



Mesis®



LOW



85/85
-50°C

E68 MESIS®

KNOW WHEN IT HAPPENS: THE SMART FILTER CAPACITOR
WISSEN, WENN'S PASSIERT: DER SMARTE FILTERKONDENSATOR



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APPLICATION NOTES AND GENERAL INFORMATION



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**CAPACITORS
FOR POWER ELECTRONICS**
KONDENSATOREN FÜR DIE LEISTUNGSELEKTRONIK



maximales I_{max} und f_{max}
entsprechend dem errechneten

E68 GA85 MESIS®

KNOW WHEN IT HAPPENS: THE SMART FILTER CAPACITOR

WISSEN, WENN'S PASSIERT: DER SMARTE FILTERKONDENSATOR



Smart capacitor signals impending failure: E68 GA85 Mesis®

Our innovative E68 Mesis® series is based on the same safety concept that we developed for our low-inductance DC capacitors and has a similar low-loss and low-inductance design. As a result, these capacitors are particularly insensitive to high frequency harmonics and currents.

Just like our tried-and-tested Break Action Mechanism (BAM), the innovative Mesis® overpressure switch responds mechanically to the internal pressure increase that is usually associated with the failure of film capacitors. The bottom of the cup bulges irreversibly, breaking through a switch card (BAC) and interrupting a monitoring circuit. As Mesis® - other than the BAM device - does not require an external extension of the housing, the capacitor can be permanently installed and connected to rigid bus bars without impairing the function of the switch.

Unlike capacitors with BAM, Mesis® capacitors do not disconnect themselves from the mains. Instead, the signal from the overpressure protection can be used on site or at a central detection point to immediately disconnect one or more affected capacitors. Particularly in filters, any change in capacitance has an immediate effect on the resonant circuit and therefore on the filter frequency. The autonomous (and therefore initially unnoticed) disconnection of conventional BAM capacitors would sometimes lead to subsequent reactions due to altered filter behaviour or asymmetries. In contrast, the dedicated transmission of a switch-off signal by Mesis® enables immediate corrective measures to be initiated, e.g. shutdown and maintenance.

E68 Mesis® capacitors are tightly sealed with metal cans and lids, providing excellent protection against environmental influences such as moisture and contamination from pollutants. Temporary condensation on these capacitors is therefore permissible. They also pass climatic tests under extreme conditions with 85%RH at 85°C. The sealed housing fulfils the requirements of hazard level HL3 in accordance with railway standard EN 45545 (fire behaviour of materials and components).



Smarter Kondensator meldet bevorstehenden Ausfall: E68 GA85 Mesis®

Unsere innovative Baureihe E68 Mesis® beruht auf demselben Sicherheitskonzept Mesis®, welches wir für unsere extrem niederinduktiven DC-Kondensatoren entwickelt haben, und verfügt über einen ähnlich verlustarmen und niederinduktiven Aufbau. Dadurch sind diese Kondensatoren besonders unempfindlich gegenüber hohen Frequenzanteilen und Betriebsströmen.

Genau wie unsere langjährig bewährten BAM-Sicherungen reagiert der innovative Mesis® Überdruckschalter mechanisch auf den inneren Druckanstieg, welcher in aller Regel mit dem Ausfall von Folienkondensatoren einhergeht. Dabei wölbt sich der Becherboden irreversibel aus, durchschlägt dabei eine Schalterkarte (BAC) und unterbricht damit einen Überwachungsstromkreis. Anders als die BAM-Sicherung kommt Mesis® ohne äußerliche Verlängerung des Gehäuses aus. Damit lässt sich der Kondensator fest verbauen und mit starren Schienen verschalten, ohne dabei die Funktion der Sicherung zu beeinträchtigen.

Im Unterschied zu den Kondensatoren mit BAM-Sicherung trennen sich Mesis®-Kondensatoren nicht selbst vom Netz. Vielmehr kann das Signal der Überdrucksicherung vor Ort oder an einer zentralen Erfassung für die sofortige Abschaltung eines oder mehrerer betroffener Kondensatoren verwendet werden. Gerade in Filtern, wo sich eine Änderung der Kapazität umgehend auf den Schwingkreis und somit auf die Filterfrequenz auswirkt, würde die autonome (und damit vorerst unbemerkte) Abschaltung herkömmlicher BAM-Kondensatoren mitunter zu Folgeaktionen durch verändertes Filterverhalten oder Asymmetrien führen. Die gezielte Übermittlung eines Abschaltsignals durch Mesis® ermöglicht demgegenüber die Einleitung sofortiger Korrekturmaßnahmen, wie Stilllegung und Wartung.

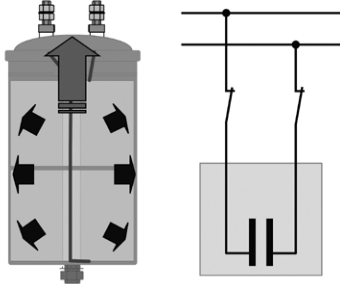
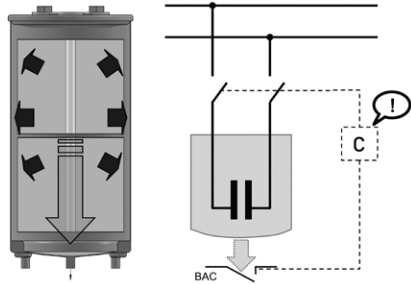
E68 Mesis®-Kondensatoren sind durch metallische Becher und Deckel dicht verschlossen und somit hervorragend gegen Umgebungseinflüsse wie Feuchtigkeit oder Verunreinigungen durch Schadstoffe abgeschirmt. So ist eine vorübergehende Betauung dieser Kondensatoren zulässig. Ebenso bestehen diese Kondensatoren Klimaprüfungen unter Extrembedingungen mit 85%RH bei 85°C. Das abgeschlossene Gehäuse erfüllt darüber hinaus die Forderungen des Hazardlevels HL3 nach Bahn-Norm EN 45545 (Brandverhalten von Werkstoffen und Komponenten).

E68 can be connected by solid bus bars. This option shows a three-phase set in star connection, with a joint Mesis® card.

E68 kann über feste Stromschienen angeschlossen werden. Diese Option zeigt ein dreiphasiges Set in Sternschaltung mit einer gemeinsamen Mesis®-Karte.

Mesis® compared to the classic Break Action Mechanism

Mesis® im Vergleich zur klassischen Abreißsicherung

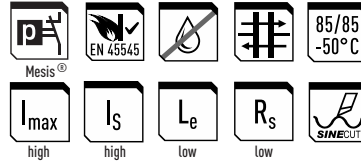
	Break action mechanism Abreißsicherung (BAM)	Mesis®
Functional principle Funktionsprinzip	The housing of the capacitor expands when internal pressure builds up. By breaking an inner connecting wire the capacitor disconnects autonomously from the mains. Das Gehäuse des Kondensators dehnt sich bei innerem Druckaufbau. Durch das Reißen des inneren Anschlussdrahts trennt sich der Kondensator selbst vom Netz. 	Internal pressure build-up triggers a switch in the base of the can. The capacitor remains connected to the mains, but signals its impending failure. Bei innerem Druckaufbau wird ein Schalter im Becherboden ausgelöst. Der Kondensator bleibt am Netz, signalisiert jedoch seinen bevorstehenden Ausfall. 
Safety function Sicherungsfunktion	The switch-off takes place independently without additional external action. Die Abschaltung erfolgt selbständig ohne äußere Einflußnahme.	A separate control circuit with proper evaluation and external safety response is necessary. Es ist ein gesonderter Kontrollkreis mit entsprechender Auswertung und externer Reaktion erforderlich.
Design	Available for single-phase and three-phase models. Verfügbar für ein- und dreiphasige Modelle.	Only available as single-phase capacitors. Nur als einphasige Kondensatoren verfügbar.
Self-inductance Eigeninduktivität	High self-inductance dictated by internal and external wiring. Hohe Eigeninduktivität, bedingt durch die interne und externe Verdrahtung.	Very low self-inductance and even connection by sandwich bus bars possible. Sehr geringe Eigeninduktivität und sogar Anschluss über Sandwich-Sammelschienen möglich.
Monitoring Überwachung	No Monitoring. The absence of the failed capacitor is only noticed during routine maintenance or due to issues caused by inadequate filtering. Das Fehlen des abgeschalteten Kondensators wird erst bei einer routinemäßigen Wartung oder durch Netzstörungen infolge der unzureichenden Filterung entdeckt.	Immediate response to changes in the filter circuit is possible. This prevents collateral or consequential damage. Auf Änderungen im Filterkreis kann sofort reagiert werden. Damit wird Kollateral- oder Folgeschäden vorgebeugt.
Connection Anschluss	Capacitors must be connected with flexible conductors. Kondensatoren müssen mit flexiblen Leitern angeschlossen werden.	Capacitors can be connected with flexible or rigid conductors. Kondensatoren können mit flexiblen oder starren Leitern angeschlossen werden.

E68.***GA85 Mesis®

AC

420...680V

Smart AC-Filter Capacitors, optimized for high frequencies
Mesis® overpressure switch
Smarte AC-Filterkondensatoren für hohe Frequenzen
Mesis®-Überdruckschalter



Standards IEC 61881/61071, UL 810,
EN 45545-2 (ext. plastic material äußere Kunststoffe HL3),
EN45545-3 (integrity Integrität E30)
can Gehäuse aluminium
mounting position optional
Einbaulage beliebig
filling material neutral insulation gas (N₂)
Füllmittel neutrales Isoliergas (N₂)
protection Mesis® pressure switch
Sicherung Mesis® Überdruckschalter
fire load Brandlast 40 MJ/kg

C_N tolerance Toleranz ±5%
tan δ₀ 2 × 10⁻⁴
limit temperatures Grenztemperaturen
θ_{min} -50°C
θ_{max} HOTSPOT +85°C¹

storing temperature Lagertemperatur -50°C ... +85°C
Life time Lebensdauer > 200 000 h
Failure rate Ausfallrate 100 FIT²

¹ endurance type test _Lebensdauertest: t₈₀ 80°C

² reference service life _Referenzbetriebsdauer 100.000 h, θ_{max} HOTSPOT <70°C



C _N (μF)	R _s (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _s (kA)	L _e (nH)	D ₁ × L ₁ (mm)	m (kg)	order no. Bestell-Nr.	pcs/box Stk./Box
U_N 420V AC		U_{rms} 300V		U_N DC 700V		U_s 1050V		U_{TT} 1050V DC		U_{Tc} 3000V AC/2s
350	0.5	5.6	40	3.8	11.4	35	116 × 108	1	E68.R10-354W60	6/FB10
400	0.6	5	40	3.6	10.8	40	116 × 120	1.1	E68.R12-404W60	6/FB15
700	0.4	3.4	80	7.7	20	35	116 × 176	1.7	E68.R17-704W60	3/FB 8
800	0.5	3	80	7.2	20	40	116 × 201	1.9	E68.R20-804W60	3/FB12
U_N 500V AC		U_{rms} 360V		U_N DC 840V		U_s 1260V		U_{TT} 1260V DC		U_{Tc} 3000V AC/2s
250	0.55	5.6	40	3.3	9.9	35	116 × 108	1	E68.R10-254W60	6/FB10
250	0.5	4.4	80	6	18	35	116 × 126	1.2	E68.R12-254W60	6/FB15
300	0.6	5	40	3.3	9.9	40	116 × 120	1.1	E68.R12-304W60	6/FB15
500	0.5	3.4	80	6	18	35	116 × 176	1.7	E68.R17-504W60	3/FB 8
600	0.6	3	80	6	18	40	116 × 201	1.9	E68.R20-604W60	3/FB12
U_N 640V AC		U_{rms} 450V		U_N DC 1000V		U_s 1500V		U_{TT} 1500V DC		U_{Tc} 3000V AC/2s
180	0.6	5.6	40	2.7	8.1	35	116 × 108	1	E68.R10-184W60	6/FB10
220	0.7	5	40	2.8	8.4	40	116 × 120	1.1	E68.R12-224W60	6/FB15
360	0.5	3.4	80	5	15	35	116 × 176	1.7	E68.R17-364W60	3/FB 8
440	0.6	3	80	5	15	40	116 × 201	1.9	E68.R20-444W60	3/FB12
U_N 680V AC		U_{rms} 480V		U_N DC 1120V		U_s 1680V		U_{TT} 1680V DC		U_{Tc} 3000V AC/2s
150	0.6	5.6	40	2.5	7.5	35	116 × 108	1	E68.R10-154W60	6/FB10
180	0.7	5	40	2.2	6.6	40	116 × 120	1.1	E68.R12-184W60	6/FB15
300	0.5	3.4	80	5.2	15.6	35	116 × 176	1.7	E68.R17-304W60	3/FB 8
360	0.5	3	80	4.5	13.5	40	116 × 201	1.9	E68.R20-364W60	3/FB12

Other values and dimensions available on request.
Andere Werte und Abmessungen auf Anfrage erhältlich.



for latest edition and updates
check www.powercapacitors.info

E68.*GA85 Mesis®**
AC
750...1350V



C_N (μ F)	R_s (m Ω)	R_{th} (K/W)	I_{max} (A)	$\hat{I}$ (kA)	I_s (kA)	L_e (nH)	$D_1 \times L_1$ (mm)	m (kg)	order no. Bestell-Nr.	pcs/box Stk./Box
U_N 750V AC		U_{rms} 530V		U_N DC 1260V		U_s 1890V		U_{TT} 1890V DC		U_{TC} 3000V AC/2s
105	0.6	5.6	40	2	6	35	116 × 108	1	E68.R10-114W60	6/FB10
130	0.8	5	40	2.1	6.3	40	116 × 120	1.1	E68.R12-134W60	6/FB15
210	0.6	3.4	80	4	12	35	116 × 176	1.7	E68.R17-214W60	3/FB 8
260	0.6	3	80	4.2	12.6	40	116 × 201	1.9	E68.R20-264W60	3/FB12
U_N 850V AC		U_{rms} 600V		U_N DC 1400V		U_s 2100V		U_{TT} 2100V DC		U_{TC} 3000V AC/2s
40	0.4	7.3	40	3.6	10.8	35	116 × 83	0.8	E68.R83-403W60	6/FB12
85	0.5	5.6	40	3.8	11.4	35	116 × 108	1	E68.R10-853W60	6/FB10
110	0.5	5	40	4	12	40	116 × 120	1.1	E68.R12-114W60	6/FB15
170	0.5	3.4	80	6	18	35	116 × 176	1.7	E68.R17-174W60	3/FB 8
220	0.5	3	80	6	18	40	116 × 201	1.9	E68.R20-224W60	3/FB12
U_N 1000V AC		U_{rms} 720V		U_N DC 1680V		U_s 2520V		U_{TT} 2520V DC		U_{TC} 3500V AC/2s
55	0.5	5.6	40	3	9	35	116 × 108	1	E68.R10-553W60	6/FB10
70	0.6	5	40	3.1	9.3	40	116 × 120	1.1	E68.R12-703W60	6/FB15
110	0.5	3.4	80	6	18	35	116 × 176	1.7	E68.R17-114W60	3/FB 8
140	0.6	3	80	6	18	40	116 × 201	1.9	E68.R20-144W60	3/FB12
U_N 1200V AC		U_{rms} 850V		U_N DC 2000V		U_s 3000V		U_{TT} 3000V DC		U_{TC} 4000V AC/2s
42	0.6	5.6	40	2.7	8.1	35	116 × 108	1	E68.R10-423W60	6/FB10
54	0.7	5	40	2.8	8.4	40	116 × 120	1.1	E68.R12-543W60	6/FB15
84	0.5	3.4	80	5.4	16.2	35	116 × 176	1.7	E68.R17-843W60	3/FB 8
100	0.5	2.5	100	6.5	19.5	50	116 × 244	2.3	E68.R24-104W60	3/FB12
108	0.6	3	80	5.7	17.1	40	116 × 201	1.9	E68.R20-114W60	3/FB12
U_N 1350V AC		U_{rms} 960V		U_N DC 2250V		U_s 3380V		U_{TT} 3380V DC		U_{TC} 4200V AC/2s
30	0.7	5.6	40	2.2	6.6	35	116 × 108	1	E68.R10-303W60	6/FB10
40	0.8	5	40	2.3	6.9	40	116 × 120	1.1	E68.R12-403W60	6/FB15
60	0.8	3.4	80	4.4	13.2	35	116 × 176	1.7	E68.R17-603W60	3/FB 8
75	0.6	3	80	4.6	13.8	40	116 × 201	1.9	E68.R20-753W60	3/FB12
80	0.8	3	80	4.9	14.7	40	116 × 201	1.9	E68.R20-803W60	3/FB12

Other values and dimensions available on request.
Andere Werte und Abmessungen auf Anfrage erhältlich.



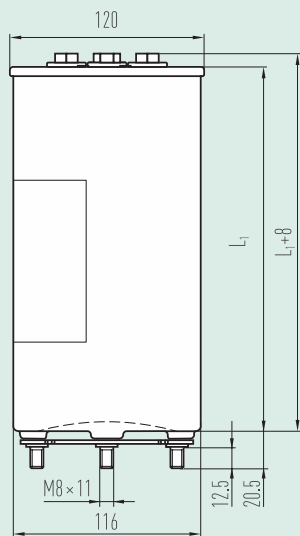
ACCESSORIES, DIMENSION DRAWINGS

ZUBEHÖR, MASSZEICHNUNGEN

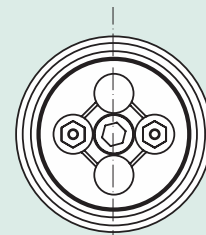




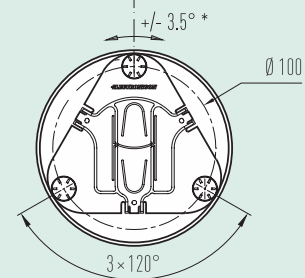
Design W6



top
view



bottom
view



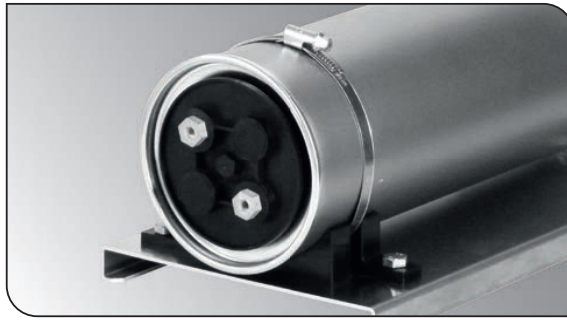
* Due to the manufacturing process, the position of the base screws in relation to the connections may deviate by up to 3.5° in both directions.
Fertigungsbedingt kann die Position der Bodenschrauben zu den Anschlüssen um bis zu 3,5° in beide Richtungen abweichen.

E68 CAPACITORS

Can material	aluminium, filled with neutral gas (N ₂)
Lid	aluminium, folded edge
Terminals	plastic insulator (UL94: V0)
internal thread	iM6 × 12 mm (7.5 Nm), tinned brass with nickel barrier
I_{max} (Terminals)	120 A
Degree of protection	IP 00
K	33 mm
L	19.5 mm
Humidity Class	C, TX (IEC 62498-1)
Switch card (BAC)	IPC class 3

E68 KONDENSATOREN

Gehäusematerial	Aluminium, gefüllt mit neutralem Gas (N ₂)
Deckel	Aluminium, gebördelt
Anschlüsse	Kunststoffisolator (UL94: V0)
Innengewinde	iM6 × 12 mm (7,5 Nm) Messing verzinkt, mit Nickelsperrschicht
I_{max} (Anschlüsse)	120 A
Schutzgrad	IP 00
K	33 mm
L	19,5 mm
Feuchtklasse	C, TX (IEC 62498-1)
Schalterkarte (BAC)	IPC Klasse 3



Holder for Horizontal Mounting

Our cylindrical capacitors can be mounted by means of this bracket on a flat vertical or horizontal surface.

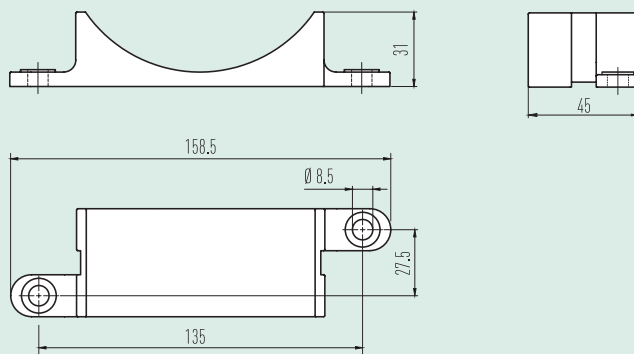
The bracket is made of glass fibre reinforced polyamide and comes as a set including a matching 9mm zinc-plated steel strap for fixation of the capacitor.

Halter für waagerechte Montage

Unsere zylindrischen Kondensatoren können mit Hilfe dieser Schelle auf einer senkrechten oder waagerechten Oberfläche montiert werden.

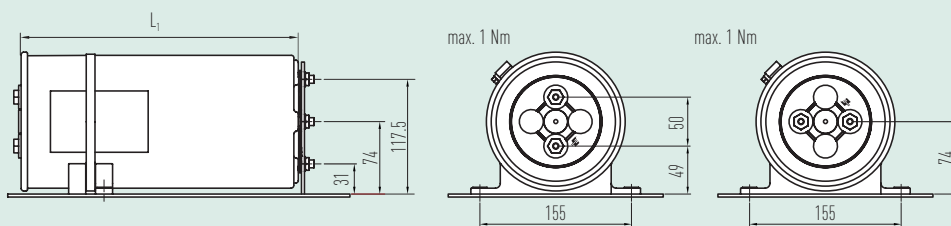
Der Halter ist aus glasfaserverstärktem Polyamid und wird inklusive passender 9mm-Schlauchschelle aus verzinktem Stahl geliefert.

Drawings Maßbilder



material Material glass fibre reinforced polyamide glasfaserverstärktes Polyamid

order-number (10 x mounting set) Bestell-Nr. (10 x mounting set) ... E50-H36-100001



Example of horizontal mounting.
Beispiel für eine waagerechte Befestigung.



Important Remarks

General

Our catalogues outline the typical technical and mechanical characteristics of the listed capacitors. The stated values are based on reference type tests, as well as empirical and experimental experience. The real values of individual capacitors may differ within the stated, or commonly known, tolerances. Any information given in this catalogue therefore describes the components in general terms and does not constitute any guarantee of individual technical values.

It is the responsibility of the user to ensure by dedicated tests the suitability and safety of operation of our components under the conditions of his application. This also applies to any accessories offered by ELECTRONICON.

Safety

Safe operation of the capacitors can be expected only if all safety recommendations as well as electrical and thermal specifications as stated on the label, in the data sheets, catalogues and the accompanying mounting instructions are strictly observed, and recommended safety devices are used as intended. Please consider the "General Safety Recommendations" of the power capacitor manufacturers organized in the German ZVEI (www.electronicon.com/en/zvei).

The capacitors shall only be used for the intended application. ELECTRONICON will not indemnify or be responsible for any kind of damages to persons or property due to the improper application of any capacitors purchased from ELECTRONICON or its distributors.

Mind that electrical or mechanical misapplication of capacitors can become hazardous. Misapplied capacitors can explode or catch fire and cause bodily injury or property damage due to the expulsion of material or metal fragments.

Please consult the detailed instructions for mounting and application stated in our brochure „Application Notes“ and on the ELECTRONICON website: www.electronicon.com/en/an

If in doubt about how to connect, operate, or discharge a capacitor, consult ELECTRONICON engineering or our distributors.

Mounting And Cooling

The useful life of a capacitor may be reduced dramatically if exposed to excessive heat. Typically an increase in the ambient temperature of 7°C will halve the expected life of the capacitor. Make sure to obey the permitted operating temperatures.

To avoid overheating the capacitors must be allowed to cool unhindered and should be shielded from external heat sources. We recommend forced ventilation for all filter applications with reactors. Give approx. 20mm clearance around capacitors for natural or forced ventilation, and do not place them directly above or next to heat sources such as detuning or tuning reactors, bus bars, etc.

Wichtige Hinweise

Allgemeines

Unsere Kataloge beschreiben die typischen technischen und mechanischen Eigenschaften der aufgeführten Kondensatoren. Die angegebenen Werte basieren auf Referenztypprüfungen sowie empirischen und experimentellen Erfahrungswerten. Die tatsächlichen Werte einzelner Kondensatoren können innerhalb der angegebenen bzw. allgemein bekannter Toleranzen abweichen. Alle Angaben in diesem Katalog beschreiben daher die Komponenten im Allgemeinen und stellen keine Garantie für individuelle technische Werte dar.

Es liegt in der Verantwortung des Anwenders, durch gezielte Prüfungen die Eignung und Betriebssicherheit unserer Komponenten unter den konkreten Betriebsbedingungen seiner Anwendung sicherzustellen. Dies gilt ebenso für gegebenenfalls von ELECTRONICON angebotene Zubehörteile.

Sicherheit

Ein sicherer Betrieb der Kondensatoren ist nur zu erwarten, wenn alle Sicherheitsempfehlungen sowie elektrische und thermische Spezifikationen entsprechend Etikett, Datenblättern, Katalogen und beiliegenden Montageanleitungen eingehalten und die empfohlenen Sicherheitseinrichtungen bestimmungsgemäß verwendet werden. Bitte beachten Sie die „Allgemeinen Sicherheitsempfehlungen“ der im deutschen ZVEI organisierten Hersteller von Leistungskondensatoren (www.electronicon.com/en/zvei).

Die Kondensatoren dürfen ausschließlich für ihren Bestimmungszweck verwendet werden. ELECTRONICON übernimmt keine Verantwortung oder Haftung für Schäden an Personen oder Eigentum, welche aus unsachgemäßer Anwendung von Kondensatoren herrührt.

Elektrisch oder mechanisch fehlerhaft eingesetzte Kondensatoren können explodieren oder Feuer fangen. Austretende Materialien bzw. Metallteile können gesundheitliche und materielle Schäden verursachen.

Bitte beachten Sie die detaillierten Anweisungen in unserer Broschüre „Anwendungshinweise“ sowie auf der Webseite von ELECTRONICON: www.electronicon.com/en/an

Bitte konsultieren Sie das Fachpersonal oder unsere Distributoren zu Fragen bezüglich Anschluss, Verwendung oder Entladung von Kondensatoren.

Montage und Kühlung

Die Lebensdauer eines Kondensators kann durch übermäßige Wärmeeinwirkung erheblich verringert werden. Im allgemeinen führt eine Erhöhung der Umgebungstemperatur um 7°C zu einer Verringerung der Lebensdauer des Kondensators um 50 %. Halten Sie die zugelassenen Betriebstemperaturen ein.

Um Überhitzung zu vermeiden, muß gewährleistet sein, daß die Kondensatoren auftretende Verlustwärme ungehindert abführen können und vor fremden Wärmequellen abgeschirmt werden. Insbesondere in Filtern ist in jedem Falle eine Zwangslüftung zu empfehlen. Zwischen und um Kondensatoren sollten etwa 20mm Platz für natürliche oder Zwangslüftung belassen werden. Bringen Sie den Kondensator nie direkt neben oder über Wärmequellen, wie Drosseln u. ä. an.

Failure Rate

The failure probability of a component is a statistical value which is described by a log-normal distribution:

$$N = N_0 \times e^{-\lambda t}$$

λ is the failure rate, which alternatively is also stated as the so-called FIT-rate (FIT = Failures In Time = $\lambda \times 10^9$).

The failure rate is very closely linked with operating temperature and operating voltage of the capacitor. The FIT rates stated in this catalogue are related to the capacitor's rated voltage and a dielectric temperature (= HOTSPOT temperature) of 70°C.

The simultaneous operation of capacitors at highest permissible voltage and operating temperature should be avoided; otherwise, failure rates may increase beyond reasonable technical reliability.

The standard reference period for the failure rate statement is 100.000 hours. Please note that FIT rates can be altered or improved by technical adjustments. Please contact us for details.

The following diagram demonstrates the correlation between FIT rate, operating voltages and operating temperatures.

Ausfallrate

Die Ausfallwahrscheinlichkeit eines Bauelements ist eine statistische Größe, die mit Hilfe einer Normalverteilung beschrieben wird. Es gilt:

N = number of functional components after period t

Anzahl der nach der Zeit t intakten Bauelemente

N_0 = total number of components at time $t = 0$

Gesamtzahl der Bauelemente zum Zeitpunkt $t = 0$

λ = failure rate Ausfallrate

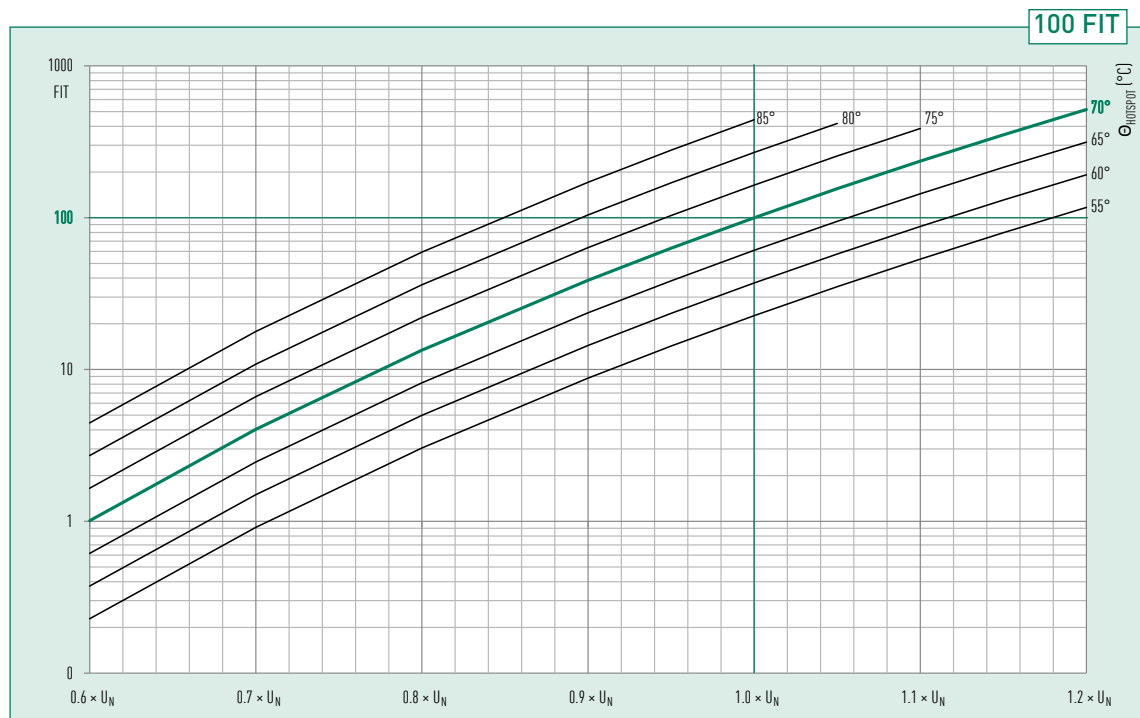
Dabei ist λ die Ausfallrate, die alternativ auch als FIT-Rate angegeben wird (FIT = $\lambda \times 10^9$)

Die Ausfallrate ist stark abhängig von der Temperatur und der Betriebsfeldstärke. Die FIT-Raten im Katalogsortiment beziehen sich auf 70°C Dielektrikumtemperatur (=Hotspot-Temperatur) und die Nennspannung des Kondensators.

Der Betrieb von Kondensatoren mit der höchsten zulässigen Spannung und der höchsten zulässigen Betriebstemperatur sollte vermieden werden, andernfalls können die Ausfallraten so hoch werden, dass keine technisch sinnvollen Zuverlässigkeiten mehr gewährleistet sind.

Der Wert für die Ausfallrate bezieht sich auf einen Referenzzeitraum von 100.000h. FIT-Raten können durch technische Anpassung der Kondensatoren beeinflusst und verbessert werden. Auskünfte hierzu erteilen wir auf Anfrage.

Das nachstehende Kurvendiagramm macht den Zusammenhang von FIT-Rate, Betriebsspannung und Betriebstemperatur deutlich.



Protection against Overvoltages and Short Circuits: Self-Healing Dielectric

All dielectric structures used in our power capacitors are „selfhealing“: In the event of a voltage breakdown the metal layers around the breakdown channel are evaporated by the temperature of the electric arc that forms between the electrodes. They are removed within a few microseconds and pushed apart by the pressure generated in the centre of the breakdown spot. An insulation area is formed which is reliably resistive and voltage proof for all operating requirements of the capacitor. The capacitor remains fully functional during and after the breakdown.

For voltages within the permitted testing and operating limits the capacitors are short-circuit- and overvoltage-proof. They are also proof against external short circuits as far as the resulting surge discharges do not exceed the specified surge current limits.

Warning:

It has to be noted that the safety system can act properly only within the permitted limits of loads and overloads. The simple presence of a safety mechanism does not mean that catastrophic failures are completely impossible. Strong overvoltages, permanent external heat, and heavy current overload, e.g. during harmonic resonances may cause sudden, uncontrollable rise of temperature and pressure inside the can which may not leave sufficient time for the Mesis® mechanism to act properly, and result in explosion and fire.

For more detailed information, please consult our “Application Notes” and the „General Safety Advice for Power Capacitors” issued by the German Electrical and Electronic Manufacturer’s Association (ZVEI).

Limited Warranty

All our products are designed, manufactured, and tested with the highest care and workmanship. The satisfaction of our customers is our highest goal. We therefore warrant remedying any defect in the goods resulting from faulty design, materials or workmanship, which appears within 3 years from the date of sale.

This warranty does not cover defects due to improper use of the goods or operation at conditions exceeding the rated values stated in the catalogue or special data sheet. Nor does it cover defects due to faulty maintenance or incorrect installation, alterations or faulty repairs undertaken by the Buyer. Finally the warranty does not cover normal wear and tear or deterioration.

See our „General Conditions” for details on Warranty and Product liability.

Schutz gegen Überspannungen und Kurzschlüsse: Selbsteheilendes Dielektrikum

Alle in unseren Leistungskondensatoren eingesetzten dielektrischen Strukturen sind selbsteheilend. Im Falle eines Kurzschlusses (Spannungsdurchschlag) verdampfen die Metallbeläge um den Durchschlagspunkt herum infolge des Lichtbogens, der sich zwischen den Elektroden bildet. Binnen Mikrosekunden wird der Metaldampf vom Zentrum des Durchschlages weggedrückt. Auf diese Weise bildet sich eine isolierende belagfreie Zone um den Durchschlagspunkt. Der Kondensator bleibt während und nach dem Durchschlag voll funktionsfähig.

Für Spannungen innerhalb der zugelassenen Test- und Betriebsbedingungen sind die Kondensatoren kurzschluss- und überspannungssicher. Sie sind außerdem sicher gegen äußere Kurzschlüsse, sofern bei den dabei entstehenden Stoßentladungen die zugelassenen Stoßströme nicht überschritten werden.

Warnung:

Es ist zu beachten, daß das Sicherungsprinzip nur innerhalb der zulässigen Be- und Überlastungsgrenzen zuverlässig wirken kann. Die Existenz eines Sicherheitsmechanismus an sich bedeutet nicht, dass gewaltsame Ausfälle gänzlich ausgeschlossen werden können. Starke Überspannungen, andauernde äußere Wärmeeinwirkung sowie starke Überstrombelastung, z.B. während Oberwellenresonanzen, können plötzlichen unkontrollierten Temperatur- und Druckanstieg im Kondensatorinnern hervorrufen, welche der Mesis®-Überdrucksicherung nicht ausreichend Zeit zum ordnungsgemäßen Abschalten lassen und zur Explosion bzw. Entzündung führen können.

Für detailliertere Informationen konsultieren Sie bitte unsere ausführliche Broschüre „Anwendungshinweise” sowie die „Allgemeinen Sicherheitshinweise für Leistungskondensatoren” des ZVEI.

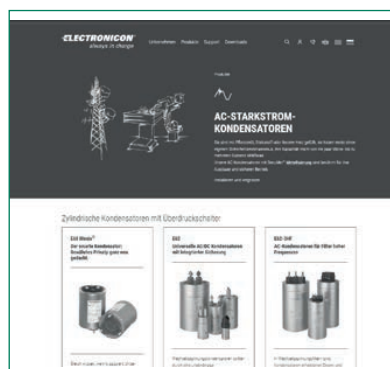
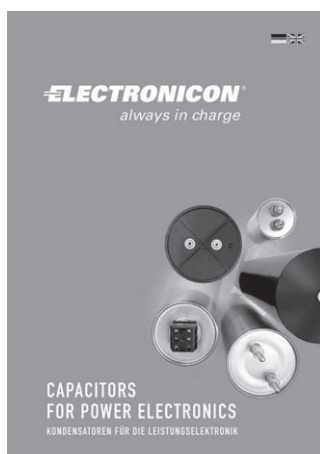
Gewährleistung

Alle unsere Erzeugnisse werden mit höchster Sorgfalt und Fachkenntnis entwickelt, hergestellt und geprüft. Die Zufriedenheit unserer Kunden ist unser höchstes Ziel. Wir verpflichten uns daher, jeden innerhalb von 3 Jahren ab Verkaufsdatum auftretenden Mangel an unseren Erzeugnissen zu beseitigen, welcher aus Fehlern in Design, Material oder Herstellung herrührt.

Diese Gewährleistung erstreckt sich nicht auf Defekte infolge unsachgemäßer Anwendung oder Betrieb außerhalb der nach Katalog oder Datenblatt zulässigen Einsatzbedingungen. Sie erfaßt ebensowenig Schäden aufgrund fehlerhafter Wartung, unsachgemäßer Montage, Änderungen oder unsachgemäßer Reparaturen durch den Käufer bzw. Anwender. Diese Gewährleistung betrifft auch nicht normale Abnutzung und Verschleiß.

Siehe unsere „Allgemeinen Geschäftsbedingungen” für Details zu Gewährleistung und Produkthaftung.

Find more information and detailed instructions in our „Application Notes“ and on www.electronicon.com. Mehr Informationen und ausführliche Anweisungen finden Sie in unseren „Anwendungshinweisen“ und unter www.electronicon.com.



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KEY COMPONENTS FOR POWER FACTOR CORRECTION IN 50Hz MAINS



FACTORY MATCHED
TO OPERATE IN PERFECT HARMONY

ELECTRONICON®
always in charge

CHECK OUR SPECIAL CATALOGUE

MSD™ FKD-MV™ DSC™

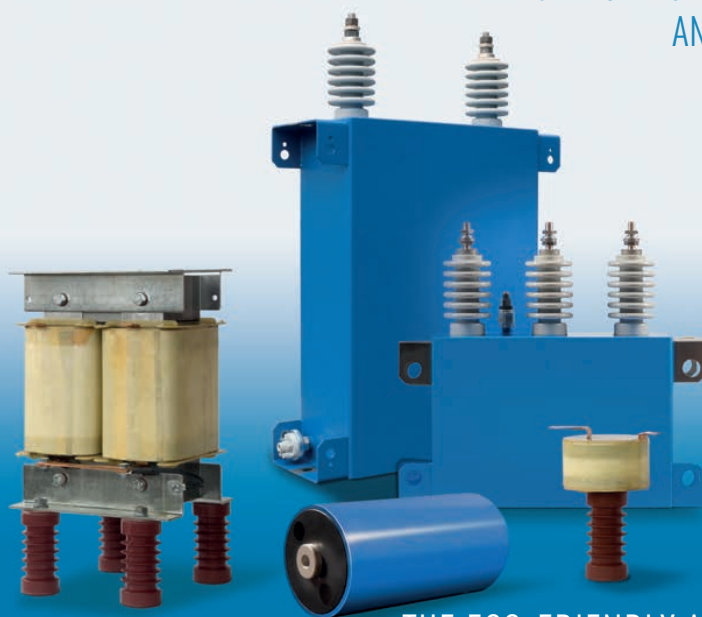
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MSD™ FKD-MV™ DSC™

MEDIUM VOLTAGE CAPACITORS
AND REACTORS



THE ECO-FRIENDLY ALTERNATIVE

ELECTRONICON®
always in charge

CAPACITORS AND OTHER KEY COMPONENTS FOR POWER FACTOR CORRECTION IN 50 Hz MAINS



ELECTRONICON KONDENSATOREN GMBH GERA • GERMANY

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INTRODUCTION

BASICS OF POWER FACTOR CORRECTION

Under normal operating conditions certain electrical loads (e.g. induction motors, welding equipment, arc furnaces and fluorescent lighting) draw not only active power from the supply, but also inductive reactive power (kvar). This reactive power is necessary for the equipment to operate correctly but could be interpreted as an undesirable burden on the supply. The power factor of a load is defined as the ratio of active power to apparent power, i.e. kW : kVA and is referred to as $\cos\varphi$. The closer $\cos\varphi$ is to unity, the less reactive power is drawn from the supply.

A capacitive reactive power resulting from the connection of a correctly sized capacitor can compensate for the inductive reactive power required by the electrical load. This ensures a reduction in the reactive power drawn from the supply and is called Power Factor Correction.

CALCULATION OF REQUIRED CAPACITOR POWER

The reactive power which is necessary to achieve a desired power factor is calculated by the formula: $Q_c = P \cdot F$

Q_c ... reactive power of the required power capacitor

P ... active power of the load to be corrected

F ... conversion factor acc. to chart 1

original power factor $\cos\varphi_1$	conversion factor F for a target power factor $\cos\varphi_2$									
	0.70	0.75	0.80	0.85	0.90	0.92	0.94	0.96	0.98	1.00
0.20	3.879	4.017	4.149	4.279	4.415	4.473	4.536	4.607	4.696	4.899
0.25	2.853	2.991	3.123	3.253	3.389	3.447	3.510	3.581	3.670	3.873
0.30	2.160	2.298	2.430	2.560	2.695	2.754	2.817	2.888	2.977	3.180
0.35	1.656	1.795	1.926	2.057	2.192	2.250	2.313	2.385	2.473	2.676
0.40	1.271	1.409	1.541	1.672	1.807	1.865	1.928	2.000	2.088	2.291
0.45	0.964	1.103	1.235	1.365	1.500	1.559	1.622	1.693	1.781	1.985
0.50	0.712	0.85	0.982	1.112	1.248	1.306	1.369	1.440	1.529	1.732
0.55	0.498	0.637	0.768	0.899	1.034	1.092	1.156	1.227	1.315	1.518
0.60	0.313	0.451	0.583	0.714	0.849	0.907	0.97	1.042	1.130	1.333
0.65	0.149	0.287	0.419	0.549	0.685	0.743	0.806	0.877	0.966	1.169
0.70		0.138	0.27	0.4	0.536	0.594	0.657	0.729	0.817	1.020
0.75			0.132	0.262	0.398	0.456	0.519	0.59	0.679	0.882
0.80				0.13	0.266	0.324	0.387	0.458	0.547	0.75
0.85					0.135	0.194	0.257	0.328	0.417	0.62
0.90						0.058	0.121	0.193	0.281	0.484
0.95								0.037	0.126	0.329

chart 1

INTRODUCTION

A. Calculation based on the consumption data

- consumption of active energy: $E_w = 300.000 \text{ kWh}$
- consumption of reactive energy: $E_b = 400.000 \text{ kvarh}$
- number of working hours: $t = 600 \text{ h}$

1) Calculation of average active power P

$$P = \frac{E_w}{t} = \frac{300.000 \text{ kWh}}{600 \text{ h}} = 500 \text{ kW}$$

2) Calculation of initial power factor $\cos\varphi_1$

$$\cos\varphi_1 = \frac{1}{\sqrt{\left(\frac{E_b}{E_w}\right)^2 + 1}} = \frac{1}{\sqrt{\left(\frac{400.000 \text{ kvarh}}{300.000 \text{ kWh}}\right)^2 + 1}} = 0.6$$

3) From chart 1, we read the factor 1.13 for the improvement of the power factor from 0.6 to 0.98.

4) Calculation of required capacitor power

$$Q_c = 500 \text{ kW} \cdot 1.13 = 565 \text{ kvar}$$

B. Calculation based on the Energy Bill

- reactive power tariff: T/kvarh
- monthly costs for reactive energy: C
- number of working hours: h

Calculation of required capacitor power for $\cos\varphi = 1$

$$Q_c = \frac{C}{h \cdot \frac{T}{\text{kvarh}}}$$



Example

INTRODUCTION

COMMON METHODS OF POWER FACTOR CORRECTION

SINGLE OR FIXED PFC, compensating for the reactive power of individual inductive loads at the point of connection so reducing the load in the connecting cables (typical for single, permanently operated loads with a constant power),

constant power
demand and long
duty cycle

single-
or group-fixed
PFC

GROUP PFC - connecting one fixed capacitor to a group of simultaneously operated inductive loads (e.g. group of motors, discharge lamps),

variable power
demand and/or
variable duty cycle

automatic
("bulk")
PFC

BULK PFC, typical for large electrical systems with fluctuating load where it is common to connect a number of capacitors to a main power distribution station or substation. The capacitors are controlled by a microprocessor based relay which continuously monitors the reactive power demand on the supply. The relay connects or disconnects the capacitors to compensate for the actual reactive power of the total load and to reduce the overall demand on the supply.

A typical power factor correction system would incorporate a number of capacitor sections determined by the characteristics and the reactive power requirements of the installation under consideration. Sections of 12.5 kvar, 25 kvar, and 50 kvar are usually employed. Larger stages (e.g. 100 kvar and above) are best achieved by cascading a number of smaller sections. This has the beneficial effect of reducing fluctuations in the mains caused by the inrush currents to the capacitors and minimizes supply disturbances. Where harmonic distortion is of concern, appropriate systems are supplied incorporating detuning reactors.

INFLUENCE OF HARMONICS, HARMONIC FILTERING



Developments in modern semiconductor technology have led to a significant increase in the number of thyristor- and inverter-fed loads. Unfortunately these non-linear loads have undesirable effects on the incoming AC supply, drawing appreciable inductive reactive power and a non-sinewave current. The supply system needs to be kept free of this harmonic distortion to prevent equipment malfunction.

A typical inverter current is composed of a mixture of sinewave currents; a fundamental component at the supply frequency and a number of harmonics whose frequencies are integer multiples of the line frequency (in three phase mains most of all the 5th, 7th, and 11th harmonic). The harmonics lead to a higher capacitor current, because the reactive resistance of a capacitor reduces with rising frequency. The rising capacitor current can be accommodated by constructional improvements in the manufacture of the capacitor. However a resonating circuit between the power factor correction capacitors, the inductance of the feeding transformer and/or the mains may occur. If the frequency of such a resonating circuit is close enough to a harmonic frequency, the resulting circuit amplifies the oscillation and leads to immense over-currents and over-voltages.

Harmonic distortion of an AC supply can result in any or all of the following:

- Premature failure of capacitors.
- Nuisance tripping of circuit breakers and other protective devices.
- Failure or maloperation of computers, motor drives, lighting circuits and other sensitive loads

Typical non-linear loads (generating harmonics)

- converters, rectifiers, inverters, choppers
- thyristor controls, three-phase controllers
- electronic valves
- phase controls
- UPS units (inverter technology)
- discharge lamps with magnetic ballasts

INTRODUCTION

WHEN IS IT NECESSARY TO INSTALL A DETUNED PFC SYSTEM?

The installation of detuned (reactor-connected) capacitors is designed to force the resonant frequency of the network below the frequency of the lowest harmonic present, thereby ensuring no resonant circuit and, by implication, no amplification of harmonic currents. Such an installation also has a partial filtering effect, reducing the level of voltage distortion on the supply, and is recommended for all cases where the share of harmonic-generating loads ("non-linear loads") is more than 10% of the rated transformer power. The resonance frequency of a detuned capacitor is always below the frequency of the lowest harmonic present. A close-tuned filter circuit however is tuned to a certain harmonic frequency and presents a very low impedance to the individual harmonic current, diverting the majority of the current into the filter bank rather than the supply.



Detuned capacitors can in general be operated in any mains. In any case, they are a safer choice than non-detuned capacitors and future-proof under the conditions of more and more deteriorating power quality in modern mains.

Attention: Non-detuned and detuned capacitors must never be combined together.



We strongly advise to conduct a comprehensive mains analysis, including measurement of the harmonic content, before designing and installing your power factor correction equipment. In cases, however, where such analysis is not possible, cautious and conservative assessment of the situation to be expected shall be made by means of the general rules in chart 3.

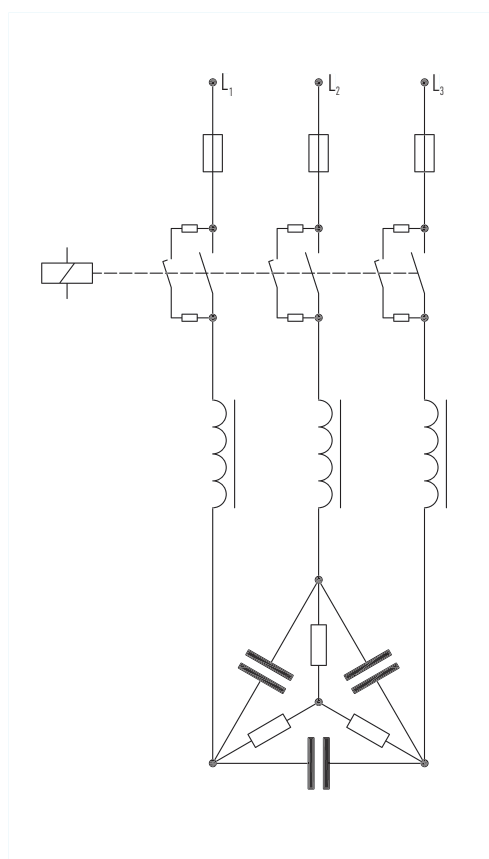
A detuned PFC system is also necessary

- if one or more harmonic voltages in the MV mains are > 2 %, and/or
- if certain audio frequency control signals are used (see page 8)

$S_{OS} : S_T$	Detuning
0 % ... 100 %	non-detuned
> 10 % ... 50 %	detuned
> 40 % ... 100 %	detailed calculation needed, installation of filter circuit if necessary

Abbreviations
 S_{OS} ... power of harmonic generating („non-linear”) loads in the own network
 S_T ... rated transformer power or connection power

chart 3



pic. 1

Installation of detuned (reactor-connected) capacitors

INTRODUCTION



DOES THE MV MAINS CONTAIN AUDIO FREQUENCY CONTROL SIGNALS?

Some energy supply companies use higher-frequency signals in their medium voltage mains for the transmission of control pulses and data. These so-called "audio frequency signals" ranging typically from 160 to 1350 Hz may become absorbed or distorted by, or cause resonance problems with capacitor installations. Such problems may be prevented by the selection of proper detuning reactors.

Capacitor/PFC system	audio frequency	reactive power	activity
non-detuned	< 250 Hz	$Q_c < 35\% \text{ of } S_T$ $Q_c > 35\% \text{ of } S_T$	no specific activity consult your power supply company and conduct mains analysis
	> 250 Hz	$Q_c < 10 \text{ kvar}$ $Q_c > 10 \text{ kvar}$	no specific activity consult your power supply company and consider special PFC system
detuned	< 250 Hz	no restrictions	consult your power supply company and consider special PFC system
	250 Hz ... 350 Hz	no restrictions	detuning factor > 7 %
	> 350 Hz	no restrictions	detuning factor > 5 %

chart 4

INTRODUCTION

OPERATION OF CAPACITORS IN HIGH-FREQUENCY-FILTERS OR WITH A VERY HIGH SHARE OF LF OR HF HARMONICS

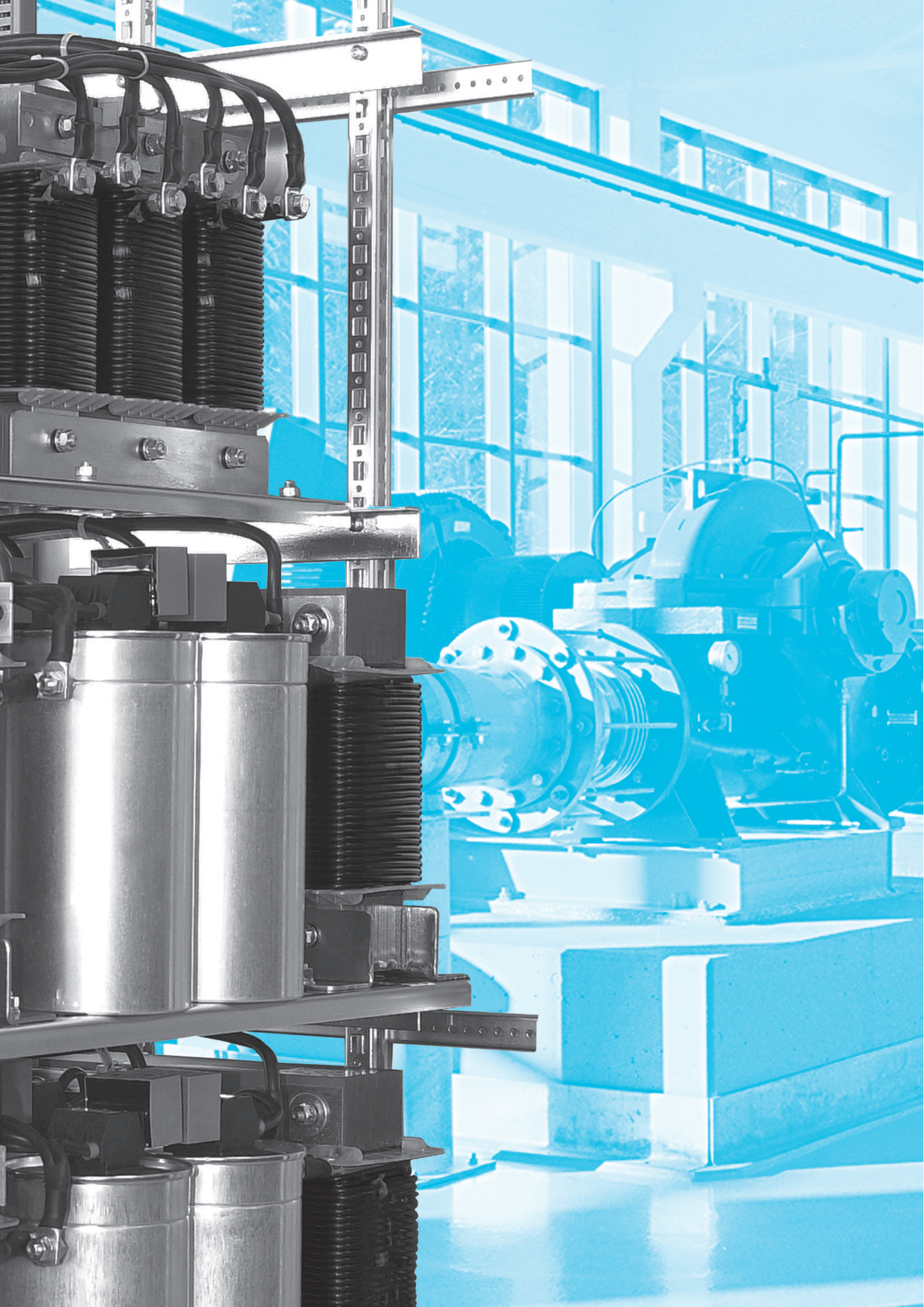
Capacitors which are operated in filters or other systems with a very high share of harmonic distortion, or with harmonics of high frequencies, must be especially selected and prepared for the specific requirements of such applications.

