



# **Aluminum electrolytic capacitors**

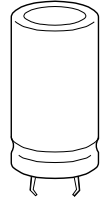
## **Snap-in capacitors**

**Series/Type:** B43545  
**Date:** November 2012

## **Long-life grade capacitors**

### **Applications**

- Frequency converters
- Solar inverters
- Uninterruptible power supplies
- Professional power supplies
- Medical appliances
- Telecommunications



### **Features**

- Outstanding ripple current capability
- Base cooling available upon request for case sizes 30 × 35 mm to 35 × 55 mm
- Long useful life
- Very high CV product, compact
- High reliability
- Extremely improved performance at high frequencies
- Outstanding low ESR at operating conditions above 50 °C
- Optimized internal thermal resistance
- Different case sizes available for each capacitance value
- Capacitors with all insulation versions pass the needle flame test according to IEC 60695-11-5 for all flame exposure times up to 120 s
- RoHS-compatible

### **Construction**

- Charge/discharge-proof, polar
- Aluminum case, fully insulated with PVC
- Version with PET insulation available
- Version with additional PET insulation cap on terminal side available for insulating the capacitor from the PCB
- Snap-in solder pins to hold component in place on PC-board
- Minus pole marking on case surface
- Minus pole not insulated from case
- Overload protection by safety vent on the case wall

### **Terminals**

- Standard version with 2 terminals,  
2 lengths available: 6.3 and 4.5 mm
- 3 terminals to ensure correct insertion: length 4.5 mm



## Specifications and characteristics in brief

Rated voltage $V_R$	400 ... 450 V DC											
Surge voltage $V_S$	$1.10 \cdot V_R$											
Rated capacitance $C_R$	82 ... 820 $\mu\text{F}$											
Capacitance tolerance	$\pm 20\% \triangle M$											
Dissipation factor $\tan \delta$ (20 °C, 120 Hz)	$V_R = 400 \text{ V DC: } \tan \delta \leq 0.15$ $V_R = 450 \text{ V DC: } \tan \delta \leq 0.20$											
Leakage current $I_{\text{leak}}$ (5 min, 20 °C)	$I_{\text{leak}} \leq 0.3 \mu\text{A} \cdot \left( \frac{C_R}{\mu\text{F}} \cdot \frac{V_R}{\text{V}} \right)^{0.7} + 4 \mu\text{A}$											
Self-inductance ESL	Approx. 20 nH											
Useful life <sup>1)</sup>		Requirements:										
105 °C; $V_R$ ; $I_{AC,R}$	> 5000 h	$\Delta C/C \leq \pm 20\%$ of initial value										
85 °C; $V_R$ ; $I_{AC,R}$	> 20000 h	$\tan \delta \leq 2$ times initial specified limit										
50 °C; $V_R$ ; $1.4 \cdot I_{AC,R}$	> 175000 h	$I_{\text{leak}} \leq$ initial specified limit										
Voltage endurance test		Post test requirements:										
105 °C; $V_R$	2000 h	$\Delta C/C \leq \pm 10\%$ of initial value										
		$\tan \delta \leq 1.3$ times initial specified limit										
		$I_{\text{leak}} \leq$ initial specified limit										
Vibration resistance test	To IEC 60068-2-6, test Fc: Frequency range 10 Hz ... 55 Hz, displacement amplitude 0.35 mm, acceleration max. 5 g, duration $3 \times 2$ h. Capacitor mounted by its body which is rigidly clamped to the work surface.											
Characteristics at low temperature	Max. impedance ratio at 100 Hz	<table><tr><td><math>V_R</math></td><td>400 V</td><td>450 V</td></tr><tr><td><math>Z_{-25\text{ °C}} / Z_{20\text{ °C}}</math></td><td>3</td><td>7</td></tr><tr><td><math>Z_{-40\text{ °C}} / Z_{20\text{ °C}}</math></td><td>7</td><td>12</td></tr></table>	$V_R$	400 V	450 V	$Z_{-25\text{ °C}} / Z_{20\text{ °C}}$	3	7	$Z_{-40\text{ °C}} / Z_{20\text{ °C}}$	7	12	
$V_R$	400 V	450 V										
$Z_{-25\text{ °C}} / Z_{20\text{ °C}}$	3	7										
$Z_{-40\text{ °C}} / Z_{20\text{ °C}}$	7	12										
IEC climatic category	To IEC 60068-1: $V_R = 400 \text{ V DC: } 40/105/56$ (–40 °C/+105 °C/56 days damp heat test) $V_R = 450 \text{ V DC: } 25/105/56$ (–25 °C/+105 °C/56 days damp heat test) The capacitors can be operated in the temperature range of –40 °C to +105 °C but the impedance at –40 °C should be taken into consideration.											
Detail specification	Similar to CECC 30301-809											
Sectional specification	IEC 60384-4											

