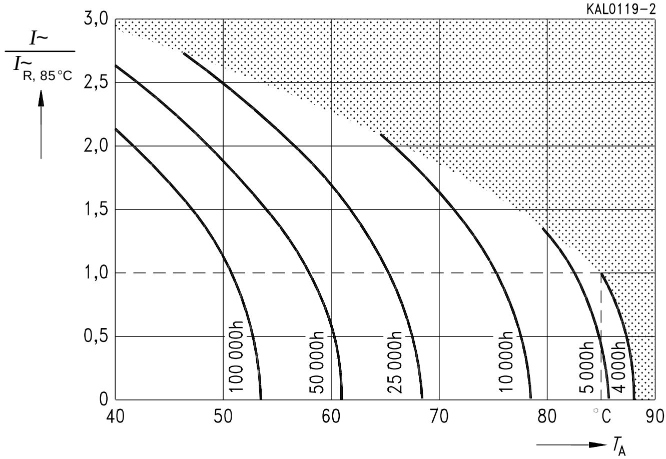
Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR,\ typ}$ 100 Hz 20 °C Ω	$R_{ESR,\ max}$ 100 Hz 20 °C Ω	Z_{max} 10 kHz 20 °C Ω	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code [1)] Short code
B43293-								
160	22	12 × 30	4,0	8,8	6,8	0,36	0,12	-A1226-T
	47	14 × 30	1,9	4,1	3,3	0,55	0,19	-A1476-T
	100	18 × 39,5	0,95	1,9	1,5	1,02	0,35	-A1107-T
	220	25 × 40	0,43	0,88	0,68	1,81	0,62	-A1227-T
250	22	12 × 30	3,3	8,8	6,8	0,39	0,13	-A2226-T
	47	16 × 30	1,5	4,1	3,3	0,67	0,23	-A2476-T
	100	21 × 40	0,72	1,9	1,5	1,3	0,44	-A2107-T
350	10	12 × 30	5,6	19	15	0,30	0,10	-A4106-T
	22	14 × 30	2,5	8,8	6,8	0,48	0,17	-A4226-T
	47	18 × 39,5	1,2	4,1	3,3	0,91	0,31	-A4476-T
	100	25 × 40	0,56	1,9	1,5	1,6	0,54	-A4107-T
385	100	25 × 40	0,56	1,9	1,5	1,6	0,54	-A0107-T
	150	25 × 45	0,37	1,3	1,0	2,0	0,70	-A0157-T

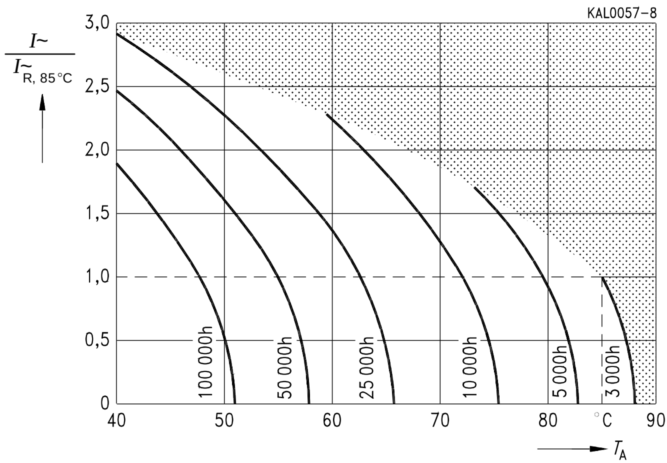
1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B43293-A1226-T
B41293-... (U_R = 10 … 100 V–)
B43293-... (U_R = 160 … 385 V–)

Useful life
versus ambient temperature T_A under ripple current operating conditions [1)]

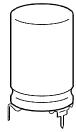
U_R = 10 … 100 V–



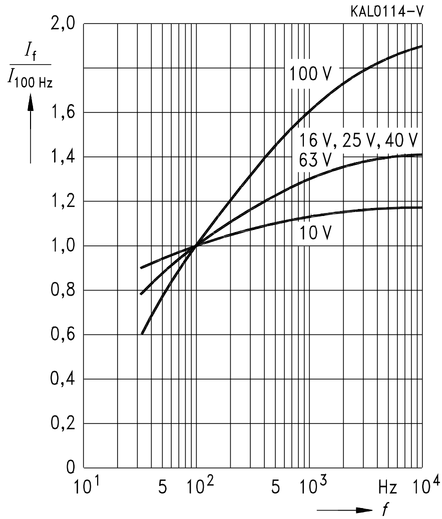
U_R = 160 … 385 V–



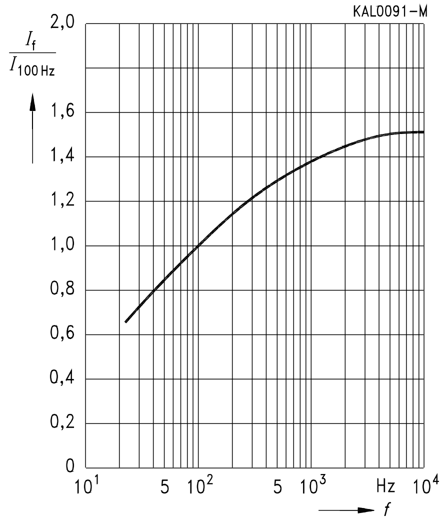
1) Refer to page 34 for an explanation on how to interpret the useful life graphs.



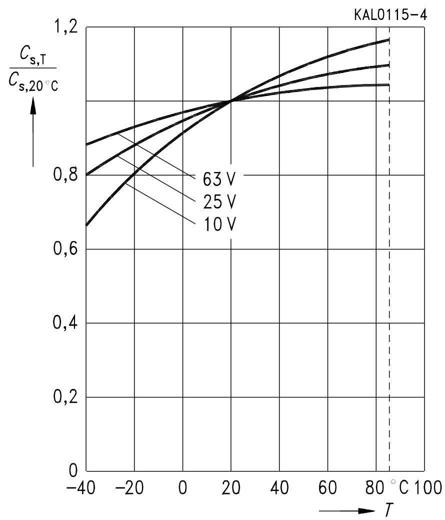
Permissible ripple current *I*~
versus frequency *f*
$U_R \leq 100$ V–



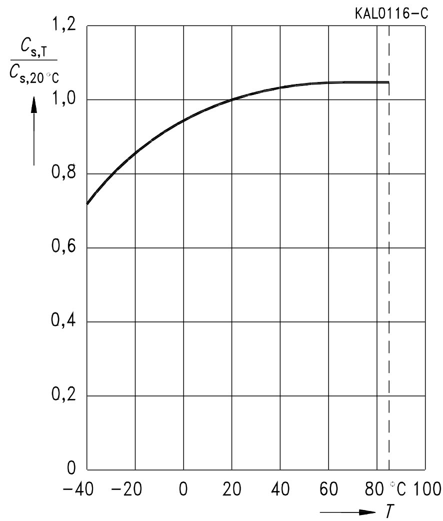
Permissible ripple current *I*~
versus frequency *f*
$U_R \geq 160$ V–

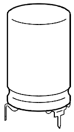


Series capacitance C_S at f = 100 Hz
versus temperature T
Typical behavior
$U_R \leq 100$ V–

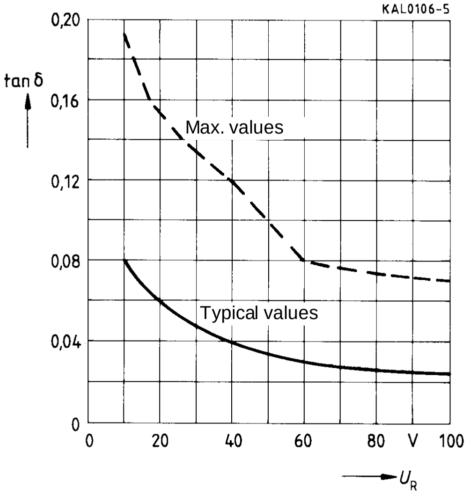


Series capacitance C_S at f = 100 Hz
versus temperature T
Typical behavior
$U_R \geq 160$ V–



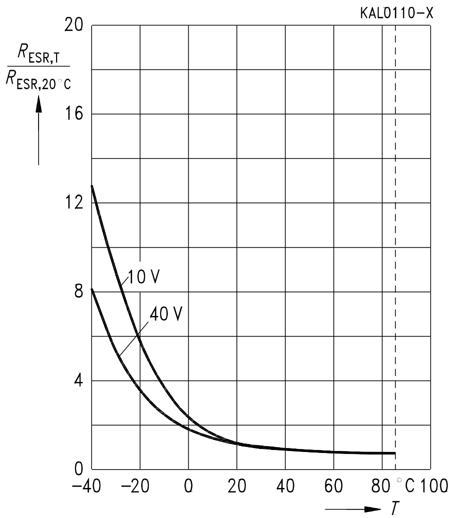


Dissipation factor tan δ
at T = 20 °C and f = 100 Hz
versus rated voltage U_R
$U_R \leq$ 100 V–

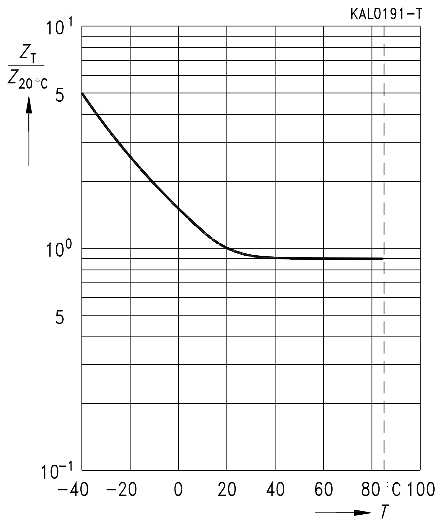


The maximum values correspond to DIN 45 910 part 126, sheet 1 and apply to $C_R \leq$ 1000 µF. The values increase by 0,02 per 1000 µF.

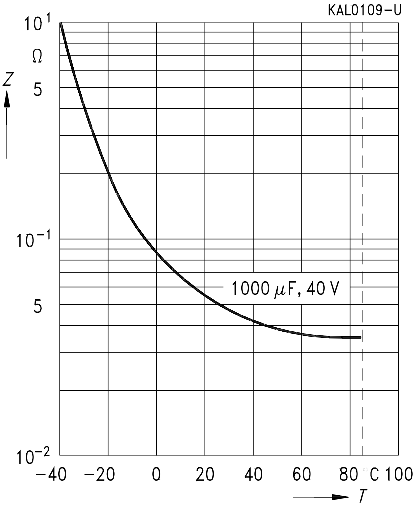
Equivalent series resistance R_{ESR}
at f = 100 Hz versus temperature T
Typical behavior
$U_R \leq$ 100 V–



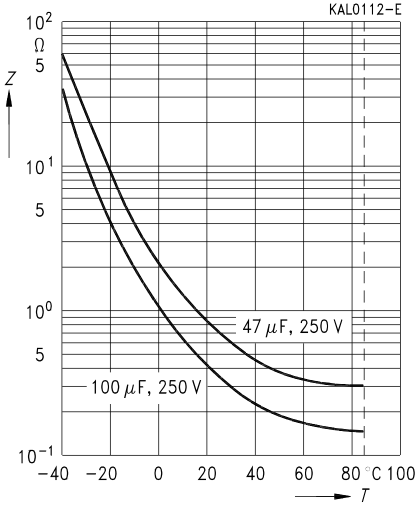
Impedance Z at f = 100 Hz
versus temperature T
Typical behavior
$U_R \geq$ 160 V–



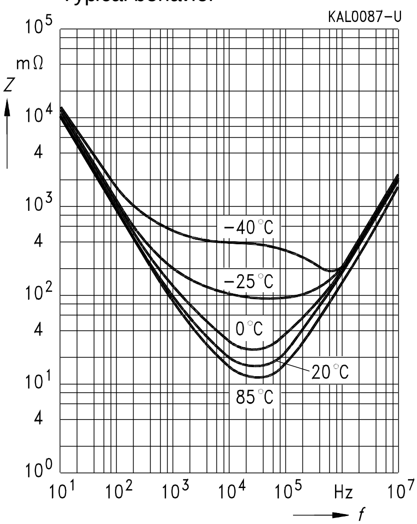
Impedance *Z* at f = 10 kHz
versus temperature T
Typical behavior
$U_R \leq 100$ V–



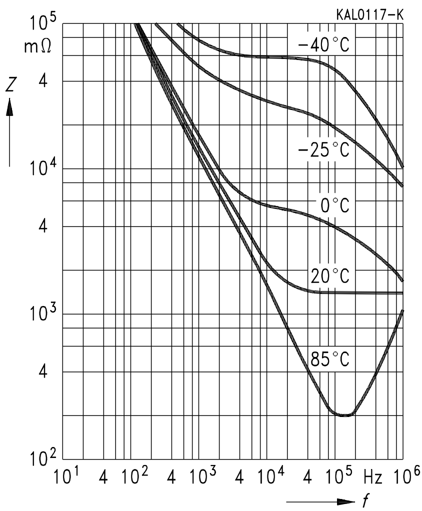
Impedance *Z* at f = 10 kHz
versus temperature T
Typical behavior
$U_R \geq 160$ V–



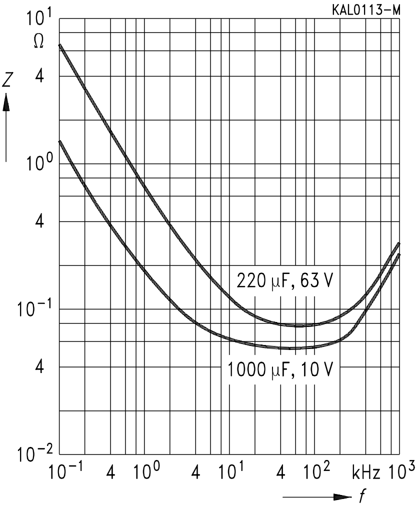
Impedance *Z*
versus frequency f
and temperature T for 1000 µF/40 V–
Typical behavior



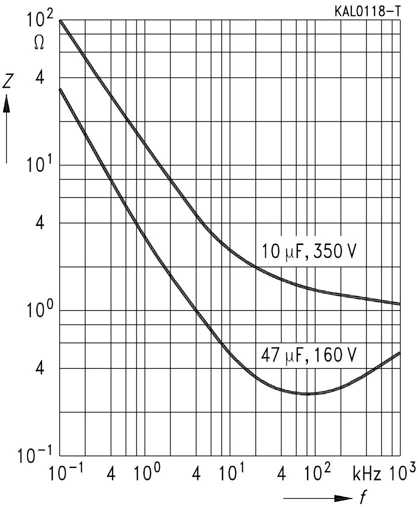
Impedance *Z*
versus frequency f
and temperature T for 22 µF/250 V–
Typical behavior



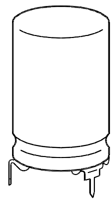
Impedance *Z*
versus frequency *f*
Typical values at 20 °C
$U_R \leq 100$ V–



Impedance *Z*
versus frequency *f*
Typical values at 20 °C
$U_R \geq 160$ V–



High reliability and long useful life


KAL0276-R

Construction

- Charge-discharge proof, polar
- Aluminum case, partially insulated
- Solder pin terminals on mounting base that is securely welded to case, ensuring perfect electrical contact
- Positive pole connection brought out axially at center
- Negative pole connected to two or three solder pins of the mounting base

Features

- High reliability and long useful life
- Can be operated at temperatures of up to 105 °C [1)]
- High parametric stability
- High vibration resistance
- Pinning ensures correct insertion

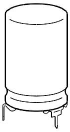
Applications

- Professional industrial electronics equipment
- Filtering, coupling and pulse circuits
- Automotive electronics

Specifications and characteristics in brief

	B 41 593	B 43 593
Rated voltage U_R Surge voltage U_S	10 … 100 V– 1,15 · U_R	160 … 350 V– 1,15 · U_R (for $U_R \leq$ 250 V–) 1,10 · U_R (for U_R = 350 V–)
Rated capacitance C_R Capacitance tolerance	47 … 4 700 µF – 10/+ 50 % ≙ T	10 … 220 µF – 10/+ 50 % ≙ T
Useful life 40 °C, U_R 85 °C, U_R; $I_{\sim R}$	 > 200 000 h (2,0 · $I_{\sim R,85°C}$) > 10 000 h	 > 200 000 h (1,7 · $I_{\sim R,85°C}$) > 8 000 h
Failure percentage	≤ 0,5 % (during useful life)	≤ 0,5 % (during useful life)
Failure rate	≤ 20 fit (≤ 20 · 10^{-9}/h)	≤ 20 fit (≤ 20 · 10^{-9}/h)
Voltage endurance test	5 000 h, 85 °C (at U_R)	5 000 h, 85 °C (at U_R)

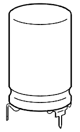
1) Operation at 105 °C and 0,6 $I_{\sim max, 85 °C}$ permissible for a total of 500 h.



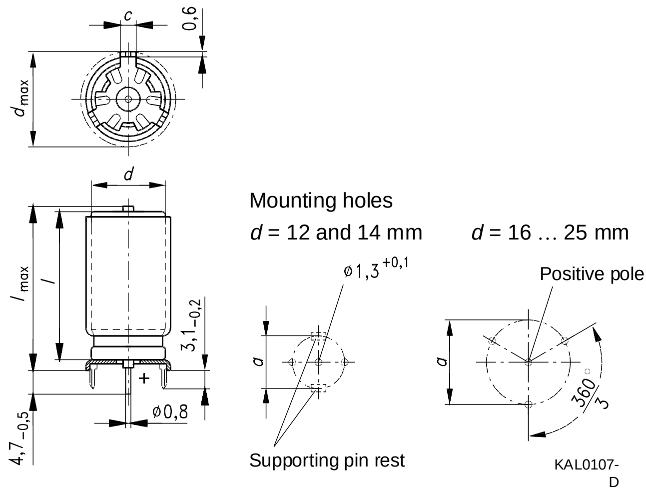
B 41 593
B 43 593

Specifications and characteristics in brief

	B 41 593			B 43 593			
Leakage current I_{lka} (5 min, 20 °C)	$I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$						
Self-inductance L_{ESL}	d (mm)	12	14	16	18	21	25
	l (mm)	30	30	30	39,5	40	40
	L_{ESL} approx. (nH)	23	37	38	37	17	17
IEC climatic category	in accordance with IEC 68–1 40/085/56 (–40 °C/+85 °C, 56 days damp heat test)						
Detail specifications	similar to CECC 30 301-049 (similar to DIN 45 910 part 1211)						
Sectional specifications	IEC 384–4 (DIN 45 910 part 12)						
Vibration resistance	in accordance with IEC 68–2–6, test Fc: displacement amplitude 0,75 mm, frequency range 10 … 55 Hz, acceleration max. 10 g, duration 3 × 2 h						



Outline drawing

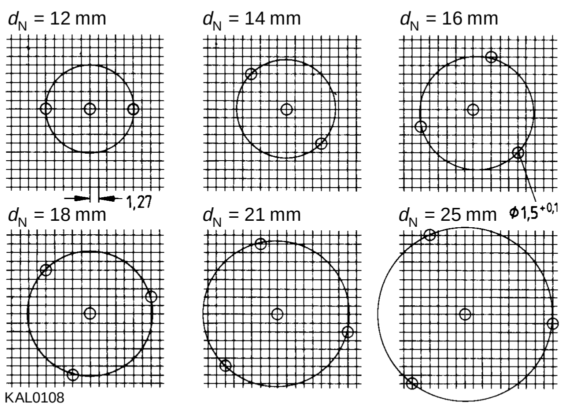


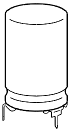
Soldering star and supports are connected to the negative pole

Dimensions (mm) $d \times l$	$d_{max} \times l_{max}$	$a \pm 0,1$	$c \pm 0,1$	Approx weight (g)	Packing units (pieces)
12 × 30	13,5 × 33	12,5	3,0	5,7	480
14 × 30	15,5 × 33	14,5		7,9	480
16 × 30	17,5 × 33	16,5		9,8	300
18 × 39,5	19,5 × 40,8	18,5		15	200
21 × 40	22,5 × 42	21,5	3,5	19	128
25 × 40	26,5 × 42	25,5		27	128

The PC-board hole arrangement specified above is based on circular arcs.