We offer special single and three phase capacitors that are optimized for the operation under such circumstances in our following ranges:

- 280 MKP-UHD: three phase Ultra Heavy Duty capacitors for demanding operating conditions in power factor correction (such as high harmonic content and high operating temperatures), see page 31
- E62-3ph: three phase capacitors for filters with harmonic frequencies of up to 1.3 kHz
- E62-3HF: three phase capacitors for filters with harmonic frequencies of >1.3 kHz
- E62: single phase capacitors for filters with substantial unbalanced loads.

Consult our catalogue brochures for details of the a.m. capacitor ranges. Please refer also to our Application Notes for specific instructions and formulas related to high frequency filters.





FACTORY MATCHED TO WORK IN PERFECT HARMONY. ALL KEY COMPONENTS FROM ONE SOURCE.

The construction of reliable equipment for power factor correction requires not only your excellent experience, but also top-class components. No compromise in quality and safety should be permitted when it comes to the key parts of your PFC equipment. Because we do care, we are offering you the full set of essential components for your capacitor bank.



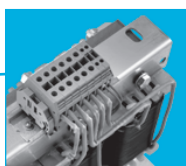
THE HEART:

Capacitors. Without them, PFC is impossible. They are the most sensitive and most important component.
Pages 14 to 37



THE MUSCLE:

Switching is one of the key functions in your PFC, and switching capacitors means maximum stress.
Pages 38 to 52



THE PROTECTION:

Most PFC nowadays cannot do without detuning reactors for harmonic protection anymore.
Pages 54 to 68



THE BRAIN:

The controller shall know what to do, and when.
Pages 70 to 74

POWER CAPACITORS

Apart from your excellent experience, the construction of reliable and competitive equipment for power factor correction requires top-class components at reasonable cost. No compromise in quality and safety should be permitted when it comes to the key part of your PFC equipment. Germany's largest manufacturer of power capacitors manufactures all components with highest care and expertise and is your best choice for power capacitors.

The dry-type phase shifters of our renowned MKPg™-series are environmentally friendly, compact, and very convenient to handle. They contain no liquids, are filled with a neutral, inert gas entirely harmless to environment and may be mounted in any desired position. Should leakage occur, the leaking gas would escape into the atmosphere causing no undesirable effects to the adjacent equipment, e.g. damage, pollution, or staining. Hence when disposing of the capacitors, no liquids or toxic gasses need to be considered. The plant oil in our MKP(D) and MKP-UHD capacitors is biodegradable and does not cause any trouble either, be it in the unlikely event of leakage or during disposal.

All our three-phase capacitors contain three separate capacitor elements connected in delta, preferably of short height and large diameter which substantially reduces inherent power losses and improves their current strength as compared with slim, tall capacitors. By using the market's best low-loss, self-healing polypropylene films and sophisticated manufacturing techniques such as high-vacuum drying and special coating patterns, they provide long service life with constant capacitance and high switching strength. As a matter of course, all our power capacitors are provided with BAM™ (overpressure break-action mechanism) as standard, for safe mode of failure.

Our original CAPAGRIP™ terminals guarantee optimum sealing of the capacitors, and offer convenient connection of cables up to 50mm². A special spring system guarantees reliable and durable operation of the clamp. They are rated IP20, i.e. protected against accidental finger contact with live parts. Whilst the options K and L4 ("CAPAGRIP II") include bleeding resistors for a discharge below 50 V within up to 60 sec as standard, options L and M also permit the direct connection of discharge reactors and discharge resistor modules, as well as easy parallel connection of additional capacitors within the current limits of the terminal.



POWER CAPACITORS

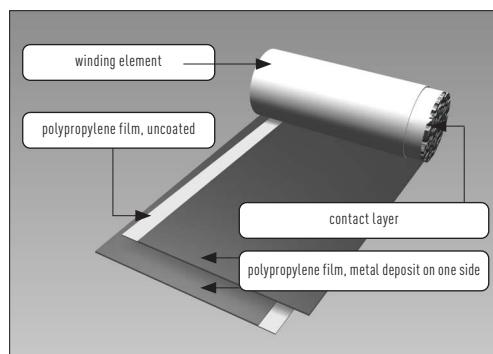


INTERNAL CONSTRUCTION



Dielectric

MKP-/MKPg-type capacitors are based on a low-loss dielectric formed by pure polypropylene film. A thin mixture of zinc and aluminium is metallized directly on one side of the PP-film under vacuum. Our long term experience as well as on-going research and improvements in this technology ensure the excellent self-healing characteristics of the dielectric and a long operating life of our capacitors. The plastic film is wound into stable cylindrical windings on the most modern automated equipment. The ends of the capacitor windings are contacted by spraying with a metal contact layer, facilitating a high current load and ensuring a low-inductance connection between the terminals and windings.



pic.2



The link between PP-film and zinc contact layer is highly stressed during high surge or rms currents and therefore considered very critical for operating life and reliability of the capacitor. By cutting the film for selected types in a wavelike manner, our SINECUT™ technology increases the contact surface between film and zinc layer which substantially reduces this strain.



Impregnants

The use of impregnants and/or filling materials in capacitors is necessary in order to insulate the capacitor electrodes from oxygen, humidity, and other environmental interference. Without such insulation, the metal coating would corrode, an increasing number of partial discharges would occur, the capacitor would lose more and more of its capacitance, suffer increased dielectric losses and a reduced operating life. Therefore, an elaborate vacuum-drying procedure is initiated immediately after insertion of the capacitor elements into the aluminium case and dried insulation gas (MKPg), or biologically degradable plant oil (MKP[D], MKP-UHD), is introduced. Both protect the winding from environmental influence and provide an extended life-expectancy and stable capacitance.



MKPg 275 – Leakage Proof and Environmentally Friendly

The gas in our MKPg-Capacitors is inert and entirely harmless to environment. When disposing of the capacitors, no liquids or toxic gasses need to be considered. Leakage of gas is extremely unlikely if the capacitors are handled and operated properly. It is possible to mount these capacitors in any desired position. However, should leakage occur, the leaking gas would escape into the atmosphere causing no undesirable effects to the adjacent equipment, e.g. damage, pollution, or staining. In the long run, such an unlikely event would result in a degradation of the capacitance; however, this process would take many months, during which the capacitor remains functional. By using gas, we are reducing the weight of a capacitor on average by 15% compared with resin or oil filled capacitors. This makes transportation and handling of the units easier. It also supports the concept of mounting the capacitors in almost any position.

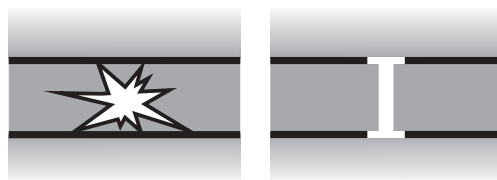
SAFE OPERATION

Protection against Overvoltages and Short Circuits: Self-Healing Dielectric

All dielectric structures used in our power capacitors are "self-healing": In the event of a voltage breakdown the metal layers around the breakdown channel are evaporated by the temperature of the electric arc that forms between the electrodes. They are removed within a few microseconds and pushed apart by the pressure generated in the centre of the breakdown spot. An insulation area is formed which is reliably resistive and voltage proof for all operating requirements of the capacitor. The capacitor remains fully functional during and after the breakdown.



For voltages within the permitted testing and operating limits the capacitors are short-circuit- and overvoltage proof. They are also proof against external short circuits as far as the resulting surge discharges do not exceed the specified surge current limits.



Self-healing
breakdown

pic.3

Protection Against Accidental Contact

All capacitors are checked by routine test (voltage test between shorted terminations and case: $U_{BG} > 2 U_N + 2000 \text{ V}$, at least 3000V) in accordance with IEC 60831. Accessible capacitors must be earthed at the bottom stud or with an additional earthing clamp.

The CAPAGRIP™ terminal blocks are rated IP20, i.e. they are protected against accidental finger contact with live parts. The discharge modules are designed in the same way (compare page 48). Unused contact cages of design M terminal blocks must be covered by a proper blank (available as standard accessory, see page 52).



CAPAGRIP™

Capacitors in design D are not provided with protection against accidental contact as standard. They are available with protective caps on request (see page 52).



SAFE OPERATION



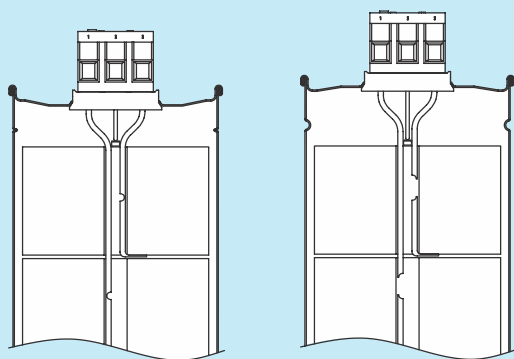
Protection against Overload and Failure at the end of Service Life

In the event of overvoltage, thermal overload or ageing at the end of the capacitor's useful service life, an increasing number of self-healing breakdowns may cause rising pressure inside the capacitor. To prevent it from bursting, the capacitor is fitted with an obligatory «break action mechanism» (BAM™). This safety mechanism is based on an attenuated spot at one, two, or all of the connecting wires inside the capacitor.

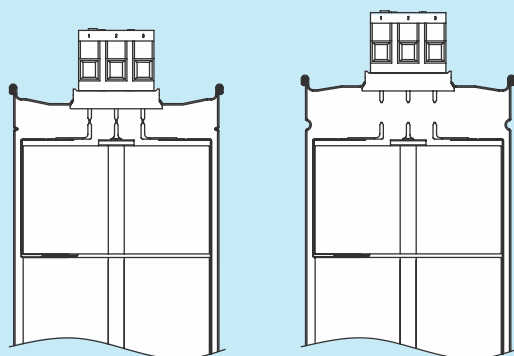
All capacitors with diameters < 85 mm as well as some traditional models with large diameters are provided with BAM 1 mechanism. All new models with diameters > 85 mm will be provided with BAM 2 mechanism.

With rising pressure the case begins to expand, mainly by opening the folded crimp and pushing the lid upwards. As a result, the prepared connecting wires are separated at the attenuated spot, and the current path is interrupted irreversibly. It has to be noted that this safety system can act properly only within the permitted limits of loads and overloads.

BAM 1



BAM 2



pic.4



Mind hazards of explosion and fire

Capacitors consist mainly of polypropylene (up to 90 %), i.e. their energy content is relatively high. They may rupture and ignite as a result of internal faults or external overload (e.g. temperature, over-voltage, harmonic distortion). It must therefore be ensured, by appropriate measures, that they do not form any hazard to their environment in the event of failure or malfunction of the safety mechanism.

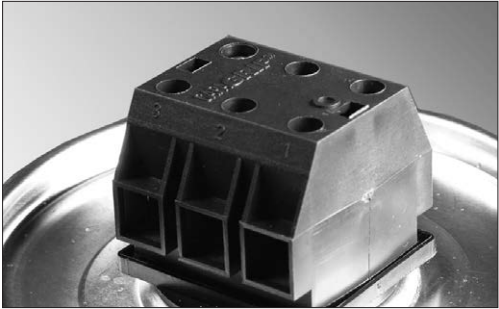
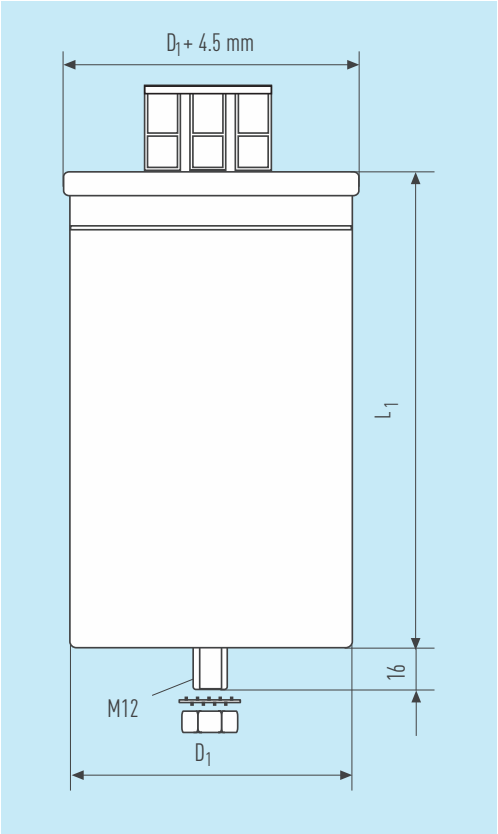


Fire Load: approx. 40 MJ/kg

Extinguish with: dry extinguisher (CO₂, foam), or other fire extinguishants suitable for this voltage level

DESIGN DRAWINGS

CAPAGRIP™ K, L, M AND CAPAGRIP II™: EASE OF ASSEMBLY WITH HIGH DEGREE OF PROTECTION



The CAPAGRIP™ terminals guarantee optimum sealing of the capacitors, and offer convenient connection of cables up to 50 mm². A special spring system guarantees reliable and durable operation of the clamp.

Whilst CAPAGRIP™ K and CAPAGRIP II™ ("L4") incorporate bleeding resistors, designs L and M permit the direct connection of discharge reactors and discharge resistor modules, as well as easy parallel connection of additional capacitors within the limits of the current capability of the respective terminal.

For single phase versions, the central screw has no contact.

Series	MKPg 275, MKP 276, MKP-UHD
Protection	IP20
Humidity class	C
Creepage distance	16 mm
Air clearance	16 mm

If flat over the entire width of the cage, the body inserted into the terminal must have a thickness of at least 1.2 mm in order to get gripped and fixed by the clamp cage. See chart 5 for minimum thickness of inserted conductor if round-shaped and/or NOT ranging over the entire width of the cage.

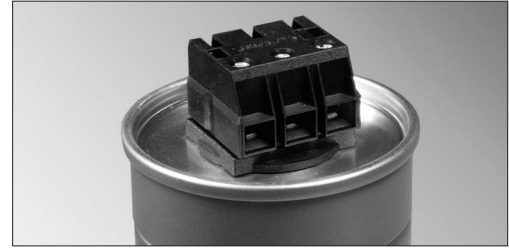
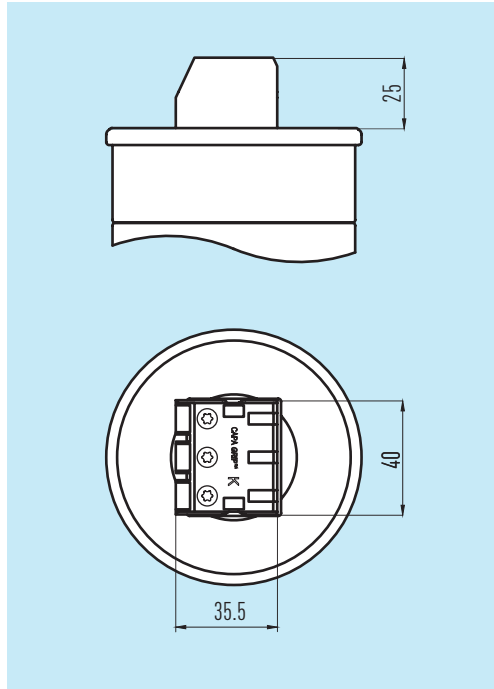
See also chart 9 on page 36 for more detailed instructions on connectors and cable sizes.

CAPAGRIP™	Clamp width	minimum conductor height (if < 0.8 × clamp width)
K	5	2
L, L4	7	2.5
M	10	2.5

chart 5

DESIGN DRAWINGS

CAPA**GRIP**™K



Available for diameters 60 ... 85 mm.

Case

extruded aluminium can with base mounting stud M12, hermetically sealed by aluminium lid (folded edge)

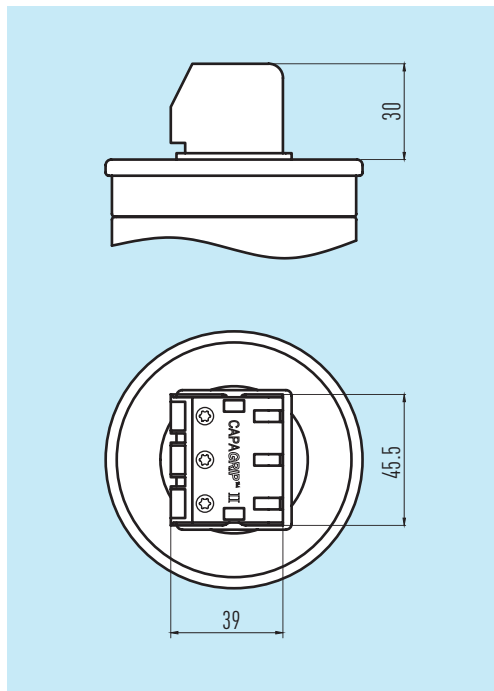
Terminal block

Steel clamp with T20 M4 screws in flame retardant plastic body (UL94-V0)

max. cable cross section: $1 \times 10 \text{ mm}^2$ per phase
max. terminal rating: 39 A/phase

Internal resistors for discharge < 50 V within < 60 s

CAPA**GRIP**™L4



Available for diameters 85 ... 136 mm.

Case

extruded aluminium can with base mounting stud M12, hermetically sealed by aluminium lid (folded edge)

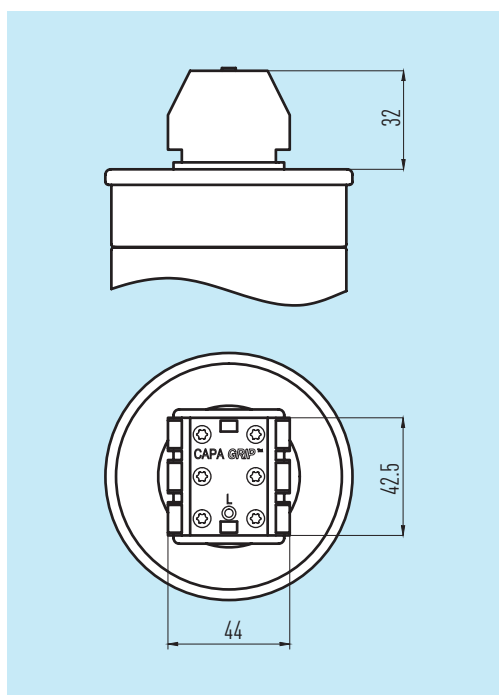
Terminal block

Steel clamp with T20 M5 screws in flame retardant plastic body (UL94-V0)

max. cable cross section: $1 \times 25 \text{ mm}^2$ per phase
max. terminal rating: 56 A/phase

Internal resistors for discharge < 50 V within < 60 s

DESIGN DRAWINGS



CAPAGRIP™ L

Available for diameters 85 ... 136 mm.

Case

extruded aluminium can with base mounting stud M12, hermetically sealed by aluminium lid (folded edge)

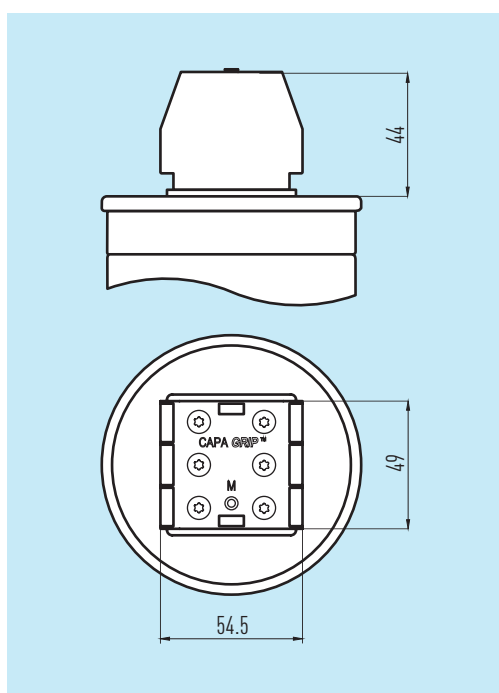
Terminal block

Steel clamp with T20 M5 screws in flame retardant plastic body (UL94:V0)

max. cable cross section: $2 \times 25 \text{ mm}^2$ per phase

max. terminal rating: 56 A/phase

discharge resistors: available as separate item (see pgs. 47ff)



CAPAGRIP™ M

Available for diameters 95 ... 136 mm.

Case

extruded aluminium can with base mounting stud M12, hermetically sealed by aluminium lid (folded edge)

Terminal block

Steel clamp with T20 M6 screws in flame retardant plastic body (UL94:V0)

max. cable cross section: $2 \times 50 \text{ mm}^2$ per phase

max. terminal rating: 104 A/phase

discharge resistors: available as separate item (see pgs. 47ff)

DESIGN DRAWINGS

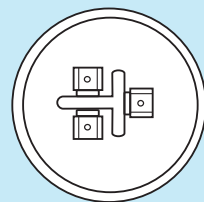
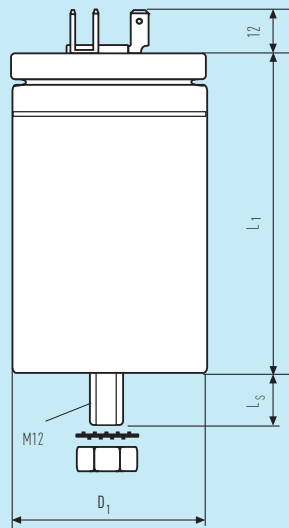
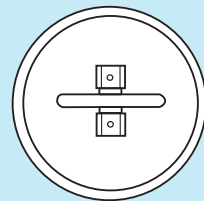
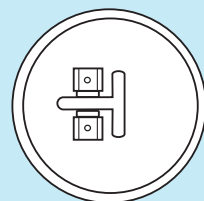
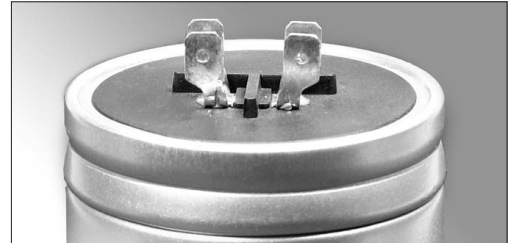
MKP(D): THE LOW-COST ALTERNATIVE



D1/D2



D3


D3
3ph

D1
1ph
 $\varnothing < 60$ mm

D2
1ph
 $\varnothing = 65 \dots 75$ mm


The low-cost alternative for single and three phase capacitors with a rated current of up to 16 A/phase and diameters of 40 to 75 mm. Also available with plastic protective cap and mounted discharge resistors.

Series	MKP(D) 276
Protection	IP00
Humidity class	F
Creepage distance	10 mm
Air clearance	8 mm

Available for diameters 40 ... 75 mm.

Case

Extruded aluminium can with base mounting stud (M12)
Hermetically sealed by plastic lid with rubber gasket

Terminals

Dual tab connectors, tinned steel 6.3×0.8 mm
max. terminal current: 21 A/phase using both terminal tabs

Discharge resistors available as separate item (see page 48)

DEFINITIONS AND SELECTION CRITERIA

Rated Voltage U_N

Root mean square of the max. permissible value of sinusoidal AC voltage in continuous operation. The rated voltage of the capacitors indicated in the data charts must not be exceeded even in cases of malfunction. Bear in mind that capacitors in detuned equipment are exposed to a higher voltage than that of the rated mains voltage; this is caused by the connection of detuning reactor and capacitor in series. Consequently, capacitors used with reactors must have a voltage rating higher than that of the regular mains voltage (compare U_C on page 57). Unless indicated otherwise, all voltages stated in this catalogue are rms values.



Maximum RMS Voltage U_{max}

Maximum rms voltage, which the capacitor can be exposed to permanently. This value also considers the maximum reactive power and the resulting power losses of the capacitor.



Test Voltage Between Terminals U_{BB}

Routine test of all capacitors conducted at room temperature, prior to delivery. A further test with 80 % of the test voltage stated in the data sheet may be carried out once at the user's location.



Voltage test between terminals and case U_{BG}

Routine test of all capacitors between short-circuited terminals and case, conducted at room temperature. May be repeated at the user's location.



Rated power Q_C

Reactive power resulting from the ratings of capacitance, frequency, and voltage: $Q_C = 2\pi f \cdot C \cdot U_N^2$



Maximum RMS Current Rating I_{max}

Maximum rms value of permissible current in continuous operation. The maximum permitted rms current for each particular capacitor is related either to construction features or to the current limits of the terminals. In accordance with IEC 60831 all ELECTRONICON capacitors are rated at least $1.3 \times I_N$ (with I_N being the nominal current of the capacitor at rated voltage and frequency), allowing for the current rise from permissible voltage and capacitance tolerances as well as harmonic distortion. As a rule, our values of maximum permitted continuous current are substantially higher. The exact value for each capacitor can be found in the individual data sheet. Higher rms values can be implemented by adjustments in construction and are available on request.



Continuous currents that exceed the I_{max} values specified in the data charts will lead to a build-up of heat in the capacitor and may cause reduced lifetime or premature failure. Permanent excess current may even result in malfunction of the capacitor's safety mechanisms, i.e. bursting or fire (see page 18).



Care must be taken not to exceed the maximum voltage and current ratings when installing capacitors in close-tuned or detuned equipment (see data sheets for maximum ratings). The thermal monitoring of reactors, or the use of overcurrent protection relays in the capacitor circuit is recommended to protect against overloads.

DEFINITIONS AND SELECTION CRITERIA



Current rating I_N

RMS value of the current at rated voltage and frequency, excluding harmonic distortion, switching transients, and capacitance tolerance.

It can be calculated by the formula $I = \frac{Q_C}{U_N} = 2\pi f \cdot C \cdot U_N$ and is not stated in the data charts.



Pulse current strength I_S

Depending on construction and voltage rating, the design of our capacitors permits short term inrush currents of $100...400 \times I_N$ and – in accordance with IEC 60831 – up to 5000 switching operations per annum as standard. However, when switching capacitors in automatic capacitor banks without detuning reactors, higher loads are very often the case. This may generate negative effects on the operational life, especially with capacitors which are frequently connected and disconnected (e.g. primary stages in automatic capacitor banks). Moreover, even detuned capacitors may experience switching currents exceeding the permissible maximum current of the reactor and causing consequential damage to both capacitor and reactor.



We strongly recommend the use of special capacitor contactors with inrush limiting resistors, or other adequate devices for limitation of the peak inrush currents.



Temperature category

The average useful life of a capacitor depends very much on the ambient temperatures it is operated at. The permissible operating temperatures are defined by the temperature class stated on the label which contains the lower limit temperature (-40°C for design D, -50°C for all CAPAGRIP™ power capacitors) and a letter, which describes the values of the upper limit temperatures. Chart 6 is based on IEC 60831 and details the maximum permitted ambient temperatures for capacitors in each temperature category.

temperature category	ambient temperature limits		
	maximum	max. average 24 hrs	max. average 365 days
B	45°C	35°C	25°C
C	50°C	40°C	30°C
D	55°C	45°C	35°C
60	60°C	50°C	40°C
65	65°C	55°C	45°C
70	70°C	60°C	50°C

chart 6



Lifetime Statements

Even though all our lifetime statements are based on many years of empirical data, testing and field statistics, they will always remain just a general prognosis based on data of the past and accelerated laboratory tests which cannot reflect all aspects of modern operating conditions. The real "lifetime" of our capacitors depends on a multitude of influencing factors, such as ambient temperatures, operating voltages, frequency of overvoltages, frequency of switching, system faults a.o. The lifetime estimations given in our data sheets are therefore linked with specific operating conditions (voltage and temperature).

It has also to be noted that any lifetime statement considers a certain percentage of permitted failures within a given lot, reflecting the fact that any component has a FIT rate (failures in time). Under rated operating conditions, our capacitors can be expected to have a FIT rate of no more than 300 (corresponding to a maximum failure rate of 3 %) during their initial 100,000 hours of operation..

Please consult our sales teams if in doubt about the specific implications of your intended operating conditions on lifetime and reliability of our capacitors.

DATA CHARTS

General Technical Data

rated voltages	230 ... 800 V, 50 Hz
permitted overvoltages and test voltages	in accordance with IEC EN 60831-1/2 (see data charts for details)
tolerance of capacitance	- 5 ... + 10 %, ± 5 % on request
maximum permissible current	at least 1.3 I _N , see data charts for details
max. inrush current	MKPg 275, MKP(D) 276 300 x I _N MKP-UHD 280 400 x I _N
dissipation losses (capacitor)	approx. 0.25 ... 0.40 W/kvar
internal connection	delta
safety device	BAM™ (overpressure break action mechanism)
dielectric material	low-loss polypropylene, dry
impregnant (filling material)	MKPg 275 inert insulation gas (N ₂) MKP(D) 276, MKP-UHD 280 resin, based on vegetable oil
mounting position	MKPg 275 any position MKP(D) 276, MKP-UHD 280 vertical position recommended
max. relative humidity	95 % (climatic class C; MKP(D) 276 only: climatic class F)
operating temperatures	see data charts for ambient temperature class
storage temperature	-50 ... +85°C
max. altitude abv.s.l.	4000 m a.s.l.
statistical life expectancy	100,000 ... 200,000 h depending on type range and operating temperatures (see charts for details)
applied standards	IEC EN 60831, VDE 0560-46/47 UL Standard No. 810, CSA C22.2 No. 190, GOST 1282-88, IS 13340/13341
approval marks	 ^C _{us} only ≥ 75 x 230 all capacitors in this catalogue: UL/C-UL recognized component, 10,000AFC internally protected selected items: CSA (C/US)

All capacitors listed in this catalogue comply with the relevant regulations and guidelines of the European Union: 2014/35/EU (Low-Voltage Directive).

This is proven by the technical documentation and compliance with the following standard: IEC/DIN EN 60831-1/2:2014



MKPg™

275.*** 3PH GAS-FILLED 400 ... 440 V 50Hz

for latest edition and updates
check www.powercapacitors.info



*only $\geq 75 \times 230$

Three-phase power capacitors, dry self-healing dielectric, gas-filled (N₂)
For detuned and non-detuned PFC equipment in mains with standard operating conditions

U _N	Θ _{ambient}	statistical life
400...415V	-50/D	>130,000 h
440V	-50/D	>100,000 h

Permitted overvoltages

8h/d	485V	1min (200×)	575V
30min/d	510V	max. peak voltage	1350V ac
5min (200×)	530V		

CAPA**GRIP**™ K and II (L4) including discharge resistors. For L and M see resistor modules on pages 48f.

Q _C 440V (kvar)	Q _C 415V (kvar)	Q _C 400V (kvar)	C _N (μF)	I _{max} (A)	D ₁ × L ₁ (mm)	m (kg)	CAPA GRIP	order no.	packg.lot / box
5	—	—	3 × 28	3 × 12	60 × 164	0.4	K	275.525-402800	10 / FB8
6	5.4	5	3 × 33	3 × 16	65 × 164	0.5	K	275.535-403300	5 / FB8
8.4	7.5	—	3 × 46	3 × 20	75 × 164	0.7	K	275.545-404600	5 / FB8
10	—	8.3	3 × 57	3 × 25	65 × 245	1	K	275.538-405700	5 / FB12
11.3	10	—	3 × 62	3 × 23	65 × 245	1	K	275.538-406200	5 / FB12
15	13.3	12.5	3 × 82	3 × 31	75 × 245	1.1	K	275.548-408200	5 / FB12
18.2	—	15	3 × 100	3 × 36	85 × 245	1.5	L4	275.258-410000	5 / FB12
20	—	16.6	3 × 110	3 × 39	85 × 245	1.5	L4	275.258-411000	5 / FB12
22.4	20	—	3 × 123	3 × 39	85 × 280	1.5	L4	275.259-412300	5 / FB10
25	—	20	3 × 137	3 × 47	85 × 280	1.5	L4	275.259-413700	5 / FB10
28.2	25	—	3 × 154	3 × 56	100 × 245	1.8	L4	275.278-415400	3 / FB12
30	—	25	3 × 166	3 × 56	95 × 280	2	L4	275.269-416600	3 / FB10
50	—	—	3 × 274	3 × 86	136 × 295	4.1	M	275.39B-527400	2 / FB15
—	50	—	3 × 308	3 × 90	136 × 295	4.1	M	275.39B-530800	2 / FB15
—	—	50	3 × 331	3 × 94	136 × 295	4.1	M	275.39B-533300	2 / FB15

Other sizes and ratings are available on request. Single phase capacitors are available on request in same dimensions and design.
Mind Mounting and Operating Instructions on pages 34ff!

MKPg™
275.* 3PH GAS-FILLED**
400 ... 480 V 50Hz



*only ≥ 75 × 230

Three-phase power capacitors, dry self-healing dielectric, gas-filled (N₂)
 For detuned and non-detuned PFC equipment in mains with severe operating conditions or substantial voltage fluctuations.

U _N	Θ _{ambient}	statistical life
400...440V	-50/60	>150,000 h
480V	-50/D (*-50/C)	>100,000 h

Permitted overvoltages

8h/d	485V	1min (200×)	575V
30min/d	510V	max. peak voltage	1350V ac
5min (200×)	530V		

CAPA**GRIP**™ K and II (L4) including discharge resistors. For L and M see resistor modules on pages 48f.

Q _C 480V (kvar)	Q _C 440V (kvar)	Q _C 415V (kvar)	Q _C 400V (kvar)	C _N (μF)	I _{max} (A)	D ₁ × L ₁ (mm)	m (kg)	CAPA GRIP	order no.	packg.lot / box
6.1	5	4.6	4.2	3 × 28	3 × 12	60 × 196	0.7	K	275.523-502800	10/FB8
7.5	6.25	—	5	3 × 33	3 × 17	75 × 164	1	K	275.545-503300	5/FB8
8.7	7.5	—	6.25	3 × 40	3 × 18	75 × 164	0.7	K	275.545-504000	5/FB8
10	8.4	7.4	7	3 × 46	3 × 18	65 × 230	0.8	K	275.536-504600	5/FB12
12.5	10	—	—	3 × 58	3 × 23	75 × 230	1	K	275.546-505800	5/FB12
13.5	—	10	—	3 × 62	3 × 27	75 × 230	1	K	275.546-506200	5/FB12
15	12.5	—	10	3 × 68	3 × 27	75 × 245	1.1	K	275.548-506800	5/FB12
16.7	14.1	12.5	—	3 × 77	3 × 33	85 × 230	1.3	L4	275.256-507700	5/FB12
18	15.2	13.4	12.4	3 × 83	3 × 33	85 × 230	1.5	L4	275.256-508300	5/FB12
24.1	20	18.0	16.8	3 × 111	3 × 49	95 × 230	1.5	L4	275.266-511100	3/FB12
24.1	20	—	—	3 × 111	3 × 49	95 × 230	1.5	L	275.166-511100	3/FB12
25	21	18.6	17.4	3 × 115	3 × 50	95 × 245	1.7	L4	275.268-511500	3/FB12
26.7	—	20	—	3 × 123	3 × 46	100 × 230	1.7	L4	275.276-512300	3/FB12
30*	25	—	20	3 × 137	3 × 54	100 × 245	1.8	L4	275.278-513700	3/FB12
30*	25	—	20	3 × 137	3 × 54	100 × 245	1.8	L	275.178-513700	3/FB12
33.3*	28.2	25	—	3 × 154	3 × 56	116 × 230	2.3	L	275.186-515400	3/FB12
33.3*	28.2	25	—	3 × 154	3 × 56	100 × 280	2.2	L4	275.279-515400	3/FB12
36*	30	—	25	3 × 166	3 × 56	116 × 230	2.3	L	275.186-516600	3/FB12
36*	30	—	25	3 × 166	3 × 56	100 × 280	2	L4	275.279-516600	3/FB10
—	—	—	30	3 × 199	3 × 56	116 × 280	2.6	L4	275.289-519900	3/FB10
—	36	—	30	3 × 199	3 × 62	116 × 280	2.6	M	275.389-519900	3/FB10
—	40	—	33.3	3 × 221	3 × 75	116 × 280	2.6	M	275.389-522100	3/FB10
—	48	—	40	3 × 265	3 × 78	136 × 280	3.7	M	275.399-526500	2/FB10

Other sizes and ratings are available on request. Single phase capacitors are available on request in same dimensions and design.
 Mind Mounting and Operating Instructions on pages 34ff!

MKPg™

275.*** 3PH GAS-FILLED 400 ... 525 V 50Hz

*only $\geq 75 \times 230$

Three-phase power capacitors, dry self-healing dielectric, gas-filled (N₂)

For detuned and non-detuned PFC equipment in mains with severe operating conditions or substantial voltage fluctuations.

U _N	Θ _{ambient}	statistical life
400...440V	-50/60 (*-50/D)	>150,000 h
480V	-50/D	>150,000 h

Permitted overvoltages

8h/d	530V	1min (200×)	625V
30min/d	555V	max. peak voltage	1450V ac
5min (200×)	580V		

For resistor modules see pages 48f.

Q _C 480V (kvar)	Q _C 440V (kvar)	Q _C 415V (kvar)	Q _C 400V (kvar)	C _N (μF)	I _{max} (A)	D ₁ × L ₁ (mm)	m (kg)	CAPA GRIP	order no.	packg.lot / box
31.1	26	23.2	21.6	3 × 143	3 × 56	116 × 245	2.5	L4	275.288-614300	3/FB12
33.4	28.2	25	23.2	3 × 154	3 × 56	116 × 245	2.5	L4	275.288-615400	3/FB12
36	30	27	25	3 × 166	3 × 56	136 × 230	3.0	L	275.196-616601	2/FB12
36	30	27	25	3 × 166	3 × 56	116 × 280	2.6	L4	275.289-616600	3/FB10
40	33.8	30	27.8	3 × 185	3 × 56	116 × 280	2.6	L4	275.289-618500	3/FB10
50	41.8*	37.2	34.6	3 × 229	3 × 80	136 × 295	4.1	M	275.39B-622900	2/FB15

Other sizes and ratings are available on request. Single phase capacitors are available on request in same dimensions and design.
Mind Mounting and Operating Instructions on pages 34ff!

Three-phase power capacitors, dry self-healing dielectric, gas-filled (N₂)

For detuned and non-detuned PFC equipment in special industrial mains and installations with tough operating conditions

All items in this range are also rated for operation at 480V 60Hz

U _N	Θ _{ambient}	statistical life
525V	-50/60	>150,000 h

Permitted overvoltages

8h/d:	580 V	1min (200×)	680 V
30min/d:	600 V	max. peak voltage	1600 V ac
5min (200×):	630 V		

CAPA**GRIP**™ K including discharge resistors. For L see resistor modules on pages 48f.

U _N 525V (kvar)	C _N (μF)	I _{max} (A)	D ₁ × L ₁ (mm)	m (kg)	CAPA GRIP	order no.	packg.lot / box
10	3 × 38	3 × 20	85 × 230	1.3	L	275.156-803800	5/FB12
25	3 × 96	3 × 45	116 × 280	2.6	L	275.189-809600	3/FB10

Other sizes and ratings are available on request. Single phase capacitors are available on request in same dimensions and design.
Mind Mounting and Operating Instructions on pages 34ff!

MKPg™

275.*** 3PH GAS-FILLED

400 ... 525 V 50Hz



*only ≥ 75 × 230

Three-phase power capacitors, dry self-healing dielectric, gas-filled (N₂)
For detuned and non-detuned PFC equipment in mains with severe operating conditions or substantial voltage fluctuations.
All items in this range are also rated for operation at 480V 60Hz

U _N	Θ _{ambient}	statistical life
400...415 V	-50/65	>150,000 h
440 V	-50/60	>150,000 h
480 V	-50/D	>150,000 h
525 V	-50/D	>100,000 h

Permitted overvoltages

8h/d	580V	1min (200×)	680V
30min/d	600V	max. peak voltage	1600 V ac
5min (200×)	630V		

CAPAGRIP™ K and II (L4) including discharge resistors. For L and M see resistor modules on pages 48f.

Q _N 525V (kvar)	Q _N 480V (kvar)	Q _C 440V (kvar)	Q _C 415V (kvar)	Q _C 400V (kvar)	C _N (μF)	I _{max} (A)	D ₁ × L ₁ (mm)	m (kg)	CAPA GRIP	order no.	packg.lot / box
2.8	2.5	2	1.8	1.6	3 × 11	3 × 5	60 × 164	0.4	K	275.525-801100	10/FB8
3.6	3	2.5	—	—	3 × 14	3 × 8	60 × 164	0.4	K	275.525-701400	10/FB8
4.4	3.7	3	—	2.5	3 × 17	3 × 6	60 × 164	0.4	K	275.525-601700	10/FB8
5	4.1	3.4	3	2.8	3 × 19	3 × 9	65 × 164	0.5	K	275.535-601900	5/FB8
7.5	6.3	5.2	4.6	4.4	3 × 29	3 × 12	75 × 164	0.7	K	275.545-602900	5/FB8
10	8.3	7	6.2	5.8	3 × 38	3 × 20	75 × 230	1.0	K	275.546-703800	5/FB12
12.5	10	8.8	7.5	7.2	3 × 48	3 × 22	75 × 230	1.0	K	275.546-604800	5/FB12
15	12.5	10.6	9.4	8.8	3 × 58	3 × 30	75 × 245	1.1	K	275.548-605800	5/FB12
16.6	14.0	11.7	10.4	9.7	3 × 64	3 × 30	85 × 230	1.3	L	275.156-606400	5/FB12
17.6	15	12.5	11	10.0	3 × 68	3 × 27	85 × 230	1.3	L4	275.256-606800	5/FB12
18.6	15.6	13.2	11.6	10.8	3 × 72	3 × 29	85 × 245	1.4	L4	275.258-607200	5/FB12
20	16.7	14	12.5	11.6	3 × 77	3 × 33	95 × 230	1.5	L4	275.266-607700	5/FB12
21.6	18	15	13.4	12.5	3 × 83	3 × 36	95 × 230	1.5	L4	275.266-608300	3/FB12
25	20.8	17.4	15.6	14.4	3 × 96	3 × 45	95 × 245	1.7	L4	275.268-609600	3/FB12
30	25	21	18.6	17.4	3 × 115	3 × 54	116 × 230	2.3	L	275.186-611500	3/FB12
30	25	21	18.6	17.4	3 × 115	3 × 43	95 × 280	2.3	L4	275.269-611500	3/FB10
32	26.7	22.4	20	18.6	3 × 123	3 × 48	116 × 230	2.3	L	275.186-612300	3/FB12
32	26.7	22.4	20	18.6	3 × 123	3 × 46	95 × 280	2.3	L4	275.269-612300	3/FB10
33.3	28.0	23.4	20.8	19.3	3 × 128	3 × 50	100 × 280	2.4	L	275.179-612800	3/FB10
37.2	31.1	26	23.2	21.6	3 × 143	3 × 56	116 × 280	2.6	L4	275.289-714301	3/FB10
40	33.4	28.2	25	23.2	3 × 154	3 × 72	136 × 230	3.7	M	275.396-715401	2/FB12
43	36	30.2	27	25	3 × 166	3 × 76	136 × 280	4.0	M	275.399-716600	2/FB10
50	41.7	35	31.2	29	3 × 192	3 × 80	136 × 295	4.1	M	275.398-719200	2/FB15

Other sizes and ratings are available on request. Single phase capacitors are available on request in same dimensions and design.
Mind Mounting and Operating Instructions on pages 34ff!

MKPg™

275.*** 3PH GAS-FILLED 690 ... 800 V 50Hz

for latest edition and updates
check www.powercapacitors.info



Three-phase power capacitors, dry self-healing dielectric, gas-filled (N₂)

For detuned and non-detuned PFC equipment in 690V mains with normal operating conditions or substantial voltage fluctuations.

U _N	Θ _{ambient}	statistical life
690V	-50/60 (*-50/D)	>150,000 h
760V	-50/D	>150,000 h

Permitted overvoltages

8h/d	840V	1min (200×)	990V
30min/d	875V	max. peak voltage	2300V ac
5min (200×)	915V		

For resistor modules see pages 48f.

Q _C 690V (kvar)	Q _C 760V (kvar)	C _N (μF)	I _{max} (A)	D ₁ × L ₁ (mm)	m (kg)	CAPA GRIP	order no.	packg.lot / box
12.5	15	3 × 27.6	3 × 17	116 × 164	1.6	L	275.185-402800	3 / FB8
27.8*	34	3 × 62	3 × 36	116 × 280	2.6	L	275.189-406200	3 / FB10
33*	40	3 × 74	3 × 43	116 × 280	2.6	L	275.189-407400	3 / FB10
50*	–	3 × 111	3 × 55	136 × 295	4.1	M	275.39B-411100	2 / FB15

Other sizes and ratings are available on request. Single phase capacitors are available on request in same dimensions and design.
Mind Mounting and Operating Instructions on pages 34ff!

U _N	Θ _{ambient}	statistical life
690V	-50/60	>150,000 h
800V	-50/D	>150,000 h

Permitted overvoltages

8h/d	880 V	1min (200×)	1040 V
30min/d	920 V	max. peak voltage	2400 V ac
5min (200×)	960 V		

For resistor modules see pages 48f.

Q _N 800V (kvar)	Q _C 690V (kvar)	C _N (μF)	I _{max} (A)	D ₁ × L ₁ (mm)	m (kg)	CAPA GRIP	order no.	packg.lot / box
16.7	12.5	3 × 27.7	3 × 19	95 × 230	1.5	L	275.166-502800	3 / FB12
30	22	3 × 49	3 × 32	116 × 280	2.6	L	275.189-504900	3 / FB10

Other sizes and ratings are available on request. Single phase capacitors are available on request in same dimensions and design.
Mind Mounting and Operating Instructions on pages 34ff!

MKP UHD™

280.*** 3PH OIL-FILLED

400 ... 580V 50Hz



Three-phase power capacitors, dry self-healing dielectric, oil-filled
For ultra heavy duty filters and detuned or non-detuned PFC equipment in mains with extreme operating conditions
All items in this range are also rated for operation at 480V 60Hz

MKP UHD™ contain three delta-switched capacitor elements of short height and large diameter. The optimized combination of winding length, film size, and winding geometry minimizes inherent power losses and allows to achieve highest ratings of surge and rms currents as well as an overvoltage strength which before would have been known only of impregnated paper capacitors. By using selected low-loss, self-healing polypropylene films and sophisticated manufacturing techniques such as high-vacuum drying and special coating patterns, MKP UHD™ combine long service life with constant capacitance and outstanding switching stability.

U_N	Θ_{ambient}	statistical life
400...440 V	-50/70	>150,000 h
480 V	-50/65	>150,000 h
525 V	-50/60	>150,000 h
580 V	-50/D	>150,000 h

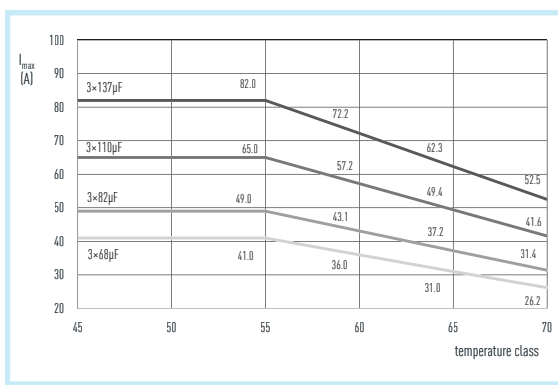
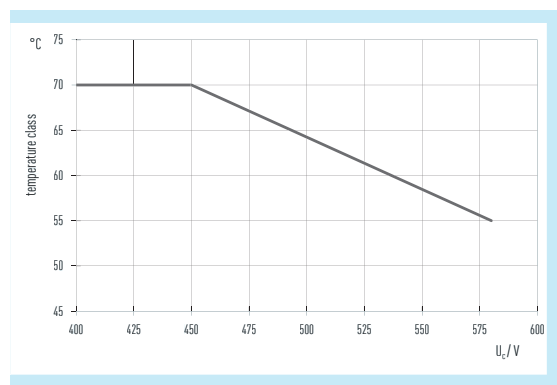
Permitted overvoltages

8h/d	640V	1min (200×)	755V
30min/d	670V	max. peak voltage	1740V ac
5min (200×)	695V		

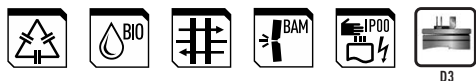
For resistor modules see pages 48f

$Q_{C 580V}$ (kvar)	$Q_{C 440V}$ (kvar)	$Q_{C 400V}$ (kvar)	C_N (μF)	I_{max} (A)	$\hat{I}_{\text{max}}$ (kA)	$D_1 \times H$ (mm)	weight (kg)	CAPA GRIP	part no.	packg.lot / box
21.5	12.5	10	3 × 68	3 × 41	3 × 6.6	95 × 280	2.3	L	280.169-306801	3 / FB10
26	15	12.5	3 × 82	3 × 49	3 × 8	100 × 280	2.5	M	280.379-308201	3 / FB10
34.6	20	16.6	3 × 110	3 × 65	3 × 10.5	116 × 280	2.9	M	280.389-311001	3 / FB10
43	25	20	3 × 137	3 × 82	3 × 13.1	136 × 280	3.9	M	280.399-313701	2 / FB10

Mind Mounting and Operating Instructions on pages 34ff!



MKP(D)

276.*** 3PH OIL-FILLED
400 ... 525V 50Hzfor latest edition and updates
check www.powercapacitors.info

Three-phase power capacitors, dry self-healing dielectric, oil-filled

For detuned and non-detuned PFC equipment in mains with severe operating conditions or substantial voltage fluctuations.

 U_N Θ_{ambient} statistical life

400...440V -40/65 >150,000 h

480V -40/D >150,000 h

Permitted overvoltages

8h/d	530V	1min (200×)	625V
30min/d	555V	max. peak voltage	1450V ac
5min (200×)	580V		

For resistor modules see page 48.

Q_C 480V (kvar)	Q_C 440V (kvar)	Q_C 415V (kvar)	Q_C 400V (kvar)	C_N (μF)	I_{max} (A)	$D_1 \times L_1$ (mm)	m (kg)	terminal	order no.	packg.lot / box
3.7	3.12	2.8	2.5	3 × 17	3 × 6.6	50 × 151	0.3	D3	276.036-501700	21 / FB0
6	5	4.5	4.17	3 × 28	3 × 11	65 × 155	0.6	D3	276.066-502800	10 / FB7
6.7	5.6	5.1	4.7	3 × 31	3 × 14	65 × 155	0.6	D3	276.066-503100	10 / FB7
–	6.25	5.5	5	3 × 34	3 × 16	65 × 155	0.6	D3	276.066-503400	10 / FB7
7.5	6.25	5.5	5	3 × 34	3 × 16	75 × 155	0.7	D3	276.076-503400	8 / FB7
9	7.5	6.7	6.25	3 × 42	3 × 14	75 × 155	0.7	D3	276.076-504200	8 / FB7
–	9	8.1	7.5	3 × 50	3 × 17	75 × 155	0.7	D3	276.076-405000	8 / FB7
–	10	8.9	8.3	3 × 55	3 × 20	65 × 215	0.8	D3	276.068-505500	10 / FB8
15	12.5	11	10	3 × 68	3 × 20	75 × 215	1	D3	276.078-506800	8 / FB8

Other sizes and ratings are available on request. Single phase capacitors are available on request in same dimensions and design.

