Index

Selection guide

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Rev. D:\EMAIN16.doc 04.06.99 12:21

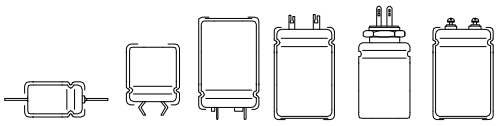
1 GENERAL INFORMATION

F&T Kondensatoren GmbH has been a manufacturer of capacitors since 1948. Many years of experience, continuous research & development and the latest production machinery guarantees products of the highest quality.

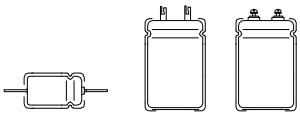
ALUMINIUM ELECTROLYTIC CAPACITORS

- **polarized capacitors**

  general industrial
  computer
  telecommunications
  switch mode power supplies
  smoothing and filtering

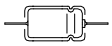


  welding and photo flash applications
  (single anode technology)

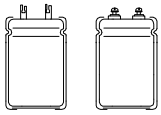


- **non polarized capacitors**

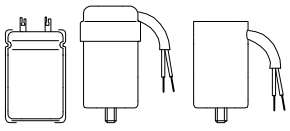
  audio - video applications



  charging capacitors for
  photo flash capacitor banks



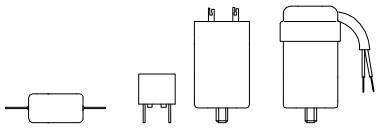
  single phase motor starting



METALLIZED FILM FOIL CAPACITORS

- mettalized Polyester (MKT)
- metallized Polypropylene (MKP)

  pulse applications
  power filter
  coupling, smoothing and filtering



We offer :

- **Technical Support From Qualified Electronic Specialists**
- **Industry Standard & Customer Specific Solutions**
- **Competitive Pricing**
- **Prompt Delivery**

1 terminal
2 aluminium can
3 insulation
4 bottom insulation
5 deck
6 sealing
7 safety vent
8 tab foil
9 winding

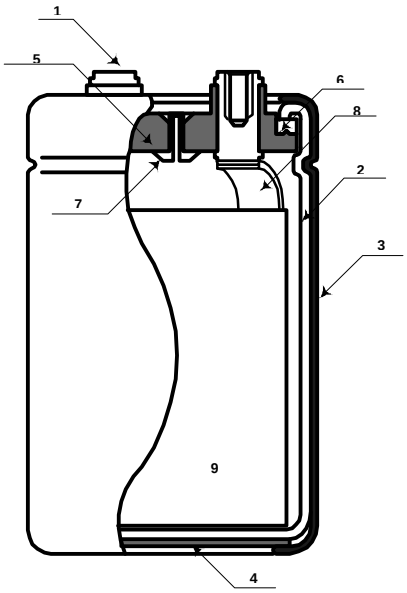


Fig. 1

1.1 Construction of Aluminium - Electrolytic - Capacitors

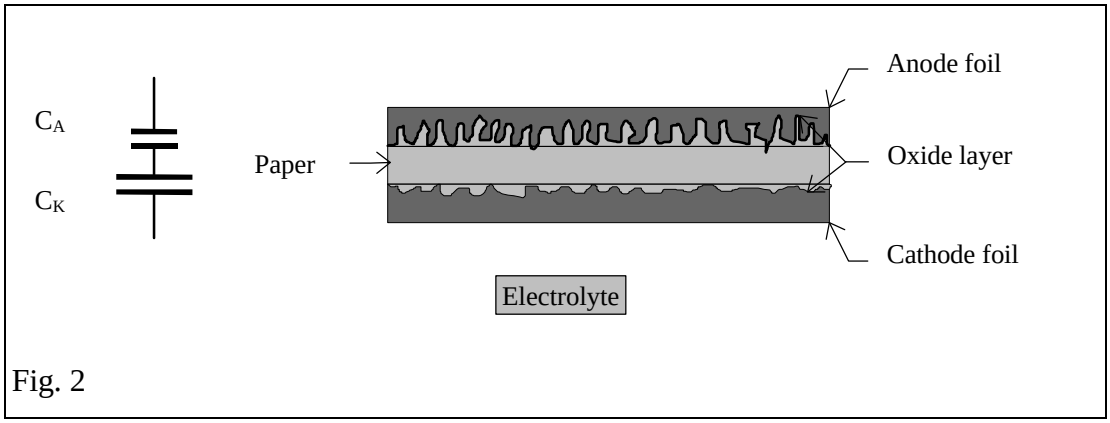


Fig. 2

Fig. 1 exhibits the construction of a typicall electrolytic capacitor. Fig.2 shows a cross section of the winding.

The strongly roughened anode foil with the thick oxide layer, which is produced by the forming, is in the top of the figure. The cathode foil with the much more thinner natural oxide layer is arranged at the bottom. An electrolytic layer of paper is provided between both foils. The electrolyte fills up the uneven pores of the aluminium foils and builds, thus, either the one elctrode of the anode or cathode capacitance. The dielectric consists of the oxide layers of the anode foil respectively the cathode foil.

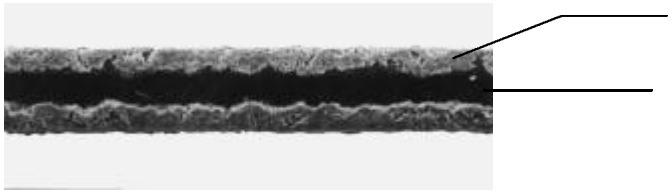
This construction builds two capacitances: the anode and the cathode capacitance. Related to its thicker oxide layer the anode capacitance is normally much smaller than the cathode capacitance.

If two capacitors are connected in serie, the total capacitance results from the relationship

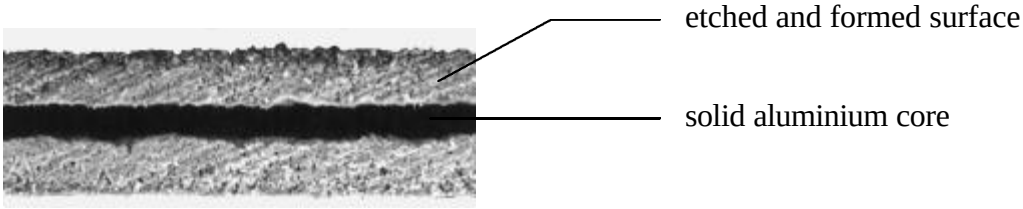
$C_G=C_A*C_K/(C_A+C_K)$.

If $C_A << C_K$ hence it follows $C_G \approx C_A$. (aspired normal case)
That means the anode capacitance determines the capacitance of the whole capacitor (the cathode foil decrease the capacitance only little). To reach that, highly rougthed cathode foils are necesarry.
Nonpolarized electrolytic capacitors use the same foil for anode and cathode ($C_A = C_K$) Therefore the capacitance of this capacitors are given by $C_G = 0,5 * C_A$.
It is obviously that a nonpolarised electrolytic capacitor needs two times the space of a polarised capacitor.

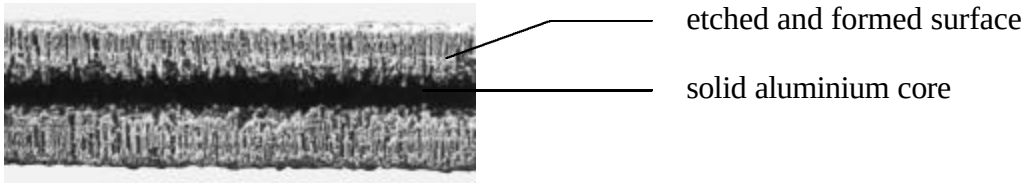
1.2 Different types of foil



cathode foil



low - voltage anode foil



high - voltage anode foil

1.3 Parameter

1.3.1 Rated Voltage

The rated Voltage (U_R) is the voltage for which the capacitor is designed. This voltage may be applied continously to the capacitor over the full temperature range..

1.3.2 Surge Voltage

The Surge voltage may be applied to the capacitors only for a short time.
$U_R \leq 315$ V : $U_S = 1{,}15 * U_R$ (5 times 1 min per hour)
$U_R > 315$ V : $U_S = 1{,}1 * U_R$ (5 times 1 min per hour)

1.3.3 Ripple Voltage

In many applications the voltage applied to a capacitors is a combination of direct and alternating voltage. Pay attentions to the following points :
1. The superposition of AC and DC must not aceed the rated voltage.
2. Reverse voltage are not allowed.
3. The ripple must not exceed the rated ripple current.

1.3.4 Max. Reverse Voltage

The max. reverse voltage is the negative voltage which may applied to the capacitor. (only for a short time < 1 s)

1.3.5 Rated Capacitance

The rated capacitance is usually determined at 100 Hz and 20 °C . In general the rated capacitance is marked on the capacitor in µF.

1.3.6 DC and AC Capacitance

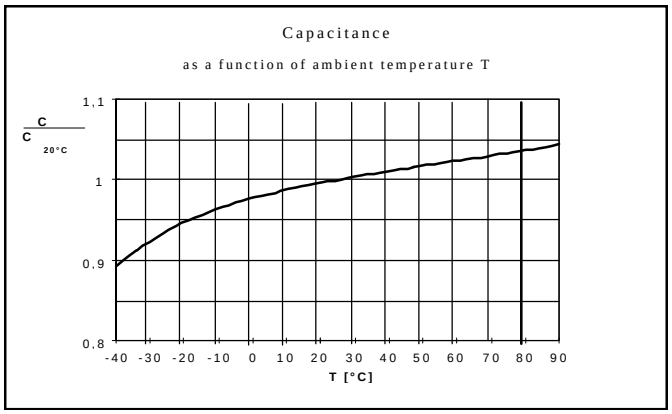
The capacitance determined by AC measurements is smaller then the capacitance determined by charge / discharge measurements.
In most applications the capacitor is applied to an alternating voltage so in generall the capacitance is measured with the AC method.

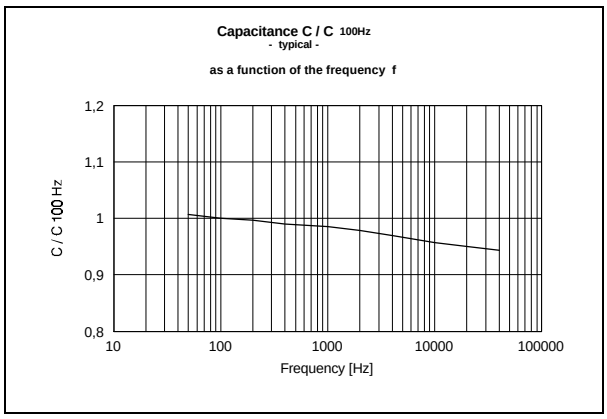
1.3.7 Capacitance vs Temperature and Frequency

The capacitance vary with temperature and Frequency

- The capacitance increase with increasing temperature
- The capacitance decrease with increasing frequency

The following diagrams exhibit typical courses of these dependences.

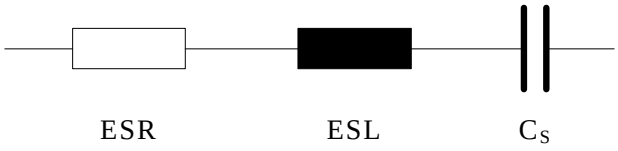




1.3.8 ESR

The equivalent series resistance represents the ohmic part (losses) of a capacitor (the resistance of the foil, electrolyt, terminals) . The ESR depends on frequency and temperature.

Equivalent circuit of an electrolytic capacitor
- simplified -



1.3.9 ESL

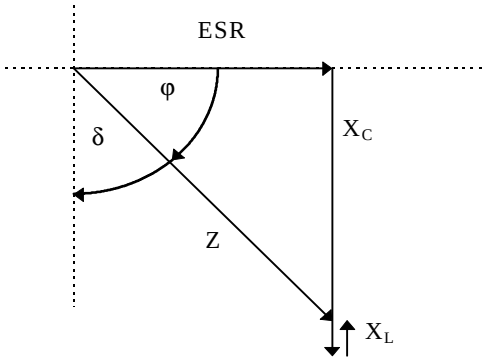
The equivalent series inductance represents the inductive part of the capacitor (leads, foil) . The ESL depends mainly on the frequency.

1.3.10 Dissipation factor tan δ (DF)

The dissipation factor is defined as the power loss of the capacitor devided by the reactive power of the capacitor.

$$\tan \delta = ESR * \omega * C_S$$

In general the DF is measured at 100 Hz and 20 °C..
As shown in the pointer diagram beside, the angle δ is the difference between the 90 ° phase shift of an ideal capacitor and the real lossy capacitor.



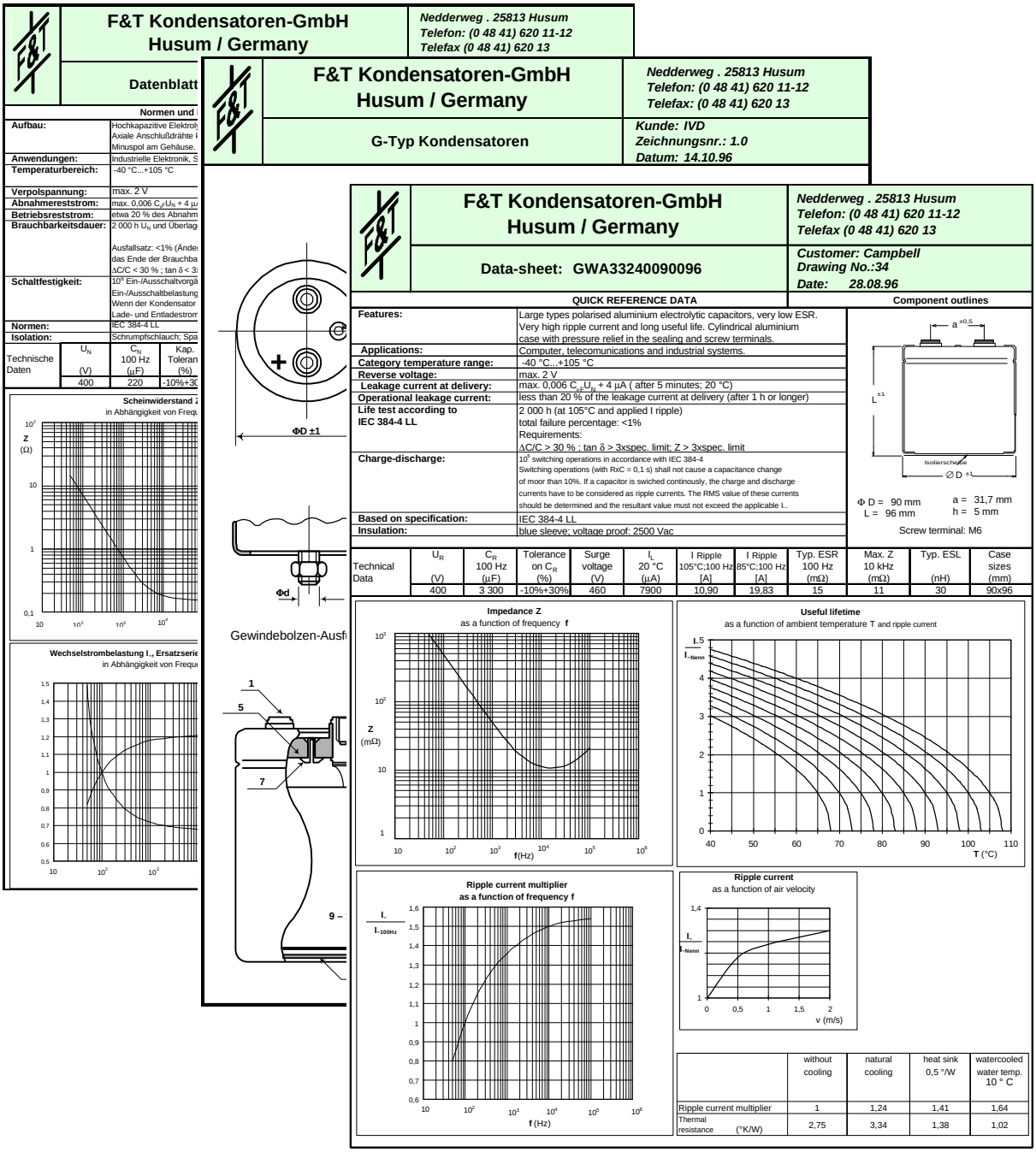
Pointer diagram

1.3.11 Impedance Z

The Impedance of the capacitor is given by the ESR,ESL and the capacitance.
The Impedance depends on the temperature and of course the frequency. The Impedance is normally measured at 10 KHz .

1.4 Datasheets

On demand please call for detailed data sheets.



F&T Kondensatoren-GmbH
Husum / Germany

Nedderweg . 25813 Husum
Telefon: (0 48 41) 620 11-12
Telefax (0 48 41) 620 13

Datenblatt

Normen und

Aufbau:	Hochkapazitive Elektrol Axiale Anschlußdrähte Minuspol am Gehäuse.
Anwendungen:	Industrielle Elektronik, S
Temperaturbereich:	-40 °C...+105 °C
Verpolspannung:	max. 2 V
Abnahmereststrom:	max. 0,006 $C_R U_N$ + 4 µ
Betriebsreststrom:	etwa 20 % des Abnahm
Brauchbarkeitsdauer:	2 000 h U_N und Überlag Ausfallsatz: <1% (Ände das Ende der Brauchba ΔC/C < 30 % ; tan δ < 3
Schaltfestigkeit:	10^5 Ein-/Ausschaltvorga Ein-/Ausschaltbelastung Wenn der Kondensator Lade- und Entladestrom
Normen:	IEC 384-4 LL
Isolation:	Schrumpfschlauch; Spa

Technische Daten	U_N (V)	C_N 100 Hz (µF)	Kap. Toleran (%)
	400	220	-10%+3

Scheinwiderstand Z
in Abhängigkeit von Freq

Wechselstrombelastung $I_{\sim}$, Ersatzserie
in Abhängigkeit von Frequ

Gewindebolzen-Ausf

F&T Kondensatoren-GmbH
Husum / Germany

Nedderweg . 25813 Husum
Telefon: (0 48 41) 620 11-12
Telefax: (0 48 41) 620 13

G-Typ Kondensatoren

Kunde: IVD
Zeichnungsnr.: 1.0
Datum: 14.10.96

F&T Kondensatoren-GmbH
Husum / Germany

Nedderweg . 25813 Husum
Telefon: (0 48 41) 620 11-12
Telefax (0 48 41) 620 13

Data-sheet: GWA33240090096

Customer: Campbell
Drawing No.:34
Date: 28.08.96

QUICK REFERENCE DATA

Features:	Large types polarised aluminium electrolytic capacitors, very low ESR. Very high ripple current and long useful life. Cylindrical aluminium case with pressure relief in the sealing and screw terminals.
Applications:	Computer, telecomunications and industrial systems.
Category temperature range:	-40 °C...+105 °C
Reverse voltage:	max. 2 V
Leakage current at delivery:	max. 0,006 $C_R U_N$ + 4 µA (after 5 minutes; 20 °C)
Operational leakage current:	less than 20 % of the leakage current at delivery (after 1 h or longer)
Life test according to IEC 384-4 LL	2 000 h (at 105°C and applied I ripple) total failure percentage: <1% Requirements: ΔC/C > 30 % ; tan δ > 3xspec. limit; Z > 3xspec. limit
Charge-discharge:	10^5 switching operations in accordance with IEC 384-4 Switching operations (with RxC = 0,1 s) shall not cause a capacitance change of moor than 10%. If a capacitor is swiched continously, the charge and discharge currents have to be considered as ripple currents. The RMS value of these currents should be determined and the resultant value must not exceed the applicable I..
Based on specification:	IEC 384-4 LL
Insulation:	blue sleeve; voltage proof: 2500 Vac

Component outlines

Φ D = 90 mm
L = 96 mm
a = 31,7 mm
h = 5 mm
Screw terminal: M6

Technical Data	U_R (V)	C_R 100 Hz (µF)	Tolerance on C_R (%)	Surge voltage (V)	I_L 20 °C (µA)	I Ripple 105°C;100 Hz [A]	I Ripple 85°C;100 Hz [A]	Typ. ESR 100 Hz (mΩ)	Max. Z 10 kHz (mΩ)	Typ. ESL (nH)	Case sizes (mm)
	400	3 300	-10%+30%	460	7900	10,90	19,83	15	11	30	90x96

Impedance Z
as a function of frequency **f**

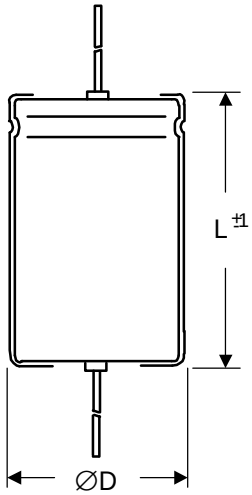
Useful lifetime
as a function of ambient temperature T and ripple current

Ripple current multiplier
as a function of frequency f

Ripple current
as a function of air velocity

	without cooling	natural cooling	heat sink 0,5 °/W	watercooled water temp. 10 ° C
Ripple current multiplier	1	1,24	1,41	1,64
Thermal resistance (°K/W)	2,75	3,34	1,38	1,02

2 Axial Capacitors Type A



Features

- polarized
- switch proofed
- welded axial leads
- high reliability
- high ripple current
- all contacts welded

Applications

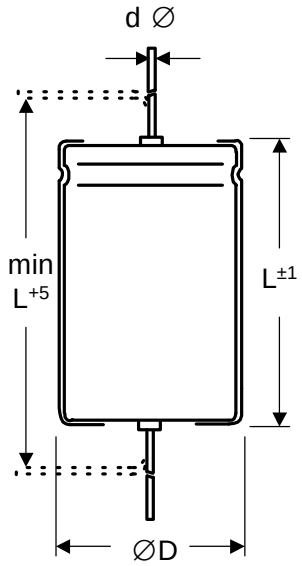
- standard- and switch mode power supplies
- computer
- telecommunications
- general industrial
- consumer - electronic

Quick reference

	$U_R \leq 100$ V	$U_R > 100$ V
Temperature range	- 40°C ... + 105°C	- 40°C ... + 85°C
Tolerance	± 20 %	
Max. reverse voltage	2V	
Useful life	see diagram useful life S. 16	
Leakage current 5 min @ U_R	0,008 * C [µF] * U [V] + 4µA [µA]	
Leakage current 1 h @ U_R	0,15 * leakage current 5 min @ U_R	
Specs	DIN 41332 IEC 384 - 4	
Insulation ∅ up to 25 mm	polyesterfilm : voltage proof ≥ 1000 V AC	
Insulation ∅ more than 25 mm	shrink - on sleeve : voltage proof ≥ 2500 V AC	
∅ leads	up to 25 mm ∅ : 0.8mm ; more than 25 mm ∅ : 1.0 mm	

2.1 Mechanical Data

D	d
up to 25 mm	0,8 mm
more than 25 mm	1,0 mm



D x L

Capacitance [µF]	Rated voltage [V]									
	16	**25**	**40**	**63**	**100**	**160**	**250**	**350**	**450**	**500**
4,7									10 x 30	
10								10 x 30	12 x 30	14 x 30
15							10 x 30	10 x 30	14 x 30	16 x 39
22							10 x 30	12 x 30	16 x 30	18 x 39
33						10 x 30	12 x 30	14 x 37	18 x 39	21 x 36
47						10 x 30	14 x 30	16 x 39	21 x 36	25 x 38
100					10 x 30	16 x 30	18 x 39	25 x 38	25 x 49	30 x 49
220				10 x 30	14 x 30	18 x 39	25 x 38	25 x 49	30 x 49	
470			10 x 30	14 x 30	16 x 39	25 x 49	30 x 49	35 x 49		
1000	10 x 30	10 x 30	14 x 30	16 x 39	25 x 38	35 x 49				
2200	14 x 30	14 x 37	16 x 39	25 x 38	30 x 49					
3300	16 x 39	16 x 39	21 x 36	25 x 49	35 x 49					
4700	16 x 39	18 x 39	25 x 38	25 x 49	35 x 66					
6800	21 x 36	25 x 38	25 x 49	35 x 49						
10000	25 x 38	25 x 49	30 x 49	35 x 66						

2.2 Standard Values Type A

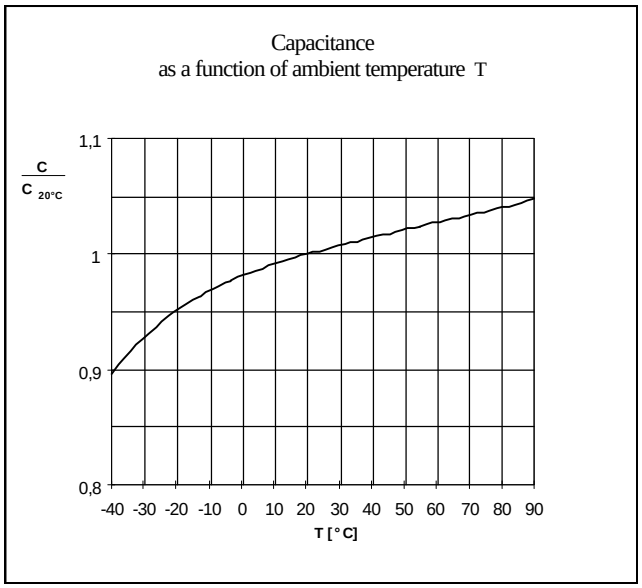
U_R	C_R	Case size	ESR 100 Hz	ESR 100Hz	tan δ 100Hz	Z 10KHz	Rated ripple current 100Hz		Order code
		∅ x L	20°C typ.	20°C max.	20°C max.	20°C max.	85°C	105°C	
[V]	[µF]	[mm]	[mΩ]	[mΩ]	[%]	[mΩ]	[A]	[A]	A...
16	1000	10 x 30	220	330	21	220		0,6	...10201610030
16	2200	14 x 30	130	195	27	130		1,0	...22201614030
16	3300	16 x 39	90	135	28	90		1,4	...33201616039
16	4700	16 x 39	60	90	29	60		1,7	...47201616039
16	6800	21 x 36	50	75	32	50		2,2	...68201621036
16	10000	25 x 38	40	60	38	40		2,6	...10301625038
25	1000	10 x 30	180	270	17	180		0,7	...10202510030
25	2200	14 x 37	120	180	25	120		1,1	...22202514037
25	3300	16 x 39	85	127	26	85		1,5	...33202516039
25	4700	18 x 39	60	90	27	60		1,9	...47202518039
25	6800	25 x 38	50	75	32	50		2,4	...68202525038
25	10000	25 x 49	35	52	33	35		3,2	...10302525049
40	470	10 x 30	220	330	10	220		0,6	...47104010030
40	1000	14 x 30	150	225	14	150		0,9	...10204014030
40	2200	16 x 39	100	150	21	100		1,3	...22204016039
40	3300	21 x 36	85	127	26	85		1,7	...33204021036
40	4700	25 x 38	60	90	27	60		2,2	...47204025038
40	6800	25 x 49	50	75	28	50		2,7	...68204025049
40	10000	30 x 49	30	45	28	30		3,7	...10304030049
63	220	10 x 30	400	600	8	400		0,5	...22106310030
63	470	14 x 30	200	300	9	200		0,8	...47106314030
63	1000	16 x 39	120	180	11	120		1,2	...10206316039
63	2200	25 x 38	95	142	22	95		1,7	...22206325038
63	3300	25 x 49	50	75	16	50		2,7	...33206325049
63	4700	25 x 49	40	60	18	40		3,0	...47206325049
63	6800	35 x 49	35	52	29	35		3,8	...68206335049
63	10000	35 x 66	30	45	20	30		4,6	...10306335066
100	100	10 x 30	750	1125	7	750		0,3	...10110010030
100	220	14 x 30	350	525	7	350		0,6	...22110014030
100	470	16 x 39	150	225	7	150		1,1	...47110016039
100	1000	25 x 38	110	165	8	110		1,6	...10210025038
100	2200	30 x 49	60	90	10	60		2,6	...22210030049
100	3300	35 x 49	50	75	12	50		3,2	...33210035049
100	4700	35 x 66	30	45	13	30		4,6	...47210035066
160	33	10 x 30	3100	4650	6	3100	0,2		...33016010030
160	47	10 x 30	1950	2925	6	1950	0,2		...47016010030
160	100	16 x 30	980	1470	6	980	0,4		...10116016030
160	220	18 x 39	470	705	6	470	0,7		...22116018039
160	470	25 x 49	150	225	6	150	1,5		...47116025049
160	1000	35 x 49	100	150	6	100	2,2		...10216035049
250	22	10 x 30	4300	6450	6	4300	0,1		...22025010030
250	33	12 x 30	2400	3600	7	2400	0,2		...33025012030
250	47	14 x 30	1600	2400	7	1600	0,3		...47025014030
250	100	18 x 39	750	1125	7	750	0,5		...10125018039
250	220	25 x 38	180	270	7	180	1,2		...22125025038
250	470	30 x 49	130	195	7	130	1,8		...47125030049