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

### Snap-in capacitors with standard insulation (PVC or PET)

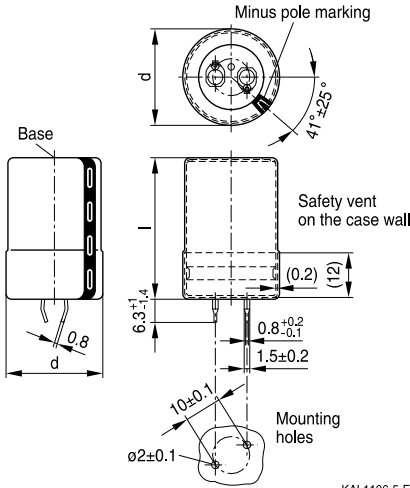


Snap-in capacitors are also available with 3 terminals (length (4.5 – 1) mm). PET insulation is marked with label "PET" on the sleeve.

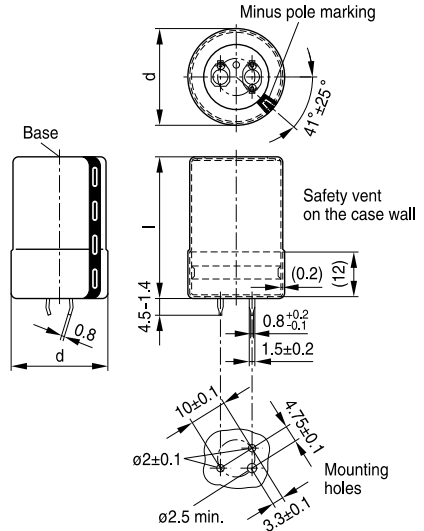
Dimensions (mm)		Approx.	Packing
d +1	l ±2	weight (g)	units (pcs.)
30	25	17	80
30	30	23	80
30	35	29	80
30	40	36	80
30	45	41	80
30	50	46	80
30	55	53	80
35	25	22	60
35	30	29	60
35	35	36	60
35	40	41	60
35	45	56	60
35	50	70	60
35	55	81	60



## Snap-in capacitors with PVC insulation and PET insulation cap on terminal side



KAL1196-5-E



KAL1197-D-E

Snap-in terminals, length  $(6.3 +1/-1.4)$  mm. Also available in a shorter version with a length of  $(4.5 -1.4)$  mm. PET insulation cap is positioned under the insulation sleeve.

Snap-in capacitors are also available with 3 terminals (length  $(4.5 -1.4)$  mm). PET insulation cap is positioned under the insulation sleeve.

Dimensions (mm)		Approx. weight (g)	Packing units (pcs.)
d +1.4	l +2.2/-2		
25	25	13	130
25	30	17	130
25	35	19	130
25	40	22	130
25	45	25	130
25	50	29	130
25	55	32	130

Dimensions (mm)		Approx. weight (g)	Packing units (pcs.)
d +1.4	l +2.2/-2		
30	25	17	80
30	30	23	80
30	35	29	80
30	40	36	80
30	45	41	80
30	50	46	80
30	55	53	80
35	25	22	60
35	30	29	60
35	35	36	60
35	40	41	60
35	45	56	60
35	50	70	60
35	55	81	60



**B43545**

**Outstanding ripple current, compact – 105 °C**

## Packing of snap-in capacitors



For ecological reasons the packing is pure cardboard. Components can be withdrawn (in full or in part) in the correct position for insertion.