Mind Mounting and Operating Instructions on pages 34ff!

 U_N Θ_{ambient} statistical life

400...440V -40/65 >150,000 h

480...525V -40/60 >150,000 h

Permitted overvoltages

8h/d	580V	1min (200×)	680V
30min/d	600V	max. peak voltage	1600V ac
5min (200×)	630V		

For resistor modules see page 48.

Q_C 525V (kvar)	Q_C 480V (kvar)	Q_C 440V (kvar)	Q_C 415V (kvar)	Q_C 400V (kvar)	C_N (μF)	I_{max} (A)	$D_1 \times L_1$ (mm)	m (kg)	terminal	order no.	packg.lot / box
5	4.17	3.5	3	2.9	3 × 19.2	3 × 10	65 × 155	0.6	D3	276.066-701900	10 / FB7
10	8.5	7	6.25	5.9	3 × 39	3 × 19	75 × 215	1	D3	276.078-703900	8 / FB8

Other sizes and ratings are available on request. Single phase capacitors are available on request in same dimensions and design.

Mind Mounting and Operating Instructions on pages 34ff!

MKP-1

276.*** 1PH OIL-FILLED

400 ... 525 V 50Hz



Single-phase power capacitors, dry self-healing dielectric, oil-filled
For detuned and non-detuned PFC equipment in mains with standard operating conditions

U_N	$\Theta_{ambient}$	statistical life
400...440V	-40/60	>150,000 h
480V	-40/D	>150,000 h

Permitted overvoltages

8h/d	530V	1min (200×)	625V
30min/d	555V	max. peak voltage	1450V ac
5min (200×)	580V		

For resistor modules see page 48.

Q_C 480V (kvar)	Q_C 440V (kvar)	Q_C 415V (kvar)	Q_C 400V (kvar)	C_N (μF)	I_{max} (A)	$D_1 \times L_1$ (mm)	m (kg)	terminal	order no.	packg.lot / box
4.1	3.3	3.1	2.9	57	11.1	50 x 148	0.3	D1	276.036-505710	21 / FB0
4.5	3.8	3.4	3.1	62	12.2	50 x 148	0.3	D1	276.036-506210	21 / FB0
4.8	4	3.6	3.3	66	13	50 x 148	0.3	D1	276.036-506610	21 / FB0
5.6	4.7	4.2	3.9	77	15.2	55 x 148	0.4	D1	276.046-507710	18 / FB0
6	5	4.5	4.2	83	16.3	60 x 148	0.5	D1	276.056-508310	18 / FB0
—	—	7.2	6.7	133	22	65 x 188	0.6	D2	276.067-513310	10 / FB8

Other sizes and ratings are available on request.
Mind Mounting and Operating Instructions pages 34ff!

U_N	$\Theta_{ambient}$	statistical life
400...525V	-40/60	>150,000 h

Permitted overvoltages

8h/d	580 V	1min (200×)	680 V
30min/d	600 V	max. peak voltage	1600 V ac
5min (200×)	630 V		

For resistor modules see page 48.

Q_C 525V (kvar)	Q_C 480V (kvar)	Q_C 440V (kvar)	Q_C 415V (kvar)	Q_C 400V (kvar)	C_N (μF)	I_{max} (A)	$D_1 \times L_1$ (mm)	m (kg)	CAPA GRIP	order no.	packg.lot / box
2.9	2.4	2	1.8	1.7	33	7.2	50 x 148	0.3	D1	276.036-703310	21 / FB0
4.17	3.5	3	2.6	2.4	48.2	10.3	55 x 148	0.4	D1	276.046-704810	18 / FB0
5.8	4.8	4	3.6	3.3	66	14.3	65 x 148	0.6	D2	276.066-706610	10 / FB0

Other sizes and ratings are available on request.
Mind Mounting and Operating Instructions pages 34ff!

MOUNTING INSTRUCTIONS



Safe operation of the capacitors can be expected only if all electrical and thermal specifications as stated on the label, in the data sheets or catalogues and the following instructions are strictly observed. ELECTRONICON does not accept responsibility for whatever damage may arise out of a non-observance.



Mounting Position

Oil-filled MKP(D) 276 and MKP UHD capacitors shall be installed upright with terminals facing upwards. Gas-filled MKPg 275 capacitors can be mounted in any position without restrictions, however, a position with terminals pointing downwards should be avoided.



Location/Cooling

The useful life of a capacitor may be reduced dramatically if exposed to excessive heat. Typically, an increase in the ambient temperature by 7°C will halve the expected life of the capacitor. The permitted temperature category of the capacitor is stated on the label. If extenuating circumstances give cause for doubt, special tests should be conducted by the user to ensure that the permitted maximum ambient temperature of the capacitor is not exceeded. It should be noted that the internal heat balance of large capacitors is only reached after a couple of hours.



To avoid overheating the capacitors must be allowed to cool unhindered and should be shielded from external heat sources. Do not place the capacitors directly above or next to heat sources such as detuning or tuning reactors, bus bars, etc. and make sure the connecting cables do not import additional heat via the terminals. We recommend forced ventilation for all applications with detuning reactors. Give at least 15 ... 20 mm clearance between the capacitors for natural convection or forced ventilation.



Mounting

All cylindrical capacitors are fitted with a "break-action" safety mechanism (BAM™, see page 18) which may cause the case to expand, especially at the crimp and at the lid.

- The folded edge of the lid must not be retained by clamps.
- A clearance of at least 35mm above the terminations shall be accommodated.
- Required clearances according to applicable voltage category must be maintained even after activation of the BAM™ and prolongation of the can.

The hermetic sealing of the capacitors is crucial for a long operating life and for the correct functioning of the break action mechanism. Please pay special attention not to damage the following critical sealing points:

- the folded edge of the lid
- the connection between screw terminal and lid (designs K, L, L4, M)
- the rubber seal and the soldering at the base of the tab connectors (design D)



The folded edge and the connection terminals must not be hit with heavy or sharp objects or tools (e.g. hammer, screw driver).



Fixation

All cylindrical capacitors can be fixed sufficiently using the mounting stud at the base of the can. Make sure to insert the washer which is delivered along with the mounting nut.

mounting stud	permitted max. torque
M8	5 Nm
M12	15 Nm

chart 7

MOUNTING INSTRUCTIONS

Vibration stress according to DIN IEC 60068-2-6

Please consult us for details of permitted vibration stress in your application.

Note that capacitors fitted with the EL-Dr discharge reactor must not be exposed to any vibration stress at all.

Connection

Fuses and cross section of the leads should be sized for at least 1.5 times of the rated capacitor current (I_N). Please ensure that the permitted maximum rms current according to data chart (I_{max}) is not exceeded. Do not exceed the permitted nominal current values per contact as specified in chart 8 even when coupling capacitors in parallel.



The capacitors shall only be connected with flexible cables or elastic copper bands to ensure unrestricted functioning of the expansion mechanism (BAM™).

Stranded cables should be fitted with ferrules when connected to the CAPAGRIP terminals. See chart 8 for minimum cable size if used **without** ferrules. Make sure to use cables with fine or medium strands only.

The solder joints on the capacitor lids guarantee the hermetical sealing of the capacitors and must not be exposed to excessive heat. It is not recommended to solder cables to type D terminals. Instead, always use appropriate tab connectors (6.3 mm) for connection.



The CAPAGRIP™ terminals (design K, L, L4, M) and the tab connectors (design D) must not be bent, twisted or moved in any other way.

Selection of cables

Cables used for the connection of power capacitors must not contribute to the power losses of the capacitor. It may therefore be appropriate to select cable sizes in excess of the minimum permitted cross sections usually specified by cable manufacturers.



Chart 8 is based on DIN VDE 0100-430 and IEC 60439-1 and related to the operation of three or four bundled copper cables at an average ambient temperature of 40°C. Mind that national rules or the standards of your application may require different ratings.

Chart 8 outlines the minimum requirements towards the connection of capacitors. We recommend dimensioning the cables for at least $1.5 \times I_N$ where possible, and using one grade larger cable ratings if expecting higher ambient temperatures and/or substantial content of harmonics.

max. nominal capacitor current (A/phase)	e.g. Q_c at 400V 50Hz (kvar)	recommended cable section (mm²/phase)	max. recommended HRC fuse* (A)
6.0	2.5	1.5	25
12.3	5...7.5	2.5	32
16.2	8.3 ... 10	4	35
20.8	12.5...15	6	40
28.5	16.7...20	10	63
37.7	25	16	80
50.0	30...33.3	25	125
60.8	40	35	125
76.2	50	50 / 35**	160

* The recommended HRC fuses are rated for cable protection only.

** Cables shall not be bundled.

chart 8

MOUNTING INSTRUCTIONS



Termination Torques

Do not exceed the permitted torque of the terminal screws (design K, L/L4, M) and the mounting studs. The test values specified by IEC 61068 must be guaranteed as a minimum value.

All CAPAGRIP™ terminals are equipped with Torx screws (T20). Use of improper screw-drivers may damage the screws and impair reliable fixation.



Terminal design	Minimum size of inserted flat conductor W x H (mm)	Cable size with ferrule or plug (mm²)	Cable size if without ferrule (mm²)	Max. nominal current (A)	Recommended torque (Nm)
D	n.a.	1.5 ... 6	n.a.	16/plug	n.a.
K	4 ... 4.8 x 1.2	2.5 ... 10	10	30	1.8 ... 2.5
L, L4	5.5 ... 6.8 x 1.2	10 ... 25	16 ... 25	43	2.5 ... 3.0
M	8 ... 9.8 x 1.2	16 ... 35	35 ... 50	80	4.0 ... 5.0

chart 9



Discharge

Standard IEC 60831 requires a safety discharge to ≤ 75 V within 3 minutes in order to protect maintenance personnel from accidental injury by residual voltage.



Capacitors must be discharged and short-circuited before working on the terminals.

In order to minimize the switching strain and to avoid high energizing currents by connection in phase opposition, capacitors shall be discharged to ≤ 10 % of the rated voltage prior to being re-connected if switched by mechanical devices (magnetic contactors). Note that in automatic capacitor banks, very often shorter discharge cycles may be required (e.g. < 50 V within 60 seconds).



Use rapid discharge reactors or switchable discharge resistors for very short discharge cycles (see chapter "Switching and Discharging Capacitors", pgs. 38ff).

Discharge Modules

For capacitors in **CAPAGRIP L/M**, separate discharge modules in finger-proof housing (IP20) are available for the discharge of single units or groups of paralleled capacitors. For **MKP(D)** capacitors, similar discharge sets are available (IP00). The correct size of the module to be applied can be taken from the selection matrix on pg. 48f.



The discharge resistors may become very hot (up to 200°C) during continuous operation!

For CAPAGRIP L/M only: Remove the lid of the discharge module if applying protective caps to the capacitors!

Capacitors in **CAPAGRIP K** and **CAPAGRIP II (L4)** are equipped with internal discharge resistors for a discharge within no more than 60 seconds from their highest rated voltage to less than 50 V.



Earthing

Capacitors with a metal case must be earthed at the mounting stud or by means of a separate metal strap or clamp.

MOUNTING INSTRUCTIONS

Environment

All capacitors are made with lead-free solder tin and comply with the ROHS and REACH regulations. Our capacitors do not contain PCB, solvents, or any other toxic or banned materials. The impregnants and filling materials of MKP(D) and MKP-UHD contain vegetable oil or polyurethane mixtures. The gas-filled MKPg™ capacitors contain only neutral, ecologically sound insulation gasses. Further details on the filling materials can be provided on request.



The capacitors do not contain hazardous substances acc. to European Directives 2003/53/EC and Council Directive 76/769/EEC. They are not classified as **“dangerous goods”** according to transit rules. The capacitors do not have to be marked under the regulations for Hazardous Goods. They are rated WGK 0 (water risk **category 0 “no general threat to water”**).



No danger for health if applied properly. In case of skin contact with filling liquids, clean with water and soap.

Disposal

Capacitors are components of electrical devices. They are NOT equipment or devices by themselves, and not subject to the Waste Electrical and Electronic Equipment Directive (WEEE). We recommend disposing of the capacitors through professional recycling centers for electric/electronic waste.



The capacitors can be disposed of as follows:

- Disposal acc. to European waste catalogue (EWC) No. 16 02 16 (“Components removed from discarded equipment other than those mentioned in 16 02 15”).
- Liquid filling materials which may have emerged from the capacitor shall be absorbed by proper granules and disposed of in accordance with EWC No. 08 04 10 (“waste adhesives and sealants other than those mentioned in 08 04 09”).

Caution: When touching or disposing capacitors with activated break-action mechanism, please consider that even after days and weeks these capacitors may still be charged with high voltages!

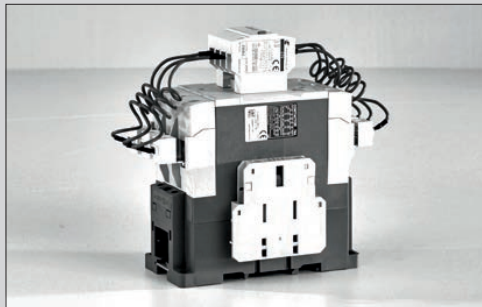


Make also sure to consult your national rules and restrictions for waste and disposal.

SWITCHING AND DISCHARGING

Our power capacitors are designed to withstand high surge currents manifold their rated current. Even so, repetitive high inrush currents may damage capacitors and should therefore be avoided by

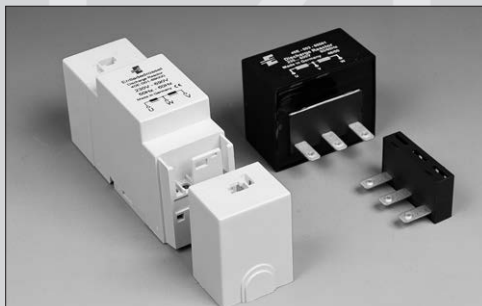
A. suppressing switching currents by the use of special capacitor contactors, see pages 40 to 42.



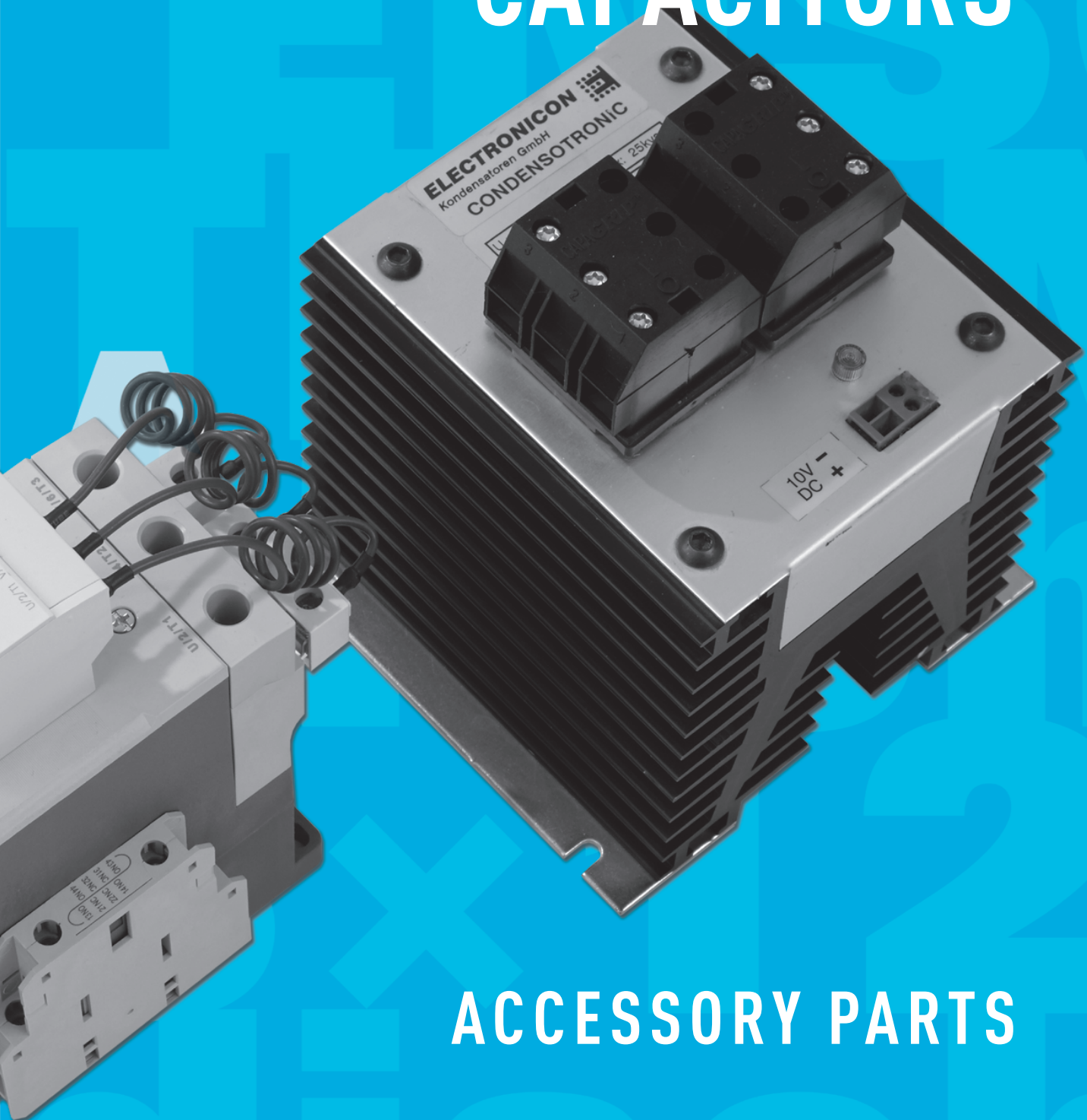
B. eliminating inrush currents by the use of suitable thyristor switches, see pages 43 to 46.



C. avoiding re-connection in phase opposition by the use of proper discharge resistors or reactors, see pages 47 to 51.



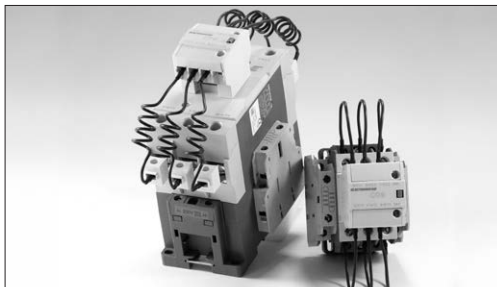
SWITCHING AND DISCHARGING CAPACITORS



ACCESSORY PARTS

CAPACITOR CONTACTORS

1301A SERIES



Power capacitors may enter high-frequency resonances with nearby inductances when being connected to the mains. Though vanishing within a few microseconds, such resonances lead to very high current surges which, if occurring regularly, may damage the capacitor elements. In accordance with IEC EN 60831-1/2, the annual number of switching operations for our standard capacitors is therefore recommended not to exceed 5000...6000 counts p.a. Special capacitors suitable for a higher annual number of switchings are available on request.

For flawless operation of our capacitors, we strongly recommend using special capacitor contactors with inrush-limiting ("leading") contacts. Such devices connect a preload channel several milliseconds prior to closing their main contact. This channel is choked down by special current limiting resistors and substantially softens the initial switching inrush surge, protecting the capacitors from destructive current surges and the contactors from premature deterioration or welding.

Our 1301A contactors are using a mechanical principle for switching the pre-load contacts. The pre-load contacts and damping resistors are supplied as a separate part and are snapped onto the main switch.

As soon as the main switch has been closed, the pre-load contacts are released again and their resistor wires taken out of circuit after no more than 5...10ms of operation. This avoids additional heat losses in the resistor wires during the operation of the capacitor branch, and contributes to the high reliability and long operational life of our contactors.

Since the disconnection of inductive loads is usually accompanied by switch arcs, the pre-load contacts of certain capacitor contactors may often face trouble when used with reactor-capacitor combinations (detuned capacitors) as they are lagging behind the main contact during the switch-off process. The contactors of our 1301A series are not affected by this problem as their pre-load contacts are already out of circuit. Hence they can be used for both detuned and non-detuned capacitor installations. ELECTRONICON strongly recommends the usage of contactors with pre-load contacts even for detuned capacitors in order to assure undisturbed switching and prevent ferro-resonances of the reactor during the start-up period.

The 1301A is enclosed in a compact, finger proof housing (IP20). Its sealed structure prevents the exposure of any arc flashes. The contactors comply with both IEC and UL standards, including UL's type II coordination requirements.

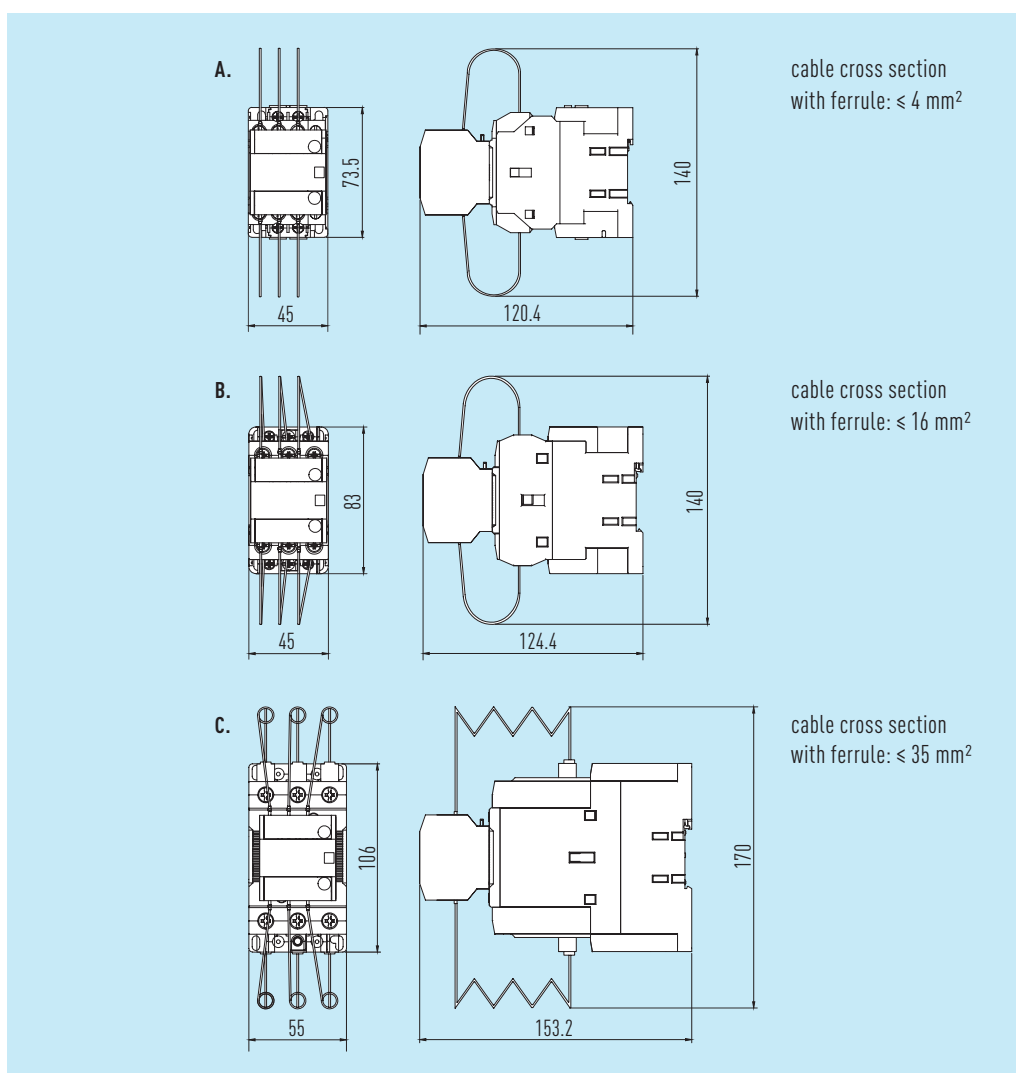
General Technical Data

design	magnetic, three phase, with mechanical pre-load contacts for inrush protection
voltage range	$U_{\text{mains}} = 220 \dots 550 \text{ V}$
control voltage	220...250 Vrms
operating temperature	-40°C/D
mounting	DIN hat rail W x H = 35 x 7.5 mm or base mounting lugs for $\varnothing 5 \text{ mm}$ screws
snap-on auxiliary contacts	available on request
standards	IEC EN 60947-4-1, UL508
approval marks	(available on request) UL, CSA

DIMENSION DRAWINGS

order no.	1301A.C0...			1301A. C7...	
	9-12.5	9-25.0	9-33.3	5-54.0	5-60.0
rated current @50°C	<18 A	<36 A	<48 A	<87 A	<92 A
max. kvar 220...240 V	<6.7	15	20	30	35
max. kvar 400...440 V	<12.5	25	33.3	54	60
max. kvar 500...550 V	<18	36	48	78	92
drawing	A	B	B	C	C
permitted switchings/hour	up to 240			up to 100	
contact life (switchings, non-detuned)	200,000			100,000	
preload contacts (obligatory accessory part)	1302A.C09-00.0			1302A.C75-00.0	
permitted operating temperature	-30 ... +60°C				

Type Range



Dimension Drawings

THYRISTOR SWITCHES

Other than conventional contactors, our semiconductor-based switches allow for exact determination of the switching moment to the millisecond. This brings about two advantages:

1. Connection of the capacitor exactly at the moment of equal voltage between mains and capacitor element(s): this eliminates inrush effects almost completely without the need for current-limiting resistors, substantially enhancing the operating conditions for the capacitor and resulting in a longer life expectancy.
2. Instantaneous power factor correction for rapidly changing loads: certain reactive loads, e.g. spot welding equipment or elevator systems, call for a high amount of power factor correction for short but very frequent periods. Thyristor switches are capable of multiple switching operations per minute. Since they always switch at zero-voltage-differential (see pt.1), the capacitors do no longer need to be discharged before re-connection, and can sustain substantially higher numbers of connections as compared with conventional magnetic contactors.

Discharge resistors and thyristor switches:

Thyristor switched capacitors do not require discharge resistors for proper operation. For the purpose of maintenance safety, however, all power capacitors are required to be equipped with bleeding resistors ensuring a discharge below 75V within no more than 3 minutes after disconnection. When selecting the discharge resistors for thyristor-switched capacitors, please consider the following important points:

1. Due to carrier storage effects during switch-off, thyristor switches may charge the capacitor with an overvoltage of up to $1.43 \times U_{AC}$ (= ca. $2 \times U_{rms}$) at the moment of disconnection. This is unproblematic for ELECTRONICON power capacitors, however frequent switching may overheat and even destroy the bleeding resistors.
2. Certain thyristor switches keep disconnected capacitors constantly charged at maximum AC voltage in order to provide a defined "point of re-entry". This permanent voltage will then be up to 1.41 times above the rated voltage of discharge resistors normally used for "standard" power capacitors!

The resistors integrated in our CAPAGRIP K and CAPAGRIP II terminals are usually rated for the nominal voltage of the connected capacitor and a discharge below 50 V within less than 60 seconds; in the 525 V range, the resistors are dimensioned for such discharge from 480 Vrms (= 680 Vac). They are not suitable for the operation with thyristor switches. You are therefore required to use capacitors from our Heavy Duty ranges with CAPAGRIP L or M terminals instead and select suitable resistor modules from our selection charts on pages 49ff.



Use resistors with a rated voltage of at least $2.2 \times U_N$. As a rule, our 275.106 modules rated 1000 V will be sufficient for equipment in 400 or 415 V mains.

Remember that the discharge is relevant for safety aspects only. Select resistor values which serve for a discharge of the capacitors below 75V within 3 or – even better – 5 minutes. This drastically reduces the power dissipation losses of the resistors.

Five minutes discharge period is not specified by standard IEC EN 60831. Make sure to place an appropriate warning sticker on capacitors or equipment if selecting resistors this way.

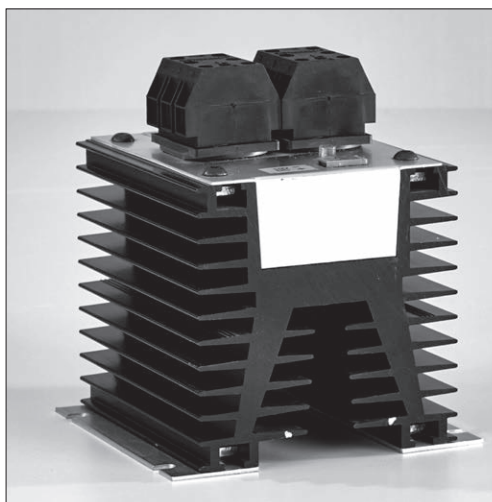
CONDENSOTRONIC CT 2000

YOU'LL BARELY FIND A MORE COMPACT ONE

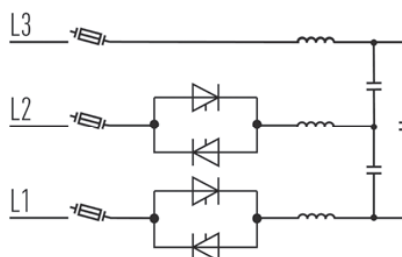
Immediate compensation of inductive reactive power is very often the only way to cope with disturbances imposed on the mains by huge, rapidly changing inductive loads. Conventional capacitor switching devices with reaction periods of 20...90 seconds cannot comply with such intensive requirements.

The CONDENSOTRONIC thyristor switch module makes reaction times of 1...20 milliseconds possible. The switching is done, practically without reactive effects, at zero voltage level (no voltage between input and output).

CONDENSOTRONIC has a very compact design, convenient connection, integral overheating protection, and LED indication for the switching signal and excessive temperature. For optimized cooling, a controllable fan is included.



The CONDENSOTRONIC CT2000 thyristor switch works according to the W3C-2 switching principle, i.e. phase L3 will not be switched.



CT 2000
Switching
Principle

design	two controlled phases (semi-controlled)
indications	LED
voltage range	$U_{\text{mains}} = 400...525 \text{ V}$ (other voltages on request)
signal voltage	$10 \text{ V} \pm 2 \text{ V DC}$
response time	0.2...15 ms
recovery time	40 ms
max. altitude	1000 m a.s.l.
ambient operating temperature	-10...40°C
storage temperature	-40...85°C
relative humidity	10...95 % (no condensation permitted)
degree of protection	IP20
mounting position	optional

General
Technical
Data

CONDENSOTRONIC CT 2000

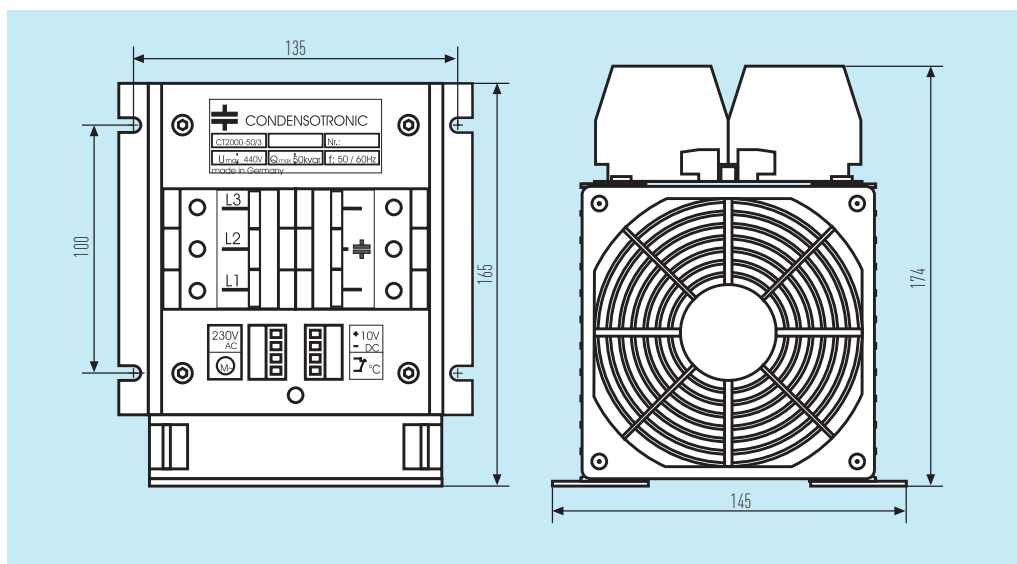
for latest edition and updates
check www.powercapacitors.info

Type Range

type	Q _c (kvar)	U _N (V)	I _{max} (A)	power losses (W@I _{max})	Fan	dimensions (mm)			weight (kg)	order code
						L	W	H		
CT2000-25/3/440	25	380 ... 440	50	110	x	145	165	174	3.5	12442.050-10.0
CT2000-25/3/525	25	500 ... 577	38	110	x	145	165	174	3.5	12572.038-10.0
CT2000-50/3/440	50	380 ... 440	100	220	x	145	165	174	3.5	12442.100-10.0
CT2000-50/3/525	50	500 ... 577	77	220	x	145	165	174	3.5	12572.077-10.0

Dimension Drawings

CT 2000-25/CT 2000-50

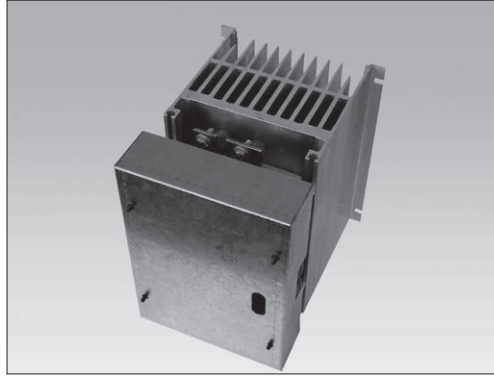


TS 12-2

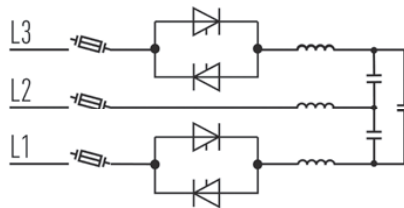
MODERN THYRISTOR SWITCHES FOR YOUR STATIC PFC SYSTEM

The new thyristor switch modules of our TS12-2 series can switch within 20 milliseconds. Other than CT2000, the TS12-2 is kept charged at peak voltage after disconnection. The switching is done, practically without reactive effects, at peak voltage mains level, i.e. when there is no voltage differential between mains voltage and the charge of the capacitor.

The TS12-2-module has a compact design and integral overheating protection. For powers above 50 kvar, a controllable fan is included.



TS12-2 works according to the W3C-2 switching principle, i.e. phase L2 will not be switched.



TS12-2
Switching
Principle

design	two controlled phases (semi-controlled)
voltage range	$U_{\text{mains}} = U_N = 400 \dots 690 \text{ V}$ (other voltages on request)
control voltage	230 V 50/60 Hz (other voltages on request)
signal voltage	8 - 30 V dc
recovery time	typically 1 period
max. altitude	1000m a.s.l.
ambient operating temperature	-10...45°C (up to 65°C with derated current ratings)
relative humidity	10...95 % (no condensation permitted)
degree of protection	IP10
mounting position	optional

General
Technical
Data

TS 12-2

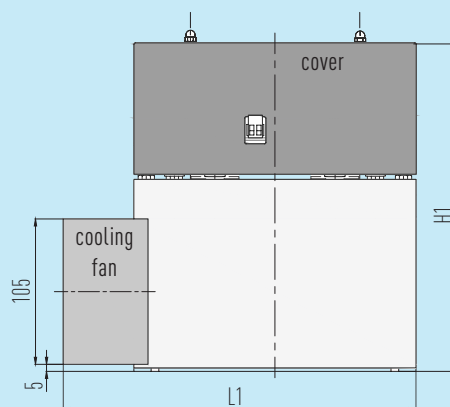
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Type Range

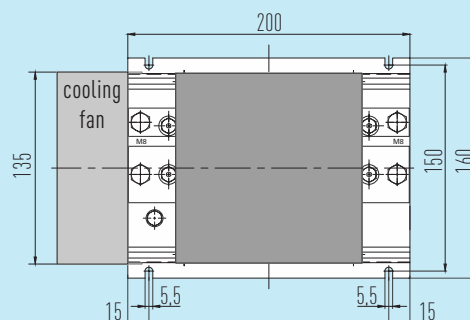
type	U _N (V)	Q _C (kvar)	I _N (A)	max. I _N (A)	power losses (W@I _{max})	Fan	dimensions (mm)		weight (kg)	order code
							L ₁	H ₁		
TS12-2_400V_36A	400	25	36	47	93	-	-	215	4.3	12402.036-00.0
TS12-2_400V_72A	400	50	72	93	165	-	-	215	4.3	12402.072-00.0
TS12-2_400V_109A	400	75	109	141	283	x	260	215	5.6	12402.109-00.0
TS12-2_400V_144A	400	100	144	187	341	x	260	215	5.6	12402.144-00.0
TS12-2_440V_33A	440	25	33	43	74	-	-	215	4.3	12442.033-00.0
TS12-2_440V_66A	440	50	66	86	153	-	-	215	4.3	12442.066-00.0
TS12-2_440V_99A	440	75	99	129	262	x	260	215	5.6	12442.099-00.0
TS12-2_440V_131A	440	100	131	170	305	x	260	215	5.6	12442.131-00.0
TS12-2_480V_30A	480	25	30	39	67	-	-	215	4.3	12482.030-00.0
TS12-2_480V_60A	480	50	60	78	139	-	-	215	4.3	12482.060-00.0
TS12-2_480V_90A	480	75	90	117	235	x	260	215	5.6	12482.090-00.0
TS12-2_480V_120A	480	100	120	156	276	x	260	215	5.6	12482.120-00.0
TS12-2_480V_150A	480	125	150	195	356	x	260	215	5.6	12482.150-00.0
TS12-2_525V_72A	525	65	72	93	159	-	-	215	4.3	12522.072-00.0
TS12-2_525V_144A	525	130	144	187	325	x	260	215	5.6	12522.144-00.0
TS12-2_690V_42A	690	50	42	54	104	-	-	250	4.6	12692.042-00.0
TS12-2_690V_84A	690	100	84	109	207	x	260	250	5.9	12692.084-00.0

Dimension Drawings

reference example with integrated fan

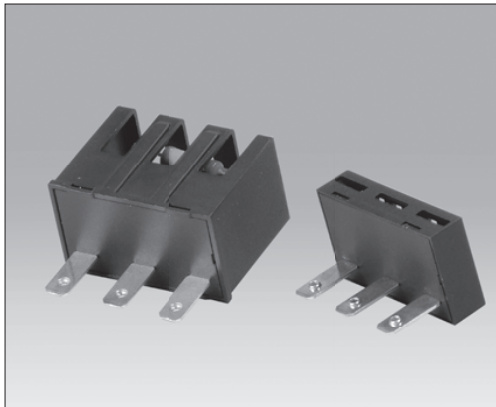


pic.1: Side view with mounted cover



pic.2: Top view with cover removed

DISCHARGE DEVICES



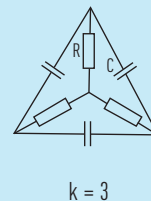
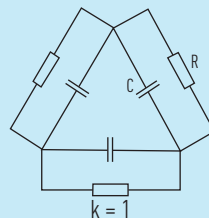
Resistor Modules

Capacitors with CAPAGRIP K and CAPAGRIP II terminals are equipped with discharge resistors for a discharge from their highest nominal voltage rating to less than 50 V within < 60 seconds. For capacitors with CAPAGRIP L, and M, as well as with D terminals we offer separate resistor modules. The correct size of the module to be applied can be selected from the data charts on pages 49f based on applied voltage, required discharge period, and capacitance to be discharged.

Alternatively, the resistors to be used for a given capacitance and operating voltage can be calculated by means of the following formula:

$$\text{three-phase: } R \leq \frac{t}{k \times C_T \times \ln \frac{U_B \times \sqrt{2}}{U_E}}$$

$$\text{single-phase: } R \leq \frac{t \times 1.5}{C_{\text{total}} \times \ln \frac{U_B \times \sqrt{2}}{U_E}}$$



t ... Discharge period in [s]
 C_T ... Partial capacitance of one phase
 C_{total} ... Total capacitance
 U_B ... Operating voltage
 U_E ... Maximum permissible voltage after period t
 R ... Module resistance value

In all cases, the closest smaller discharge module available shall be applied.

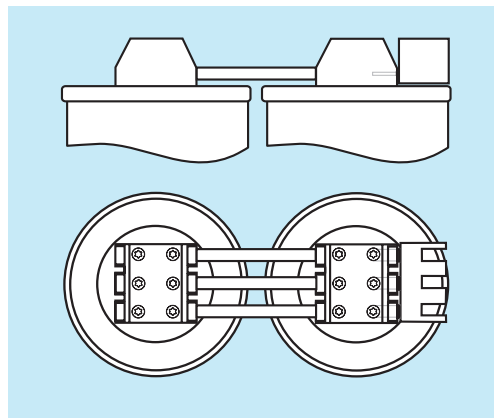
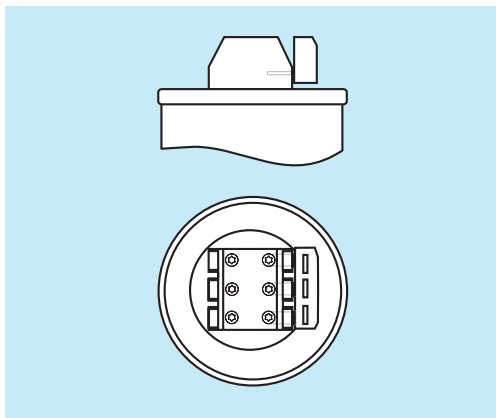
The discharge resistors may become very hot (up to 200°C) during continuous operation!

For design L/M only: Remove the lid of the discharge module if applying protective caps to the capacitors!



Sets for CAPAGRIP™ L & M Capacitors (Protection: IP20)

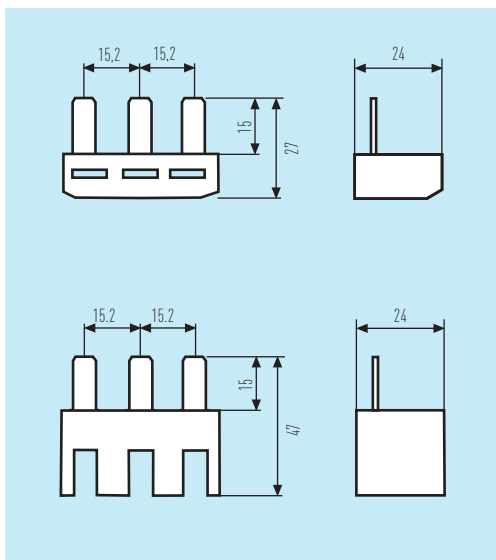
CAPAGRIP™ resistor modules can be connected to single capacitors as well as to groups of parallel units. Both type 1 and 2 are equally compatible with CAPAGRIP™ L or M terminals.



DISCHARGE DEVICES

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Type 1

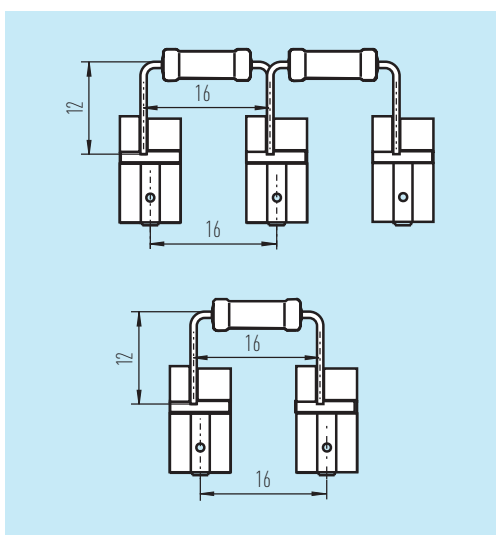


Type 2

U_{max} (V)	R_N (k Ω)	module type	selection code	order code
1000	3 Y 300	2	(1)	275.106-10300
1000	3 Y 180	2	(2)	275.106-10180
850	3 Y 120	2	(3)	275.106-10120
760	3 $\times$ 300	1	(4)	275.100-10300
720	3 $\times$ 180	2	(5)	275.105-10180
600	3 $\times$ 180	1	(6)	275.100-10180
600	3 $\times$ 120	2	(7)	275.105-10120
480	3 $\times$ 120	1	(8)	275.100-10120
530	3 $\times$ 100	2	(9)	275.105-10100
480	3 $\times$ 82	2	(10)	275.105-10082
400	3 $\times$ 82	1	(11)	275.100-10082
440	3 $\times$ 68	2	(12)	275.105-10068

Sets for Design D1/D3 Capacitors (Protection: IP00)

3ph



1ph

U_{max} (V)	R_N (k Ω)	module type	selection code	order code
three phase				
750	2 $\times$ 300	D3	(13)	275.110-10301
630	2 $\times$ 200	D3	(14)	275.110-10201
600	2 $\times$ 180	D3	(15)	275.110-10181
480	2 $\times$ 120	D3	(16)	275.110-10121
single phase				
750	300	D1	(17)	275.111-10301
600	180	D1	(18)	275.111-10181

Selection Charts

The selection charts state the maximum capacitance per voltage level which can be discharged with each resistor module:

1. Select the line of your **operating** voltage. Mind that in detuned systems, the actual voltage at the capacitor is higher than the rated mains voltage.
2. Look for the column with the capacitance which is closest to your capacitor. Look up BLACK figures if you want to discharge below 50 V within no more than 60 seconds. Look up BLUE figures if you want a discharge below 75 V within 3 minutes. Go for GREY figures if 5 min discharge is sufficient.
3. Determine the resistor module to be ordered in the head of the column.

DISCHARGE DEVICES

Selection Matrix for CAPAGRIP™ Resistor Modules (3ph, star connected)

capacitor voltage (V)		C _{max} to be discharged (μF)											
U _{max}	U _{AC}	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
230	325	3×36	3×59	3×89	3×107	3×178	3×178	3×267	3×267	3×320	3×391	3×391	3×471
		3×136	3×227	3×341	3×409	3×682	3×682	3×1022	3×1022	3×1227	3×1496	3×1496	3×1804
		3×227	3×379										
280	395	3×32	3×54	3×81	3×97	3×161	3×161	3×242	3×242	3×290	3×354	3×354	3×426
		3×120	3×200	3×301	3×361	3×601	3×601	3×902	3×902	3×1082	3×1319	3×1319	3×1591
		3×200	3×334										
400	565	3×27	3×46	3×69	3×82	3×137	3×137	3×206	3×206	3×247	3×302	3×302	3×364
		3×99	3×165	3×247	3×297	3×495	3×495	3×742	3×742	3×891	3×1086	3×1086	3×1310
		3×165	3×275										
415	585	3×27	3×45	3×68	3×81	3×135	3×135	3×203	3×203	3×244	3×297		3×358
		3×97	3×162	3×243	3×292	3×486	3×486	3×729	3×729	3×875	3×1067		3×1287
		3×162	3×270										
440	620	3×26	3×44	3×66	3×79	3×132	3×132	3×198	3×198	3×238	3×290		3×350
		3×95	3×158	3×236	3×284	3×473	3×473	3×709	3×709	3×851	3×1037		3×1251
		3×158	3×263										
480	680	3×26	3×43	3×64	3×77	3×128	3×128	3×192	3×192	3×230	3×281		
		3×91	3×151	3×227	3×272	3×454	3×454	3×681	3×681	3×817	3×996		
		3×151	3×252										
525	740	3×25	3×41	3×62	3×74	3×124	3×124	3×185		3×222			
		3×87	3×145	3×218	3×262	3×436	3×436	3×654		3×785			
		3×145	3×242										
600	850	3×24	3×39	3×59	3×71	3×118	3×118	3×177					
		3×82	3×137	3×206	3×247	3×412	3×412	3×618					
		3×137	3×229										
690	975	3×22	3×37	3×56	3×67	3×112							
		3×78	3×130	3×195	3×234	3×390							
		3×130	3×217										
760	1075	3×22	3×36	3×54	3×65								
		3×75	3×125	3×188	3×225								
		3×125	3×209										
800	1130	3×21	3×36	3×53									
		3×74	3×123	3×184									
		3×123	3×205										
850	1200	3×21	3×35	3×52									
		3×72	3×120	3×180									
		3×120	3×200										
1000	1415	3×20	3×33										
		3×68	3×114										
		3×114	3×189										

C_{max} for discharge < 50 V within 1 min

C_{max} for discharge < 75 V within 3 min

C_{max} for discharge < 75 V within 5 min*

*Recommended for thyristor-switched equipment.

NOTE: Warning about 5 min discharge time should be placed on the equipment.

DISCHARGE DEVICES

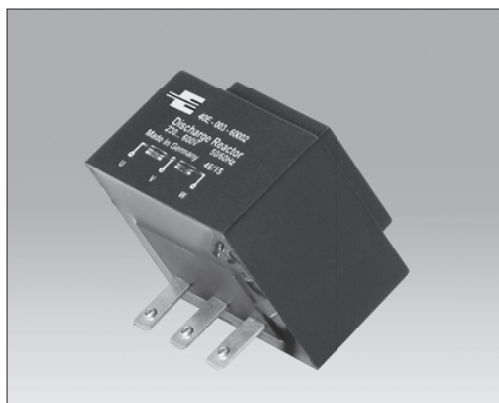
capacitor voltage		$C_{\max}$ to be discharged (μF)					
U_{rms}	U_{AC}	(13)	(14)	(15)	(16)	(17)	(18)
230	325	3×36	3×53	3×59	3×89	107	178
		3×136	3×204	3×227	3×341	409	682
280	395	3×32	3×48	3×54	3×81	97	161
		3×120	3×180	3×200	3×301	361	601
400	565	3×27	3×41	3×46	3×69	82	137
		3×99	3×148	3×165	3×247	297	495
415	585	3×27	3×41	3×45	3×68	81	135
		3×97	3×146	3×162	3×243	292	486
440	620	3×26	3×40	3×44	3×66	79	132
		3×95	3×142	3×158	3×236	284	473
480	680	3×26	3×38	3×43	3×64	77	128
		3×91	3×136	3×151	3×227	272	454
525	740	3×25	3×37	3×41		74	124
		3×87	3×131	3×145		262	436
600	850	3×24	3×35	3×39		71	118
		3×82	3×124	3×137		247	412
690	975	3×22				67	
		3×78				234	

$C_{\max}$ for discharge <50V within 1 min

$C_{\max}$ for discharge <75V within 3 min

EL-DR DISCHARGE REACTOR

40E.003-60003



The increasing demand for shorter discharge periods cannot be satisfied by traditional discharge means (fixed resistors). The installation of additional fast discharge resistors at the capacitor contactor results in an increase in material and installation costs. Our discharge reactor replaces the compulsory fixed resistors and additional rapid discharge resistors, and at the same time it reduces the heat dissipation losses inside the capacitor bank. It further avoids additional heating of the capacitor terminals by standard discharge resistors.

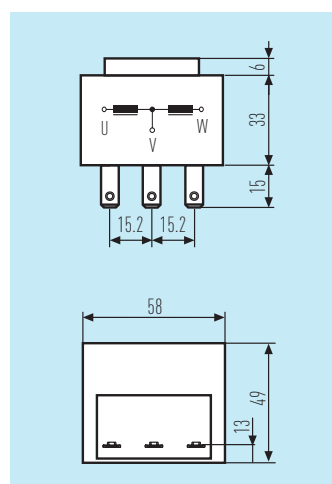
Discharge reactors must NOT be used in combination with thyristor switches. Frequent switching and the charging function of many switches will damage the reactor.



design	two controlled phases (semi-controlled)
construction	dual reactor with iron core in plastic housing
DC resistance per coil	7600 Ohm
duty cycle	continuous operation
rated voltage	230 ... 600 V 3ph, 50/60Hz
capacitor ob e discharged	5 ... 50kvar
connection	direct mounting on capacitor terminal (design L/M)
vibration stress	not permitted
dissipation losses	< 1W
ambient temperature	max. 40° C
degree of protection	IP20
dimensions W × H × D	58 × 49 × 39 mm
weight	290 g
insulation	class B (135°C)
standard	IEC 61558-2-20
CE conformity	2014/35/EU Low-Voltage Directive

General Technical Data

Q _c (kvar)	permitted no. of discharges/min at 40°C		discharge period (sec)						
	400...525 V	230 V/600 V	230 V	400 V	440 V	480 V	525 V	600 V	
12.5	5	4	12	5	4	4	4	2.6	
25	4	3	24	10	9	8	7	5	
30	3	2	-	12	10	9	8	6	
50	2	1	-	20	17	15	14	10.5	



Dimension Drawings

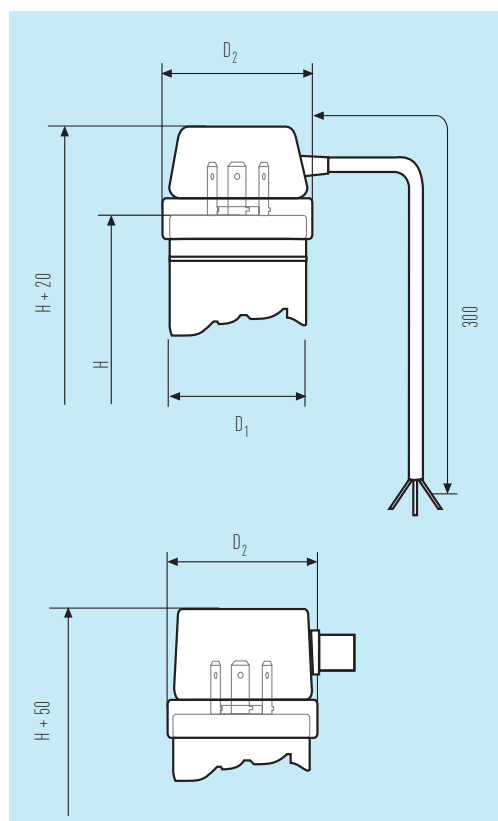
ACCESSORY PARTS

Protective caps for MKP(D) capacitors

Plastic protective caps to protect the capacitor terminals from accidental contact or the influence of dust and water are available as an option.