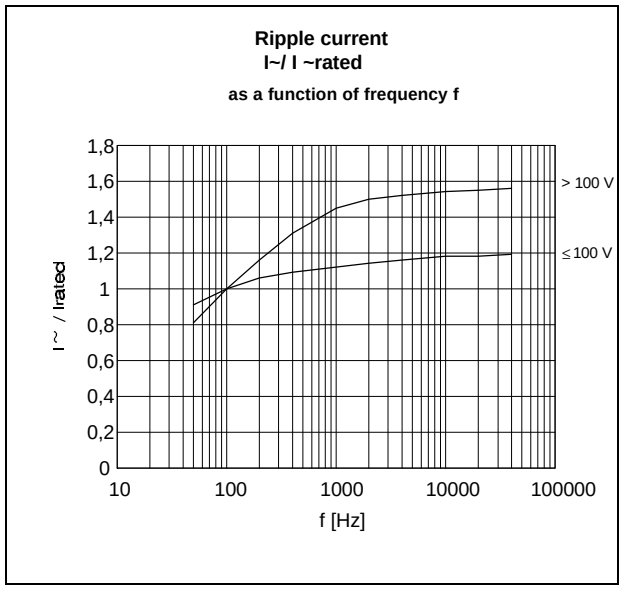
Standard Values Type A

U_R [V]	C_R [µF]	Case size ∅ x L [mm]	ESR 100 Hz 20°C typ. [mΩ]	ESR 100Hz 20°C max. [mΩ]	tan δ 100Hz 20°C max. [%]	Z 10KHz 20°C max. [mΩ]	Rated ripple current 100Hz 85°C [A]	Rated ripple current 100Hz 105°C [A]	Order code A...
350	10	10 x 30	8800	13200	6	8800	0,1		...10035010030
350	15	10 x 30	7000	10500	6	7000	0,1		...15035010030
350	22	12 x 30	2600	3900	6	2600	0,2		...22035012030
350	33	14 x 37	1500	2250	6	1500	0,3		...33035014037
350	47	16 x 39	1300	1950	6	1300	0,4		...47035016039
350	100	25 x 38	580	870	6	580	0,7		...10135025038
350	220	25 x 49	400	600	6	400	0,9		...22135025049
350	470	35 x 49	120	180	6	120	2,0		...47135035049
450	4,7	10 x 30	10000	15000	6	10000	0,1		...4,745010030
450	10	12 x 30	7000	10500	6	7000	0,1		...10045012030
450	15	14 x 30	4800	7200	6	4800	0,2		...15045014030
450	22	16 x 30	4500	6750	6	4500	0,2		...22045016030
450	33	18 x 39	3800	5700	6	3800	0,2		...33045018039
450	47	21 x 36	1300	1950	6	1300	0,4		...47045021036
450	100	25 x 49	700	1050	6	700	0,7		...10145025049
450	220	30 x 49	400	600	6	400	1,0		...22145030049
500	10	14 x 30	7000	10500	6	7000	0,1		...10050014030
500	15	16 x 39	4800	7200	6	4800	0,2		...15050016039
500	22	18 x 39	4500	6750	6	4500	0,2		...22050018039
500	33	21 x 36	3800	5700	6	3800	0,2		...33050021036
500	47	25 x 38	1800	2700	6	1800	0,4		...47050025038
500	100	30 x 49	800	1200	6	800	0,7		...10150030049

We produce also customer specific capacitors (case size / voltage / capacitance) at reasonable prices !
Please contact us for more information.

2.3 Technical Data Type A



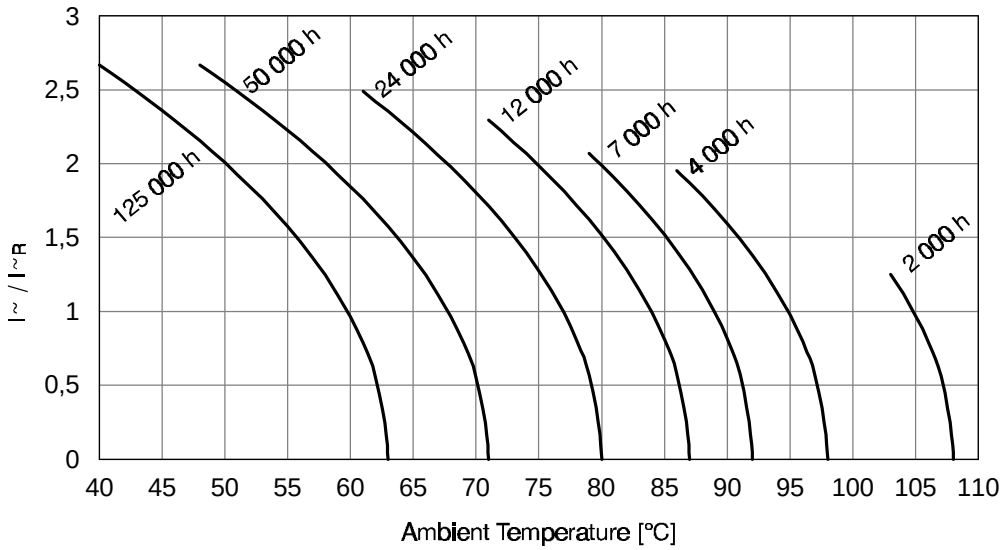


2.3.1 Useful Life Type A

Useful Life

as a function of ambient temperature and ripple current

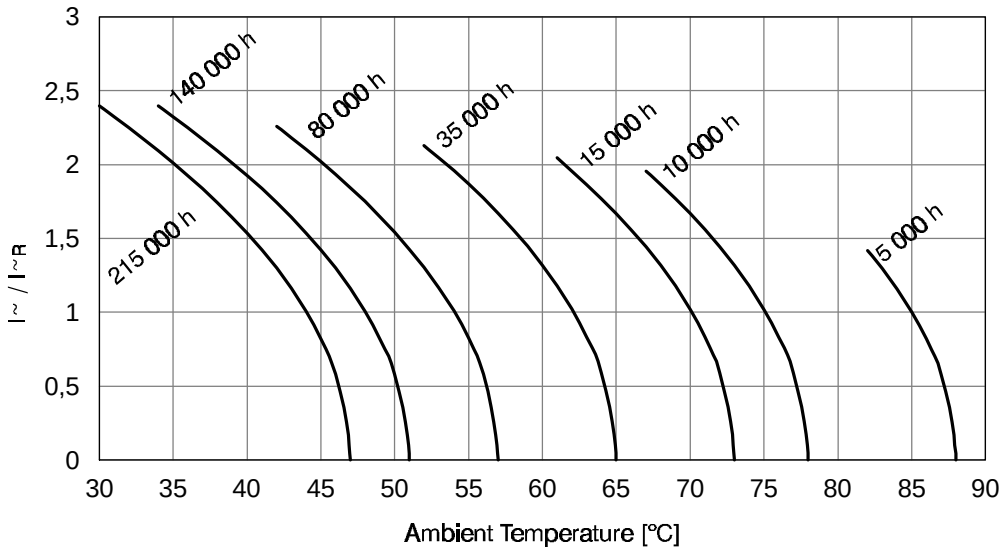
$U_R \leq 100$ V

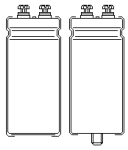


Useful Life

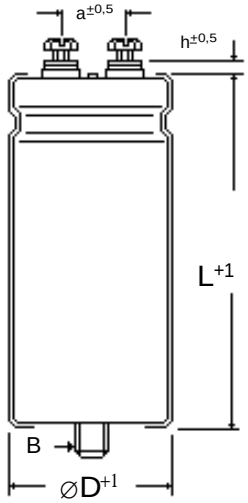
as a function of ambient temperature and ripple current

$U_R > 100$ V





3 Power Capacitors Type G



Features

- high capacitance
- long useful life
- high ripple current
- all contacts welded
- screw terminals
- GA - clamp mounted
- GB - stud mounted

Applications

- standard- and switch mode power supplies
- computer
- telecommunication
- general industrial
- welding machinery
- uninterruptable power supplies
- inverter

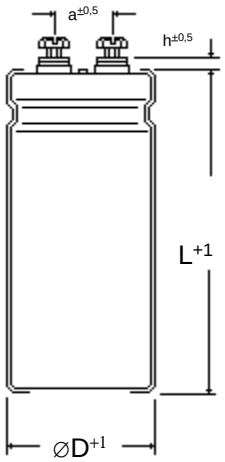
Quick reference

	$U_R \leq 400$ V	$U_R > 400$ V
Temperature range	- 40°C ... + 105°C	- 40°C ... + 85°C
Tolerance	+ 30% -10%	
Max. reverse voltage	2V	
Useful life	see diagram useful life page S. 26	
Leakage current 5 min @ U_R	0,008 * C [µF] * U [V] + 4 µA [µA]	
Leakage current 1 h @ U_R	0,12 * leakage current 5 min @ U_R	
Specs.	DIN 41332 IEC 384 - 4	
Insulation	shrink - on sleeve voltage proof ≥ 2500 V AC	
Content of supply	GA... termination screws GB... termination screws and fixing nut	
Terminals	up to 75 mm ∅ M 5 , beyond M 6	

3.1 Mechanical Data Type G

GA

clamp mounted

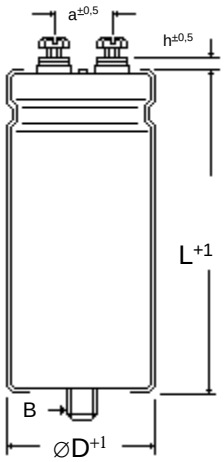


D [mm]	h [mm]	a [mm]	B	terminals
35	6	13	M 8 x 12	M 5
50	5	22	M 12 x 16	M 5
65	5	28,5	M 12 x 16	M 5
75	5	31,7	M 12 x 16	M 5 (M 6)
90	5	31,7	M 12 x 16	M 6

	thread	max. tightening torque
terminals	M 5	2,0 Nm
terminals	M 6	2,5 Nm
mounting	M 8	4,0 Nm
mounting	M 12	10,0 Nm

GB

stud mounted



Capacitance [µF]	Rated voltage [V]										
	16	25	40	63	100	160	250	350	400	450	500
100									35 x 54	35 x 54	35 x 54
220								35 x 54	35 x 54	35 x 80	35 x 54
330								35 x 80	35 x 80	35 x 80	35 x 80
470						35 x 54	35 x 80	50 x 80	50 x 80	50 x 80	50 x 80
680						35 x 54	50 x 80	50 x 80	50 x 80	50 x 100	50 x 100
1000					35 x 54	35 x 80	50 x 80	50 x 100	50 x 100	65 x 100	65 x 100
1500					35 x 54	35 x 80	50 x 80	50 x 100	65 x 100	75 x 100	75 x 100
2200				35 x 54	35 x 70	50 x 80	65 x 80	65 x 100	75 x 100	75 x 145	75 x 145
3300				35 x 54	35 x 80	50 x 80	65 x 100	75 x 100	75 x 145	75 x 145	90 x 148
4700			35 x 54	35 x 70	50 x 80	50 x 100	75 x 100	75 x 145	75 x 145	90 x 148	
6800			35 x 54	35 x 80	50 x 80	65 x 100	75 x 145	75 x 165	90 x 148	90 x 170	
10000	35 x 54	35 x 54	35 x 70	50 x 80	50 x 100	75 x 100	75 x 145	75 x 225	90 x 170		
15000	35 x 54	35 x 70	35 x 80	50 x 80	65 x 100	75 x 145	90 x 148	90 x 230			
22000	35 x 70	35 x 80	50 x 80	50 x 100	75 x 100	75 x 165	90 x 230				
33000	35 x 80	50 x 80	50 x 80	65 x 100	75 x 145	90 x 170					
47000	50 x 80	50 x 80	65 x 80	75 x	75 x	90 x					

				100	165	230					
68000	50 x 80	50 x 100	65 x 100	75 x 145	75 x 225						
100000	65 x 80	65 x 100	75 x 100	75 x 165	90 x 230						
150000	65 x 100	75 x 100	75 x 145	75 x 225							
220000	75 x 100	75 x 145	75 x 165	90 x 230							
330000	75 x 145	75 x 165	75 x 225								
470000	75 x 165	75 x 225	90 x 230								
680000	75 x 225	90 x 230									
1000000	90 x 230										

3.2 Standard Values Type G

U_R	C_R	Case size	$ESR_{100\ Hz}$	ESR_{100Hz}	$\tan\delta_{100Hz}$	Z_{10KHz}	Rated ripple current 100Hz		Order code
		∅ x L	20°C typ.	20°C max.	20°C max.	20°C max.	85°C	105°C	GA...
[V]	[µF]	[mm]	[mΩ]	[mΩ]	[%]	[mΩ]	[A]	[A]	GB...
16	10000	35 x 54	30	42	28	30		4,2	...10301635054
16	15000	35 x 54	26	29	37	24		4,6	...15301635054
16	22000	35 x 70	18	23	37	19		6,1	...22301635070
16	33000	35 x 80	12	20	37	15		7,8	...33301635080
16	47000	50 x 80	10	16	44	12		9,6	...47301650080
16	68000	50 x 80	9	14	58	10		10,1	...68301650080
16	100000	65 x 80	6	12	57	8		14,0	...10401665080
16	150000	65 x 100	5	9	71	7		16,7	...15401665100
16	220000	75 x 100	4	8	83	6		18,6	...22401675100
16	330000	75 x 145	3	7	93	5		24,8	...33401675145
16	470000	75 x 165	3	7	133	5		26,1	...47401675165
16	680000	75 x 225	3	7	192	5		29,7	...68401675225
16	1000000	90 x 230	3	7	283	5		33,3	...10501690230
25	10000	35 x 54	23	34	22	23		4,8	...10302535054
25	15000	35 x 70	21	28	30	18		5,6	...15302535070
25	22000	35 x 80	14	23	29	15		7,2	...22302535080
25	33000	50 x 80	13	19	40	12		8,4	...33302550080
25	47000	50 x 80	10	16	44	10		9,6	...47302550080
25	68000	50 x 100	7	13	45	8		12,5	...68302550100
25	100000	65 x 100	6	11	57	7		15,2	...10402565100
25	150000	75 x 100	4	9	57	5		18,6	...15402575100
25	220000	75 x 145	4	8	83	4		21,5	...22402575145
25	330000	75 x 165	3	6	93	4		26,1	...33402575165
25	470000	75 x 225	2	6	89	3		36,4	...47402575225
25	680000	90 x 230	2	5	128	3		40,8	...68402590230
40	4700	35 x 54	33	48	15	28		4,0	...47204035054
40	6800	35 x 54	23	39	15	23		4,8	...68204035054
40	10000	35 x 70	15	31	14	18		6,6	...10304035070
40	15000	35 x 80	14	25	20	14		7,2	...15304035080
40	22000	50 x 80	13	20	27	12		8,4	...22304050080
40	33000	50 x 80	12	17	37	10		8,8	...33304050080
40	47000	65 x 80	8	14	35	8		12,2	...47304065080
40	68000	65 x 100	5	12	32	7		16,7	...68304065100
40	100000	75 x 100	4	10	38	6		18,6	...10404075100
40	150000	75 x 145	4	9	57	4		21,5	...15404075145
40	220000	75 x 165	3	7	62	4		26,1	...22404075165
40	330000	75 x 225	3	7	93	3		29,7	...33404075225
40	470000	90 x 230	2	5	89	3		40,8	...47404090230

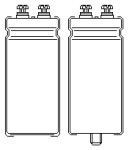
Please choose type GH (p. 34) for a longer useful life.

Please choose type GM (p. 27) for a higher CU product.

Standard Values Type G

U_R	C_R	Case size	$ESR_{100\ Hz}$	ESR_{100Hz}	$\tan\delta_{100Hz}$	Z_{10KHz}	Rated ripple current 100Hz		Order code
		∅ x L	20°C typ.	20°C max.	20°C max.	20°C max.	85°C	105°C	GA...
[V]	[µF]	[mm]	[mΩ]	[mΩ]	[%]	[mΩ]	[A]	[A]	GB...
63	2200	35 x 54	55	60	11	35		3,1	...22206335054
63	3300	35 x 54	33	46	10	27		4,0	...33206335054
63	4700	35 x 70	23	36	10	22		5,4	...47206335070
63	6800	35 x 80	18	31	12	18		6,4	...68206335080
63	10000	50 x 80	15	26	14	14		7,8	...10306350080
63	15000	50 x 80	14	20	20	12		8,1	...15306350080
63	22000	50 x 100	10	16	21	10		10,5	...22306350100
63	33000	65 x 100	6	13	19	8		15,2	...33306365100
63	47000	75 x 100	5	11	22	7		16,7	...47306375100
63	68000	75 x 145	4	9	26	6		21,5	...68306375145
63	100000	75 x 165	4	8	38	5		22,6	...10406375165
63	150000	75 x 225	3	7	42	4		29,7	...15406375225
63	220000	90 x 230	3	6	62	4		33,3	...22406390230
100	1000	35 x 54	70	81	6	40		2,8	...10210035054
100	1500	35 x 54	65	70	6	35		2,9	...15210035054
100	2200	35 x 70	58	60	12	27		3,4	...22210035070
100	3300	35 x 80	43	49	13	21		4,1	...33210035080
100	4700	50 x 80	28	38	12	17		5,7	...47210050080
100	6800	50 x 80	20	30	13	14		6,8	...68210050080
100	10000	50 x 100	16	24	15	11		8,3	...10310050100
100	15000	65 x 100	10	19	14	9		11,8	...15310065100
100	22000	75 x 100	8	15	17	8		13,2	...22310075100
100	33000	75 x 145	5	11	16	7		19,2	...33310075145
100	47000	75 x 165	5	10	22	6		20,2	...47310075165
100	68000	75 x 225	4	9	26	5		25,7	...68310075225
100	100000	90 x 230	3	8	28	5		33,3	...10410090230
160	470	35 x 54	130	160	6	70		2,0	...47116035054
160	680	35 x 54	100	130	6	60		2,3	...68116035054
160	1000	35 x 80	85	115	8	40		2,9	...10216035080
160	1500	35 x 80	50	70	7	35		3,8	...15216035080
160	2200	50 x 80	35	40	7	32		5,1	...22216050080
160	3300	50 x 80	25	35	8	23		6,1	...33216050080
160	4700	50 x 100	20	30	9	15		7,4	...47216050100
160	6800	65 x 100	15	18	8	12		9,6	...68216065100
160	10000	75 x 100	13	15	9	11		10,3	...10316075100
160	15000	75 x 145	9	12	13	10		14,3	...15316075145
160	22000	75 x 165	8	11	17	9		16,0	...22316075165
160	33000	90 x 170	7	10	22	8		19,1	...33316090170
160	47000	90 x 230	6	9	27	7		23,6	...47316090230

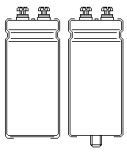
Please choose type GH (p. 34) for a longer useful life.
Please choose type GM (p. 27) for a higher CU product.



Standard Values TypeG

U_R [V]	C_R [µF]	Case size ∅ x L [mm]	ESR 100 Hz 20°C typ. [mΩ]	ESR 100Hz 20°C max. [mΩ]	tan δ 100Hz 20°C max. [%]	Z 10KHz 20°C max. [mΩ]	Rated ripple current 100Hz 85°C [A]	Rated ripple current 100Hz 105°C [A]	Order code GA... GB...
250	470	35 x 80	170	200	8	80		2,1	...47125035080
250	680	50 x 80	120	150	8	49		2,8	...68125050080
250	1000	50 x 80	60	90	6	39		3,9	...10225050080
250	1500	50 x 80	50	70	7	34		4,3	...15225050080
250	2200	65 x 80	35	50	7	30		5,8	...22225065080
250	3300	65 x 100	25	35	8	22		7,5	...33225065100
250	4700	75 x 100	20	30	9	14		8,3	...47225075100
250	6800	75 x 145	15	21	6	11		11,1	...68225075145
250	10000	75 x 145	12	18	8	9		12,4	...10325075145
250	15000	90 x 148	9	16	11	8		16,1	...15325090148
250	22000	90 x 230	8	12	15	7		20,4	...22325090230
350	220	35 x 54	190	250	4	125		1,7	...22135035054
350	330	35 x 80	160	220	5	95		2,1	...33135035080
350	470	50 x 80	140	180	6	75		2,6	...47135050080
350	680	50 x 80	80	120	5	52		3,4	...68135050080
350	1000	50 x 100	50	80	5	35		4,7	...10235050100
350	1500	50 x 100	45	70	6	32		4,9	...15235050100
350	2200	65 x 100	30	55	6	29		6,8	...22235065100
350	3300	75 x 100	25	35	8	20		7,5	...33235075100
350	4700	75 x 145	20	25	9	13		9,6	...47235075145
350	6800	75 x 165	19	23	12	13		10,4	...68235075165
350	10000	75 x 225	18	22	17	12		12,1	...10335075225
350	15000	90 x 230	15	20	21	10		14,9	...15335090230
400	100	35 x 54	250	300	2	200		1,5	...10140035054
400	220	35 x 54	200	250	4	140		1,6	...22140035054
400	330	35 x 80	180	220	6	110		2,0	...33140035080
400	470	50 x 80	150	190	7	95		2,5	...47140050080
400	680	50 x 80	90	130	6	60		3,2	...68140050080
400	1000	50 x 100	60	90	6	41		4,3	...10240050100
400	1500	65 x 100	50	75	7	36		5,3	...15240065100
400	2200	75 x 100	35	50	7	34		6,3	...22240075100
400	3300	75 x 145	25	35	8	22		8,6	...33240075145
400	4700	75 x 145	23	32	10	20		9,0	...47240075145
400	6800	90 x 148	22	30	14	18		10,3	...68240090148
400	10000	90 x 170	20	28	19	16		11,3	...10340090170

Please choose type GH (p. 34) for a longer useful life.

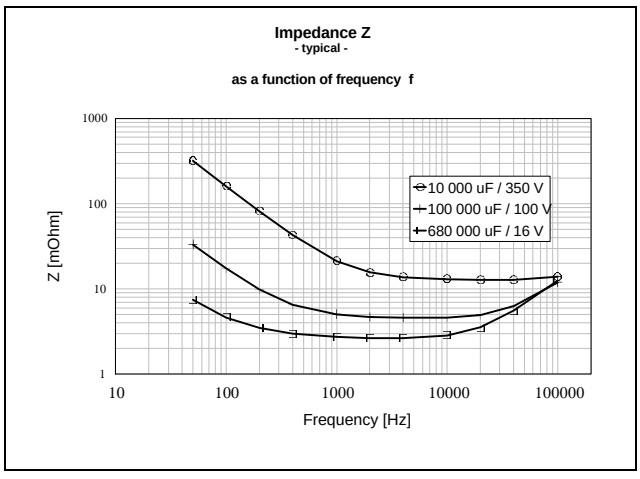


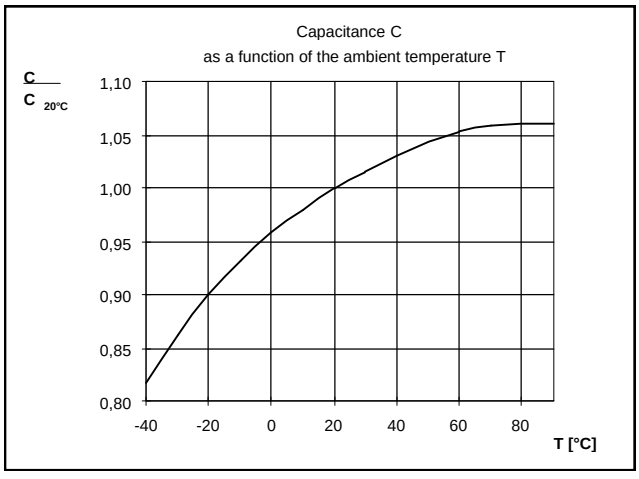
Please choose type GM (p. 27) for a higher CU product.