## Ordering codes for terminal styles and insulation features

Identification in 3rd block of ordering code

Snap-in capacitors

Terminal version	Insulation version		
	PVC	PET	PVC plus PET cap
Standard terminals 6.3 mm	M000	M060	M080
Short terminals 4.5 mm	M007	M067	M087
3 terminals 4.5 mm	M002	M062	M082

Ordering examples:

- B43545A5107M007 } snap-in capacitor with short terminals and standard PVC insulation
- B43545A5107M062 } snap-in capacitor with 3 terminals and PET insulation
- B43545A5107M080 } snap-in capacitor with standard terminals and PVC insulation with additional PET insulation cap on terminal side



### Overview of available types

$V_R$ (V DC)	400	450
	Case dimensions $d \times l$ (mm)	
$C_R$ (μF)		
82		25 × 25
100		25 × 30
120	25 × 25	25 × 35 30 × 25
150	25 × 30	25 × 40 30 × 30
180	25 × 35 30 × 25	25 × 45 30 × 35 35 × 25
220	25 × 35 30 × 30	25 × 50 30 × 35 35 × 30
270	25 × 45 30 × 35 35 × 25	30 × 45 35 × 35
330	25 × 50 30 × 35 35 × 30	30 × 50 35 × 40
390	25 × 55 30 × 40 35 × 35	30 × 55 35 × 45
470	30 × 50 35 × 40	35 × 50
560	30 × 55 35 × 40	35 × 55
680	35 × 50	
820	35 × 55	

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


**B43545**
**Outstanding ripple current, compact – 105 °C**
**Technical data and ordering codes**

$C_R$ 100 Hz 20 °C μF	Case dimensions d × l mm	$ESR_{typ}$ 100 Hz 20 °C mΩ	$ESR_{typ}$ 300 Hz 60 °C mΩ	$Z_{max}$ 10 kHz 20 °C mΩ	$I_{AC,max}$ 100 Hz 60 °C A	$I_{AC,max}$ 100 Hz 85 °C A	$I_{AC,R}^{1)}$ 100 Hz 105 °C A	Ordering code (composition see below)
<b><math>V_R = 400</math> V DC</b>								
120	25 × 25	500	160	700	2.23	1.64	0.88	B43545A9127M0*#
150	25 × 30	400	130	550	2.60	1.92	1.04	B43545A9157M0*#
180	25 × 35	330	110	460	2.96	2.19	1.18	B43545A9187M0*#
180	30 × 25	330	100	460	3.12	2.31	1.24	B43545B9187M0*#
220	25 × 35	270	90	380	3.36	2.48	1.33	B43545A9227M0*#
220	30 × 30	270	85	370	3.58	2.64	1.42	B43545B9227M0*#
270	25 × 45	220	70	310	3.96	2.93	1.58	B43545A9277M0*#
270	30 × 35	220	70	300	4.12	3.04	1.64	B43545B9277M0*#
270	35 × 25	220	75	310	4.15	3.06	1.65	B43545C9277M0*#
330	25 × 50	180	60	260	4.58	3.39	1.82	B43545A9337M0*#
330	30 × 35	180	55	250	4.69	3.46	1.86	B43545B9337M0*#
330	35 × 30	180	60	260	4.79	3.54	2.03	B43545C9337M0*#
390	25 × 55	160	50	220	5.19	3.84	2.07	B43545A9397M0*#
390	30 × 40	150	50	210	5.30	3.91	2.24	B43545B9397M0*#
390	35 × 35	150	50	220	5.38	3.98	2.28	B43545C9397M0*#
470	30 × 50	130	40	180	6.11	4.51	2.59	B43545A9477M0*#
470	35 × 40	130	40	180	6.11	4.52	2.59	B43545B9477M0*#
560	30 × 55	110	34	150	6.95	5.13	2.94	B43545A9567M0*#
560	35 × 40	110	36	160	6.80	5.02	2.87	B43545B9567M0*#
680	35 × 50	90	30	130	7.87	5.82	3.33	B43545A9687M0*#
820	35 × 55	75	26	110	8.99	6.64	3.80	B43545A9827M0*#
<b><math>V_R = 450</math> V DC</b>								
82	25 × 25	1110	290	1680	1.80	1.32	0.71	B43545A5826M0*#
100	25 × 30	910	240	1370	2.06	1.52	0.82	B43545A5107M0*#
120	25 × 35	760	200	1140	2.34	1.73	0.94	B43545B5127M0*#
120	30 × 25	750	190	1140	2.47	1.81	0.98	B43545A5127M0*#
150	25 × 40	610	160	920	2.74	2.02	1.09	B43545A5157M0*#
150	30 × 30	600	150	910	2.86	2.10	1.14	B43545B5157M0*#
180	25 × 45	500	130	770	3.13	2.30	1.25	B43545A5187M0*#