If, however, the mounting holes have to be matched to a standard drilling raster, a spacing of 1,27 mm ($^1/_{20}''$) has proved to be sufficiently accurate if the following arrangements are used:





Overview of available types

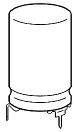
Type B 41 593

U_R (V–)	10	16	25	40	63	100
C_R (µF)	Case dimensions $d \times l$ (mm)					
47						12 × 30
100					12 × 30	16 × 30
220			12 × 30	12 × 30	16 × 30	18 × 39,5
470	12 × 30	12 × 30	14 × 30	16 × 30	21 × 40	25 × 40
1 000	14 × 30	16 × 30	18 × 39,5	21 × 40	25 × 40	
2 200	18 × 39,5	18 × 39,5	21 × 40	25 × 40		
4 700	25 × 40	25 × 40				

Type B 43 593

U_R (V–)	160	250	350
C_R (µF)	Case dimensions $d \times l$ (mm)		
10			12 × 30
22	12 × 30	14 × 30	14 × 30
47	14 × 30	16 × 30	18 × 39,5
100	18 × 39,5	21 × 40	25 × 40
220	25 × 40		

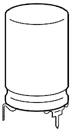
The above capacitance and voltage ratings are available in smaller cases upon request. Other capacitance and voltage ratings are also available upon request.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C Ω	$R_{ESR, max}$ 100 Hz 20 °C Ω	Z_{max} 10 kHz 20 °C Ω	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code 1) Short code
B41593-								
10	470	12 × 30	0,20	0,50	0,11	1,59	0,55	-A3477-T
	1 000	14 × 30	0,10	0,25	0,07	2,40	0,85	-J3108-T
	2 200	18 × 39,5	0,06	0,14	0,05	4,13	1,42	-A3228-T
	4 700	25 × 40	0,05	0,07	0,05	5,48	1,88	-A3478-T
16	470	12 × 30	0,18	0,45	0,11	1,70	0,57	-J4477-T
	1 000	16 × 30	0,10	0,25	0,06	2,70	0,92	-A4108-T
	2 200	18 × 39,5	0,06	0,12	0,05	4,10	1,42	-J4228-T
	4 700	25 × 40	0,05	0,06	0,05	5,50	1,88	-A4478-T
25	220	12 × 30	0,28	0,70	0,19	1,30	0,46	-A5227-T
	470	14 × 30	0,16	0,40	0,10	1,90	0,64	-J5477-T
	1 000	18 × 39,5	0,10	0,19	0,06	3,20	1,11	-J5108-T
	2 200	21 × 40	0,06	0,10	0,05	4,50	1,55	-A5228-T
40	220	12 × 30	0,25	0,63	0,18	1,40	0,49	-J7227-T
	470	16 × 30	0,13	0,33	0,10	2,20	0,77	-J7477-T
	1 000	21 × 40	0,07	0,16	0,06	4,00	1,39	-J7108-T
	2 200	25 × 40	0,04	0,08	0,05	5,90	2,00	-A7228-T
63	100	12 × 30	0,40	1,00	0,33	1,10	0,38	-J8107-T
	220	16 × 30	0,18	0,45	0,17	1,90	0,65	-J8227-T
	470	21 × 40	0,10	0,25	0,09	3,30	1,13	-J8477-T
	1 000	25 × 40	0,05	0,12	0,06	5,30	1,80	-A8108-T
100	47	12 × 30	0,60	1,50	0,62	0,90	0,31	-A9476-T
	100	16 × 30	0,32	0,80	0,31	1,40	0,49	-A9107-T
	220	18 × 39,5	0,16	0,40	0,15	2,40	0,83	-J9227-T
	470	25 × 40	0,09	0,23	0,09	4,10	1,39	-A9477-T

1) For instructions on how to determine ordering codes, refer to page 246.



Technical data and ordering codes

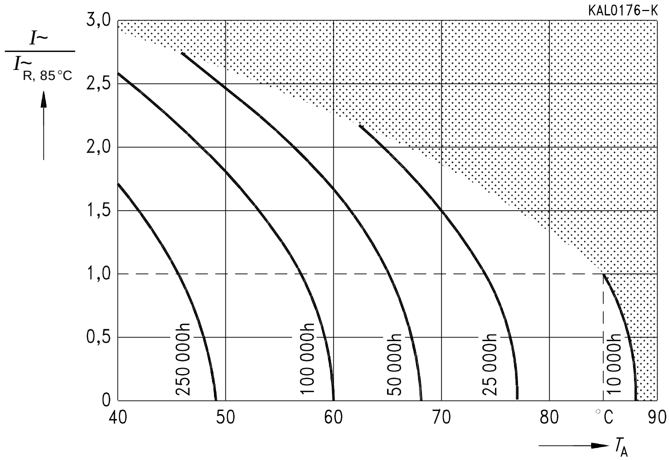
U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C Ω	$R_{ESR, max}$ 100 Hz 20 °C Ω	Z_{max} 10 kHz 20 °C Ω	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim R}$ 100 Hz 85 °C A	Ordering code [1)] Short code
B43593-								
160	22	12 × 30	3,60	8,00	3,30	0,38	0,13	-A1226-T
	47	14 × 30	1,70	3,80	1,60	0,58	0,20	-A1476-T
	100	18 × 39,5	0,80	1,80	0,75	1,11	0,38	-A1107-T
	220	25 × 40	0,36	0,80	0,35	1,97	0,68	-A1227-T
250	22	14 × 30	2,90	7,20	3,10	0,45	0,15	-A2226-T
	47	16 × 30	1,40	3,40	1,50	0,70	0,24	-A2476-T
	100	21 × 40	0,64	1,50	0,70	1,37	0,47	-A2107-T
350	10	12 × 30	4,80	12,00	6,40	0,33	0,11	-A4106-T
	22	14 × 30	2,20	5,50	2,90	0,51	0,18	-A4226-T
	47	18 × 39,5	1,00	2,50	1,40	1,00	0,34	-A4476-T
	100	25 × 40	0,48	1,30	0,67	1,71	0,59	-A4107-T

1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B43593-A1226-T
B41593-... (U_R = 10 … 100 V–)
B43593-... (U_R = 160 … 350 V–)

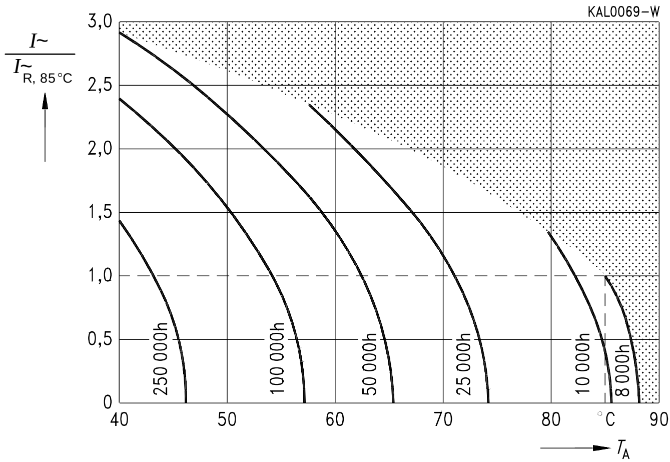
Useful life

versus ambient temperature T_A under ripple current operating conditions [1)]

U_R = 10 … 100 V–

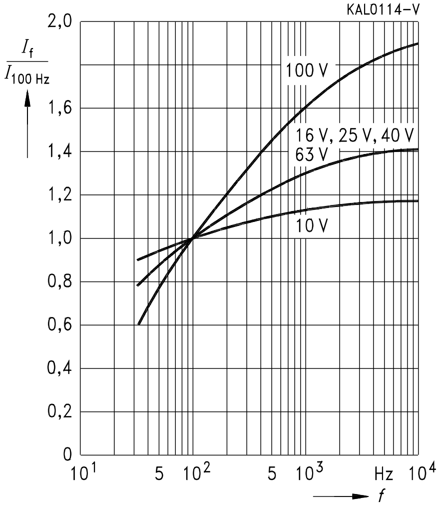


U_R = 160 … 350 V–

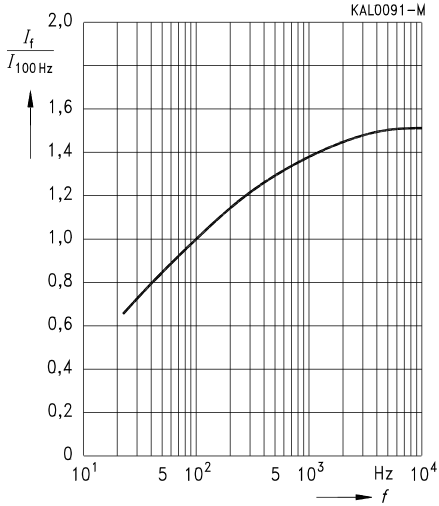


1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

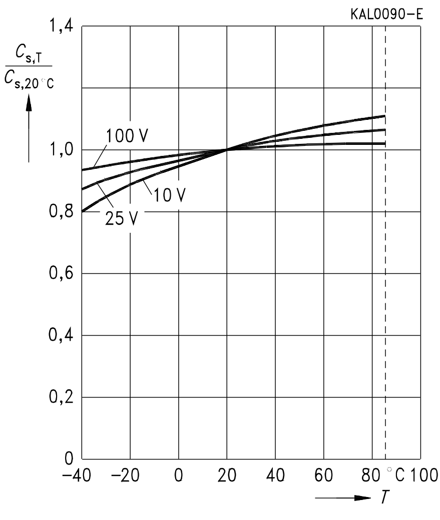
Permissible ripple current *I~*
versus frequency *f*
$U_R \leq 100$ V–



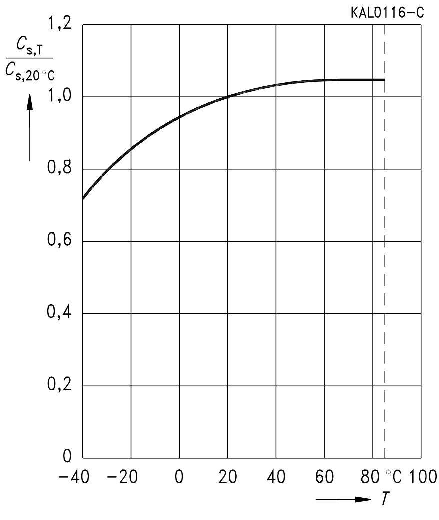
Permissible ripple current *I~*
versus frequency *f*
$U_R \geq 160$ V–

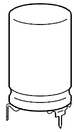


Series capacitance C_s at $f = 100$ Hz
versus temperature *T*
Typical behavior
$U_R \leq 100$ V–

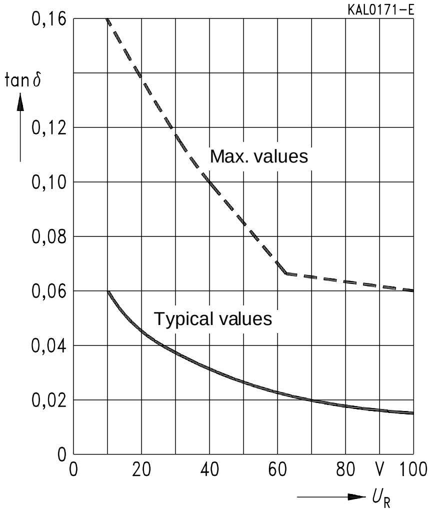


Series capacitance C_s at $f = 100$ Hz
versus temperature *T*
Typical behavior
$U_R \geq 160$ V–



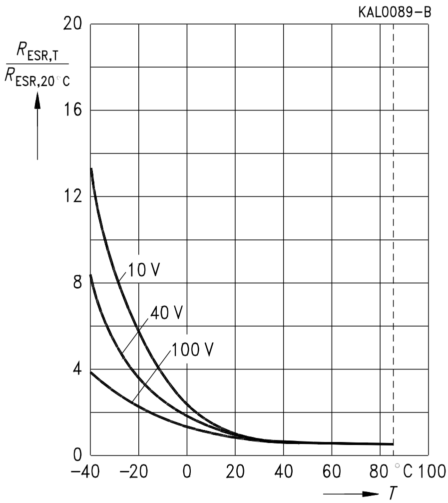


Dissipation factor tan δ
at T = 20 °C and f = 100 Hz
versus rated voltage U_R
$U_R \leq$ 100 V–

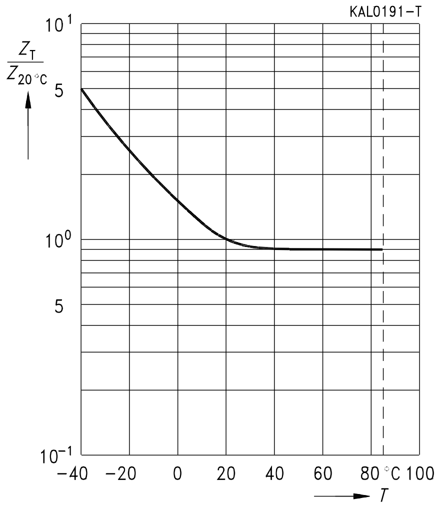


The maximum values correspond to DIN 45 910 part 123 and apply to $C_R \leq$ 1000 µF.
The values increase by 0,02 per 1000 µF.

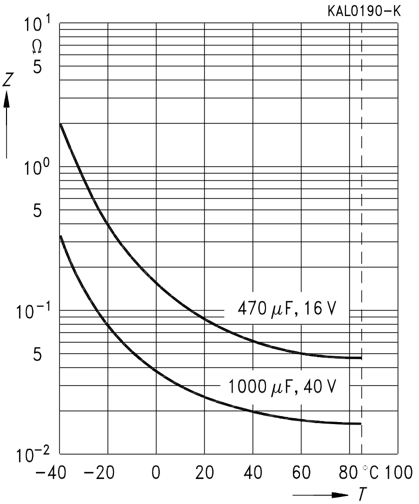
Equivalent series resistance R_{ESR}
at f = 100 Hz versus temperature T
Typical behavior
$U_R \leq$ 100 V–



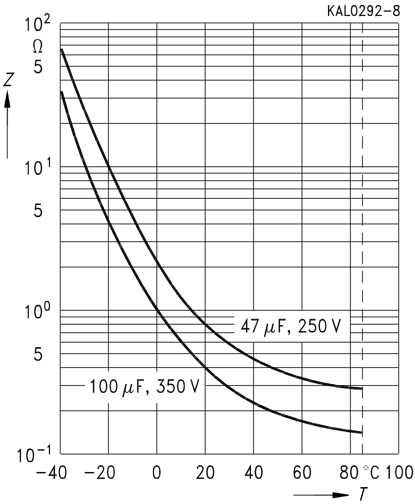
Impedance Z at f = 100 Hz
versus temperature T
Typical behavior
$U_R \geq$ 160 V–



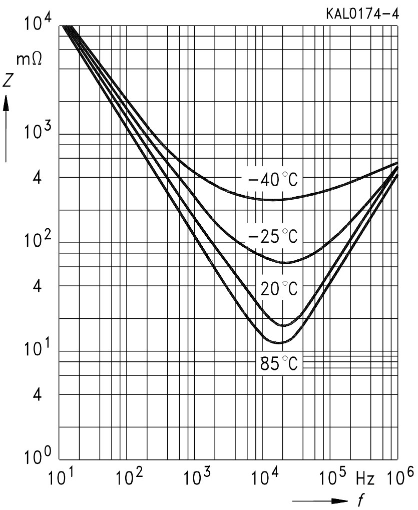
Impedance *Z* at *f* = 10 kHz
versus temperature *T*
Typical behavior
$U_R \leq 100$ V–



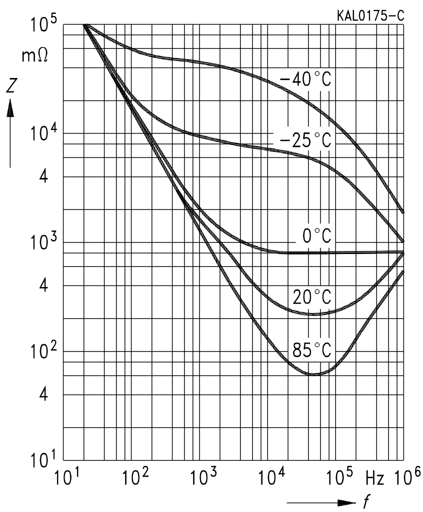
Impedance *Z* at *f* = 10 kHz
versus temperature *T*
Typical behavior
$U_R \geq 160$ V–

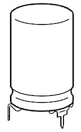


Impedance *Z*
versus frequency *f*
and temperature *T* for 1000 µF/40 V–
Typical behavior

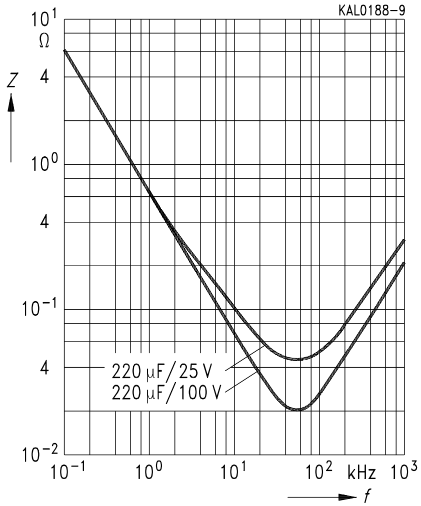


Impedance *Z*
versus frequency *f*
and temperature *T* for 22 µF/250 V–
Typical behavior

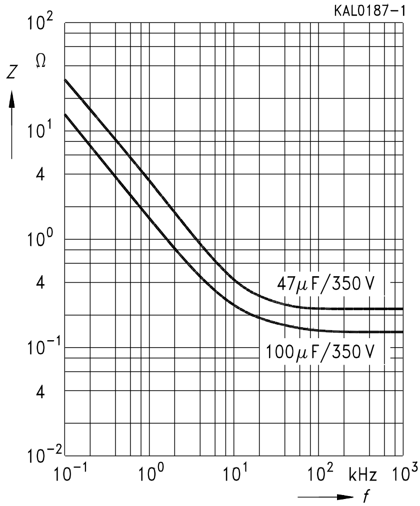




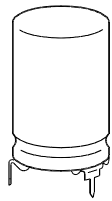
Impedance *Z*
versus frequency *f*
Typical values at 20 °C
$U_R \leq 100$ V–



Impedance *Z*
versus frequency *f*
Typical values at 20 °C
$U_R \geq 160$ V–



Extremely high reliability and long useful life
Operation at temperatures up to 125 °C



KAL0276-R

Construction

- Charge-discharge proof, polar
- Aluminum case, partially insulated
- Solder pin terminals on mounting base that is securely welded to case, ensuring perfect electrical contact
- Positive pole connection brought out axially at center
- Negative pole connected to two or three solder pins of the mounting base

Features

- Extemely high reliability and long useful life
- Very wide temperature range
- Outstanding parametric stability
- High ripple current capability
- Can be operated at temperatures of up to 145 °C [1)]
- Shelf life up to 10 years
- Pinning ensures correct insertion

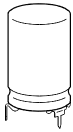
Applications

- High-reliability equipment in industrial and automotive electronics

Specifications and characteristics in brief

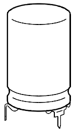
Rated voltage U_R Surge voltage U_S	10 to 100 V– 1,15 · U_R	
Rated capacitance C_R Capacitance tolerance	47 to 4 700 µF – 10/+ 50 % ≙ T	
Useful life	$d \leq$ 18 mm	d = 21 mm, 25 mm
40 °C, U_R 85 °C, U_R; $I_{\sim max}$ 125 °C, U_R; $I_{\sim R}$	> 200 000 h (3,5 · $I_{\sim R,125°C}$) > 15 000 h > 3 000 h	> 200 000 h (3,2 · $I_{\sim R,125°C}$) > 10 000 h > 2 000 h
Failure percentage	≤ 0,5 % (during useful life)	
Failure rate	≤ 10 fit (≤ 10 · 10^{-9}/h)	
Voltage endurance test	2 000 h, 125 °C (at U_R)	

1) Operation at 145 °C and 0,6 V_R permissible for a total of 500 h.