Standard Values TypeG

U_R [V]	C_R [µF]	Case size ∅ x L [mm]	ESR 100 Hz 20°C typ. [mΩ]	ESR 100Hz 20°C max. [mΩ]	tan δ 100Hz 20°C max. [%]	Z 10KHz 20°C max. [mΩ]	Rated ripple current 100Hz 85°C [A]	Rated ripple current 100Hz 105°C [A]	Order code GA... GB...
450	100	35 x 54	600	700	6	250	1,3		...10145035054
450	220	35 x 80	220	300	5	180	2,6		...22145035080
450	330	35 x 80	200	250	6	150	2,7		...33145035080
450	470	50 x 80	150	210	7	120	3,5		...47145050080
450	680	50 x 100	100	140	6	80	4,7		...68145050100
450	1000	65 x 100	90	110	7	50	5,6		...10245065100
450	1500	75 x 100	60	80	8	40	6,8		...15245075100
450	2200	75 x 145	40	60	8	36	9,6		...22245075145
450	3300	75 x 145	35	55	11	34	10,3		...33245075145
450	4700	90 x 148	30	50	13	32	12,5		...47245090148
450	6800	90 x 170	28	45	18	30	13,5		...68245090170
500	100	35 x 54	850	1700	8	1500	1,1		...10150035054
500	220	35 x 54	390	780	8	700	1,7		...22150035054
500	330	35 x 80	280	560	9	430	2,3		...33150035080
500	470	50 x 80	200	400	9	350	3,0		...47150050080
500	680	50 x 100	140	280	9	260	4,0		...68150050100
500	1000	65 x 100	100	200	9	180	5,3		...10250065100
500	1500	75 x 100	70	140	10	110	6,3		...15250075100
500	2200	75 x 145	50	100	10	80	8,6		...22250075145
500	3300	90 x 148	40	80	12	60	10,8		...33250090148

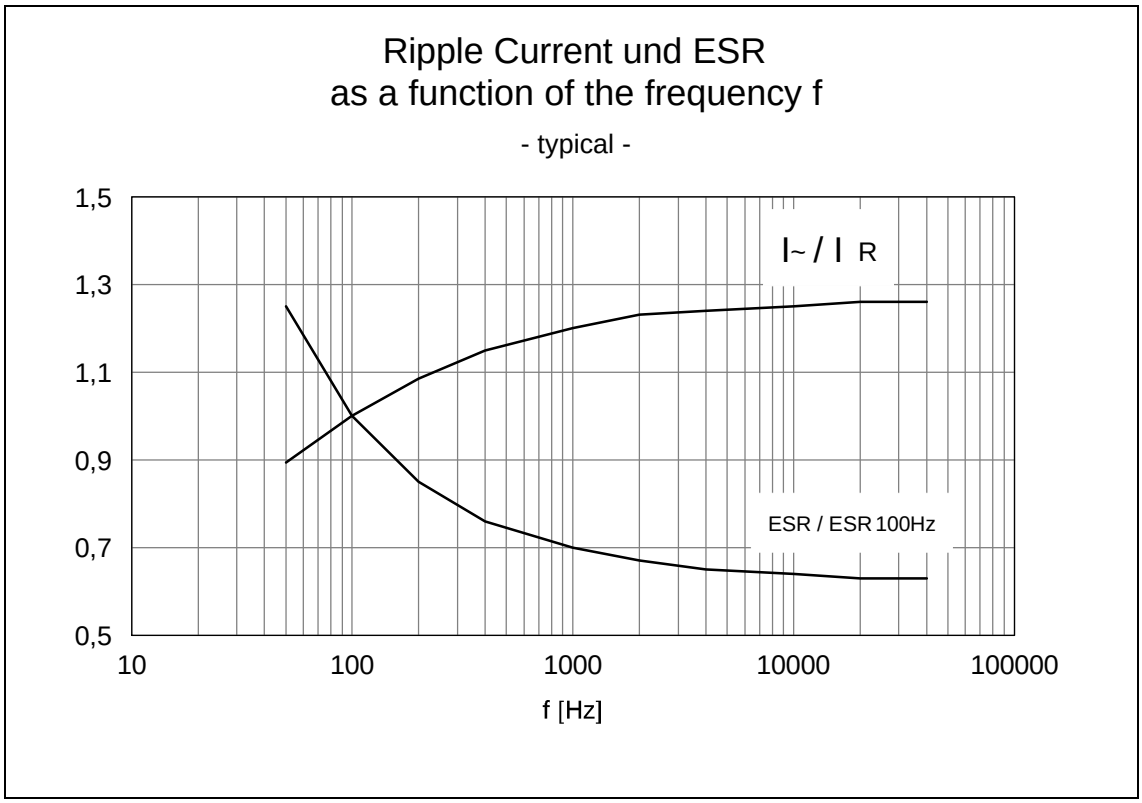
3.3 Technical Data Type G





ESL

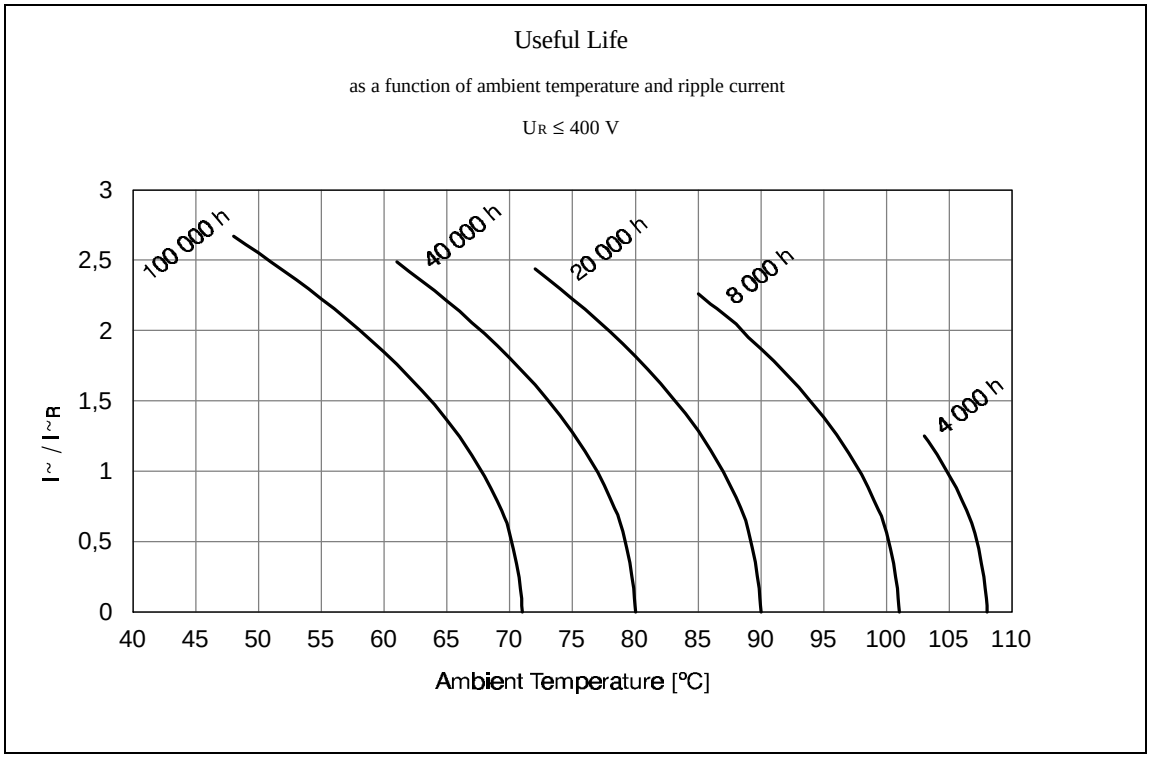
diameter	≤50 mm	65 mm	75 mm	90 mm
ESL [nH]	≈ 10	≈ 15	≈ 20	≈ 20

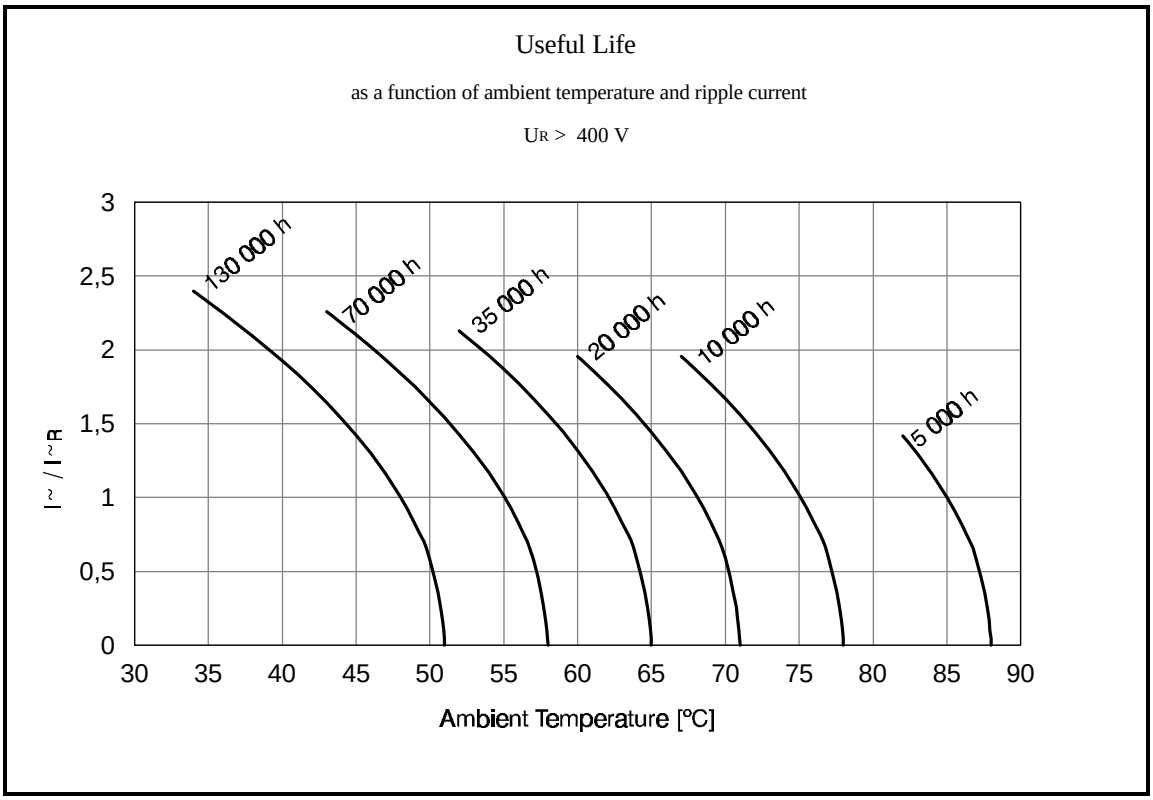


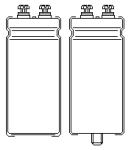
Because the contact elements have a limited current loading, the following currents may not be exeeded.

diameter	≤ 50 mm	65 mm	75 mm	90 mm
max. ripple current	30 A	40 A	50 A	60 A

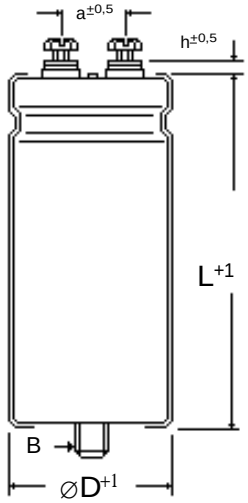
3.3.1 Useful Life Type G







4 High Capacity Capacitors Type GM



Features

- high CU product
- long useful life
- all contacts welded
- threaded terminals
- type GMA for clamp mounting
- type GMB for stud mounting

Applications

- standard and switched mode power supplies
- computer
- telecumunications
- general industrial
- audio HiFi systems

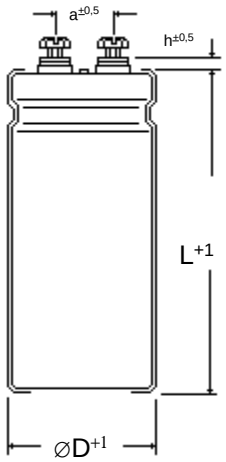
Quick reference

Temperature range	- 40°C ... + 85°C
Tolerance	± 20%
Max. reverse voltage	2V
Useful life	see diagram Useful life p. 33
Leakage current 5 min @ U_R	0,008 * C [µF] * U [V] + 6µA [µA]
Leakage current 1 h @ U_R	0,15 * leakage current 5 min @ U_R
Specs.	DIN 41332 IEC 384 - 4
Insulation	shrink - on sleeve voltage proof ≥ 2500 V AC
Content of supply	GMA... connecting screws GMB... connecting screws + mounting nut
Terminals	up to 75 mm ∅ M 5 , beyond M 6

4.1 Mechanical Data Type GM

GMA

clamp mounted

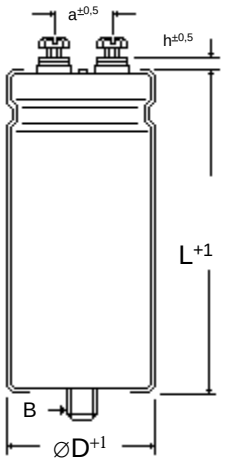


D [mm]	h [mm]	a [mm]	B	terminals
35	6	13	M 8 x 12	M 5
40	5	18	M 8 x 12	M 5
50	5	22	M 12 x 16	M 5
65	5	28,5	M 12 x 16	M 5
75	5	31,7	M 12 x 16	M 5 (M 6)
90	5	31,7	M 12 x 16	M 6

	thread	max. tightening torque
terminals	M 5	2,0 Nm
terminals	M 6	2,5 Nm
mounting	M 8	4,0 Nm
mounting	M 12	10,0 Nm

GMB

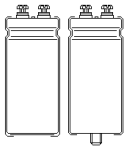
bolt mounted



Capacitance [µF]	Rated voltage [V]								
	40	63	80	100	160	250	350	400	500
220									35 x 70
330									35 x 70
470							35 x 54	35 x 70	40 x 70
680							35 x 70	40 x 70	50 x 70
1000					35 x 54	40 x 70	40 x 70	50 x 80	50 x 100
1500					35 x 70	50 x 70	50 x 80	50 x 100	65 x 100
2200				35 x 54	35 x 80	50 x 80	50 x 100	65 x 100	75 x 100
3300				35 x 54	40 x 100	65 x 80	65 x 100	75 x 100	75 x 145
4700			35 x 54	40 x 70	50 x 100	65 x 100	75 x 100	75 x 145	90 x 148
6800		35 x 54	35 x 70	40 x 70	65 x 100	75 x 100	75 x 145	90 x 148	
10000	35 x 54	35 x 70	40 x 70	50 x 80	75 x 100	75 x 145	90 x 148	90 x 170	
15000	35 x 70	40 x 70	50 x 80	50 x 100	75 x 145	90 x 148	90 x 170	90 x 230	
22000	40 x 70	50 x 80	65 x 100	65 x 100	90 x 148	90 x 230			
33000	50 x 70	50 x 100	75 x 100	75 x 100	90 x 170				
47000	50 x 80	65 x 100	75 x 145	75 x 145	90 x 230				
68000	65 x 80	75 x 100	90 x 148	90 x 148					
100000	75 x 100	75 x 145	90 x 170	90 x 170					
150000	75 x 145	90 x 148	90 x 230	90 x 230					
220000	90 x 148	90 x 170							
330000	90 x 170	90 x 230							
470000	90 x 230								

4.2 Standard Values Type GM

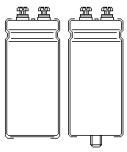
U_R [V]	C_R [µF]	Case size ∅ x L [mm]	$ESR_{100\ Hz}$ 20°C typ. [mΩ]	ESR_{100Hz} 20°C max. [mΩ]	tan δ_{100Hz} 20°C max. [%]	Z_{10KHz} 20°C max. [mΩ]	Rated ripple current 100Hz 85°C [A]	Order code GMA... GMB...
40	10000	35 x 54	30	42	28	30	4,2	...10304035054
40	15000	35 x 70	26	29	37	24	5,0	...15304035070
40	22000	40 x 70	18	23	37	19	6,4	...22304040070
40	33000	50 x 70	12	20	37	15	8,3	...33304050070
40	47000	50 x 80	10	16	44	12	9,6	...47304050080
40	68000	65 x 80	9	14	58	10	11,5	...68304065080
40	100000	75 x 100	6	12	57	8	15,2	...10404075100
40	150000	75 x 145	5	9	71	7	19,2	...15404075145
40	220000	90 x 148	4	8	83	6	24,0	...22404090148
40	330000	90 x 170	3	7	93	5	29,1	...33404090170
40	470000	90 x 230	3	7	133	5	33,3	...47404090230
63	6800	35 x 54	23	40	15	35	4,8	...68206335054
63	10000	35 x 70	15	34	14	23	6,6	...10306335070
63	15000	40 x 70	14	28	20	18	7,2	...15306340070
63	22000	50 x 80	13	23	27	15	8,4	...22306350080
63	33000	50 x 100	12	19	37	12	9,6	...33306350100
63	47000	65 x 100	8	16	35	10	13,2	...47306365100
63	68000	75 x 100	5	13	32	8	16,7	...68306375100
63	100000	75 x 145	5	11	47	7	19,2	...10406375145
63	150000	90 x 148	4	9	57	5	24,2	...15406390148
63	220000	90 x 170	4	8	83	4	25,2	...22406390170
63	330000	90 x 230	3	6	93	4	33,3	...33406390230
80	4700	35 x 54	33	48	15	28	4,0	...47208035054
80	6800	35 x 70	23	39	15	23	5,4	...68208035070
80	10000	40 x 70	15	31	14	18	7,0	...10308040070
80	15000	50 x 80	14	25	20	14	8,1	...15308050080
80	22000	65 x 100	13	20	27	12	10,4	...22308065100
80	33000	75 x 100	12	17	37	10	10,8	...33308075100
80	47000	75 x 145	8	14	35	8	15,2	...47308075145
80	68000	90 x 148	5	12	32	7	21,6	...68308090148
80	100000	90 x 170	4	10	38	6	25,2	...10408090170
80	150000	90 x 230	4	9	57	4	28,9	...15408090230
100	2200	35 x 54	55	60	11	35	3,1	...22210035054
100	3300	35 x 54	33	46	10	27	4,0	...33210035054
100	4700	40 x 70	23	36	10	22	5,6	...47210040070
100	6800	40 x 70	18	31	12	18	6,4	...68210040070
100	10000	50 x 80	15	26	14	14	7,8	...10310050080
100	15000	50 x 100	14	20	20	12	8,8	...15310050100
100	22000	65 x 100	10	16	21	10	11,8	...22310065100
100	33000	75 x 100	6	13	19	8	15,2	...33310075100
100	47000	75 x 145	5	11	22	7	19,2	...47310075145
100	68000	90 x 148	4	9	26	6	24,2	...68310090148
100	100000	90 x 170	4	8	38	5	25,2	...10410090170
100	150000	90 x 230	4	7	45	5	28,9	...15410090230



Standard Values Type GM

U_R [V]	C_R [µF]	Case size ∅ x L [mm]	ESR 100 Hz 20°C typ. [mΩ]	ESR 100Hz 20°C max. [mΩ]	tan δ 100Hz 20°C max. [%]	Z 10KHz 20°C max. [mΩ]	Rated ripple current 100Hz 85°C [A]	Order code GMA... GMB...
160	1000	35 x 54	63	81	6	40	2,9	...10216035054
160	1500	35 x 70	40	70	6	35	4,1	...15216035070
160	2200	35 x 80	58	60	12	27	3,6	...22216035080
160	3300	40 x 100	43	49	13	21	4,7	...33216040100
160	4700	50 x 100	28	38	12	17	6,3	...47216050100
160	6800	65 x 100	20	30	13	14	8,3	...68216065100
160	10000	75 x 100	16	24	15	11	9,3	...10316075100
160	15000	75 x 145	10	19	14	9	13,6	...15316075145
160	22000	90 x 148	8	15	17	8	17,1	...22316090148
160	33000	90 x 170	5	11	16	7	22,6	...33316090170
160	47000	90 x 230	5	10	22	6	25,8	...47316090230
250	1000	40 x 70	70	130	7	150	3,2	...10225040070
250	1500	50 x 70	60	90	8	130	3,7	...15225050070
250	2200	50 x 80	40	70	8	90	4,8	...22225050080
250	3300	65 x 80	32	42	10	60	6,1	...33225065080
250	4700	65 x 100	25	35	11	50	7,5	...47225065100
250	6800	75 x 100	15	24	10	40	9,6	...68225075100
250	10000	75 x 145	17	30	16	30	10,4	...10325075145
250	15000	90 x 148	12	20	17	28	14,0	...15325090148
250	22000	90 x 230	9	16	19	26	19,2	...22325090230
350	470	35 x 54	90	130	4	175	2,4	...47135035054
350	680	35 x 70	80	110	5	125	2,9	...68135035070
350	1000	40 x 70	60	80	6	110	3,5	...10235040070
350	1500	50 x 80	50	70	7	75	4,3	...15235050080
350	2200	50 x 100	35	40	7	45	5,6	...22235050100
350	3300	65 x 100	25	35	8	30	7,5	...33235065100
350	4700	75 x 100	20	30	9	21	8,3	...47235075100
350	6800	75 x 145	12	15	8	15	12,4	...68235075145
350	10000	90 x 148	10	13	9	13	15,3	...10335090148
350	15000	90 x 170	9	12	13	12	16,8	...15335090170
400	470	35 x 70	170	200	8	200	1,9	...47140035070
400	680	40 x 70	120	150	8	130	2,5	...68140040070
400	1000	50 x 80	60	90	6	85	3,9	...10240050080
400	1500	50 x 100	50	70	7	62	4,7	...15240050100
400	2200	65 x 100	35	50	7	55	6,3	...22240065100
400	3300	75 x 100	25	35	8	36	7,5	...33240075100
400	4700	75 x 145	20	30	9	25	9,6	...47240075145
400	6800	90 x 148	10	19	6	18	15,3	...68240090148
400	10000	90 x 170	9	18	8	15	16,8	...10340090170
400	15000	90 x 230	8	16	11	12	20,4	...15340090230

Please choose type GH (p. 34) for a longer useful life.
Please choose type G (p. 17) for higher ripple currents.

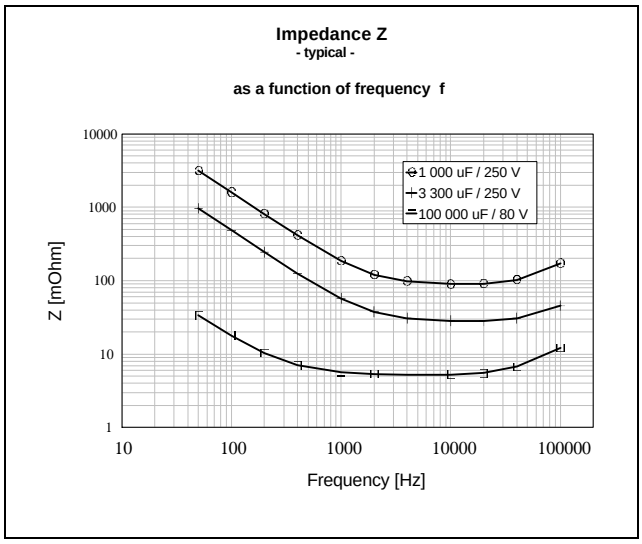


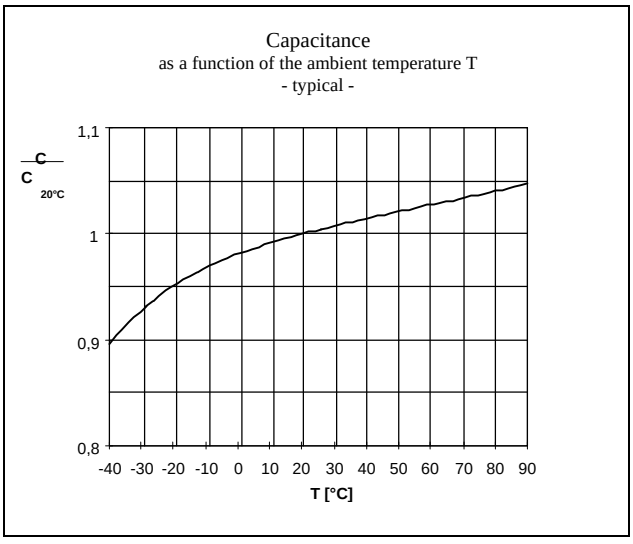
Standard Values Type GM

U_R [V]	C_R [µF]	Case size ∅ x L [mm]	ESR 100 Hz 20°C typ. [mΩ]	ESR 100Hz 20°C max. [mΩ]	tan δ 100Hz 20°C max. [%]	Z 10KHz 20°C max. [mΩ]	Rated ripple current 100Hz 85°C [A]	Order code GMA... GMB...
500	220	35 x 70	240	360	5	600	1,7	...22150035070
500	330	35 x 70	220	330	7	520	1,7	...33150035070
500	470	40 x 70	170	255	8	400	2,1	...47150040070
500	680	50 x 70	112	168	7	330	2,7	...68150050070
500	1000	50 x 100	80	120	8	250	3,7	...10250050100
500	1500	65 x 100	65	97	9	120	4,6	...15250065100
500	2200	75 x 100	44	66	9	80	5,6	...22250075100
500	3300	75 x 145	34	51	11	70	7,4	...33250075145
500	4700	90 x 148	28	42	12	50	9,1	...47250090148

Please choose type GH (p. 34) for a longer useful life.
Please choose type G (p. 17) for higher ripple currents

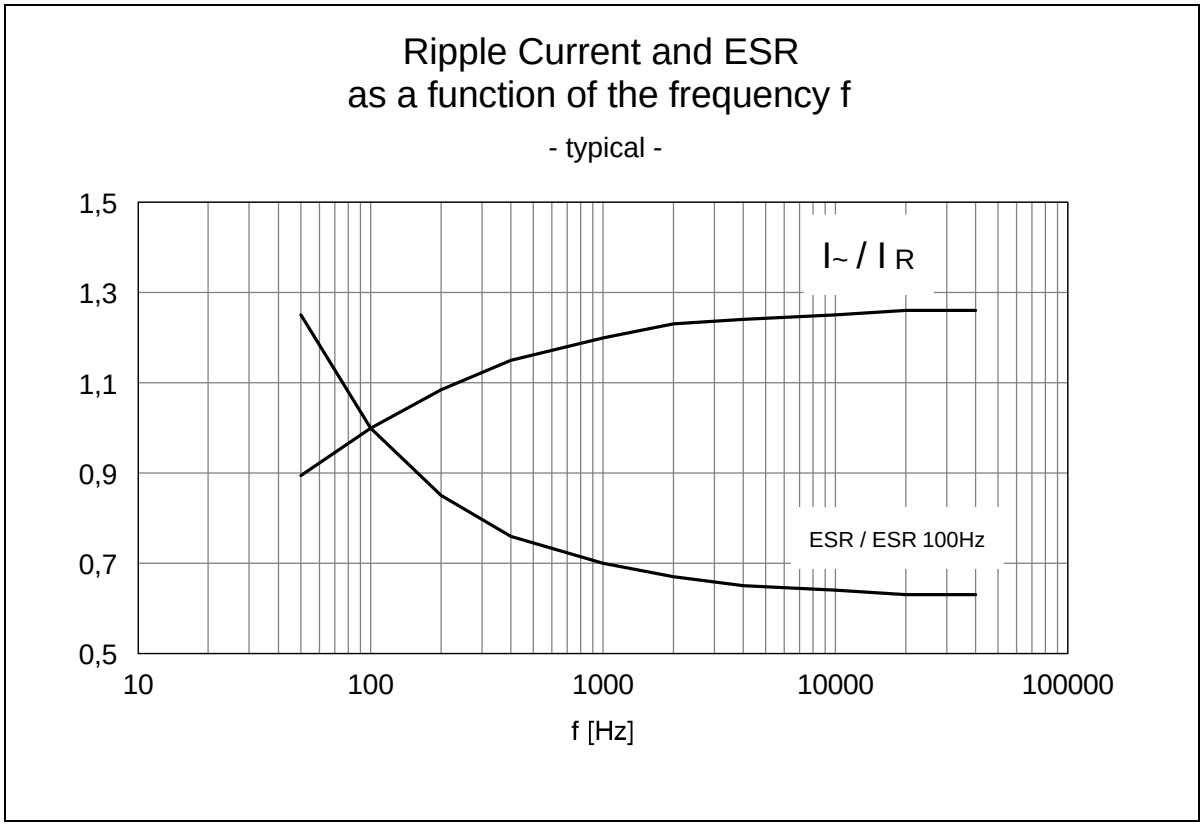
4.3 Technical Data Type GM





ESL

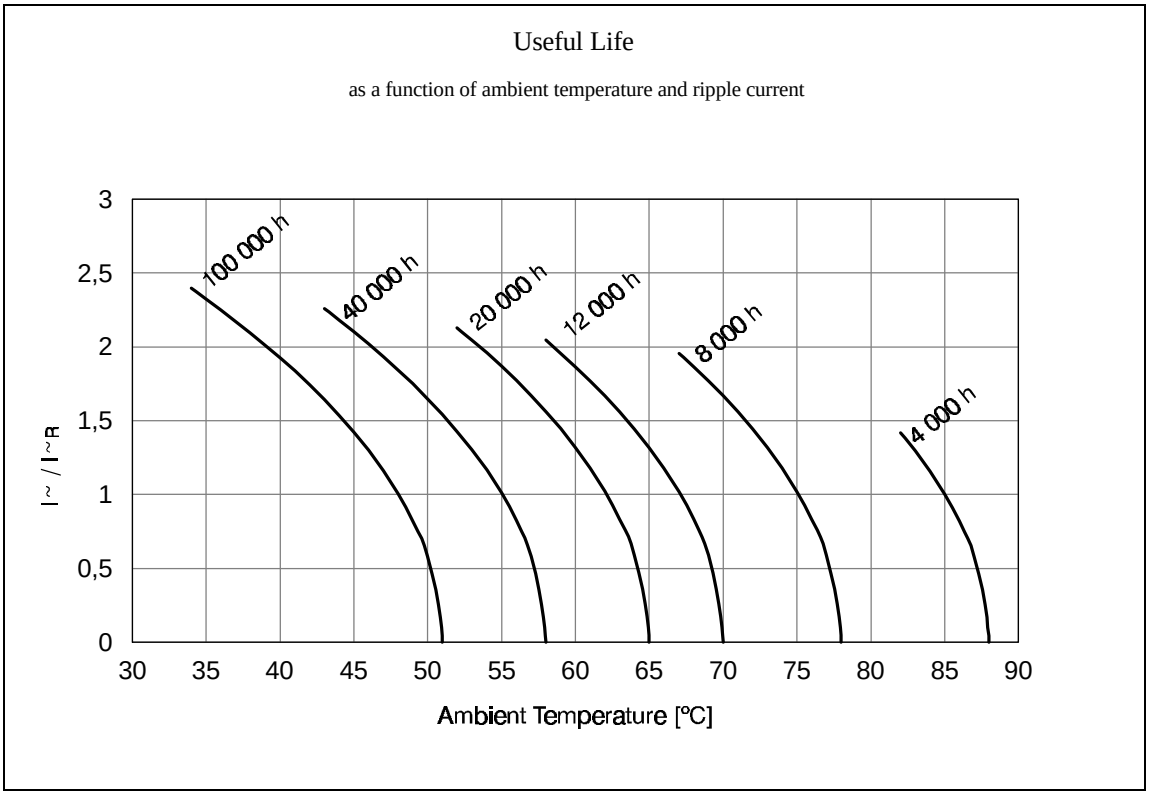
diameter	≤50 mm	65 mm	75 mm	90 mm
ESL [nH]	≈ 10	≈ 15	≈ 20	≈ 20