For diameters up to 60mm, the caps are fitted to the capacitors during manufacture, to give an IP50 rating. In this case, cable and integral discharge resistors are also fitted.

MKP(D)
 $D_1 \leq 60$



$D_1 = 65 \dots 75$



Order code:

„0“ in the center group of the capacitor code changes into „K“: 276.K××-yyyyyy

For capacitors in design D3 with diameters of 65 and 75mm, the caps must be ordered as separate parts. Cables and discharge resistors are not included. Note that these caps do not comply with an IP classification.

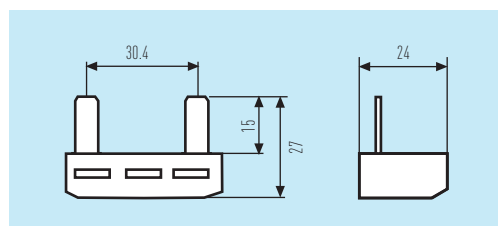
Order code:

Ø65mm: 275.137-10010

Ø75mm: 275.147-10010

Protective Blank for CAPAGRIP™ M Terminal (IP20)

Type M terminals are designed for accepting 50mm² cables. If one side of the terminal block is not used, then this blank must be fitted to maintain the IP20 rating.



Order code:

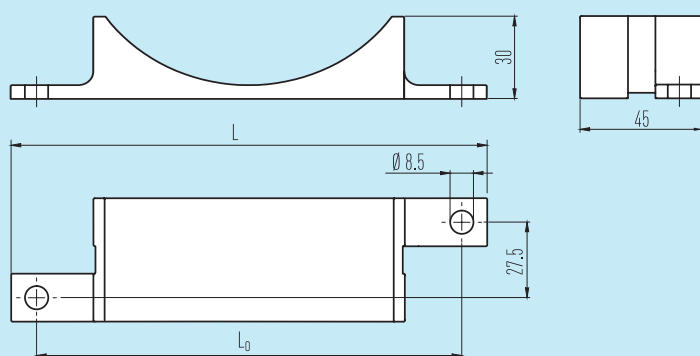
275.100-10000 (10/box.)

Holder for Horizontal Mounting

All cylindrical capacitors with diameter 116mm and 136mm can be mounted by means of this bracket on a flat vertical or horizontal surface.

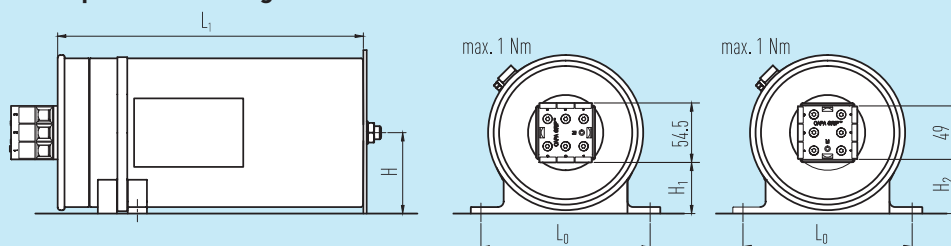
The bracket is made of glass fibre reinforced polyamide and comes as a set including a matching 9mm zinc-plated steel strap for fixation of the capacitor.

Drawings



material: glass fibre reinforced polyamid

Example for M3 design



Example of horizontal mounting.

for Diameter	L	L ₀	H	H ₁	H ₂	order no. (10 × mounting set)
116	159	135	64	37	40	E50.H16-100000
136	174	155	74	47	50	E50.H36-100001

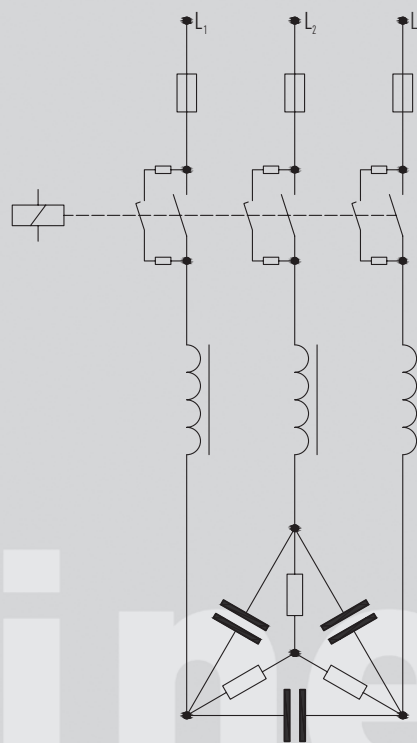
DETUNING REACTORS

The growing use of power electronic devices is causing an increasing level of harmonic distortion in the electrical system which very often leads to problems with capacitor installations. This is the reason why more and more energy suppliers demand the installation of detuned capacitors.

A detuned capacitor performs the function of power factor improvement whilst preventing any amplification of harmonic currents and voltages caused by resonance between capacitors and inductances in the electrical system.

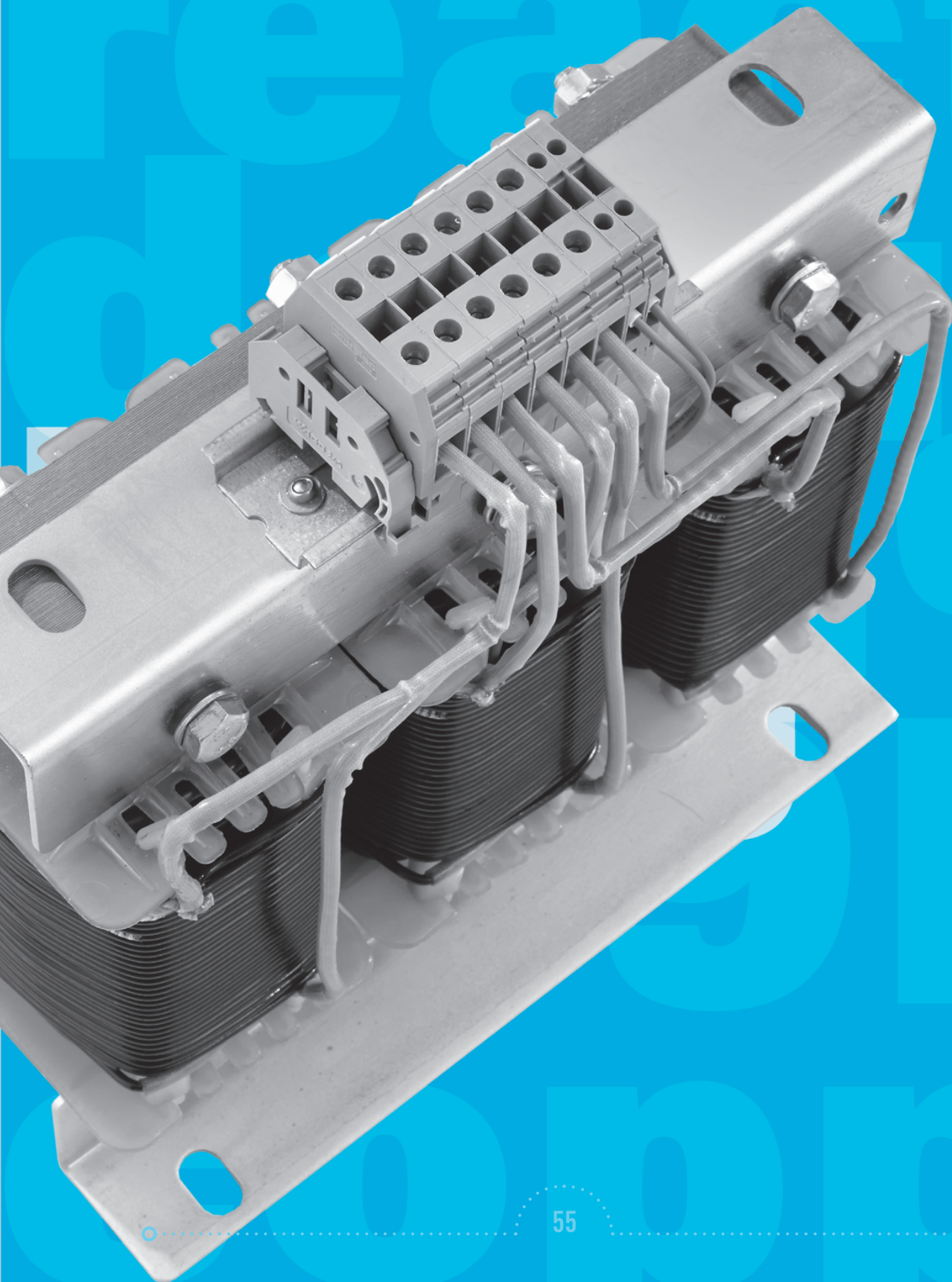
By adding an appropriately rated series reactor to the power capacitor, both elements form a **resonating circuit with its resonant frequency below the lowest order harmonic** in the system (usually the 5th). All frequencies above this resonant frequency now see this circuit as inductive hence eliminating the possibility of dangerous resonances being set up between the capacitors and system inductances (provided the reactor has been dimensioned properly).

It has to be ensured, however, that non-detuned capacitors and capacitors with detuning reactors are never operated in the same mains. Such combination may cause unforeseeable interactions and equalising currents leading to damage and destruction of capacitors, reactors, and other components.



DETUNING REACTORS

PROTECTING CAPACITORS



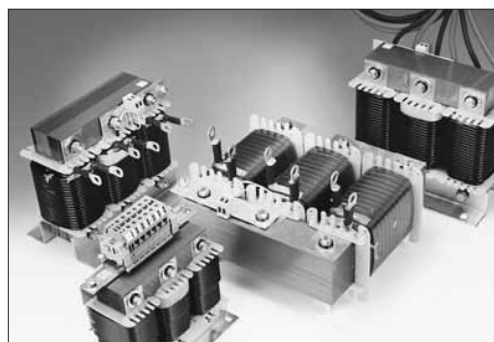
DETUNING REACTORS

Design features

Our filter reactors are made of **high-class transformer sheets** and **copper wire or aluminium band**.

They are dried and impregnated in a vacuum with environmentally friendly, low-styrole resin which ensures they can withstand high voltages, have low noise levels, and offer a long operating life.

Depending on their rated power, the reactors are provided with either terminal blocks or terminal lugs/cables. The connection of the aluminium reactors is made through copper terminals as well, which are reliably connected with the aluminium band by a special, well-proven welding method.



High-class iron cores with multiple air gaps as well as a staid designing approach guarantee **high current linearity** and **low heat dissipation losses**, at the same time allowing for compact dimensions and competitive cost. Compared with low-end reactors, our FK-Dr may save up to 100 Watts of heat dissipation losses per piece, a very important factor for the long-term operational cost (and amortisation) of the equipment.

High insulation class or low temperature rise?

Other than certain manufacturers which take special pride in offering their reactors with insulation class ratings for operation at temperatures of up to 165°C or even beyond, we focus on the operating environment of the the application's key component: the capacitor. In most cases, reactors are placed in close vicinity of the capacitor, and should therefore not serve as a destructive heat source. The conservative layout of our reactors is to limit the maximum temperature of the reactor to 115°C under rated operating conditions. An integrated reversible thermal switch allows external monitoring for disconnection of the reactor in the event of impermissible buildup of heat (>125°C).

How to avoid ferro-resonance

Commercial pressures and the desire for ever smaller switchgear dimensions lead to an increasingly intense utilisation of systems and components. Even the detuning reactors have become more compact, which has been accompanied by a reduction of their internal resistance.

Despite excellent linearity of inductance at high currents - usually the most important criterion when evaluating reactors - problems may occur in operation under unknown mains conditions. e.g. insufficient damping (low impedance) by upstream switchgear components, even at relatively low levels of harmonic distortion. Due to the magnitude of the initial switching current, the inductance of the reactor may break down to a fraction of its nominal value. In these cases, the core becomes saturated; strong audible humming and currents exceeding the rated current can occur. This phenomenon is also called **Ferro-resonance**. As the use of adequately sized reactors with higher load capability is usually ruled out for cost and space considerations, the use of **capacitor contactors with inrush protection** is recommended in all cases where the mains conditions are not known exactly. These can provide a damping effect which substantially exceeds that achieved by adaptation of the reactor dimensions, and at a much reduced cost.

It should be noted that, even when using capacitor contactors with inrush protection, sufficient current linearity of the reactor must be provided in accordance with its operating conditions.

DEFINITIONS AND SELECTION CRITERIA

Rated Inductance L_N

Inductance rating of the reactor, measured at rated current I_N , in mH (Milli-Henry). Mean value across the three phases.



Rated Voltage U_N

Root mean square value of the permissible value of sinusoidal AC voltage in continuous operation (mains voltage). The rated voltage of the reactors indicated in the data charts and the permissible overvoltage limits specified in IEC 60831 and DIN EN 50160 must not be exceeded even in cases of malfunction.



Capacitor Voltage U_C

Required voltage strength of the capacitor. The series connection of capacitor and reactor causes a voltage rise at the capacitor terminals as described by the following formula which must be considered when selecting a capacitor for the application.



$$\begin{aligned} U_N &= 400 \text{ V} \\ p &= 7 \% \end{aligned}$$

$$U_C = \frac{U_N}{\left(1 - \frac{p}{100\%}\right)} = 430.1 \text{ V}$$

The capacitor to be selected must have a voltage strength of at least 430 V.



Example

Detuning Factor p

Ratio between the reactances of reactor X_L and corresponding capacitor X_C (in %).

$$p = 100\% \cdot \frac{X_L}{X_C}$$



Series Resonance Frequency f_r

The detuning factor determines the series resonance frequency between reactor and capacitor which in turn is important for the blocking and filtering effect.

$$f_r = f_N \cdot \sqrt{\frac{100\%}{p}}$$



The standard reactors listed in this catalogue have been designed for common detuning factors and resonance frequencies as shown in chart 11:

Detuning factor p	Resonance frequency f_r	
	$f_n = 50 \text{ Hz}$	$f_n = 60 \text{ Hz}$
5.67 %	210 Hz	252 Hz
7 %	189 Hz	227 Hz
14 %	134 Hz	-

chart 11

Rated Power of the Detuned System Q_{LC}

Care must be taken when stating the reactor power in order to avoid misunderstanding. As a rule, the rated power of a reactor does not describe its real reactance but either the reactive power of the capacitor to be detuned, or the total output of the entire LC-circuit at rated system voltage U_N .



There are two principal approaches which are described in detail on the following pages.

DEFINITIONS AND SELECTION CRITERIA

**I. Non-adapted Rating:**

The non-adapted reactor is matched to a power capacitor with standard rating at system voltage. This allows for use of capacitors "off the shelf". However, with the increased output of kvar due to voltage rise inside the LC circuit, more power output is installed than actually required: the kvar output of a capacitor depends on the voltage it is charged with, and at higher voltage, equal capacitance delivers more kvar (in the example below: 26.9 instead of 25 kvar). In this case, the rated power of the capacitor is used to define the reactor rating.



Caution: Bear in mind that the capacitors to be detuned will be exposed to increased voltage; excessive voltage load may lead to reduced life or even failure or destruction of the capacitor!



Check capacitance and general state of the capacitors before adding detuning reactors to existing non-detuned systems as these may have been harmed by their previous operation without reactor protection!



Example

Capacitor 275.186-516600 (page 27) with 25kvar 400V 50Hz $3 \times 166\mu\text{F}$ (498 μF) shall be detuned to 189Hz ($p = 7\%$).

Calculation

Step 1: Determination of the reactor

Capacitor Reactance

$$X_C = \frac{1}{2 \pi f \cdot C} = 6.39 \Omega$$

Required reactance of the reactor
 $X_L = X_C \cdot p = 6.39 \Omega \cdot 0.07 = 0.45 \Omega$

Required inductance

$$L = \frac{X_L}{2 \pi f} = 1.432 \text{ mH}$$

Step 2: Calculation of resulting PFC current and net kvar output into the mains

PFC current

$$X_{\text{total}} = X_C - X_L = 5.94 \Omega$$

$$I_C = \frac{U_{\text{mains}}}{X_{\text{total}}} = \frac{400 \text{ V}}{5.94 \Omega} = 67.3 \text{ A}^*$$

Real PFC output into mains

$$Q_{LC} = U_{\text{mains}} \cdot I_C = 400 \text{ V} \cdot 67.3 \text{ A}$$

$$= 26.9 \text{ kvar}$$

Selection
from catalogue**Step 1: Determination of the reactor**

Alternatively, reactors matching the most common capacitor ratings can be selected directly from our data charts of reactors with "non-adapted rating" (page 48):

Look up the mains voltage 400 V
in combination with 7 %

Select the capacitance of your
intended capacitor ($3 \times 166 \mu\text{F}$)

Find 444.125-40D2A
"FK-Dr 25/400/50/7/D"

Step 2: Determination of net kvar output into the mains and calculation of PFC current

Look up the kvar value under $Q_{LC}(U_N)$:
26.9 kvar

Calculate PFC current:

$$I_C = \frac{Q_{LC}}{U_N} = \frac{26.900 \text{ var}}{400 \text{ V}} = 67.3 \text{ A}^*$$

(*current over three phases = phase current $\cdot \sqrt{3}$)

DEFINITIONS AND SELECTION CRITERIA

II. Adapted Rating:

The adapted reactor is designed to create – in combination with a specially sized capacitor - exactly the desired output of reactive power, allowing for the internal voltage rise inside the resonating circuit.

Advantage: The exact power is installed as required by the customer, and switching devices are stressed less.



25kvar 400V 50Hz to be detuned to 189Hz (p = 7%)



Example

Calculation

Step 1: Calculation of the capacitor

Current for the power factor correction of 25 kvar 400 V 50 Hz

$$I_c = \frac{Q_c}{U_{\text{mains}}} = \frac{25000 \text{ var}}{400 \text{ V}} = 62.5 \text{ A}$$

Voltage at capacitor terminations

$$U_c = \frac{U_{\text{mains}}}{1-p} = \frac{400 \text{ V}}{1-0.07} = 430 \text{ V}$$

Adjustment of necessary capacitance

$$C = \frac{I_c}{2\pi f \cdot U_c} = \frac{62.5 \text{ A}}{430 \text{ V} \cdot 2\pi \cdot 50 \text{ Hz}} = 463 \mu\text{F}$$

463μF = 3 · 154μF 275.286-515400 "28.2 kvar 440V 50Hz" (page 27)

Step 2: Calculation of the reactor

Capacitor Reactance

$$X_c = \frac{1}{2\pi f \cdot C} = \frac{1}{2\pi \cdot 50 \text{ Hz} \cdot 463 \mu\text{F}} = 6.88 \Omega$$

Required reactance of the reactor

$$X_L = X_c \cdot p = 6.88 \Omega \cdot 0.07 = 0.48 \Omega$$

Required inductance

$$L = \frac{X_L}{2\pi f} = \frac{0.48 \Omega}{2\pi \cdot 50 \text{ Hz}} = 1.53 \text{ mH}$$

> 444.125-4032A "Fk-Dr 25/400/50/7/Dla" (page 67)

Step 1: Determination of the reactor

Alternatively, reactors matching the most common capacitor ratings can be selected directly from our data charts of reactors with "adapted rating" (page 67):

Selection
from catalogue

Look up the mains voltage 400 V in combination with 7 %

Select the required output power of the capacitor branch under "Power Output $Q_{Lc}(U_N)$ ": 25 kvar

Find 444.125-4032 A "FK-Dr 25/400/50/7/Dla"

Step 2: Determination of the matching capacitor

Look up the corresponding capacitance value in column "Capacitor C": 3 × 154 μF

Select a proper capacitor with the capacitance found under 1.) from the data charts for capacitors on pages 26 to 33. Make sure to obey the minimum voltage rating U_c for the capacitor as stated in column " U_N " (here: > 430 V).

DEFINITIONS AND SELECTION CRITERIA



Dissipation Power P_{eff}

Sum of all iron-, copper-, and stray field losses at max. specified overvoltage and harmonic content. Depending on the detuning factor, the effective dissipation power of our reactors is between 4 and 6 W/kvar.



Rated Current (also: Fundamental Current) I_N

RMS value of the current – caused by the series-connected capacitor – at rated voltage and frequency, excluding harmonic distortion, switching transients, and tolerance of capacitance.



RMS Current I_{eff}

Current load on the reactor in permanent operation, caused by the fundamental wave plus harmonics in the system. For all data given in this catalogue, we are presuming a 10 % increase of the fundamental current I_N , resulting from voltage tolerances as permitted by DIN EN 50160: $I_{\text{eff}} = \sqrt{(I_1^2 + I_3^2 + I_5^2 + \dots + I_n^2)}$ $I_1 = 1.1 \cdot I_N$



Maximum Current Rating I_{lin} and Current Linearity

Maximum current, up to which the inductance of the reactor remains "linear", i.e. does not decrease by more than 5 % below its rated inductance. This maximum current is specified in the data charts as a multiple K of the fundamental current:

$$I_{\text{lin}} = K \cdot I_N \quad (I_{\text{lin}} \geq 0.95 I_N !)$$

K ... overcurrent factor

Exceeding I_{rms} or I_{lin} will cause increased power losses inside the reactor and may result in its thermal destruction. We recommend thermal monitoring of the reactors by means of the integrated temperature switch, or the use of switching devices with overcurrent relays in the capacitor circuit, to protect against overloads.



Ambient Operating Conditions

Permissible ambient conditions for safe operation of the reactor. For our reactors, we specify the climate category in the data charts as "CTT" in accordance with DIN EN 50019 and DIN EN 60934/IEC 60439-1:

C	climatic areas	TT	Θ_{ambient}	Θ_{average} in 24 h
T	„Moderate climate“	45	-5 ... 45°C	≤ 40°C
		50	-5 ... 50°C	≤ 45°C
		55	-5 ... 55°C	≤ 50°C

chart 12

Under these conditions, the temperature of our low loss reactors does not exceed 115°C which is an important advantage for the capacitors and all other components in the installation. Please consult us if you require reactors for more severe ambient conditions.

Insulation Class

Maximum permitted operating temperature for the insulation materials used in the reactor. Thanks to careful design and the use of high-class materials, the operating temperature of our low-loss reactors does not exceed 115°C when operated within specification. Our standard rating of insulation class B (135°C) should therefore be sufficient for the majority of your operating environments. Reactors with insulation class F or higher are available as an option on request.



Temperature Switch

response temperature	125°C
voltage	250 V (<6.3 A) ... 500 V (<2 A)
tolerance	± 5 K
terminal	screw clamp 0.75 mm ²

All reactors are provided with a separate screw terminal for the temperature switch (NC – normally closed) which is located inside the central coil.

DATA CHARTS



rated voltages	230...700 V 50 Hz
design	three phase
tolerance of inductance	- 3 ... + 3 % (mean value across three phases)
terminals	terminal blocks, cable lugs temperature-proof flexible cables available on request
winding material	aluminium band or copper wire
core material	low loss iron sheets
safety device	thermal switch
impregnant	polyester resin Class F
insulation class	class B (higher classes available on request)
protection class	IP00 (indoor mounting)
current linearity	see data charts
permitted harmonic load (continuous operation)	$U_3 = 0.5 \% U_N$ $U_5 = 6 \% U_N$ $U_7 = 5 \% U_N$ $U_{11} = 3.5 \% U_N$ $U_{13} = 3 \% U_N$
insulation voltage winding to core	3 kV
max. relative humidity	95 %
temperature class	see data charts
cooling	natural
altitude	4000 m.a.s.l.
statistical life expectancy	> 200 000 h (permitted failure rate $\leq 3 \%$)
standards	IEC EN 61558-2-20:2011, VDE 0570-2, IEC 60076-6:2007, UL508, C22.2 No.14
approval marks	 for selected types

General
Technical
Data

DATA CHARTS

CE Conformity

All reactors listed in this catalogue comply with the relevant regulations and guidelines of the European Union: 2014/35/EU (Low-Voltage Directive)



This is proven by the technical documentation and compliance with the following standards: IEC EN 61558-2-20:2011, IEC EN 60076-6:2007

DIMENSION DRAWINGS

Dimension
Chart

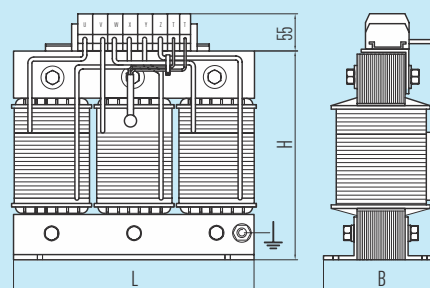
Code	L (mm)	H (mm)	Design A B (mm)	Design B B (mm)	pcs./pallet	pallet height (mm)
A1	155	140	78	-	48	350
A2	155	140	92	85	36	350
B1	190	165	82	87	33	350
B2	190	165	92	97	27	350
B3	190	165	102	107	24	350
B4	190	165	126	131	20	350
C1	240	215	121	112	20	550
C2	240	215	131	122	20	550
C3	240	215	141	132	18	550
C4	240	215	151	142	16	550
C5	240	215	155	146	12	550
D2	300	265	165	139	10	550
D3	300	265	177	152	10	550
D4	300	265	192	167	10	550
D5	300	265	203	178	8	550
F3	300	190	166	-	10	350
F4	300	190	180	155	10	350
F5	300	190	191	166	10	350
F6	300	190	201	175	10	350
G1	240	255	121	112	16	550
G2	240	255	153	144	12	550
H1	420	370	188	190	8	600
I1	300	315	166	141	10	600

Type 1

Connection Type 1

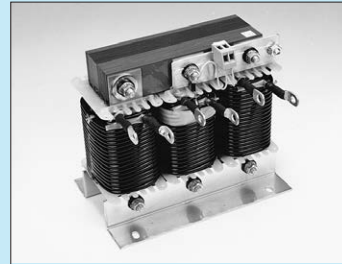
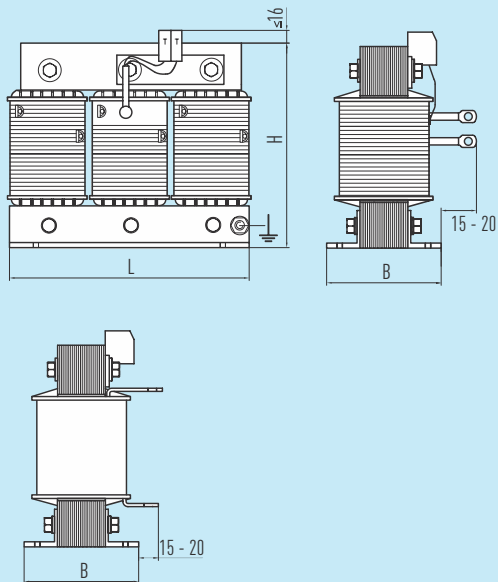


Type 1: Screw terminal block, 10 mm²
Available with copper windings only



DIMENSION DRAWINGS

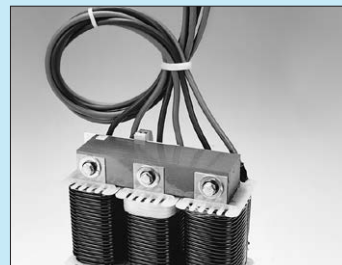
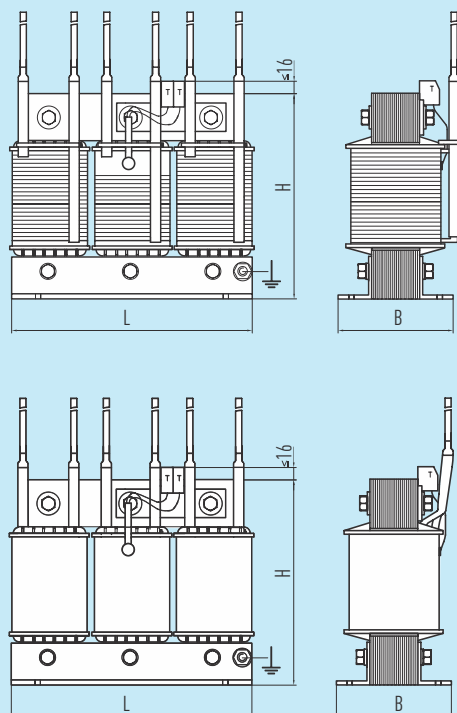
Connection Type 2



Type 2: Cable lug (tinned copper)
Available with copper or aluminium windings

Type 2

Connection Type 3



Type 3: Flexible cable,
temperature proof up to 140°C,
length: 500 or 800 mm
Available with copper or aluminium windings

Type 3

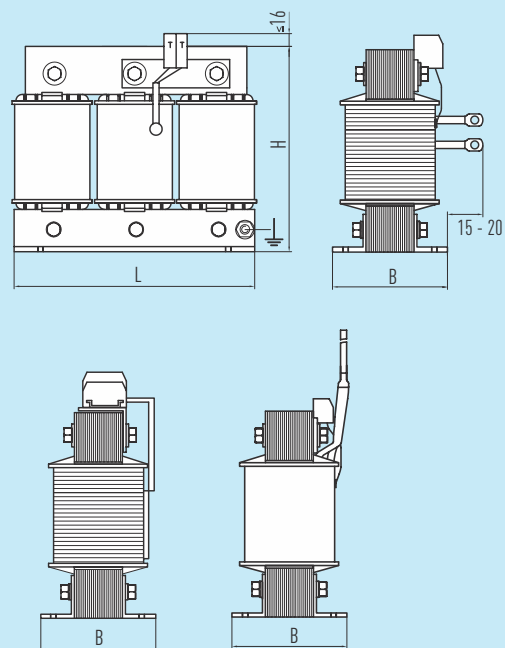
DIMENSION DRAWINGS

Design A

Mounting Design A

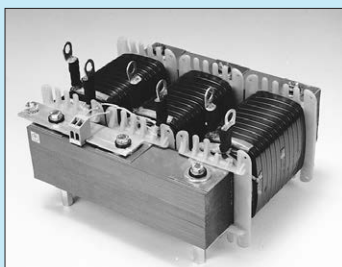


Standard version
with base mounting bracket

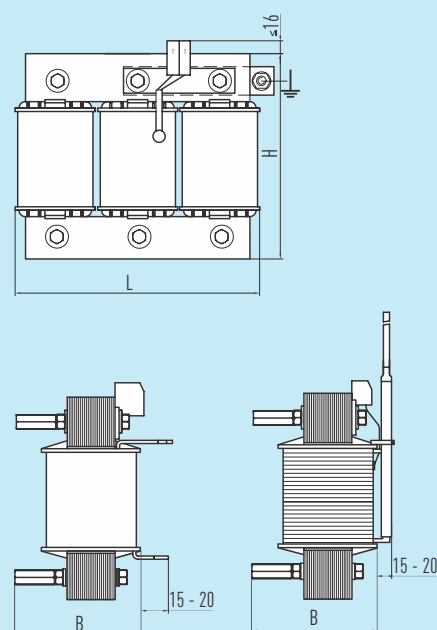


Design B

Mounting Design B



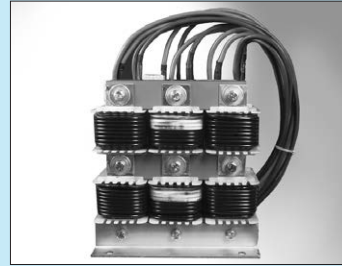
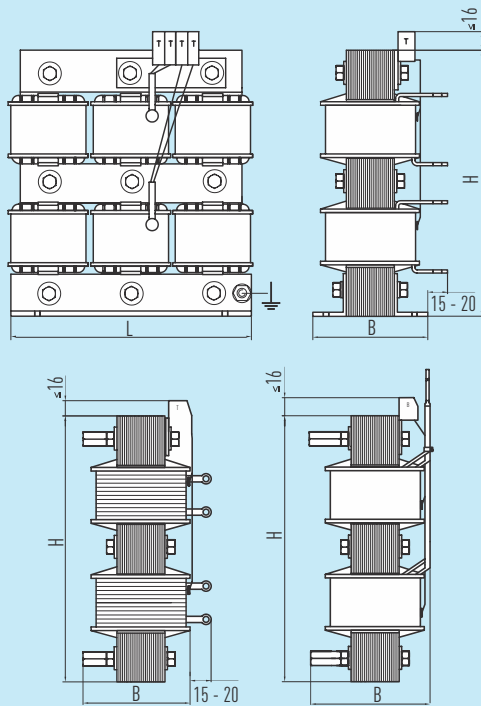
Four threaded bolts (M6i or M8i)
for lateral mounting



DIMENSION DRAWINGS

Design 2in1

This very compact design combines two partial powers in one unit. They can be operated independently from each other.



Available terminals: type 2 and 3.
Available designs: A and B.

Design 2in1

FK-Dr

NON-ADAPTED RATING (D)

5.67 %, 7 %



for latest edition and updates
check www.powercapacitors.info



Reactors for standard capacitors (non-adapted rating)

Power Output $Q_{LC} (U_N)$ (kvar)	Capacitor C_N (μF)	Reactor / Drossel													
		type designation FK-Dr ...	winding	L_N (mH)	I_{eff} (A)	Temp. class	size (S.pg. 62)	weight (kg)	order code (standard version)	connection / design					
U_N 400 V		$U_c > 430$ V	$p = 7 \%$ (189 Hz)			$I_{lin} 1.8 I_N$									
13.4	3 × 82	12.5/400/50/7/D	Cu	3 × 2.88	22.5	T50	B2	8	428.094-40D2A	○	●	○	●	○	
26.9	3 × 166	25/400/50/7/D	Cu	3 × 1.43	45.5	T50	C2	17	444.125-40D2A		●	○	●	○	
26.9	3 × 166	25/400/50/7/D	Al	3 × 1.43	45.5	T50	C4	17	444.326+40D3A		●	○	●	○	
53.8	3 × 332	50/400/50/7/D	Cu	3 × 0.71	91	T50	F5	31	458.259-40D2A		●	○	●	○	
53.8	3 × 332	50/400/50/7/D	Al	3 × 0.71	91	T45	F4	26.4	458.258+40D3A0		●	○	●	○	
U_N 415 V		$U_c > 460$ V	$p = 7 \%$ (189 Hz)			$I_{lin} 1.8 I_N$									
26.9	3 × 154	25/415/50/7/D	Cu	3 × 1.54	43.9	T50	C2	16	444.125-42D2A		●	○	●	○	
26.9	3 × 154	25/415/50/7/D	Al	3 × 1.54	43.9	T50	C4	17	444.326+42D3A0		●	○	●	○	
53.8	3 × 308	50/415/50/7/D	Cu	3 × 0.77	87.8	T50	F5	33	458.259-42D2A		●	○	●	○	
53.8	3 × 308	50/415/50/7/D	Al	3 × 0.77	87.8	T45	F6	30.5	458.260+42D3A		●	○	●	○	
U_N 415 V		$U_c > 460$ V	$p = 5.67 \%$ (210 Hz)			$I_{lin} 2.2 I_N$									
5.7	3 × 33	5.4/415/50/5.67/D	Cu	3 × 5.76	10.4	T50	B1	6	407.093-42B10	●	○	○	●	○	
10.6	3 × 62	10/415/50/5.67/D	Cu	3 × 3.09	19.5	T50	B2	8.5	425.094-42B10	●	○	○	●	○	
13.3	3 × 77	12.5/415/50/5.67/D	Cu	3 × 2.49	24.2	T50	B3	9	428.095-42B10	●	○	○	●	○	
21.2	3 × 123	20/415/50/5.67/D	Cu	3 × 1.55	38.6	T50	C1	15.6	440.125-42B20		●	○	●	○	
26.5	3 × 154	25/415/50/5.67/D	Cu	3 × 1.24	48.4	T50	C3	18.5	444.126-42B20		●	○	●	○	
53	3 × 308	50/415/50/5.67/D	Al	3 × 0.62	96.7	T50	D3	32.6	458.157+42B300		●	○	●	○	
U_N 690 V		$U_c > 760$ V	$p = 7 \%$ (189 Hz)			$I_{lin} 1.8 I_N$									
26.8	3 × 56	25/690/50/7/D	Cu	3 × 4.22	26.5	T50	C2	17.5	444.125-69D2A		●	○	●	○	
53.7	3 × 111	50/690/50/7/D	Cu	3 × 2.12	53	T50	D2	30	458.156+69D3A0		●	○	●	○	
80.6	3 × 168	75/690/50/7/D	Cu	3 × 1.41	80	T55	D5	42	468.160+69D3A0		●		●	○	
107.5	3 × 223	100/690/50/7/D	Al	3 × 1.06	106	T55	H1	68	478.209+69D3A0		●		●	○	
U_N 690 V		$U_c > 760$ V	$p = 5.67 \%$ (210 Hz)			$I_{lin} 2.2 I_N$									
26.5	3 × 56	25/690/50/5.67/D	Cu	3 × 3.42	29.3	T50	C2	16	444.125-69B20		●	○	●	○	
53	3 × 112	50/690/50/5.67/D	Cu	3 × 1.7	58.5	T50	D3	33	458.157-69B20		●	○	●	○	

- standard design
- other available options

Other ratings, linearities and detuning factors are available on request.

FK-Dr

ADAPTED RATING (Dla)

7 %



Reactors for capacitors with adapted rating

Power Output $Q_{LC} (U_N)$ (kvar)	Capacitor C_N (μF)	Reactor / Drossel													
		type designation FK-Dr ...	winding	L_N (mH)	I_{eff} (A)	Temp. class	size (S.pg. 62)	weight (kg)	order code (standard version)	connection / design					
U_N 400 V $U_c > 430$ V $p = 7 \%$ (189 Hz) $I_{lin} 1.8 I_N$															
5	3 × 31	5/400/50/7/Dla	Cu	3 × 7.7	8.5	T55	A2	4.5	407.074-4031A0	●	○	○	●	○	
6.25	3 × 39	6.25/400/50/7/Dla	Cu	3 × 6.13	10.6	T55	A2	5	412.074-4031A	●	○	○	●	○	
10	3 × 62	10/400/50/7/Dla	Cu	3 × 3.83	16.9	T55	B1	6.9	425.093-4032A	●	○	○	●	○	
12.5	3 × 77	12.5/400/50/7/Dla	Cu	3 × 3.07	21.2	T55	B2	8.3	428.094-4032A	●	○	○	●	○	
2 × 12.5	2 × 3 × 77	2/12.5/400/50/7/Dla	Cu	2 × 3 × 3.07	21.2	T55	G1	16	428.241-4032A	●	○	○	●	○	
20	3 × 123	20/400/50/7/Dla	Cu	3 × 1.92	33.8	T50	C1	13.5	440.124-4032A		●	○	●	○	
25	3 × 154	25/400/50/7/Dla	Cu	3 × 1.54	42.3	T55	C2	15.4	444.125-4032A		●	○	●	○	
25	3 × 154	25/400/50/7/Dla	Al	3 × 1.54	42.3	T50	C3	17	444.126+4033A		●	○	●	○	
2 × 25	2 × 3 × 154	2/25/400/50/7/Dla	Cu	2 × 3 × 1.54	42.3	T55	G2	26	444.273-4032A		●	○	●	○	
2 × 25	2 × 3 × 154	2/25/400/50/7/Dla	Al	2 × 3 × 1.54	42.3	T55	I1	34.5	444.266+4033A0		●	○	●	○	
30	3 × 185	30/400/50/7/Dla	Al	3 × 1.28	51	T55	F3	21	450.256+4033A0		●	○	●	○	
40	3 × 246	40/400/50/7/Dla	Cu	3 × 0.96	67.6	T55	F4	27	454.258-4032A		●	○	●	○	
40	3 × 246	40/400/50/7/Dla	Al	3 × 0.96	67.6	T55	F4	26	454.258+4033A0		●	○	●	○	
50	3 × 308	50/400/50/7/Dla	Cu	3 × 0.77	84.6	T50	F4	28	458.258-4032A		●	○	●	○	
50	3 × 308	50/400/50/7/Dla	Al	3 × 0.77	84.6	T45	F5	29.5	458.259+4033A		●	○	●	○	
75	3 × 462	75/400/50/7/Dla	Cu	3 × 0.51	127	T45	D4	42	468.159-4032A		●		●	○	
75	3 × 462	75/400/50/7/Dla	Al	3 × 0.51	127	T45	D4	39	468.159+4033A		●		●	○	
100	3 × 616	100/400/50/7/Dla	Al	3 × 0.38	170	T45	D5	45.5	4H0.160+4033A0		●		●	○	
U_N 415 V $U_c > 450$ V $p = 7 \%$ (189 Hz) $I_{lin} 1.8 I_N$															
12.5	3 × 71	12.5/415/50/7/Dla	Cu	3 × 3.3	20.4	T55	B2	7.5	428.094-4232A	●	○	○	●	○	
25	3 × 143	25/415/50/7/Dla	Al	3 × 1.65	40.8	T50	C3	17	444.126+4233A		●	○	●	○	
50	3 × 286	50/415/50/7/Dla	Al	3 × 0.83	81.5	T45	F6	30	458.260+4233A		●	○	●	○	
50	3 × 286	50/415/50/7/Dla	Al	3 × 0.83	81.5	T45	F6	28	458.259+4233L0*		●	○	●	○	
75	3 × 429	75/415/50/7/Dla	Al	3 × 0.55	122.4	T45	D4	38	468.159+4233A0		●	○	●	○	
100	3 × 573	100/415/50/7/Dla	Al	3 × 0.41	163	T55	H1	65	4H0.218+4233A0		●		●	○	
U_N 690 V $U_c > 760$ V $p = 7 \%$ (189 Hz) $I_{lin} 1.8 I_N$															
25	3 × 52	25/690/50/7/Dla	Cu	3 × 4.57	24.5	T50	B4	16	444.097-6932A0		●	○	●	○	
50	3 × 104	50/690/50/7/Dla	Al	3 × 2.29	49	T55	F5	29	458.259+6933A0		●	○	●	○	
100	3 × 207	100/690/50/7/Dla	Cu	3 × 1.14	98	T55	D4	45	478.159-6932A		●	○	●	○	

*Linearity $1.6 \times I_N$

FK-Dr

ADAPTED RATING (Dla)

5.67 %, 14 %

for latest edition and updates
check www.powercapacitors.info



Reactors for capacitors with adapted rating

Power Output $Q_{LC} (U_N)$ (kvar)	Capacitor C_N (μF)	Reactor / Drossel													
		type designation FK-Dr ...	winding	L_N (mH)	I_{eff} (A)	Temp. class	size (S.pg. 62)	weight (kg)	order code (standard version)	connection / design					
12345															
U_N 400 V		$U_c > 430V$	$p = 5.67 \% (210 \text{ Hz})$			$I_{lin} 2.2 I_N$									
12.5	3 × 77	12.5/400/50/5.67/Dla	Cu	3 × 2.49	23.3	T55	B2	9	428.094-40120	●	○	○	●	○	
25	3 × 154	25/400/50/5.67/Dla	Cu	3 × 1.24	47.4	T55	C2	16.5	444.125-40120		●	○	●	○	
25	3 × 154	25/400/50/5.67/Dla	Al	3 × 1.24	47.4	T55	C3	18	444.326+401300		●	○	●	○	
50	3 × 308	50/400/50/5.67/Dla	Al	3 × 0.62	94.2	T50	D3	31	458.157+40130		●	○	●	○	
75	3 × 462	75/400/50/5.67/Dla	Cu	3 × 0.41	140	T50	D4	42	468.159-40120		●		○	●	
100	3 × 626	100/400/50/5.67/Dla	Al	3 × 0.31	190	T55	H1	69	4H0.218+401300		●	○	●	○	
U_N 690 V		$U_c > 760 V$	$p = 5.67 \% (210 \text{ Hz})$			$I_{lin} 2.2 I_N$									
25	3 × 52	25/690/50/5.67/Dla	Al	3 × 3.70	27.4	T55	C4	18	444.326+691300		●	○	●	○	
50	3 × 104	50/690/50/5.67/Dla	Al	3 × 1.85	54	T55	D4	38	458.159+691300		●	○	●	○	
U_N 400 V		$U_c > 465 V$	$p = 14 \% (134 \text{ Hz})$			$I_{lin} 1.6 I_N$									
12.5	3 × 71	12.5/400/50/14/Dla	Cu	3 × 6.66	19.9	T55	C1	14	428.124-4052L		●	○	●	○	
25	3 × 143	25/400/50/14/Dla	Cu	3 × 3.30	40	T55	C5	23	444.127-4052L		●	○	●	○	
25	3 × 143	25/400/50/14/Dla	Al	3 × 3.30	40	T55	F4	23	444.258+4053L		●	○	●	○	
50	3 × 285	50/400/50/14/Dla	Cu	3 × 1.66	80	T50	D3	43	458.157-4052L		●	○	●	○	
50	3 × 285	50/400/50/14/Dla	Al	3 × 1.66	80	T50	D5	43	458.160+4053M0		●	○	○	●	
U_N 690 V		$U_c > 800 V$	$p = 14 \% (134 \text{ Hz})$			$I_{lin} 1.6 I_N$									
25	3 × 48	25/690/50/14/Dla	Cu	3 × 9.87	23.2	T50	C4	24	444.127-6952L		●	○	●	○	
50	3 × 98	50/690/50/14/Dla	Cu	3 × 4.93	46.4	T50	D3	40	458.157-6952L0		●	○	●	○	

- standard design
- other available options

Other ratings, linearities and detuning factors are available on request.

POWER FACTOR CONTROLLERS

The quality of power supply is an important criterion for safe operation of modern technical equipment. In this context, the functionality of installations for power factor correction and their control and safety features gain a special bearing. Power factor correction banks have the ability to improve power quality, but they can also cause substantial problems.

Modern power factor controllers are self-optimizing and determine the correct power of the capacitor steps within a few trial switchings. If the $\cos\varphi$ deviates from the programmed limits, the necessary capacitor power for compensation is calculated and a suitable output or a combination of outputs are switched, considering the situation of supply system and power factor correction equipment.

A state-of-the-art power factor controller must also be in a position to monitor all relevant data of equipment and supply system, to alarm in case of overload and, if required, to switch off the whole equipment or capacitor steps temporarily or permanently.

P
F
R
-
M



POWER FACTOR CONTROLLERS



POWER FACTOR CONTROLLERS

PFR-X **R / PFR-M **T

for latest edition and updates
check www.powercapacitors.info

BECAUSE EXCELLENT CAPACITORS ARE NOT ENOUGH



The plug'n'play power factor controllers of our PFR-series calculate the active and reactive power in the mains from the measured current and voltage. Their intelligent control algorithm optimizes the switching sequences and guarantees for short regulation times with a minimum number of switchings. At the same time, equal distribution of switchings for capacitors of equal size extends the lifetime of the capacitors. The integrated connection control immediately detects in which phases voltage and current are measured, and adapts the entire system automatically. The very low current threshold of 15 mA allows for very reliable and exact PF control. 1 A as well as 5 A current transformers can be used without additional manual adjustments. The power supply of PFR-X covers a voltage range of 90...550 V, the PFR-M supply is rated for a voltage range of 207-253 V; it can easily be modified to 100-132 V by a jumper setting.

The rated mains voltage is the only value to be entered before commencing operation. The controller blocks operation to protect the capacitors if the tolerances of this voltage setting are exceeded during operation. All other relevant parameters have been preset by the manufacturer for immediate start of operation in nearly any common configuration. Individual adjustment and optimization of the control parameters is possible at any time, even during operation of the equipment.

Once connected, the size of capacitors or reactors is detected automatically. The life cycle of capacitors is monitored via the degradation of capacitance, and a pre-failure alarm can be provided.

The controllers will operate correctly even if the value of the current transformer ratio has not been entered. Please note that in case of the PFR-X, all display functions related to current measurements will be disabled.

PFR-M can monitor the temperature inside the capacitor cabinet by means of an integrated sensor. For PFR-X, the sensor comes as an optional part which can simply be plugged onto the back of the case. It can activate a fan connected to one of the output relays (PFR-X)/the digital output (PFR-M), or switch off the capacitors if required. External thermostats may be connected in parallel to the integrated temperature sensor (PFR-X)/to the digital input (PFR-M) for monitoring of the temperature in other related cabinets.

For maintenance purposes, all branches can be switched manually.

Display

The backlit LC-Display delivers information about the equipment itself and about the mains conditions. It is also necessary for the controller setup.

Reported mains conditions

PFR-X: Voltage, THD U, current, active power, reactive power, apparent power, frequency, ΔQ (power to be compensated), detailed voltage harmonics 3...19, $\cos\phi$

PFR-M: Voltage, THD U, current, THD I, active power, reactive power, apparent power, frequency, ΔQ (power to be compensated), detailed voltage and current harmonics 3...30, $\cos\phi$, counters

POWER FACTOR CONTROLLERS

PFR-X **R / PFR-M **T

Reported information on the equipment

Passed operation time (hours), number of switchings per branch, max temperature in the equipment, average power factor, actual power per branch, actual percentage of originally installed branch power.

The $\cos\phi$ and status of branches are displayed permanently.

Monitoring

The monitoring functions ensure long and reliable operation of the capacitor equipment:

- zero-voltage tripping to avoid contactor fibrillation
- overvoltage protection
- over-temperature protection
- harmonic monitoring of voltage (PFR-M: voltage and current)
- detection of defect branches (with adjustable threshold value)
- alarm at under-compensation
- maintenance reminder
- fan control (using one of the branch outputs)
- overcurrent
- no current

PFR-M only:

- $\cos\phi$ alarm
- frequency alarm
- overload Q
- overload P
- P export

Malfunctions and status signals of the equipment are indicated in the LC-Display. Malfunctions can also be transmitted through the isolated alarm relay (PFR-X: N-O contact, PFR-M: S-P-D-T contact) or to the digital output (PFR-M only).

Special Features of PFR-M

- Transistor outputs for the operation with thyristor switches (dynamic compensations)
- Optionally available with relay outputs or as hybrid version (PFR-M 12RT) with 6 relay outputs for static loads and 6 transistor outputs for dynamic loads.
- Fast algorithm for dynamic thyristor operation (switching time ~20 ms).
- Available with optional modbus communication
- Optional 3 phase current measurement

Modbus Option

The MODBUS extension of the PFR-M offers the possibility to read values from, and modify the settings of, the device. The PFR-M can transmit up to 30 values. The MODBUS-protocol doesn't restrict the user to one single physical transmission system. With the bus-capable RS485 interface of the PFR-M, it is possible to connect more than one controller to a single pair of wires and access the units by use of an ID number. Many commercial devices and PLCs are able to use the MODBUS protocol, either as bus master or slave. Various SCADA solutions are also available from a variety of vendors. So, the integration of the PFR-M in a new or existing bus-system is only a minor issue.

Type	outputs	measurement	Order code
PFR-X 06R	6 relays	1ph	11091.100-06.R
PFR-X 12R	12 relays	1ph	11091.100-12.R
PFR-M 06T	6 transistors	1ph	11050.100-06.T
PFR-M 12T	12 transistors	1ph	11050.100-12.T
PFR-M 12RT	6 relays + 6 transistors	1ph	11050.100-12.H

Type Range

DATA CHART

General Technical Data

Feature	PFR-X	PFR-M
Operation voltage	90-550 V rms, 45...65 Hz, 5 VA, 1 ph	230 V (optional 115 V) rms, 45...65 Hz
Measuring voltage	90-550 V rms	50-530V rms
No of output relays	6, 12	6, 12
Output rating	250 V / 5 A	8 ... 32 V DC hybrid option: also 250 V / 5 A
Switching delay	1 s ... 6500 s	20 ms
Display	LCD	graphic LCD
Operating elements	rubber buttons	foil keyboard
Measuring current	15 mA ... 6 A	15 mA ... 6 A
Adjustable transformer ratio	1 ... 9600	1 ... 6500
External Alarm contact	isolated relay, closed contact	isolated relay, changeover contact
Terminals	multiple contact plug (2.5 mm ²)	multiple contact plug (2.5 mm ²)
Fuses	to be installed externally (see manual)	to be installed externally (see manual)
Fan control	through branch output	digital output (DO)
Interface	TTL (back)	MODBUS RS485 (optional)
Ambient temperature	-20°C ... 70°C	0°C ... 70°C
Storage temperature	-20°C ... +85°C	-20°C ... +85°C
Humidity	0 % ... 95 % (no condensation)	
Temperature measurement	NTC	
Protection class	Front Back	IP50 (IP54 with special gasket) IP20
Pollution degree	3 (DIN VDE 0110, Pt 1 / IEC60664-1)	
Mounting position	no restrictions	
Case	Front Back	plastic (UL94: V0) metal
Dimensions H × W × D	144 × 144 × 58 mm (window size 138 × 138 mm)	
Weight	ca. 0.6 kg	
Standards	DIN VDE 0110 1 (IEC 60664-1:1992) VDE 0411 1 (IEC/DIN EN 61010-1:2001) VDE 0843 20 (IEC/DIN EN 61326: 1997 + A1:1998 + A2: 2000) GOST 15150-69 UL 508 – Industrial Control Equipment CSA C22.2 No. 14-M95 - Industrial Control Equipment	
Approval marks	UL, Rostest, c-UL	



CE Conformity

The controller is declared to conform to the following European Directives:

2014/35/EU Low-Voltage Directive

2004/108/EG EMC directive

ANNEX



Sicherheitshinweise

Allgemeine Sicherheitshinweise zur Verwendung von Starkstromkondensatoren

I. Geltungsbereich

Dieses Sicherheitsdatenblatt gilt für die im Folgenden genannten Starkstromkondensatoren und Normen. Damit soll der Stand der Technik, der im Regelfall bei allen einschlägigen Liefer- und Leistungsverträgen einzuhalten ist, beschrieben werden.