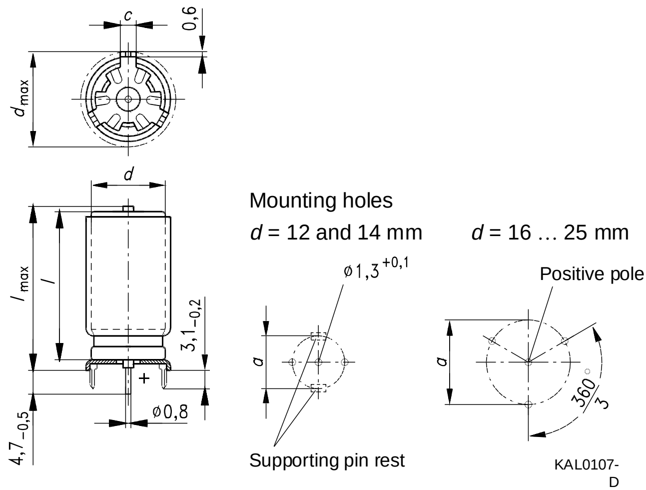
Specifications and characteristics in brief

Leakage current I_{lka} (5 min, 20 °C)	$I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$						
Self-inductance L_{ESL}	d (mm)	12	14	16	18	21	25
	l (mm)	30	30	30	39,5	40	40
	L_{ESL} approx. (nH)	23	37	37	37	17	17
IEC climatic category	in accordance with IEC 68-1 55/125/56 (– 55 °C/+ 125 °C, 56 days damp heat test)						
Detail specification	similar to CECC 30 301-802						
Sectional specifications	IEC 384-4 (DIN 45 910 part 12)						
Vibration resistance	in accordance with IEC 68–2–6, test Fc: displacement amplitude 0,75 mm, frequency range 10 … 55 Hz, acceleration max. 10 g, duration 3 × 2 h						



B 41 592

Outline drawing

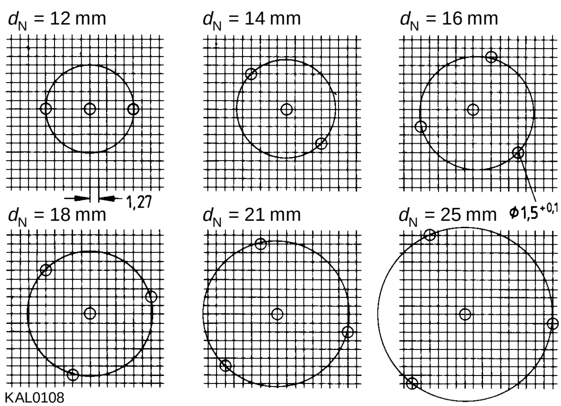


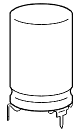
Soldering star and supports are connected to the negative pole

Dimensions (mm)				Approx weight (g)	Packing units (pieces)
$d \times l$	$d_{max} \times l_{max}$	$a \pm 0,1$	$c \pm 0,1$		
12 × 30	13,5 × 33	12,5	3,0	5,7	480
14 × 30	15,5 × 33	14,5		7,9	480
16 × 30	17,5 × 33	16,5		9,8	300
18 × 39,5	19,5 × 40,8	18,5		15	200
21 × 40	22,5 × 42	21,5	3,5	19	128
25 × 40	26,5 × 42	25,5		27	128

The PC-board hole arrangement specified above is based on circular arcs.

If, however, the mounting holes have to be matched to a standard drilling raster, a spacing of 1,27 mm ($^1/_{20}$″) has proved to be sufficiently accurate if the following arrangements are used:

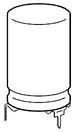




Overview of available types

U_R (V–)	10	16	25	40	63	100
C_R (µF)	Case dimensions $d \times l$ (mm)					
47						12 × 30
100					12 × 30	16 × 30
220			12 × 30	12 × 30	16 × 30	18 × 39,5
470	12 × 30	12 × 30	14 × 30	16 × 30	18 × 39,5	25 × 40
1 000	14 × 30	16 × 30	18 × 39,5	21 × 40	25 × 40	
2 200	18 × 39,5	18 × 39,5	21 × 40	25 × 40		
4 700	25 × 40	25 × 40				

The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.



Technical data and ordering codes

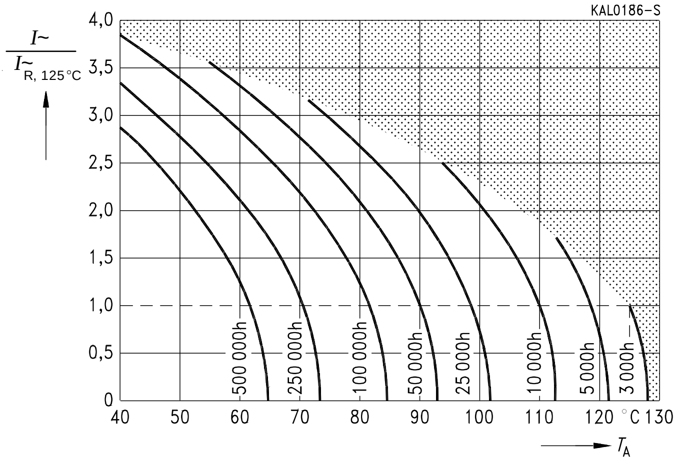
U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C Ω	$R_{ESR, max}$ 100 Hz 20 °C Ω	Z_{max} 10 kHz 20 °C Ω	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	$I_{\sim R}$ 100 Hz 125 °C A	Ordering code [1)] Short code
10	470	12 × 30	0,29	0,56	0,22	1,8	1,3	0,45	-A3477-T
	1 000	14 × 30	0,14	0,26	0,14	2,8	1,9	0,69	-A3108-T
	2 200	18 × 39,5	0,06	0,12	0,10	5,6	3,9	1,40	-A3228-T
	4 700	25 × 40	0,04	0,07	0,07	8,0	5,6	2,00	-A3478-T
16	470	12 × 30	0,25	0,48	0,22	2,0	1,4	0,49	-A4477-T
	1 000	16 × 30	0,12	0,23	0,12	3,2	2,2	0,80	-A4108-T
	2 200	18 × 39,5	0,06	0,10	0,10	5,6	3,9	1,40	-A4228-T
	4 700	25 × 40	0,04	0,06	0,06	8,0	5,6	2,00	-A4478-T
25	220	12 × 30	0,41	0,79	0,38	1,5	1,1	0,38	-A5227-T
	470	14 × 30	0,20	0,37	0,20	2,3	1,6	0,58	-A5477-T
	1 000	18 × 39,5	0,10	0,18	0,12	4,0	2,8	1,00	-A5108-T
	2 200	21 × 40	0,05	0,10	0,10	6,4	4,5	1,60	-A5228-T
40	220	12 × 30	0,34	0,64	0,36	1,7	1,2	0,42	-A7227-T
	470	16 × 30	0,16	0,30	0,20	2,8	1,9	0,69	-A7477-T
	1 000	21 × 40	0,08	0,16	0,12	5,2	3,6	1,30	-A7108-T
	2 200	25 × 40	0,04	0,08	0,08	8,0	5,6	2,00	-A7228-T
63	100	12 × 30	0,63	1,20	0,66	1,2	0,87	0,31	-A8107-T
	220	16 × 30	0,31	0,56	0,34	2,0	1,4	0,50	-A8227-T
	470	18 × 39,5	0,14	0,26	0,18	3,5	2,5	0,88	-A8477-T
	1 000	25 × 40	0,08	0,14	0,12	5,6	3,9	1,40	-A8108-T
100	47	12 × 30	1,8	3,40	1,90	0,72	0,5	0,18	-A9476-T
	100	16 × 30	0,79	1,50	0,90	1,2	0,87	0,31	-A9107-T
	220	18 × 39,5	0,38	0,72	0,50	2,2	1,5	0,54	-A9227-T
	470	25 × 40	0,20	0,38	0,30	3,5	2,5	0,88	-A9477-T

1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B41592-A3477-T

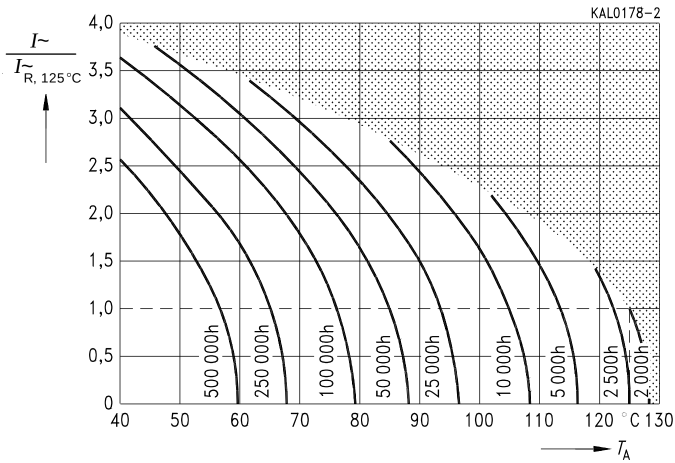
Useful life

versus ambient temperature T_A under ripple current operating conditions [1)]

$d \geq$ 12 mm … 18 mm

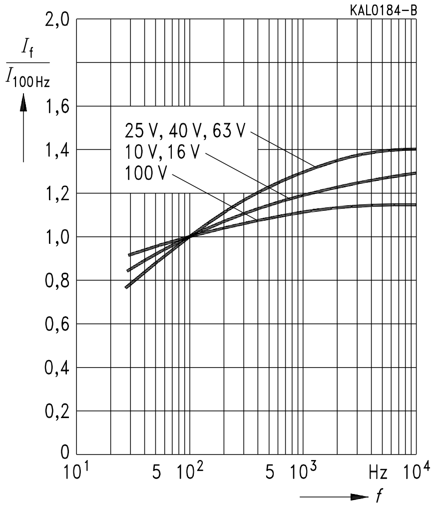


d = 21 mm, 25 mm

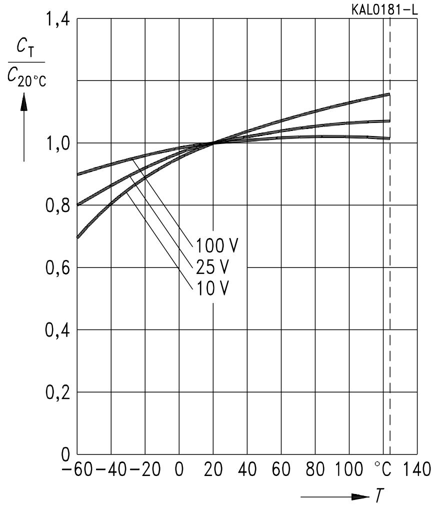


1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

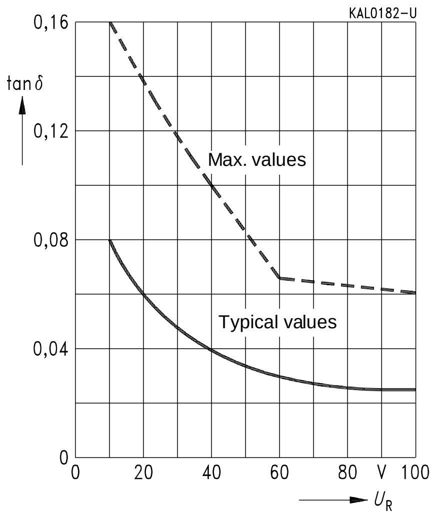
Permissible ripple current *I~*
versus frequency *f*



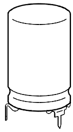
Series capacitance C_s at f = 100 Hz
versus temperature *T*
Typical behavior



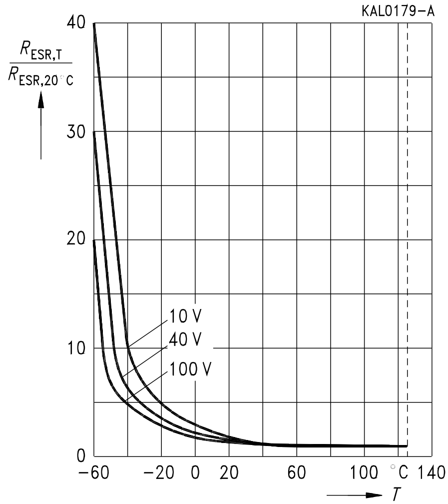
Dissipation factor tan δ
at T = 20 °C and f = 100 Hz
versus rated voltage U_R
Typical behavior



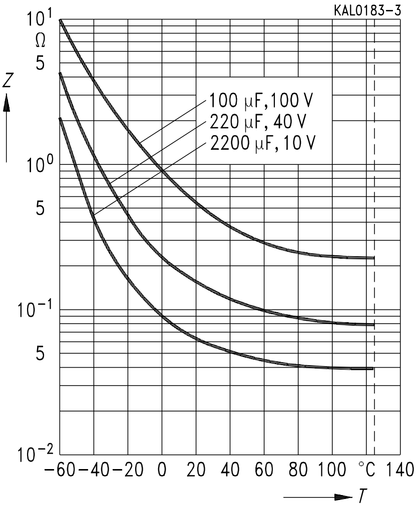
The maximum values correspond to DIN 45910 part 123 and apply to $C_R \leq$ 1000 µF.
The values increase by 0,02 per 1000 µF.



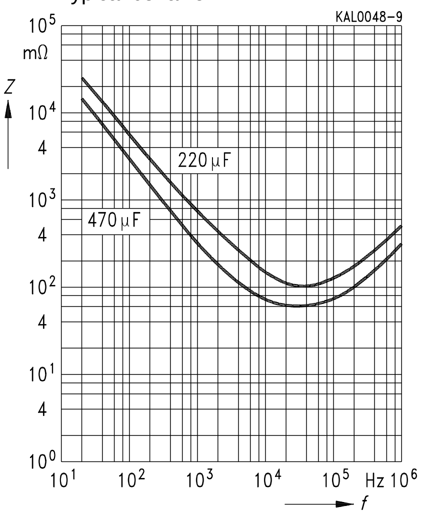
Equivalent series resistance R_{ESR}
at f = 100 Hz versus temperature T
Typical behavior



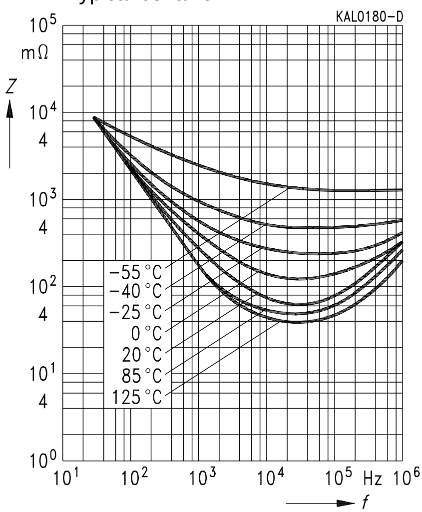
Impedance Z at 10 kHz
versus temperature T
Typical behavior



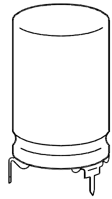
Impedance Z
versus frequency f
for U_R = 40 V–, at 20°C
Typical behavior



Impedance Z
versus frequency f
and temperature T for 470 µF/40 V–
Typical behavior



High ripple current capability
Operation at temperatures up to 105 °C



Construction

- Charge-discharge proof, polar
- Aluminum case, partially insulated
- Solder pins on mounting base that is securely welded to the case, ensuring perfect electrical contact
- Positive pole connection brought out axially at center
- Negative pole connected to two or three solder pins of the mounting base

Features

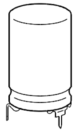
- High reliability and long useful life
- Wide temperature range
- Excellent electrical characteristics
- High ripple current capability
- High vibration resistance
- Pinning ensures correct insertion

Applications

- High-reliability equipment in industrial and automotive electronics

Specifications and characteristics in brief

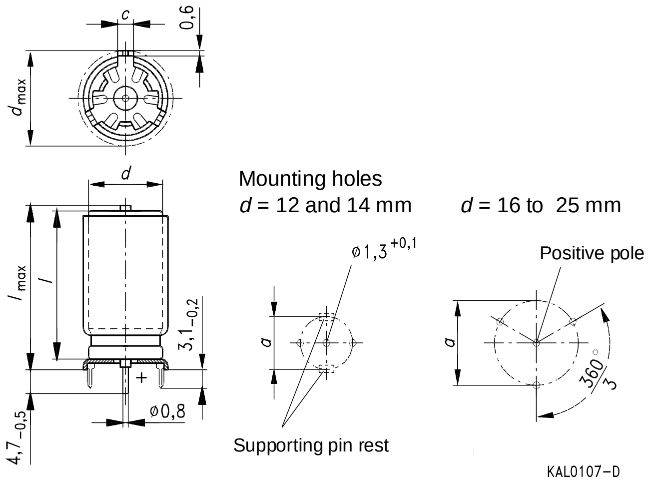
Rated voltage U_R Surge voltage U_S	160 to 350 V– $1{,}15 \cdot U_R$ (for $U_R \leq 250$ V–) $1{,}10 \cdot U_R$ (for $U_R = 350$ V–)
Rated capacitance C_R Capacitance tolerance	10 to 220 µF – 10/+ 50 % ≙ T
Useful life 40 °C, U_R 85 °C, U_R; $I_{\sim max}$ 105 °C, U_R; $I_{\sim R}$	 > 200 000 h ($2{,}7 \cdot I_{\sim R,105°C}$) > 10 000 h > 4 000 h
Failure percentage	≤ 1 % (during useful life)
Failure rate	≤ 20 fit ($\leq 20 \cdot 10^{-9}$/h)
Voltage endurance test	2 000 h, 105 °C (at U_R)
Leakage current I_{lka} (5 min, 20 °C)	$I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$



Specifications and characteristics in brief

Self-inductance L_{ESL}	d (mm)	12	14	16	18	25
	l (mm)	30	30	30	39,5	40
	L_{ESL} approx. (nH)	20	40	40	40	20
IEC climatic category	in accordance with IEC 68-1 40/105/56 (–40 °C/+105 °C, 56 days damp heat test)					
Detail specifications Sectional specifications	(similar to DIN 45 910 part 1211) IEC 384-4 (DIN 45 910 part 12)					
Vibration resistance	in accordance with IEC 68-2–6, test Fc: displacement amplitude 0,75 mm, frequency range 10 to 55 Hz, acceleration max. 10 g, duration 3 × 2 h					

Outline drawing

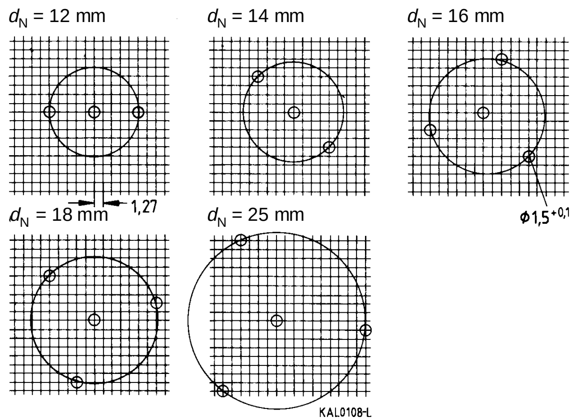


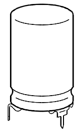
Soldering star and supports are connected to the negative pole.

Dimensions (mm)				Approx.	Packing units
$d \times l$	$d_{max} \times l_{max}$	$a \pm 0{,}1$	$c \pm 0{,}1$	weight (g)	(pieces)
12 × 30	13,5 × 33	12,5	3	5,4	480
14 × 30	15,5 × 33	14,5		7,5	480
16 × 30	17,5 × 33	16,5		9,3	300
18 × 39,5	19,5 × 40,8	18,5		14	200
25 × 40	26,5 × 42	25,5	3,5	26	128

The PC-board hole arrangement specified above is based on circular arcs.

If, however, the mounting holes have to be matched to a standard drilling raster, a spacing of 1,27 mm ($^1/_{20}$″) has proved to be sufficiently accurate if the following arrangements are used:





Overview of available types

U_R (V–)	160	250	350
C_R (μF)	Case dimensions $d \times l$ (mm)		
10		12 × 30	12 × 30
22	12 × 30	14 × 30	16 × 30
47	16 × 30	18 × 39,5	18 × 39,5
100	18 × 39,5	25 × 40	25 × 40
220	25 × 40		

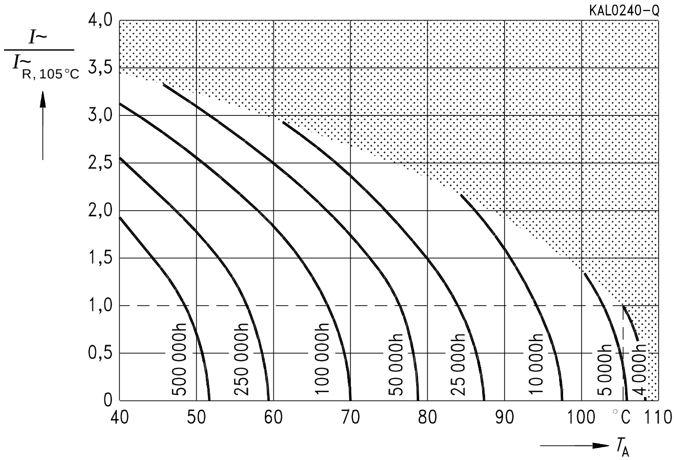
The above capacitance and voltage ratings are available in smaller cases upon request. Other capacitance and voltage ratings are also available upon request.