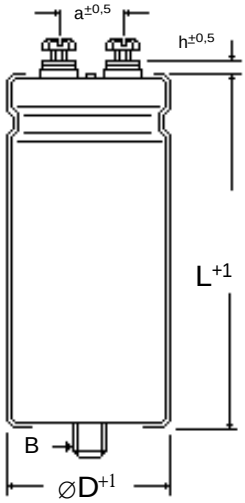
Because the contact elements have a limited current loading, the following currents may not be exeeded.

diameter	≤ 50 mm	65 mm	75 mm	90 mm
max. ripple current	30 A	40 A	50 A	60 A

4.3.1 Useful Life Type GM



5 Long Life Capacitors Type GH



Features

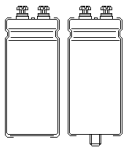
- very long useful life
- all contacts welded
- threaded terminals
- type GHA for clamp mounting
- type GHB for bolt mounting

Applications

- standard- and switched mode power supply
- computer
- telecommunication
- industries electrical and electronic
- inverter

Quick reference

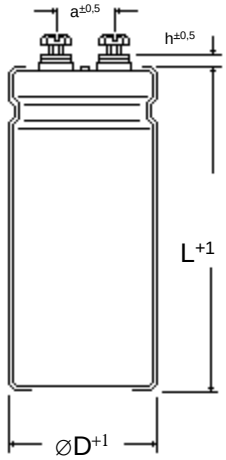
	U_R < 400 V	U_R 400 V
Temperature range	- 40°C ... + 105°C	- 40°C ... + 85°C
Tolerance	+ 30% -10%	
Max. reverse voltage	2V	
Useful life	see diagram useful life p. 35	
Leakage current 5 min @ U_R	0,006 * C [µF] * U [V] + 4 µA [µA]	
Leakage current 1 h @ U_R	0,15 * leakage current 5 min @ U_R	
Specs.	DIN 41332 IEC 384 - 4 LL	
Insulation	shrink - on sleeve voltage proof ≥ 2500 V AC	
Content of supply	GA... connecting screws GB... connecting screws and fixing nut	
Terminals	up to 75 mm ∅ M 5 , beyond M 6	



5.1 Mechanical Data Type GH

GHA

clamp mounted

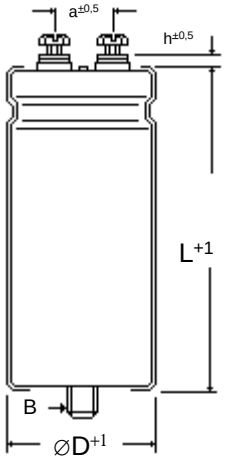


D [mm]	h [mm]	a [mm]	B	terminals
35	6	13	M 8 x 12	M 5
50	5	22	M 12 x 16	M 5
65	5	28,5	M 12 x 16	M 5
75	5	31,7	M 12 x 16	M 5
90	5	31,7	M 12 x 16	M 6

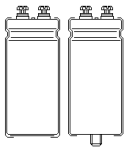
	thread	max. tightening torque
terminals	M 5	2,0 Nm
terminals	M 6	2,5 Nm
mounting	M 8	4,0 Nm
mounting	M 12	10,0 Nm

GHB

stud mounted

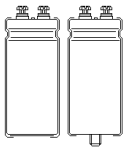


Capacitance [µF]	Rated voltage [V]									
	16	25	40	63	100	160	250	350	400	450
220								35 x 54	35 x 80	35 x 100
330								35 x 80	50 x 70	50 x 70
470						35 x 54	35 x 80	50 x 70	50 x 80	50 x 80
680						35 x 70	50 x 70	50 x 80	50 x 100	50 x 100
1000					35 x 54	35 x 80	50 x 80	50 x 100	65 x 100	65 x 100
1500					35 x 70	50 x 70	50 x 100	65 x 100	75 x 100	75 x 100
2200				35 x 54	35 x 80	50 x 80	65 x 100	75 x 100	75 x 145	75 x 145
3300				35 x 70	50 x 70	65 x 100	75 x 100	75 x 145	75 x 145	
4700			35 x 70	35 x 80	50 x 80	75 x 100	75 x 145			
6800		35 x 54	35 x 80	35 x 100	50 x 100	75 x 145				
10000	35 x 54	35 x 70	35 x 100	50 x 80	65 x 100					
15000	35 x 70	35 x 100	50 x 70	50 x 100	75 x 100					
22000	35 x 100	50 x 70	50 x 100	65 x 100	75 x 145					
33000	50 x 70	50 x 80	65 x 100	75 x 100						
47000	50 x 100	65 x 100	75 x 100	75 x 145						
68000	65 x 100	75 x 100	75 x 100							
100000	75 x 100	75 x 145	75 x 145							
150000	75 x 145	75 x 145								
220000	75 x 145									



5.2 Standard Values Type GH

U_R	C_R	Case size	ESR 100 Hz	ESR 100Hz	Z 10KHz	Rated ripple current 100Hz		Order code
		∅ x L	20°C typ.	20°C max.	20°C max.	85°C	105°C	GHA...
[V]	[µF]	[mm]	[mΩ]	[mΩ]	[mΩ]	[A]	[A]	GHB...
16	10000	35 x 54	26	39	34		3,7	...10301635054
16	15000	35 x 70	17	26	22		5,1	...15301635070
16	22000	35 x 100	14	21	18		6,5	...22301635100
16	33000	50 x 70	10	15	13		7,4	...33301650070
16	47000	50 x 100	9	14	12		9,0	...47301650100
16	68000	65 x 100	8	12	10		10,8	...68301665100
16	100000	75 x 100	7	11	9		11,5	...10401675100
16	150000	75 x 145	6	9	8		14,3	...15401675145
16	220000	75 x 145	6	9	8		14,3	...22401675145
25	6800	35 x 54	27	41	35		3,6	...68202535054
25	10000	35 x 70	23	35	30		4,4	...10302535070
25	15000	35 x 100	21	32	27		5,3	...15302535100
25	22000	50 x 70	13	20	17		6,5	...22302550070
25	33000	50 x 80	11	17	14		7,5	...33302550080
25	47000	65 x 100	10	15	13		9,6	...47302565100
25	68000	75 x 100	8	12	10		10,8	...68302575100
25	100000	75 x 145	7	11	9		13,2	...10402575145
25	150000	75 x 145	6	9	8		14,3	...15402575145
40	4700	35 x 70	28	42	36		4,0	...47204035070
40	6800	35 x 80	23	35	30		4,6	...68204035080
40	10000	35 x 100	19	29	25		5,6	...10304035100
40	15000	50 x 70	14	21	18		6,3	...15304050070
40	22000	50 x 100	12	18	16		7,8	...22304050100
40	33000	65 x 100	10	15	13		9,6	...33304065100
40	47000	75 x 100	8	12	10		10,8	...47304075100
40	68000	75 x 100	5	8	7		13,6	...68304075100
40	100000	75 x 145	4	6	5		17,5	...10404075145
63	2200	35 x 54	49	74	64		2,7	...22206335054
63	3300	35 x 70	33	50	43		3,7	...33206335070
63	4700	35 x 80	22	33	29		4,8	...47206335080
63	6800	35 x 100	18	27	23		5,7	...68206335100
63	10000	50 x 80	12	18	16		7,1	...10306350080
63	15000	50 x 100	9	14	12		9,0	...15306350100
63	22000	65 x 100	8	12	10		10,8	...22306365100
63	33000	75 x 100	6	9	8		12,4	...33306375100
63	47000	75 x 145	5	8	7		15,7	...47306375145
100	1000	35 x 54	63	95	82		2,4	...10210035054
100	1500	35 x 70	40	60	52		3,3	...15210035070
100	2200	35 x 80	30	45	39		4,0	...22210035080
100	3300	50 x 70	25	38	33		4,7	...33210050070
100	4700	50 x 80	22	33	29		5,3	...47210050080
100	6800	50 x 100	19	29	25		6,2	...68210050100
100	10000	65 x 100	12	18	16		8,8	...10310065100
100	15000	75 x 100	9	14	12		10,1	...15310075100
100	22000	75 x 145	8	12	10		12,4	...22310075145



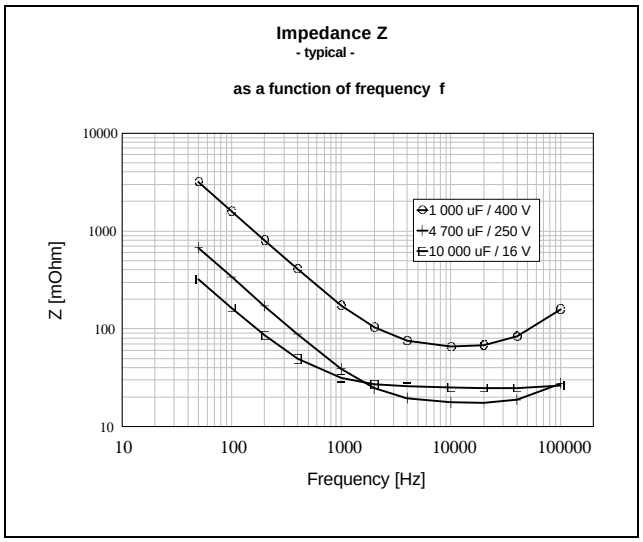
Standard Values Type GH

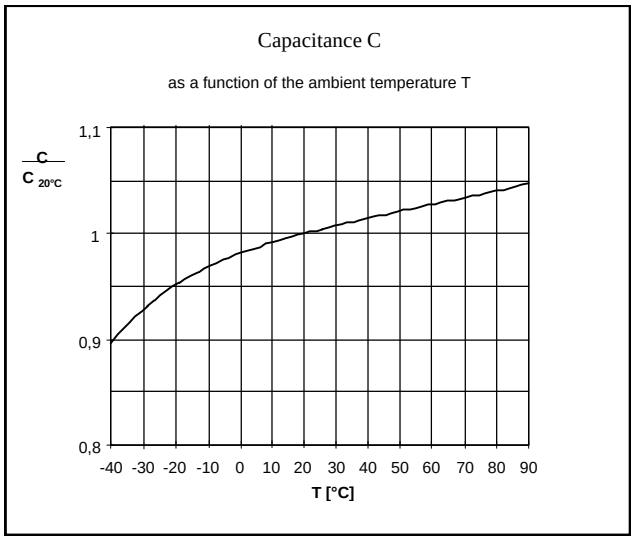
U_R	C_R	Case size	ESR 100 Hz	ESR 100Hz	Z 10KHz	Rated ripple current 100Hz		Order code
		∅ x L	20°C typ.	20°C max.	20°C max.	85°C	105°C	GHA...
[V]	[µF]	[mm]	[mΩ]	[mΩ]	[mΩ]	[A]	[A]	GHB...
160	470	35 x 54	160	240	208		1,5	...47116035054
160	680	35 x 70	100	150	130		2,1	...68116035070
160	1000	35 x 80	80	120	104		2,5	...10216035080
160	1500	50 x 70	60	90	78		3,0	...15216050070
160	2200	50 x 80	40	60	52		3,9	...22216050080
160	3300	65 x 100	27	41	35		5,9	...33216065100
160	4700	75 x 100	20	30	26		6,8	...47216075100
160	6800	75 x 145	16	24	21		8,8	...68216075145
250	470	35 x 80	160	240	208		1,8	...47125035080
250	680	50 x 70	110	165	143		2,2	...68125050070
250	1000	50 x 80	60	90	78		3,2	...10225050080
250	1500	50 x 100	50	75	65		3,8	...15225050100
250	2200	65 x 100	35	53	46		5,1	...22225065100
250	3300	75 x 100	23	35	30		6,3	...33225075100
250	4700	75 x 145	17	26	22		8,5	...47225075145
350	220	35 x 54	190	285	247		1,4	...22135035054
350	330	35 x 80	160	240	208		1,8	...33135035080
350	470	50 x 70	140	210	182		2,0	...47135050070
350	680	50 x 80	80	120	104		2,8	...68135050080
350	1000	50 x 100	50	75	65		3,8	...10235050100
350	1500	65 x 100	45	68	59		4,5	...15235065100
350	2200	75 x 100	30	45	39		5,6	...22235075100
350	3300	75 x 145	25	38	33		7,0	...33235075145
400	220	35 x 80	200	300	260	1,9		...22140035080
400	330	50 x 70	180	270	234	2,1		...33140050070
400	470	50 x 80	150	225	195	2,5		...47140050080
400	680	50 x 100	90	135	117	3,5		...68140050100
400	1000	65 x 100	60	90	78	4,8		...10240065100
400	1500	75 x 100	50	75	65	5,3		...15240075100
400	2200	75 x 145	35	53	46	7,3		...22240075145
400	3300	75 x 145	29	44	40	8,0		...33240075145
450	220	35 x 100	220	330	286	2,0		...22145035100
450	330	50 x 70	200	300	260	2,0		...33145050070
450	470	50 x 80	150	225	195	2,5		...47145050080
450	680	50 x 100	100	150	130	3,3		...68145050100
450	1000	65 x 100	70	105	91	4,5		...10245065100
450	1500	75 x 100	60	90	78	4,8		...15245075100
450	2200	75 x 145	40	60	52	6,8		...22245075145

Please choose type GM (p. 23) for a higher CU product.

Please choose type G (p. 17) for higher ripple currents.

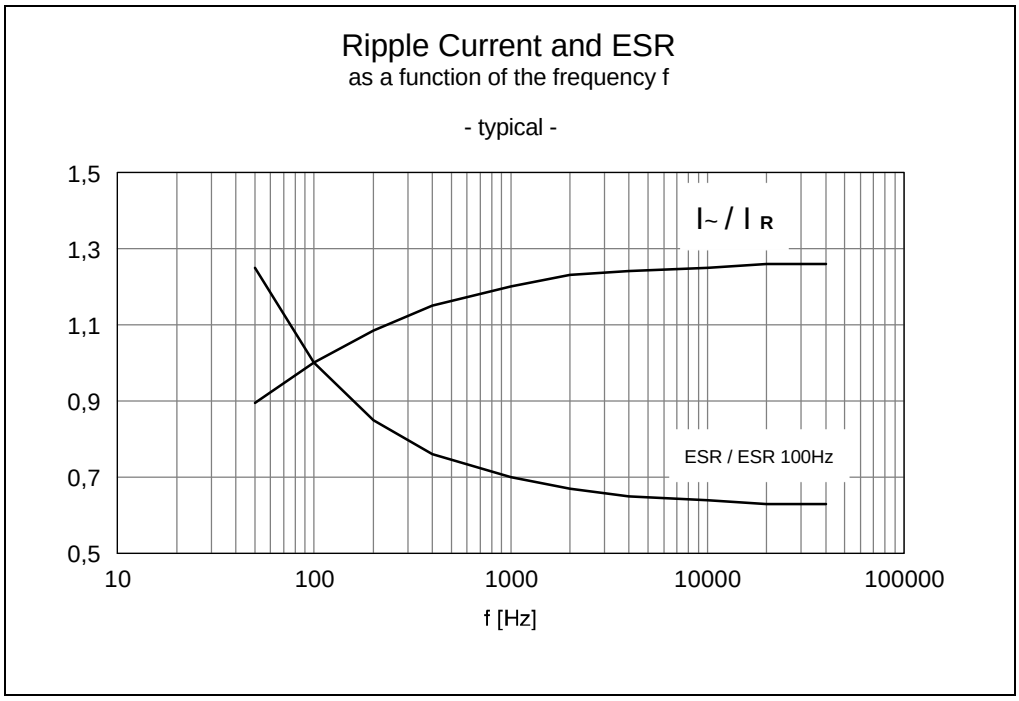
5.3 Technical Data Type GH





ESL

diameter	≤50 mm	65 mm	75 mm	90 mm
ESL [nH]	≈ 10	≈ 15	≈ 20	≈ 20



Because the contact elements have a limited current loading, the following currents may not be exeeded.

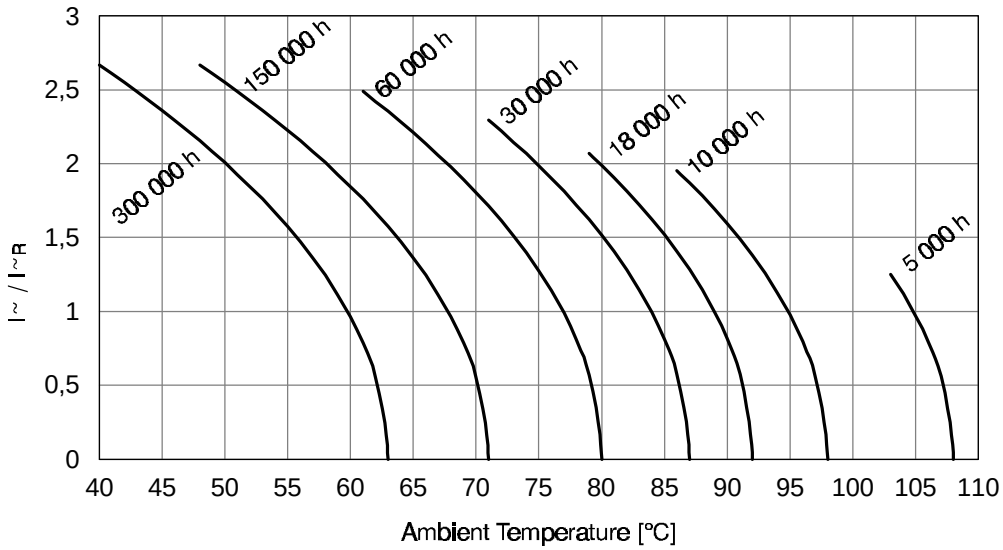
diameter	≤ 50 mm	65 mm	75 mm	90 mm
max. ripple current	30 A	40 A	50 A	60 A

5.3.1 Useful Life Type GH

Useful Life

as a function of ambient temperature and ripple current

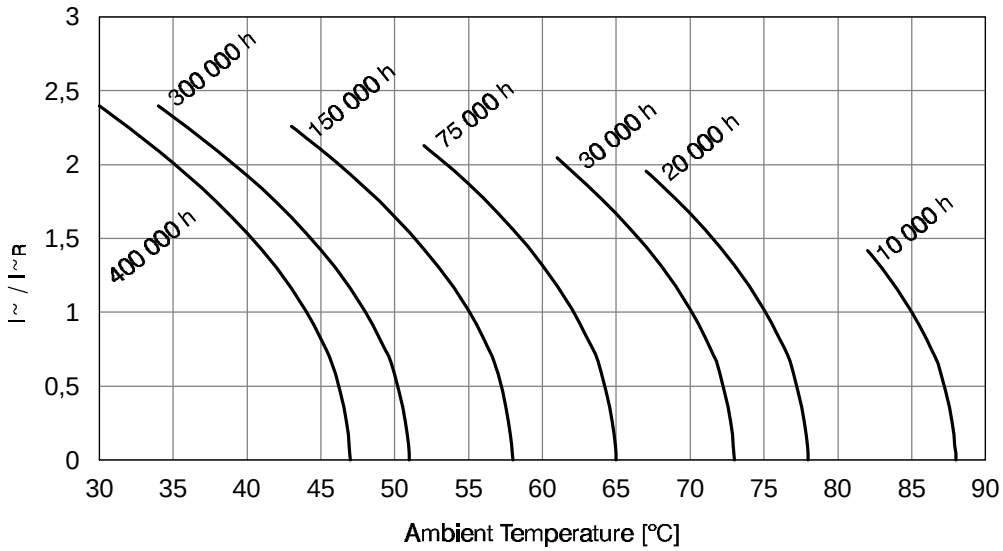
$U_R \leq 350$ V

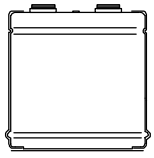


Useful Life

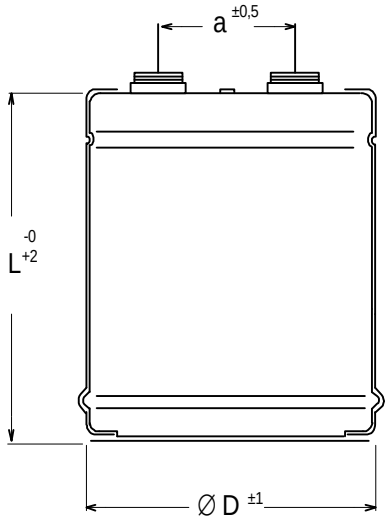
as a function of ambient temperature and ripple current

$U_R > 350$ V





6 High Performance Capacitors Type GW



Features

- low thermal resistance
- long useful life
- very high ripple currents
- all contacts welded
- screw terminals
- clamp mounting
- best suited for heatsink mounting
- ultra low inductance

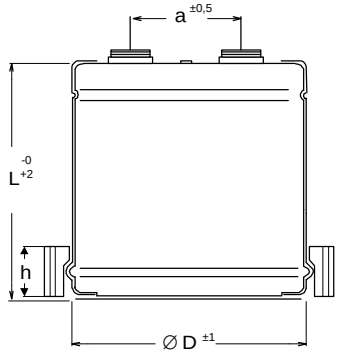
Applications

- standard and switched mode power supplies
- electronic industries
- welding machinery
- uninterruptible power supplies
- frequency converters
- automotive applications

Quick reference

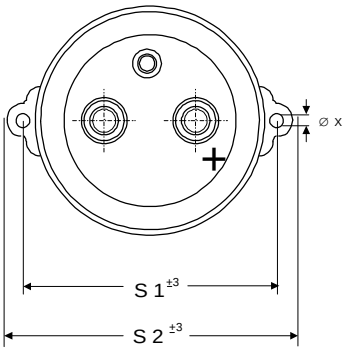
	$U_R \leq 400$ V	$U_R > 400$ V
Temperature range	- 40°C - + 105°C	- 40°C - + 85°C
Tolerance	+ 30% -10%	
Max. reverse voltage	2V	
Useful life	see diagram Useful Life p. 39 / 40	
Leakage current after 5 min @ U_R	0,008 * C [µF] * U [V] + 4µA [µA]	
Leakage current 1 h @ U_R	0,12 * leakage current 5 min @ U_R	
Specs.	DIN 41332 IEC 384 - 4	
Insulation	shrink - on sleeve / silicon disk voltage proof ≥ 2500 V AC	
Content of supply	connecting screws and mounting clamp	
Terminals	screw terminals M 6	

6.1 Mechanical Data Type GW



D [mm]	h [mm]	a [mm]	S 1 [mm]	S 2 [mm]	X [mm]	terminals
90	20	31,7	106	118	4,5	M 6
100	20	31,7	116	128	4,5	M 6

	thread	max. tightening torque
mounting	M 4	2.0 Nm
terminals	M 6	3.0 Nm



Other case size and voltage- / capacitance combinations are available on request !

D x L see table below

Capacitance [µF]	Rated voltage [V]						
	40	63	100	250	400	450	500
1000						90 x 69	90 x 69
2200					90 x 69	90 x 69	
3300					90 x 98	90 x 98	
4700				90 x 69	90 / 100 x 98	100 x 98	
10000			90 x 69	100 x 98			
22000		90 x 69	90 x 69				
47000	90 x 69						
100000	90 x 69						

The new GW type capacitors offer small dimensions combined with high ripple current. This has been achieved by having cans with a large base area (63 cm^2) and a thermally conductive pad which provides electrical isolation.
The special design of the internal winding provides efficient removal of the heat generated, via the can base, to the external heat sink. This results in lower hot spot temperatures, higher ripple current and longer operational life.
A novel clamp requires only two vertical screws and gives a uniformly distributed pressure between the capacitor bottom and the heatsink.
As a result of these advanced designs the thermal resistance is significantly below 2 °/W.