- Leistungskondensatoren für Blindstromkompensation (PFC) bis 1000 V
IEC / DIN EN 60831 und 60931
- Leistungskondensatoren für Blindstromkompensation (PFC) über 1000 V
IEC / DIN EN 60871
- Leistungskondensatoren für induktive Wärmeerzeugung (PFC)
IEC / DIN EN 60110
- Kondensatoren für die Leistungselektronik (PEC)
IEC / DIN EN 61071
- Kondensatoren für Bahnanwendungen (PEC)
IEC / DIN EN 61881
- Leuchtenkondensatoren (AC)
IEC / DIN EN 61048/49
- Motorkondensatoren (AC)
IEC / DIN EN 60252
- Überspannungsschutzkondensatoren
DIN VDE / 0560-3
(derzeit keine gültige IEC)

II. Allgemeine Sicherheitsregeln

Starkstromkondensatoren sind elektrische Ladungsspeicher und deshalb stets mit Vorsicht zu handhaben. Sie können auch nach dem Abschalten über längere Zeiträume noch mit lebensgefährlich hohen Spannungen geladen sein. Gleiches gilt für alle Anlagenteile und Geräte, die in elektrisch leitender Verbindung zum Kondensator stehen. Grundsätzlich sind die allgemeinen Regeln der Elektrotechnik für den Umgang mit spannungsführenden Teilen in elektrischen Anlagen zu beachten.

III. Allgemeine Lager- und Einsatzbedingungen

- Grundsätzlich sind die Montage, Applikations- und Wartungshinweise des Herstellers und die einschlägigen Normen zu beachten.
- Kondensatoren dürfen zu keinem Zeitpunkt außerhalb der spezifizierten Temperaturbereiche gelagert oder eingesetzt werden.
- Kondensatoren dürfen nicht in korrosiver Atmosphäre gelagert oder betrieben werden, insbesondere dann nicht, wenn Chloride, Sulfide, Säuren, Laugen, Salze, organische Lösemittel oder ähnliche Substanzen auftreten.

- In staub- und schmutzgefährdeter Umgebung ist eine regelmäßige Kontrolle und Wartung, insbesondere der Anschlussklemmen und Isolatoren, unbedingt erforderlich um eine Kriechwegebildung zwischen potentialführenden Teilen untereinander und/oder zum Schutzleiter/Erde zu verhindern.
- Die im Datenblatt angegebenen maximalen Temperaturen (incl. Eigenerwärmung), Spannungen, Ströme, Leistungen, thermische Widerstände, Frequenzen, Entladezeiten und Schalthäufigkeiten sind einzuhalten.
- Für ausreichende Abführung der Verlustwärme (Belüftung, Kühlung) oder im Fehlerfall austretende Gase und Flüssigkeiten ist Sorge zu tragen. Geforderte Mindestabstände z. B. zu Wärmequellen sind einzuhalten.
- Angegebene Drehmomente für elektrische Anschlüsse und Befestigungselemente sind einzuhalten.
- Mechanisch oder elektrisch beschädigte, undichte oder anderweitig vorgeschädigte Kondensatoren dürfen nicht eingesetzt oder weiterverwendet werden.
- Vorhandene Schutzeinrichtungen der Kondensatoren dürfen nicht manipuliert, entfernt oder in ihrer Funktion beeinträchtigt werden.

IV. Schutzeinrichtungen

- Die folgende Tabelle gibt einen Überblick über die bekannten internen Schutzeinrichtungen:

Schutzeinrichtung / Schutzmechanismus	Anwendungsbereich		
	PEC	PFC	AC
Ohne Schutzeinrichtung	X		
Ausschließlich Selbstheilung ¹⁾	X	X	X
Einzelnen oder in Kombination			
Verbesserte Selbstheilung ²⁾	X		
Überdruckunterbrecher	X	X	X
Überdruckschalter	X	X	X
Überdruckventil	X	X	
Verstärktes Gehäuse	X	X	
Segmentierter Film	X	X	X
Wickelsicherung		X	X

Tabelle 1: Überblick über die bekannten internen Schutzeinrichtungen und Anwendungsbereiche

1) Selbstheilung kennzeichnet die Kondensatorstechnologie. Selbstheilfähigkeit stellt noch keinen Schutzmechanismus dar!

2) Verbesserte Selbstheilung als Schutzmechanismus setzt voraus, dass die Schutzfunktion in einem gesonderten Test praktisch nachgewiesen wurde. Allerdings stellt auch eine verbesserte Selbstheilung keine z.B. mit einem Überdruckschalter vergleichbare Schutzeinrichtung dar, sondern reduziert lediglich signifikant die Ausfallwahrscheinlichkeit.

- Interne Schutzeinrichtungen bieten einen Basisschutz bei bestimmten inneren Fehlern, Alterungserscheinungen und Überlastfällen. Vorhandene Schutzeinrichtungen der Kondensatoren dürfen nicht manipuliert, entfernt oder in ihrer Funktion beeinträchtigt werden.
- Interne Schutzeinrichtungen sind allein nicht ausreichend, um alle im Fehlerfall denkbare Gefahren abzuwenden. Die so genannte Selbstheilfähigkeit darf nicht mit Ausfallsicherheit gleichgesetzt werden.
- Die meisten internen Schutzeinrichtungen können die Spannung nur innerhalb des Kondensators unterbrechen. Sie sind keine Sicherungen im klassischen Sinne wie Leitungs- oder Geräteschutzsicherungen, die die Spannung vor dem fehlerhaften Anlagenteil unterbrechen.
- Es ist empfehlenswert interne Schutzeinrichtungen durch externe Schutzeinrichtung zu ergänzen wie z. B.:
 - Kurzschlusschutz durch Sicherungen oder Leistungsschalter /Schutzrelais
 - Überlastschutz für Grund- und Oberschwingungen mittels Strommessung
 - Unsymmetrieschutz
 - Temperaturüberwachung

- Schutzeinrichtungen unterliegen, abhängig vom Schutzmechanismus, technischen und funktionellen Grenzen, deren Überschreitung zwangsläufig zu Fehlern führt. Solche Überschreitungen können sein: Übertemperatur, Überspannung, falsche Applikation, falsche Installation, mangelhafte Wartung, mechanische Beschädigung, Betrieb außerhalb der technischen Grenzen der Spezifikation.

V. Risikofaktoren für den Kondensator

Die Risikofaktoren, die am häufigsten zu Kondensatorschäden und möglicherweise auch zum Versagen der internen Schutzeinrichtungen führen, sind:

- Überschreiten der zulässigen Temperatur an der Kondensatoroberfläche (jede Temperaturerhöhung von 7° K halbiert die Lebenserwartung).
- Spannungserhöhungen, Überströme und hohe Einschaltströme, auch wenn sie nur kurzzeitig oder periodisch auftreten (eine dauerhafte Erhöhung der Betriebsspannung des Kondensators von 8 Prozent halbiert die Lebenserwartung).
- Netzüberschwingungen, Anregung von Resonanzen durch Oberschwingungen oder Flicker, auch wenn sie nur kurzzeitig oder periodisch auftreten.
Alterungserscheinungen an Leuchtmitteln und damit verbundene Übertemperatur oder hohe UV-Belastung
Ausfall anderer Bauelemente in einer gemeinsamen Schaltung und damit verbundene Überspannungen oder Überströme.
- Wechselwirkungen mit anderen Blindleistungselementen, auch parasitären Kapazitäten (Kabel) oder Induktivitäten, in gemeinsamen Schaltungen.
- Die bestandene Prüfung nach Kondensatornorm garantiert keine umfassende Sicherheit gegen Überlastungsmöglichkeiten.
 - Teilweise besteht für Kondensatoren ohne Schutzeinrichtungen der Kundenwunsch nach Sonderprüfungen mit extremen Überspannungen und Temperaturen zum Nachweis der Sicherheit.
 - Solche zusätzlichen, „Zerstörungsprüfungen“ genannten Tests, an selbstheilenden PEC-Kondensatoren ohne Schutzeinrichtung (unprotected) sind nicht IEC-konform und untauglich das Gefährdungspotential solcher Kondensatoren, bzw. deren Verhalten im Fehlerfall, zu bewerten.
 - Stattdessen sollten kritische Zustände von PEC-Kondensatoren, welche zum Ausfall führen könnten, z. B. durch eine geeignete Überwachung (Strom/Spannung/Temperatur) innerhalb der Anwendung erkannt werden.
- Beim Betrieb bestimmter thyristorgeschalteter Kondensatoranlagen können an den Kondensatoren nicht eingeschalteter Kompensationsstufen dauerhaft hohe Gleichspannungen auftreten. Diese DC-Spannungen sind bei der Auslegung der Kondensatoren sowie deren Entladeeinrichtungen zu berücksichtigen.

VI. Risiken im Fehlerfall

- Starkstromkondensatoren können aufgrund ihrer gespeicherten Energie und/oder ihrer Eigenschaften beim Betrieb in Netzen mit hohen Kurzschlussleistungen im Fehlerfall ein erhebliches Risiko darstellen.
 - Der Einsatz von immer größeren Kondensatoren, wie z.B. in Multilevel-HGÜ-Anwendungen (HGÜ: Hochspannungs- Gleichstrom-Übertragung), welche hinsichtlich Größe, Anordnung und Anzahl von Kondensatoren besonders herausragen, bergen besondere Gefahren.
 - Für Energieinhalte von mehr als 30 kJ pro Kondensatoreinheit ist im Fehlerfall bei einer unkontrollierten Freisetzung dieser Energie von einer Potenzierung des Risikos auszugehen. Dies führt bei Anlagen mit mehreren Kondensatoreinheiten durch mögliche Lawineneffekte zu einem zusätzlichen Gefährdungspotenzial.
- Starkstromkondensatoren können bei fehlenden, falsch dimensionierten oder versagenden internen oder externen Schutzeinrichtungen aktiv ausfallen. Sie können platzen, brennen oder im Extremfall explodieren.
- Im Schadensfall austretende Gase (z. B. Kohlenwasserstoffe als Zersetzungsprodukte der eingesetzten organischen Isoliermaterialien) sind brennbar und können explosive Gemische ergeben. Das gilt auch für die aus internen Schutzeinrichtungen (Überdruckventil) austretenden Gase.
- Die Brandlast eines Starkstromkondensators beträgt ca. 40 MJ/kg. Dabei ist zu beachten, dass abhängig von der Größe und bezogen auf die Gesamtmasse des Kondensators bei kleinen Baugrößen etwa 55 Prozent und bei großen maximal 75 Prozent aus brennbaren Materialien bestehen.

VII. Risikominimierung

- Der Kondensatorhersteller kann nicht alle Belastungsmöglichkeiten eines Starkstromkondensators voraussehen und in der Konstruktion berücksichtigen. Hier trägt der Anwender entscheidende Mitverantwortung. Schon deshalb sollten bei der Kondensatorauswahl Sicherheit und Qualität an erster Stelle stehen. Deshalb ist dringend zu empfehlen, Kondensatoren mit entsprechenden internen Schutzeinrichtungen einzusetzen.
- Kondensatoren sind im Vorfeld der Anwendung auf ihre Eignung für den vorgesehenen Einsatzfall zu prüfen. Das gilt insbesondere dann, wenn der Kondensator durch seine räumliche Nähe zu Personen ein besonderes Gefährdungspotential aufweist, wie dies z.B. bei Traktionsanwendungen immer der Fall ist. In diesem Fall sind stets Kondensatoren mit Schutzrichtungen bevorzugt zu verwenden. Bei der Risikobewertung / Eignungsprüfung sind alle Einflüsse (Parameter) zu berücksichtigen. Das schließt auch mögliche Produktionsfehler des Kondensators und deren Auswirkungen auf die Sicherheit in der Anwendung mit ein. Die bedenkenlose Übernahme des Kondensators in eine Anwendung ohne konkrete Risikobewertung kann schwerwiegende Folgen für die Anlagensicherheit haben.
- Besonders bei sensiblen Anwendungen müssen die internen Schutzeinrichtungen der Kondensatoren vom Anwender durch geeignete externe Schutzmaßnahmen ergänzt werden. Externe Schutzmaßnahmen sind beim Einsatz von Kondensatoren ohne interne Schutzeinrichtungen sogar zwingend erforderlich.
- Grundsätzlich ist beim Einsatz von Leistungskondensatoren durch geeignete Maßnahmen dafür zu sorgen, dass sowohl im Betriebs-, als auch im Schadensfall keine Gefahren für Menschen, Tiere und Sachen entstehen. Dies gilt für Kondensatoren ohne und mit Schutzeinrichtungen. Dazu sind eine regelmäßige, fachgerechte Prüfung und Wartung erforderlich.
- Die im ZVEI organisierten Starkstromkondensatorhersteller sind gerne bereit, den Anwender schon im Vorfeld des Einsatzes zu beraten und konkrete Anwendungsempfehlungen zu geben sowie Serviceleistungen anzubieten.

Kontakt

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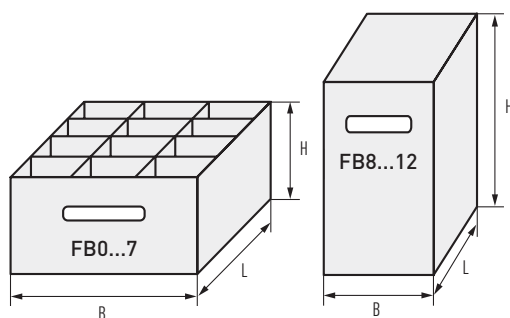
ZVEI e. V. • Verband der Elektro- und Digitalindustrie • Lyoner Straße 9 • 60528 Frankfurt am Main
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Datum: 16.03.2023

PACKING DETAILS

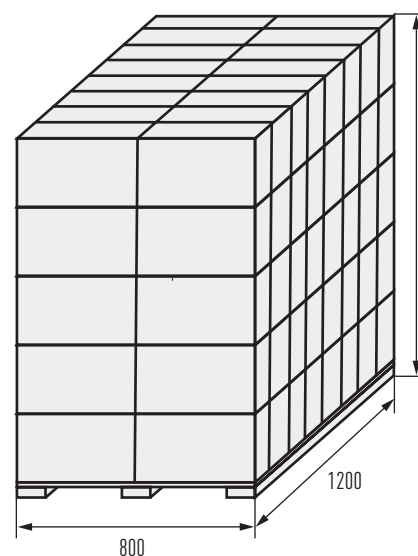
Capacitors

Type Box	L × B × H mm	Box/ pallet
FB 0	383 × 203 × 193	80
FB 2	383 × 203 × 148	80
FB 7	383 × 203 × 208	80
FB 8	393 × 153 × 270	84
FB 10	393 × 153 × 370	56
FB 12	393 × 153 × 330	56



Box

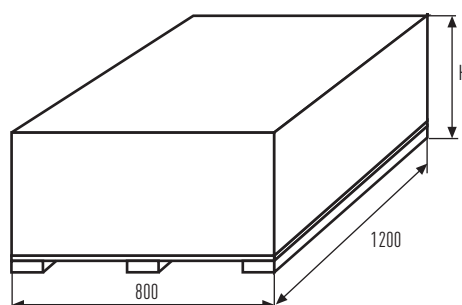
Carton, sealed with adhesive paper tape



Pallet

Standard Euro-pallet
(fumigated if required), wrapped in PP-foil
air freight < 1600
see freight < 1800

Reactors



Pallet

Wooden frame on standard Euro-pallet
(fumigated if required)



Also available:
Capacitors for Power Electronics

AC and DC capacitors with integrated safety mechanism
E62 AC/DC E62-3ph AC Filter E63 DC

Low-inductance capacitors
E50 PK16™ DC E53 AC/DC E61 DC

Low-inductance High-voltage capacitors
E51

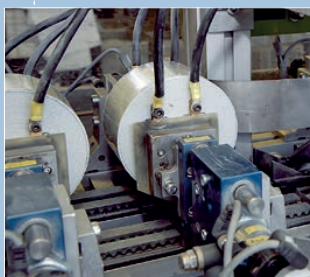
AC and DC capacitors with large capacitance
E56 DC E59 AC/DC E70 AC E50.U SR17™ DC

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EXCELLENT EXPERIENCE IN CAPACITOR MAKING FOR OVER 75 YEARS

Gera has been a centre of capacitor making since 1938. ELECTRONICON Kondensatoren GmbH which emerged from previous RFT/VEB ELEKTRONIK Gera in 1992, has become one of Europe's leading capacitor manufacturers supplying customers worldwide and being an open and competent partner for manufacturers and users of power factor correction equipment, for many manufacturers of drives, power electronics, home appliances, and for the lighting industry. Regular investments in advanced and environmentally sound technologies guarantee the highest levels in manufacture and quality to modern standards which are approved and monitored by leading certification authorities.



In today's globalised competition, we distinguish ourselves by

- Absolute reliability and safety of our products
- Close co-operation between manufacturer and client to meet both technical and commercial requirements
- Improvement and development of our technical expertise in capacitor design and manufacture, as well as film coating, with special attention paid to the MKPg-technology
- Early identification and incorporation of new trends and methods in the manufacturing of capacitors
- Flexibility and punctual fulfilment of our commercial obligations

Our experienced development engineers are competent and responsible for both implementing the latest technical trends applicable to our products and ensuring that our products adapt to the challenges of traditional and new markets. The close and intense co-operation between the departments of Marketing & Sales, Research & Development, and Production has become the keystone of our success. ELECTRONICON is continually striving to establish a similarly close and interactive relationship with its distributors and direct clients both in home and overseas markets, to become not just one out of many suppliers, but your preferred partner for ideas and solutions.

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KEY COMPONENTS FOR POWER FACTOR CORRECTION IN 60Hz MAINS



FACTORY MATCHED
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MSD™ FKD-MV™ DSC™

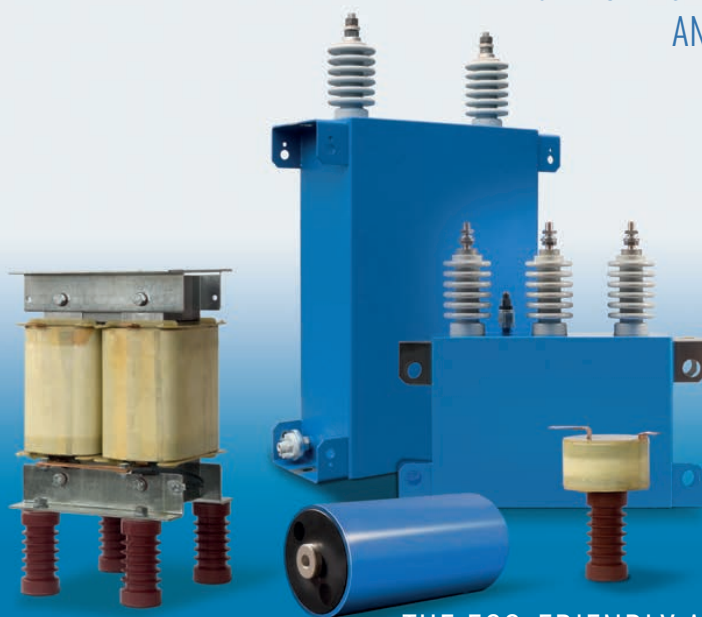
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CAPACITORS AND OTHER KEY COMPONENTS FOR POWER FACTOR CORRECTION IN 60Hz MAINS



ELECTRONICON KONDENSATOREN GMBH GERA • GERMANY

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INTRODUCTION

BASICS OF POWER FACTOR CORRECTION

Under normal operating conditions certain electrical loads (e.g. induction motors, welding equipment, arc furnaces and fluorescent lighting) draw not only active power from the supply, but also inductive reactive power (kvar). This reactive power is necessary for the equipment to operate correctly but could be interpreted as an undesirable burden on the supply. The power factor of a load is defined as the ratio of active power to apparent power, i.e. kW : kVA and is referred to as $\cos\varphi$. The closer $\cos\varphi$ is to unity, the less reactive power is drawn from the supply.

A capacitive reactive power resulting from the connection of a correctly sized capacitor can compensate for the inductive reactive power required by the electrical load. This ensures a reduction in the reactive power drawn from the supply and is called Power Factor Correction.

CALCULATION OF REQUIRED CAPACITOR POWER

The reactive power which is necessary to achieve a desired power factor is calculated by the formula: $Q_c = P \cdot F$

Q_c ... reactive power of the required power capacitor

P ... active power of the load to be corrected

F ... conversion factor acc. to chart 1

original power factor $\cos\varphi_1$	conversion factor F for a target power factor $\cos\varphi_2$									
	0.70	0.75	0.80	0.85	0.90	0.92	0.94	0.96	0.98	1.00
0.20	3.879	4.017	4.149	4.279	4.415	4.473	4.536	4.607	4.696	4.899
0.25	2.853	2.991	3.123	3.253	3.389	3.447	3.510	3.581	3.670	3.873
0.30	2.160	2.298	2.430	2.560	2.695	2.754	2.817	2.888	2.977	3.180
0.35	1.656	1.795	1.926	2.057	2.192	2.250	2.313	2.385	2.473	2.676
0.40	1.271	1.409	1.541	1.672	1.807	1.865	1.928	2.000	2.088	2.291
0.45	0.964	1.103	1.235	1.365	1.500	1.559	1.622	1.693	1.781	1.985
0.50	0.712	0.85	0.982	1.112	1.248	1.306	1.369	1.440	1.529	1.732
0.55	0.498	0.637	0.768	0.899	1.034	1.092	1.156	1.227	1.315	1.518
0.60	0.313	0.451	0.583	0.714	0.849	0.907	0.97	1.042	1.130	1.333
0.65	0.149	0.287	0.419	0.549	0.685	0.743	0.806	0.877	0.966	1.169
0.70		0.138	0.27	0.4	0.536	0.594	0.657	0.729	0.817	1.020
0.75			0.132	0.262	0.398	0.456	0.519	0.59	0.679	0.882
0.80				0.13	0.266	0.324	0.387	0.458	0.547	0.75
0.85					0.135	0.194	0.257	0.328	0.417	0.62
0.90						0.058	0.121	0.193	0.281	0.484
0.95								0.037	0.126	0.329

chart 1

INTRODUCTION

A. Calculation based on the consumption data

- consumption of active energy: $E_w = 300.000 \text{ kWh}$
- consumption of reactive energy: $E_b = 400.000 \text{ kvarh}$
- number of working hours: $t = 600 \text{ h}$

1) Calculation of average active power P

$$P = \frac{E_w}{t} = \frac{300.000 \text{ kWh}}{600 \text{ h}} = 500 \text{ kW}$$

2) Calculation of initial power factor $\cos\varphi_1$

$$\cos\varphi_1 = \frac{1}{\sqrt{\left(\frac{E_b}{E_w}\right)^2 + 1}} = \frac{1}{\sqrt{\left(\frac{400.000 \text{ kvarh}}{300.000 \text{ kWh}}\right)^2 + 1}} = 0.6$$

3) From chart 1, we read the factor 1.13 for the improvement of the power factor from 0.6 to 0.98.

4) Calculation of required capacitor power

$$Q_c = 500 \text{ kW} \cdot 1.13 = 565 \text{ kvar}$$

B. Calculation based on the Energy Bill

- reactive power tariff: T/kvarh
- monthly costs for reactive energy: C
- number of working hours: h

Calculation of required capacitor power for $\cos\varphi = 1$

$$Q_c = \frac{C}{h \cdot \frac{T}{\text{kvarh}}}$$



Example

INTRODUCTION

COMMON METHODS OF POWER FACTOR CORRECTION

SINGLE OR FIXED PFC, compensating for the reactive power of individual inductive loads at the point of connection so reducing the load in the connecting cables (typical for single, permanently operated loads with a constant power),

constant power
demand and long
duty cycle

single-
or group-fixed
PFC

GROUP PFC - connecting one fixed capacitor to a group of simultaneously operated inductive loads (e.g. group of motors, discharge lamps),

variable power
demand and/or
variable duty cycle

automatic
("bulk")
PFC

BULK PFC, typical for large electrical systems with fluctuating load where it is common to connect a number of capacitors to a main power distribution station or substation. The capacitors are controlled by a microprocessor based relay which continuously monitors the reactive power demand on the supply. The relay connects or disconnects the capacitors to compensate for the actual reactive power of the total load and to reduce the overall demand on the supply.

A typical power factor correction system would incorporate a number of capacitor sections determined by the characteristics and the reactive power requirements of the installation under consideration. Sections of 12.5 kvar, 25 kvar, and 50 kvar are usually employed. Larger stages (e.g. 100 kvar and above) are best achieved by cascading a number of smaller sections. This has the beneficial effect of reducing fluctuations in the mains caused by the inrush currents to the capacitors and minimizes supply disturbances. Where harmonic distortion is of concern, appropriate systems are supplied incorporating detuning reactors.

INFLUENCE OF HARMONICS, HARMONIC FILTERING



Developments in modern semiconductor technology have led to a significant increase in the number of thyristor- and inverter-fed loads. Unfortunately these non-linear loads have undesirable effects on the incoming AC supply, drawing appreciable inductive reactive power and a non-sinewave current. The supply system needs to be kept free of this harmonic distortion to prevent equipment malfunction.

A typical inverter current is composed of a mixture of sinewave currents; a fundamental component at the supply frequency and a number of harmonics whose frequencies are integer multiples of the line frequency (in three phase mains most of all the 5th, 7th, and 11th harmonic). The harmonics lead to a higher capacitor current, because the reactive resistance of a capacitor reduces with rising frequency. The rising capacitor current can be accommodated by constructional improvements in the manufacture of the capacitor. However a resonating circuit between the power factor correction capacitors, the inductance of the feeding transformer and/or the mains may occur. If the frequency of such a resonating circuit is close enough to a harmonic frequency, the resulting circuit amplifies the oscillation and leads to immense over-currents and over-voltages.

Harmonic distortion of an AC supply can result in any or all of the following:

- Premature failure of capacitors.
- Nuisance tripping of circuit breakers and other protective devices.
- Failure or maloperation of computers, motor drives, lighting circuits and other sensitive loads

Typical non-linear loads (generating harmonics)

- converters, rectifiers, inverters, choppers
- thyristor controls, three-phase controllers
- electronic valves
- phase controls
- UPS units (inverter technology)
- discharge lamps with magnetic ballasts

INTRODUCTION

WHEN IS IT NECESSARY TO INSTALL A DETUNED PFC SYSTEM?

The installation of detuned (reactor-connected) capacitors is designed to force the resonant frequency of the network below the frequency of the lowest harmonic present, thereby ensuring no resonant circuit and, by implication, no amplification of harmonic currents. Such an installation also has a partial filtering effect, reducing the level of voltage distortion on the supply, and is recommended for all cases where the share of harmonic-generating loads ("non-linear loads") is more than 10% of the rated transformer power. The resonance frequency of a detuned capacitor is always below the frequency of the lowest harmonic present. A close-tuned filter circuit however is tuned to a certain harmonic frequency and presents a very low impedance to the individual harmonic current, diverting the majority of the current into the filter bank rather than the supply.



Detuned capacitors can in general be operated in any mains. In any case, they are a safer choice than non-detuned capacitors and future-proof under the conditions of more and more deteriorating power quality in modern mains.

Attention: Non-detuned and detuned capacitors must never be combined together.



We strongly advise to conduct a comprehensive mains analysis, including measurement of the harmonic content, before designing and installing your power factor correction equipment. In cases, however, where such analysis is not possible, cautious and conservative assessment of the situation to be expected shall be made by means of the general rules in chart 3.

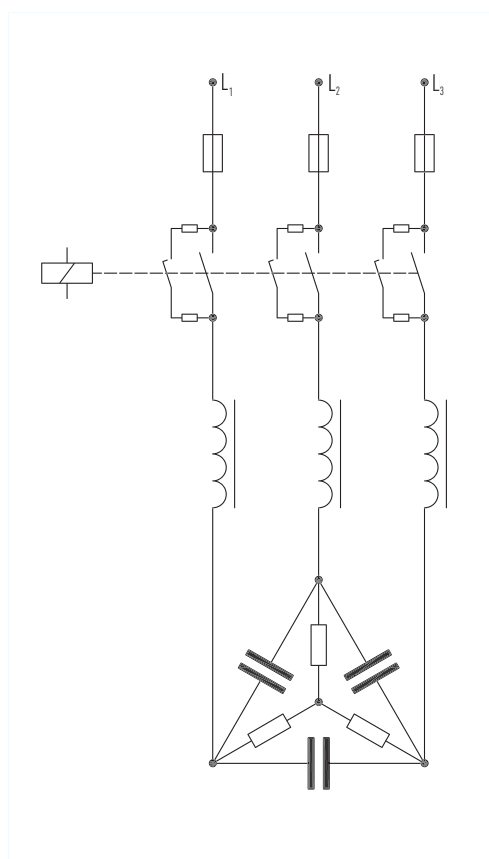
A detuned PFC system is also necessary

- if one or more harmonic voltages in the MV mains are > 2 %, and/or
- if certain audio frequency control signals are used (see page 10)

$S_{OS} : S_T$	Detuning
0 % ... 100 %	non-detuned
> 10 % ... 50 %	detuned
> 40 % ... 100 %	detailed calculation needed, installation of filter circuit if necessary

Abbreviations
 S_{OS} ... power of harmonic generating („non-linear”) loads in the own network
 S_T ... rated transformer power or connection power

chart 3



pic. 1

Installation of detuned (reactor-connected) capacitors

INTRODUCTION



DOES THE MV MAINS CONTAIN AUDIO FREQUENCY CONTROL SIGNALS?

Some energy supply companies use higher-frequency signals in their medium voltage mains for the transmission of control pulses and data. These so-called "audio frequency signals" ranging typically from 160 to 1350 Hz may become absorbed or distorted by, or cause resonance problems with capacitor installations. Such problems may be prevented by the selection of proper detuning reactors.

Capacitor/PFC system	audio frequency	reactive power	activity
non-detuned	< 300 Hz	$Q_c < 35\% \text{ of } S_T$ $Q_c > 35\% \text{ of } S_T$	no specific activity consult your power supply company and conduct mains analysis
	> 300 Hz	$Q_c < 10 \text{ kvar}$ $Q_c > 10 \text{ kvar}$	no specific activity consult your power supply company and consider special PFC system
detuned	< 300 Hz	no restrictions	consult your power supply company and consider special PFC system
	300 Hz ... 420 Hz	no restrictions	detuning factor > 7 %
	> 420 Hz	no restrictions	detuning factor > 5 %

chart 4

INTRODUCTION

OPERATION OF CAPACITORS IN HIGH-FREQUENCY-FILTERS OR WITH A VERY HIGH SHARE OF LF OR HF HARMONICS

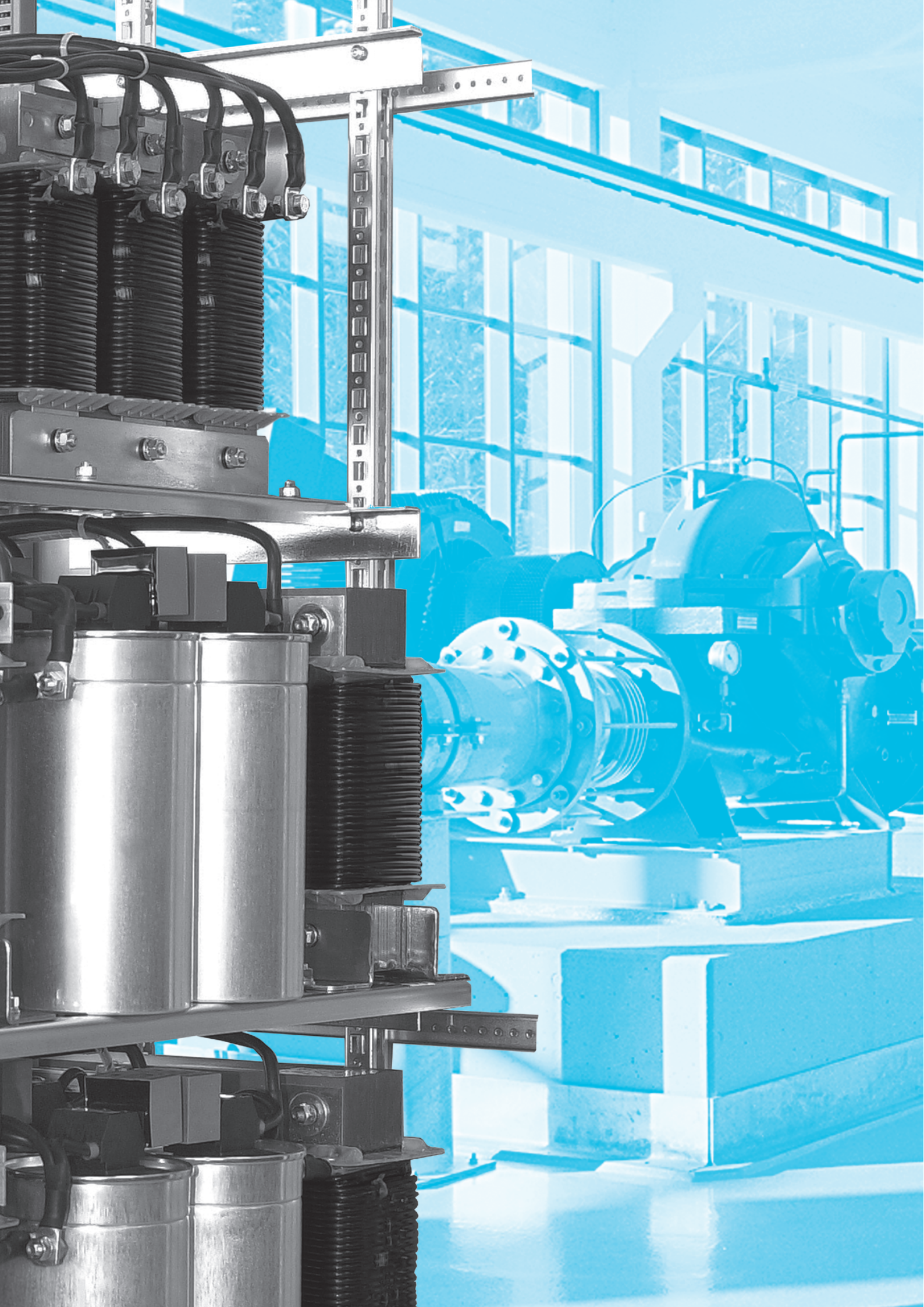
Capacitors which are operated in filters or other systems with a very high share of harmonic distortion, or with harmonics of high frequencies, must be especially selected and prepared for the specific requirements of such applications.

We offer special single and three phase capacitors that are optimized for the operation under such circumstances in our following ranges:

- 280 MKP-UHD: three phase Ultra Heavy Duty capacitors for demanding operating conditions in power factor correction (such as high harmonic content and high operating temperatures)
- E62-3ph: three phase capacitors for filters with harmonic frequencies of up to 1.3 kHz
- E62-3HF: three phase capacitors for filters with harmonic frequencies of >1.3 kHz
- E62: single phase capacitors for filters with substantial unbalanced loads.

Consult our catalogue brochures for details of the a.m. capacitor ranges. Please refer also to our Application Notes for specific instructions and formulas related to high frequency filters.





FACTORY MATCHED TO WORK IN PERFECT HARMONY. ALL KEY COMPONENTS FROM ONE SOURCE.

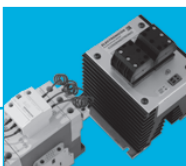
The construction of reliable equipment for power factor correction requires not only your excellent experience, but also top-class components. No compromise in quality and safety should be permitted when it comes to the key parts of your PFC equipment. Because we do care, we are offering you the full set of essential components for your capacitor bank.



THE HEART:

Capacitors. Without them, PFC is impossible. They are the most sensitive and most important component.

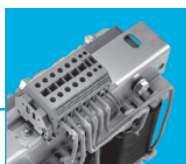
Pages 14 to 35



THE MUSCLE:

Switching is one of the key functions in your PFC, and switching capacitors means maximum stress.

Pages 36 to 50



THE PROTECTION:

Most PFC nowadays cannot do without detuning reactors for harmonic protection anymore.

Pages 50 to 64



THE BRAIN:

The controller shall know what to do, and when.

Pages 66 to 70

POWER CAPACITORS

Apart from your excellent experience, the construction of reliable and competitive equipment for power factor correction requires top-class components at reasonable cost. No compromise in quality and safety should be permitted when it comes to the key part of your PFC equipment. Germany's largest manufacturer of power capacitors manufactures all components with highest care and expertise and is your best choice for power capacitors.

The dry-type phase shifters of our renowned MKPg™-series are environmentally friendly, compact, and very convenient to handle. They contain no liquids, are filled with a neutral, inert gas entirely harmless to environment and may be mounted in any desired position. Should leakage occur, the leaking gas would escape into the atmosphere causing no undesirable effects to the adjacent equipment, e.g. damage, pollution, or staining. Hence when disposing of the capacitors, no liquids or toxic gasses need to be considered. The plant oil in our MKP capacitors is biodegradable and does not cause any trouble either, be it in the unlikely event of leakage or during disposal.

All our three-phase capacitors contain three separate capacitor elements connected in delta, preferably of short height and large diameter which substantially reduces inherent power losses and improves their current strength as compared with slim, tall capacitors. By using the market's best low-loss, self-healing polypropylene films and sophisticated manufacturing techniques such as high-vacuum drying and special coating patterns, they provide long service life with constant capacitance and high switching strength. As a matter of course, all our power capacitors are provided with BAM™ (overpressure break-action mechanism) as standard, for safe mode of failure.

Our original CAPAGRIP™ terminals guarantee optimum sealing of the capacitors, and offer convenient connection of cables up to 50mm². A special spring system guarantees reliable and durable operation of the clamp. They are rated IP20, i.e. protected against accidental finger contact with live parts. Whilst the options K and L4 ("CAPAGRIP II") include bleeding resistors for a discharge below 50 V within up to 60 sec as standard, options L and M also permit the direct connection of discharge reactors and discharge resistor modules, as well as easy parallel connection of additional capacitors within the current limits of the terminal.



POWER CAPACITORS

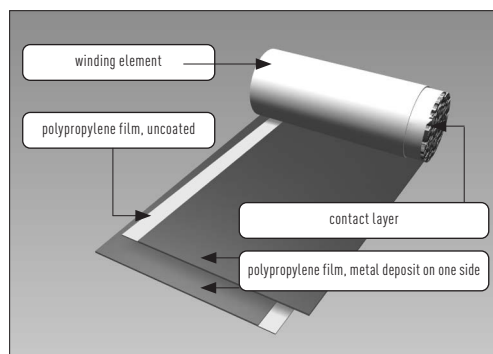


INTERNAL CONSTRUCTION



Dielectric

MKP-/MKPg-type capacitors are based on a low-loss dielectric formed by pure polypropylene film. A thin mixture of zinc and aluminium is metallized directly on one side of the PP-film under vacuum. Our long term experience as well as on-going research and improvements in this technology ensure the excellent self-healing characteristics of the dielectric and a long operating life of our capacitors. The plastic film is wound into stable cylindrical windings on the most modern automated equipment. The ends of the capacitor windings are contacted by spraying with a metal contact layer, facilitating a high current load and ensuring a low-inductance connection between the terminals and windings.



pic.2



The link between PP-film and zinc contact layer is highly stressed during high surge or rms currents and therefore considered very critical for operating life and reliability of the capacitor. By cutting the film for selected types in a wavelike manner, our SINECUT™ technology increases the contact surface between film and zinc layer which substantially reduces this strain.



Impregnants

The use of impregnants and/or filling materials in capacitors is necessary in order to insulate the capacitor electrodes from oxygen, humidity, and other environmental interference. Without such insulation, the metal coating would corrode, an increasing number of partial discharges would occur, the capacitor would lose more and more of its capacitance, suffer increased dielectric losses and a reduced operating life. Therefore, an elaborate vacuum-drying procedure is initiated immediately after insertion of the capacitor elements into the aluminium case and dried insulation gas (MKPg), or biologically degradable plant oil (MKP), is introduced. Both protect the winding from environmental influence and provide an extended life-expectancy and stable capacitance.



MKPg 265 – Leakage Proof and Environmentally Friendly

The gas in our MKPg-Capacitors is inert and entirely harmless to environment. When disposing of the capacitors, no liquids or toxic gasses need to be considered. Leakage of gas is extremely unlikely if the capacitors are handled and operated properly. It is possible to mount these capacitors in any desired position. However, should leakage occur, the leaking gas would escape into the atmosphere causing no undesirable effects to the adjacent equipment, e.g. damage, pollution, or staining. In the long run, such an unlikely event would result in a degradation of the capacitance; however, this process would take many months, during which the capacitor remains functional. By using gas, we are reducing the weight of a capacitor on average by 15% compared with resin or oil filled capacitors. This makes transportation and handling of the units easier. It also supports the concept of mounting the capacitors in almost any position.

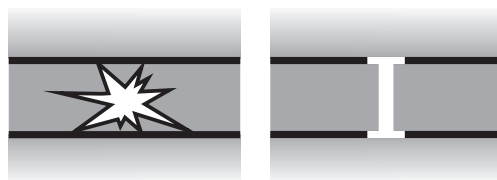
SAFE OPERATION

Protection against Overvoltages and Short Circuits: Self-Healing Dielectric

All dielectric structures used in our power capacitors are "self-healing": In the event of a voltage breakdown the metal layers around the breakdown channel are evaporated by the temperature of the electric arc that forms between the electrodes. They are removed within a few microseconds and pushed apart by the pressure generated in the centre of the breakdown spot. An insulation area is formed which is reliably resistive and voltage proof for all operating requirements of the capacitor. The capacitor remains fully functional during and after the breakdown.



For voltages within the permitted testing and operating limits the capacitors are short-circuit- and overvoltage proof. They are also proof against external short circuits as far as the resulting surge discharges do not exceed the specified surge current limits.



Self-healing
breakdown

pic.3

Protection Against Accidental Contact

All capacitors are checked by routine test (voltage test between shorted terminations and case: $U_{bb} > 2 U_N + 2000 \text{ V}$, at least 3000V) in accordance with IEC 60831. Accessible capacitors must be earthed at the bottom stud or with an additional earthing clamp.

The CAPAGRIP™ terminal blocks are rated IP20, i.e. they are protected against accidental finger contact with live parts. The discharge modules are designed in the same way (compare page 45). Unused contact cages of design M terminal blocks must be covered by a proper blank (available as standard accessory, see page 49).



CAPAGRIP™

SAFE OPERATION



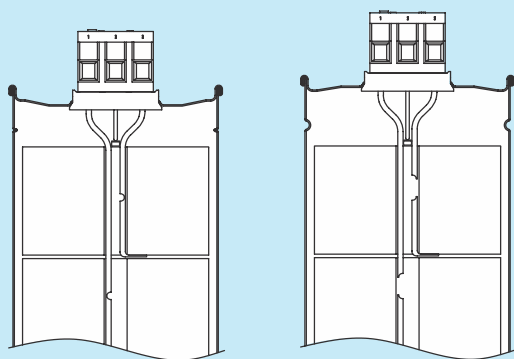
Protection against Overload and Failure at the end of Service Life

In the event of overvoltage, thermal overload or ageing at the end of the capacitor's useful service life, an increasing number of self-healing breakdowns may cause rising pressure inside the capacitor. To prevent it from bursting, the capacitor is fitted with an obligatory «break action mechanism» (**BAM™**). This safety mechanism is based on an attenuated spot at one, two, or all of the connecting wires inside the capacitor.

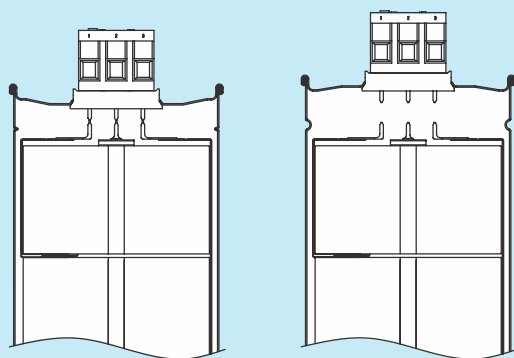
All capacitors with diameters < 85 mm as well as some traditional models with large diameters are provided with BAM 1 mechanism. All new models with diameters > 85 mm will be provided with BAM 2 mechanism.

With rising pressure the case begins to expand, mainly by opening the folded crimp and pushing the lid upwards. As a result, the prepared connecting wires are separated at the attenuated spot, and the current path is interrupted irreversibly. It has to be noted that this safety system can act properly only within the permitted limits of loads and overloads.

BAM 1



BAM 2



pic.4



Mind hazards of explosion and fire

Capacitors consist mainly of polypropylene (up to 90 %), i.e. their energy content is relatively high. They may rupture and ignite as a result of internal faults or external overload (e.g. temperature, over-voltage, harmonic distortion). It must therefore be ensured, by appropriate measures, that they do not form any hazard to their environment in the event of failure or malfunction of the safety mechanism.

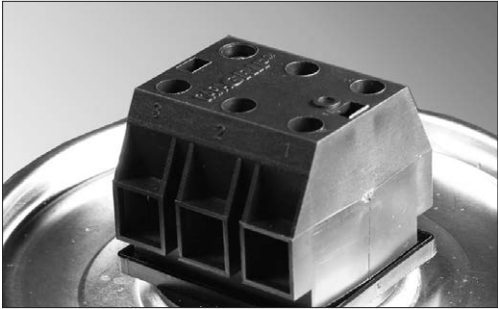
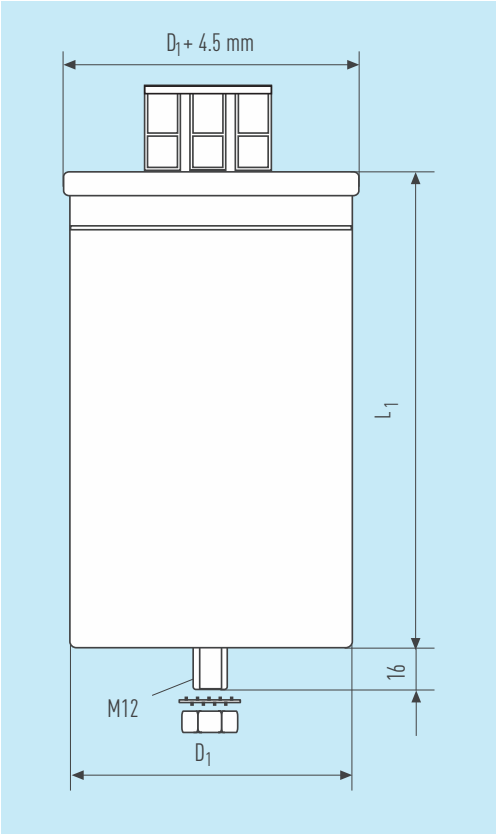


Fire Load: approx. 40 MJ/kg

Extinguish with: dry extinguisher (CO₂, foam), or other fire extinguishants suitable for this voltage level

DESIGN DRAWINGS

CAPAGRIP™ K, L, M AND CAPAGRIP II™: EASE OF ASSEMBLY WITH HIGH DEGREE OF PROTECTION



The CAPAGRIP™ terminals guarantee optimum sealing of the capacitors, and offer convenient connection of cables up to 50 mm². A special spring system guarantees reliable and durable operation of the clamp.

Whilst CAPAGRIP™ K and CAPAGRIP II™ ("L4") incorporate bleeding resistors, designs L and M permit the direct connection of discharge reactors and discharge resistor modules, as well as easy parallel connection of additional capacitors within the limits of the current capability of the respective terminal.

For single phase versions, the central screw has no contact.

Series	MKPg 265, MKP 266
Protection	IP20
Humidity class	C
Creepage distance	16 mm
Air clearance	16 mm

If flat over the entire width of the cage, the body inserted into the terminal must have a thickness of at least 1.2 mm in order to get gripped and fixed by the clamp cage. See chart 5 for minimum thickness of inserted conductor if round-shaped and/or NOT ranging over the entire width of the cage.

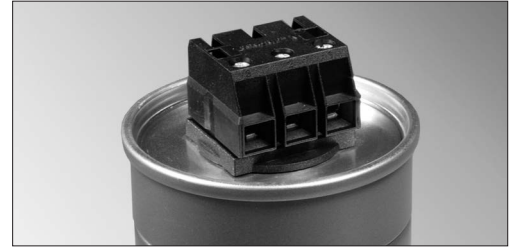
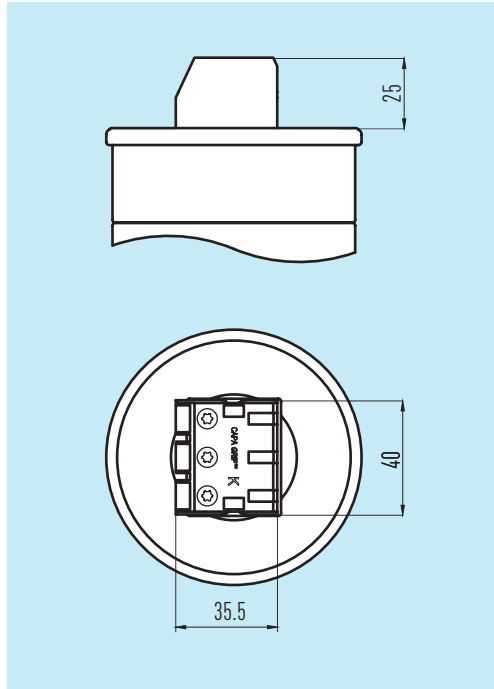
See also chart 9 on page 34 for more detailed instructions on connectors and cable sizes.

CAPAGRIP™	Clamp width	minimum conductor height (if < 0.8 × clamp width)
K	5	2
L, L4	7	2.5
M	10	2.5

chart 5

DESIGN DRAWINGS

CAPA**GRIP**™K



Available for diameters 60 ... 85 mm.

Case

extruded aluminium can with base mounting stud M12, hermetically sealed by aluminium lid (folded edge)

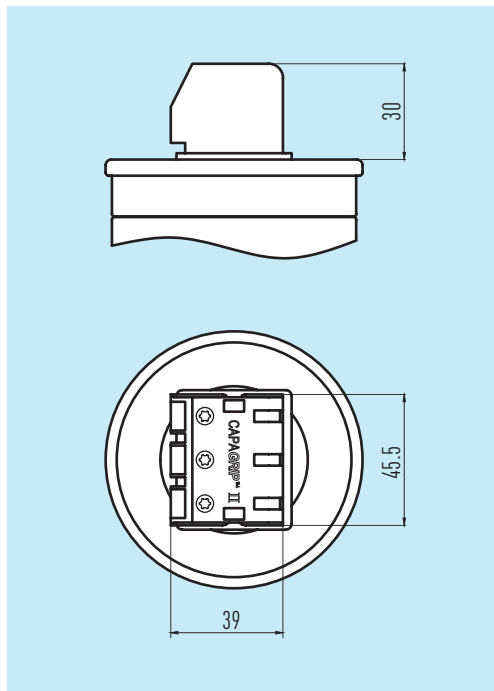
Terminal block

Steel clamp with T20 M4 screws in flame retardant plastic body (UL94-V0)

max. cable cross section: $1 \times 10 \text{ mm}^2$ per phase
max. terminal rating: 39 A/phase

Internal resistors for discharge < 50 V within < 60 s

CAPA**GRIP**™L4



Available for diameters 85 ... 136 mm.