Technical data and ordering codes

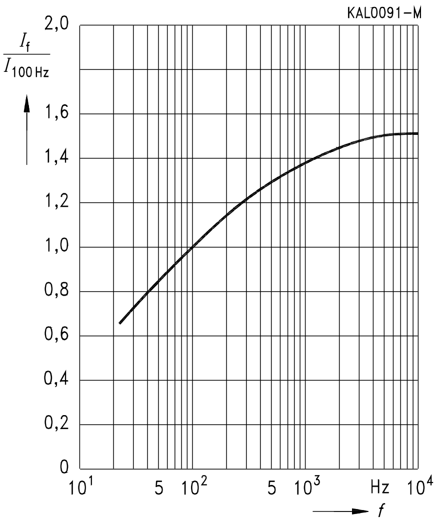
U_R V–	C_R μF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C Ω	$R_{ESR, max}$ 100 Hz 20 °C Ω	Z_{max} 10 kHz 20 °C Ω	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	$I_{\sim R}$ 100 Hz 105 °C A	Ordering code[1)] Short code
160	22	12 × 30	3,0	7,2	3,1	0,48	0,29	0,14	-A1226-T
	47	16 × 30	1,4	3,4	1,5	0,82	0,5	0,24	-A1476-T
	100	18 × 39,5	0,7	1,6	0,71	1,4	0,84	0,4	-A1107-T
	220	25 × 40	0,3	0,7	0,33	2,4	1,5	0,72	-A1227-T
250	10	12 × 30	5,0	13	6,5	0,37	0,23	0,11	-A2106-T
	22	14 × 30	2,5	6,4	2,9	0,54	0,34	0,16	-A2226-T
	47	18 × 39,5	1,2	3,0	1,4	1,0	0,63	0,3	-A2476-T
	100	25 × 40	0,54	1,4	0,7	1,8	1,1	0,53	-A2107-T
350	10	12 × 30	4,1	10	6,1	0,4	0,25	0,12	-A4106-T
	22	16 × 30	1,9	4,8	2,8	0,68	0,42	0,2	-A4226-T
	47	18 × 39,5	0,85	2,1	1,3	1,2	0,76	0,36	-A4476-T
	100	25 × 40	0,41	1,0	0,64	2,1	1,3	0,62	-A4107-T

1) To obtain the required ordering code, prefix the type number to the short code.
E. g.: B43592-A1226-T

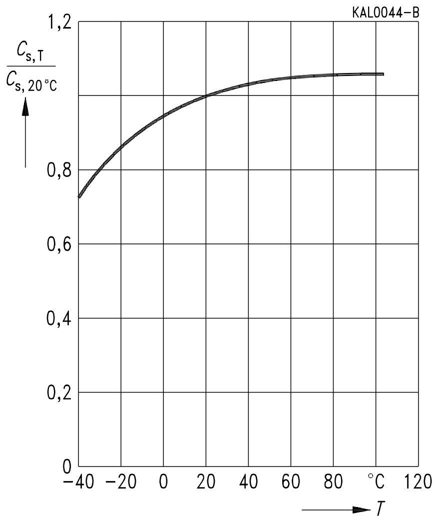
Useful life
versus ambient temperature T_A under ripple current operating conditions[1)]



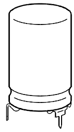
Permissible ripple current ***I~***
versus frequency *f*



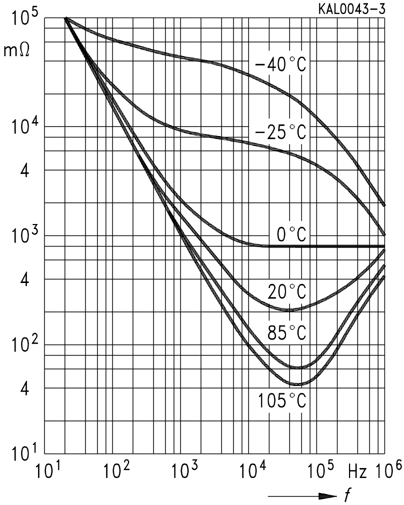
Series capacitance C_S at f = 100 Hz
versus temperature T
Typical behavior



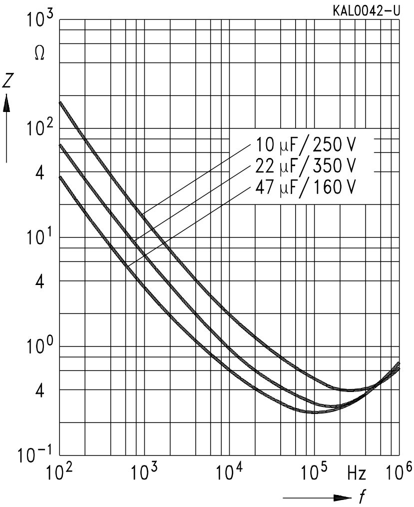
1) Refer to page 34 for an explanation on how to interpret the useful life graphs.



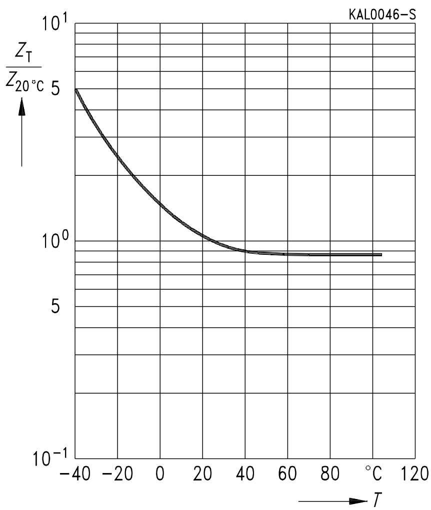
Impedance *Z*
versus frequency *f*
and temperature *T* for 100 µF/250 V–
Typical behavior



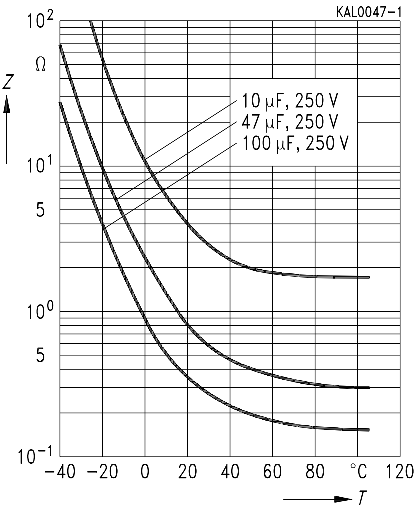
Impedance *Z*
versus frequency *f*
Typical values at 20 °C



Impedance *Z* at *f* = 100 Hz
versus temperature *T*
Typical behavior



Impedance *Z* at *f* = 10 kHz
versus temperature *T*
Typical behavior



Siemens Matsushita Components

SAW resonators for radio remote control

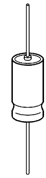
Making a lot of things a lot easier

The key to convenience and security: radio remote controls for keyless entry in automobiles and opening the garage gate. Or in the household, for cordless headphones or metering heating costs for example. Here the evaporation pipe is replaced by a sensor that signals consumption by

a transmitter to a receiver outside the domicile, thus doing away with readings on all the radiators. Transmitter and receiver are both fitted with a SAW resonator.

SCS – dependable, fast and competent

Axial-Lead Capacitors

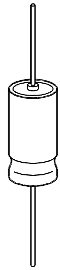


Overview

Quality grade	Type	U_R V–	C_R µF	Temperature [1)] °C	Special features Fields of application	Page
GP	B 41 283 B 41 010	6,3 … 100	4,7 … 10 000	– 40 … + 85 (+ 105)	Standard type with small dimensions High ripple current capability General-purpose use in entertainment electronics For filtering, coupling and pulse circuits	268
LL	B 41 588 B 43 588	10… 100 160 … 350 (450)	4,7 … 4 700 1 … 220	– 40 … + 85 (+ 105)	High reliability and long useful life Good parametric stability For filtering, coupling and pulse circuits For electronic ballasts For automotive electronics	277
SIKOREL	B 41 590	10 … 100	4,7 … 4 700	– 55 … + 125 (+ 145)	Extremely high reliability and long useful life Shelf life up to 10 years For high-reliability equipment in industrial and automotive electronics	289
High performance	B 43 590	160 … 350	2,2 … 220	– 40 … + 105	High ripple current capability Excellent electrical characteristics For high-reliability equipment in industrial and automotive electronics	298
Taping and packing						305

1) The temperature specified in brackets applies for operation at derated voltage and current.

Standard type with small dimensions



KAL0277-Z

Construction

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

Features

- Standard type with small dimensions
- Operation at temperatures up to 105 °C[1)]
- Good electrical characteristics
- High ripple current capability

Applications

- For general-purpose applications in entertainment electronics
- Semi-professional to professional application range
- For filtering, coupling and pulse circuits

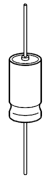
Tape packaging

Capacitors with $d \le 16$ mm are also available on tape.
Refer to page 305 for information on tapes and examples on how to order them.

Specifications and characteristics in brief

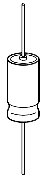
Rated voltage U_R	6,3 to 100 V–	
Surge voltage U_S	1,15 · U_R	
Rated capacitance C_R	4,7 to 10 000 µF	
Capacitance tolerance	– 10/+ 50 % ≙ T	
Useful life	$d \le 10$ mm	$d \ge 12$ mm
40 °C, U_R 85 °C, U_R; $I_{\sim max}$	> 200 000 h ($I_{\sim R,85°C}$) > 3 000 h	> 200 000 h (1,4 · $I_{\sim R,85°C}$) > 4 000 h
Failure percentage	≤ 1 % (during useful life)	
Failure rate (1 fit = 1 · 10^{-9}/h)	$d \le 10$ mm: ≤ 100 fit $d \ge 12$ mm: ≤ 40 fit	
Voltage endurance test	2 000 h, 85 °C (at U_R)	
Leakage current I_{lka} (5 min, 20 °C)	$I_{lka} \le 0{,}3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)^{0,7} + 4\ \mu A$	

1) Operation at 105 °C and 0,6 $I_{\sim max,85\,°C}$ permissible for a total of 500 h.



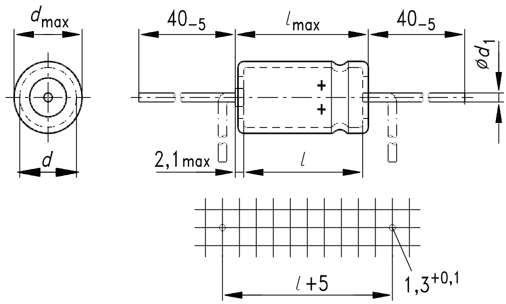
Specifications and characteristics in brief

Self-inductance L_{ESL}	*d* (mm)	6,5	8,5	10	12	14	16	18	21	25	
	l (mm)	15,5	15,5	25	30	30	30	39,5	40	40	
	L_{ESL} approx. (nH)	14	17	35	37	38	45	57	30	34	
IEC climatic category	in accordance with IEC 68-1 40/085/56 (–40 °C/+85 °C, 56 days damp heat test)										
Detail specifications	similar to CECC 30 301-044 (similar to DIN 45 910 part 126)										
Sectional specifications	IEC 384-4 (DIN 45 910 part 12)										
Vibration resistance	in accordance with IEC 68-2–6, test Fc: displacement amplitude 0,35 mm, frequency range 10 to 55 Hz, acceleration max. 5 *g*, duration 3 × 2 h										



B 41 010
B 41 283

Outline drawing

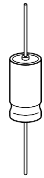


Minimum lead spacin KAL0058-G

Type	Dimensions (mm) $d \times l$	$d_{max} \times l_{max}$	Lead wire diameter d_1	Approximate weight (g)
B 41 283	6,5 × 15,5	7,0 × 17	0,6	1,1
	8,5 × 15,5	9,0 × 17		1,8
	10 × 25	10,5 × 26,5		3,2
B 41 010	12 × 30	12,5 × 32	0,8	5,4
	14 × 30	14,5 × 32		7,5
	16 × 30	16,5 × 32		9,3
	18 × 39,5	18,5 × 40,3		14
	21 × 40	21,5 × 41,5		18
	25 × 40	25,5 × 41,5		26

Packing units

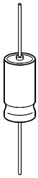
Case dimensions $d \times l$ (mm)	Bulk PU (pcs.)	Reel packing PU (pcs./reel)
6,5 × 15,5	2000	1300
8,5 × 15,5	1500	1000
10 × 25	900	600
12 × 30	600	450
14 × 30	400	350
16 × 30	350	250
18 × 39,5	250	–
21 × 40	200	–
25 × 40	150	–



Overview of available types

U_R (V–)	6,3	10	16	25	40	63	100
C_R (µF)	Case dimensions $d \times l$ (mm)						
4,7							6,5 × 15,5
10						6,5 × 15,5	8,5 × 15,5
22					6,5 × 15,5	8,5 × 15,5	8,5 × 15,5
47				6,5 × 15,5	8,5 × 15,5	8,5 × 15,5	10 × 25
100		6,5 × 15,5	8,5 × 15,5	8,5 × 15,5	10 × 25	10 × 25	12 × 30
220		8,5 × 15,5	8,5 × 15,5	10 × 25	10 × 25	12 × 30	16 × 30
470	8,5 × 15,5	10 × 25	10 × 25	12 × 30	12 × 30	16 × 30	21 × 40
1 000	10 × 25	12 × 30	12 × 30	14 × 30	16 × 30	21 × 40	
2 200	12 × 30	14 × 30	16 × 30	18 × 39,5	21 × 40		
4 700	16 × 30	18 × 39,5	21 × 40	25 × 40			
10 000		25 × 40					

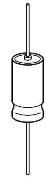
The above capacitance and voltage ratings are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C mΩ	$R_{ESR, max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim R}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	Ordering code[1)] Short code
B41283- ($d \leq$ 10 mm)**, B41010-** ($d \geq$ 12 mm)								
6,3	470	8,5 × 15,5	0,44	0,75	0,46	0,73	0,25	-D2477-T90
	1 000	10 × 25	0,24	0,35	0,22	1,2	0,42	-B2108-T90
	2 200	12 × 30	0,12	0,19	0,10	2,1	0,71	-B2228-T
	4 700	16 × 30	0,08	0,11	0,05	3,2	1,1	-E2478-T
10	100	6,5 × 15,5	1,5	3,2	1,7	0,35	0,12	-C3107-T90
	220	8,5 × 15,5	0,65	1,4	0,79	0,61	0,21	-D3227-T90
	470	10 × 25	0,32	0,68	0,37	1,0	0,36	-B3477-T90
	1 000	12 × 30	0,18	0,32	0,16	1,7	0,57	-A3108-T
	2 200	14 × 30	0,19	0,18	0,08	2,3	0,81	-C3228-T
	4 700	18 × 39,5	0,06	0,10	0,05	4,1	1,4	-C3478-T
	10 000	25 × 40	0,05	0,07	0,05	5,5	1,9	-C3109-T
16	100	8,5 × 15,5	1,3	2,8	1,4	0,41	0,14	-C4107-T90
	220	8,5 × 15,5	0,58	1,3	0,65	0,61	0,21	-C4227-T90
	470	10 × 25	0,27	0,60	0,30	1,1	0,39	-B4477-T90
	1 000	12 × 30	0,15	0,28	0,13	1,8	0,63	-B4108-T
	2 200	16 × 30	0,09	0,16	0,06	2,7	0,93	-E4228-T
	4 700	21 × 40	0,06	0,09	0,05	4,4	1,5	-C4478-T
25	47	6,5 × 15,5	2,4	5,3	2,1	0,26	0,09	-C5476-T90
	100	8,5 × 15,5	1,0	2,5	1,0	0,46	0,16	-C5107-T90
	220	10 × 25	0,44	1,1	0,45	0,81	0,28	-C5227-T90
	470	12 × 30	0,21	0,53	0,19	1,5	0,53	-B5477-T
	1 000	14 × 30	0,12	0,25	0,09	2,1	0,74	-C5108-T
	2 200	18 × 39,5	0,07	0,14	0,05	3,8	1,3	-C5228-T
	4 700	25 × 40	0,05	0,09	0,05	5,2	1,8	-C5478-T

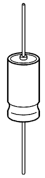
1) For instructions on how to determine ordering codes, refer to page 273.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR,\,typ}$ 100 Hz 20 °C mΩ	$R_{ESR,\,max}$ 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{\sim R}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	Ordering code[1)] Short code
B41283- ($d \le 10$ mm)**, B41010-** ($d \ge 12$ mm)								
40	22	6,5 × 15,5	4,0	8,0	3,6	0,20	0,07	-C7226-T90
	47	8,5 × 15,5	1,5	3,8	1,7	0,38	0,13	-E7476-T90
	100	10 × 25	0,7	1,8	0,80	0,64	0,22	-C7107-T90
	220	10 × 25	0,36	0,80	0,36	0,96	0,33	-A7227-T
	470	12 × 30	0,18	0,38	0,15	1,7	0,57	-B7477-T
	1 000	16 × 30	0,10	0,18	0,08	2,6	0,88	-E7108-T
	2 200	21 × 40	0,07	0,11	0,05	4,1	1,4	-C7228-T
63	10	6,5 × 15,5	5,0	13	6,0	0,17	0,06	-B8106-T90
	22	8,5 × 15,5	2,5	6,3	2,7	0,29	0,10	-D8226-T90
	47	8,5 × 15,5	1,2	3,0	1,2	0,44	0,15	-D8476-T90
	100	10 × 25	0,55	1,4	0,60	0,78	0,27	-B8107-T90
	220	12 × 30	0,30	0,64	0,25	1,3	0,44	-B8227-T
	470	16 × 30	0,14	0,30	0,12	2,1	0,74	-D8477-T
	1 000	21 × 40	0,08	0,14	0,06	3,8	1,3	-B8108-T
100	4,7	6,5 × 15,5	9,5	24	10	0,15	0,05	-B9475-T90
	10	8,5 × 15,5	4,0	10	5,0	0,23	0,08	-K9106-T90
	22	8,5 × 15,5	1,8	4,5	2,2	0,35	0,12	-D9226-T90
	47	10 × 25	0,85	2,1	1,0	0,64	0,22	-B9476-T90
	100	12 × 30	0,40	1,0	0,45	1,1	0,38	-B9107-T
	220	16 × 30	0,22	0,55	0,20	1,7	0,59	-E9227-T
	470	21 × 40	0,12	0,26	0,10	2,9	1,0	-B9477-T

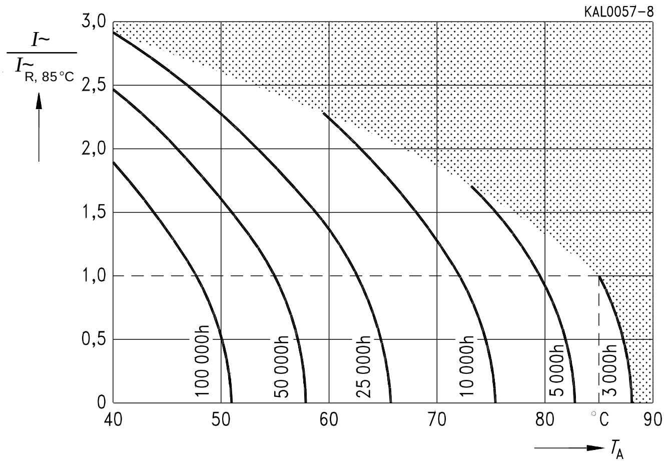
1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B41283-B7226-T
B41283-... ($d \le 10$ mm)
B41010-... ($d \ge 12$ mm)



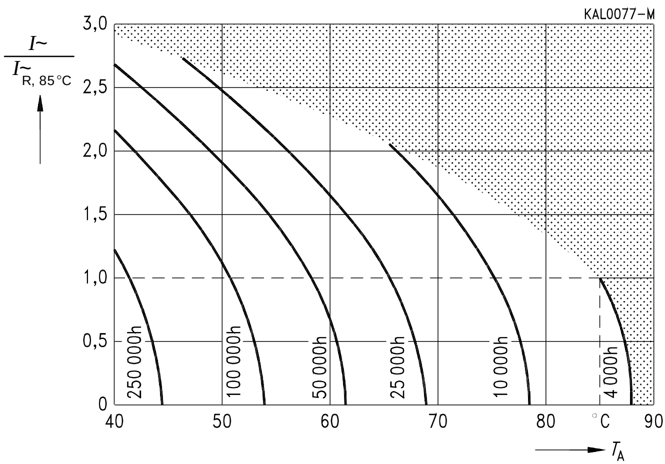
Useful life

versus ambient temperature T_A under ripple current operating conditions[1)]