6.2 Standard Values Type GW

U_R	C_R	Case size	$ESR_{100\ Hz}$	ESR_{100Hz}	$\tan\delta_{100Hz}$	Ripple current 10 KHz with Heatsink *	Rated ripple current 100Hz		Order code
		∅ x L	20°C typ.	20°C max.	20°C max.		85°C	105°C	
[V]	[µF]	[mm]	[mΩ]	[mΩ]	[%]	[A]	[A]	[A]	GW
40	47000	90 x 69	7	11	31	84		14,0	...47304090069
40	100000	90 x 69	4	6	38	100		18,6	...10404090069
63	22000	90 x 69	8	12	17	80		13,1	...22306390069
100	10000	90 x 69	8	12	8	80		13,1	...10310090069
100	22000	90 x 69	6	9	12	91		15,2	...22310090069
250	4700	90 x 69	11	17	5	67		11,2	...47225090069
250	10000	100 x 98	6	11	6	91		18,2	...10325010098
400	2200	90 x 69	20	30	4	56		8,3	...22240090069
400	3300	90 x 98	15	23	5	58		10,7	...33240090098
400	4700	90 x 98	15	23	5	48	12,5		...47240090098
400	4700	100 x 98	13	20	6	62		12,4	...47240010098
450	1000	90 x 69	70	105	7	24	5,7		...10245090069
450	2200	90 x 69	30	45	6	36	9,8		...22245090069
450	3300	90 x 98	19	29	6	46	12,3		...33245090098
450	4700	100 x 98	15	23	7	51	14,9		...47245010098
500	1000	90 x 69	100	150	9	20	4,8		...10250090069

*R_{th} Heatsink 0,4 °/W $T_{ambient}$ = 40 °C

6.3 Technical Data Type GW

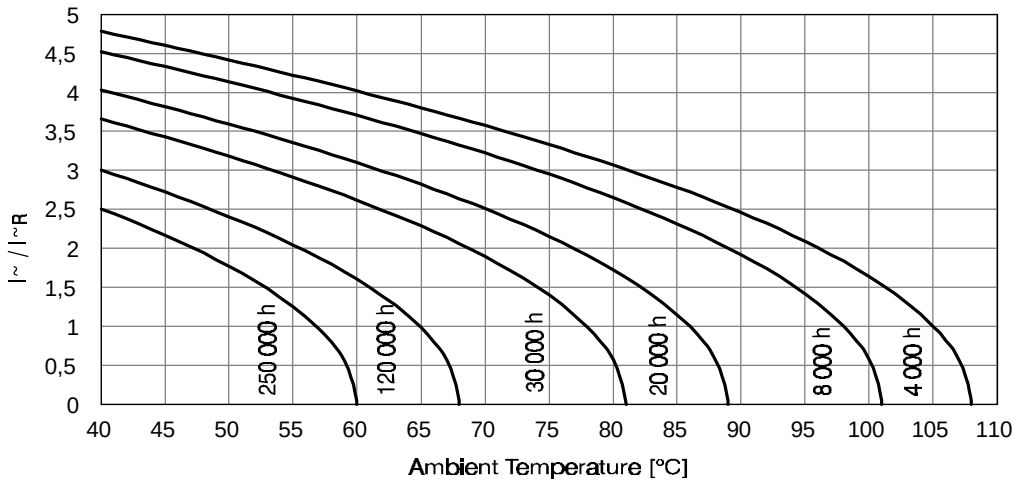
Because of the limited current handling capability by the contacts, a max. current of 100A may not be exceeded.

6.3.1 Useful Life Type GW

Useful Life

as a function of ambient temperature and ripple current

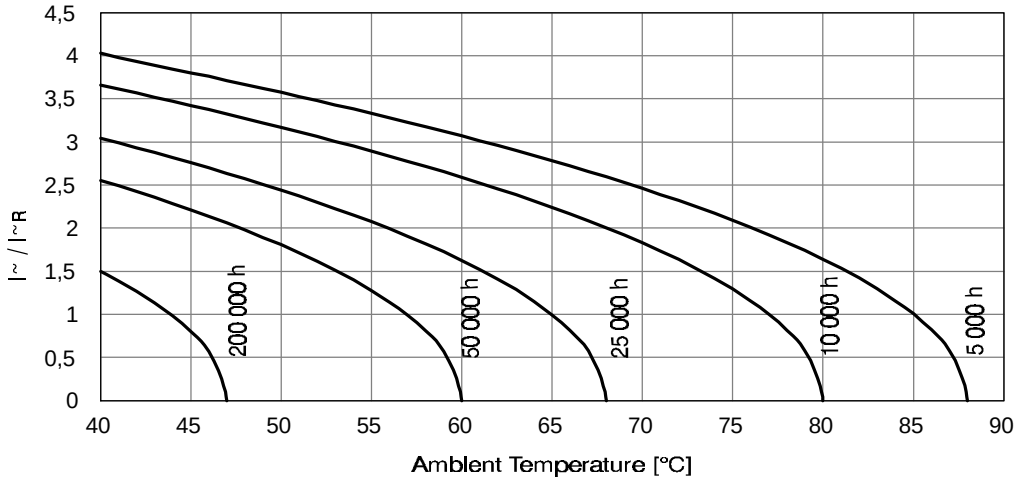
$U_R \leq 400$ V



Useful Life

as a function of ambient temperature and ripple current

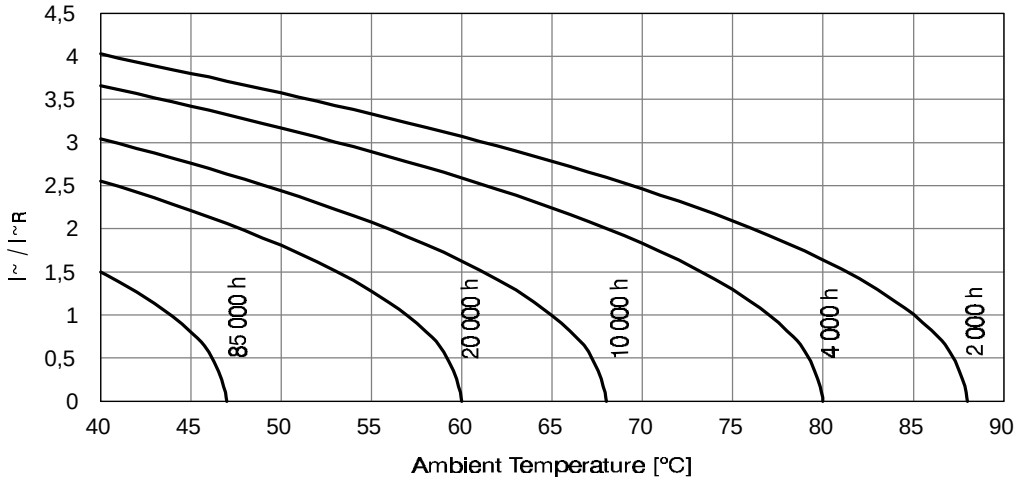
U_R = 450 V



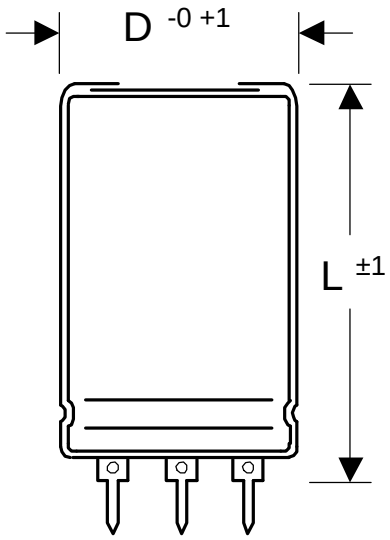
Useful Life

as a function of ambient temperature and ripple current

U_R = 500 V



7 Capacitors for PCB mounting Type GS



Features

- high mechanical stability
- polarized
- charge / discharge proof
- long useful life
- keyed polarity

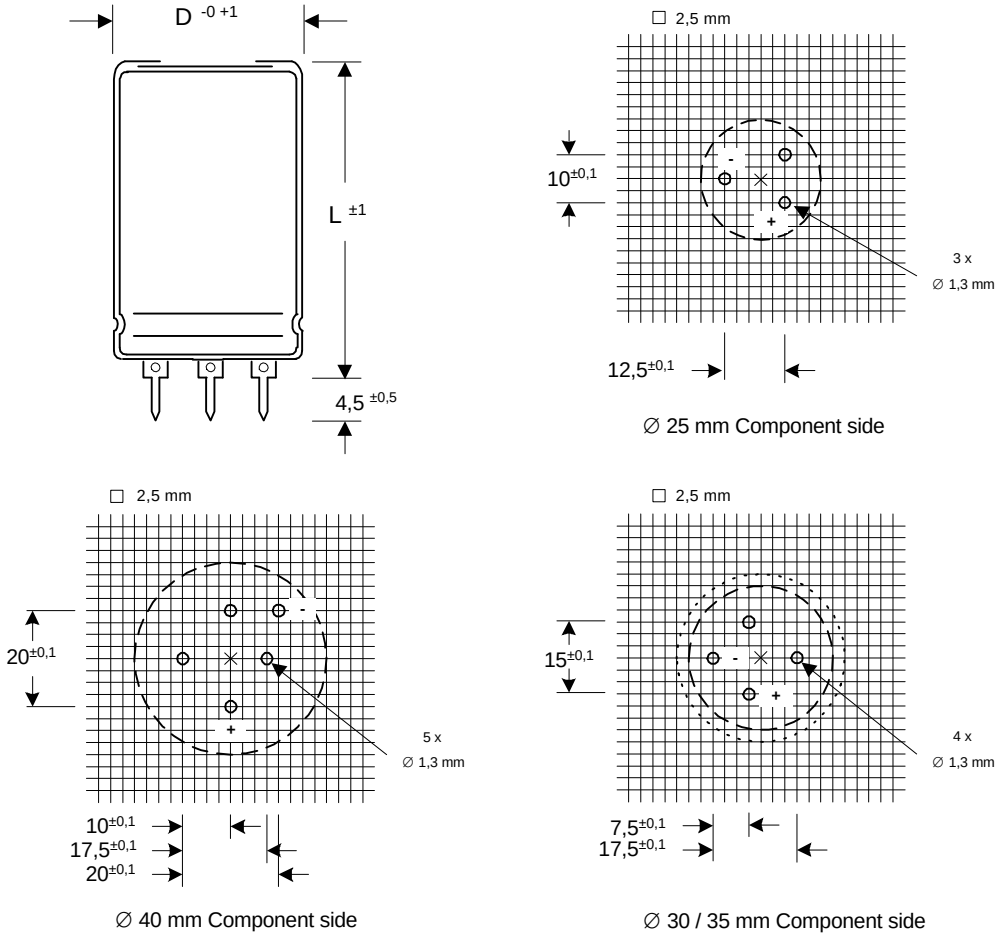
Applications

- industries electrical and electronic
- telecommunications
- computer

Quick reference

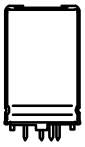
	U_R < 100 V	U_R ≥ 100 V
Temperature range	- 40°C ... + 105°C	- 40°C ... + 85°C
Tolerance	+ 30% -10%	
Max. reverse voltage	2V	
Useful life	see diagram useful life p. 45	
Leakage current 5 min @ U_R	0,008 * C [µF] * U [V] + 4 µA [µA]	
Leakage current 1 h @ U_R	0,05 * leakage current 5 min @ U_R	
Specs.	DIN 41332 IEC 384 - 4	
Insulation	shrink - on sleeve voltage proof ≥ 2500 V AC	
Terminals	positive pole at (1), negative pole is marked with -	

7.1 Mechanical Data / Leads Layout Type GS



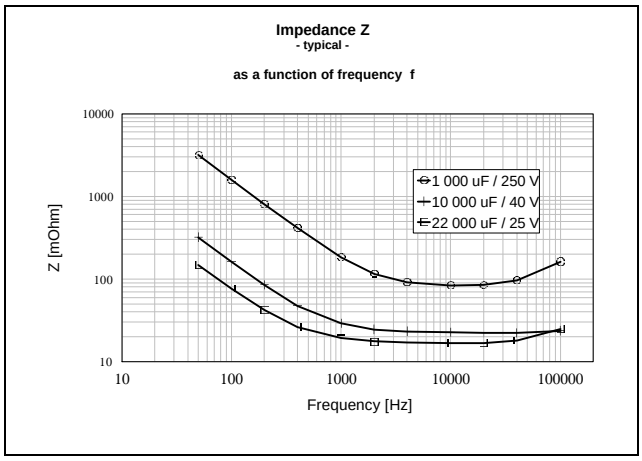
D x L

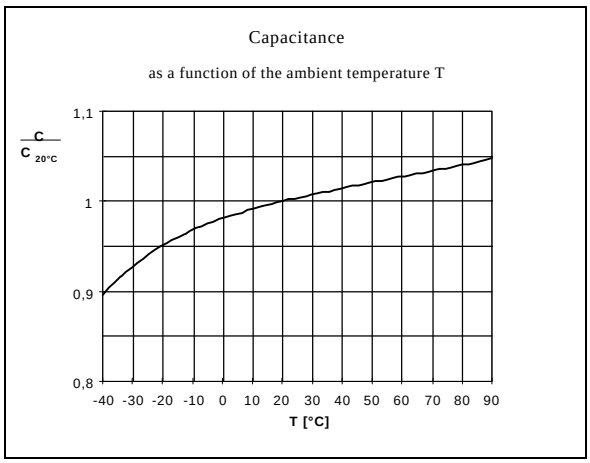
Capacitance [µF]	Rated voltage [V]									
	16	25	40	63	100	160	250	350	385	450
47								25 x 40	25 x 40	30 x 40
100							25 x 40	30 x 40	30 x 40	30 x 50
220							25 x 40	30 x 50	30 x 50	35 x 50
470					25 x 40	30 x 40	35 x 50	40 x 52	40 x 52	40 x 68
1000				25 x 40	30 x 40	35 x 50	40 x 68	40 x 98	40 x 98	
2200		25 x 40	25 x 40	30 x 40	35 x 50	40 x 98				
4700	25 x 40	30 x 40	30 x 40	35 x 50	40 x 52					
10000	30 x 40	30 x 50	35 x 50	40 x 52						
15000	30 x 50	35 x 50	40 x 52	40 x 68						
22000	35 x 50	40 x 52	40 x 68							
33000	35 x 68									



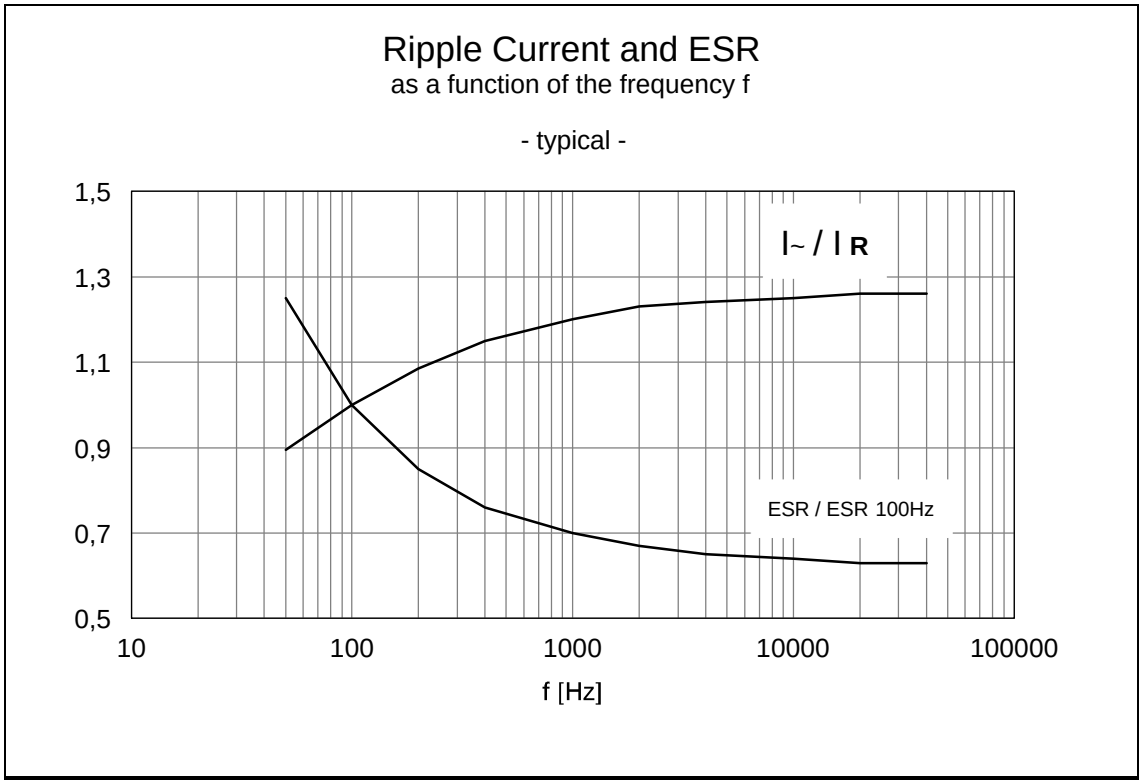
7.2 Standard Values Type GS

U_R [V]	C_R [µF]	Case size D x L [mm]	ESR 100 Hz 20°C typ. [mΩ]	ESR 100Hz 20°C max. [mΩ]	tan δ 100Hz 20°C max. [%]	Rated ripple current 100Hz 85°C [A]	Rated ripple current 100Hz 105°C [A]	Order code GS...
16	4700	25 x 40	33	50	25		2,3	...47201625040
16	10000	30 x 40	30	45	30		2,6	...10301630040
16	15000	30 x 50	27	40	32		3,0	...15301630050
16	22000	35 x 50	20	30	36		3,9	...22301635050
16	33000	35 x 70	13	20	38		5,4	...33301635070
25	2200	25 x 40	32	48	15		2,3	...22202525040
25	4700	30 x 40	30	45	18		2,6	...47202530040
25	10000	30 x 50	27	40	22		3,0	...10302530050
25	15000	35 x 50	20	30	25		3,9	...15302535050
25	22000	40 x 52	17	26	30		4,5	...22302540052
40	2200	25 x 40	45	68	12		2,0	...22204025040
40	4700	30 x 40	40	60	14		2,3	...47204030040
40	10000	35 x 50	23	35	20		3,6	...10304035050
40	15000	40 x 52	14	21	22		5,0	...15304040052
40	22000	40 x 68	15	22	25		5,4	...22304040068
63	1000	25 x 40	93	140	10		1,4	...10206325040
63	2200	30 x 40	63	95	12		1,8	...22206330040
63	4700	35 x 50	37	55	13		2,8	...47206335050
63	10000	40 x 52	21	31	14		4,1	...10306340052
63	15000	40 x 68	13	20	15		5,6	...15306340068
100	470	25 x 40	167	250	9		1,0	...47110025040
100	1000	30 x 40	107	160	10		1,4	...10210030040
100	2200	35 x 50	60	90	12		2,2	...22210035050
100	4700	40 x 52	37	55	15		3,1	...47210040052
160	470	30 x 40	200	300	9	1,0		...47116030040
160	1000	35 x 50	93	140	10	1,8		...10216035050
160	2200	40 x 98	67	100	10	2,9		...22216040098
250	100	25 x 40	493	740	7	0,6		...10125025040
250	220	25 x 40	347	520	8	0,7		...22125025040
250	470	35 x 50	167	250	8	1,3		...47125035050
250	1000	40 x 68	80	120	9	2,3		...10225040068
350	47	25 x 40	1267	1900	7	0,4		...47035025040
350	100	30 x 40	1000	1500	7	0,5		...10135030040
350	220	30 x 50	387	580	7	0,8		...22135030050
350	470	40 x 52	187	280	8	1,4		...47135040052
350	1000	40 x 98	93	140	10	2,5		...10235040098
385	47	25 x 40	1333	2000	7	0,4		...47038525040
385	100	30 x 40	1067	1600	7	0,4		...10138530040
385	220	30 x 50	400	600	7	0,8		...22138530050
385	470	40 x 52	207	310	8	1,3		...47138540052
385	1000	40 x 98	167	250	9	1,8		...10238540098
450	47	30 x 40	1000	1500	8	0,5		...47045030040
450	100	30 x 50	547	820	8	0,7		...10145030050
450	220	35 x 50	213	320	8	1,2		...22145035050
450	470	40 x 68	100	150	8	2,1		...47145040068

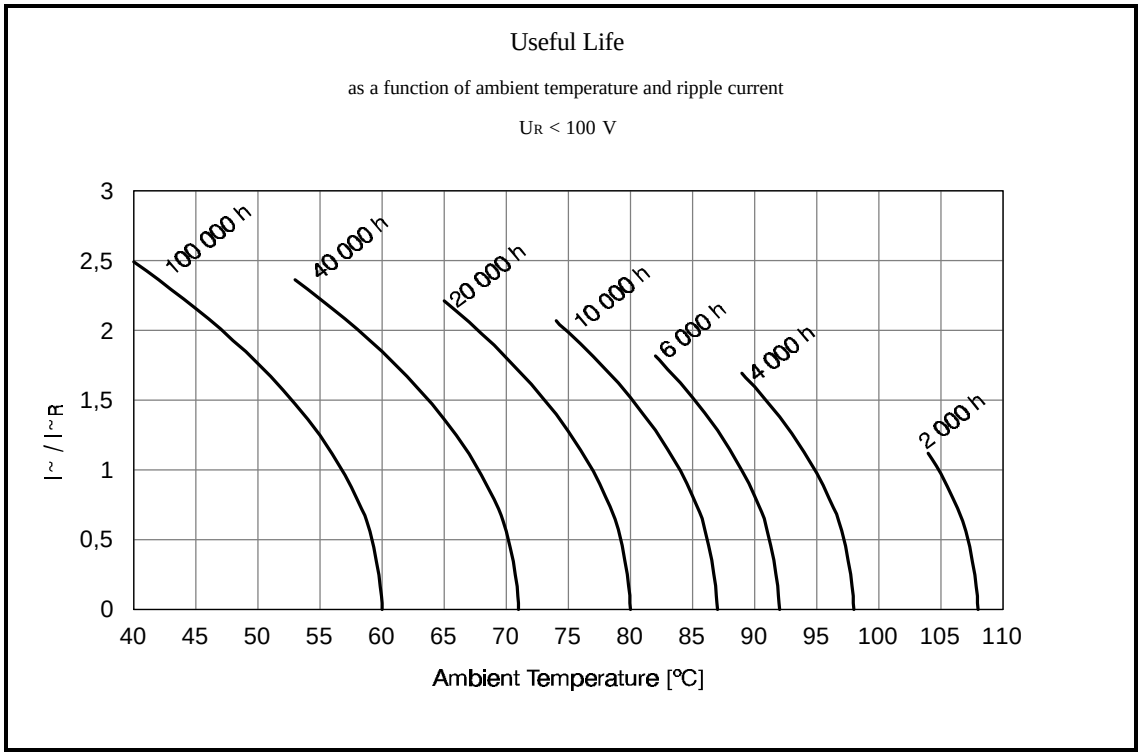


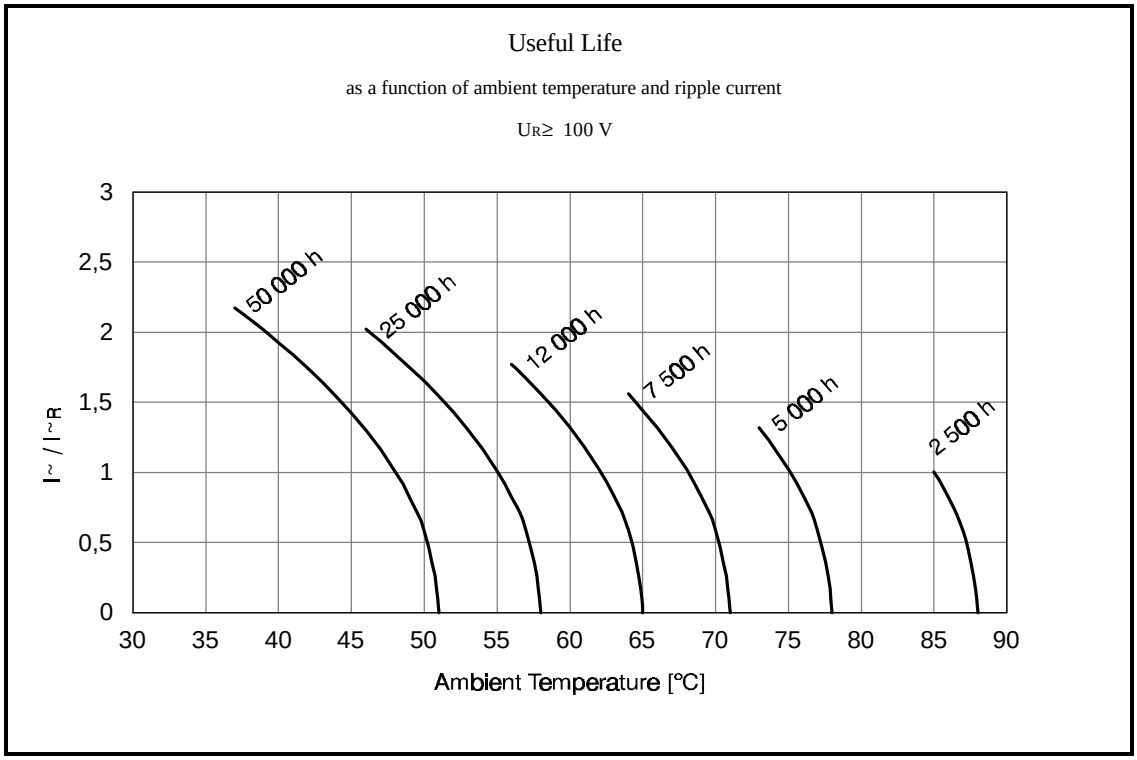


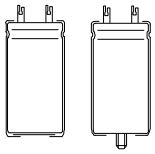
7.3 Technical Data Type GS



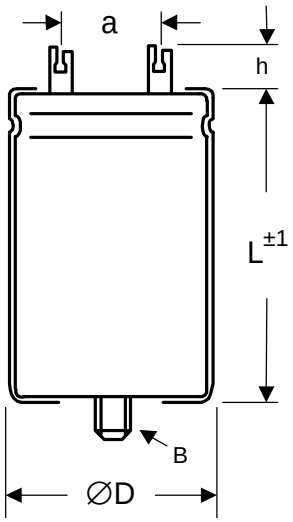
7.3.1 Useful Life Type GS







8 Soldering Lug Capacitors Type LF



Features

- high capacitance
- long useful life
- high ripple currents
- LFA clamp mounted
- LFB stud mounted

Applications

- standard and switched mode power supplies
- computer
- telecommunication
- industrial electronic

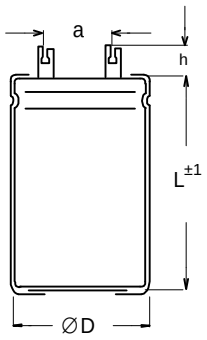
Quick reference

	$U_R \leq 100$ V	$U_R > 100$ V
Temperature range	- 40°C - + 105°C	- 40°C - + 85°C
Tolerance	+ 30% -10%	
Max. reverse voltage	2V	
Useful life	see diagram Useful Life p. 49	
Leakage current 5 min @ U_R	0,008 * C [µF] * U [V] + 4µA [µA]	
Leakage current 1 h @ U_R	0,12 * leakage current 5 min @ U_R	
Specs.	DIN 41332 IEC 384 - 4	
Insulation	shrink - on sleeve voltage proof ≥ 2500 V AC	
Content of supply	LFB with mounting nut	
Terminals	soldering lugs	

8.1 Mechanical Data Type LF

LFA

clamp mounted

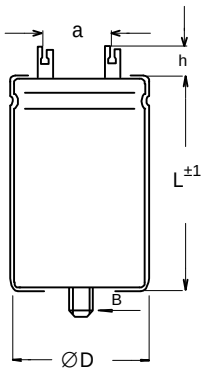


D [mm]	h [mm]	a [mm]	B
25	10	10	M 8 x 12
30	10	10	M 8 x 12
35	10	10	M 8 x 12
40	10	20	M 8 x 12
50	10	20	M 12 x 16