**Composition of ordering code**

\* = Insulation feature

0 = PVC insulation

6 = PET insulation

 8 = PVC insulation with additional PET insulation  
cap on terminal side

# = Terminal style

0 = snap-in standard terminals (6.3 mm)

2 = snap-in 3 terminals (4.5 mm)

7 = snap-in short terminals (4.5 mm)

 1) 120-Hz conversion factor of ripple current:  $I_{AC}(120\text{ Hz}) = 1.03 \cdot I_{AC}(100\text{ Hz})$





### Technical data and ordering codes

$C_R$	Case dimensions	$ESR_{typ}$ 100 Hz 20 °C $\mu F$	$ESR_{typ}$ 300 Hz 60 °C $m\Omega$	$Z_{max}$ 10 kHz 20 °C $m\Omega$	$I_{AC,max}$ 100 Hz 60 °C A	$I_{AC,max}$ 100 Hz 85 °C A	$I_{AC,R^{(2)}}$ 100 Hz 105 °C A	Ordering code (composition see below)
$V_R = 450 \text{ V DC}$								
180	30 × 35	500	130	760	3.24	2.38	1.29	B43545B5187M0*#
180	35 × 25	510	130	770	3.32	2.44	1.32	B43545C5187M0*#
220	25 × 50	410	110	630	3.63	2.67	1.45	B43545A5227M0*#
220	30 × 35	410	110	630	3.70	2.72	1.47	B43545B5227M0*#
220	35 × 30	410	110	630	3.82	2.81	1.62	B43545C5227M0*#
270	30 × 45	330	85	510	4.31	3.17	1.83	B43545A5277M0*#
270	35 × 35	340	90	510	4.37	3.22	1.85	B43545B5277M0*#
330	30 × 50	270	70	420	4.98	3.66	2.11	B43545A5337M0*#
330	35 × 40	280	70	420	5.02	3.69	2.13	B43545B5337M0*#
390	30 × 55	230	60	350	5.64	4.15	2.39	B43545A5397M0*#
390	35 × 45	230	60	360	5.63	4.14	2.39	B43545B5397M0*#
470	35 × 50	190	50	300	6.41	4.72	2.72	B43545A5477M0*#
560	35 × 55	160	45	250	7.28	5.35	3.08	B43545A5567M0*#

### Composition of ordering code

\* = Insulation feature

0 = PVC insulation

6 = PET insulation

8 = PVC insulation with additional PET insulation cap on terminal side

# = Terminal style

0 = snap-in standard terminals (6.3 mm)

2 = snap-in 3 terminals (4.5 mm)

7 = snap-in short terminals (4.5 mm)

2) 120-Hz conversion factor of ripple current:  $I_{AC}(120 \text{ Hz}) = 1.03 \cdot I_{AC}(100 \text{ Hz})$



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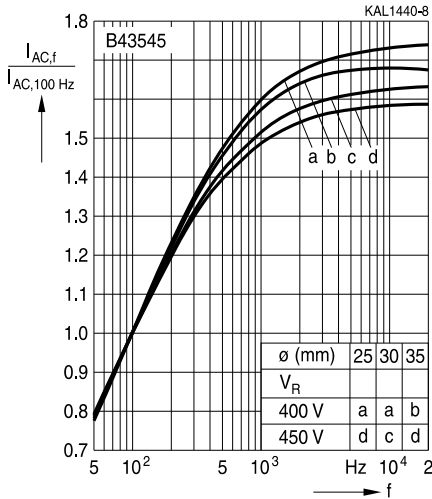
**Outstanding ripple current, compact – 105 °C**

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

The useful life graph is calculated for each individual capacitor and is available upon request.