B 41 283 ($d \leq 10$ mm)

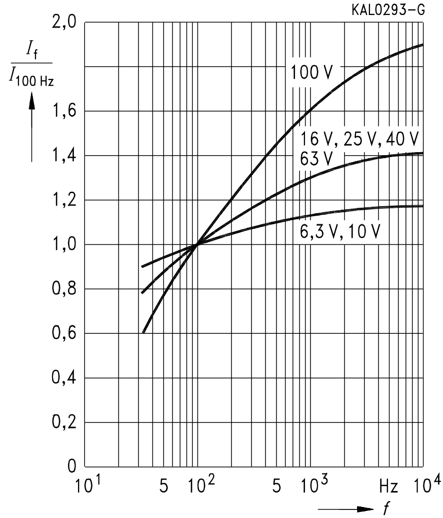


B 41 010 ($d \geq 12$ mm)

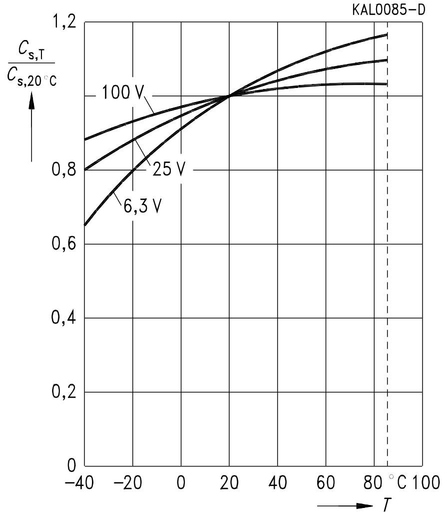


1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

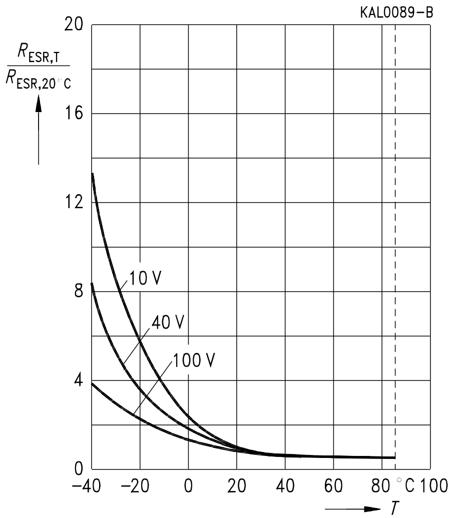
Permissible ripple current *I*~
versus frequency *f*



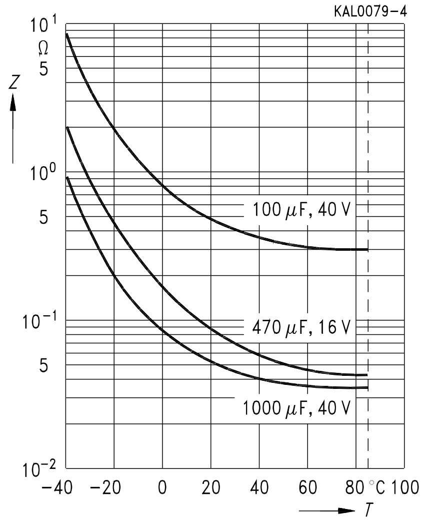
Series capacitance C_S at f = 100 Hz
versus temperature T
Typical behavior

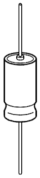


Equivalent series resistance R_{ESR}
at f = 100 Hz
versus temperature T
Typical behavior

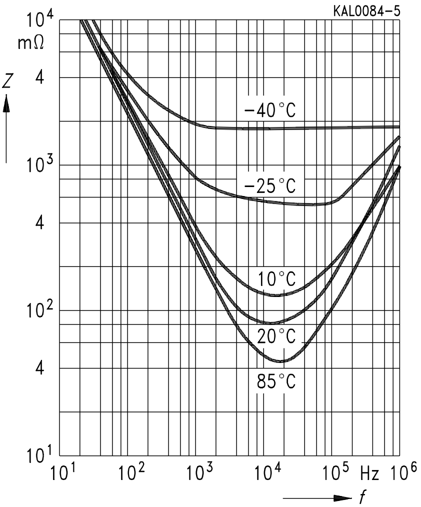


Impedance *Z*
at f = 10 kHz
versus temperature T
Typical behavior

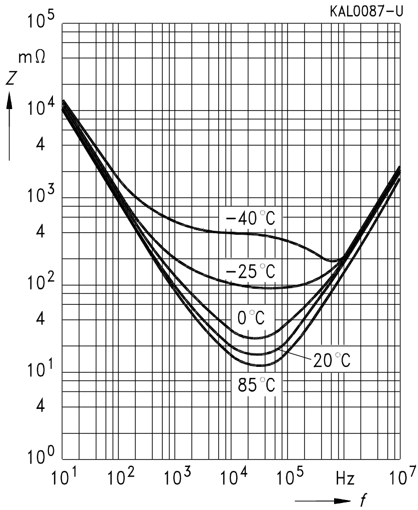




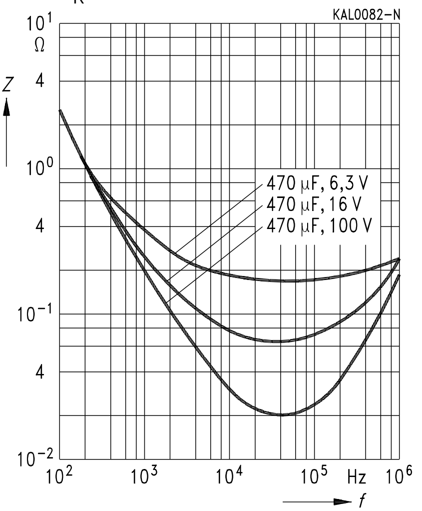
Impedance *Z*
versus frequency *f*
and temperature *T* for 470 µF/16 V–
Typical behavior



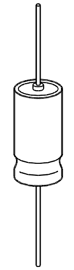
Impedance *Z*
versus frequency *f*
and temperature *T* for 1000 µF/40 V–
Typical behavior



Impedance *Z*
versus frequency *f*
Typical values at 20 °C
$U_R \leq 100$ V–



For professional industrial electronics equipment



KAL0277-Z

Construction

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

Features

- High reliability and long useful life
- Can be operated at temperatures of up to 105 °C[1)]
- High parametric stability
- High ripple current capability

Applications

- Professional industrial electronics equipment
- For filtering, coupling and pulse circuits
- Automotive electronics
- 450-V versions for electronic ballasts
  available upon request

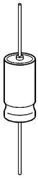
Tape packaging

Capacitors with $d \le 16$ mm are also available on tape.
Refer to page 305 for information on tapes and examples on how to order them.

Specifications and characteristics in brief

	B 41 588		B 43 588	
Rated voltage U_R	10 to 100 V–		160 to 350 V–	
Surge voltage U_S	$1{,}15 \cdot U_R$		$1{,}15 \cdot U_R$ (for $U_R \le 250$ V–) $1{,}10 \cdot U_R$ (for $U_R = 350$ V–)	
Rated capacitance C_R	4,7 to 4 700 µF		1 to 220 µF	
Capacitance tolerance	– 10/+ 50 % ≙ T		– 10/+ 50 % ≙ T	
Useful life	$d \le 8{,}5$ mm	$d \ge 10$ mm	$d \le 8{,}5$ mm	$d \ge 10$ mm
40 °C, U_R 85 °C, U_R; $I_{\sim max}$	> 200 000 h ($1{,}3 \cdot I_{\sim R,85°C}$) > 6 000 h	> 200 000 h ($2{,}0 \cdot I_{\sim R,85°C}$) > 10 000 h	> 200 000 h ($1{,}3 \cdot I_{\sim R,85°C}$) > 6 000 h	> 200 000 h ($1{,}7 \cdot I_{\sim R,85°C}$) > 8 000 h
Failure percentage	≤ 0,5 % (during useful life)		≤ 0,5 % (during useful life)	
Failure rate (1 fit = $1 \cdot 10^{-9}$/h)	$d \le 8{,}5$ mm: ≤ 50 fit $d \ge 10$ mm: ≤ 20 fit		$d \le 8{,}5$ mm: ≤ 50 fit $d \ge 10$ mm: ≤ 20 fit	

1) Operation at 105 °C and 0,6 $I_{\sim max,85\,°C}$ permissible for a total of 500 h.



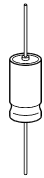
B 41 588
B 43 588

Specifications and characteristics in brief

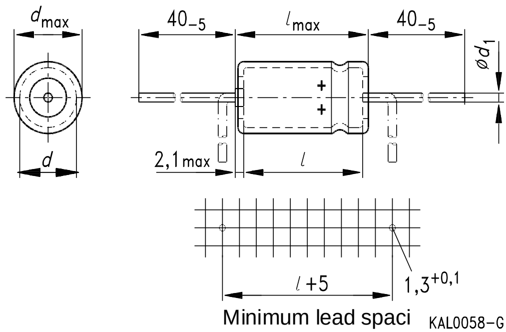
	B 41 588	B 43 588
Voltage endurance test	5 000 h, 85 °C (at U_R)	
Leakage current I_{lka} (5 min, 20 °C)	$C_R \cdot U_R \leq 1\,000\ \mu C$: $I_{lka} \leq 0{,}01\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)$ or 1 µA (the larger value applies) $1\,000\ \mu C \leq C_R \cdot U_R < 470\,000\ \mu C$: $I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$	
Self-inductance L_{ESL}	see table below	
IEC climatic category	in accordance with IEC 68-1 40/085/56 (–40 °C/+85 °C, 56 days damp heat test)	
Detail specifications	similar to CECC 30 301-801 (similar to CECC 30 301-003, DIN 45 910 part 123)	
Sectional specifications	IEC 384-4 (DIN 45 910 part 12)	
Vibration resistance	in accordance with IEC 68-2–6, test Fc: displacement amplitude 0,35 mm, frequency range 10 to 55 Hz, acceleration max. 5 *g*, duration 3 × 2 h	

Self-inductance L_{ESL}:

d (mm)	6,5	8,5	10	12	14	16	18	21	25	
l (mm)	15,5	15,5	25	30	30	30	39,5	40	40	
L_{ESL} approx. (nH)	14	17	35	37	38	45	57	30	34	



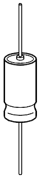
Outline drawing



Dimensions (mm) $d \times l$	$d_{max} \times l_{max}$	Lead wire diameter d_1	Approximate weight (g)
6,5 × 15,5	7,0 × 17	0,6	1,1
8,5 × 15,5	9,0 × 17		1,8
10 × 25	10,5 × 26,5		3,2
12 × 30	12,5 × 32	0,8	5,4
14 × 30	14,5 × 32		7,5
16 × 30	16,5 × 32		9,3
18 × 39,5	18,5 × 40,3		14
21 × 40	21,5 × 41,5		18
25 × 40	25,5 × 41,5		26

Packing units

Case dimensions $d \times l$ (mm)	Bulk PU (pcs.)	Reel packing PU (pcs./reel)
6,5 × 15,5	2000	1300
8,5 × 15,5	1500	1000
10 × 25	900	600
12 × 30	600	450
14 × 30	400	350
16 × 30	350	250
18 × 39,5	250	–
21 × 40	200	–
25 × 40	150	–



Overview of available types

Type B 41 588

U_R (V–)	10	16	25	40	63	100
C_R (µF)	Case dimensions $d \times l$ (mm)					
4,7					6,5 × 15,5	8,5 × 15,5
10				6,5 × 15,5	8,5 × 15,5	8,5 × 15,5
22				8,5 × 15,5	8,5 × 15,5	10 × 25
47	6,5 × 15,5	8,5 × 15,5	8,5 × 17,5	8,5 × 15,5	10 × 25	12 × 30
100	8,5 × 15,5	8,5 × 15,5	10 × 25	10 × 25	12 × 30	16 × 30
220	10 × 25	10 × 25	12 × 30	12 × 30	16 × 30	18 × 39,5
470	12 × 30	12 × 30	14 × 30	16 × 30	21 × 40	25 × 40
1 000	14 × 30	16 × 30	18 × 39,5	21 × 40	25 × 40	
2 200	18 × 39,5	18 × 39,5	21 × 40	25 × 40		
4 700	25 × 40	25 × 40				

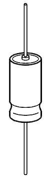
Type B 43 588

U_R (V–)	160	250	350
C_R (µF)	Case dimensions $d \times l$ (mm)		
1,0			6,5 × 15,5
2,2	6,5 × 15,5	8,5 × 15,5	8,5 × 15,5
4,7	8,5 × 15,5	10 × 25	10 × 25
10	10 × 25	10 × 25	12 × 30
22	12 × 30	14 × 30	14 × 30
47	14 × 30	16 × 30	18 × 39,5
100	18 × 39,5	21 × 40	25 × 40
220	25 × 40		

The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.

Upon request we also supply special versions with rated voltages of up to 450 V–, surge voltages of up to 600 V– and capacitance ratings of 6,8 µF, 10 µF, 15 µF, 22 µF (e. g. for electronic ballast applications).

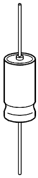
Temperature range – 40 … + 85 °C/+ 105 °C.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C Ω	$R_{ESR, max}$ 100 Hz 20 °C Ω	Z_{max} 10 kHz 20 °C Ω	$I_{\sim R}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	Ordering code[1] Short code
B41588-								
10	47	6,5 × 15,5	2,0	5,0	0,88	0,29	0,10	-D3476-T90
	100	8,5 × 15,5	0,95	2,4	0,43	0,49	0,17	-D3107-T90
	220	10 × 25	0,43	1,1	0,21	0,83	0,28	-E3227-T90
	470	12 × 30	0,20	0,50	0,11	1,6	0,55	-C3477-T
	1 000	14 × 30	0,10	0,25	0,07	2,5	0,85	-E3108-T
	2 200	18 × 39,5	0,06	0,14	0,05	4,1	1,4	-C3228-T
	4 700	25 × 40	0,05	0,07	0,05	5,5	1,9	-A3478-T
16	47	8,5 × 15,5	1,6	4,0	0,82	0,34	0,12	-C4476-T90
	100	8,5 × 15,5	0,75	1,9	0,40	0,52	0,18	-D4107-T90
	220	10 × 25	0,36	0,90	0,20	0,96	0,33	-D4227-T90
	470	12 × 30	0,18	0,45	0,11	1,7	0,57	-D4477-T
	1 000	16 × 30	0,10	0,25	0,06	2,7	0,92	-M4108-T
	2 200	18 × 39,5	0,06	0,12	0,05	4,1	1,4	-D4228-T
	4 700	25 × 40	0,05	0,06	0,05	5,5	1,9	-A4478-T
25	47	8,5 × 15,5	1,3	3,3	0,78	0,41	0,14	-D5476-T90
	100	10 × 25	0,60	1,5	0,38	0,70	0,24	-E5107-T90
	220	12 × 30	0,28	0,70	0,19	1,3	0,46	-L5227-T
	470	14 × 30	0,16	0,40	0,10	1,9	0,64	-E5477-T
	1 000	18 × 39,5	0,10	0,19	0,06	3,2	1,1	-D5108-T
	2 200	21 × 40	0,06	0,10	0,05	4,5	1,6	-A5228-T
40	10	6,5 × 15,5	5,0	13	3,3	0,17	0,06	-D7106-T90
	22	8,5 × 15,5	2,2	5,5	1,5	0,32	0,11	-D7226-T90
	47	8,5 × 15,5	1,0	2,5	0,72	0,46	0,16	-E7476-T90
	100	10 × 25	0,50	1,3	0,36	0,81	0,28	-E7107-T90
	220	12 × 30	0,25	0,63	0,18	1,4	0,49	-D7227-T
	470	16 × 30	0,13	0,33	0,10	2,2	0,77	-M7477-T
	1 000	21 × 40	0,07	0,16	0,06	4,0	1,4	-D7108-T
	2 200	25 × 40	0,04	0,08	0,05	5,9	2,0	-A7228-T

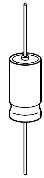
1) For instructions on how to determine ordering codes, refer to page 283.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C Ω	$R_{ESR, max}$ 100 Hz 20 °C Ω	Z_{max} 10 kHz 20 °C Ω	$I_{\sim R}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	Ordering code[1)] Short code
B41588-								
63	4,7	6,5 × 15,5	9,5	24	6,5	0,15	0,05	-K8475-T90
	10	8,5 × 15,5	4,0	10	3,1	0,23	0,08	-K8106-T90
	22	8,5 × 15,5	1,8	4,5	1,4	0,35	0,12	-K8226-T90
	47	10 × 25	0,80	2,0	0,67	0,64	0,22	-K8476-T90
	100	12 × 30	0,40	1,0	0,33	1,1	0,38	-J8107-T
	220	16 × 30	0,18	0,45	0,17	1,9	0,65	-B8227-T
	470	21 × 40	0,10	0,25	0,09	3,3	1,1	-J8477-T
	1 000	25 × 40	0,05	0,12	0,06	5,3	1,8	-A8108-T
100	4,7	8,5 × 15,5	7,0	18	6,0	0,17	0,06	-C9475-T90
	10	8,5 × 15,5	3,0	7,5	2,8	0,26	0,09	-D9106-T90
	22	10 × 25	1,3	3,3	1,3	0,52	0,18	-D9226-T90
	47	12 × 30	0,60	1,5	0,62	0,90	0,31	-D9476-T
	100	16 × 30	0,32	0,80	0,31	1,4	0,49	-E9107-T
	220	18 × 39,5	0,16	0,40	0,15	2,4	0,83	-D9227-T
	470	25 × 40	0,09	0,23	0,09	4,1	1,4	-A9477-T
B43588-								
160	2,2	6,5 × 15,5	36	80	33	0,07	0,02	-C1225-T90
	4,7	8,5 × 15,5	17	38	15	0,12	0,04	-D1475-T90
	10	10 × 25	8,0	18	7,2	0,19	0,07	-D1106-T90
	22	12 × 30	3,6	8,0	3,3	0,38	0,13	-C1226-T
	47	14 × 30	1,7	3,8	1,6	0,59	0,20	-D1476-T
	100	18 × 39,5	0,80	1,8	0,75	1,1	0,38	-D1107-T
	220	25 × 40	0,40	0,80	0,35	2,0	0,68	-A1227-T
250	2,2	8,5 × 15,5	29	72	31	0,09	0,03	-C2225-T90
	4,7	10 × 25	14	24	14	0,15	0,05	-C2475-T90
	10	10 × 25	6,4	16	6,8	0,24	0,08	-D2106-T90
	22	14 × 30	2,9	7,2	3,1	0,45	0,15	-D2226-T
	47	16 × 30	1,4	3,4	1,5	0,70	0,24	-M2476-T
	100	21 × 40	0,60	1,5	0,70	1,4	0,47	-D2107-T

1) For instructions on how to determine ordering codes, refer to page 283.



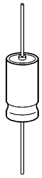
Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C Ω	$R_{ESR, max}$ 100 Hz 20 °C Ω	Z_{max} 10 kHz 20 °C Ω	$I_{\sim R}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	Ordering code[1)] Short code
B43588-								
350	1,0	6,5 × 15,5	48	120	64	0,06	0,02	-D4105-T90
	2,2	8,5 × 15,5	22	55	29	0,10	0,04	-D4225-T90
	4,7	10 × 25	10	25	14	0,17	0,06	-D4475-T90
	10	12 × 30	4,8	12	6,4	0,33	0,11	-D4106-T
	22	14 × 30	2,2	5,5	2,9	0,51	0,18	-E4226-T
	47	18 × 39,5	1,0	2,5	1,4	1,0	0,34	-D4476-T
	100	25 × 40	0,50	1,3	0,67	1,7	0,59	-A4107-T

Upon request we also supply special versions with rated voltages of up to 450 V–, surge voltages of up to 600 V– and capacitance ratings of 6,8 µF, 10 µF, 15 µF, 22 µF (e. g. for electronic ballast applications).

Temperature range – 40 … + 85 °C/+ 105 °C.