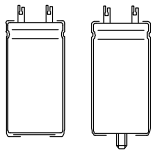
	thread	max. tightening torque
mounting	M 8	4 Nm
mounting	M 12	10 Nm

LFB

stud mounted

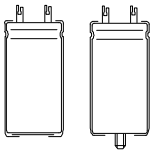


Capacitance [µF]	Rated voltage [V]										
	16	25	40	63	100	160	250	350	400	450	500
47									25 x 36	25 x 36	30 x 50
68								25 x 36	25 x 36	30 x 36	30 x 50
100							25 x 36	30 x 36	30 x 36	30 x 36	35 x 50
150							30 x 36	30 x 50	30 x 50	35 x 50	35 x 66
220						25 x 36	30 x 36	35 x 50	35 x 50	35 x 66	35 x 66
330						30 x 36	30 x 50	35 x 66	35 x 66	40 x 66	
470					25 x 36	30 x 50	35 x 50	40 x 66	40 x 66	40 x 66	
680					30 x 36	35 x 50	35 x 50	40 x 66	50 x 66		
1000				25 x 36	30 x 36	35 x 50	40 x 66	50 x 66			
1500				25 x 36	30 x 50						
2200			25 x 36	30 x 36	35 x 50						
3300			30 x 36	30 x 50	35 x 66						
4700		25 x 36	30 x 36	35 x 50	40 x 66						
6800		25 x 36	30 x 50	35 x 66	50 x 66						
10000	30 x 36	30 x 36	35 x 50	35 x 66	50 x 95						
15000	30 x 50	30 x 50	35 x 66	40 x 66							
22000	35 x 50	35 x 50	40 x 66								
33000	35 x 66	35 x 66									
47000	35 x 66	40 x 66									



8.2 Standard Values Type LF

U_R	C_R	Case size	$ESR_{100\ Hz}$	ESR_{100Hz}	$\tan\delta_{100Hz}$	Z_{10KHz}	Rated ripple current 100Hz		Order code
		∅ x L	20°C typ.	20°C max.	20°C max.	20°C max.	85°C	105°C	LFA...
[V]	[µF]	[mm]	[mΩ]	[mΩ]	[%]	[mΩ]	[A]	[A]	LFB...
16	10000	30 x 36	25	38	30	40		3,6	...10301630036
16	15000	30 x 50	22	33	31	30		4,4	...15301630050
16	22000	35 x 50	20	30	41	30		5,0	...22301635050
16	33000	35 x 66	15	23	45	20		6,5	...33301635066
16	47000	35 x 66	12	18	45	20		7,2	...47301635066
25	4700	25 x 36	20	30	20	30		3,7	...47202525036
25	6800	25 x 36	19	29	22	30		3,8	...68202525036
25	10000	30 x 36	17	26	25	30		4,4	...10302530036
25	15000	30 x 50	16	24	27	30		5,1	...15302530050
25	22000	35 x 50	15	23	31	20		5,8	...22302535050
25	33000	35 x 66	12	18	31	20		7,2	...33302535066
25	47000	40 x 66	11	17	32	20		7,9	...47302540066
40	2200	25 x 36	60	90	12	80		2,2	...22204025036
40	3300	30 x 36	50	75	12	70		2,6	...33204030036
40	4700	30 x 36	40	60	14	60		2,9	...47204030036
40	6800	30 x 50	30	45	18	40		3,7	...68204030050
40	10000	35 x 50	25	38	20	40		4,5	...10304035050
40	15000	35 x 66	19	29	22	30		5,8	...15304035066
40	22000	40 x 66	17	26	25	30		6,4	...22304040066
50	2200	25 x 36	60	90	12	80		2,2	...22205025036
50	3300	30 x 36	38	57	12	50		2,9	...33205030036
50	4700	30 x 50	35	53	15	50		3,5	...47205030050
50	6800	35 x 50	25	38	16	40		4,5	...68205035050
50	10000	35 x 66	20	30	19	30		5,6	...10305035066
50	15000	40 x 66	17	26	24	30		6,4	...15305040066
63	1000	25 x 36	90	135	8	120		1,8	...10206325036
63	1500	25 x 36	60	90	8	80		2,2	...15206325036
63	2200	30 x 36	50	75	10	70		2,6	...22206330036
63	3300	30 x 50	43	65	13	60		3,1	...33206330050
63	4700	35 x 50	32	48	15	50		4,0	...47206335050
63	6800	35 x 66	30	45	16	40		4,6	...68206335066
63	10000	35 x 66	21	32	16	30		5,5	...10306335066
63	15000	40 x 66	15	23	16	20		6,8	...15306340066
100	470	25 x 36	190	285	8	260		1,2	...47110025036
100	680	30 x 36	130	195	8	180		1,6	...68110030036
100	1000	30 x 36	80	120	8	110		2,0	...10210030036
100	1500	30 x 50	55	83	8	80		2,8	...15210030050
100	2200	35 x 50	45	68	9	60		3,4	...22210035050
100	3300	35 x 66	35	53	11	50		4,2	...33210035066
100	4700	40 x 66	31	47	14	50		4,7	...47210040066
100	6800	50 x 66	30	45	15	40		5,2	...68210050066
100	10000	50 x 95	27	41	15	40		6,2	...10310050095



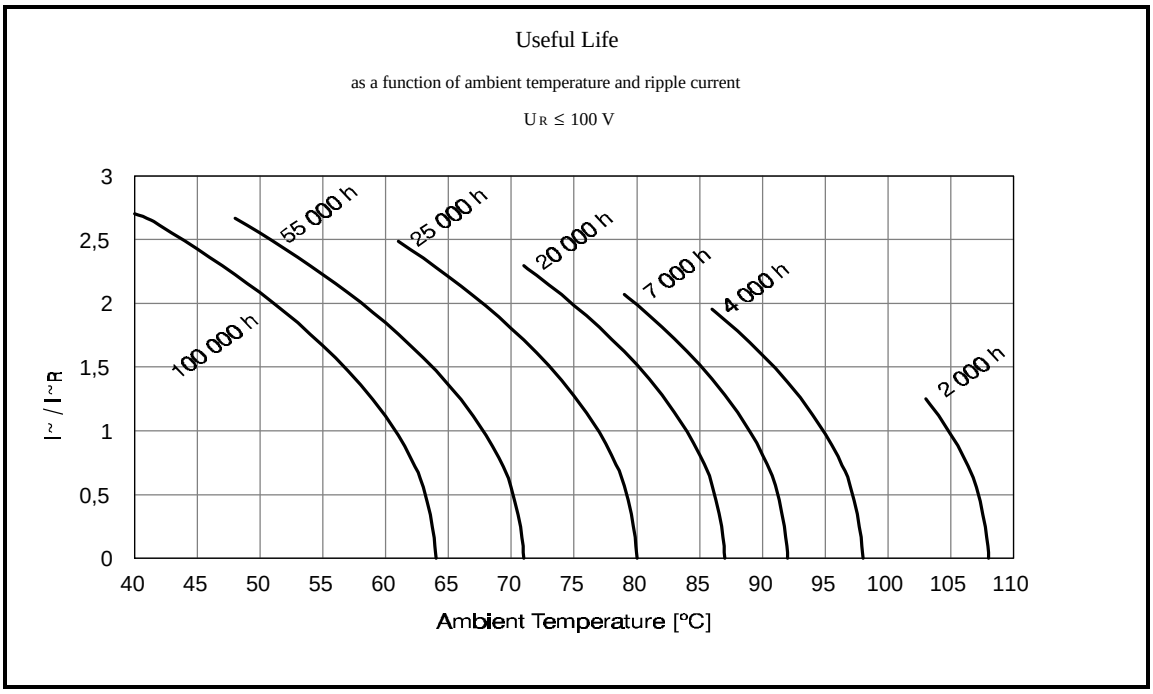
Standard Values Type LF

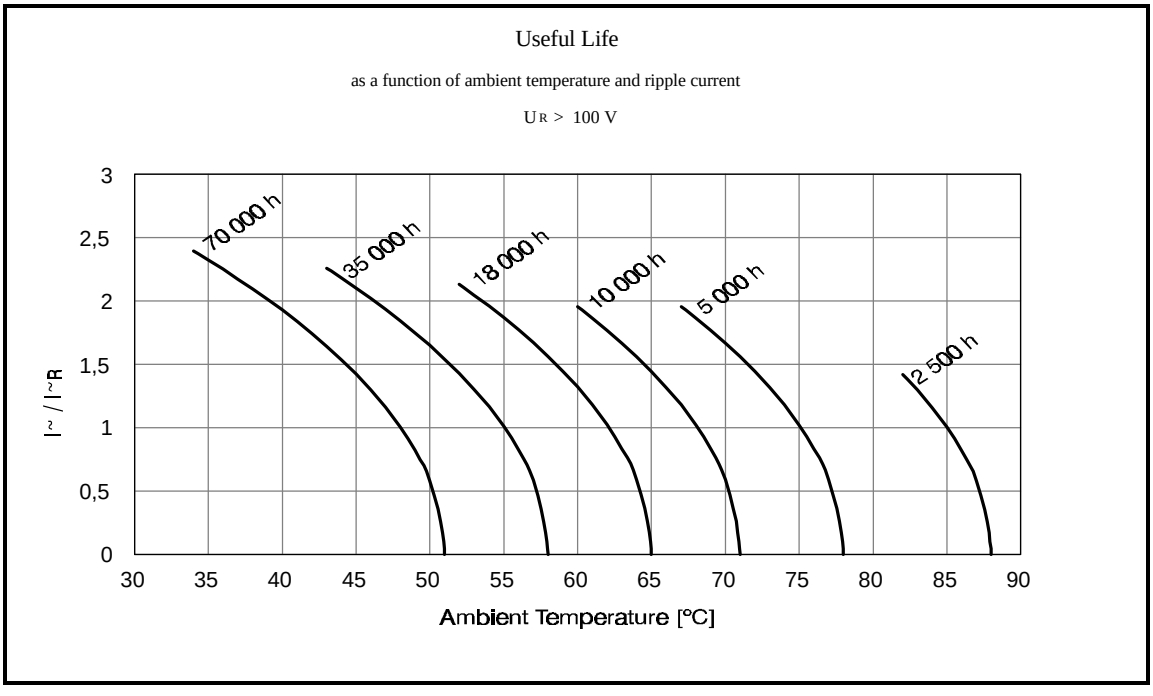
U_R	C_R	Case size	$ESR_{100\ Hz}$	ESR_{100Hz}	$\tan\delta_{100Hz}$	Z_{10KHz}	Rated ripple current 100Hz		Order code
		∅ x L	20°C typ.	20°C max.	20°C max.	20°C max.	85°C	105°C	LFA...
[V]	[µF]	[mm]	[mΩ]	[mΩ]	[%]	[mΩ]	[A]	[A]	LFB...
160	220	25 x 36	400	600	8	530	0,8		...22116025036
160	330	30 x 36	267	400	8	360	1,1		...33116030036
160	470	30 x 50	200	300	9	270	1,4		...47116030050
160	680	35 x 50	133	200	9	180	2,0		...68116035050
160	1000	35 x 50	93	140	9	130	2,3		...10216035050
250	100	25 x 36	493	740	8	680	0,8		...10125025036
250	150	30 x 36	440	660	8	590	0,9		...15125030036
250	220	30 x 36	347	520	8	470	1,0		...22125030036
250	330	30 x 50	227	340	8	310	1,4		...33125030050
250	470	35 x 50	167	250	8	230	1,7		...47125035050
250	680	35 x 50	140	210	8	190	1,9		...68125035050
250	1000	40 x 66	80	120	9	110	2,9		...10225040066
350	68	25 x 36	1133	1700	5	1510	0,5		...68035025036
350	100	30 x 36	1000	1500	5	1320	0,6		...10135030036
350	150	30 x 50	733	1100	5	970	0,8		...15135030050
350	220	35 x 50	387	580	5	520	1,1		...22135035050
350	330	35 x 66	253	380	5	340	1,6		...33135035066
350	470	40 x 66	187	280	5	250	1,9		...47135040066
350	680	40 x 66	147	220	5	200	2,2		...68135040066
350	1000	50 x 66	93	140	5	130	2,9		...10235050066
400	47	25 x 36	1333	2000	5	1790	0,5		...47040025036
400	68	25 x 36	1267	1900	5	1680	0,5		...68040025036
400	100	30 x 36	1067	1600	5	1410	0,6		...10140030036
400	150	30 x 50	800	1200	5	1050	0,7		...15140030050
400	220	35 x 50	400	600	5	530	1,1		...22140035050
400	330	35 x 66	280	420	5	370	1,5		...33140035066
400	470	40 x 66	207	310	5	280	1,8		...47140040066
400	680	50 x 66	167	250	5	220	2,2		...68140050066
450	47	25 x 36	1000	1500	7	1380	0,5		...47045025036
450	68	30 x 36	867	1300	7	1170	0,6		...68045030036
450	100	30 x 36	547	820	7	750	0,8		...10145030036
450	150	35 x 50	340	510	7	470	1,2		...15145035050
450	220	35 x 66	213	320	7	300	1,7		...22145035066
450	330	40 x 66	180	270	7	250	2,0		...33145040066
450	470	40 x 66	100	150	7	140	2,6		...47145040066
500	47	30 x 50	1000	1500	10	1380	0,6		...47050030050
500	68	30 x 50	667	1000	10	920	0,8		...68050030050
500	100	35 x 50	567	850	10	770	0,9		...10150035050
500	150	35 x 66	413	620	10	560	1,2		...15150035066
500	220	35 x 66	233	350	10	320	1,6		...22150035066

Other case size and voltage - / capacitance combinations are available on request !
Also in small lots !

Please call us! It is a pleasure for us to make you an offer..

8.3 Useful Life Type LF

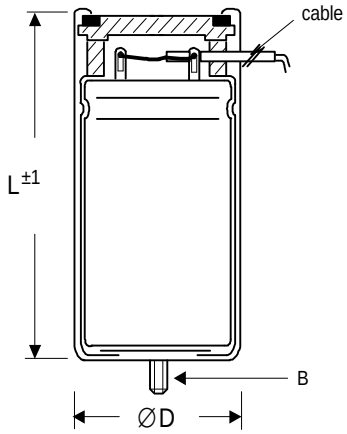




Ripple current as a function of the frequency f

f [Hz]	50	100	200	400	1 000	2 000	4000	10 000	20 000	40 000
I / I_R	0,97	1,0	1,08	1,12	1,15	1,18	1,2	1,25	1,25	1,25

9 Motor - Starting Capacitors Type MDK



Features

- double-potted design
- protection according to IP 54
- high current loading
- connection cable
- with clamp attachment or mounting stud

Applications

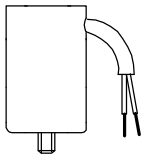
- starting capacitors for single-phase motors with auxiliary phase

Quick reference

Temperature range	- 10°C ... + 60°C
Tolerance	±10%
Specs.	VDE 560 / 8
Content of supply	if mounting stud then with fixing nut
Terminals	connection cable: normal length 300mm or custom-tailored

The alternating current loading may occur at most 20 times per hour with the following values:

percentage duty cycle	ripple current loading
AB 0,55 % ED	20 turn-ons with each 1,0 sec duration
AB 1,50 % ED	20 turn-ons with each 2,7 sec duration
AB 1,70 % ED	20 turn-ons with each 3,0 sec duration

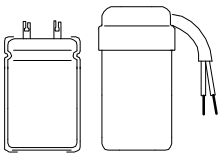


9.1 Standard Values Type MDK

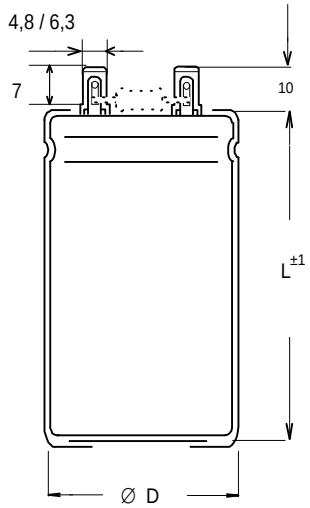
U_R ~ 50-60 Hz [V]	C_R [µF]	ED	∅ x L [mm]	VDE sign	Order code.
160 V ~	100	1,70 %	36,8 x 69	-	MDK 155
160 V ~	125	1,70 %	36,8 x 69	-	MDK 156
160 V ~	140	1,70 %	36,8 x 69	-	MDK 157
160 V ~	160	1,70 %	36,8 x 69	-	MDK 158
160 V ~	180	1,70 %	36,8 x 69	-	MDK 166
160 V ~	200	1,70 %	36,8 x 69	-	MDK 159
160 V ~	250	1,70 %	36,8 x 83	-	MDK 160
160 V ~	300	1,70 %	36,8 x 83	-	MDK 161
160 V ~	350	1,70 %	36,8 x 83	-	MDK 162
160 V ~	400	1,70 %	41,8 x 83	-	MDK 163
160 V ~	450	1,70 %	41,8 x 83	-	MDK 164
160 V ~	500	1,70 %	41,8 x 83	-	MDK 165
160 V ~	850	1,70 %	51,8 x 118	-	MDK 170
320 V ~	70	0,55 %	36,8 x 83	-	MDK 326
320 V ~	80	0,55 %	36,8 x 83	-	MDK 327
320 V ~	90	0,55 %	36,8 x 83	-	MDK 328
320 V ~	100	0,55 %	36,8 x 83	-	MDK 329
320 V ~	125	0,55 %	36,8 x 83	-	MDK 330
320 V ~	140	0,55 %	36,8 x 83	-	MDK 331
320 V ~	160	0,55 %	41,8 x 83	-	MDK 332
320 V ~	180	0,55 %	41,8 x 83	-	MDK 336
320 V ~	200	0,55 %	41,8 x 83	-	MDK 333
320 V ~	250	0,55 %	51,8 x 118	-	MDK 334
320 V ~	300	0,55 %	51,8 x 118	-	MDK 335
320 V ~	10	1,70 %	36,8 x 69	yes	MDK 417
320 V ~	15	1,70 %	36,8 x 69	yes	MDK 400
320 V ~	20	1,70 %	36,8 x 69	yes	MDK 401
320 V ~	25	1,70 %	36,8 x 69	yes	MDK 402
320 V ~	30	1,70 %	36,8 x 69	yes	MDK 403
320 V ~	40	1,70 %	36,8 x 69	yes	MDK 404
320 V ~	50	1,70 %	36,8 x 83	yes	MDK 405
320 V ~	60	1,70 %	36,8 x 83	yes	MDK 406
320 V ~	70	1,70 %	36,8 x 83	yes	MDK 407
320 V ~	80	1,70 %	41,8 x 83	yes	MDK 408
320 V ~	90	1,70 %	41,8 x 83	yes	MDK 416
320 V ~	100	1,70 %	41,8 x 83	yes	MDK 409
320 V ~	125	1,70 %	51,8 x 118	yes	MDK 410
320 V ~	140	1,70 %	51,8 x 118	-	MDK 411
320 V ~	160	1,70 %	51,8 x 118	-	MDK 412
320 V ~	180	1,70 %	51,8 x 118	-	MDK 413
320 V ~	200	1,70 %	51,8 x 118	-	MDK 414

Please state additionally to your order:

- cable length (normal length 300mm)
- with or without discharge resistor (22 / **47** / 100 KΩ)
- with or without stud



10 Motor - Starting Capacitors Type MEK



Features

- insulated aluminium can
- with cap and conneting cable or plug - in tags

Applications

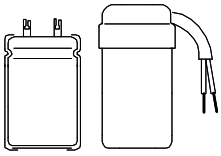
- starting capacitors for single-phase motors with auxiliary phase

Quick reference

temperature range	- 10°C ... + 60°C
tolerance	±10%
specs.	VDE 560 / 8
terminals	cap and cable or plug in tags 6.3 or 4.8

The alternating current loading may occur at most 20 times per hour with the following values:

percentage duty cycle	ripple current loading
AB 0,55 % ED	20 turn-ons with each 1,0 sec duration
AB 1,50 % ED	20 turn-ons with each 2,7 sec duration
AB 1,70 % ED	20 turn-ons with each 3,0 sec duration



10.1 Standard Values Type MEK

U_R ~ 50-60 Hz [V]	C_R [µF]	ED AB	D x L / with cap [mm]	VDE sign	Order code
320 V ~	60	1,70 %	35 x 66 / 85	yes	MEK 60
320 V ~	70	1,70 %	35 x 66 / 85	yes	MEK 70
320 V ~	80	1,70 %	40 x 66 / 85	yes	MEK 80
320 V ~	90	1,70 %	40 x 66 / 85	yes	MEK 90
320 V ~	95	1,70 %	40 x 66 / 85	yes	MEK 95
320 V ~	100	1,70 %	40 x 66 / 85	yes	MEK 100
320 V ~	125	1,70 %	50 x 66 / 85	yes	MEK 125
320 V ~	140	1,70 %	50 x 96 / 112	-	MEK 140
320 V ~	160	1,70 %	50 x 96 / 112	-	MEK 160
320 V ~	180	1,70 %	50 x 96 / 112	-	MEK 180
320 V ~	200	1,70 %	50 x 96 / 112	-	MEK 200

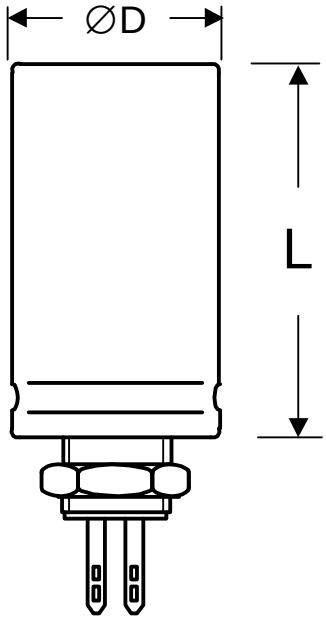
10.2 Special versions of the MEK

U_R ~ 50-60 Hz [V]	C_R [µF]	ED AB	D x L [mm]	VDE sign	Order code
320 V ~	95	0,60 %	35 x 66	yes	MEK 38
250 V ~	220	0,55 %	35 x 76	-	MEK 33

Please state additionally to your order:

- with or without cap
- cable length
- plug connections 4.8 or 6.3
- with or without discharge resistor
  22 KΩ
  47 KΩ (Standard)
  100 KΩ
- with mounting clip

11 Central mounted Capacitors Type S



Features

- central mounting
- roughened anode
- long useful life
- soldering lug terminals

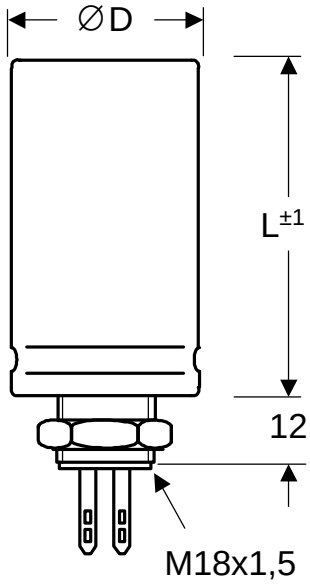
Applications

- electronic industries
- tube amplifier

Quick reference

	U_R < 160 V	U_R ≥ 160 V
Temperature range	- 40°C ... + 105°C	- 40°C ... + 85°C
Tolerance	+ 30% -10%	
Max. reverse voltage	2V	
Useful life	see diagram useful life p. 57	
Leakage current 5 min @ U_R	0,008 * C [µF] * U [V] + 4 µA [µA]	
Leakage current 1 h @ U_R	0,12 * leakage current 5 min @ U_R	
Specs.	DIN 41332 IEC 384 - 4	
Insulation	single capacitance with shrink - on sleeve (on request)	
Delivered with	mounting nut M 18	
Terminals single capacitance	soldering lugs (positive and negative pole)	
Terminals double capacitance	positive pole : soldering lugs; Negative pole : case	

11.1 Mechanical Data Type S

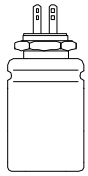


all dimensions in mm

D x L

Capacitance [µF]	Rated voltage [V]								
	16	25	40	63	100	160	250	350	450
22									25 x 40
33									25 x 40
47								25 x 40	25 x 40
100						25 x 40	25 x 40	25 x 40	30 x 54
220					25 x 40	25 x 40	25 x 54	25 x 54	35 x 54
470				25 x 40	25 x 40	30 x 54	35 x 54	35 x 70	
1000			25 x 40	25 x 40	25 x 54	35 x 70			
2200		25 x 40	25 x 40	25 x 40	35 x 54				
4700		25 x 40	30 x 40	30 x 54					
10000	30 x 40	30 x 54	35 x 54	35 x 70					
22000	35 x 54	35 x 54							
22 + 22									25 x 40
33 + 33								25 x 40	25 x 54
47 + 47								25 x 40	30 x 54
100 + 100								30 x 54	35 x 54

Type S is also manufactured for higher requirements. Please call us, if need arises. It is a pleasure for us to make you an offer.