Case

extruded aluminium can with base mounting stud M12, hermetically sealed by aluminium lid (folded edge)

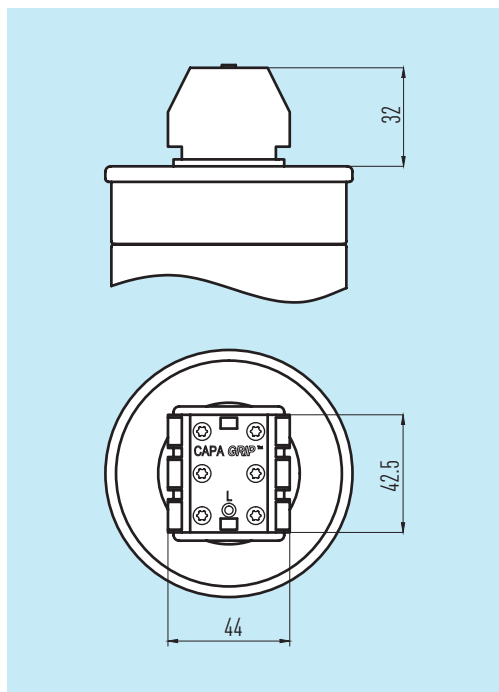
Terminal block

Steel clamp with T20 M5 screws in flame retardant plastic body (UL94-V0)

max. cable cross section: $1 \times 25 \text{ mm}^2$ per phase
max. terminal rating: 56 A/phase

Internal resistors for discharge < 50 V within < 60 s

DESIGN DRAWINGS



CAPAGRIP™ L

Available for diameters 85 ... 136 mm.

Case

extruded aluminium can with base mounting stud M12, hermetically sealed by aluminium lid (folded edge)

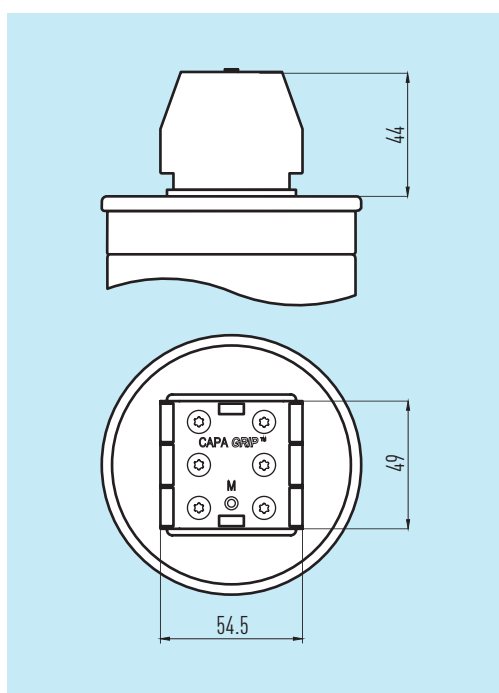
Terminal block

Steel clamp with T20 M5 screws in flame retardant plastic body (UL94:V0)

max. cable cross section: $2 \times 25 \text{ mm}^2$ per phase

max. terminal rating: 56 A/phase

discharge resistors: available as separate item (see pgs. 45ff)



CAPAGRIP™ M

Available for diameters 95 ... 136 mm.

Case

extruded aluminium can with base mounting stud M12, hermetically sealed by aluminium lid (folded edge)

Terminal block

Steel clamp with T20 M6 screws in flame retardant plastic body (UL94:V0)

max. cable cross section: $2 \times 50 \text{ mm}^2$ per phase

max. terminal rating: 104 A/phase

discharge resistors: available as separate item (see pgs. 45ff)

DEFINITIONS AND SELECTION CRITERIA



Rated Voltage U_N

Root mean square of the max. permissible value of sinusoidal AC voltage in continuous operation. The rated voltage of the capacitors indicated in the data charts must not be exceeded even in cases of malfunction. Bear in mind that capacitors in detuned equipment are exposed to a higher voltage than that of the rated mains voltage; this is caused by the connection of detuning reactor and capacitor in series. Consequently, capacitors used with reactors must have a voltage rating higher than that of the regular mains voltage (compare U_c on page 55). Unless indicated otherwise, all voltages stated in this catalogue are rms values.



Maximum RMS Voltage U_{max}

Maximum rms voltage, which the capacitor can be exposed to permanently. This value also considers the maximum reactive power and the resulting power losses of the capacitor.



Test Voltage Between Terminals U_{BB}

Routine test of all capacitors conducted at room temperature, prior to delivery. A further test with 80 % of the test voltage stated in the data sheet may be carried out once at the user's location.



Voltage test between terminals and case U_{BG}

Routine test of all capacitors between short-circuited terminals and case, conducted at room temperature. May be repeated at the user's location.



Rated power Q_c

Reactive power resulting from the ratings of capacitance, frequency, and voltage: $Q_c = 2\pi f \cdot C \cdot U_N^2$



Maximum RMS Current Rating I_{max}

Maximum rms value of permissible current in continuous operation. The maximum permitted rms current for each particular capacitor is related either to construction features or to the current limits of the terminals. In accordance with IEC 60831 all ELECTRONICON capacitors are rated at least $1.3 \times I_N$ (with I_N being the nominal current of the capacitor at rated voltage and frequency), allowing for the current rise from permissible voltage and capacitance tolerances as well as harmonic distortion. As a rule, our values of maximum permitted continuous current are substantially higher. The exact value for each capacitor can be found in the individual data sheet. Higher rms values can be implemented by adjustments in construction and are available on request.



Continuous currents that exceed the I_{max} values specified in the data charts will lead to a build-up of heat in the capacitor and may cause reduced lifetime or premature failure. Permanent excess current may even result in malfunction of the capacitor's safety mechanisms, i.e. bursting or fire (see page 18).

Care must be taken not to exceed the maximum voltage and current ratings when installing capacitors in close-tuned or detuned equipment (see data sheets for maximum ratings). The thermal monitoring of reactors, or the use of overcurrent protection relays in the capacitor circuit is recommended to protect against overloads.

DEFINITIONS AND SELECTION CRITERIA

Current rating I_N

RMS value of the current at rated voltage and frequency, excluding harmonic distortion, switching transients, and capacitance tolerance.

It can be calculated by the formula $I = \frac{Q_C}{U_N} = 2\pi f \cdot C \cdot U_N$ and is not stated in the data charts.



Pulse current strength I_s

Depending on construction and voltage rating, the design of our capacitors permits short term inrush currents of $100...400 \times I_N$ and – in accordance with IEC 60831 – up to 5000 switching operations per annum as standard. However, when switching capacitors in automatic capacitor banks without detuning reactors, higher loads are very often the case. This may generate negative effects on the operational life, especially with capacitors which are frequently connected and disconnected (e.g. primary stages in automatic capacitor banks). Moreover, even detuned capacitors may experience switching currents exceeding the permissible maximum current of the reactor and causing consequential damage to both capacitor and reactor.



We strongly recommend the use of special capacitor contactors with inrush limiting resistors, or other adequate devices for limitation of the peak inrush currents.



Temperature category

The average useful life of a capacitor depends very much on the ambient temperatures it is operated at. The permissible operating temperatures are defined by the temperature class stated on the label which contains the lower limit temperature (-50°C) and a letter, which describes the values of the upper limit temperatures. Chart 6 is based on IEC 60831 and details the maximum permitted ambient temperatures for capacitors in each temperature category.



temperature category	ambient temperature limits		
	maximum	max. average 24 hrs	max. average 365 days
B	45°C	35°C	25°C
C	50°C	40°C	30°C
D	55°C	45°C	35°C
60	60°C	50°C	40°C
65	65°C	55°C	45°C

chart 6

Lifetime Statements

Even though all our lifetime statements are based on many years of empirical data, testing and field statistics, they will always remain just a general prognosis based on data of the past and accelerated laboratory tests which cannot reflect all aspects of modern operating conditions. The real "lifetime" of our capacitors depends on a multitude of influencing factors, such as ambient temperatures, operating voltages, frequency of overvoltages, frequency of switching, system faults a.o. The lifetime estimations given in our data sheets are therefore linked with specific operating conditions (voltage and temperature).

It has also to be noted that any lifetime statement considers a certain percentage of permitted failures within a given lot, reflecting the fact that any component has a FIT rate (failures in time). Under rated operating conditions, our capacitors can be expected to have a FIT rate of no more than 300 (corresponding to a maximum failure rate of 3 %) during their initial 100,000 hours of operation..

Please consult our sales teams if in doubt about the specific implications of your intended operating conditions on lifetime and reliability of our capacitors.



DATA CHARTS

General Technical Data

rated voltages		230 ... 800 V, 60 Hz
permitted overvoltages and test voltages		in accordance with IEC EN 60831-1/2 (see data charts for details)
tolerance of capacitance		- 5 ... + 10 %, ± 5 % on request
maximum permissible current		at least $1.3 I_N$, see data charts for details
max. inrush current		$300 \times I_N$
dissipation losses (capacitor)		approx. 0.25 ... 0.40 W/kvar
internal connection		delta
safety device		BAM™ (overpressure break action mechanism)
dielectric material		low-loss polypropylene, dry
impregnant (filling material)	MKPg 265 MKP 266	inert insulation gas (N ₂) resin, based on vegetable oil
mounting position	MKPg 265 MKP 266	any position vertical position recommended
max. relative humidity		95 % (climatic class C)
operating temperatures		see data charts for ambient temperature class
storage temperature		-50 ... +85°C
max. altitude abv.s.l.		4000 m a.s.l.
statistical life expectancy		100,000 ... 150,000 h depending on type range and operating temperatures (see charts for details)
applied standards		IEC EN 60831, VDE 0560-46/47 UL Standard No. 810, CSA C22.2 No. 190, GOST 1282-88, IS 13340/13341
approval marks		all capacitors in this catalogue: UL/C-UL recognized component, 10,000AFC internally protected



All capacitors listed in this catalogue comply with the relevant regulations and guidelines of the European Union: 2014/35/EU (Low-Voltage Directive).

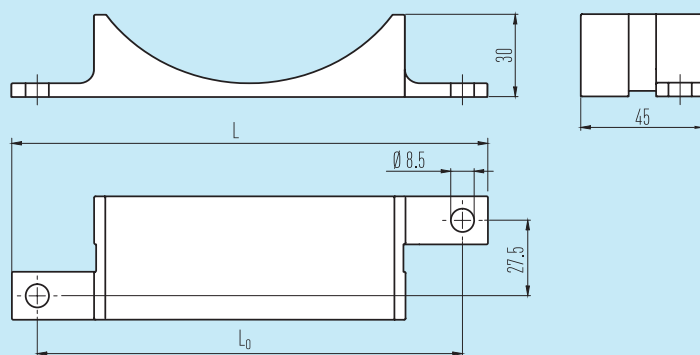
This is proven by the technical documentation and compliance with the following standard: IEC/DIN EN 60831-1/2:2014

Holder for Horizontal Mounting

All cylindrical capacitors with diameter 116mm and 136mm can be mounted by means of this bracket on a flat vertical or horizontal surface.

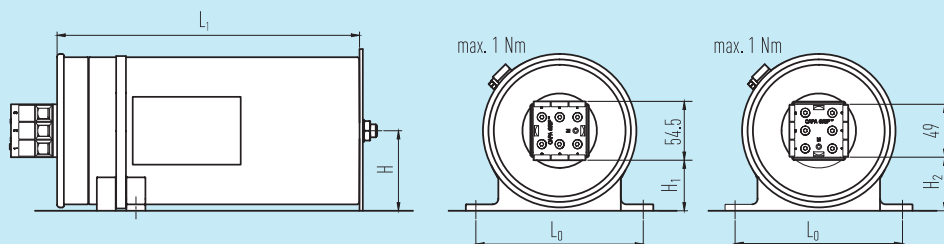
The bracket is made of glass fibre reinforced polyamide and comes as a set including a matching 9mm zinc-plated steel strap for fixation of the capacitor.

Drawings



materialglass fibre reinforced polyamid

Example for M3 design



Example of horizontal mounting.

for Diameter	L	L ₀	H	H ₁	H ₂	order no. (10 × mounting set)
116	159	135	64	37	40	E50.H16-100000
136	174	155	74	47	50	E50.H36-100001

MKPg™

265.*** 3PH GAS-FILLED 230 ... 280 V 60Hz

for latest edition and updates
check www.powercapacitors.info



Three-phase power capacitors, dry self-healing dielectric, gas-filled (N₂)

For detuned and non-detuned PFC equipment in mains with severe operating conditions or substantial voltage fluctuations.

U_N **Θ_{ambient}** **statistical life**

230V -50/60 >150,000 h

260V -50/D >150,000 h

280V -50/D >130,000 h

Permitted overvoltages

8h/d 308V

30min/d 320V

5min (200×) 335V

1min (200×) 365V

max. peak voltage 850V ac

CAPA**GRIP**™ K and II (L4) including discharge resistors. For L and M see resistor modules on pages 46f.

Q _c 280V (kvar)	Q _c 260V (kvar)	Q _c 230V (kvar)	C _N (μF)	I _{max} (A)	D ₁ × L ₁ (mm)	m (kg)	CAPA GRIP	order no.	packg.lot / box
3.5	3.1	2.5	3 × 40	3 × 13	60 × 164	0.4	K	265.525-304000	10/FB8
5.6	5.0	3.8	3 × 63	3 × 30	75 × 164	0.7	K	265.545-306300	5/FB8
7.5	6.3	5.0	3 × 84	3 × 31	85 × 164	1	L4	265.255-308400	5/FB8
11.0	9.6	7.5	3 × 125	3 × 35	75 × 230	1	K	265.546-312500	5/FB12
23.2	20.0	15.7	3 × 262	3 × 70	100 × 245	1.8	M	265.378-326200	3/FB12

Other sizes and ratings are available on request. Single phase capacitors are available on request in same dimensions and design.

Mind Mounting and Operating Instructions on pages 32ff!

MKPg™

265.*** 3PH GAS-FILLED

380 ... 480 V 60Hz



Three-phase power capacitors, dry self-healing dielectric, gas-filled (N₂)
For detuned and non-detuned PFC equipment in mains with standard operating conditions

U _N	Θ _{ambient}	statistical life
380...400V	-50/60 (*-50/D)	>150,000 h
440V	-50/D	>150,000 h
480V	-50/C	>100,000 h

Permitted overvoltages

8h/d	530V	1min (200×)	625V
30min/d	555V	max. peak voltage	1425V ac
5min (200×)	580V		

CAPA **GRIP**™ K and II (L4) including discharge resistors. For L and M see resistor modules on pages 46f.

Q _C 480V (kvar)	Q _C 440V (kvar)	Q _C 400V (kvar)	Q _C 380V (kvar)	C _N (μF)	I _{max} (A)	D ₁ × L ₁ (mm)	m (kg)	CAPA GRIP	order no.	packg.lot / box
5.5	4.6	3.8	3.4	3 × 21	3 × 11	60 × 164	0.4	K	265.525-502100	10/FB8
7.3	6.1	5	4.6	3 × 28	3 × 15	60 × 196	0.7	K	265.523-502800	10/FB12
10.4	8.8	7.3	6.5	3 × 40	3 × 25	75 × 164	0.7	K	265.545-504000	10/FB8
12	10	8.3	7.5	3 × 46	3 × 25	85 × 164	1	L4	265.255-504600	5/FB8
14.3	12	10	9	3 × 55	3 × 26	75 × 230	1	K	265.546-505500	5/FB12
15	12.5	10.5	9.4	3 × 58	3 × 27	75 × 230	1	K	265.546-505800	5/FB12
17.7	15	12.3	11.1	3 × 68	3 × 32	75 × 245	1	K	265.548-506800	10/FB12
20	16.9	13.9	12.5	3 × 77	3 × 36	85 × 230	1.3	L4	265.256-507700	5/FB12
21.6	18.2	15	13.5	3 × 83	3 × 40	85 × 230	1.5	L4	265.256-508300	5/FB12
24	20	16.6	15	3 × 92	3 × 43	85 × 245	1.5	L4	265.258-509200	5/FB12
28.9	24	20	18	3 × 111	3 × 52	95 × 230	1.5	L4	265.266-511100	3/FB12
-	30	25	22.4	3 × 137	3 × 56	100 × 245	1.8	L4	265.278-513700	3/FB12
-	33.7	27.9	25	3 × 154	3 × 56	116 × 230	2.3	L4	265.286-515400	3/FB12
-	36	30	27	3 × 166	3 × 56	116 × 230	2.3	L4	265.286-516600	3/FB12
-	40	33.3	30	3 × 185	3 × 68	116 × 280	2.6	M	265.389-518500	3/FB10
-	-	40*	36	3 × 221	3 × 75	116 × 280	2.6	M	265.389-522100	3/FB10

Other sizes and ratings are available on request. Single phase capacitors are available on request in same dimensions and design.
Mind Mounting and Operating Instructions on pages 32ff!

MKPg™
265.* 3PH GAS-FILLED**
440 ... 525 V 60Hz



Three-phase power capacitors, dry self-healing dielectric, gas-filled (N₂)
For detuned and non-detuned PFC equipment in mains with severe operating conditions or substantial voltage fluctuations.

U _N	Θ _{ambient}	statistical life	Permitted overvoltages		
440V	-50/65	>150,000 h	8h/d	580V	1min (200×) 680V
480V	-50/60	>150,000 h	30min/d	600V	max. peak voltage 1600V ac
525V	-50/D	>150,000 h	5min (200×)	630V	

CAPAGRIP™ K and II (L4) including discharge resistors. For L and M see resistor modules on pages 46f.

Q _N 525V (kvar)	Q _N 480V (kvar)	Q _C 440V (kvar)	C _N (μF)	I _{max} (A)	D ₁ × L ₁ (mm)	m (kg)	CAPA GRIP	order no.	packg.lot / box
3.1	2.5	2.2	3 × 10	3 × 6	60 × 164	0.4	K	265.525-801000	10/FB8
4.4	3.7	3	3 × 14	3 × 9	60 × 164	0.5	K	265.525-701400	10/FB8
6.5	5.5	4.6	3 × 21	3 × 13	75 × 164	0.7	K	265.545-702100	5/FB8
7.5	6.3	5	3 × 24	3 × 14	75 × 164	1	K	265.545-702400	5/FB8
12	10	8.3	3 × 38	3 × 20	75 × 230	1	K	265.546-703800	5/FB12
13.9	11.6	10	3 × 44.5	3 × 23	85 × 230	1.3	L4	265.256-704500	5/FB12
20	16.7	14	3 × 64	3 × 33	95 × 230	1.5	L4	265.266-706400	3/FB12
24	20	16.9	3 × 77	3 × 40	100 × 245	1.8	L4	265.278-707700	3/FB12
27.7	23	20	3 × 89	3 × 46	116 × 230	2.3	L4	265.286-708900	3/FB12
30	25	21	3 × 96	3 × 50	116 × 230	2.3	L4	265.286-709600	3/FB12
35.9	30	25	3 × 115	3 × 56	116 × 280	2.6	L4	265.289-711500	3/FB10
40	33.3	28	3 × 128	3 × 65	136 × 230	2.9	M	265.396-712800	2/FB12

Other sizes and ratings are available on request. Single phase capacitors are available on request in same dimensions and design.
 Mind Mounting and Operating Instructions on pages 32ff!

MKPg™

265.*** 3PH GAS-FILLED 480 ... 800 V 60Hz

for latest edition and updates
check www.powercapacitors.info



Three-phase power capacitors, dry self-heating dielectric, gas-filled (N₂)

For detuned and non-detuned PFC equipment in 690V mains with normal operating conditions or substantial voltage fluctuations.

U _N	Θ _{ambient}	statistical life
480V	-50/65	>150,000 h
600V	-50/60	>150,000 h
690V	-50/D	>130,000 h
760V	-50/D	>100,000 h

Permitted overvoltages

8h/d	840V	1min (200×)	990V
30min/d	875V	max. peak voltage	2300V ac
5min (200×)	915V		

For resistor modules see pages 46f.

Q _C 760V (kvar)	Q _C 690V (kvar)	Q _C 600V (kvar)	Q _C 480V (kvar)	C _N (μF)	I _{max} (A)	D ₁ × L ₁ (mm)	m (kg)	CAPA GRIP	order no.	packg.lot / box
5	4.17	3.1	2	3 × 7.7	3 × 8	75 × 164	0.7	K	265.545-597700	5/FB8
6.3	5	4	2.5	3 × 9.7	3 × 9	75 × 164	0.7	K	265.545-401000	5/FB8
40	33.3	25	16	3 × 62	3 × 47	116 × 280	2.6	L	265.189-406200	3/FB10
-	-	30	19.3	3 × 74	3 × 54	116 × 280	2.6	L	265.189-407400	3/FB10
-	50	37.4	24	3 × 93	3 × 55	136 × 280	3.7	M	265.399-409300	2/FB10

U _N	Θ _{ambient}	statistical life
480V	-50/65	>150,000 h
600V	-50/60	>150,000 h
690V	-50/D	>130,000 h
800V	-50/D	>100,000 h

Permitted overvoltages

8h/d	880V	1min (200×)	1040V
30min/d	920V	max. peak voltage	2400V ac
5min (200×)	960V		

For resistor modules see pages 46f.

Q _C 800V (kvar)	Q _C 690V (kvar)	Q _C 600V (kvar)	Q _C 480V (kvar)	C _N (μF)	I _{max} (A)	D ₁ × L ₁ (mm)	m (kg)	CAPA GRIP	order no.	packg.lot / box
20	15	11.4	7.5	3 × 28	3 × 21	95 × 230	1.5	L	265.166-502800	3/FB12
35.5	26.4	20	12.5	3 × 49	3 × 49	116 × 280	2.6	L	265.189-504900	3/FB10
40	29	22	14.2	3 × 54.4	3 × 55	116 × 280	2.6	L	265.189-505401	3/FB10

Other sizes and ratings are available on request. Single phase capacitors are available on request in same dimensions and design.
Mind Mounting and Operating Instructions on pages 32ff!

MKP

266.*** 3PH OIL-FILLED 480 ... 800V 60Hz



Three-phase power capacitors, dry self-healing dielectric, gas-filled (N₂)
For detuned and non-detuned PFC equipment in 690V mains with normal operating conditions or substantial voltage fluctuations.

U _N	Θ _{ambient}	statistical life	Permitted overvoltages		
480 V	-50/65	>150,000 h	8h/d	880 V	1min (200×) 1040 V
600 V	-50/60	>150,000 h	30min/d	920 V	max. peak voltage 2400 V ac
690 V	-50/D	>130,000 h	5min (200×)	960 V	
800 V	-50/D	>100,000 h			

For resistor modules see pages 46f

Q _c 800V (kvar)	Q _c 690V (kvar)	Q _c 600V (kvar)	Q _c 480V (kvar)	C _N (μF)	I _{max} (A)	D ₁ × L ₁ (mm)	weight (kg)	CAPA GRIP	part no.	packg.lot / box
35	26.4	20	12.5	3 × 49	3 × 50	116 × 280	2.9	L	266.189-504900	3/FB10
40.5	30	23	15	3 × 56	3 × 56	136 × 230	3.2	M	266.396-505601	2/FB12

Other sizes and ratings are available on request. Single phase capacitors are available on request in same dimensions and design.
Mind Mounting and Operating Instructions on pages 32ff!

MOUNTING INSTRUCTIONS



Safe operation of the capacitors can be expected only if all electrical and thermal specifications as stated on the label, in the data sheets or catalogues and the following instructions are strictly observed. ELECTRONICON does not accept responsibility for whatever damage may arise out of a non-observance.



Mounting Position

Oil-filled MKP 266 capacitors shall be installed upright with terminals facing upwards. Gas-filled MKPg 265 capacitors can be mounted in any position without restrictions, however, a position with terminals pointing downwards should be avoided.



Location/Cooling

The useful life of a capacitor may be reduced dramatically if exposed to excessive heat. Typically, an increase in the ambient temperature by 7°C will halve the expected life of the capacitor. The permitted temperature category of the capacitor is stated on the label. If extenuating circumstances give cause for doubt, special tests should be conducted by the user to ensure that the permitted maximum ambient temperature of the capacitor is not exceeded. It should be noted that the internal heat balance of large capacitors is only reached after a couple of hours.



To avoid overheating the capacitors must be allowed to cool unhindered and should be shielded from external heat sources. Do not place the capacitors directly above or next to heat sources such as detuning or tuning reactors, bus bars, etc. and make sure the connecting cables do not import additional heat via the terminals. We recommend forced ventilation for all applications with detuning reactors. Give at least 15 ... 20 mm clearance between the capacitors for natural convection or forced ventilation.



Mounting

All cylindrical capacitors are fitted with a "break-action" safety mechanism (BAM™, see page 18) which may cause the case to expand, especially at the crimp and at the lid.

- The folded edge of the lid must not be retained by clamps.
- A clearance of at least 35mm above the terminations shall be accommodated.
- Required clearances according to applicable voltage category must be maintained even after activation of the BAM™ and prolongation of the can.

The hermetic sealing of the capacitors is crucial for a long operating life and for the correct functioning of the break action mechanism. Please pay special attention not to damage the following critical sealing points:

- the folded edge of the lid
- the connection between screw terminal and lid (designs K, L, L4, M)



The folded edge and the connection terminals must not be hit with heavy or sharp objects or tools (e.g. hammer, screw driver).



Fixation

All cylindrical capacitors can be fixed sufficiently using the mounting stud at the base of the can. Make sure to insert the washer which is delivered along with the mounting nut.

mounting stud	Permitted max. torque
M8	5 Nm
M12	15 Nm

chart 7

MOUNTING INSTRUCTIONS

Vibration stress according to DIN IEC 60068-2-6

Please consult us for details of permitted vibration stress in your application.

Note that capacitors fitted with the EL-Dr discharge reactor must not be exposed to any vibration stress at all.

Connection

Fuses and cross section of the leads should be sized for at least 1.5 times of the rated capacitor current (I_N). Please ensure that the permitted maximum rms current according to data chart (I_{max}) is not exceeded. Do not exceed the permitted nominal current values per contact as specified in chart 8 even when coupling capacitors in parallel.



The capacitors shall only be connected with flexible cables or elastic copper bands to ensure unrestricted functioning of the expansion mechanism (BAM™).

Stranded cables should be fitted with ferrules when connected to the CAPAGRIP terminals. See chart 8 for minimum cable size if used **without** ferrules. Make sure to use cables with fine or medium strands only.

The solder joints on the capacitor lids guarantee the hermetical sealing of the capacitors and must not be exposed to excessive heat.



The CAPAGRIP™ terminals (design K, L, L4, M) must not be bent, twisted or moved in any other way.

Selection of cables

Cables used for the connection of power capacitors must not contribute to the power losses of the capacitor. It may therefore be appropriate to select cable sizes in excess of the minimum permitted cross sections usually specified by cable manufacturers.



Chart 8 is based on DIN VDE 0100-430 and IEC 60439-1 and related to the operation of three or four bundled copper cables at an average ambient temperature of 40°C. Mind that national rules or the standards of your application may require different ratings.

Chart 8 outlines the minimum requirements towards the connection of capacitors. We recommend dimensioning the cables for at least $1.5 \times I_N$ where possible, and using one grade larger cable ratings if expecting higher ambient temperatures and/or substantial content of harmonics.

max. nominal capacitor current (A/phase)	e.g. Q_{Cmax} 480V 60Hz (kvar)	recommended cable section (mm²/phase)	max. recommended HRC fuse* (A)
6	5	1.5	25
12.3	10	2.5	32
16.2	13	4	35
20.8	17	6	40
28.5	24	10	63
37.7	30	16	80
50	40	25	125
60.8	50	35	125
76.2	63	50 / 35**	160

* The recommended HRC fuses are rated for cable protection only.

** Cables shall not be bundled.

chart 8

MOUNTING INSTRUCTIONS



Termination Torques

Do not exceed the permitted torque of the terminal screws (design K, L/L4, M) and the mounting studs. The test values specified by IEC 61068 must be guaranteed as a minimum value.

All CAPAGRIP™ terminals are equipped with Torx screws (T20). Use of improper screw-drivers may damage the screws and impair reliable fixation.



Terminal design	Minimum size of inserted flat conductor W x H (mm)	Cable size with ferrule or plug (mm²)	Cable size if without ferrule (mm²)	Max. nominal current (A)	Recommended torque (Nm)
K	4 ... 4.8 x 1.2	2.5 ... 10	10	30	1.8 ... 2.5
L, L4	5.5 ... 6.8 x 1.2	10 ... 25	16 ... 25	43	2.5 ... 3.0
M	8 ... 9.8 x 1.2	16 ... 35	35 ... 50	80	4.0 ... 5.0

chart 9



Discharge

Standard IEC 60831 requires a safety discharge to ≤ 75 V within 3 minutes in order to protect maintenance personnel from accidental injury by residual voltage.



Capacitors must be discharged and short-circuited before working on the terminals.

In order to minimize the switching strain and to avoid high energizing currents by connection in phase opposition, capacitors shall be discharged to ≤ 10 % of the rated voltage prior to being re-connected if switched by mechanical devices (magnetic contactors). Note that in automatic capacitor banks, very often shorter discharge cycles may be required (e.g. < 50 V within 60 seconds).



Use rapid discharge reactors or switchable discharge resistors for very short discharge cycles (see chapter "Switching and Discharging Capacitors", pgs. 36ff).

Discharge Modules

For capacitors in **CAPAGRIP L/M**, separate discharge modules in finger-proof housing (IP20) are available for the discharge of single units or groups of paralleled capacitors. The correct size of the module to be applied can be taken from the selection matrix on pg. 46f.



The discharge resistors may become very hot (up to 200°C) during continuous operation!

For CAPAGRIP L/M only: Remove the lid of the discharge module if applying protective caps to the capacitors!

Capacitors in **CAPAGRIP K** and **CAPAGRIP II (L4)** are equipped with internal discharge resistors for a discharge within no more than 60 seconds from their highest rated voltage to less than 50 V.



Earthing

Capacitors with a metal case must be earthed at the mounting stud or by means of a separate metal strap or clamp.

MOUNTING INSTRUCTIONS

Environment

All capacitors are made with lead-free solder tin and comply with the ROHS and REACH regulations. Our capacitors do not contain PCB, solvents, or any other toxic or banned materials. The impregnants and filling materials of MKP contain vegetable oil or polyurethane mixtures. The gas-filled MKPg™ capacitors contain only neutral, ecologically sound insulation gasses. Further details on the filling materials can be provided on request.



The capacitors do not contain hazardous substances acc. to European Directives 2003/53/EC and Council Directive 76/769/EEC. They are not classified as **“dangerous goods”** according to transit rules. The capacitors do not have to be marked under the regulations for Hazardous Goods. They are rated WGK 0 (water risk **category 0 “no general threat to water”**).



No danger for health if applied properly. In case of skin contact with filling liquids, clean with water and soap.

Disposal

Capacitors are components of electrical devices. They are NOT equipment or devices by themselves, and not subject to the Waste Electrical and Electronic Equipment Directive (WEEE). We recommend disposing of the capacitors through professional recycling centers for electric/electronic waste.



The capacitors can be disposed of as follows:

- Disposal acc. to European waste catalogue (EWC) No. 16 02 16 (“Components removed from discarded equipment other than those mentioned in 16 02 15”).
- Liquid filling materials which may have emerged from the capacitor shall be absorbed by proper granules and disposed of in accordance with EWC No. 08 04 10 (“waste adhesives and sealants other than those mentioned in 08 04 09”).

Caution: When touching or disposing capacitors with activated break-action mechanism, please consider that even after days and weeks these capacitors may still be charged with high voltages!

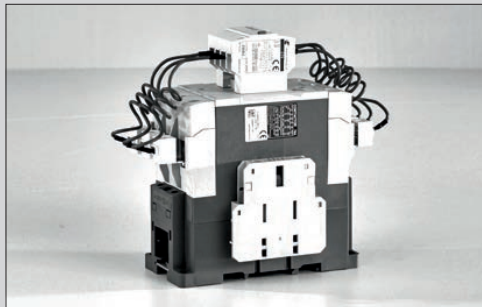


Make also sure to consult your national rules and restrictions for waste and disposal.

SWITCHING AND DISCHARGING

Our power capacitors are designed to withstand high surge currents manifold their rated current. Even so, repetitive high inrush currents may damage capacitors and should therefore be avoided by

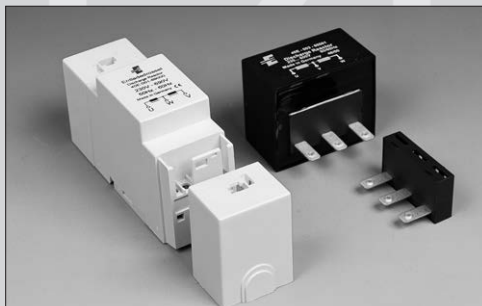
A. suppressing switching currents by the use of special capacitor contactors, see pages 38 to 40.



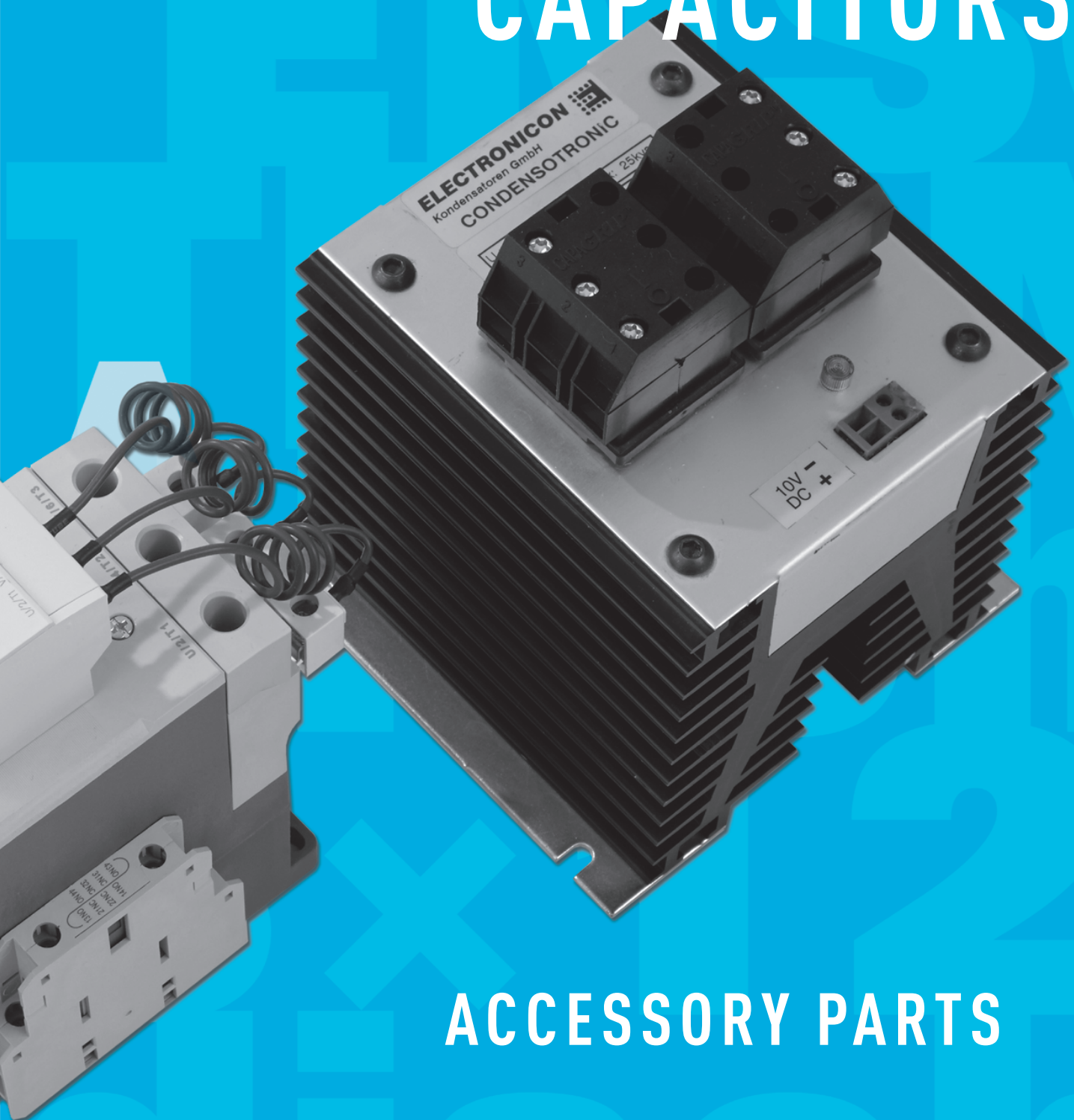
B. eliminating inrush currents by the use of suitable thyristor switches, see pages 41 to 44.



C. avoiding re-connection in phase opposition by the use of proper discharge resistors or reactors, see pages 45 to 49.

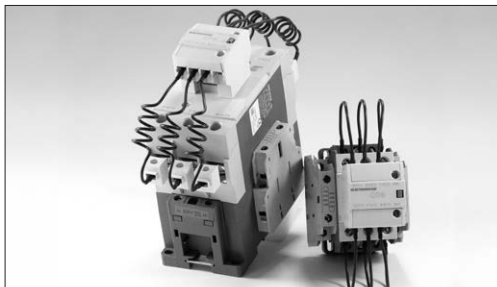


SWITCHING AND DISCHARGING CAPACITORS



ACCESSORY PARTS

CAPACITOR CONTACTORS 1301A SERIES



Power capacitors may enter high-frequency resonances with nearby inductances when being connected to the mains. Though vanishing within a few microseconds, such resonances lead to very high current surges which, if occurring regularly, may damage the capacitor elements. In accordance with IEC EN 60831-1/2, the annual number of switching operations for our standard capacitors is therefore recommended not to exceed 5000...6000 counts p.a. Special capacitors suitable for a higher annual number of switchings are available on request.

For flawless operation of our capacitors, we strongly recommend using special capacitor contactors with inrush-limiting ("leading") contacts. Such devices connect a preload channel several milliseconds prior to closing their main contact. This channel is choked down by special current limiting resistors and substantially softens the initial switching inrush surge, protecting the capacitors from destructive current surges and the contactors from premature deterioration or welding.

Our 1301A contactors are using a mechanical principle for switching the pre-load contacts. The pre-load contacts and damping resistors are supplied as a separate part and are snapped onto the main switch.

As soon as the main switch has been closed, the pre-load contacts are released again and their resistor wires taken out of circuit after no more than 5...10ms of operation. This avoids additional heat losses in the resistor wires during the operation of the capacitor branch, and contributes to the high reliability and long operational life of our contactors.

Since the disconnection of inductive loads is usually accompanied by switch arcs, the pre-load contacts of certain capacitor contactors may often face trouble when used with reactor-capacitor combinations (detuned capacitors) as they are lagging behind the main contact during the switch-off process. The contactors of our 1301A series are not affected by this problem as their pre-load contacts are already out of circuit. Hence they can be used for both detuned and non-detuned capacitor installations. ELECTRONICON strongly recommends the usage of contactors with pre-load contacts even for detuned capacitors in order to assure undisturbed switching and prevent ferro-resonances of the reactor during the start-up period.

The 1301A is enclosed in a compact, finger proof housing (IP20). Its sealed structure prevents the exposure of any arc flashes. The contactors comply with both IEC and UL standards, including UL's type II coordination requirements.

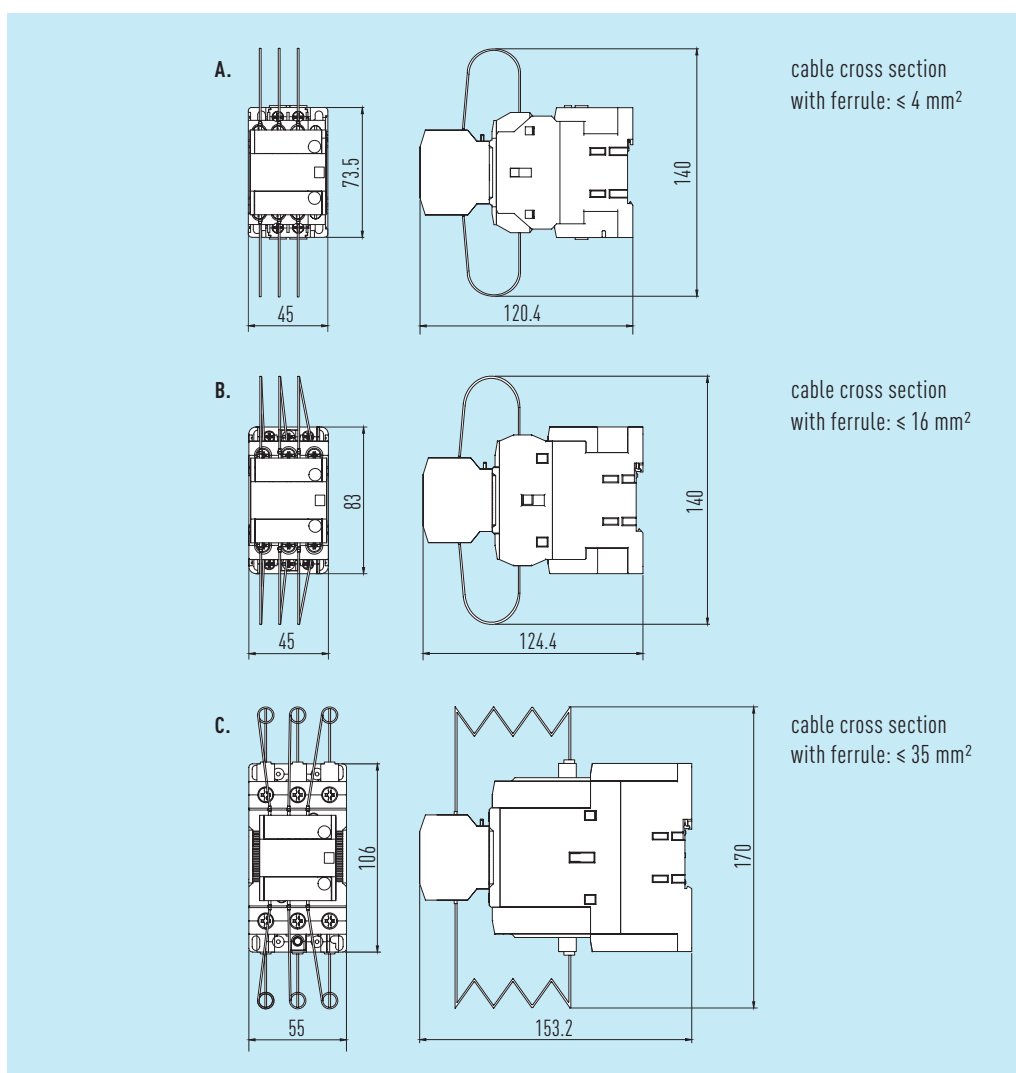
General Technical Data

design	magnetic, three phase, with mechanical pre-load contacts for inrush protection
voltage range	$U_{\text{mains}} = 220 \dots 550 \text{ V}$
control voltage	220...250 Vrms
operating temperature	-40°C/D
mounting	DIN hat rail W x H = 35 x 7.5 mm or base mounting lugs for $\varnothing 5 \text{ mm}$ screws
snap-on auxiliary contacts	available on request
standards	IEC EN 60947-4-1, UL508
approval marks	(available on request) UL, CSA

DIMENSION DRAWINGS

order no.	1301A.C0...			1301A. C7...	
	9-12.5	9-25.0	9-33.3	5-54.0	5-60.0
rated current @50°C	<18 A	<36 A	<48 A	<87 A	<92 A
max. kvar 220...240 V	<6.7	15	20	30	35
max. kvar 400...440 V	<12.5	25	33.3	54	60
max. kvar 500...550 V	<18	36	48	78	92
drawing	A	B	B	C	C
permitted switchings/hour	up to 240			up to 100	
contact life (switchings, non-detuned)	200,000			100,000	
preload contacts (obligatory accessory part)	1302A.C09-00.0			1302A.C75-00.0	
permitted operating temperature	-30 ... +60°C				

Type Range



Dimension Drawings

THYRISTOR SWITCHES

Other than conventional contactors, our semiconductor-based switches allow for exact determination of the switching moment to the millisecond. This brings about two advantages:

1. Connection of the capacitor exactly at the moment of equal voltage between mains and capacitor element(s): this eliminates inrush effects almost completely without the need for current-limiting resistors, substantially enhancing the operating conditions for the capacitor and resulting in a longer life expectancy.
2. Instantaneous power factor correction for rapidly changing loads: certain reactive loads, e.g. spot welding equipment or elevator systems, call for a high amount of power factor correction for short but very frequent periods. Thyristor switches are capable of multiple switching operations per minute. Since they always switch at zero-voltage-differential (see pt.1), the capacitors do no longer need to be discharged before re-connection, and can sustain substantially higher numbers of connections as compared with conventional magnetic contactors.

Discharge resistors and thyristor switches:

Thyristor switched capacitors do not require discharge resistors for proper operation. For the purpose of maintenance safety, however, all power capacitors are required to be equipped with bleeding resistors ensuring a discharge below 75V within no more than 3 minutes after disconnection. When selecting the discharge resistors for thyristor-switched capacitors, please consider the following important points:

1. Due to carrier storage effects during switch-off, thyristor switches may charge the capacitor with an overvoltage of up to $1.43 \times U_{AC}$ (= ca. $2 \times U_{rms}$) at the moment of disconnection. This is unproblematic for ELECTRONICON power capacitors, however frequent switching may overheat and even destroy the bleeding resistors.
2. Certain thyristor switches keep disconnected capacitors constantly charged at maximum AC voltage in order to provide a defined "point of re-entry". This permanent voltage will then be up to 1.41 times above the rated voltage of discharge resistors normally used for "standard" power capacitors!

The resistors integrated in our CAPAGRIP K and CAPAGRIP II terminals are usually rated for the nominal voltage of the connected capacitor and a discharge below 50 V within less than 60 seconds; in the 525 V range, the resistors are dimensioned for such discharge from 480 Vrms (= 680 Vac). They are not suitable for the operation with thyristor switches. You are therefore required to use capacitors from our Heavy Duty ranges with CAPAGRIP L or M terminals instead and select suitable resistor modules from our selection charts on pages 46ff.



Use resistors with a rated voltage of at least $2.2 \times U_N$. As a rule, our 275.106 modules rated 1000 V will be sufficient for equipment in 400 or 440 V mains.

Remember that the discharge is relevant for safety aspects only. Select resistor values which serve for a discharge of the capacitors below 75V within 3 or – even better – 5 minutes. This drastically reduces the power dissipation losses of the resistors.

Five minutes discharge period is not specified by standard IEC EN 60831. Make sure to place an appropriate warning sticker on capacitors or equipment if selecting resistors this way.

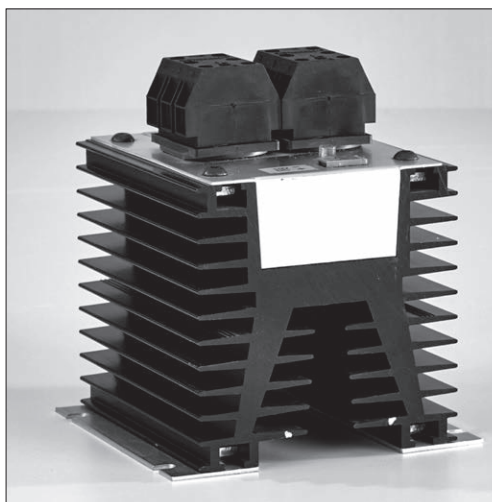
CONDENSOTRONIC CT 2000

YOU'LL BARELY FIND A MORE COMPACT ONE

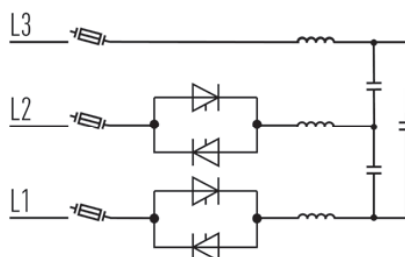
Immediate compensation of inductive reactive power is very often the only way to cope with disturbances imposed on the mains by huge, rapidly changing inductive loads. Conventional capacitor switching devices with reaction periods of 20...90 seconds cannot comply with such intensive requirements.

The CONDENSOTRONIC thyristor switch module makes reaction times of 1...20 milliseconds possible. The switching is done, practically without reactive effects, at zero voltage level (no voltage between input and output).

CONDENSOTRONIC has a very compact design, convenient connection, integral overheating protection, and LED indication for the switching signal and excessive temperature. For powers above 25kvar, a controllable fan is included.



The CONDENSOTRONIC CT2000 thyristor switch works according to the W3C-2 switching principle, i.e. phase L3 will not be switched.



CT 2000
Switching
Principle

design	two controlled phases (semi-controlled)
indications	LED
voltage range	$U_{\text{mains}} = 400...525 \text{ V}$ (other voltages on request)
signal voltage	$10 \text{ V} \pm 2 \text{ V DC}$
response time	0.2...15 ms
recovery time	40 ms
max. altitude	1000 m a.s.l.
ambient operating temperature	-10...45°C (up to 65°C with derated current ratings)
storage temperature	-40...85°C
relative humidity	10...95 % (no condensation permitted)
degree of protection	IP20
mounting position	optional

General
Technical
Data

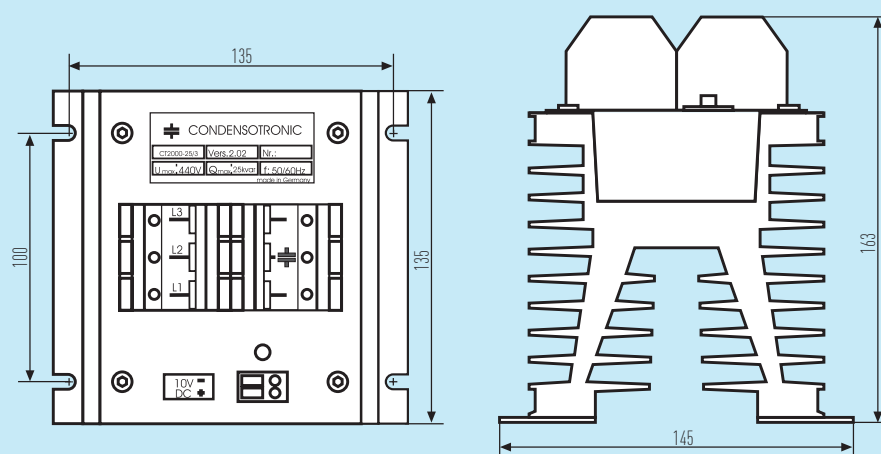
CONDENSOTRONIC CT 2000

Type Range

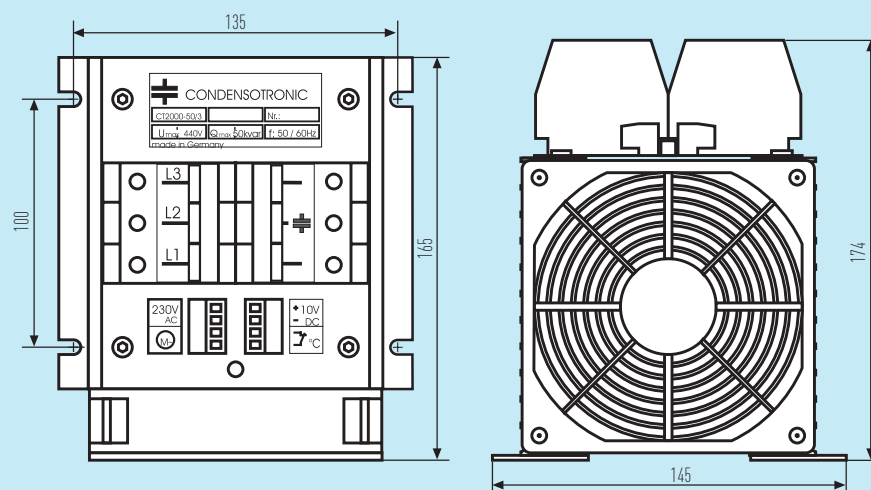
type	Q _c (kvar)	U _N (V)	I _{max} (A)	power losses (W@I _{max})	Fan	dimensions (mm)			weight (kg)	order code
						L	W	H		
CT2000-25-415	25	380 ... 415	52	156	-	145	135	163	3.1	12412.052-10.0
CT2000-25-525	25	400 ... 525	38	132	-	145	135	163	3.1	12522.038-10.0
CT2000-50-415	50	380 ... 415	100	312	x	145	165	174	3.5	12412.100-10.0
CT2000-50-525	50	440 ... 525	78	264	x	145	165	174	3.5	12522.078-10.0

Dimension Drawings

CT 2000-25



CT 2000-50

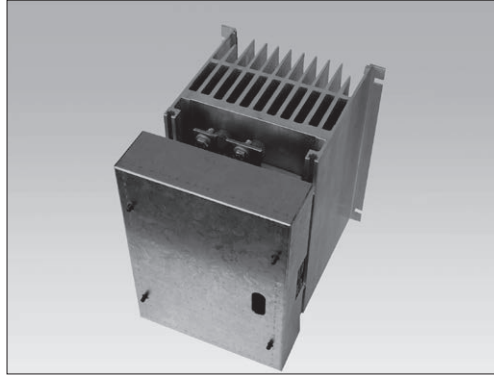


TS 12-2

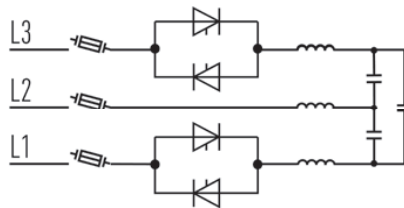
MODERN THYRISTOR SWITCHES FOR YOUR STATIC PFC SYSTEM

The new thyristor switch modules of our TS12-2 series can switch within 20 milliseconds. Other than CT2000, the TS12-2 is kept charged at peak voltage after disconnection. The switching is done, practically without reactive effects, at peak voltage mains level, i.e. when there is no voltage differential between mains voltage and the charge of the capacitor.