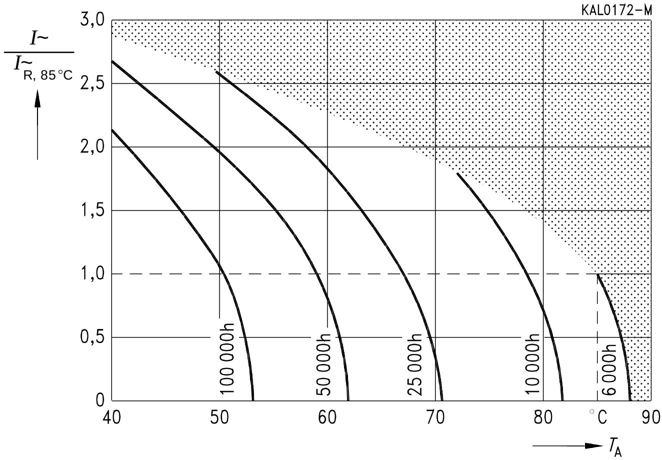
1) To obtain the required ordering code, prefix the type number to the short code. E. g.: B43588-C4105-T
B41588-... (U_R = 10 to 100 V–)
B43588-... (U_R = 160 to 350 V–)



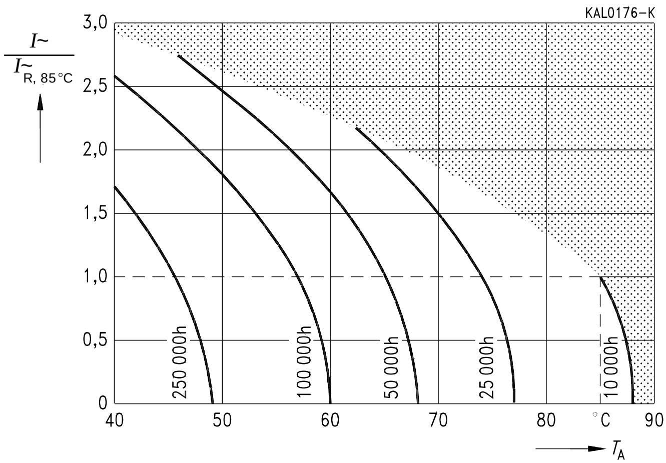
Useful life

versus ambient temperature T_A under ripple current operating conditions[1)]

U_R = 10 to 350 V– ($d \leq$ 8,5 mm)



U_R = 10 to 100 V– ($d \geq$ 10 mm)

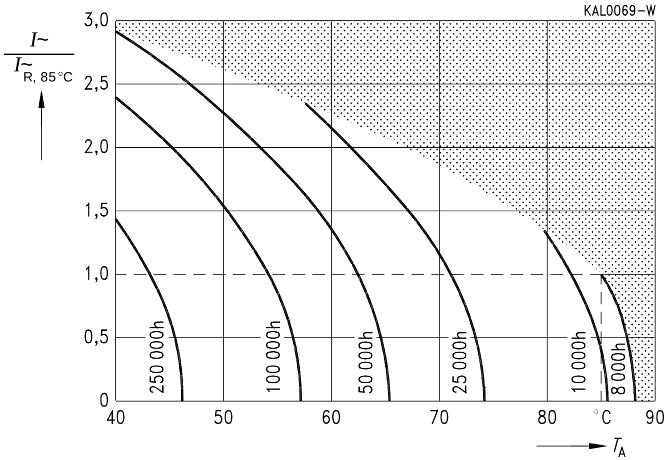


1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

Useful life

versus ambient temperature T_A under ripple current operating conditions[1)]

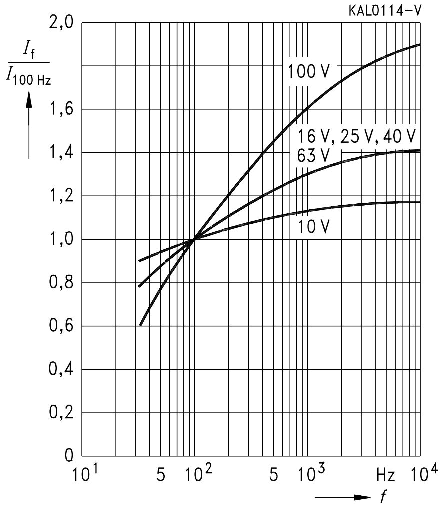
U_R = 160 to 350 V– ($d \geq$ 10 mm)



Permissible ripple current *I*~

versus frequency *f*

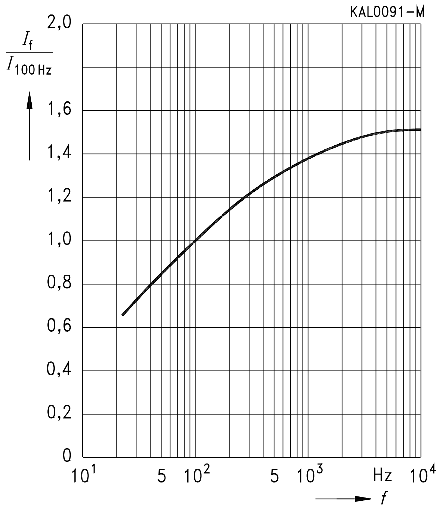
$U_R \leq$ 100 V–



Permissible ripple current *I*~

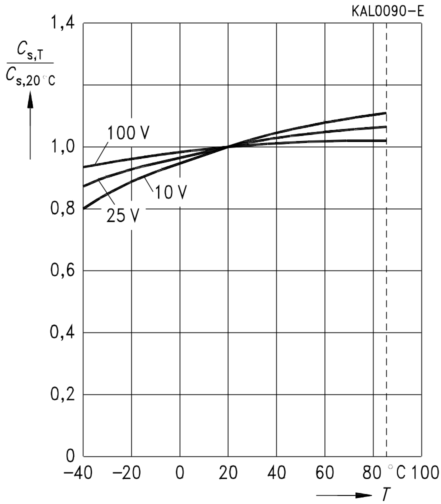
versus frequency *f*

$U_R \geq$ 160 V–

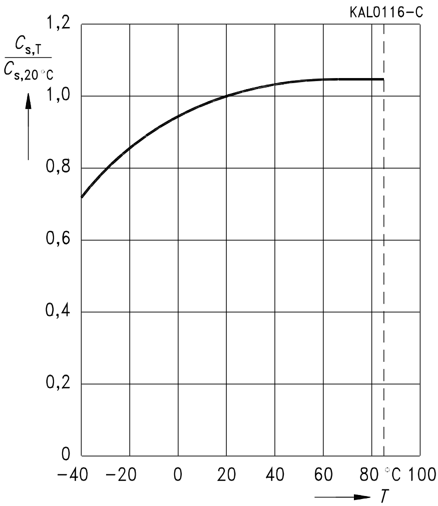


1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

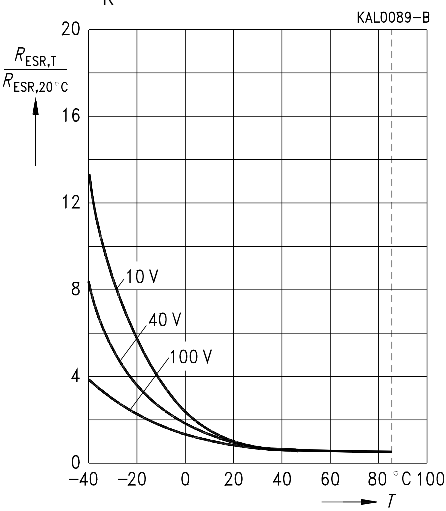
Series capacitance C_S at f = 100 Hz
versus temperature T
Typical behavior
$U_R \leq 100$ V–



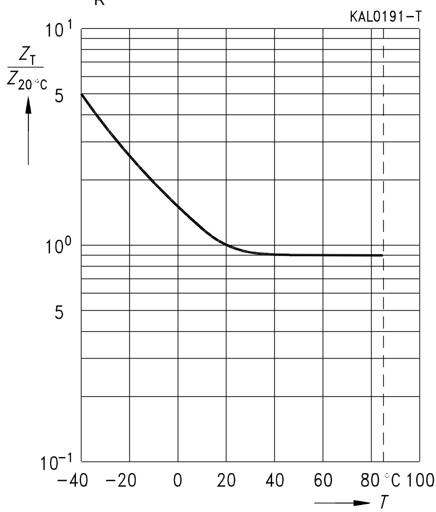
Series capacitance C_S at f = 100 Hz
versus temperature T
Typical behavior
$U_R \geq 160$ V–

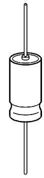


Equivalent series resistance R_{ESR}
at f = 100 Hz versus temperature T
Typical behavior
$U_R \leq 100$ V–

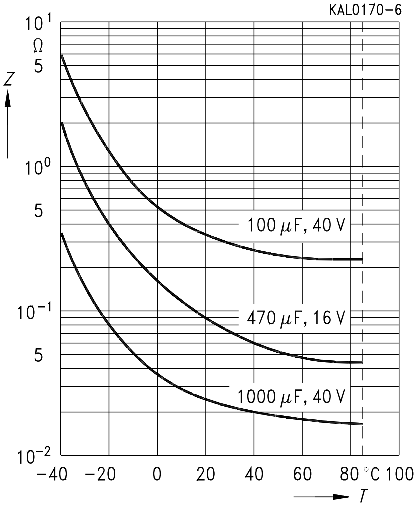


Impedance Z at f = 100 Hz
versus temperature T
Typical behavior
$U_R \geq 160$ V–

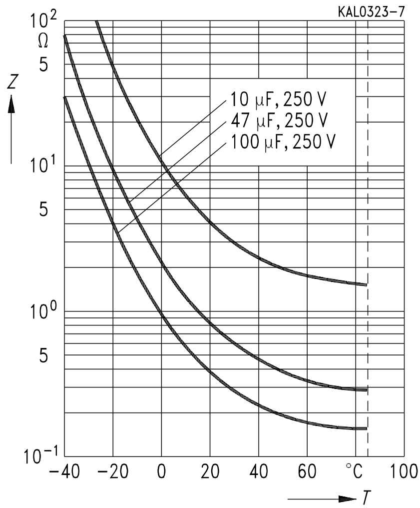




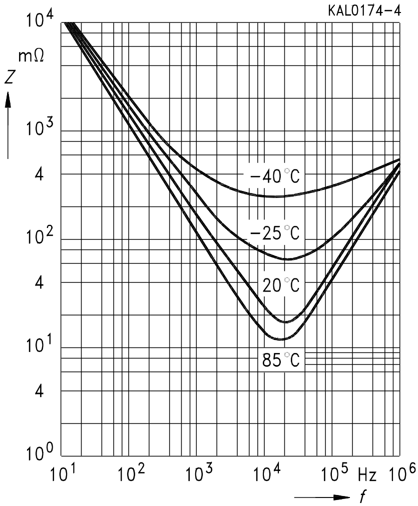
Impedance *Z* at f = 10 kHz
versus temperature T
Typical behavior
$U_R \leq 100$ V–



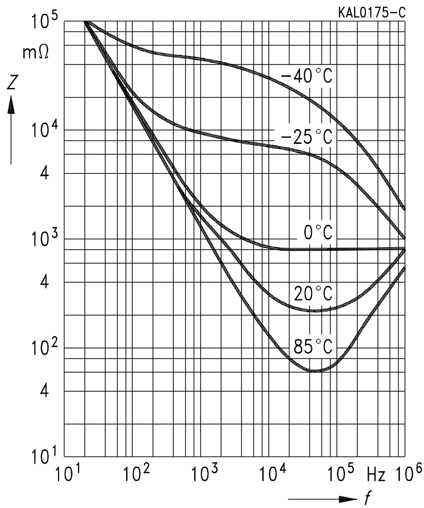
Impedance *Z* at f = 10 kHz
versus temperature T
Typical behavior
$U_R \geq 160$ V–



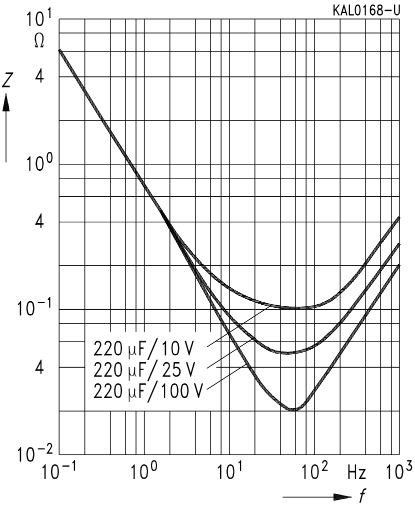
Impedance *Z*
versus frequency f
and temperature T for 1000 µF/40 V–
Typical behavior



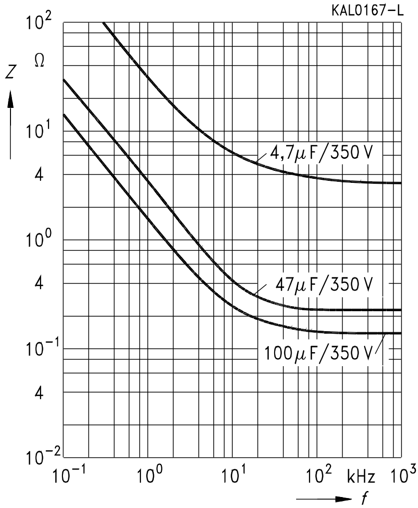
Impedance *Z*
versus frequency f
and temperature T for 100 µF/250 V–
Typical behavior



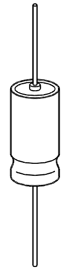
Impedance *Z*
versus frequency *f*
Typical values at 20 °C
$U_R \leq 100$ V–



Impedance *Z*
versus frequency *f*
Typical values at 20 °C
$U_R \geq 160$ V–



Extremely high reliability and long useful life
Operation at temperatures up to 125 °C



KAL0277-Z

Construction

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

Features

- Extremely high reliability and long useful life
- Very wide temperature range
- Can be operated at temperatures of up to 145 °C[1]
- Outstanding parametric stability
- High ripple current capability
- Shelf life up to 10 years

Applications

- High-reliability equipment in industrial and automotive electronics

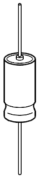
Tape packaging

Capacitors with $d \le 16$ mm are also available on tape.
Refer to page 305 for information on tapes and examples on how to order them.

Specifications and characteristics in brief

Rated voltage U_R	10 to 100 V–	
Surge voltage U_S	1,15 · U_R	
Rated capacitance C_R	4,7 to 4 700 µF	
Capacitance tolerance	– 10/+ 50 % ≙ T	
Useful life	$d \le 10$ mm, $d = 21$ mm, 25 mm	$d \ge 12$ mm to 18 mm
40 °C, U_R	> 200 000 h (3,2 · $I_{\sim R,125°C}$)	> 200 000 h (3,5 · $I_{\sim R,125°C}$)
85 °C, U_R; $I_{\sim max}$	> 10 000 h	> 15 000 h
125 °C, U_R; $I_{\sim R}$	> 2 000 h	> 3 000 h
Failure percentage	≤ 0,5 % (during useful life)	
Failure rate	≤ 10 fit ($\le 10 \cdot 10^{-9}$/h)	
Voltage endurance test	2 000 h, 125 °C (at U_R)	

1) For capacitors with $d \le 18$ mm: operation at 145 °C and 0,6 $I_{\sim max}$ permissible for a total of 500 h.



B 41 590

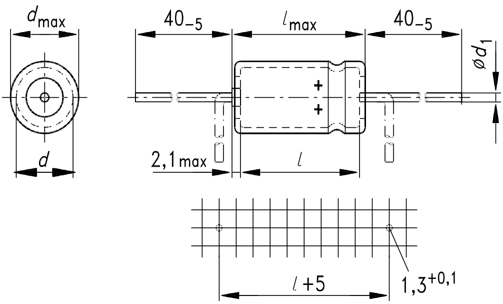
Specifications and characteristics in brief

Leakage current I_{lka} (5 min, 20 °C)	$C_R \cdot U_R \leq 1\,000\ \mu C$: $I_{lka} \leq 0{,}01\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)$ or 1 µA (the larger value applies) $1\,000\ \mu C \leq C_R \cdot U_R < 470\,000\ \mu C$: $I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$

Self-inductance L_{ESL}	d (mm)	6,5	8,5	10	12	14	16	18	21	25	
	l (mm)	15,5	15,5	25	30	30	30	39,5	40	40	
	L_{ESL} approx. (nH)	14	17	35	37	38	45	57	30	34	

IEC climatic category	in accordance with IEC 68-1 55/125/56 (–55 °C/+125 °C, 56 days damp heat test)
Detail specifications Sectional specifications	similar to CECC 30 301-802 IEC 384-4 (DIN 45 910 part 12)
Vibration resistance	in accordance with IEC 68-2–6, test Fc: displacement amplitude 0,75 mm, frequency range 10 to 55 Hz, acceleration max. 10 *g*, duration 3 × 2 h

Outline drawing

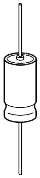


Minimum lead spacin KAL0058-G

Dimensions (mm) $d \times l$	$d_{max} \times l_{max}$	Lead wire diameter d_1	Approximate weight (g)
6,5 × 15,5	7,0 × 19	0,6	1,1
8,5 × 15,5	9,0 × 19		1,8
10 × 25	10,5 × 26,5		3,2
12 × 30	12,5 × 32	0,8	5,4
14 × 30	14,5 × 32		7,5
16 × 30	16,5 × 32		9,3
18 × 39,5	18,5 × 40,3		14
21 × 40	21,5 × 41,5		18
25 × 40	25,5 × 41,5		26

Packing units

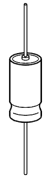
Case dimensions $d \times l$ (mm)	Bulk PU (pcs.)	Reel packing PU (pcs./reel)
6,5 × 15,5	2000	1300
8,5 × 15,5	1500	1000
10 × 25	900	600
12 × 30	600	450
14 × 30	400	350
16 × 30	350	250
18 × 39,5	250	–
21 × 40	200	–
25 × 40	150	–



Overview of available types

U_R (V–)	10	16	25	40	63	100
C_R (µF)	Case dimensions $d \times l$ (mm)					
4,7					6,5 × 15,5	8,5 × 15,5
10				6,5 × 15,5	8,5 × 15,5	8,5 × 15,5
22				8,5 × 15,5	8,5 × 15,5	10 × 25
47	6,5 × 15,5	8,5 × 15,5	8,5 × 15,5	8,5 × 15,5	10 × 25	12 × 30
100	8,5 × 15,5	8,5 × 15,5	10 × 25	10 × 25	12 × 30	16 × 30
220	10 × 25	10 × 25	12 × 30	12 × 30	16 × 30	18 × 39,5
470	12 × 30	12 × 30	14 × 30	16 × 30	18 × 39,5	25 × 40
1 000	14 × 30	16 × 30	18 × 39,5	21 × 40	25 × 40	
2 200	18 × 39,5	18 × 39,5	21 × 40	25 × 40		
4 700	25 × 40	25 × 40				

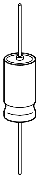
The capacitance and voltage ratings listed above are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.