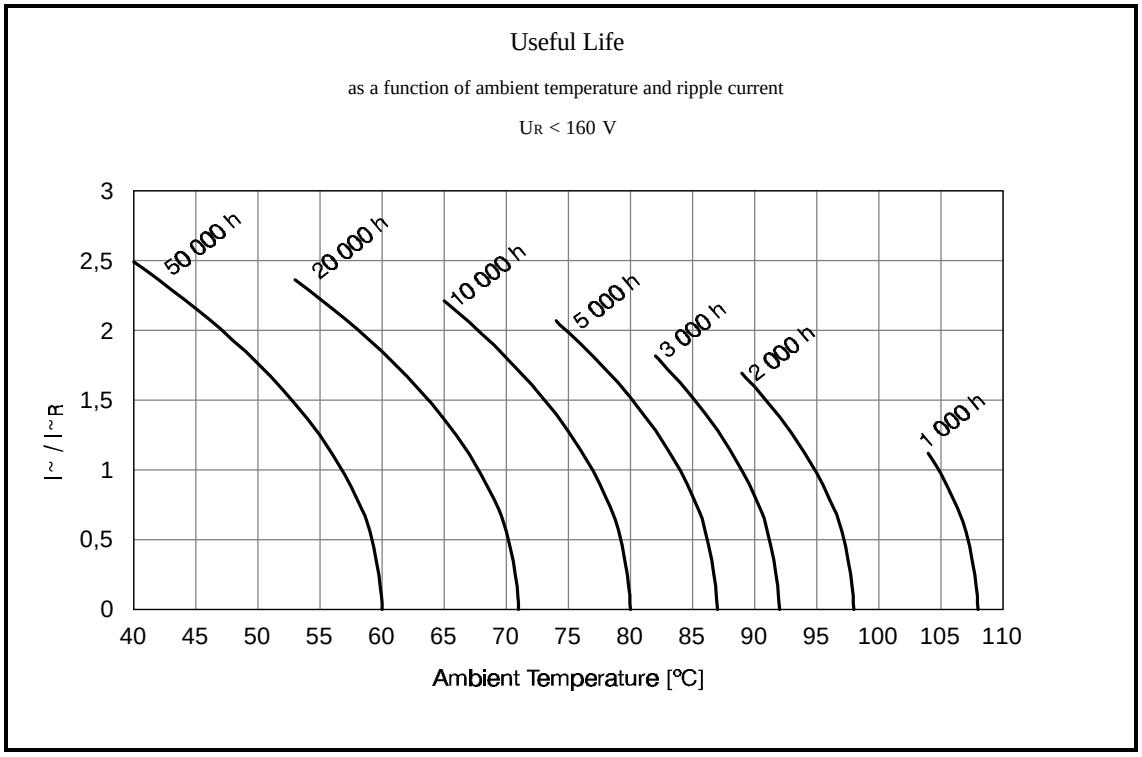


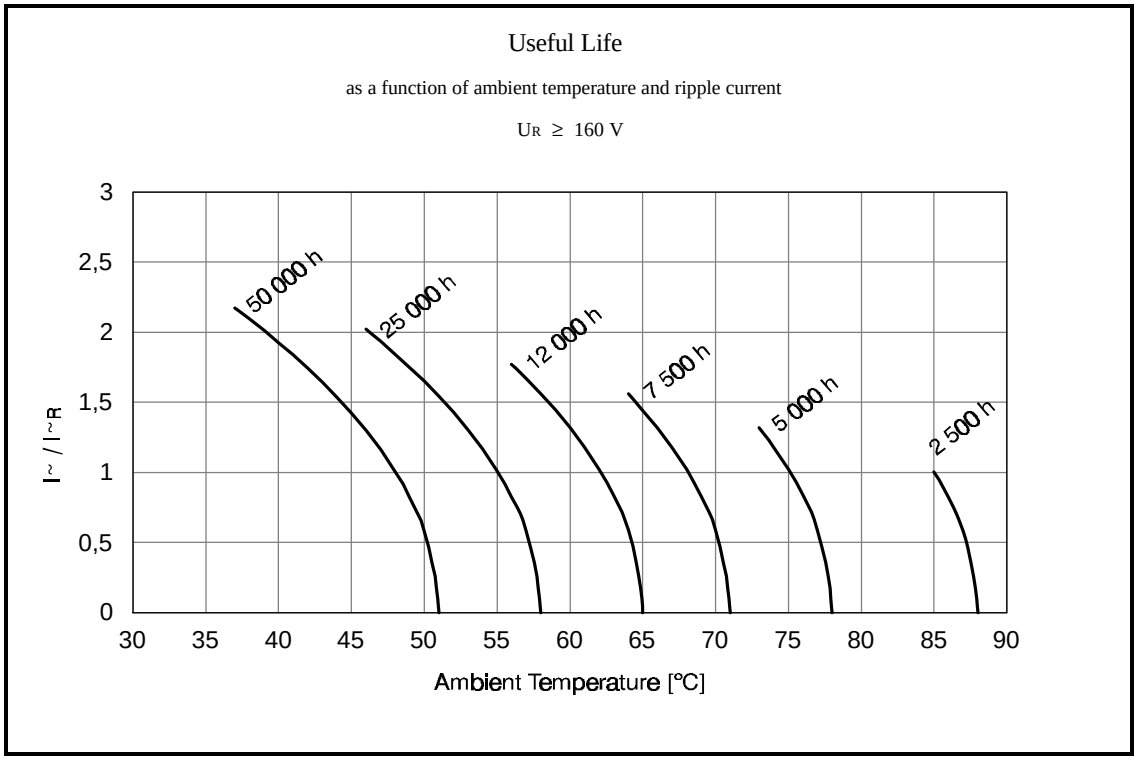
11.2 Standard Values Type S

U_R [V]	C_R [µF]	Case size ∅ x L [mm]	ESR 100 Hz 20°C typ. [mΩ]	ESR 100Hz 20°C max. [mΩ]	tan δ 100Hz 20°C max. [%]	Rated ripple current 100Hz 85°C [A]	Rated ripple current 100Hz 105°C [A]	Order code
16	10000	30 x 40	30	45	30		1,9	S10301630040
16	22000	35 x 54	20	30	36		2,8	S22301635054
25	2200	25 x 40	32	48	15		1,7	S22202525040
25	4700	25 x 40	30	45	18		1,7	S47202525040
25	10000	30 x 54	27	40	22		2,2	S10302530054
25	22000	35 x 54	17	26	30		3,0	S22302535054
40	1000	25 x 40	50	75	11		1,3	S10204025040
40	2200	25 x 40	45	68	12		1,4	S22204025040
40	4700	30 x 40	40	60	14		1,6	S47204030040
40	10000	35 x 54	23	35	20		2,6	S10304035054
63	470	25 x 40	113	170	10		0,9	S47106325040
63	1000	25 x 40	93	140	10		1,0	S10206325040
63	2200	25 x 40	63	95	12		1,2	S22206325040
63	4700	30 x 54	37	55	13		1,9	S47206330054
63	10000	35 x 70	21	31	14		3,1	S10306335070
100	220	25 x 40	233	350	8		0,6	S22110025040
100	470	25 x 40	167	250	9		0,7	S47110025040
100	1000	25 x 54	107	160	10		1,0	S10210025054
100	2200	35 x 54	60	90	12		1,6	S22210035054
160	100	25 x 40	500	750	8	0,7		S10116025040
160	220	25 x 40	400	600	9	0,8		S22116025040
160	470	30 x 54	200	300	9	1,4		S47116030054
160	1000	35 x 70	93	140	10	2,5		S10216035070
250	100	25 x 40	493	740	7	0,7		S10125025040
250	220	25 x 54	347	520	8	1,0		S22125025054
250	470	35 x 54	167	250	8	1,7		S47125035054
350	47	25 x 40	1267	1900	7	0,5		S47035025040
350	100	25 x 40	1000	1500	7	0,5		S10135025040
350	220	25 x 54	387	580	7	0,9		S22135025054
350	470	35 x 70	187	280	8	1,8		S47135035070
450	22	25 x 40	1600	2400	8	0,4		S22045025040
450	33	25 x 40	1200	1800	8	0,5		S33045025040
450	47	25 x 40	1000	1500	8	0,5		S47045025040
450	100	30 x 54	547	820	8	0,8		S10145030054
450	220	35 x 54	213	320	8	1,5		S22145035054
350	33 + 33	25 x 40	1600	2400	15	0,2		SZ33035025040
350	47 + 47	25 x 40	1267	1900	15	0,2		SZ47035025040
350	100 + 100	30 x 54	1000	1500	15	0,3		SZ10135030054
450	22 + 22	25 x 40	1600	2400	15	0,2		SZ22045025040
450	33 + 33	25 x 54	1200	1800	15	0,3		SZ33045025054
450	47 + 47	30 x 54	1000	1500	15	0,3		SZ47045030054
450	100 + 100	35 x 54	547	820	15	0,5		SZ10145035054

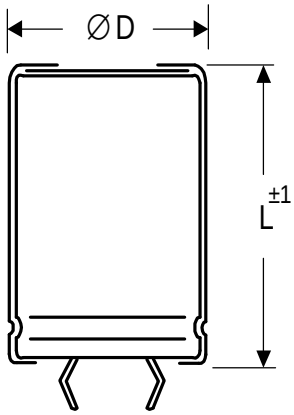
Please notice the new order code.

11.2.1 Useful Life Typ S





12 Snap In Capacitors
General Purpose Type SI / SI4P



Long Life Type SIH / SI4PH

Features

- long useful life
- all contacts welded
- small dimensions
- **SI4P(H) – improved mechanical stability**
- **SI4P(H) - keyed polarity**

Applications

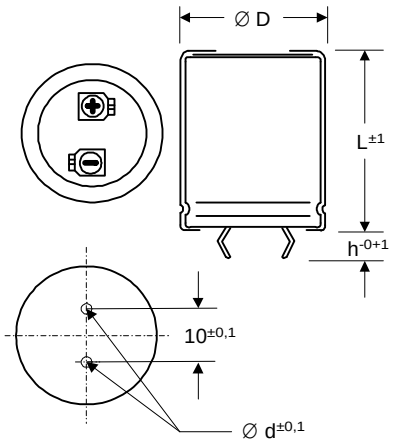
- standard and switched mode power supply
- computer
- telecommunication
- industries electrical and electronic
- inverter

Quick reference

	SI / SI4P	SIH / SI4PH
Temperature range	- 40°C ... + 85°C	- 40°C ... + 105°C
Tolerance	± 20 %	
Max. reverse voltage	2V	
Useful life	see diagram useful life p. 63	see diagram useful life p. 67
Leakage current 5 min @ U_R	0,007 * C [µF] * U [V] + 6µA [µA]	
Leakage current 1 h @ U_R	0,15 * leakage current 5 min @ U_R	
Specs.	DIN 41332 IEC 384 - 4	DIN 41332 IEC 384 – 4 LL
Insulation	shrink - on sleeve voltage proof ≥ 2500 V AC	
Terminals	snap in	

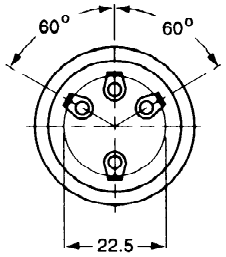
12.1 Mechanical Data Type SI / SIH

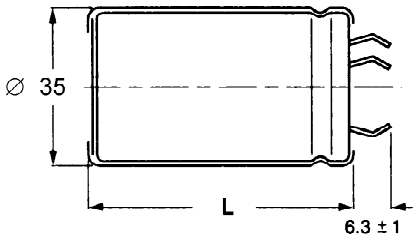
h [mm]	d [mm]
6,3	2

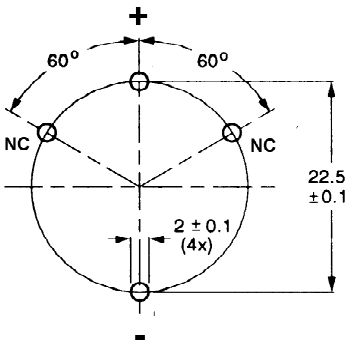


Drill plan

12.2 Mechanical Data Type SI4P / SI4PH





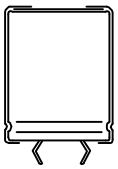


It is not allowed to connect the NC terminals to the electrical circuit !

12.3 Overwiev Standard Values SI / SI4P (General Purpose)

Only SI available
Only SI4P available
SI and SI4P available

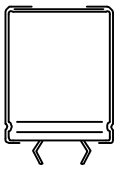
Capacitance [µF]	Rated voltage [V]										
	16	25	40	63	100	160	250	350	400	450	500
22											22 x 30
22											25 x 25
33											22 x 40
33											25 x 30
47										25 x 25	25 x 40
47											30 x 30
68									22 x 30	22 x 30	30 x 40
68									25 x 25		35 x 30
100						22 x 30		22 x 30	22 x 40	22 x 40	30 x 50
100								25 x 25	25 x 30		35 x 40
150						25 x 25	25 x 25	22 x 40	25 x 40	25 x 40	35 x 50
150								30 x 30	30 x 30	35 x 30	
220						22 x 30	22 x 40	25 x 40	30 x 40	30 x 40	
220						25 x 25		30 x 30	35 x 30		
330						25 x 30	25 x 40	30 x 40	30 x 50	35 x 50	
330							30 x 30		35 x 40		
470					22 x 30	25 x 40	30 x 40	35 x 40	35 x 50	35 x 50	
470						30 x 30	35 x 30				
680					22 x 30	30 x 40	30 x 50				
680					25 x 25	35 x 30	35 x 40				
1000				22 x 30	22 x 40	35 x 40	35 x 50			40 x 75	
1000					25 x 30						
2200			22 x 30	22 x 40	30 x 40						
2200				25 x 30							
3300		22 x 30	25 x 30	25 x 40	35 x 40						
3300				30 x 30							
4700	22 x 30	22 x 30	22 x 40	30 x 40							
4700		25 x 25	30 x 30	35 x 30							
6800	25 x 25	22 x 40	30 x 40	30 x 50							
6800		30 x 30	35 x 30	35 x 40							
10000	22 x 40	25 x 40	30 x 50	35 x 50							
10000	30 x 30	35 x 30	35 x 40								
15000	25 x 40	30 x 40	35 x 50								
22000	30 x 40	35 x 50									
33000	35 x 50										



12.4 Standard Values Type SI / SI4P (General Purpose)

U_R [V]	C_R [µF]	Case size D x L [mm]	ESR 100 Hz 20°C typ. [mΩ]	ESR 100Hz 20°C max. [mΩ]	tan δ 100Hz 20°C max. [%]	Z 10KHz 20°C max. [mΩ]	ripple current @100Hz max. @ 40°C [A]	ripple current @100Hz rated 85°C [A]	Order code SI... SI4P... only 35mm ∅
16	4700	22 x 30	75	113	33	98	3,7	1,7	...47201622030
16	6800	25 x 25	60	90	38	78	4,2	1,9	...68201625025
16	10000	22 x 40	30	45	28	39	6,5	2,9	...10301622040
16	10000	30 x 30	30	45	28	39	7,0	3,1	...10301630030
16	15000	25 x 40	20	30	28	26	8,7	3,9	...15301625040
16	15000	35 x 30	20	30	28	26	9,5	4,2	...15301635030
16	22000	30 x 40	12	18	25	16	12,2	5,4	...22301630040
16	33000	35 x 50	11	17	34	14	15,2	6,8	...33301635050
25	3300	22 x 30	60	90	19	78	4,1	1,9	...33202522030
25	4700	22 x 30	55	83	24	72	4,3	1,9	...47202522030
25	4700	25 x 25	55	83	24	72	4,4	2,0	...47202525025
25	6800	22 x 40	50	75	32	65	5,1	2,3	...68202522040
25	6800	30 x 30	50	75	32	65	5,4	2,4	...68202530030
25	10000	25 x 40	35	53	33	46	6,6	2,9	...10302525040
25	10000	35 x 30	35	53	33	46	7,2	3,2	...10302535030
25	15000	30 x 40	30	45	42	39	7,7	3,4	...15302530040
25	22000	35 x 50	30	45	62	39	9,2	4,1	...22302535050
40	2200	22 x 30	60	90	12	78	4,1	1,9	...22204022030
40	3300	25 x 30	45	68	14	59	5,2	2,3	...33204025030
40	4700	22 x 40	40	60	18	52	5,7	2,5	...47204022040
40	4700	30 x 30	40	60	18	52	6,0	2,7	...47204030030
40	6800	30 x 40	35	53	22	46	7,1	3,2	...68204030040
40	6800	35 x 30	35	53	22	46	7,2	3,2	...68204035030
40	10000	30 x 50	30	45	28	39	8,4	3,7	...10304030050
40	10000	35 x 40	30	45	28	39	8,5	3,8	...10304035040
40	15000	35 x 50	25	38	35	33	10,1	4,5	...15304035050
63	1000	22 x 30	85	128	8	111	3,5	1,6	...10206322030
63	1500	22 x 30	65	98	9	85	4,0	1,8	...15206322030
63	1500	25 x 25	65	98	9	85	4,1	1,8	...15206325025
63	2200	22 x 40	55	83	11	72	4,8	2,2	...22206322040
63	2200	25 x 30	55	83	11	72	4,7	2,1	...22206325030
63	3300	25 x 40	35	53	11	46	6,6	2,9	...33206325040
63	3300	30 x 30	35	53	11	46	6,4	2,9	...33206330030
63	4700	30 x 40	32	48	14	42	7,5	3,3	...47206330040
63	4700	35 x 30	32	48	14	42	7,5	3,3	...47206335030
63	6800	30 x 50	30	45	19	39	8,4	3,7	...68206330050
63	6800	35 x 40	30	45	19	39	8,5	3,8	...68206335040
63	10000	35 x 50	25	38	24	33	10,1	4,5	...10306335050

Other case size and voltage - / capacitance combinations are available on request !
Also in small lots !
Please call us! It is a pleasure for us to make you an offer.

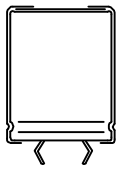


Standard Values Type SI / SI4P

U_R [V]	C_R [µF]	Case size D x L [mm]	ESR 100 Hz 20°C typ. [mΩ]	ESR 100Hz 20°C max. [mΩ]	tan δ 100Hz 20°C max. [%]	Z 10KHz 20°C max. [mΩ]	ripple current @100Hz max. @ 40°C [A]	ripple current @100Hz rated 85°C [A]	Order code SI... SI4P... only 35mm ∅
100	470	22 x 30	170	255	8	221	2,5	1,1	...47110022030
100	680	22 x 30	130	195	8	169	2,8	1,3	...68110022030
100	680	25 x 25	130	195	8	169	2,9	1,3	...68110025025
100	1000	22 x 40	80	120	8	104	4,0	1,8	...10210022040
100	1000	25 x 30	80	120	8	104	3,9	1,7	...10210025030
100	1500	25 x 40	75	113	11	98	4,5	2,0	...15210025040
100	1500	30 x 30	75	113	11	98	4,4	2,0	...15210030030
100	2200	30 x 40	60	90	12	78	5,4	2,4	...22210030040
100	3300	35 x 40	50	75	16	65	6,6	2,9	...33210035040
160	100	22 x 30	1300	1950	12	1690	0,9	0,4	...10116022030
160	150	25 x 25	800	1200	11	1040	1,2	0,5	...15116025025
160	220	22 x 30	750	1125	16	975	1,2	0,5	...22116022030
160	220	25 x 25	750	1125	16	975	1,2	0,5	...22116025025
160	330	25 x 30	550	825	17	715	1,5	0,7	...33116025030
160	470	25 x 40	380	570	17	494	2,0	0,9	...47116025040
160	470	30 x 30	380	570	17	494	2,0	0,9	...47116030030
160	680	30 x 40	260	390	17	338	2,6	1,2	...68116030040
160	680	35 x 30	260	390	17	338	2,6	1,2	...68116035030
160	1000	35 x 40	210	315	20	273	3,2	1,4	...10216035040
160	1500	35 x 50	165	248	23	215	3,9	1,8	...15216035050
250	150	25 x 25	900	1350	13	1170	1,1	0,5	...15125025025
250	220	22 x 40	860	1290	18	1118	1,2	0,5	...22125022040
250	330	25 x 40	500	750	16	650	1,7	0,8	...33125025040
250	330	30 x 30	500	750	16	650	1,7	0,8	...33125030030
250	470	30 x 40	320	480	14	416	2,4	1,1	...47125030040
250	470	35 x 30	320	480	14	416	2,4	1,1	...47125035030
250	680	30 x 50	230	345	15	299	3,0	1,4	...68125030050
250	680	35 x 40	230	345	15	299	3,1	1,4	...68125035040
250	1000	35 x 50	180	270	17	234	3,8	1,7	...10225035050
350	100	22 x 30	790	1185	7	1027	1,1	0,5	...10135022030
350	100	25 x 25	790	1185	7	1027	1,2	0,5	...10135025025
350	150	22 x 40	550	825	8	715	1,5	0,7	...15135022040
350	150	30 x 30	550	825	8	715	1,6	0,7	...15135030030
350	220	25 x 40	360	540	7	468	2,0	0,9	...22135025040
350	220	30 x 30	360	540	7	468	2,0	0,9	...22135030030
350	330	30 x 40	250	375	8	325	2,7	1,2	...33135030040
350	470	35 x 40	180	270	8	234	3,5	1,6	...47135035040

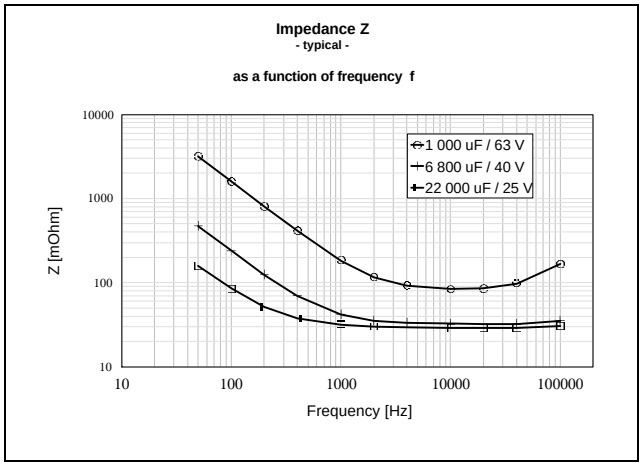
Other case size and voltage - / capacitance combinations are available on request !
Also in small lots !

Please call us! It is a pleasure for us to make you an offer.

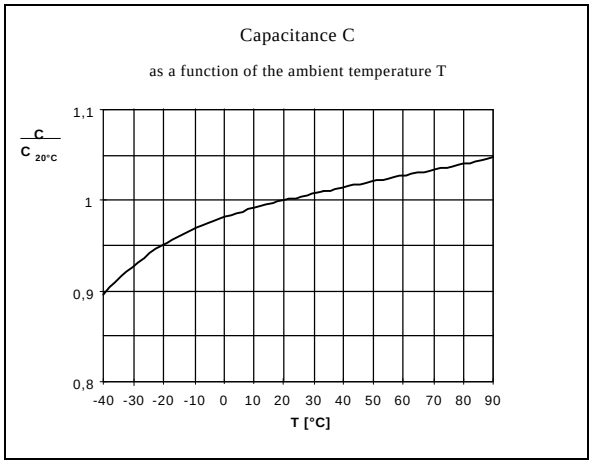


Standard Values Type SI / SI4P

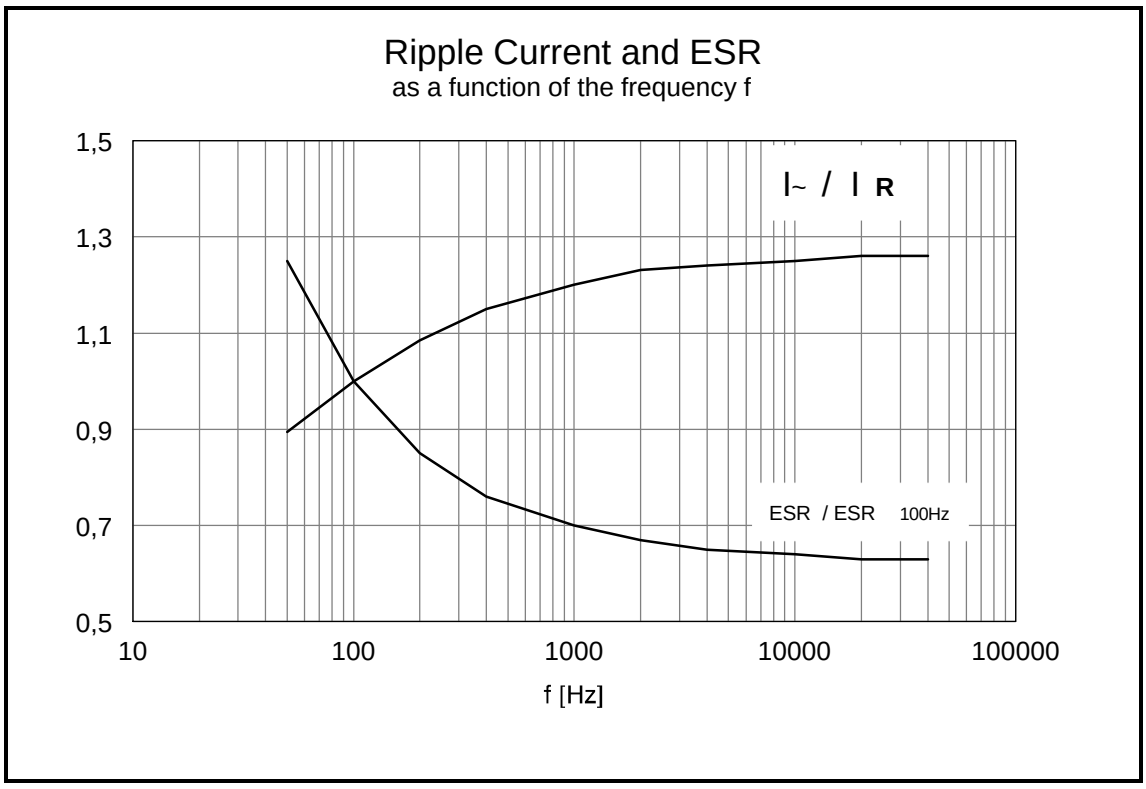
U_R [V]	C_R [µF]	Case size D x L [mm]	ESR 100 Hz 20°C typ. [mΩ]	ESR 100Hz 20°C max. [mΩ]	tan δ 100Hz 20°C max. [%]	Z 10KHz 20°C max. [mΩ]	ripple current @100Hz max. @ 40°C [A]	ripple current @100Hz rated 85°C [A]	Order code SI... SI4P... only 35mm ∅ 40mm ∅ only SI4P
400	68	22 x 30	1250	1875	8	1625	0,9	0,4	...68040022030
400	68	25 x 25	1250	1875	8	1625	0,9	0,4	...68040025025
400	100	22 x 40	800	1200	8	1040	1,3	0,6	...10140022040
400	100	25 x 30	800	1200	8	1040	1,2	0,6	...10140025030
400	150	25 x 40	480	720	7	624	1,8	0,8	...15140025040
400	150	30 x 30	480	720	7	624	1,7	0,8	...15140030030
400	220	30 x 40	400	600	8	520	2,1	0,9	...22140030040
400	220	35 x 30	400	600	8	520	2,1	0,9	...22140035030
400	330	30 x 50	320	480	10	416	2,6	1,1	...33140030050
400	330	35 x 40	320	480	10	416	2,6	1,2	...33140035040
400	470	35 x 50	260	390	12	338	3,1	1,4	...47140035050
450	47	25 x 25	1450	2175	6	1885	0,9	0,4	...47045025025
450	68	22 x 30	1400	2100	9	1820	0,9	0,4	...68045022030
450	100	22 x 40	1250	1875	12	1625	1,0	0,5	...10145022040
450	150	25 x 40	650	975	9	845	1,5	0,7	...15145025040
450	150	35 x 30	650	975	9	845	1,7	0,7	...15145035030
450	220	30 x 40	500	750	10	650	1,9	0,8	...22145030040
450	330	35 x 50	380	570	12	494	2,6	1,2	...33145035050
450	470	35 x 50	240	360	11	312	3,3	1,5	...47145035050
450	1000	40 x 75	80	120	11	200	5,7	2,6	SI4P10245040075
500	22	22 x 30	3900	5850	8	5070	0,5	0,2	...22050022030
500	22	25 x 25	3900	5850	8	5070	0,5	0,2	...22050025025
500	33	22 x 40	2100	3150	7	2730	0,8	0,3	...33050022040
500	33	25 x 30	2100	3150	7	2730	0,8	0,3	...33050025030
500	47	25 x 40	1550	2325	7	2015	1,0	0,4	...47050025040
500	47	30 x 30	1550	2325	7	2015	1,0	0,4	...47050030030
500	68	30 x 40	950	1425	6	1235	1,4	0,6	...68050030040
500	68	35 x 30	950	1425	6	1235	1,4	0,6	...68050035030
500	100	30 x 50	680	1020	6	884	1,8	0,8	...10150030050
500	100	35 x 40	580	870	5	754	1,9	0,9	...10150035040
500	150	35 x 50	400	600	6	520	2,5	1,1	...15150035050