The TS12-2-module has a compact design and integral overheating protection. For powers above 50 kvar, a controllable fan is included.



TS12-2 works according to the W3C-2 switching principle, i.e. phase L2 will not be switched.



TS12-2
Switching
Principle

design	two controlled phases (semi-controlled)
voltage range	$U_{\text{mains}} = U_N = 400 \dots 690 \text{ V}$ (other voltages on request)
control voltage	230 V 50/60 Hz (other voltages on request)
signal voltage	8 - 30 V dc
recovery time	typically 1 period
max. altitude	1000m a.s.l.
ambient operating temperature	-10...45°C (up to 65°C with derated current ratings)
relative humidity	10...95 % (no condensation permitted)
degree of protection	IP10
mounting position	optional

General
Technical
Data

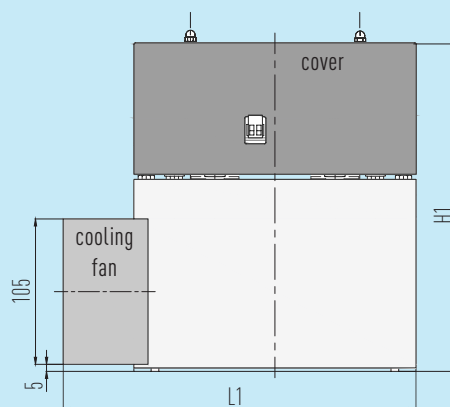
TS 12-2

Type Range

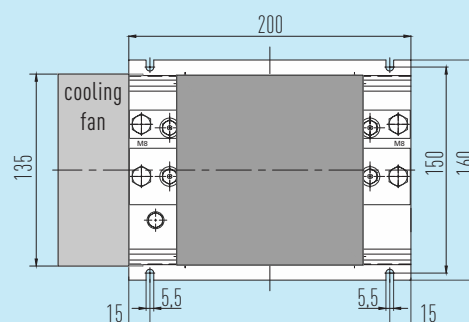
type	U _N (V)	Q _c (kvar)	I _N (A)	max. I _N (A)	power losses (W@I _{max})	Fan	dimensions (mm)		weight (kg)	order code
							L ₁	H ₁		
TS12-2-36-400	400	25	36	47	93	-	-	215	4.3	12402.036-00.0
TS12-2-72-400	400	50	72	93	165	-	-	215	4.3	12402.072-00.0
TS12-2-109-400	400	75	109	141	283	x	260	215	5.6	12402.109-00.0
TS12-2-144-400	400	100	144	187	341	x	260	215	5.6	12402.144-00.0
TS12-2-33-440	440	25	33	43	74	-	-	215	4.3	12442.033-00.0
TS12-2-66-440	440	50	66	86	153	-	-	215	4.3	12442.066-00.0
TS12-2-99-440	440	75	99	129	262	x	260	215	5.6	12442.099-00.0
TS12-2-131-440	440	100	131	170	305	x	260	215	5.6	12442.131-00.0
TS12-2-30-480	480	25	30	39	67	-	-	215	4.3	12482.030-00.0
TS12-2-60-480	480	50	60	78	139	-	-	215	4.3	12482.060-00.0
TS12-2-90-480	480	75	90	117	235	x	260	215	5.6	12482.090-00.0
TS12-2-120-480	480	100	120	156	276	x	260	215	5.6	12482.120-00.0
TS12-2-150-480	480	125	150	195	356	x	260	215	5.6	12482.150-00.0
TS12-2-72-525	525	65	72	93	159	-	-	215	4.3	12522.072-00.0
TS12-2-144-525	525	130	144	187	325	x	260	215	5.6	12522.144-00.0
TS12-2-42-690	690	50	42	54	104	-	-	250	4.6	12692.042-00.0
TS12-2-84-690	690	100	84	109	207	x	260	250	5.9	12692.084-00.0

Dimension Drawings

reference example with integrated fan

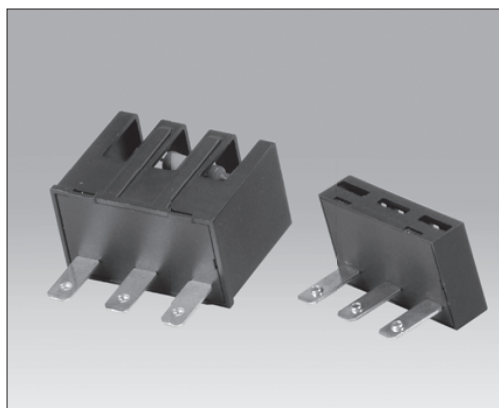


pic.1: Side view with mounted cover



pic.2: Top view with cover removed

DISCHARGE DEVICES



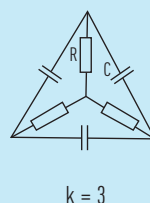
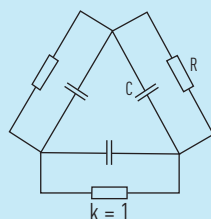
Resistor Modules

Capacitors with CAPAGRIP K and CAPAGRIP II terminals are equipped with discharge resistors for a discharge from their highest nominal voltage rating to less than 50 V within < 60 seconds. For capacitors with CAPAGRIP L and M we offer separate resistor modules. The correct size of the module to be applied can be selected from the data charts on pages 47f based on applied voltage, required discharge period, and capacitance to be discharged.

Alternatively, the resistors to be used for a given capacitance and operating voltage can be calculated by means of the following formula:

$$\text{three-phase: } R \leq \frac{t}{k \times C_T \times \ln \frac{U_B \times \sqrt{2}}{U_E}}$$

$$\text{single-phase: } R \leq \frac{t \times 1.5}{C_{\text{total}} \times \ln \frac{U_B \times \sqrt{2}}{U_E}}$$



t ... Discharge period in [s]
 C_T ... Partial capacitance of one phase
 C_{total} ... Total capacitance
 U_B ... Operating voltage
 U_E ... Maximum permissible voltage after period t
 R ... Module resistance value

In all cases, the closest smaller discharge module available shall be applied.

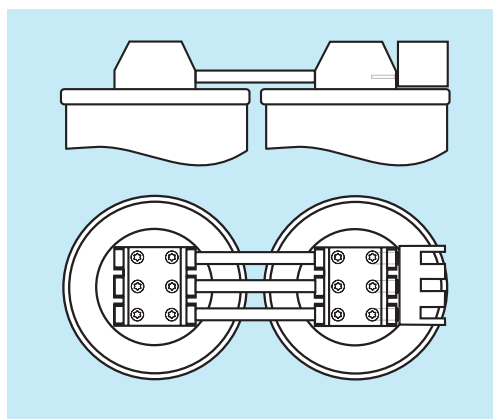
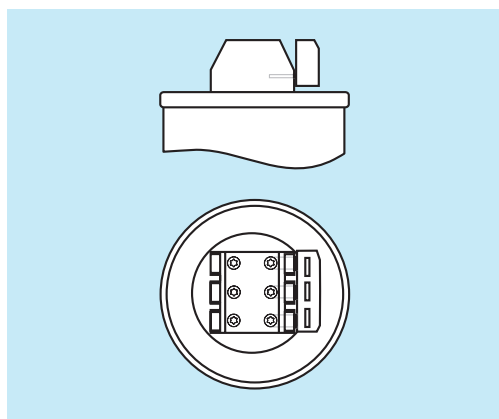
The discharge resistors may become very hot (up to 200°C) during continuous operation!

For design L/M only: Remove the lid of the discharge module if applying protective caps to the capacitors!



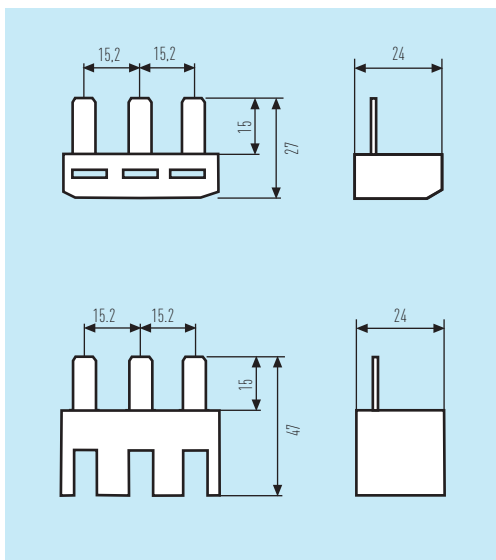
Sets for CAPAGRIP™ L & M Capacitors (Protection: IP20)

CAPAGRIP™ resistor modules can be connected to single capacitors as well as to groups of parallel units. Both type 1 and 2 are equally compatible with CAPAGRIP™ L or M terminals.



DISCHARGE DEVICES

Type 1



Type 2

$U_{\max}$ (V)	R_N (k Ω)	module type	selection code	order code
1000	3 Y 300	2	(1)	275.106-10300
1000	3 Y 180	2	(2)	275.106-10180
850	3 Y 120	2	(3)	275.106-10120
760	3 $\times$ 300	1	(4)	275.100-10300
720	3 $\times$ 180	2	(5)	275.105-10180
600	3 $\times$ 180	1	(6)	275.100-10180
600	3 $\times$ 120	2	(7)	275.105-10120
480	3 $\times$ 120	1	(8)	275.100-10120
530	3 $\times$ 100	2	(9)	275.105-10100
480	3 $\times$ 82	2	(10)	275.105-10082
400	3 $\times$ 82	1	(11)	275.100-10082
440	3 $\times$ 68	2	(12)	275.105-10068

Selection Charts

The selection charts state the maximum capacitance per voltage level which can be discharged with each resistor module:

1. Select the line of your **operating** voltage. Mind that in detuned systems, the actual voltage at the capacitor is higher than the rated mains voltage.
2. Look for the column with the capacitance which is closest to your capacitor. Look up **BLACK** figures if you want to discharge below 50 V within no more than 60 seconds. Look up **BLUE** figures if you want a discharge below 75 V within 3 minutes. Go for **GREY** figures if 5 min discharge is sufficient.
3. Determine the resistor module to be ordered in the head of the column.

DISCHARGE DEVICES

Selection Matrix for CAPAGRIP™ Resistor Modules (3ph, star connected)

capacitor voltage (V)		C _{max} to be discharged (μF)											
U _{max}	U _{AC}	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
230	325	3×36	3×59	3×89	3×107	3×178	3×178	3×267	3×267	3×320	3×391	3×391	3×471
		3×136	3×227	3×341	3×409	3×682	3×682	3×1022	3×1022	3×1227	3×1496	3×1496	3×1804
		3×227	3×379										
280	395	3×32	3×54	3×81	3×97	3×161	3×161	3×242	3×242	3×290	3×354	3×354	3×426
		3×120	3×200	3×301	3×361	3×601	3×601	3×902	3×902	3×1082	3×1319	3×1319	3×1591
		3×200	3×334										
400	565	3×27	3×46	3×69	3×82	3×137	3×137	3×206	3×206	3×247	3×302	3×302	3×364
		3×99	3×165	3×247	3×297	3×495	3×495	3×742	3×742	3×891	3×1086	3×1086	3×1310
		3×165	3×275										
415	585	3×27	3×45	3×68	3×81	3×135	3×135	3×203	3×203	3×244	3×297		3×358
		3×97	3×162	3×243	3×292	3×486	3×486	3×729	3×729	3×875	3×1067		3×1287
		3×162	3×270										
440	620	3×26	3×44	3×66	3×79	3×132	3×132	3×198	3×198	3×238	3×290		3×350
		3×95	3×158	3×236	3×284	3×473	3×473	3×709	3×709	3×851	3×1037		3×1251
		3×158	3×263										
480	680	3×26	3×43	3×64	3×77	3×128	3×128	3×192	3×192	3×230	3×281		
		3×91	3×151	3×227	3×272	3×454	3×454	3×681	3×681	3×817	3×996		
		3×151	3×252										
525	740	3×25	3×41	3×62	3×74	3×124	3×124	3×185		3×222			
		3×87	3×145	3×218	3×262	3×436	3×436	3×654		3×785			
		3×145	3×242										
600	850	3×24	3×39	3×59	3×71	3×118	3×118	3×177					
		3×82	3×137	3×206	3×247	3×412	3×412	3×618					
		3×137	3×229										
690	975	3×22	3×37	3×56	3×67	3×112							
		3×78	3×130	3×195	3×234	3×390							
		3×130	3×217										
760	1075	3×22	3×36	3×54	3×65								
		3×75	3×125	3×188	3×225								
		3×125	3×209										
800	1130	3×21	3×36	3×53									
		3×74	3×123	3×184									
		3×123	3×205										
850	1200	3×21	3×35	3×52									
		3×72	3×120	3×180									
		3×120	3×200										
1000	1415	3×20	3×33										
		3×68	3×114										
		3×114	3×189										

C_{max} for discharge < 50 V within 1 min

C_{max} for discharge < 75 V within 3 min

C_{max} for discharge < 75 V within 5 min*

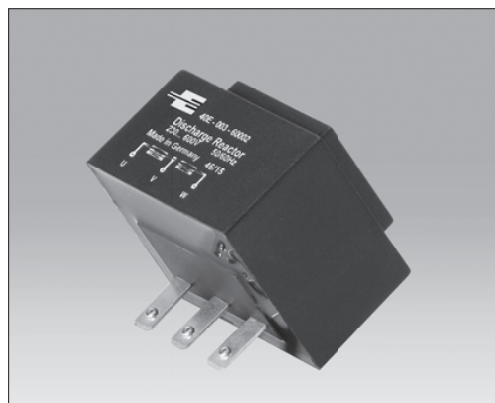
*Recommended for thyristor-switched equipment.

NOTE: Warning about 5 min discharge time should be placed on the equipment.

EL-DR DISCHARGE REACTOR

40E.003-60003

The increasing demand for shorter discharge periods cannot be satisfied by traditional discharge means (fixed resistors). The installation of additional fast discharge resistors at the capacitor contactor results in an increase in material and installation costs. Our discharge reactor replaces the compulsory fixed resistors and additional rapid discharge resistors, and at the same time it reduces the heat dissipation losses inside the capacitor bank. It further avoids additional heating of the capacitor terminals by standard discharge resistors.

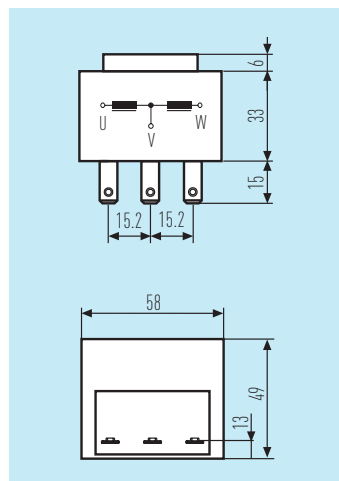


Discharge reactors must NOT be used in combination with thyristor switches. Frequent switching and the charging function of many switches will damage the reactor.

General Technical Data

design	two controlled phases (semi-controlled)
construction	dual reactor with iron core in plastic housing
DC resistance per coil	7600 Ohm
duty cycle	continuous operation
rated voltage	230 ... 600 V 3ph, 50/60Hz
capacitor to be discharged	5 ... 50kvar
connection	direct mounting on capacitor terminal (design L/M)
vibration stress	not permitted
dissipation losses	< 1W
ambient temperature	max. 40° C
degree of protection	IP20
dimensions W × H × D	58 × 49 × 39 mm
weight	290 g
insulation	class B (135°C)
standard	IEC 61558-2-20
CE conformity	2014/35/EU Low-Voltage Directive

Dimension Drawings

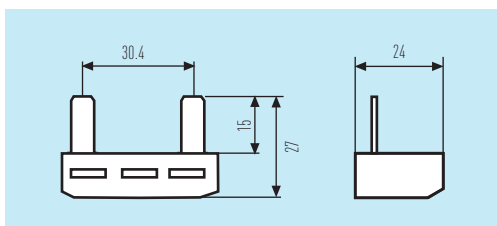


Q _c (kvar)	permitted no. of discharges/min at 40°C		discharge period (sec)						
	400...525 V	230 V/600 V	230 V	400 V	440 V	480 V	525 V	600 V	
12.5	5	4	12	5	4	4	4	2.6	
25	4	3	24	10	9	8	7	5	
30	3	2	-	12	10	9	8	6	
50	2	1	-	20	17	15	14	10.5	

ACCESSORY PARTS

Protective Blank for CAPAGRIP™ M Terminal (IP20)

Type M terminals are designed for accepting 50mm² cables. If one side of the terminal block is not used, then this blank must be fitted to maintain the IP20 rating.



Order code:
275.100-10000 (10/box.)

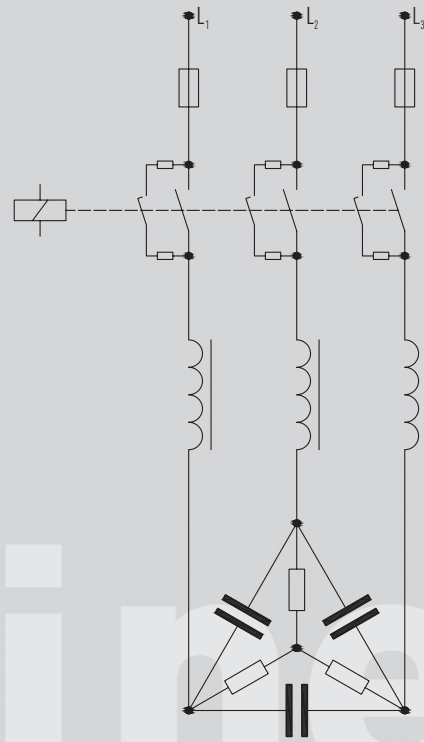
DETUNING REACTORS

The growing use of power electronic devices is causing an increasing level of harmonic distortion in the electrical system which very often leads to problems with capacitor installations. This is the reason why more and more energy suppliers demand the installation of detuned capacitors.

A detuned capacitor performs the function of power factor improvement whilst preventing any amplification of harmonic currents and voltages caused by resonance between capacitors and inductances in the electrical system.

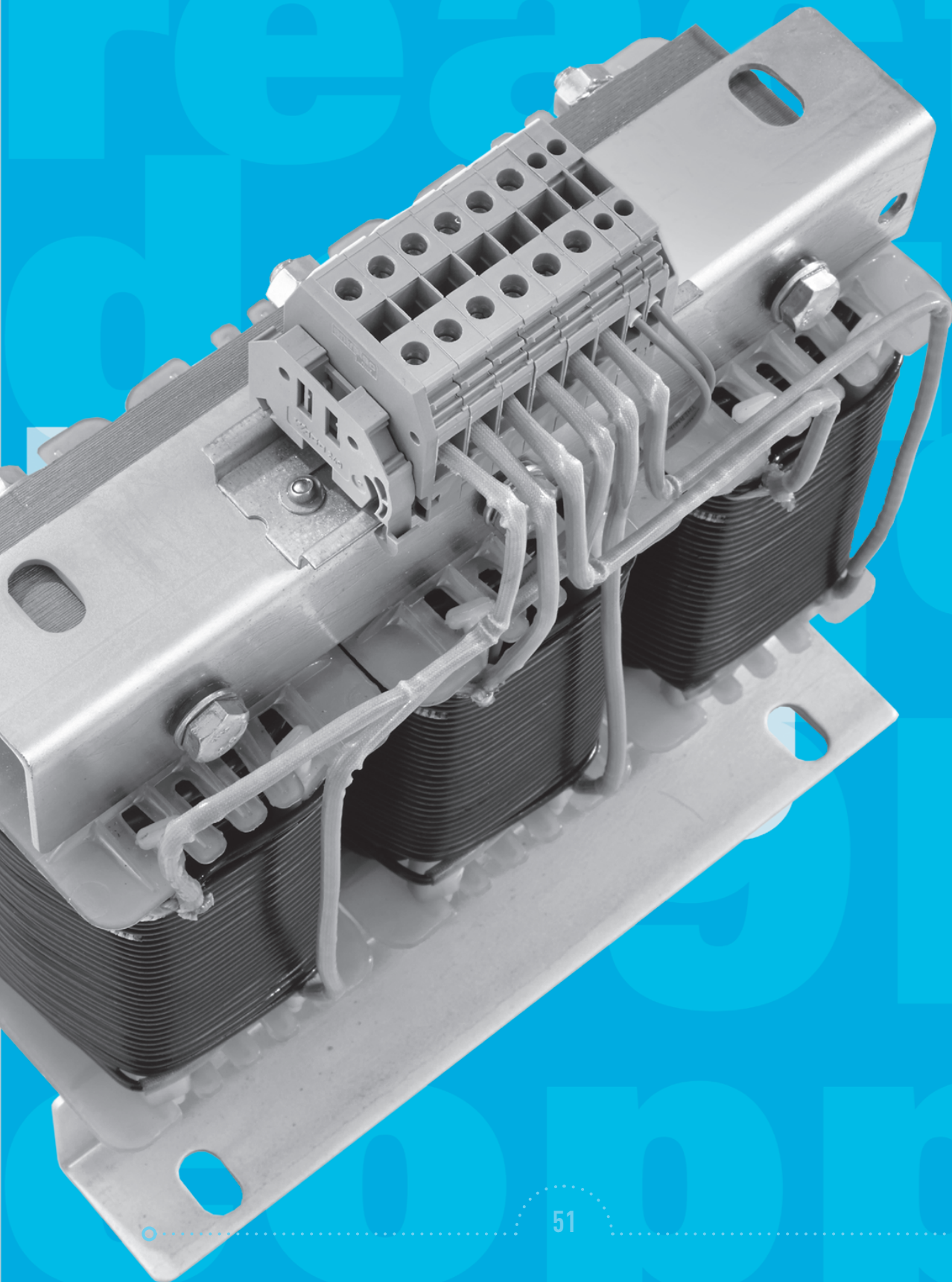
By adding an appropriately rated series reactor to the power capacitor, both elements form a **resonating circuit with its resonant frequency below the lowest order harmonic** in the system (usually the 5th). All frequencies above this resonant frequency now see this circuit as inductive hence eliminating the possibility of dangerous resonances being set up between the capacitors and system inductances (provided the reactor has been dimensioned properly).

It has to be ensured, however, that non-detuned capacitors and capacitors with detuning reactors are never operated in the same mains. Such combination may cause unforeseeable interactions and equalising currents leading to damage and destruction of capacitors, reactors, and other components.



DETUNING REACTORS

PROTECTING CAPACITORS



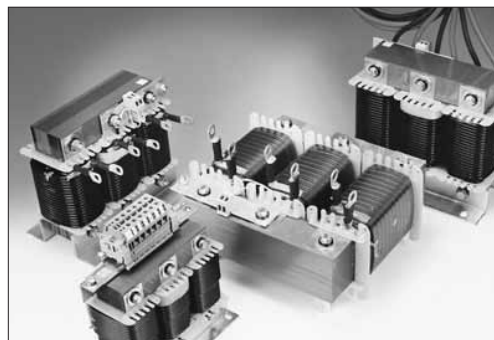
DETUNING REACTORS

Design features

Our filter reactors are made of **high-class transformer sheets** and **copper wire or aluminium band**.

They are dried and impregnated in a vacuum with environmentally friendly, low-styrole resin which ensures they can withstand high voltages, have low noise levels, and offer a long operating life.

Depending on their rated power, the reactors are provided with either terminal blocks or terminal lugs/cables. The connection of the aluminium reactors is made through copper terminals as well, which are reliably connected with the aluminium band by a special, well-proven welding method.



High-class iron cores with multiple air gaps as well as a staid designing approach guarantee **high current linearity** and **low heat dissipation losses**, at the same time allowing for compact dimensions and competitive cost. Compared with low-end reactors, our FK-Dr may save up to 100 Watts of heat dissipation losses per piece, a very important factor for the long-term operational cost (and amortisation) of the equipment.

High insulation class or low temperature rise?

Other than certain manufacturers which take special pride in offering their reactors with insulation class ratings for operation at temperatures of up to 165°C or even beyond, we focus on the operating environment of the the application's key component: the capacitor. In most cases, reactors are placed in close vicinity of the capacitor, and should therefore not serve as a destructive heat source. The conservative layout of our reactors is to limit the maximum temperature of the reactor to 115°C under rated operating conditions. An integrated reversible thermal switch allows external monitoring for disconnection of the reactor in the event of impermissible buildup of heat (>125°C).

How to avoid ferro-resonance

Commercial pressures and the desire for ever smaller switchgear dimensions lead to an increasingly intense utilisation of systems and components. Even the detuning reactors have become more compact, which has been accompanied by a reduction of their internal resistance.

Despite excellent linearity of inductance at high currents - usually the most important criterion when evaluating reactors - problems may occur in operation under unknown mains conditions. e.g. insufficient damping (low impedance) by upstream switchgear components, even at relatively low levels of harmonic distortion. Due to the magnitude of the initial switching current, the inductance of the reactor may break down to a fraction of its nominal value. In these cases, the core becomes saturated; strong audible humming and currents exceeding the rated current can occur. This phenomenon is also called **Ferro-resonance**. As the use of adequately sized reactors with higher load capability is usually ruled out for cost and space considerations, the use of **capacitor contactors with inrush protection** is recommended in all cases where the mains conditions are not known exactly. These can provide a damping effect which substantially exceeds that achieved by adaptation of the reactor dimensions, and at a much reduced cost.

It should be noted that, even when using capacitor contactors with inrush protection, sufficient current linearity of the reactor must be provided in accordance with its operating conditions.

DEFINITIONS AND SELECTION CRITERIA

Rated Inductance L_N

Inductance rating of the reactor, measured at rated current I_N , in mH (Milli-Henry). Mean value across the three phases.



Rated Voltage U_N

Root mean square value of the permissible value of sinusoidal AC voltage in continuous operation (mains voltage). The rated voltage of the reactors indicated in the data charts and the permissible overvoltage limits specified in IEC 60831 and DIN EN 50160 must not be exceeded even in cases of malfunction.



Capacitor Voltage U_C

Required voltage strength of the capacitor. The series connection of capacitor and reactor causes a voltage rise at the capacitor terminals as described by the following formula which must be considered when selecting a capacitor for the application.



$$\begin{aligned} U_N &= 400 \text{ V} \\ p &= 7 \% \end{aligned}$$

$$U_C = \frac{U_N}{\left(1 - \frac{p}{100\%}\right)} = 430.1 \text{ V}$$

The capacitor to be selected must have a voltage strength of at least 430 V.



Example

Detuning Factor p

Ratio between the reactances of reactor X_L and corresponding capacitor X_C (in %).

$$p = 100\% \cdot \frac{X_L}{X_C}$$



Series Resonance Frequency f_r

The detuning factor determines the series resonance frequency between reactor and capacitor which in turn is important for the blocking and filtering effect.

$$f_r = f_N \cdot \sqrt{\frac{100\%}{p}}$$



Note: In certain countries, it is common to describe the Detuning factor as the ratio of the detuning frequency in relation to the basic frequency (Hz) of the supply.

The standard reactors listed in this catalogue have been designed for common detuning factors and resonance frequencies as shown in chart 11:

Detuning factor p	f_r -Ratio	Resonance frequency f_r
5.67 %	4.2 H	252 Hz
6 %	4.1 H	245 Hz
7 %	3.8 H	227 Hz

chart 11

Rated Power of the Detuned System Q_{LC}

Care must be taken when stating the reactor power in order to avoid misunderstanding. As a rule, the rated power of a reactor does not describe its real reactance but either the reactive power of the capacitor to be detuned, or the total output of the entire LC-circuit at rated system voltage U_N .



There are two principal approaches which are described in detail on the following pages.

DEFINITIONS AND SELECTION CRITERIA

**I. Non-adapted Rating:**

The non-adapted reactor is matched to a power capacitor with standard rating at system voltage. This allows for use of capacitors "off the shelf". However, with the increased output of kvar due to voltage rise inside the LC circuit, more power output is installed than actually required: the kvar output of a capacitor depends on the voltage it is charged with, and at higher voltage, equal capacitance delivers more kvar (in the example below: 26.9 instead of 25 kvar). In this case, the rated power of the capacitor is used to define the reactor rating.



Caution: Bear in mind that the capacitors to be detuned will be exposed to increased voltage; excessive voltage load may lead to reduced life or even failure or destruction of the capacitor!



Check capacitance and general state of the capacitors before adding detuning reactors to existing non-detuned systems as these may have been harmed by their previous operation without reactor protection!



Example

Capacitor 265.278-609600 (page 28) with 25kvar 480V 60Hz $3 \times 96\mu\text{F}$ (288 μF) shall be detuned to 227Hz ($p = 7\%$ or 3.8H).

Calculation**Step 1: Determination of the reactor**

Reactance of capacitor

$$X_c = \frac{1}{2 \pi f \cdot C} = 9.21 \Omega$$

Required reactance of the reactor

$$X_L = X_c \cdot p = 9.21 \Omega \cdot 0.07 = 0.645 \Omega$$

Required inductance

$$L = \frac{X_L}{2 \pi f} = 1.71 \text{ mH}$$

> 444.126+4808A0 "Fk-Dr 25/480/60/7/D" (page 63)

Step 2: Calculation of resulting PFC current and net kvar output into the mains

PFC current

$$X_{\text{total}} = X_c - X_L = 8.57 \Omega$$

$$I_c = \frac{U_{\text{mains}}}{X_{\text{total}}} = \frac{480 \text{ V}}{8.57 \Omega} = 56 \text{ A}^*$$

Real PFC output into mains

$$Q_{LC} = U_{\text{mains}} \cdot I_c = 480 \text{ V} \cdot 56 \text{ A} = 26.9 \text{ kvar}$$

Selection from catalogue**Step 1: Determination of the reactor**

Alternatively, reactors matching the most common capacitor ratings can be selected directly from our data charts of reactors with "non-adapted rating" (page 62/63):

Look up the mains voltage 480 V in combination with 7 %

Select the capacitance of your intended capacitor ($3 \times 96 \mu\text{F}$)

Find 444.124-4807A "FK-Dr 25/480/60/7/D"

Step 2: Determination of net kvar output into the mains and calculation of PFC current

Look up the kvar value under $Q_{LC}(U_N)$:
26.9 kvar

Calculate PFC current:

$$I_c = \frac{Q_{LC}}{U_N} = \frac{26.900 \text{ var}}{480 \text{ V}} = 56 \text{ A}^*$$

(*current over three phases = phase current $\cdot \sqrt{3}$)

DEFINITIONS AND SELECTION CRITERIA

II. Adapted Rating:

The adapted reactor is designed to create – in combination with a specially sized capacitor - exactly the desired output of reactive power, allowing for the internal voltage rise inside the resonating circuit.

Advantage: The exact power is installed as required by the customer, and switching devices are stressed less.



25kvar 480V 60Hz to be detuned to 227Hz (p = 7%)



Example

Calculation

Step 1: Calculation of the capacitor

Current for the power factor correction of 25 kvar 400 V 50 Hz

$$I_c = \frac{Q_c}{U_{\text{mains}}} = \frac{25000 \text{ var}}{480 \text{ V}} = 52.1 \text{ A}$$

Voltage at capacitor terminations

$$U_c = \frac{U_{\text{mains}}}{1-p} = \frac{480 \text{ V}}{1-0.07} = 516.1 \text{ V}$$

Adjustment of necessary capacitance

$$C = \frac{I_c}{2\pi f \cdot U_c} = \frac{52.1 \text{ A}}{516.1 \text{ V} \cdot 2\pi \cdot 60 \text{ Hz}} = 268 \mu\text{F}$$

268μF = 3 × 89μF 265.286-708900 "27.7 kvar 525V 60Hz" (page 29)

Step 2: Calculation of the reactor

Capacitor Reactance

$$X_c = \frac{1}{2\pi f \cdot C} = \frac{1}{2\pi \cdot 60 \text{ Hz} \cdot 268 \mu\text{F}} = 9.9 \Omega$$

Required reactance of the reactor

$$X_L = X_c \cdot p = 9.9 \Omega \cdot 0.07 = 0.693 \Omega$$

Required inductance

$$L = \frac{X_L}{2\pi f} = \frac{0.693 \Omega}{2\pi \cdot 60 \text{ Hz}} = 1.838 \text{ mH}$$

> 444.125-4837A0 "Fk-Dr 25/480/60/7/Dla" (page 64)

Step 1: Determination of the reactor

Alternatively, reactors matching the most common capacitor ratings can be selected directly from our data charts of reactors with "adapted rating" (page 64):

Selection
from catalogue

Look up the mains voltage 480 V in combination with 7 %

Select the required output power of the capacitor branch under "Power Output $Q_{LC}(U_N)$ ": 25 kvar

Find 444.125-4837A0 "FK-Dr 25/480/60/7/Dla"

Step 2: Determination of the matching capacitor

Look up the corresponding capacitance value in column "Capacitor C": 3 × 89 μF

Select a proper capacitor with the capacitance found under 1.) from the data charts for capacitors on pages 26 to 33. Make sure to obey the minimum voltage rating U_c for the capacitor as stated in the chart (here: ≤ 525 V).

DEFINITIONS AND SELECTION CRITERIA

**Dissipation Power P_{eff}**

Sum of all iron-, copper-, and stray field losses at max. specified overvoltage and harmonic content. Depending on the detuning factor, the effective dissipation power of our reactors is between 4 and 6 W/kvar.

**Rated Current (also: Fundamental Current) I_N**

RMS value of the current – caused by the series-connected capacitor – at rated voltage and frequency, excluding harmonic distortion, switching transients, and tolerance of capacitance.

**RMS Current I_{eff}**

Current load on the reactor in permanent operation, caused by the fundamental wave plus harmonics in the system. For all data given in this catalogue, we are presuming a 10 % increase of the fundamental current I_N , resulting from voltage tolerances as permitted by DIN EN 50160: $I_{\text{eff}} = \sqrt{I_1^2 + I_3^2 + I_5^2 + \dots + I_n^2}$ $I_1 = 1.1 \cdot I_N$

**Maximum Current Rating I_{lin} and Current Linearity**

Maximum current, up to which the inductance of the reactor remains “linear”, i.e. does not decrease by more than 5 % below its rated inductance. This maximum current is specified in the data charts as a multiple K of the fundamental current:

$$I_{\text{lin}} = K \cdot I_N \quad (I_{\text{lin}} \geq 0.95 I_N !)$$

K ... overcurrent factor

Exceeding I_{rms} or I_{lin} will cause increased power losses inside the reactor and may result in its thermal destruction. We recommend thermal monitoring of the reactors by means of the integrated temperature switch, or the use of switching devices with overcurrent relays in the capacitor circuit, to protect against overloads.

**Ambient Operating Conditions**

Permissible ambient conditions for safe operation of the reactor. For our reactors, we specify the climate category in the data charts as “CTT” in accordance with DIN EN 50019 and DIN EN 60934/IEC 60439-1:

C	climatic areas	TT	Θ_{ambient}	Θ_{average} in 24 h
T	„Moderate climate“	45	-5 ... 45°C	≤ 40°C
		50	-5 ... 50°C	≤ 45°C
		55	-5 ... 55°C	≤ 50°C

chart 12

Under these conditions, the temperature of our low loss reactors does not exceed 115°C which is an important advantage for the capacitors and all other components in the installation. Please consult us if you require reactors for more severe ambient conditions.

Insulation Class

Maximum permitted operating temperature for the insulation materials used in the reactor. Thanks to careful design and the use of high-class materials, the operating temperature of our low-loss reactors does not exceed 115°C when operated within specification. Our standard rating of insulation class B (135°C) should therefore be sufficient for the majority of your operating environments. Reactors with insulation class F or higher are available as an option on request.

**Temperature Switch**

response temperature	125°C
voltage	250 V (<6.3 A) ... 500 V (<2 A)
tolerance	± 5 K
terminal	screw clamp 0.75 mm ²

All reactors are provided with a separate screw terminal for the temperature switch (NC – normally closed) which is located inside the central coil.

DATA CHARTS



rated voltages	230...480 V 60 Hz
design	three phase
tolerance of inductance	- 3 ... + 3 % (mean value across three phases)
terminals	terminal blocks, cable lugs temperature-proof flexible cables available on request
winding material	aluminium band or copper wire
core material	low loss iron sheets
safety device	thermal switch
impregnant	polyester resin Class F
insulation class	class B (higher classes available on request)
protection class	IP00 (indoor mounting)
current linearity	see data charts
permitted harmonic load (continuous operation)	$U_3 = 0.5 \% U_N$ $U_5 = 6 \% U_N$ $U_7 = 5 \% U_N$ $U_{11} = 3.5 \% U_N$ $U_{13} = 3 \% U_N$
insulation voltage winding to core	3 kV
max. relative humidity	95 %
temperature class	see data charts
cooling	natural
altitude	4000 m.a.s.l.
statistical life expectancy	> 200 000 h (permitted failure rate $\leq 3 \%$)
standards	IEC EN 61558-2-20:2011, VDE 0570-2, IEC 60076-6:2007, C22.2 No.14

General
Technical
Data



DATA CHARTS

CE Conformity

All reactors listed in this catalogue comply with the relevant regulations and guidelines of the European Union: 2014/35/EU (Low-Voltage Directive)



This is proven by the technical documentation and compliance with the following standards: IEC EN 61558-2-20:2011, IEC EN 60076-6:2007

DIMENSION DRAWINGS

Dimension
Chart

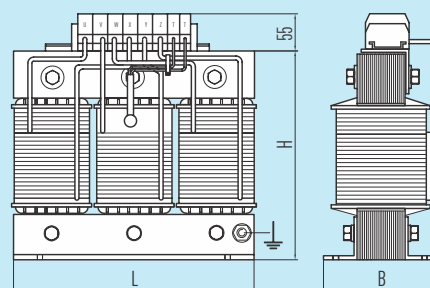
Code	L (mm)	H (mm)	Design A B (mm)	Design B B (mm)	pcs./pallet	pallet height (mm)
A1	155	140	78	-	48	350
A2	155	140	92	85	36	350
B1	190	165	82	87	33	350
B2	190	165	92	97	27	350
B3	190	165	102	107	24	350
C1	240	215	121	112	20	550
C2	240	215	131	122	20	550
C3	240	215	141	132	18	550
C4	240	215	151	142	16	550
C5	240	215	155	146	12	550
D2	300	265	165	139	10	550
D3	300	265	177	152	10	550
D4	300	265	192	167	10	550
D5	300	265	203	178	8	550
F3	300	190	166	-	10	350
F4	300	190	180	155	10	350
F5	300	190	191	166	10	350
F6	300	190	201	175	10	350
G1	240	255	121	112	16	550
G2	240	255	153	144	12	550
H1	420	370	188	190	8	600
I1	300	315	166	141	10	600

Type 1

Connection Type 1

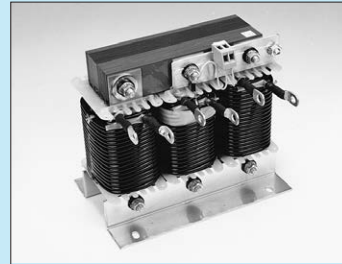
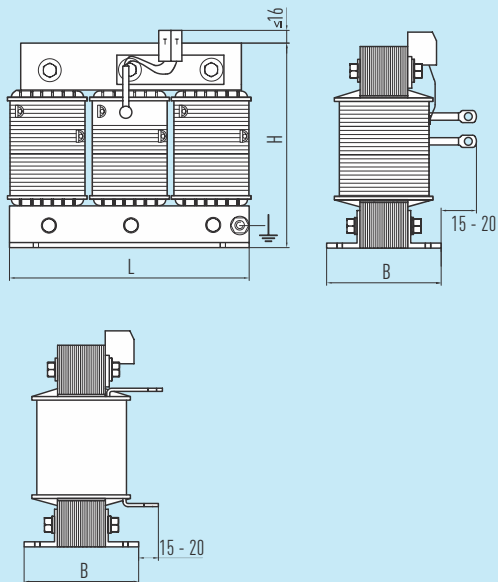


Type 1: Screw terminal block, 10 mm²
Available with copper windings only



DIMENSION DRAWINGS

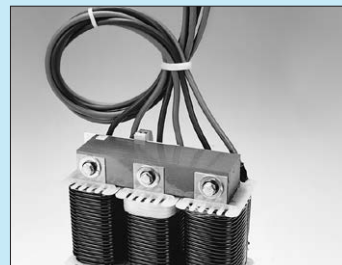
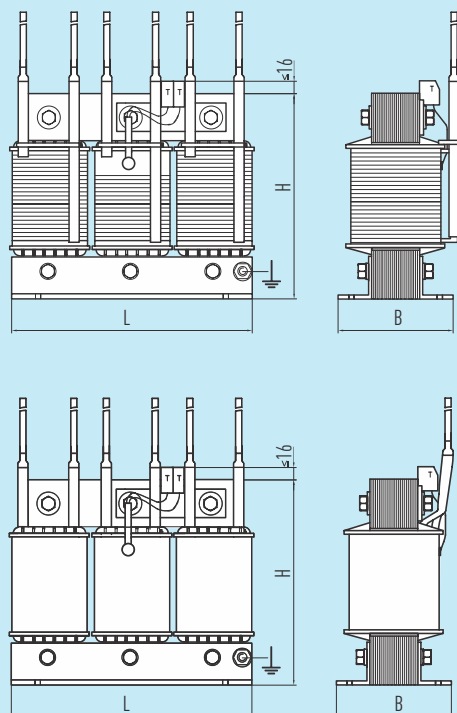
Connection Type 2



Type 2: Cable lug (tinned copper)
Available with copper or aluminium windings

Type 2

Connection Type 3



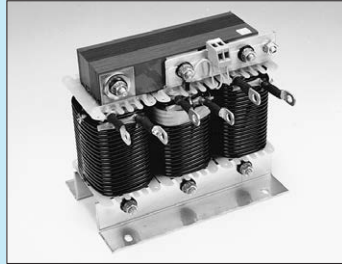
Type 3: Flexible cable,
temperature proof up to 140°C,
length: 500 or 800 mm
Available with copper or aluminium windings

Type 3

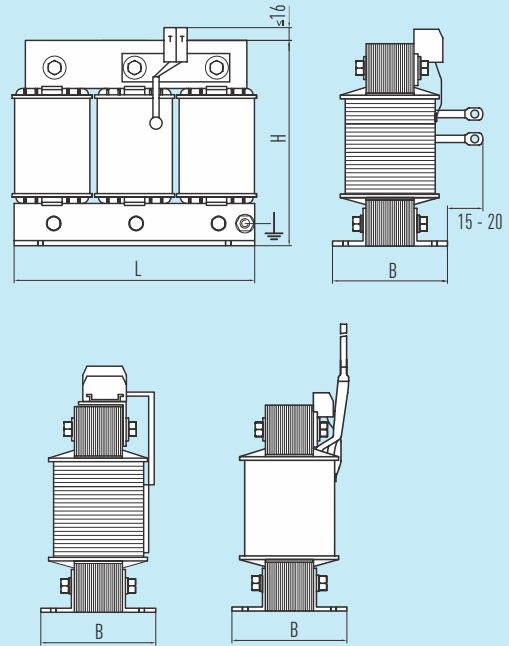
DIMENSION DRAWINGS

Design A

Mounting Design A

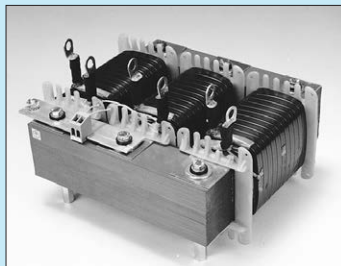


Standard version
with base mounting bracket

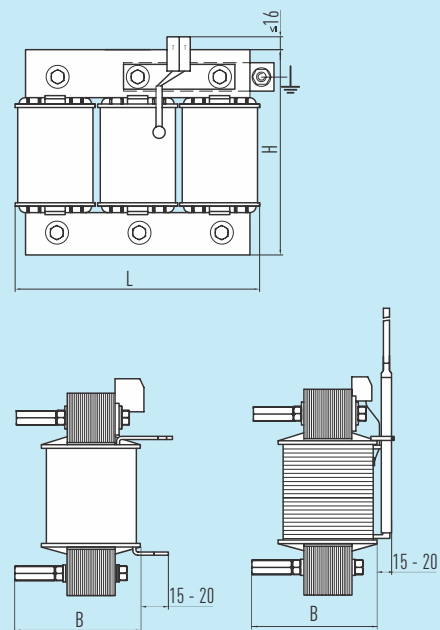


Design B

Mounting Design B



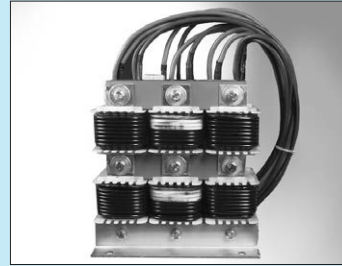
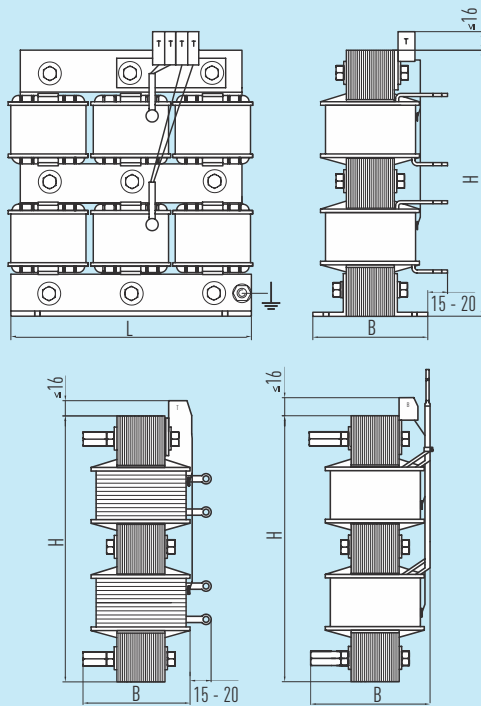
Four threaded bolts (M6i or M8i)
for lateral mounting



DIMENSION DRAWINGS

Design 2in1

This very compact design combines two partial powers in one unit. They can be operated independently from each other.



Available terminals: type 2 and 3.
Available designs: A and B.

Design 2in1

FK-Dr

NON-ADAPTED RATING (D)

5.67 %, 7 %



Reactors for standard capacitors (non-adapted rating)

Power Output $Q_{LC} (U_N)$ (kvar)	Capacitor C_N (μF)	Reactor / Drossel												
		type designation FK-Dr ...	winding	L_N (mH)	I_{eff} (A)	Temp. class	size (S.pg. 58)	weight (kg)	order code (standard version)	connection / design				
										1	2	3	A	B
U_N 230 V		$U_c \leq 250$ V	$p = 5.67 \%$ (252 Hz)			$I_{lin} 1.8 \dots 2.2 I_N$								
5.3	3 × 84	5/230/60/5.67/D	Cu	3 × 1.59	3 × 17	T55	B1	5.3	407.093-24B900	○		●	●	○
8	3 × 125	7.50/230/60/5.67/D	Cu	3 × 1.06	3 × 26	T55	B1	6	417.093-24B905	○		●	●	○
10.6	3 × 167	10/230/60/5.67/D	Cu	3 × 0.8	3 × 35	T55	B2	7.7	425.094-24B900	○	○	●	●	○
13.3	3 × 209	12.5/230/60/5.67/D	Cu	3 × 0.64	3 × 44	T45	B2	8.6	428.094-24B905	○	○	●	●	○
15.9	3 × 251	15/230/60/5.67/D	Cu	3 × 0.53	3 × 52	T55	C1	12.4	433.124-24B900		○	●	●	○
21.2	3 × 333	20/230/60/5.67/D	Cu	3 × 0.4	3 × 70	T45	C1	14.4	440.124-24B900		○	●	●	○
21.2	3 × 333	20/230/60/5.67/D	Alu	3 × 0.4	3 × 70	T55	C3	15.5	440.126+24B800		●	○	●	○
26.5	3 × 418	25/230/60/5.67/D	Alu	3 × 0.32	3 × 87	T55	C4	18.2	444.127+24B800		●	○	●	○
53	3 × 836	50/230/60/5.67/D	Alu	3 × 0.16	3 × 174	T55	D3	31	458.157+24B800		●	○	●	○
U_N 230 V		$U_c \leq 250$ V	$p = 7 \%$ (227 Hz)			$I_{lin} 1.8 I_N$								
10.8	3 × 167	10/230/60/7/D	Cu	3 × 0.98	3 × 32	T55	B2	7.3	425.094-24D7A0	○	●	○	●	○
13.4	3 × 209	12.5/230/60/7/D	Cu	3 × 0.79	3 × 40	T45	B2	7.6	428.094-24D7A	○	●	○	●	○
16.1	3 × 251	15/230/60/7/D	Cu	3 × 0.65	3 × 47	T55	C6	11.1	433.225-24D7A0	○	●	○	●	○
21.5	3 × 334	20/230/60/7/D	Alu	3 × 0.49	3 × 63	T55	C1	12	440.124+24D8A0		●	○	●	○
26.9	3 × 418	25/230/60/7/D	Cu	3 × 0.39	3 × 79	T55	C2	16.1	444.125-24D7A		●	○	●	○
32.3	3 × 502	30/230/60/7/D	Alu	3 × 0.33	3 × 95	T55	F3	20.4	450.256+24D8A0		●	○	●	○
43	3 × 666	40/230/60/7/D	Cu	3 × 0.25	3 × 127	T50	F4	26	454.258-24D7A0		●	○	●	○
53.8	3 × 836	50/230/60/7/D	Cu	3 × 0.2	3 × 158	T50	D2	29.8	458.156-24D7A		●	○	●	○
U_N 440 V		$U_c \leq 480$ V	$p = 7 \%$ (227 Hz)			$I_{lin} 1.8 I_N$								
13.4	3 × 58	12.5/440/60/7/D	Cu	3 × 2.88	3 × 20	T45	B1	7	428.093-44D7A	○	●	○	●	○
26.9	3 × 115	25/440/60/7/D	Cu	3 × 1.44	3 × 39	T45	C1	14.1	444.124-44D7A		●	○	●	○
53.8	3 × 230	50/440/60/7/D	Alu	3 × 0.72	3 × 83	T45	F5	29.1	458.259+44D8A0		●	○	●	○
80.7	3 × 345	75/440/60/7/D	Cu	3 × 0.48	3 × 118	T45	D3	37	468.157-44D7A		●	○	●	○

- standard design
- other available options

Other ratings, linearities and detuning factors are available on request.