Technical data and ordering codes

U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C Ω	$R_{ESR, max}$ 100 Hz 20 °C Ω	Z_{max} 10 kHz 20 °C Ω	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	$I_{\sim R}$ 100 Hz 125 °C A	Ordering code[1)] Short code
10	47	6,5 × 15,5	2,9	5,6	1,8	0,32	0,22	0,08	-B3476-T90
	100	8,5 × 15,5	1,4	2,6	0,86	0,52	0,36	0,13	-B3107-T90
	220	10 × 25	0,63	1,2	0,42	0,96	0,67	0,24	-B3227-T90
	470	12 × 30	0,29	0,56	0,22	1,8	1,3	0,45	-A3477-T
	1 000	14 × 30	0,14	0,26	0,14	2,8	1,9	0,69	-A3108-T
	2 200	18 × 39,5	0,06	0,12	0,10	5,6	3,9	1,4	-A3228-T
	4 700	25 × 40	0,04	0,07	0,07	8,0	5,6	2,0	-A3478-T
16	47	8,5 × 15,5	2,5	4,8	1,6	0,40	0,28	0,10	-B4476-T90
	100	8,5 × 15,5	1,2	2,3	0,80	0,60	0,42	0,15	-B4107-T90
	220	10 × 25	0,53	1,0	0,40	1,1	0,78	0,28	-B4227-T90
	470	12 × 30	0,25	0,48	0,22	2,0	1,4	0,49	-A4477-T
	1 000	16 × 30	0,12	0,23	0,12	3,2	2,2	0,80	-A4108-T
	2 200	18 × 39,5	0,06	0,10	0,10	5,6	3,9	1,4	-A4228-T
	4 700	25 × 40	0,04	0,06	0,06	8,0	5,6	2,0	-A4478-T
25	47	8,5 × 15,5	2,0	3,7	1,6	0,44	0,31	0,11	-B5476-T90
	100	10 × 25	0,95	1,8	0,76	0,76	0,53	0,19	-B5107-T90
	220	12 × 30	0,41	0,79	0,38	1,5	1,1	0,38	-A5227-T
	470	14 × 30	0,20	0,37	0,20	2,3	1,6	0,58	-A5477-T
	1 000	18 × 39,5	0,10	0,18	0,12	4,0	2,8	1,0	-A5108-T
	2 200	21 × 40	0,05	0,10	0,10	6,4	4,5	1,6	-A5228-T
40	10	6,5 × 15,5	7,4	14	6,6	0,20	0,14	0,05	-B7106-T90
	22	8,5 × 15,5	3,4	6,4	3,0	0,36	0,25	0,09	-B7226-T90
	47	8,5 × 15,5	1,6	3,0	1,4	0,52	0,36	0,13	-B7476-T90
	100	10 × 25	0,74	1,4	0,72	0,92	0,64	0,23	-B7107-T90
	220	12 × 30	0,34	0,64	0,36	1,7	1,2	0,42	-A7227-T
	470	16 × 30	0,16	0,30	0,20	2,8	1,9	0,69	-A7477-T
	1 000	21 × 40	0,08	0,16	0,12	5,2	3,6	1,3	-A7108-T
	2 200	25 × 40	0,04	0,08	0,08	8,0	5,6	2,0	-A7228-T

1) For instructions on how to determine ordering codes, refer to page 294.



Technical data and ordering codes

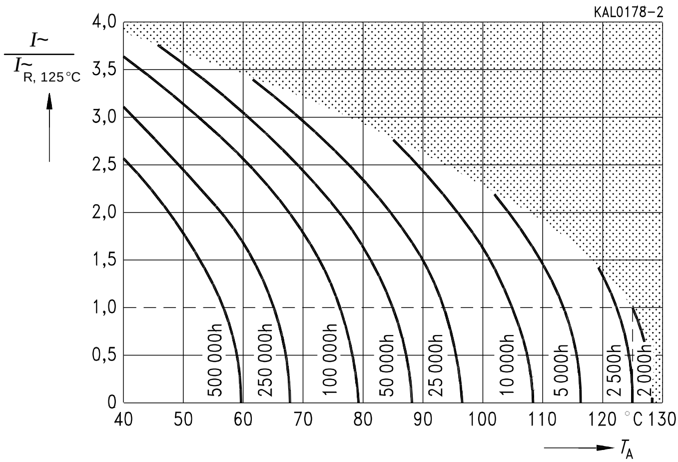
U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C Ω	$R_{ESR, max}$ 100 Hz 20 °C Ω	Z_{max} 10 kHz 20 °C Ω	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	$I_{\sim R}$ 100 Hz 125 °C A	Ordering code[1] Short code
63	4,7	6,5 × 15,5	14	26	13	0,16	0,11	0,04	-B8475-T90
	10	8,5 × 15,5	6,5	12,3	6,2	0,24	0,17	0,06	-B8106-T90
	22	8,5 × 15,5	2,9	5,6	2,8	0,36	0,25	0,09	-B8226-T90
	47	10 × 25	1,4	2,6	1,34	0,68	0,48	0,17	-B8476-T90
	100	12 × 30	0,63	1,2	0,66	1,2	0,87	0,31	-A8107-T
	220	16 × 30	0,31	0,56	0,34	2,0	1,4	0,50	-A8227-T
	470	18 × 39,5	0,14	0,26	0,18	3,5	2,5	0,88	-A8477-T
	1 000	25 × 40	0,08	0,14	0,12	5,6	3,9	1,4	-A8108-T
100	4,7	8,5 × 15,5	18	33,6	18	0,16	0,11	0,04	-B9475-T90
	10	8,5 × 15,5	8,3	15,7	8,4	0,24	0,17	0,06	-B9106-T90
	22	10 × 25	3,8	7,2	3,9	0,40	0,28	0,10	-B9226-T90
	47	12 × 30	1,8	3,4	1,9	0,72	0,50	0,18	-A9476-T
	100	16 × 30	0,79	1,5	0,90	1,2	0,87	0,31	-A9107-T
	220	18 × 39,5	0,38	0,72	0,50	2,2	1,5	0,54	-A9227-T
	470	25 × 40	0,20	0,38	0,30	3,5	2,5	0,88	-A9477-T

1) To obtain the required ordering code, prefix the type number to the short code.
E. g.: B41590-A8475-T

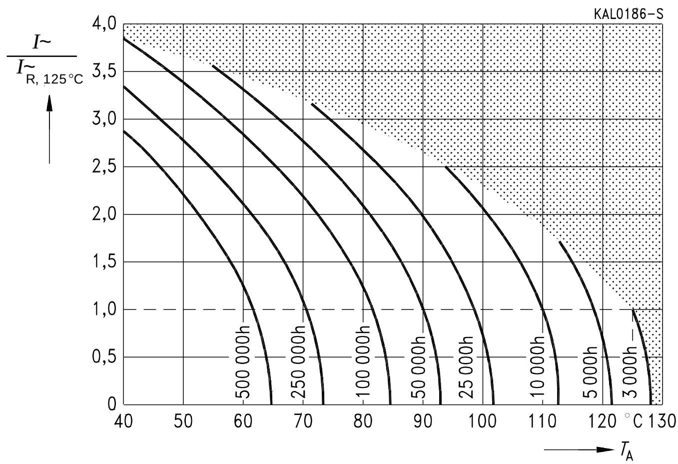
Useful life

versus ambient temperature T_A under ripple current operating conditions[1)]

$d \leq$ 10 mm, 21 mm, 25 mm

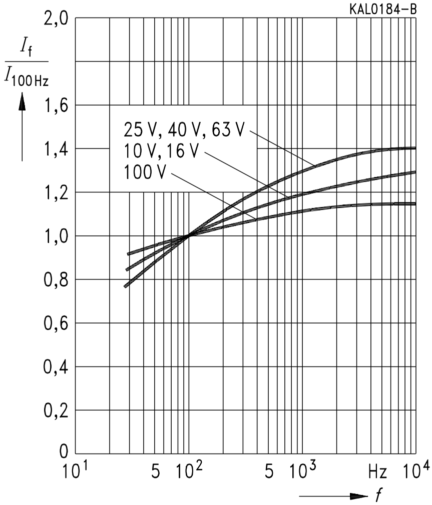


d = 12 mm to 18 mm

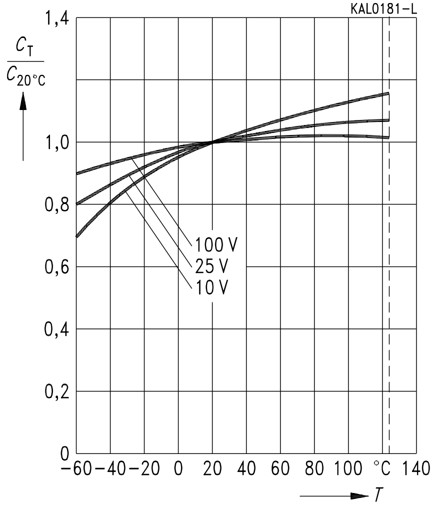


1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

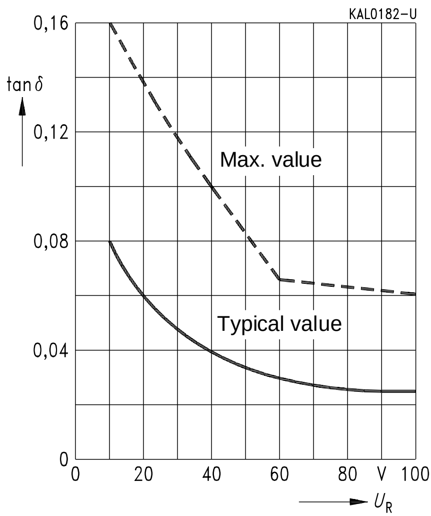
Permissible ripple current *I*~
versus frequency *f*



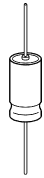
Series capacitance C_S at f = 100 Hz
versus temperature T
Typical behavior



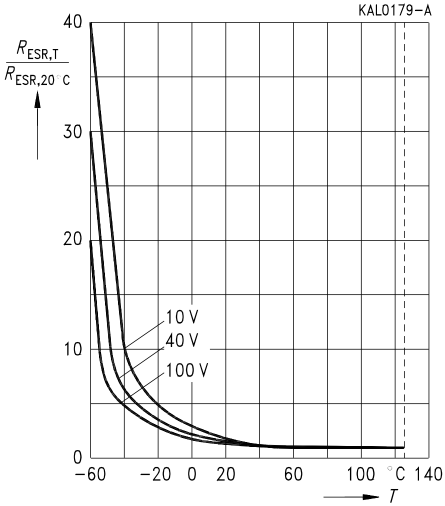
Dissipation factor tan δ
at T = 20 °C and f = 100 Hz
versus rated voltage U_R



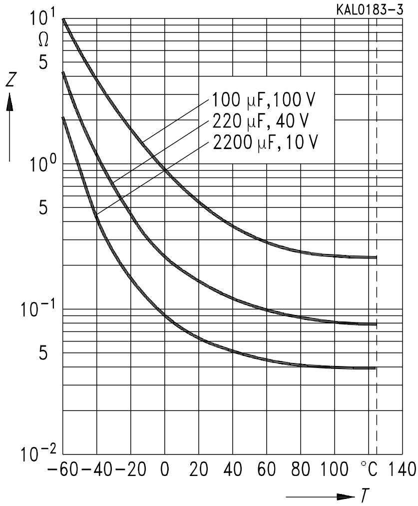
The maximum values correspond to DIN 45 910 part 123 and apply to $C_R \leq$ 1 000 µF.
The values increase by 0,02 per 1 000 µF.



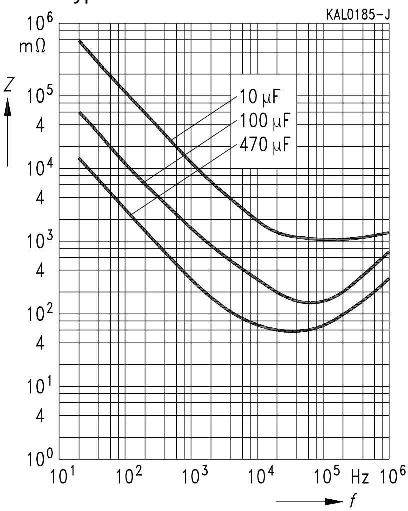
Equivalent series resistance R_{ESR}
at f = 100 Hz
versus temperature T
Typical behavior



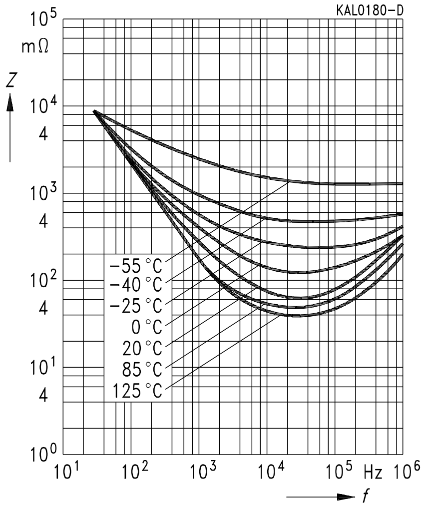
Impedance Z at f = 100 Hz
versus temperature T
Typical behavior



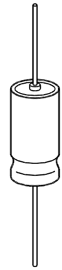
Impedance Z
versus frequency f
for U_R = 40 V–, at 20°C
Typical behavior



Impedance Z
versus frequency f
and temperature T for 470 μF/40 V–



High ripple current capability
Operation at temperatures up to 105 °C



KAL0277-Z

Construction

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

Features

- Extremely high reliability and long useful life
- Wide temperature range
- High parametric stability
- High ripple current capability

Applications

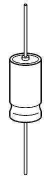
- High-reliability equipment in industrial and automotive electronics

Tape packaging

Capacitors with $d \leq 16$ mm are also available on tape.
Refer to page 305 for information on tapes and examples on how to order them.

Specifications and characteristics in brief

Rated voltage U_R	160 to 350 V–	
Surge voltage U_S	$1{,}15 \cdot U_R$ (for $U_R \leq 250$ V–) $1{,}10 \cdot U_R$ (for $U_R = 350$ V–)	
Rated capacitance C_R	2,2 to 220 µF	
Capacitance tolerance	– 10/+ 50 % ≙ T	
Useful life	$d \leq 10$ mm	$d \geq 12$ mm
40 °C, U_R	> 200 000 h (2,5 · $I_{\sim R,105°C}$)	> 200 000 h (2,7 · $I_{\sim R,105°C}$)
85 °C, U_R; $I_{\sim max}$	> 7 500 h	> 10 000 h
105 °C, U_R; $I_{\sim R}$	> 3 000 h	> 4 000 h
Failure percentage	≤ 1 % (during useful life)	
Failure rate	≤ 20 fit (≤ 20 · 10^{-9}/h)	
Voltage endurance test	2 000 h, 105 °C (at U_R)	

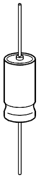


Specifications and characteristics in brief

<table>
<tr><td>Leakage current I_{lka}
(5 min, 20 °C)</td><td colspan="9">$C_R \cdot U_R \leq 1\,000\ \mu C$:
$I_{lka} \leq 0{,}01\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right)$ or 1 µA (the larger value applies)

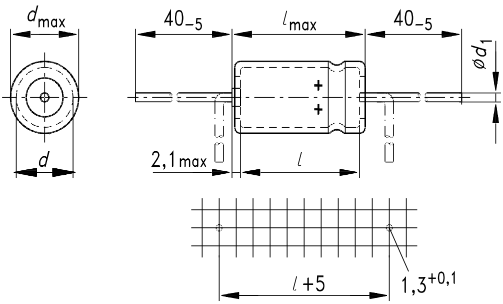
$1\,000\ \mu C \leq C_R \cdot U_R < 470\,000\ \mu C$:
$I_{lka} \leq 0{,}006\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{U_R}{V}\right) + 4\ \mu A$</td></tr>
<tr><td rowspan="3">Self-inductance L_{ESL}</td><td>d (mm)</td><td>8,5</td><td>10</td><td>12</td><td>14</td><td>16</td><td>18</td><td>25</td><td></td></tr>
<tr><td>l (mm)</td><td>15,5</td><td>25</td><td>30</td><td>30</td><td>30</td><td>40</td><td>40</td><td></td></tr>
<tr><td>L_{ESL} approx. (nH)</td><td>14</td><td>30</td><td>40</td><td>40</td><td>40</td><td>60</td><td>60</td><td></td></tr>
<tr><td>IEC climatic category</td><td colspan="9">in accordance with IEC 68-1
40/105/56 (–40 °C/+105 °C, 56 days damp heat test)</td></tr>
<tr><td>Detail specifications

Sectional specifications</td><td colspan="9">similar to CECC 30 301-801
(similar to CECC 30 301-003, DIN 45 910 part 123)
IEC 384-4
(DIN 45 910 part 12)</td></tr>
<tr><td>Vibration resistance</td><td colspan="9">in accordance with IEC 68-2–6, test Fc:
displacement amplitude 0,75 mm, frequency range 10 to 55 Hz,
acceleration max. 10 g, duration 3 × 2 h</td></tr>
</table>



B 43 590

Outline drawing

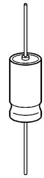


Minimum lead spacin KAL0058-G

Dimensions (mm) $d \times l$	 $d_{max} \times l_{max}$	 Lead wire diameter d_1	Approximate weight (g)
8,5 × 15,5	9,0 × 17	0,6	1,8
10 × 25	10,5 × 26,5		3,2
12 × 30	12,5 × 32	0,8	5,4
14 × 30	14,5 × 32		7,5
16 × 30	16,5 × 32		9,3
18 × 39,5	18,5 × 40,3		14
25 × 40	25,5 × 41,5		26

Packing units

Case dimensions $d \times l$ (mm)	Bulk PU (pcs.)	Reel packing PU (pcs./reel)
8,5 × 15,5	1500	1000
10 × 25	900	600
12 × 30	600	450
14 × 30	400	350
16 × 30	350	250
18 × 39,5	250	–
25 × 40	150	–



Overview of available types

U_R (V–)	160	250	350
C_R (µF)	Case dimensions $d \times l$ (mm)		
2,2		8,5 × 15,5	8,5 × 15,5
4,7	8,5 × 15,5	10 × 25	10 × 25
10	10 × 25	12 × 30	12 × 30
22	12 × 30	14 × 30	16 × 30
47	16 × 30	18 × 39,5	18 × 39,5
100	18 × 39,5	25 × 39,5	25 × 39,5
220	25 × 40		

The above capacitance and voltage ratings are available in smaller cases upon request. Other voltage and capacitance ratings are also available upon request.

Technical data and ordering codes

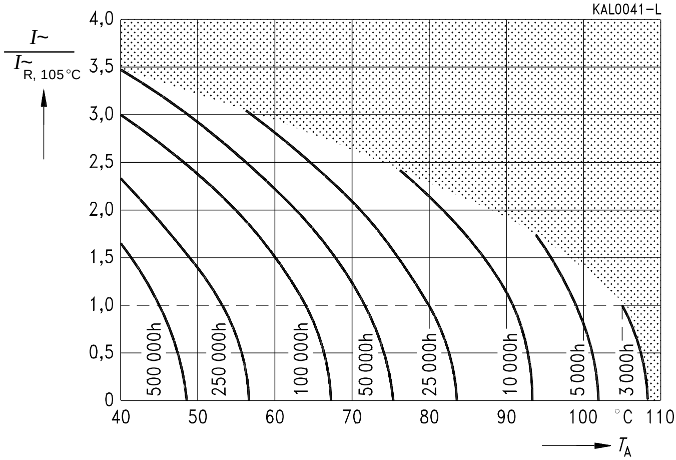
U_R V–	C_R µF	Case dimensions $d \times l$ mm	$R_{ESR, typ}$ 100 Hz 20 °C Ω	$R_{ESR, max}$ 100 Hz 20 °C Ω	Z_{max} 10 kHz 20 °C Ω	$I_{\sim max}$ 100 Hz 40 °C A	$I_{\sim max}$ 100 Hz 85 °C A	$I_{\sim R}$ 100 Hz 105 °C A	Ordering code[1)] Short code
160	4,7	8,5 × 15,5	14	34	14	0,14	0,088	0,042	-B1475-T90
	10	10 × 25	6,8	16	6,8	0,26	0,16	0,075	-B1106-T90
	22	12 × 30	3,0	7,2	3,1	0,48	0,29	0,14	-A1226-T
	47	16 × 30	1,4	3,4	1,5	0,82	0,50	0,24	-A1476-T
	100	18 × 39,5	0,70	1,6	0,71	1,4	0,84	0,40	-A1107-T
	220	25 × 40	0,30	0,70	0,33	2,4	1,5	0,72	-A1227-T
250	2,2	8,5 × 15,5	25	63	29	0,11	0,067	0,032	-B2225-T90
	4,7	10 × 25	12	30	13	0,18	0,11	0,053	-B2475-T90
	10	12 × 30	5,0	13	6,5	0,37	0,23	0,11	-A2106-T
	22	14 × 30	2,5	6,4	2,9	0,54	0,34	0,16	-A2226-T
	47	18 × 39,5	1,2	3,0	1,4	1,0	0,63	0,30	-A2476-T
	100	25 × 40	0,54	1,4	0,7	1,8	1,1	0,53	-A2107-T
350	2,2	8,5 × 15,5	19	48	28	0,12	0,076	0,036	-B4225-T90
	4,7	10 × 25	8,5	21	13	0,23	0,15	0,069	-B4475-T90
	10	12 × 30	4,1	10	6,1	0,40	0,25	0,12	-A4106-T
	22	16 × 30	1,9	4,8	2,8	0,68	0,42	0,20	-A4226-T
	47	18 × 39,5	0,85	2,1	1,3	1,2	0,76	0,36	-A4476-T
	100	25 × 40	0,41	1,0	0,64	2,1	1,3	0,62	-A4107-T

1) To obtain the required ordering code, prefix the type number to the short code. E.g.: B43590-A1475-T

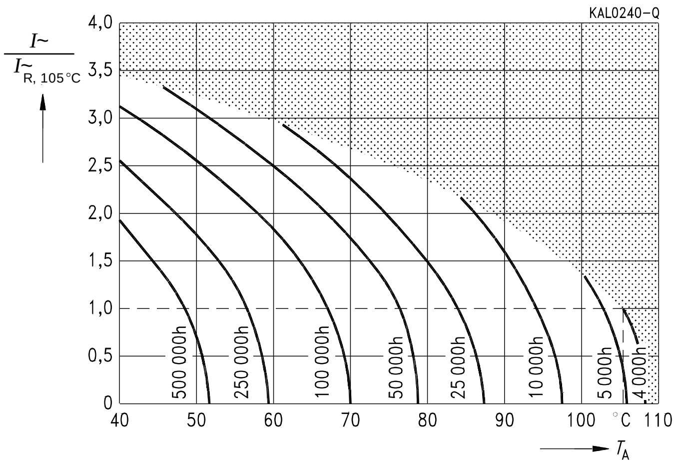
Useful life

versus ambient temperature T_A under ripple current operating conditions[1)]

$d \leq$ 10 mm

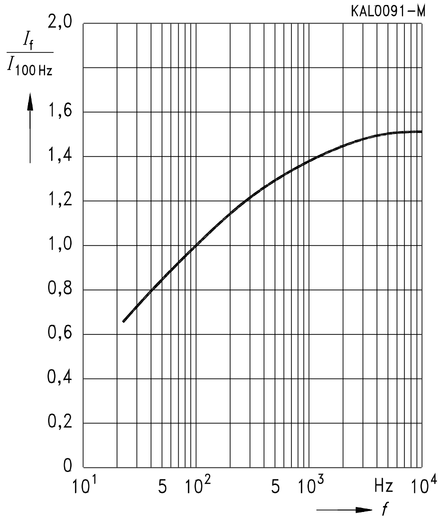


$d \geq$ 12 mm

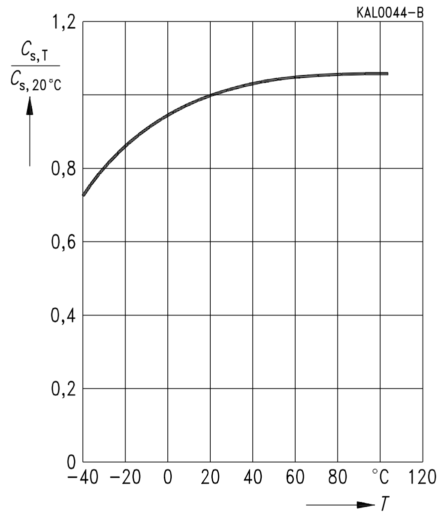


1) Refer to page 34 for an explanation on how to interpret the useful life graphs.