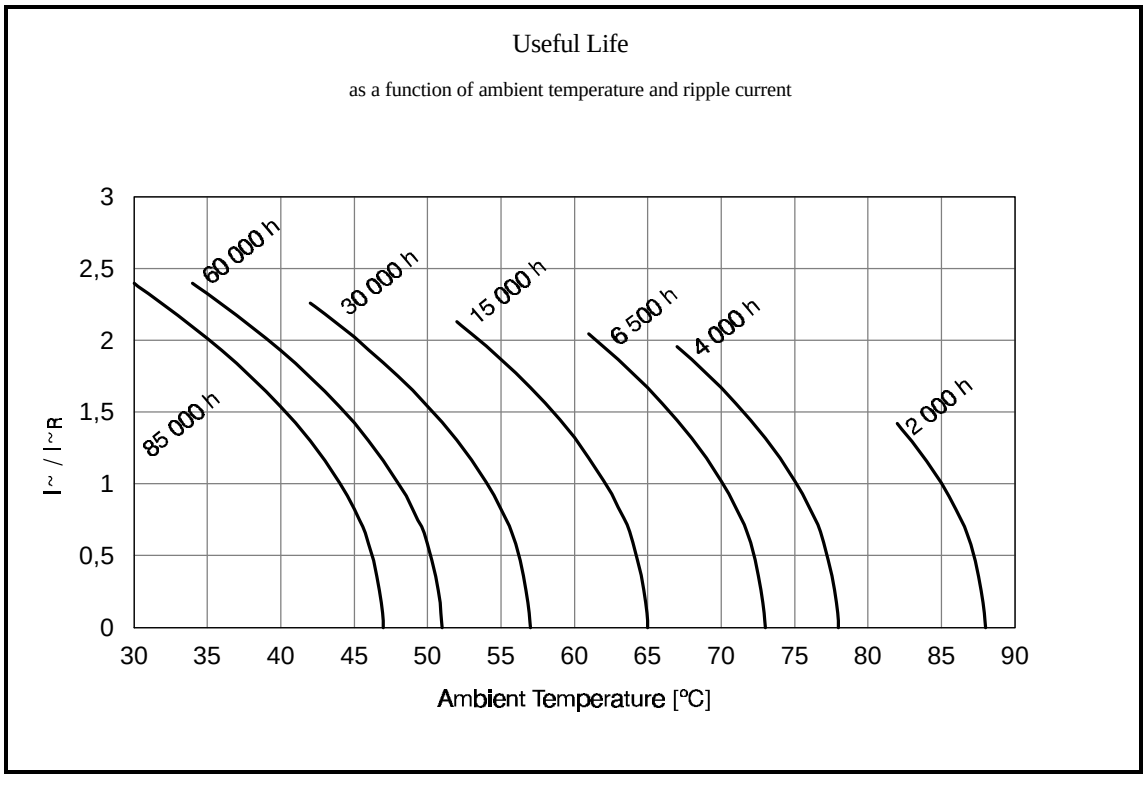


12.5 Technical Data Type SI



12.5.1 Useful Life Type SI / SI4P



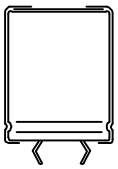


12.6 Overview Standard Values Type SIH / SI4PH (Long Life)

Only SIH available
Only SI4PH available
SIH and SI4PH available

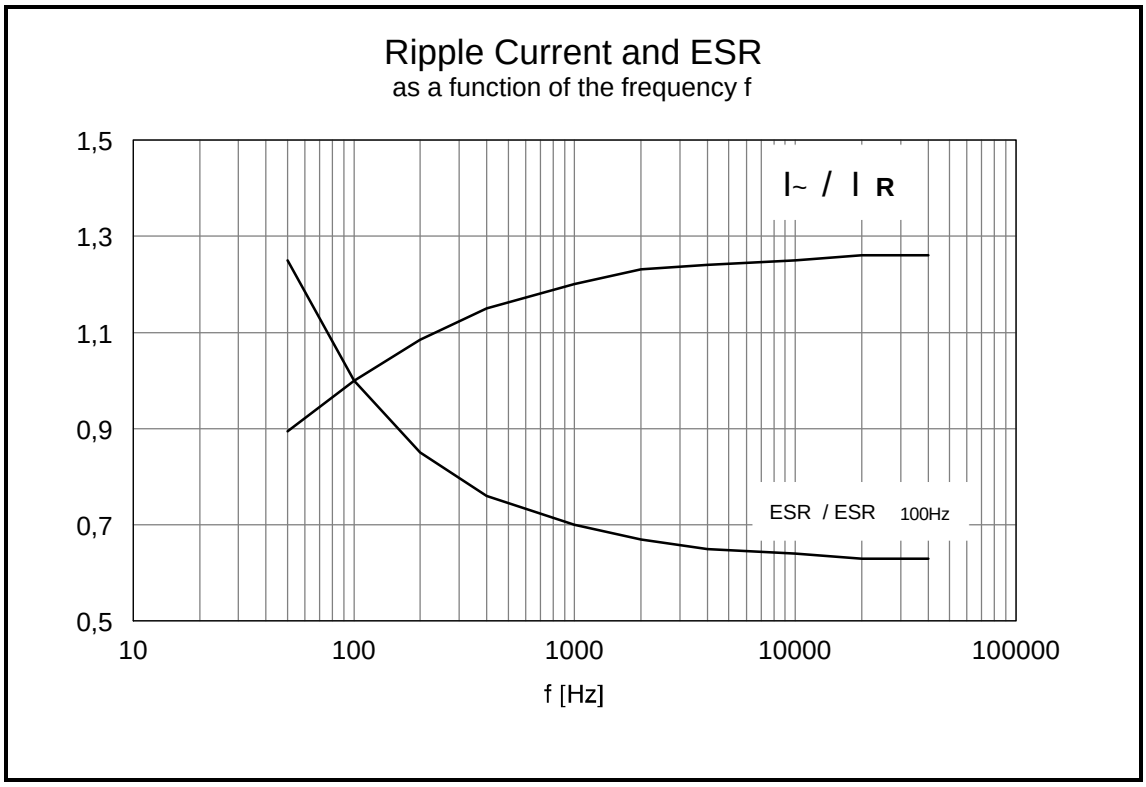
Capacitance [µF]	Rated voltage [V] 200	250	400	450
82				22 x 30
100			22 x 30	25 x 30
120				22 x 40
150			22 x 40	22 x 50
180				25 x 45
220			22 x 50	35 x 30
270		22 x 30	35 x 30	30 x 45
330			30 x 40	30 x 50
390	22 x 30	25 x 30	30 x 45	35 x 45
470	25 x 30	25 x 35	30 x 50	35 x 50
560	22 x 40	22 x 50	35 x 45	35 x 50
680	25 x 40	30 x 35	35 x 50	35 x 66
820	35 x 25		35 x 66	40 x 75
1000	35 x 30	30 x 45	40 x 75	
1200	35 x 35	30 x 50		
1500	30 x 50	35 x 50		
1800	35 x 45			
2200	35 x 50			

Other case size and voltage - / capacitance combinations are available on request !
Also in small lots !
Please call us! It is a pleasure for us to give you technical support or to make you an offer.

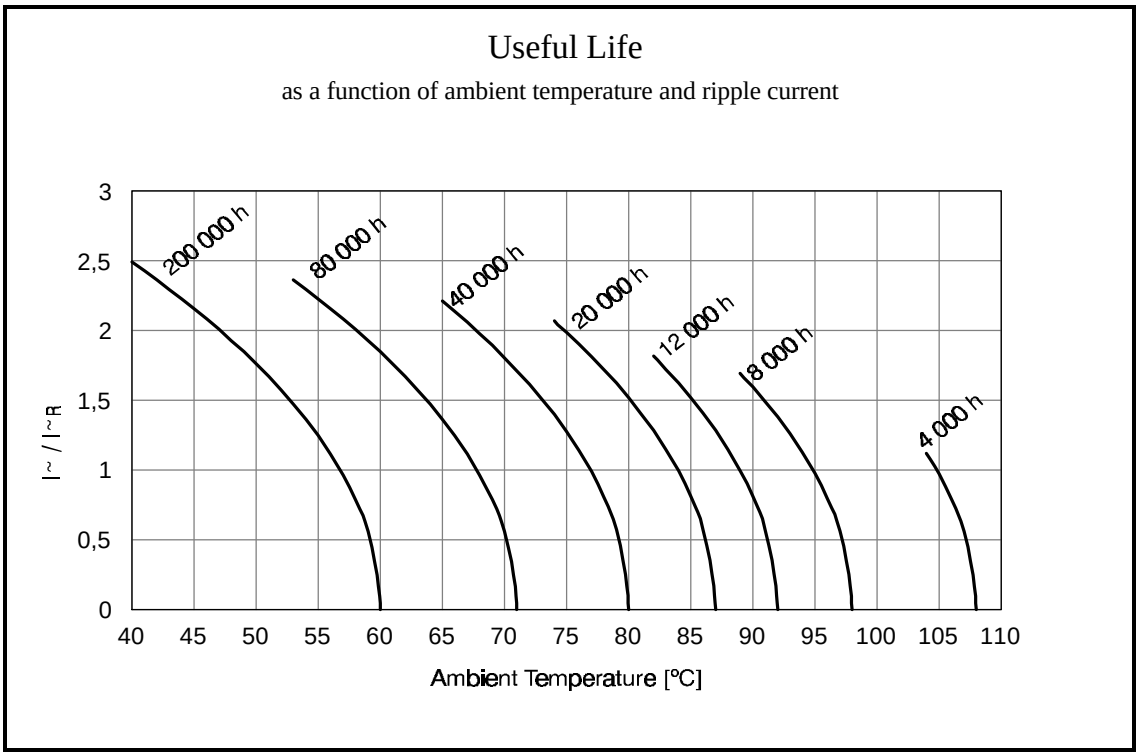


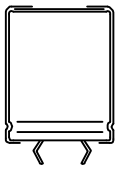
12.7 Standard Values Type SIH / SI4PH (Long Life)

U_R [V]	C_R [µF]	Case size D x L [mm]	$ESR_{100\ Hz}$ 20°C typ. [mΩ]	tan δ 100 Hz 20°C max. [mΩ]	Rated ripple current 100Hz / 105°C [A]	Order code 4 pins (SI4PH)	Order code 2 pins (SIH)
200	390	22 x 30	245	13	1,09		SIH39120022030
200	470	25 x 30	203	13	1,30		SIH47120025030
200	560	22 x 40	171	13	1,45		SIH56120022040
200	680	25 x 40	140	13	1,73		SIH68120025040
200	820	35 x 25	116	13	1,96	SI4PH82120035025	SIH82120035025
200	1000	35 x 30	95	13	2,29	SI4PH10220035030	SIH10220035030
200	1200	35 x 35	80	13	2,64	SI4PH12220035035	SIH12220035035
200	1500	30 x 50	64	13	3,04		SIH15220030050
200	1800	35 x 45	53	13	3,53	SI4PH18220035045	SIH18220035045
200	2200	35 x 50	43	13	4,06	SI4PH22220035050	SIH22220035050
250	270	22 x 30	354	13	0,90		SIH27125022030
250	390	25 x 30	245	13	1,18		SIH39125025030
250	470	25 x 35	203	13	1,37		SIH47125025035
250	560	22 x 50	171	13	1,59		SIH56125022050
250	680	30 x 35	140	13	1,79		SIH68125030035
250	1000	30 x 45	95	13	2,39		SIH10225030045
250	1200	30 x 50	80	13	2,72		SIH12225030050
250	1500	35 x 50	64	13	3,35	SI4PH15225035050	SIH15225035050
400	100	22 x 30	875	13	0,57		SIH10140022030
400	150	22 x 40	584	13	0,78		SIH15140022040
400	220	22 x 50	398	13	1,04		SIH22140022050
400	270	35 x 30	324	13	1,24	SI4PH27140035030	SIH27140035030
400	330	30 x 40	265	13	1,37		SIH33140030040
400	390	30 x 45	224	13	1,56		SIH39140030045
400	470	30 x 50	186	13	1,78		SIH47140030050
400	560	35 x 45	156	13	2,05	SI4PH56140035045	SIH56140035045
400	680	35 x 50	129	13	2,36	SI4PH68140035050	SIH68140035050
400	820	35 x 66	107	13	2,87	SI4PH82140035066	SIH82140035066
400	1000	40 x 75	88	13	3,5	SI4PH10240040075	
450	82	22 x 30	1068	13	0,52		SIH82045022030
450	100	25 x 30	875	13	0,62		SIH10145025030
450	120	22 x 40	729	13	0,70		SIH12145022040
450	150	22 x 50	584	13	0,86		SIH15145022050
450	180	25 x 45	486	13	0,97		SIH18145025045
450	220	35 x 30	398	13	1,12	SI4PH22145035030	SIH22145035030
450	270	30 x 45	324	13	1,30		SIH27145030045
450	330	30 x 50	265	13	1,49		SIH33145030050
450	390	35 x 45	224	13	1,71	SI4PH39145035045	SIH39145035045
450	470	35 x 50	186	13	1,96	SI4PH47145035050	SIH47145035050
450	560	35 x 50	156	13	2,14	SI4PH56145035050	SIH56145035050
450	680	35 x 66	129	13	2,62	SI4PH68145035066	SIH68145035066
450	820	40 x 75	107	13	3,2	SI4PH82145040075	



12.7.1 Useful Life Type SIH / SI4PH





13 Photoflash Capacitors

Features

- low losses due to single anode construction
- high flash frequencies
- high total amount of flashes
- numerous terminal types

Applications

- photoflash devices
- professional photoflash devices
- warning and safety lamps

Quick reference

Temperature range	- 10°C - + 60°C
Tolerance	±10% / -10 % + 30 %
Max. reverse voltage	2V
Specs.	DIN 41332 IEC 384 - 4
Insulation radial types	shrink - on sleeve voltage proof ≥ 2500 V_{AC}
Insulation axial types	up to 25 mm ∅ : polyesterfilm voltage proof > 1000 V_{AC} more than 25 mm∅ : shrink - on sleeve ≥ 2500 V_{AC}

13.1 Overview of common photoflash capacitors

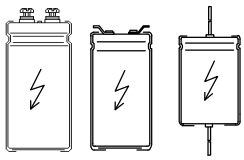
Photoflash capacitors are specially adapted to the application. Hence, the following overview includes only the common capacitance / voltage / dimension - combinations. Please contact if you need technical support. The questionnaire on page 68 should help you on the occasion.

Axial case

Voltage [V]	Capacitance [µF]	Stored energy [Ws]	∅ x L [mm]
250	100	3,1	16 x 39
350	12	0,7	12 x 30
350	22	1,3	12 x 30
360	120	7,8	30 x 49
400	22	1,8	16 x 30
500	33	4,1	18 x 39
500	47	5,9	25 x 38

Radial case

Voltage [V]	Capacitance [µF]	Stored energy [Ws]	∅ x L [mm]
350	330	20,0	30 x 55
360	100	6,5	25 x 36
360	220	14,3	25 x 40
360	2200	142,6	35 x 85
500	100	12,5	35 x 53
500	220	27,5	45 x 42
500	600	75,0	35 x 80
500	950	118,8	50 x 80
500	1600	200,0	50 x 100
500	2000	250,0	75 x 145
550	1000	151,3	50 x 95
550	3300	499,1	75 x 145



13.2 Questionnaire for dimensioning of photoflash electrolytic capacitors

To From

F & T Kondensatoren
Nedderweg
25813 Husum
Germany

Please contact our technical support if you need any assistance
Tel .: +49 (0)4841 / 8957 0
Fax .: +49 (0)4841 / 8957 45
Email : info@ftcap.de

Rated voltage _____ V

Rated capacitance _____ µF

Flash frequency _____ Hz Ambient temperature ____ °C

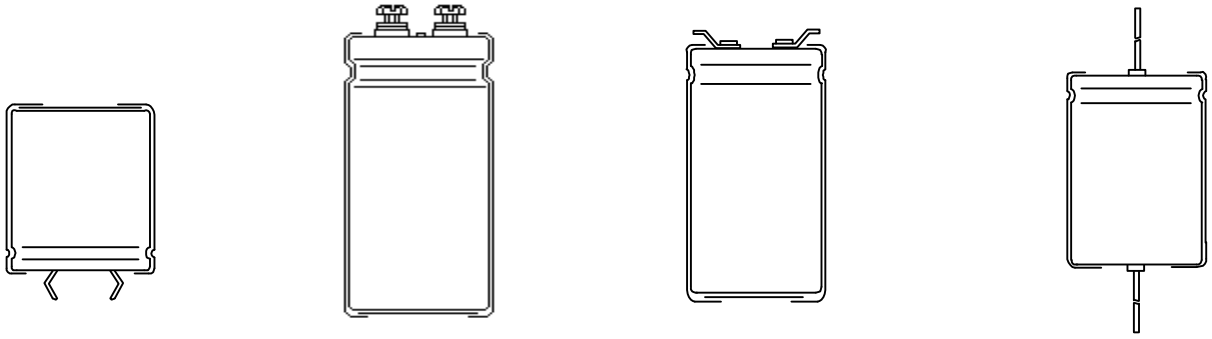
Cooling conditions :

Required / max. case size ∅ _____ mm length _____ mm

Attachment :

O stud O clamp

Design



not presented design _____

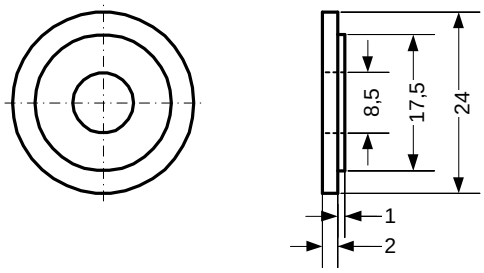
Annual demand _____ pieces

Other points

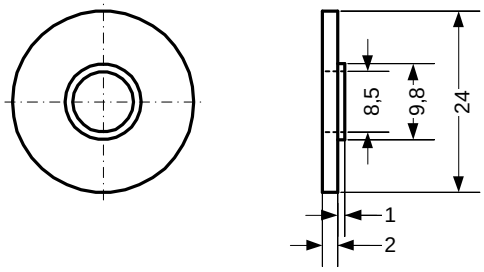
14 Accessory equipment

14.1 Insulating disks and nuts

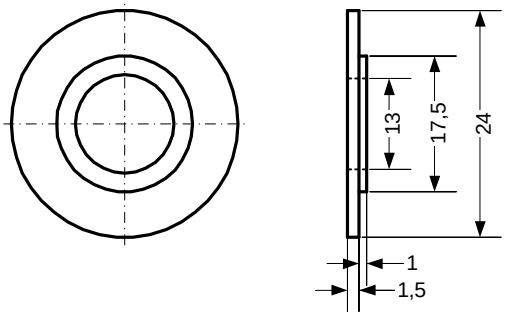
Insulation disc for stud M8
18 mm mounting hole
Order code I 8 – 18



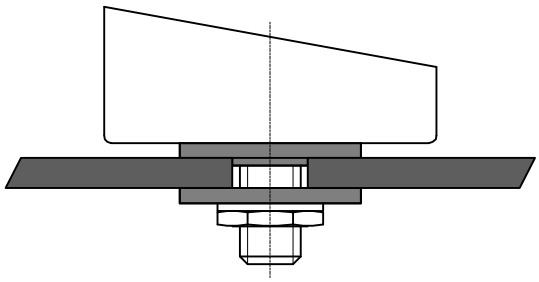
Insulation disc for stud M8
10 mm mounting hole
Order code I 8 – 10



Insulation disc for stud M12
18 mm mounting hole
Order code I 12 – 18



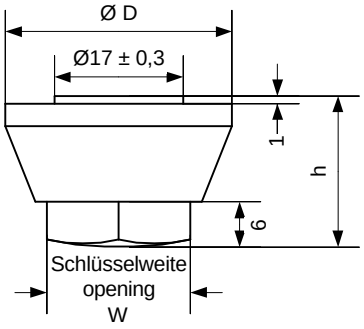
Mounting example



Nylon cap nuts

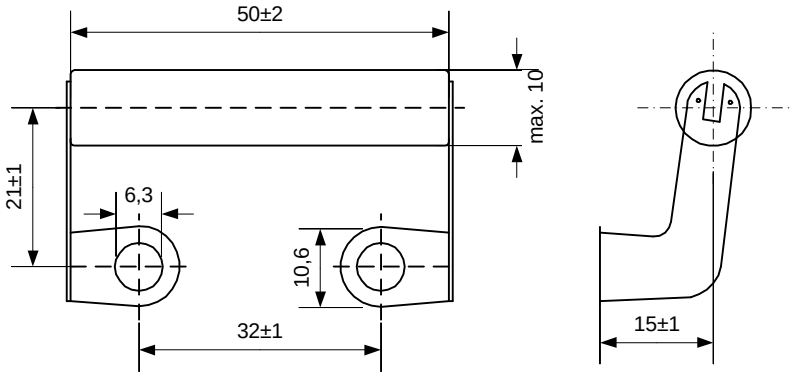
for stud M8 : order code HM 8
for stud M12 : order code HM 12

	D	h	W
HM 8	25 mm	15 mm	17
HM 12	30 mm	20 mm	19



14.2 Discharge / Balancing Resistor

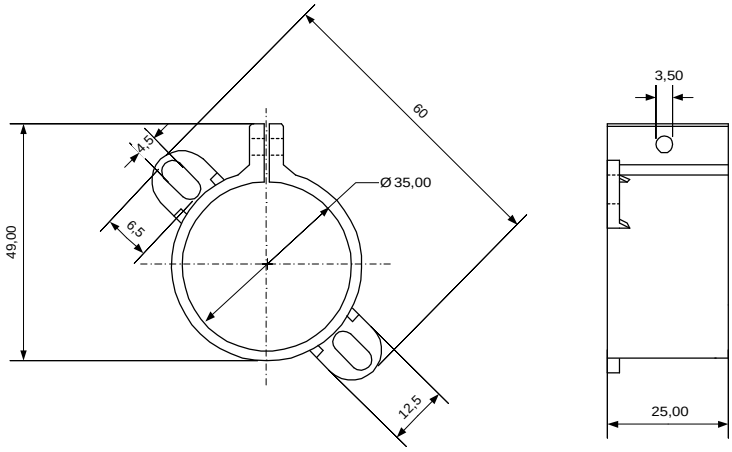
Resistor for discharge and / or voltage balancing.
Suitable for can diameter 65 / 75 / 90 mm
Other values on request



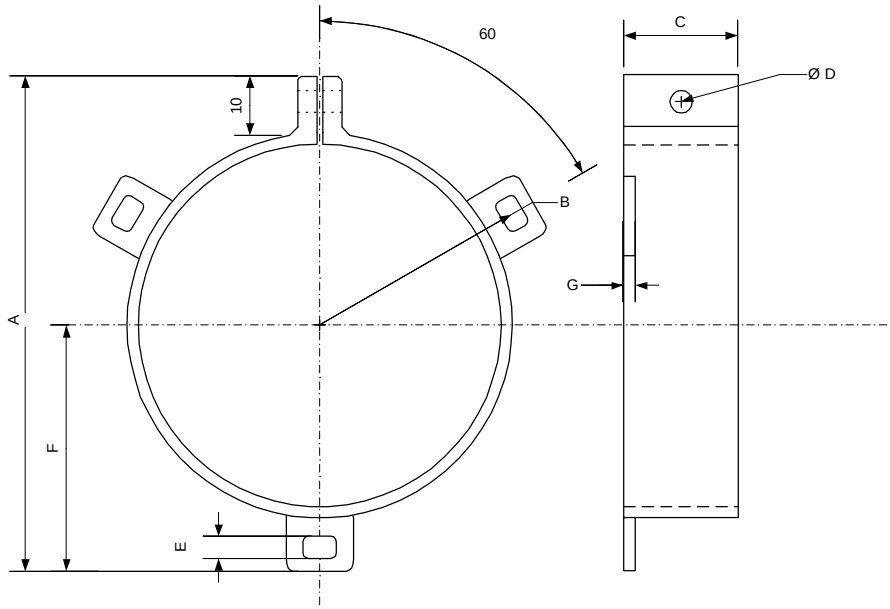
Rated Voltage	700VDc
Temp. range	-55 +105°C
Tolerance	±5%
Resistance	47KOhm

14.3 Nylon Clamps

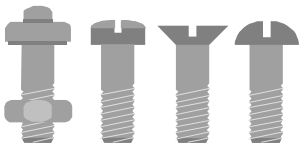
Can diameter 35 mm
Order code NRS 35



Can diameter 50 / 65 / 75



Order Code	CAN Ø	A	B	C	D	E	F	G
NRS 50	50	74	32	25	4	4,7	37	2,5
NRS 65	65	87	38,5	25	4	4,7	43,5	2,5
NRS 75	75	100	45	25	4	4,7	50	2,5



Material : Nylon - all dim. in mm

15 Distributors

Country	Name of Agent, Representative or Distributor	Adress
Australia	Semikron Australia Pyt Ltd.	Factory 7, 12-14 Miles-Street, Mulgrave/Victora 3170 Phone 0061-356-18769, FAX 0061-356-18769
Belgium	Vibo Belgium N.V.	Ambachtenlaan 21, Bus 9 B-3001 Heverlee-Leuven Phone 0032-16400431, FAX: 0032-16400128
Finland	Sarkkinen Oy.	Martinkuja 2 FIN-02270 Espoo Phone: 003589-88702515, FAX: 003523-8886150
UK	Campbell Collins Ltd.	Boulton Road, Stevenage Hertfordshire SG1 4QX Phone: 0044-1438369466, FAX: 0044-1438316465
USA	Seacor Inc.	123 Woodland Avenue Westwood, NJ 07675 Phone 001 201 666 5600, FAX 001 201 664 8544
Greece	Theo Theodoropulos	Georg. Glististraße 34 GR-117 44 Athen Phone: 0030-19014373, FAX: 0030-19014373
New Zealand	Semikron Ltd., innovation+service	P.O. Box 10 01 97 NSMC Auckland Phone: 0064-94732180, FAX: 0064-94732181
Netherlands	van Delden B.V.	Coenecoop 15 NL-2741 PG Waddinxveen Phone: 0031-182630001, FAX: 0031-182619955
Austria	Semikron GmbH	Otto-Bauer-Gasse 12 A-1060 Wien Phone: 0043-15863658, FAX: 0043-1586365032
Switzerland	CAMATEC AG	Viale Papio 8 CH-6612 Ascona Phone: 0041-917851150, FAX: 0041-917891151
Sweden	OEM-Component AB	Box 1011 S-573 28 Tranäs Phone: 0046-87959800, FAX: 0046-87952729
Italy	MEGATECH S.r.l.	Via Castelli Romani 22 I – 00040 Pomezia (Roma) Phone: 06/9111371, FAX: 06/9111371

16 Safety Precautions

16.1 Charged Capacitors

Electrolytic capacitors may store high amonts of energy (especially photo flash and high voltage capacitors).

To avoid electrical shocks and sparks always discharge electrolytic capacitors before handling.

For higher voltage it is recommended to shorten the terminals during handling.

16.2 Misapplication

Explosions of electrolytic capacitors may occur if the capacitor is exposed to

- reverse voltage above specified limit
- voltage above specified limit
- ripple currents above specified limit
- ambient temperatures above specified limit
- high mechanical impact

16.3 Exposure to electrolyte liquid

The electrolyte consist of Monoethylenglykol and a little amount of anorganic and organic salts. Some of them are classified as unhealthy but none is classified as poisonous. The elektrolyte doesn't contain PCB, Cadmium or asbestos. Use protective gloves and glasses when handling capacitors with broken sealing. Avoid inhalation of electrolyte vapour or smoke of burning capacitors.
If skin is exposed to electrolyte clean immediately with running water and soap.
If eye is exposed or electrolyte is swallowed clean eyes / mouth with large amount of running water and seek medical help immediately.

Notes