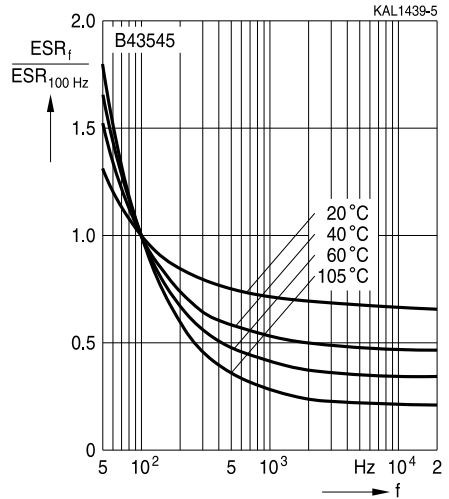
### Frequency factor of permissible ripple current $I_{AC}$ versus frequency $f$

Typical behavior



### Frequency characteristics of ESR

Typical behavior

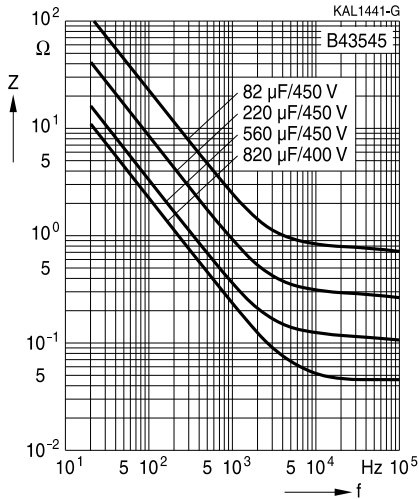


1) Refer to chapter "General technical information, 5 Useful life" on how to interpret useful life.



## Impedance Z versus frequency f

Typical behavior at 20 °C





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## **Cautions and warnings**

### **Personal safety**

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

Furthermore, some of the high-voltage electrolytes used by EPCOS are self-extinguishing.

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

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

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

MSDS (Material Safety Data Sheets) are available for all of our electrolytes upon request.

Nevertheless, the following rules should be observed when handling aluminum electrolytic capacitors: No electrolyte should come into contact with eyes or skin. If electrolyte does come into contact with the skin, wash the affected areas immediately with running water. If the eyes are affected, rinse them for 10 minutes with plenty of water. If symptoms persist, seek medical treatment. Avoid inhaling electrolyte vapor or mists. Workplaces and other affected areas should be well ventilated. Clothing that has been contaminated by electrolyte must be changed and rinsed in water.



## Product safety

The table below summarizes the safety instructions that must be observed without fail. A detailed description can be found in the relevant sections of chapter "General technical information".

Topic	Safety information	Reference chapter "General technical information"
Polarity	Make sure that polar capacitors are connected with the right polarity.	1 "Basic construction of aluminum electrolytic capacitors"
Reverse voltage	Voltages polarity classes should be prevented by connecting a diode.	3.1.6 "Reverse voltage"
Mounting position of screw-terminal capacitors	Do not mount the capacitor with the terminals (safety vent) upside down.	11.1. "Mounting positions of capacitors with screw terminals"
Robustness of terminals	The following maximum tightening torques must not be exceeded when connecting screw terminals: M5: 2.5 Nm M6: 4.0 Nm	11.3 "Mounting torques"
Mounting of single-ended capacitors	The internal structure of single-ended capacitors might be damaged if excessive force is applied to the lead wires. Avoid any compressive, tensile or flexural stress. Do not move the capacitor after soldering to PC board. Do not pick up the PC board by the soldered capacitor. Do not insert the capacitor on the PC board with a hole space different to the lead space specified.	11.4 "Mounting considerations for single-ended capacitors"
Soldering	Do not exceed the specified time or temperature limits during soldering.	11.5 "Soldering"
Soldering, cleaning agents	Do not allow halogenated hydrocarbons to come into contact with aluminum electrolytic capacitors.	11.6 "Cleaning agents"
Upper category temperature	Do not exceed the upper category temperature.	7.2 "Maximum permissible operating temperature"
Passive flammability	Avoid external energy, such as fire or electricity.	8.1 "Passive flammability"


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Topic	Safety information	Reference chapter "General technical information"
Active flammability	Avoid overload of the capacitors.	8.2 "Active flammability"
Maintenance	Make periodic inspections of the capacitors. Before the inspection, make sure that the power supply is turned off and carefully discharge the electricity of the capacitors. Do not apply any mechanical stress to the capacitor terminals.	10 "Maintenance"
Storage	Do not store capacitors at high temperatures or high humidity. Capacitors should be stored at +5 to +35 °C and a relative humidity of $\leq 75\%$ .	7.3 Storage conditions
		Reference chapter "Capacitors with screw terminals"
Breakdown strength of insulating sleeves	Do not damage the insulating sleeve, especially when ring clips are used for mounting.	"Screw terminals – accessories"