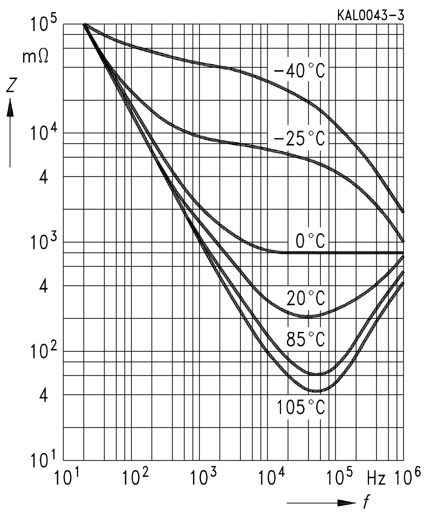
Permissible ripple current *I*~
versus frequency *f*



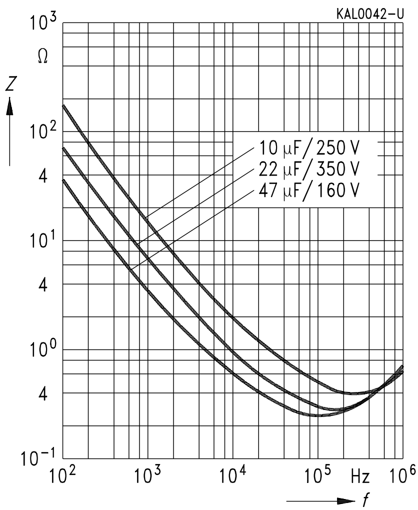
Series capacitance C_S at f = 100 Hz
versus temperature T
Typical behavior



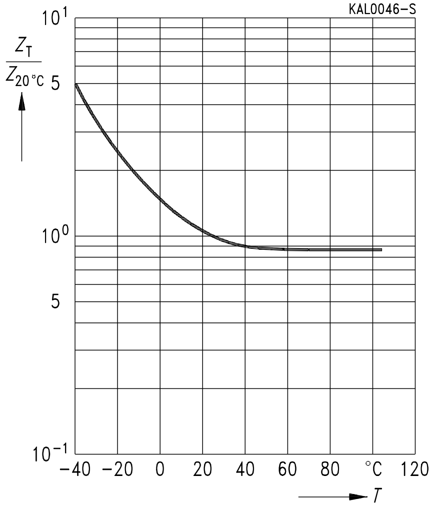
Impedance *Z*
versus frequency *f*
and temperature for 100 µF/250 V–
Typical behavior



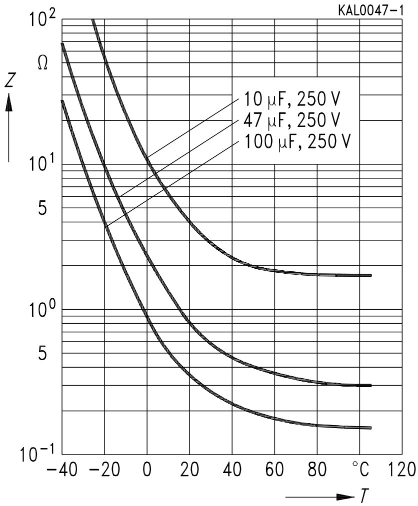
Impedance *Z*
versus frequency *f*
Typical values at 20 °C



Impedance *Z* at f = 100 Hz
versus temperature T
Typical behavior



Impedance *Z* at f = 10 kHz
versus temperature T
Typical behavior



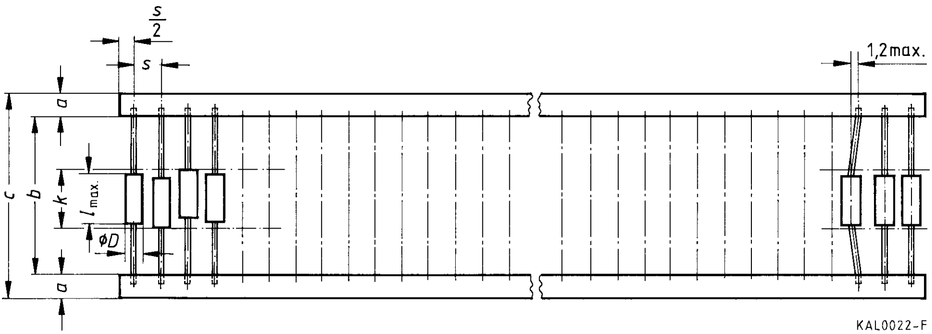
General information

For automatic component insertion machines, we can also provide aluminum electrolytic capacitors with axial wire leads (**nominal diameters up to 16 mm**) on tapes. Tape packaging complies with IEC 286-1.

The capacitors are uniformly oriented, i. e. identical poles point to the same tape side/direction. The tape on the cathode terminal side is blue to facilitate identification of the polarity.

The tapes are either supplied on reels.

Dimensions and tolerances



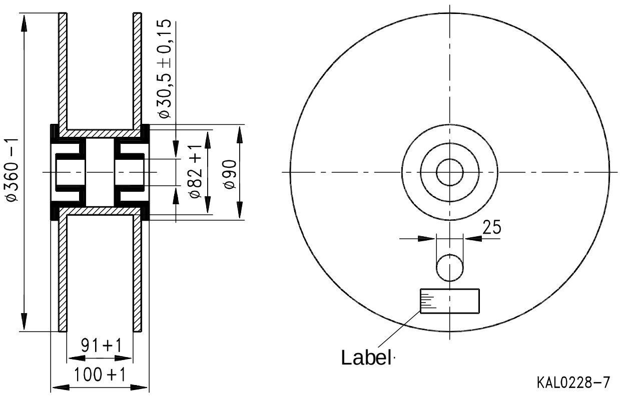
In order to obtain a uniform tape width, the leads are shortened accordingly. The lead ends do not protrude beyond the edge of the tapes.

Nominal diameter *D*	Tape package		Body location *k*	Tape width *a*	Tape spacing (inner) *b*	Tape width *c*
	Spacing *s*	Tolerance over 10 spacings Δs				
mm	mm	mm	mm	mm	mm	mm
6,5 … 8,5	10 ± 0,5	± 2				
10 … 14	15 ± 0,5	± 3	l_{max} [1] + 1,4	6 ± 1	73 ± 2	85 ± 5
16	20 ± 1	± 4				

1) Measured in accordance with DIN 41 099, sheet 1 or IEC 294.

Taping and Packing

Reel packing



Packing units and minimum order quantities

It would be uneconomical to use taped components in small quantities, as the proportion of the costs for taping and packing would be too high. Because of this, minimum order quantities have been determined, corresponding to the capacity of the reel.

Capacitor nominal diameter mm	Packing unit / Minimum order quantity Pieces/reel
6,5	1300
8,5	1000
10	600
12	450
14	350
16	250

Types available on tape and ordering codes

The following capacitor types are suitable for tape packaging:

B 41 010	B 41 588	B 43 588
B 41 283	B 41 590	B 43 590

To obtain the ordering code append a “9” to the normal ordering code.

Example of how to order

B41590-A∗∗∗∗-T∗

Type — B41590

Short code according to data sheet — A∗∗∗∗

Code number for type of packing — ∗
9 ≙ Reel packing

General Information

Photographic flashlights are subjected to widely varying demands. This must be taken into account when selecting the aluminum electrolytic capacitors to be used. In the following section, only the basic data of our relevant product range are listed. If you require such capacitors, please contact your nearest S+M Components representative, using the questionnaire shown on page 312 as a guide. This questionnaire describes the most important selection criteria.

Features

The design and construction of photoflash capacitors by S+M Components have been optimally adapted to the wide variety of operating conditions.

- Constant capacitance values for large numbers of flash discharges, even with short flash repetition intervals, ensure constant flash factors.
- Low leakage currents, even after long idle periods, guarantee a large number of flashes per battery charge and enable their use in equipment that is powered by batteries only.
- Small dimensions for given voltage-capacitance combinations enable compact equipment designs.
- When the capacitors and flash tubes are correctly matched, low internal resistances ensure optimum light efficiency.

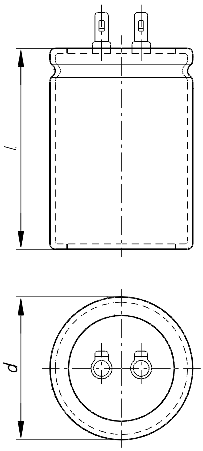
Overview

Type series	Description	Rated capacitance range	Rated voltage range
B 43 405 B 43 406	Photoflash electrolytic capacitors with solder lugs, for professional flash equipment	approx. 120 µF to 17 000 µF	310 V– to 500 V–
B 43 407	Photoflash electrolytic capacitors with screw terminals, for professional flash equipment	approx. 120 µF to 17 000 µF	310 V– to 500 V–

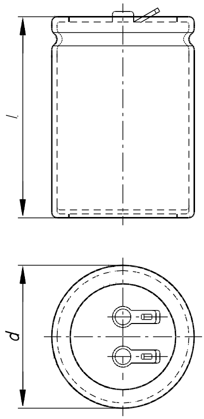
Terminal styles

B 43 405, B 43 406: Solder lugs

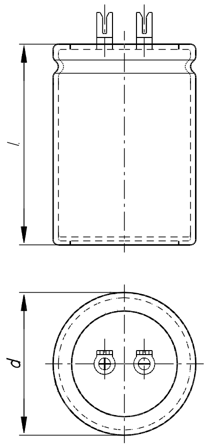
Sturdy solder lug terminals enable secure connection of wire or metal strap leads. Three standard versions are available.



KAL0256-C

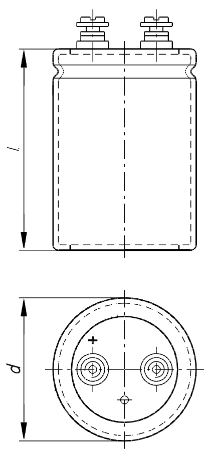


KAL0257-K



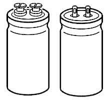
KAL0258-T

B 43 407: Screw terminals



KAL0255-4

For a list of accessories, refer to “Capacitors with Screw Terminals”, page 139.



	B 43 405	B 43 406 B 43 407
Construction	Single-anode version with particularly low dissipation factor Double-anode version with particularly small dimensions	
Applications	Photographic flash	Photographic flash (high load capability, for professional equipment)
Case dimensions *d* (mm)	22 to 50	B 43 406: 33 to 50 B 43 407: 35,7 to 91,0
l (mm)	35 to 85	B 43 406: 35 to 85 B 43 407: 56,7 to 144,5
Insulation	With insulating sleeve	With insulating sleeve
Load capability		
1. Flash discharges	≥ 20 000	≥ 100 000
2. Flash repetition period	≥ 5 s	≥ 2 s
3. Number of flashes with minimum repetition period	≤ 100	≤ 200
4. Pause after case 3.	≥ 1 h	≥ 45 min
5. Average flash sequence with pauses	≥ 40 s	≥ 15 s
6. Flashes per week	≤ 1 000	≤ 3 500
7. Charging resistance	≥ 10 Ω	≥ 10 Ω
8. Discharge resistance	≥ 0,5 Ω	≥ 0,5 Ω

Capacitance

The DC capacitance is the decisive factor for the light energy yield. This characteristic is approximately 1,2 times the AC capacitance. Since the loss angle can only be determined using alternating currents and the AC capacitance is measured together with this value, it is usual, in agreement with the users, to state the AC capacitance. The permitted deviation from the rated capacitance value is + 20/– 10 %. The values are measured at a frequency of 100 Hz.

Leakage current (measuring conditions)

The leakage current value limits quoted by S+M Components apply to the capacitors in new condition. When the leakage current is determined, the current is measured after the capacitor has been connected, for a period of five minutes, via a 1 kΩ resistor to a stabilized power supply set to the rated voltage.

Charge-discharge capability

After 10 000 flash discharges at normal operating temperatures (5 °C to 35 °C), the capacitor will remain within the limits specified below.

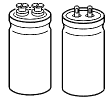
Leakage current: 150 % of the initial limit

Capacitance change: ± 15 % of the initial value

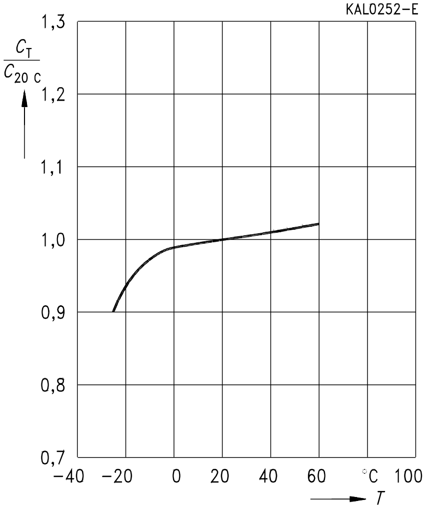
Dissipation factor: 150 % of the initial limit.

Temperature

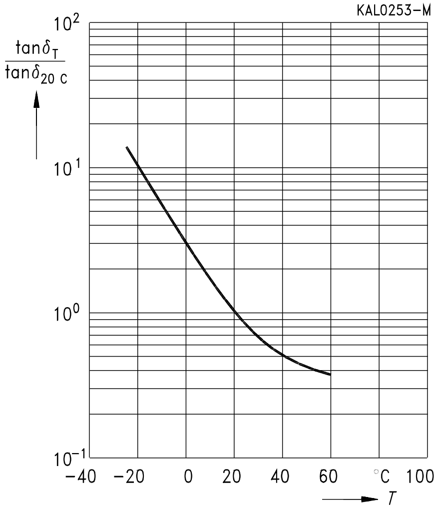
The lower diagram on the next page shows the temperature dependence of the leakage current. In order to prevent thermal instabilities, no switching loads that can lead to overtemperatures of more than 15 K may be applied. The surface temperature of the capacitor should never be allowed to exceed 60 °C at any point.



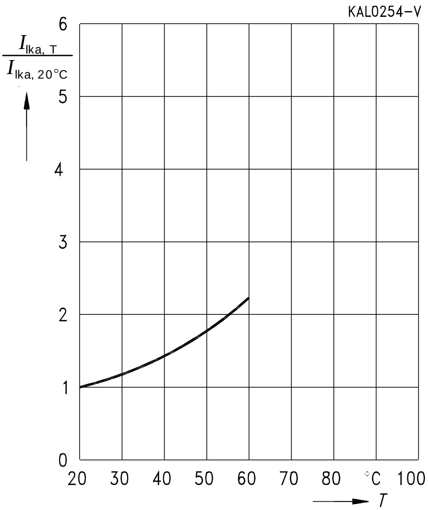
DC capacitance
versus temperature
U_N = 350 V
Typical behavior

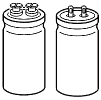


Dissipation factor tan δ
versus temperature, U_N = 350 V
Measuring frequency = 120 Hz
Typical behavior



Leakage current I_{lka}
versus temperature
Measurement duration = 5 mins.
Typical behavior





B 43 405 …
B 43 407

The characteristic data listed in the questionnaire below are essentially the most important information for determining design dimensions of electrolytic capacitors for photoflash applications.

Please use the questionnaire when making enquiries, so that the flashlight capacitor can be optimally adapted to suit your particular application.

When making enquiries, please take into consideration that electrolytic capacitors for photoflash applications can only be produced in economically feasible minimum lot sizes.

Questionnaire

Rated capacitance ________________________________ µF

Rated voltage ________________________________ V–

Required dimensions: Diameter ________________________________ mm

Length ________________________________ mm

Terminals ________________________________

Ambient temperature ________________________________ °C

Discharge conditions

Internal resistance of the discharge tube ________________________________ Ω

Charging resistance (series resistance) ________________________________ Ω

Flash sequence ________________________________

Pause periods ________________________________

Other special operating conditions ________________________________

Expected useful life ________________________________

Number of units per annum ________________________________

Subject Index

Symbols and Terms

Symbol	Term
C	Capacitance
C_R	Rated capacitance
ΔC_R	Capacitance tolerance
C_s	Series capacitance
$C_{s,T}$	Series capacitance at temperature T
C_f	Capacitance at frequency f
d	Case diameter, nominal dimension
d_{max}	Maximum case diameter
f	Frequency
I	Current
$I\sim$	Alternating current
$I\sim_{rms}$	Alternating current, root-mean-square
$I\sim_f$	Ripple current at frequency f
$I\sim_{max}$	Maximum permissible ripple current
$I\sim_R$	Rated ripple current
$I\sim_{R,UCT}$	Rated ripple current at upper category temperature
$I\sim_{UCT}$	Ripple current at upper category temperature
I_{lk}	Leakage current
I_{lka}	Leakage current for acceptance test
I_{lkop}	Operating leakage current
L_{ESL}	Capacitor self-inductance
l	Case length, nominal dimension
l_{max}	Maximum case length (without terminals and mounting stud)
R	Resistance
R_{ESR}	Equivalent series resistance
$R_{ESR,f}$	Equivalent series resistance at frequency f
$R_{ESR,T}$	Equivalent series resistance at temperature T
R_{is}	Insulation resistance
R_{Symm}	Balancing resistance
T	Temperature
ΔT	Temperature difference
T_A	Ambient temperature
t	Time
Δt	Period
t_b	Service life
U	Voltage
U_{op}	Operating voltage
U_F	Forming voltage
U_C	Category voltage
U_R	Rated voltage, dc voltage
U_S	Surge voltage

Symbol	Term
Z	Impedance
Z_T	Impedance at temperature T
λ	Failure rate (1 fit = $1 \cdot 10^{-9}$/h)
ε_r	Relative dielectric constant
ε_0	Absolute permittivity
ω	Angular frequency; $2 \cdot \pi \cdot f$
$\tan \delta$	Dissipation factor

The commas used in numerical values denote decimal points.
All dimensions are given in mm.

Vakatseite