## Symbols and terms

Symbol	English	German
C	Capacitance	Kapazität
$C_R$	Rated capacitance	Nennkapazität
$C_S$	Series capacitance	Serienkapazität
$C_{S,T}$	Series capacitance at temperature T	Serienkapazität bei Temperatur T
$C_f$	Capacitance at frequency f	Kapazität bei Frequenz f
d	Case diameter, nominal dimension	Gehäusedurchmesser, Nennmaß
$d_{max}$	Maximum case diameter	Maximaler Gehäusedurchmesser
ESL	Self-inductance	Eigeninduktivität
ESR	Equivalent series resistance	Ersatzserienwiderstand
$ESR_f$	Equivalent series resistance at frequency f	Ersatzserienwiderstand bei Frequenz f
$ESR_T$	Equivalent series resistance at temperature T	Ersatzserienwiderstand bei Temperatur T
f	Frequency	Frequenz
I	Current	Strom
$I_{AC}$	Alternating current (ripple current)	Wechselstrom
$I_{AC,rms}$	Root-mean-square value of alternating current	Wechselstrom, Effektivwert
$I_{AC,f}$	Ripple current at frequency f	Wechselstrom bei Frequenz f
$I_{AC,max}$	Maximum permissible ripple current	Maximal zulässiger Wechselstrom
$I_{AC,R}$	Rated ripple current	Nennwechselstrom
$I_{AC,R} (B)$	Rated ripple current for base cooling	Nennwechselstromstrom für Bodenkühlung
$I_{leak}$	Leakage current	Reststrom
$I_{leak,op}$	Operating leakage current	Betriebsreststrom
l	Case length, nominal dimension	Gehäuselänge, Nennmaß
$l_{max}$	Maximum case length (without terminals and mounting stud)	Maximale Gehäuselänge (ohne Anschlüsse und Gewindebolzen)
R	Resistance	Widerstand
$R_{ins}$	Insulation resistance	Isolationswiderstand
$R_{symm}$	Balancing resistance	Symmetrierwiderstand
T	Temperature	Temperatur
$\Delta T$	Temperature difference	Temperaturdifferenz
$T_A$	Ambient temperature	Umgebungstemperatur
$T_C$	Case temperature	Gehäusetemperatur
$T_B$	Capacitor base temperature	Temperatur des Becherbodens
t	Time	Zeit
$\Delta t$	Period	Zeitraum
$t_b$	Service life (operating hours)	Brauchbarkeitsdauer (Betriebszeit)



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Symbol	English	German
V	Voltage	Spannung
V <sub>F</sub>	Forming voltage	Formierspannung
V <sub>op</sub>	Operating voltage	Betriebsspannung
V <sub>R</sub>	Rated voltage, DC voltage	Nennspannung, Gleichspannung
V <sub>S</sub>	Surge voltage	Spitzenspannung
X <sub>C</sub>	Capacitive reactance	Kapazitiver Blindwiderstand
X <sub>L</sub>	Inductive reactance	Induktiver Blindwiderstand
Z	Impedance	Scheinwiderstand
Z <sub>T</sub>	Impedance at temperature T	Scheinwiderstand bei Temperatur T
tan δ	Dissipation factor	Verlustfaktor
λ	Failure rate	Ausfallrate
ε <sub>0</sub>	Absolute permittivity	Elektrische Feldkonstante
ε <sub>r</sub>	Relative permittivity	Dielektrizitätszahl
ω	Angular velocity; 2 · π · f	Kreisfrequenz; 2 · π · f

#### Note

All dimensions are given in mm.



## Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application**. As a rule, EPCOS is either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an EPCOS product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified**. In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or lifesaving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
3. **The warnings, cautions and product-specific notes must be observed.**
4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous)**. Useful information on this will be found in our Material Data Sheets on the Internet ([www.epcos.com/material](http://www.epcos.com/material)). Should you have any more detailed questions, please contact our sales offices.
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