FK-Dr

NON-ADAPTED RATING (D)

5.67 %, 6 %, 7 %



Reactors for standard capacitors (non-adapted rating)

Power Output $Q_{LC} (U_N)$ (kvar)	Capacitor C_N (μF)	Reactor / Drossel												
		type designation FK-Dr ...	winding	L_N (mH)	I_{eff} (A)	Temp. class	size (S.pg. 58)	weight (kg)	order code (standard version)	connection / design				
U_N 380 V		$U_C \leq 410$ V	$p = 6 \%$ (245 Hz)			$I_{lin} 1.8 I_N$								
6.7	3 × 38	6.25/380/60/6/D	Cu	3 × 3.68	3 × 13	T55	B1	5.8	412.093-38C6A	●		○	●	○
13.3	3 × 77	12.5/380/60/6/D	Cu	3 × 1.8	3 × 25	T45	B1	6.6	428.093-38C7A0	○	●	○	●	○
26.6	3 × 154	25/380/60/6/D	Cu	3 × 0.9	3 × 51	T45	C1	13.4	444.124-38C7A0		●	○	●	○
53.2	3 × 308	50/380/60/6/D	Cu	3 × 0.46	3 × 101	T45	F4	26.6	458.258-38C7A		●	○	●	○
53.5	3 × 308	50/380/60/6/D	Alu	3 × 0.46	3 × 102	T45	F5	27.7	458.259+38C8A0		●	○	●	○
U_N 380 V		$U_C \leq 410$ V	$p = 7 \%$ (227 Hz)			$I_{lin} 1.8 I_N$								
13.4	3 × 77	12.5/380/60/7/D	Cu	3 × 2.15	3 × 24	T45	B2	8	428.094-38D7A	○	●	○	●	○
26.9	3 × 154	25/380/60/7/D	Cu	3 × 1.07	3 × 48	T45	C1	14.6	444.124-38D7A		●	○	●	○
53.8	3 × 308	50/380/60/7/D	Cu	3 × 0.54	3 × 96	T45	F4	28	458.258-38D7A		●	○	●	○
80.7	3 × 462	75/380/60/7/D	Cu	3 × 0.36	3 × 143	T45	D4	41	468.159-38D7A		●	○	●	○
U_N 480 V		$U_C \leq 525$ V	$p = 5.67 \%$ (252 Hz)			$I_{lin} 2.2 I_N$								
6.7	3 × 24	6.3/480/60/5.67/D	Cu	3 × 5.5	3 × 11	T55	A2	5.1	413.074-48B600	●		○	●	○
8	3 × 29	7.5/480/60/5.67/D	Cu	3 × 4.62	3 × 12	T55	B1	6.4	417.093-48B605	●		○	●	○
10.6	3 × 38	10/480/60/5.67/D	Cu	3 × 3.47	3 × 17	T55	B2	8	425.094-48B700	○	●	○	●	○
13.3	3 × 48	12.5/480/60/5.67/D	Cu	3 × 2.77	3 × 21	T55	B2	8.4	428.094-48B70	○	●	○	●	○
21.2	3 × 77	20/480/60/5.67/D	Cu	3 × 1.73	3 × 33	T55	B5	12.9	440.097-48B700		●	○	●	○
26.5	3 × 96	25/480/60/5.67/D	Alu	3 × 1.39	3 × 42	T55	C3	16.4	444.126+48B800		●	○	●	○
53.01	3 × 192	50/480/60/5.67/D	Alu	3 × 0.69	3 × 84	T55	D3	31	458.157+48B800		●	○	●	○
U_N 480 V		$U_C \leq 525$ V	$p = 7 \%$ (227 Hz)			$I_{lin} 1.8 I_N$								
13.4	3 × 48	12.5/480/60/7/D	Cu	3 × 3.42	3 × 19	T55	B2	7.9	428.094-48D7A	○	●	○	●	○
21.3	3 × 77	20/480/60/7/D	Alu	3 × 2.16	3 × 32	T55	C2	13.7	440.125+48D8A0		●	○	●	○
26.9	3 × 96	25/480/60/7/D	Cu	3 × 1.71	3 × 38	T45	C1	14.6	444.124-48D7A		●	○	●	○
26.9	3 × 96	25/480/60/7/D	Alu	3 × 1.71	3 × 38	T55	C3	16.1	444.126+48D8A0		●	○	●	○
32.2	3 × 115	30/480/60/7/D	Alu	3 × 1.43	3 × 48	T55	C4	20	450.326+48D8A0		●	○	●	○
42.9	3 × 154	40/480/60/7/D	Alu	3 × 1.07	3 × 63	T50	C4	19.5	454.127+48D8A0		●	○	●	○
53.8	3 × 192	50/480/60/7/D	Cu	3 × 0.86	3 × 76	T45	F4	28.1	458.258-48D7A		●	○	●	○
53.8	3 × 192	50/480/60/7/D	Alu	3 × 0.86	3 × 76	T55	F6	31	458.260+48D8A0		●	○	●	○
80.7	3 × 288	75/480/60/7/D	Alu	3 × 0.57	3 × 114	T55	D4	39	468.159+48D8A0		●	○	●	○
107.5	3 × 384	100/480/60/7/D	Alu	3 × 0.43	3 × 152	T45	D5	44	480.160+48D8A0		●	○	●	○

FK-Dr

ADAPTED RATING (Dla)

5.67 %, 6 %, 7 %



Reactors for capacitors with adapted rating

Power Output $Q_{LC} (U_N)$ (kvar)	Capacitor C_N (μF)	Reactor / Drossel													
		type designation FK-Dr ...	winding	L_N (mH)	I_{eff} (A)	Temp. class	size (S.pg. 58)	weight (kg)	order code (standard version)	connection / design					
1	2	3	A	B											
U_N 380 V $U_c \leq 410V$ $p = 6 \%$ (245 Hz) $I_{lin} 1.8 I_N$															
10	3 × 57.5	10/380/60/6/Dla	Cu	3 × 2.44	3 × 19	T55	B1	5.6	425.093-3826A0	●	○	○	●	○	
20	3 × 115	20/380/60/6/Dla	Cu	3 × 1.22	3 × 38	T55	C1	12.6	440.124-38270		●	○	●	○	
40	3 × 230	40/380/60/6/Dla	Alu	3 × 0.62	3 × 76	T45	C4	17.5	454.326+3828A0		●	○	●	○	
80	3 × 460	80/380/60/6/Dla	Alu	3 × 0.31	3 × 152	T50	D4	36	470.159+3828A0		●	○	●	○	
U_N 380 V $U_c \leq 410V$ $p = 7 \%$ (227 Hz) $I_{lin} 1.8 I_N$															
40	3 × 230	40/380/60/7/Dla	Alu	3 × 0.72	3 × 71	T45	C5	19.8	454.327+3838A0		●	○	●	○	
50	3 × 288	50/380/60/7/Dla	Alu	3 × 0.58	3 × 89	T55	F5	28.2	458.259+3838A0		●	○	●	○	
60	3 × 345	60/380/60/7/Dla	Alu	3 × 0.48	3 × 107	T45	D2	28.1	462.156+3838A0		●	○	●	○	
80	3 × 460	80/380/60/7/Dla	Alu	3 × 0.36	3 × 142	T45	D4	38	470.K59+3838A0		●	○	●	○	
U_N 480 V $U_c \leq 525V$ $p = 5.67 \%$ (252 Hz) $I_{lin} 2.2 I_N$															
12.5	3 × 44.5	12.5/480/60/5.67/Dla	Cu	3 × 2.99	3 × 19	T50	B2	7.5	428.094-481700	○	●	○	●	○	
25	3 × 89	25/480/60/5.67/Dla	Alu	3 × 1.5	3 × 39	T45	C3	15.8	444.126+481800		●	○	●	○	
50	3 × 178	50/480/60/5.67/Dla	Alu	3 × 0.75	3 × 77	T45	D3	29.9	458.157+481800		●	○	●	○	
U_N 480 V $U_c \leq 525V$ $p = 7 \%$ (227 Hz) $I_{lin} 1.8 I_N$															
12.5	3 × 44.5	12.5/480/60/7/Dla	Cu	3 × 3.68	3 × 18	T55	B2	7.3	428.094-4837A0	○	●	○	●	○	
25	3 × 89	25/480/60/7/Dla	Cu	3 × 1.84	3 × 35	T55	C2	14.6	444.125-4837A0		●	○	●	○	
50	3 × 178	50/480/60/7/Dla	Cu	3 × 0.92	3 × 71	T45	F4	27.3	458.258-4837A0		●	○	●	○	
75	3 × 267	75/480/60/7/Dla	Alu	3 × 0.61	3 × 106	T45	D3	31	468.157+4838A0		●	○	●	○	

- standard design
- other available options

Other ratings, linearities and detuning factors are available on request.

POWER FACTOR CONTROLLERS

The quality of power supply is an important criterion for safe operation of modern technical equipment. In this context, the functionality of installations for power factor correction and their control and safety features gain a special bearing. Power factor correction banks have the ability to improve power quality, but they can also cause substantial problems.

Modern power factor controllers are self-optimizing and determine the correct power of the capacitor steps within a few trial switchings. If the $\cos\varphi$ deviates from the programmed limits, the necessary capacitor power for compensation is calculated and a suitable output or a combination of outputs are switched, considering the situation of supply system and power factor correction equipment.

A state-of-the-art power factor controller must also be in a position to monitor all relevant data of equipment and supply system, to alarm in case of overload and, if required, to switch off the whole equipment or capacitor steps temporarily or permanently.

P
F
R
-
M



POWER FACTOR CONTROLLERS



POWER FACTOR CONTROLLERS

PFR-X⁺ **R / PFR-M **T

for latest edition and updates
check www.powercapacitors.info

BECAUSE EXCELLENT CAPACITORS ARE NOT ENOUGH

The plug'n'play power factor controllers of our PFR-series calculate the active and reactive power in the mains from the measured current and voltage. Their intelligent control algorithm optimizes the switching sequences and guarantees for short regulation times with a minimum number of switching cycles. At the same time, equal distribution of switchings for capacitors of equal size extends the lifetime of the capacitors. The integrated connection control immediately detects in which phases voltage and current are measured, and adapts the entire system automatically. The very low current threshold of 15 mA (PFR-M**T) / 5mA (PFR-X⁺ **R) allows for very reliable and exact PF control. 1A as well as 5A current transformers can be used without additional manual adjustments. The power supply of PFR-X⁺ covers a voltage range of 90...550V, the PFR-M supply is rated for a voltage range of 207-253V or 100-132V.

The rated mains voltage is the only value to be entered before commencing operation. The controller blocks operation to protect the capacitors if the tolerance of this voltage setting is exceeded during operation. All other relevant parameters have been preset by the manufacturer for immediate start of operation in nearly any common configuration. Individual adjustment and optimization of the control parameters is possible at any time, even during operation of the equipment.

Once connected, the size of capacitors or reactors is detected automatically. The lifecycles of the capacitors are determined by the degradation of capacitance, and a pre-failure alarm can be provided.

The controllers will operate correctly even if the value of the current transformer ratio has not been entered. Please note that in case of the PFR-X⁺, all display functions related to current measurements will be disabled.

Our controllers can monitor the temperature inside the capacitor cabinet with an integrated sensor. The temperature control can activate a fan connected to the related output relay (PFR-X⁺)/the digital output (PFR-M), or switch off the capacitors if necessary. External thermostats may be connected in parallel to the integrated temperature sensor (PFR-X⁺)/to the digital input (PFR-M) to monitor the temperature in other related cabinets.

For maintenance purposes, all capacitor outputs can be switched manually.

Display

The backlit LC-Display delivers information about the equipment and the mains conditions. Additionally, it facilitates the input of changes during commissioning and operation.

Reported mains conditions

PFR-X⁺: Voltage, current, active power, reactive power, apparent power, frequency, $\cos\varphi$, ΔQ (power to be compensated), THD U, THD I, detailed voltage and current harmonics 3...19

PFR-M: Voltage, current, active power, reactive power, apparent power, frequency, $\cos\varphi$, ΔQ (power to be compensated), counters, THD U, THD I, detailed voltage and current harmonics 3...19

Reported information on the equipment

Passed operation time (hours), number of switching cycles per capacitor output, max temperature in the equipment, average power factor, actual power per branch, actual percentage of originally installed reactive power. Moreover, the $\cos\varphi$ and the status of the capacitor outputs are displayed permanently.



CE Conformity

The controller is declared to conform to the following European Directives:

2014/35/EU Low-Voltage Directive

2004/108/EG EMC directive

POWER FACTOR CONTROLLERS

PFR-X⁺ **R / PFR-M **T

Monitoring

The monitoring functions ensure long and reliable operation of the capacitor equipment:

- zero-voltage tripping to avoid contactor fibrillation
- overvoltage protection
- over-temperature protection
- harmonic monitoring of voltage and current
- detection of defect capacitors (with adjustable threshold value)
- alarm at under-compensation
- maintenance reminder
- fan control output (can also be used as additional capacitor output)
- overcurrent
- no current

PFR-M only:

- cosφ alarm
- frequency alarm
- overload Q
- overload P
- P export

Malfunctions and status signals of the equipment are indicated in the LC-Display. Malfunctions can also be transmitted through the isolated alarm relay (PFR-X⁺: N-O contact, PFR-M: S-P-D-T contact) or to the digital output (PFR-M only).

Special Features of PFR-M

- Transistor outputs for the operation with thyristor switches (dynamic compensation)
- Optionally available with relay outputs or as hybrid version (PFR-M 12RT) with 6 relay outputs for static loads and 6 transistor outputs for dynamic loads
- fast algorithm for dynamic thyristor operation (switching time ~20ms)
- Available with optional modbus communication
- Optional 3 Phase current measurement

Special Features of PFR-X⁺

- Guided setup through commissioning process of the controller
- Fan relay can be used as 7th or 13th step
- Step balancing (equal distribution of switching cycles) available based either on operation hours per step or on number of switching cycles.
- optional modbus communication
- Storage of the last 10 alarms
- Suppression of "I lo" alarms possible via digital input.

Modbus Option

The MODBUS extension offers the possibility to read values from the device and modify various settings.

The MODBUS-protocol doesn't restrict the user to one single physical transmission system. With the bus-capable RS485 interface, it is possible to connect more than one controller to a single pair of wires and access the units by use of an ID number.

Many commercial devices and PLCs are able to use the MODBUS protocol either as bus master or slave. Various SCADA solutions are also available from a variety of vendors. For this reason, the integration in a new or existing bus-system is only a minor issue.

Type	outputs	measurement	Order code
PFR-X ⁺ 06R	6 relays	1ph	11091.100-06.R
PFR-X ⁺ 12R	12 relays	1ph	11091.100-12.R
PFR-M 06T	6 transistors	1ph	11050.100-06.T
PFR-M 12T	12 transistors	1ph	11050.100-12.T
PFR-M 12RT	6 relays + 6 transistors	1ph	11050.100-12.H

Type Range

DATA CHART

General Technical Data

Feature	PFR-X*	PFR-M
Operation voltage	90-550V rms, 45...65Hz, 5VA, 1ph	230V (optional 115V) rms, 45...65Hz
Measuring voltage	90-550V rms	50-530V rms
No of output relays	6, 12	6, 12
Output rating	250V AC / 5A 400V AC / 1A	8...32V DC Hybrid option also: 250V AC / 5A
Control algorithms	LIFO, FIFO, automatic (best fit), progressive	LIFO, automatic (best fit), combi-filter, progressive, fast
Digital input	90 ... 250V AC	90 ... 250V AC
Switching delay	adjustable 1s ... 6500s	≤ 20 ms
Display	LCD	graphic LCD
Operating elements	rubber buttons	foil keyboard
Measuring current	5mA ... 6A	15mA...6A
Adjustable transformer ratio	1...9600	1...6500
External Alarm contact	isolated relay, NC 48V DC / 1A 250V AC / 5A 400V AC / 1A	isolated relay, changeover contact
Terminals	multiple contact plug (2.5 mm ²)	multiple contact plug (2.5 mm ²)
Fuses	must be installed externally (see manual)	must installed externally (see manual)
Fan control	isolated relay, NC 48V DC / 1A 250V AC / 5A 400V AC / 1A	digital output (DO)
Interface	MODBUS RS485 (optional)	
Data Storage	Latest 10 alarms	-
Ambient temperature	-20°C ... 70°C	0°C ... 70°C
Storage temperature	-40°C...+85°C	-20°C ... +85°C
Humidity	0% ... 95% (no condensation)	
Temperature measurement	NTC	
Protection class	Front Back	IP50 (IP54 with special gasket) IP20
Pollution degree	3 (DIN VDE 0110, Pt 1 / IEC60664-1)	
Max. altitude	2000 m	
Mounting position	no restrictions	
Case	Front Back	plastic (UL94: V0), IP41 Metal, IP20
Dimensions H × W × D	144 × 144 × 58mm (window size 138 × 138mm)	
Weight	ca. 0.6 kg	
Standards	IEC/DIN EN 61010-1, 61000-6-2/-4 (level B) IEC/DIN EN 61326 UL 61010	
Approval marks	UL, c-UL	

ANNEX



Sicherheitshinweise

Allgemeine Sicherheitshinweise zur Verwendung von Starkstromkondensatoren

I. Geltungsbereich

Dieses Sicherheitsdatenblatt gilt für die im Folgenden genannten Starkstromkondensatoren und Normen. Damit soll der Stand der Technik, der im Regelfall bei allen einschlägigen Liefer- und Leistungsverträgen einzuhalten ist, beschrieben werden.

- Leistungskondensatoren für Blindstromkompensation (PFC) bis 1000 V
IEC / DIN EN 60831 und 60931
- Leistungskondensatoren für Blindstromkompensation (PFC) über 1000 V
IEC / DIN EN 60871
- Leistungskondensatoren für induktive Wärmeerzeugung (PFC)
IEC / DIN EN 60110
- Kondensatoren für die Leistungselektronik (PEC)
IEC / DIN EN 61071
- Kondensatoren für Bahnanwendungen (PEC)
IEC / DIN EN 61881
- Leuchtenkondensatoren (AC)
IEC / DIN EN 61048/49
- Motorkondensatoren (AC)
IEC / DIN EN 60252
- Überspannungsschutzkondensatoren
DIN VDE / 0560-3
(derzeit keine gültige IEC)

II. Allgemeine Sicherheitsregeln

Starkstromkondensatoren sind elektrische Ladungsspeicher und deshalb stets mit Vorsicht zu handhaben. Sie können auch nach dem Abschalten über längere Zeiträume noch mit lebensgefährlich hohen Spannungen geladen sein. Gleiches gilt für alle Anlagenteile und Geräte, die in elektrisch leitender Verbindung zum Kondensator stehen. Grundsätzlich sind die allgemeinen Regeln der Elektrotechnik für den Umgang mit spannungsführenden Teilen in elektrischen Anlagen zu beachten.

III. Allgemeine Lager- und Einsatzbedingungen

- Grundsätzlich sind die Montage, Applikations- und Wartungshinweise des Herstellers und die einschlägigen Normen zu beachten.
- Kondensatoren dürfen zu keinem Zeitpunkt außerhalb der spezifizierten Temperaturbereiche gelagert oder eingesetzt werden.
- Kondensatoren dürfen nicht in korrosiver Atmosphäre gelagert oder betrieben werden, insbesondere dann nicht, wenn Chloride, Sulfide, Säuren, Laugen, Salze, organische Lösemittel oder ähnliche Substanzen auftreten.

- In staub- und schmutzgefährdeter Umgebung ist eine regelmäßige Kontrolle und Wartung, insbesondere der Anschlussklemmen und Isolatoren, unbedingt erforderlich um eine Kriechwegebildung zwischen potentialführenden Teilen untereinander und/oder zum Schutzleiter/Erde zu verhindern.
- Die im Datenblatt angegebenen maximalen Temperaturen (incl. Eigenerwärmung), Spannungen, Ströme, Leistungen, thermische Widerstände, Frequenzen, Entladezeiten und Schalthäufigkeiten sind einzuhalten.
- Für ausreichende Abführung der Verlustwärme (Belüftung, Kühlung) oder im Fehlerfall austretende Gase und Flüssigkeiten ist Sorge zu tragen. Geforderte Mindestabstände z. B. zu Wärmequellen sind einzuhalten.
- Angegebene Drehmomente für elektrische Anschlüsse und Befestigungselemente sind einzuhalten.
- Mechanisch oder elektrisch beschädigte, undichte oder anderweitig vorgeschädigte Kondensatoren dürfen nicht eingesetzt oder weiterverwendet werden.
- Vorhandene Schutzeinrichtungen der Kondensatoren dürfen nicht manipuliert, entfernt oder in ihrer Funktion beeinträchtigt werden.

IV. Schutzeinrichtungen

- Die folgende Tabelle gibt einen Überblick über die bekannten internen Schutzeinrichtungen:

Schutzeinrichtung / Schutzmechanismus	Anwendungsbereich		
	PEC	PFC	AC
Ohne Schutzeinrichtung	X		
Ausschließlich Selbstheilung ¹⁾	X	X	X
Einzelnen oder in Kombination			
Verbesserte Selbstheilung ²⁾	X		
Überdruckunterbrecher	X	X	X
Überdruckschalter	X	X	X
Überdruckventil	X	X	
Verstärktes Gehäuse	X	X	
Segmentierter Film	X	X	X
Wickelsicherung		X	X

Tabelle 1: Überblick über die bekannten internen Schutzeinrichtungen und Anwendungsbereiche

1) Selbstheilung kennzeichnet die Kondensatortechnologie. Selbstheilfähigkeit stellt noch keinen Schutzmechanismus dar!

2) Verbesserte Selbstheilung als Schutzmechanismus setzt voraus, dass die Schutzfunktion in einem gesonderten Test praktisch nachgewiesen wurde.

Allerdings stellt auch eine verbesserte Selbstheilung keine z.B. mit einem Überdruckschalter vergleichbare Schutzeinrichtung dar, sondern reduziert lediglich signifikant die Ausfallwahrscheinlichkeit.

- Interne Schutzeinrichtungen bieten einen Basisschutz bei bestimmten inneren Fehlern, Alterungserscheinungen und Überlastfällen. Vorhandene Schutzeinrichtungen der Kondensatoren dürfen nicht manipuliert, entfernt oder in ihrer Funktion beeinträchtigt werden.
- Interne Schutzeinrichtungen sind allein nicht ausreichend, um alle im Fehlerfall denkbare Gefahren abzuwenden. Die so genannte Selbstheilfähigkeit darf nicht mit Ausfallsicherheit gleichgesetzt werden.
- Die meisten internen Schutzeinrichtungen können die Spannung nur innerhalb des Kondensators unterbrechen. Sie sind keine Sicherungen im klassischen Sinne wie Leitungs- oder Geräteschutzsicherungen, die die Spannung vor dem fehlerhaften Anlagenteil unterbrechen.
- Es ist empfehlenswert interne Schutzeinrichtungen durch externe Schutzeinrichtung zu ergänzen wie z. B.:
 - Kurzschlusschutz durch Sicherungen oder Leistungsschalter / Schutzrelais
 - Überlastschutz für Grund- und Oberschwingungen mittels Strommessung
 - Unsymmetrieschutz
 - Temperaturüberwachung

- Schutzeinrichtungen unterliegen, abhängig vom Schutzmechanismus, technischen und funktionellen Grenzen, deren Überschreitung zwangsläufig zu Fehlern führt. Solche Überschreitungen können sein: Übertemperatur, Überspannung, falsche Applikation, falsche Installation, mangelhafte Wartung, mechanische Beschädigung, Betrieb außerhalb der technischen Grenzen der Spezifikation.

V. Risikofaktoren für den Kondensator

Die Risikofaktoren, die am häufigsten zu Kondensatorschäden und möglicherweise auch zum Versagen der internen Schutzeinrichtungen führen, sind:

- Überschreiten der zulässigen Temperatur an der Kondensatoroberfläche (jede Temperaturerhöhung von 7° K halbiert die Lebenserwartung).
- Spannungserhöhungen, Überströme und hohe Einschaltströme, auch wenn sie nur kurzzeitig oder periodisch auftreten (eine dauerhafte Erhöhung der Betriebsspannung des Kondensators von 8 Prozent halbiert die Lebenserwartung).
- Netzoberschwingungen, Anregung von Resonanzen durch Oberschwingungen oder Flicker, auch wenn sie nur kurzzeitig oder periodisch auftreten.
Alterungserscheinungen an Leuchtmitteln und damit verbundene Übertemperatur oder hohe UV-Belastung
Ausfall anderer Bauelemente in einer gemeinsamen Schaltung und damit verbundene Überspannungen oder Überströme.
- Wechselwirkungen mit anderen Blindleistungselementen, auch parasitären Kapazitäten (Kabel) oder Induktivitäten, in gemeinsamen Schaltungen.
- Die bestandene Prüfung nach Kondensatornorm garantiert keine umfassende Sicherheit gegen Überlastungsmöglichkeiten.
 - Teilweise besteht für Kondensatoren ohne Schutzeinrichtungen der Kundenwunsch nach Sonderprüfungen mit extremen Überspannungen und Temperaturen zum Nachweis der Sicherheit.
 - Solche zusätzlichen, „Zerstörungsprüfungen“ genannten Tests, an selbstheilenden PEC-Kondensatoren ohne Schutzeinrichtung (unprotected) sind nicht IEC-konform und untauglich das Gefährdungspotential solcher Kondensatoren, bzw. deren Verhalten im Fehlerfall, zu bewerten.
 - Stattdessen sollten kritische Zustände von PEC-Kondensatoren, welche zum Ausfall führen könnten, z. B. durch eine geeignete Überwachung (Strom/Spannung/Temperatur) innerhalb der Anwendung erkannt werden.
- Beim Betrieb bestimmter thyristorgeschalteter Kondensatoranlagen können an den Kondensatoren nicht eingeschalteter Kompensationsstufen dauerhaft hohe Gleichspannungen auftreten. Diese DC-Spannungen sind bei der Auslegung der Kondensatoren sowie deren Entladeeinrichtungen zu berücksichtigen.

VI. Risiken im Fehlerfall

- Starkstromkondensatoren können aufgrund ihrer gespeicherten Energie und/oder ihrer Eigenschaften beim Betrieb in Netzen mit hohen Kurzschlussleistungen im Fehlerfall ein erhebliches Risiko darstellen.
 - Der Einsatz von immer größeren Kondensatoren, wie z.B. in Multilevel-HGÜ-Anwendungen (HGÜ: Hochspannungs- Gleichstrom-Übertragung), welche hinsichtlich Größe, Anordnung und Anzahl von Kondensatoren besonders herausragen, bergen besondere Gefahren.
 - Für Energieinhalte von mehr als 30 kJ pro Kondensatoreinheit ist im Fehlerfall bei einer unkontrollierten Freisetzung dieser Energie von einer Potenzierung des Risikos auszugehen. Dies führt bei Anlagen mit mehreren Kondensatoreinheiten durch mögliche Lawineneffekte zu einem zusätzlichen Gefährdungspotenzial.
- Starkstromkondensatoren können bei fehlenden, falsch dimensionierten oder versagenden internen oder externen Schutzeinrichtungen aktiv ausfallen. Sie können platzen, brennen oder im Extremfall explodieren.
- Im Schadensfall austretende Gase (z. B. Kohlenwasserstoffe als Zersetzungsprodukte der eingesetzten organischen Isoliermaterialien) sind brennbar und können explosive Gemische ergeben. Das gilt auch für die aus internen Schutzeinrichtungen (Überdruckventil) austretenden Gase.
- Die Brandlast eines Starkstromkondensators beträgt ca. 40 MJ/kg. Dabei ist zu beachten, dass abhängig von der Größe und bezogen auf die Gesamtmasse des Kondensators bei kleinen Baugrößen etwa 55 Prozent und bei großen maximal 75 Prozent aus brennbaren Materialien bestehen.

VII. Risikominimierung

- Der Kondensatorhersteller kann nicht alle Belastungsmöglichkeiten eines Starkstromkondensators voraussehen und in der Konstruktion berücksichtigen. Hier trägt der Anwender entscheidende Mitverantwortung. Schon deshalb sollten bei der Kondensatoraushwahl Sicherheit und Qualität an erster Stelle stehen. Deshalb ist dringend zu empfehlen, Kondensatoren mit entsprechenden internen Schutzseinrichtungen einzusetzen.
- Kondensatoren sind im Vorfeld der Anwendung auf ihre Eignung für den vorgesehenen Einsatzfall zu prüfen. Das gilt insbesondere dann, wenn der Kondensator durch seine räumliche Nähe zu Personen ein besonderes Gefährdungspotential aufweist, wie dies z.B. bei Traktionsanwendungen immer der Fall ist. In diesem Fall sind stets Kondensatoren mit Schutzrichtungen bevorzugt zu verwenden. Bei der Risikobewertung / Eignungsprüfung sind alle Einflüsse (Parameter) zu berücksichtigen. Das schließt auch mögliche Produktionsfehler des Kondensators und deren Auswirkungen auf die Sicherheit in der Anwendung mit ein. Die bedenkenlose Übernahme des Kondensators in eine Anwendung ohne konkrete Risikobewertung kann schwerwiegende Folgen für die Anlagensicherheit haben.
- Besonders bei sensiblen Anwendungen müssen die internen Schutzseinrichtungen der Kondensatoren vom Anwender durch geeignete externe Schutzmaßnahmen ergänzt werden. Externe Schutzmaßnahmen sind beim Einsatz von Kondensatoren ohne interne Schutzseinrichtungen sogar zwingend erforderlich.
- Grundsätzlich ist beim Einsatz von Leistungskondensatoren durch geeignete Maßnahmen dafür zu sorgen, dass sowohl im Betriebs-, als auch im Schadensfall keine Gefahren für Menschen, Tiere und Sachen entstehen. Dies gilt für Kondensatoren ohne und mit Schutzseinrichtungen. Dazu sind eine regelmäßige, fachgerechte Prüfung und Wartung erforderlich.
- Die im ZVEI organisierten Starkstromkondensatorhersteller sind gerne bereit, den Anwender schon im Vorfeld des Einsatzes zu beraten und konkrete Anwendungsempfehlungen zu geben sowie Serviceleistungen anzubieten.

Kontakt

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Tel.: +49 69 6302462 • Mobil: +49 162 2664928 • E-Mail: marcus.dietrich@zvei.org

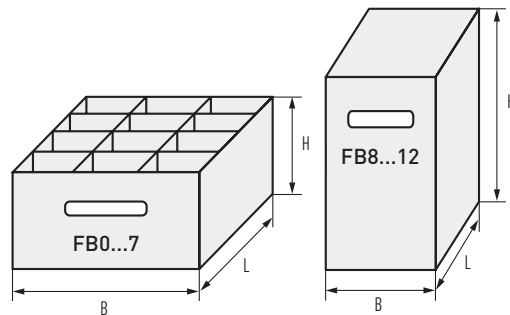
ZVEI e. V. • Verband der Elektro- und Digitalindustrie • Lyoner Straße 9 • 60528 Frankfurt am Main
Lobbyregisternr.: R002101 • EU Transparenzregister ID: 94770746469-09 • www.zvei.org

Datum: 16.03.2023

PACKING DETAILS

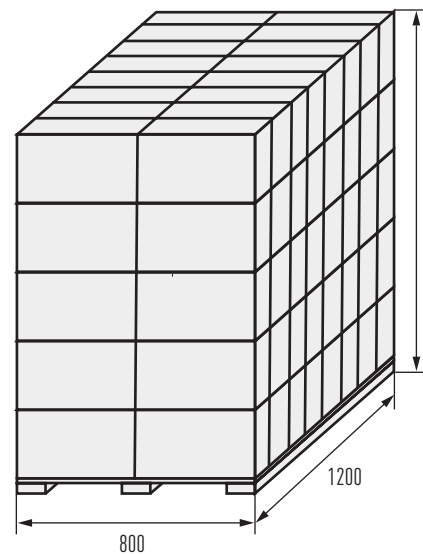
Capacitors

Type Box	L × B × H mm	Box/ pallet
FB 0	383 × 203 × 193	80
FB 2	383 × 203 × 148	80
FB 7	383 × 203 × 208	80
FB 8	393 × 153 × 270	80
FB 10	393 × 153 × 370	56
FB 12	393 × 153 × 330	70



Box

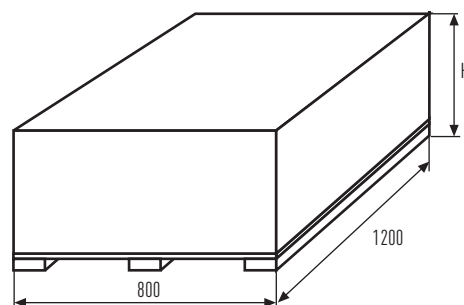
Carton, sealed with adhesive paper tape



Pallet

Standard Euro-pallet
(fumigated if required), wrapped in PP-foil
air freight < 1600
see freight < 1800

Reactors



Pallet

Wooden frame on standard Euro-pallet
(fumigated if required)

Also available:
Capacitors for Power Electronics

AC and DC capacitors with integrated safety mechanism
E62 AC/DC E62-3ph AC Filter E63 DC

Low-inductance capacitors
E50 PK16™ DC E53 AC/DC E61 DC

Low-inductance High-voltage capacitors
E51

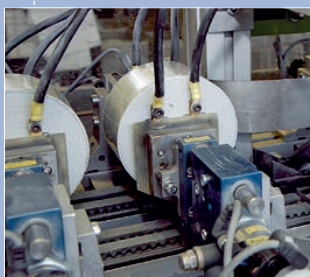
AC and DC capacitors with large capacitance
E56 DC E59 AC/DC E70 AC E50.U SR17™ DC

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EXCELLENT EXPERIENCE IN CAPACITOR MAKING FOR OVER 75 YEARS

Gera has been a centre of capacitor making since 1938. ELECTRONICON Kondensatoren GmbH which emerged from previous RFT/VEB ELEKTRONIK Gera in 1992, has become one of Europe's leading capacitor manufacturers supplying customers worldwide and being an open and competent partner for manufacturers and users of power factor correction equipment, for many manufacturers of drives, power electronics, home appliances, and for the lighting industry. Regular investments in advanced and environmentally sound technologies guarantee the highest levels in manufacture and quality to modern standards which are approved and monitored by leading certification authorities.



In today's globalised competition, we distinguish ourselves by

- Absolute reliability and safety of our products
- Close co-operation between manufacturer and client to meet both technical and commercial requirements
- Improvement and development of our technical expertise in capacitor design and manufacture, as well as film coating, with special attention paid to the MKPg-technology
- Early identification and incorporation of new trends and methods in the manufacturing of capacitors
- Flexibility and punctual fulfilment of our commercial obligations

Our experienced development engineers are competent and responsible for both implementing the latest technical trends applicable to our products and ensuring that our products adapt to the challenges of traditional and new markets. The close and intense co-operation between the departments of Marketing & Sales, Research & Development, and Production has become the keystone of our success. ELECTRONICON is continually striving to establish a similarly close and interactive relationship with its distributors and direct clients both in home and overseas markets, to become not just one out of many suppliers, but your preferred partner for ideas and solutions.

ELECTRONICON®

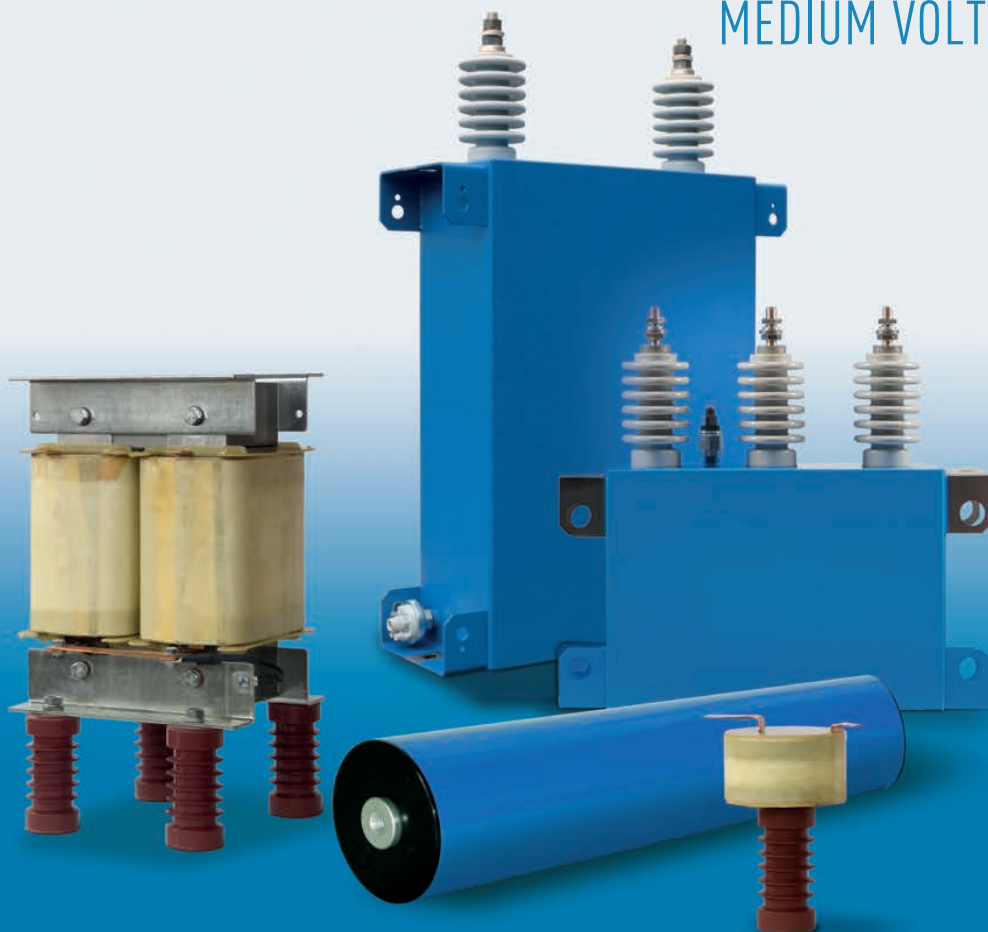
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MSD™ FKD-MV™ DSC™

MEDIUM VOLTAGE CAPACITORS
AND REACTORS



THE ECO-FRIENDLY ALTERNATIVE

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E93 DSC™

SURGE PROTECTION CAPACITOR



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MSD™

**SELF-HEALING MEDIUM VOLTAGE
CAPACITORS IN DRY TECHNOLOGY**

SELBSTHEILENDE MITTELSPANNUNGSKONDENSATOREN
IN TROCKENTECHNOLOGIE

FKD-MV™

**DETUNING REACTORS FOR MEDIUM
VOLTAGE CAPACITORS**

FILTERKREISDROSSELN FÜR MITTELSPANNUNGSKONDENSATOREN

DSC™

**SELF-HEALING SURGE PROTECTION
CAPACITORS IN DRY TECHNOLOGY**

SELBSTHEILENDE ÜBERSpannungSSCHUTZKONDENSATOREN
IN TROCKENTECHNOLOGIE

ELECTRONICON KONDENSATOREN GMBH GERA • GERMANY





MSD – The Clever Alternative

Self-healing dielectric: No short circuits

- Short-circuit currents are not possible due to the high-resistance fault characteristic of the self-healing dielectric. Special, short-circuit current limiting capacitor fuses are not necessary. Functional switching devices are sufficient for tripping.

Reliable monitoring by pressure switch

- The costs of the monitoring circuit are very low. It is sufficient to control the tripping function of the switch via the normally closed contact of the pressure monitor and lock it against re-connection.
- Every enclosure is monitored separately. Any number of individual capacitors can be grouped together for protection purposes.

Asymmetries are impossible

- As a consequence of the different partial failure mode of MSD capacitors compared to that of Allfilm capacitors, the possibility of current imbalance in the three phases can be ruled out almost completely. Hence monitoring of the star point is unnecessary which leads to further reduction of installation cost.

MSD – Die clevere Alternative

Selbstheilendes Dielektrikum: keine Kurzschlüsse

- Wegen des hochohmigen Fehlerbildes des selbstheilenden Dielektrikums sind keine Kurzschlussströme möglich. Spezielle, kurzschlussstrombegrenzende Kondensatorsicherungen sind nicht erforderlich. Für die Auslösung sind Betriebsschaltgeräte ausreichend.

Zuverlässige Überwachung durch Druckschalter

- Geringe Kosten für die Überwachungsschaltung. Es genügt, die Auslösefunktion des vorgelagerten Schaltgerätes über den Öffnerkontakt der Drucküberwachung anzusteuern und gegen Wiedereinschaltung zu verriegeln.
- Jedes Gehäuse wird einzeln überwacht. Beliebig viele Einzelkondensatoren können schutztechnisch zusammengefasst werden.

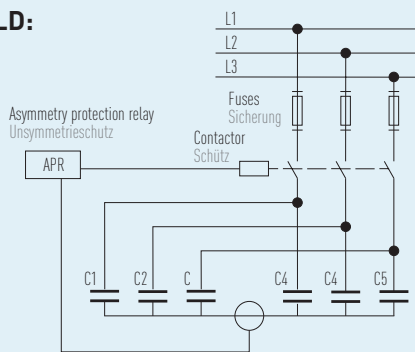
Unsymmetrien faktisch ausgeschlossen

- Infolge des andersartigen Ausfallverhaltens selbstheilender Kondensatoren ist das Risiko von Unsymmetrie praktisch ausgeschlossen. Damit erübrigt sich eine Überwachung des Sternpunktes, wodurch sich der Installationsaufwand wesentlich verringert.



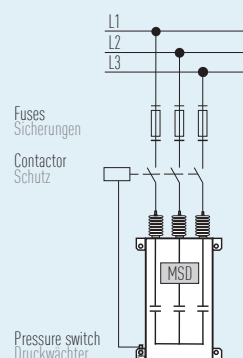
conventional installation of 1ph capacitors with asymmetry protection
herkömmliche Installation 1 ph Kondensatoren mit Unsymmetrieschutz

OLD:



MSD installation – simple and economical
MSD-Installation – einfach und sparsam

NEW:



No liquids, no environmental risk

- Oil sumps are unnecessary due to the dry design; no oil which could pollute the local environment. No disposal problems at the end of useful service life.

Long-term stable capacitance

- Reliability during applications in de-tuned and tuned filters and double filters by
 - long term stability of capacitance
 - very small capacitance tolerances up to $\pm 2.5\%$

Keine Flüssigkeiten, kein Umweltrisiko

- Dank Trockenaufbau keine Ölauffangwannen erforderlich. Keine grundwassergefährdenden Öle, damit auch kein Entsorgungsproblem am Ende der Gebrauchsdauer.

Langzeitstabile Kapazität

- Sicherheit beim Einsatz in verstimmten und abgestimmten Filterkreislagen sowie Doppelfiltern durch
 - hohe Langzeitstabilität
 - sehr enge Kapazitätstoleranzen bis zu $\pm 2.5\%$



Design and characteristics



The MSD technology is based on the logical development of proven self-healing technology for low-voltage power capacitors. It also permits the economic manufacture of medium voltage capacitors without employing inflammable and environmentally critical fluid oil fillings. The actual active capacitor element consists of a large number of high-quality, self-healing round MKP elements, which are wired to each other and installed in a steel enclosure.

Die MSD-Technik basiert auf der konsequenten Weiterentwicklung der bewährten Technologie von selbstheilenden Niederspannungs-Leistungskondensatoren. Sie gestattet es, nun auch Mittelspannungskondensatoren ohne brennbare und umweltschädliche flüssige Ölfüllung wirtschaftlich herzustellen. Der eigentliche Aktivteil des Kondensators besteht aus einer größeren Zahl hochwertiger, selbstheilender MKP-Rundwickel, die, miteinander verschaltet, als Paket in ein Stahlgehäuse eingebaut werden.



Our MSD capacitors are filled with solid materials, i.e. dry, instead of combustible liquid as with Allfilm medium voltage capacitors.



High-quality insulation between the active elements and the enclosure is achieved using a special process, which is designed and tested to suit the requirements for the nominal insulation voltage of the capacitor. This special insulation is of crucial importance for the safe operation of the internal pressure monitor: self-healing capacitors are not (yet) covered by current standards for medium voltage capacitors, such as IEC 60871, however, our MSD series fulfils all electrical and safety requirements of these standards. It has to be noted that the MSD capacitors – like any self healing capacitor – do not produce short circuits and can therefore not be disconnected from the system by internal or external blow-out fuses. This task is performed by integrated over-pressure switches as described in the standards applicable to capacitors for power electronics and for inductive heating. (VDE-EN 61071 and VDE-EN 60110). Note that, once the pressure switch has caused disconnection of capacitor, it must be locked externally against re-connection.



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Economic viability

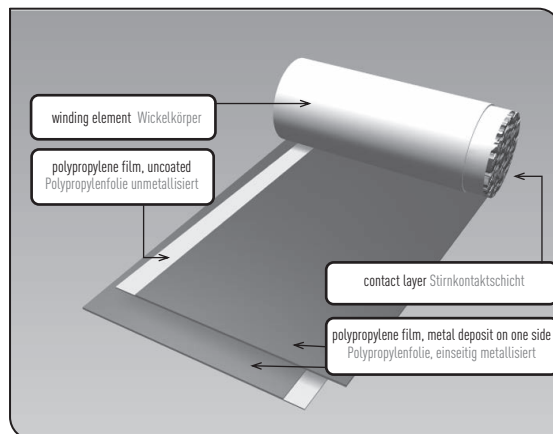
The pure capacitor manufacturing costs are slightly higher than former Allfilm capacitors as a result of the employment of especially high quality materials and a special production process.

If the total system costs including electrical protection systems such as asymmetry protection, fire protection and environmental protection measures are also considered, then significant cost benefits are achieved in the small to medium power range of 50...6000 kvar. MSD is also generally interesting for larger powers in the voltage range up to 12kV. Oil-filled capacitors are not permitted at locations with special fire risk, e.g. in mines, in protected water catchment areas or drinking water pump stations, so that other alternatives are often unavailable.

Application

Fixed motor and transformer compensation, automatic capacitor banks, mobile sub-stations, de-tuned and tuned filter circuits, in double filters, audio frequency links and other applications in critical areas for application in the 1.9 to 12kV range.

Aufbau und Eigenschaften



Statt mit brennbarer Flüssigkeit wie bei Allfilm-Mittelspannungskondensatoren sind unsere MSD-Kondensatoren mit Feststoffen gefüllt, also trocken.

Durch ein spezielles Verfahren wird eine qualitativ hochwertige Isolation zwischen Aktivteil und Gehäuse erreicht, die entsprechend den Anforderungen der Nennisolationsspannung des Kondensators ausgelegt und geprüft ist. Diese spezielle Isolation ist für die sichere Funktion der Innendrucküberwachung von ausschlaggebender Bedeutung: obwohl selbstheilende Kondensatoren von den derzeit gültigen Standards für Mittelspannungskondensatoren, wie z.B. IEC 60871, (noch) nicht erfasst werden, erfüllt unsere MSD-Serie alle elektrischen und sicherheitstechnischen Anforderungen dieser Standards. Es ist jedoch zu beachten, dass die MSD-Kondensatoren – wie alle selbstheilenden Kondensatoren – im Fehlerfall keine Kurzschlüsse erzeugen und somit nicht durch interne oder externe Schmelzsicherungen vom Netz getrennt werden können. Diese Aufgabe übernimmt ein integrierter Überdruckschalter wie in den Normen für Kondensatoren der Leistungselektronik und für induktive Erwärmung beschrieben. (VDE-EN 61071 sowie VDE-EN 60110). Achtung: Nachdem der Druckschalter die Abschaltung eines Kondensators erzwungen hat, muss jener extern gegen Wiedereinschaltung verriegelt werden.

Wirtschaftlichkeit

Bedingt durch den Einsatz besonders hochwertiger Materialien und einen speziellen Fertigungsprozess sind die reinen Kondensator-Herstellkosten etwas höher als bei herkömmlichen Allfilm-Kondensatoren.

Werden jedoch die gesamten Anlagenkosten einschließlich elektrischer Schutztechnik wie Unsymmetrieschutz, Brandschutz und Umweltschutzmaßnahmen am Aufstellort und spätere Entsorgungskosten hinzugerechnet, ergeben sich deutliche Kostenvorteile im Bereich kleiner bis mittlerer Leistungen von 50 bis etwa 6.000 kvar. Grundsätzlich ist MSD im Spannungsbereich bis 12kV auch für größere Leistungen interessant. An Aufstellungs-orten mit besonderer Brandgefährdung, wie z.B. unter Tage, in Wasserschutzgebieten oder Trinkwasserpumpstationen, sind ölgefüllte Kondensatoren nicht zugelassen, so dass oft keine anderen Alternativen bestehen.

Anwendung

Motor- und Transformatorfestkompensation, automatische Blindleistungs-Kompensationsanlagen, mobile Umspannstationen, verstimmte und abgestimmte Filterkreise, in Doppelfiltern, Tonfrequenzankopplungen und sonstige Anwendungen speziell im kritischen Umfeld.



for latest edition and updates
check www.powercapacitors.info

MSD E90.***
3ph
2.4...3.3kV

Three phase MV Capacitors for PFC and Harmonic Filters
Dreiphasige Mittelspannungskondensatoren für Kompensation und Filter

Permitted operating voltages Zulässige Betriebsspannungen

24h	U_N
12h/d	$1.1 \times U_N$
30min/d	$1.15 \times U_N$
5min (200x)	$1.2 \times U_N$
1min (200x)	$1.3 \times U_N$
max. peak rating zulässiger Spitzenwert	$3 \times U_N$

Test voltage Prüfspannung

U_{IT}	$AC\ 2 \times U_N$
----------	--------------------

Internal connection innere Verschaltung Y

Inrush current Einschaltstrom max. $150 \times I_N$

Discharge resistor Entladewiderstand inside innen
<75V / <10min

C_N tolerance Toleranz $\pm 5\%$

(other values on request_ andere Werte auf Anfrage)



lower limit temperature -40°C
untere Grenztemperatur

Dissipation losses Verlustleistung

Dielectric Dielektrikum < 0.20 W/kvar

Total capacitor Kondensator gesamt < 0.25 W/kvar

Life expectancy Lebensdauer (permitted failure rate_ bei einer Ausfallrate 3%)

at temperature acc. to chart >100 000 h

bei Temperaturklasse lt. Tabelle

Overpressure switch changeover switch

Überdruckschalter Wechsler 4A/250V AC

Ambient conditions Aufstellungsort indoor innen

Height a.s.l. Höhe ü.NN (standard) 2000m

Q_c (kvar)	C_N (µF)	I_N (A)	temp.cat. Temp.klasse	L × B × H (mm)	a (mm)	m (kg)	order no. Bestell-Nr.
U_N 2400V 60Hz		U_{TC} (BIL) 13/45kV					
50	3 × 23	3 × 12	D	340 × 125 × 315	129	18	E90.C31-233440
100	3 × 46.1	3 × 24.1	D	340 × 125 × 425	129	23	E90.C42-463440
150	3 × 69.1	3 × 36.1	D	340 × 125 × 425	129	23	E90.C42-693440
200	3 × 92.1	3 × 48.1	C	415 × 150 × 455	158	40	E90.G45-923440
250	3 × 115.1	3 × 60.1	C	415 × 150 × 455	158	40	E90.G45-124440
300	3 × 138.2	3 × 72.2	B	415 × 150 × 585	158	43	E90.G58-144440
U_N 3300V 50Hz		U_{TC} (BIL) 10/40kV					
50	3 × 14.6	3 × 8.7	D	340 × 125 × 315	129	18	E90.C31-153340
100	3 × 29.2	3 × 17.5	D	340 × 125 × 425	129	23	E90.C42-293340
150	3 × 43.8	3 × 26.2	D	415 × 150 × 455	158	40	E90.G45-443340
200	3 × 58.5	3 × 35	C	415 × 150 × 455	158	40	E90.G45-593340
250	3 × 73.1	3 × 43.7	C	415 × 150 × 585	158	43	E90.G58-733340
300	3 × 87.7	3 × 52.5	B	415 × 150 × 585	158	43	E90.G58-883340
400	3 × 116.9	3 × 70	B	415 × 150 × 715	158	55	E90.G71-124340
U_N 3300V 60Hz		U_{TC} (BIL) 10/40kV					
50	3 × 12.2	3 × 8.7	D	340 × 125 × 315	129	18	E90.C31-123440
100	3 × 24.4	3 × 17.5	D	340 × 125 × 425	129	23	E90.C42-243440
150	3 × 36.5	3 × 26.2	D	340 × 125 × 425	158	40	E90.C42-373440
200	3 × 48.7	3 × 35	C	415 × 150 × 455	158	40	E90.G45-493440
250	3 × 60.9	3 × 43.7	C	415 × 150 × 585	158	43	E90.G58-613440
300	3 × 73.1	3 × 52.5	B	415 × 150 × 585	158	43	E90.G58-733440

Other power and voltage ratings available on request.
Andere Leistungen und Nennspannungen auf Anfrage erhältlich.



MSD E90.***
3ph
3.6...7.1kV

Q_c (kvar)	C_N (μ F)	I_N (A)	temp.cat. Temp.klasse	L × B × H (mm)	a (mm)	m (kg)	order no. Bestell-Nr.
U_N 3600V 50Hz		U_{TC} (BIL) 10/40kV					
50	3 × 12.3	3 × 8	D	340 × 125 × 315	129	18	E90.C31-123340
100	3 × 24.6	3 × 16	D	340 × 125 × 425	129	23	E90.C42-253340
134	3 × 32.9	3 × 21.4	D	415 × 150 × 455	129	23	E90.G45-333340
150	3 × 36.8	3 × 24.1	D	415 × 150 × 455	158	40	E90.G45-373340
200	3 × 49.1	3 × 32.1	C	415 × 150 × 455	158	40	E90.G45-493340
250	3 × 61.4	3 × 40.1	C	415 × 150 × 585	158	43	E90.G58-613340
268	3 × 65.8	3 × 43	C	415 × 150 × 585	158	43	E90.G58-663341
300	3 × 73.7	3 × 48.1	B	415 × 150 × 585	158	43	E90.G58-743340
400	3 × 98.2	3 × 64.2	B	415 × 150 × 715	158	55	E90.G71-983340
U_N 4160V 60Hz		U_{TC} (BIL) 24/75kV					
50	3 × 7.7	3 × 6.9	D	340 × 125 × 315	129	18	E90.C31-772440
100	3 × 15.3	3 × 13.9	D	340 × 125 × 425	129	23	E90.C42-153440
150	3 × 23	3 × 20.8	D	340 × 125 × 425	129	23	E90.C42-233440
200	3 × 30.7	3 × 27.8	C	415 × 150 × 455	158	40	E90.G45-313440
250	3 × 38.3	3 × 34.7	C	415 × 150 × 455	158	40	E90.G45-383440
300	3 × 46	3 × 41.6	B	415 × 150 × 585	158	43	E90.G58-463440
U_N 6600V 50Hz		U_{TC} (BIL) 20/60kV					
50	3 × 3.7	3 × 4.4	D	340 × 125 × 315	129	18	E90.C31-372340
100	3 × 7.3	3 × 8.7	D	340 × 125 × 425	129	23	E90.C42-732340
150	3 × 11	3 × 13.1	D	415 × 150 × 455	158	40	E90.G45-113340
200	3 × 14.6	3 × 17.5	D	415 × 150 × 455	158	40	E90.G45-153340
250	3 × 18.3	3 × 21.9	C	415 × 150 × 585	158	43	E90.G58-183340
300	3 × 21.9	3 × 26.2	C	415 × 150 × 585	158	43	E90.G58-223340
400	3 × 29.2	3 × 35	C	415 × 150 × 840	158	63	E90.G84-293340
U_N 6600V 60Hz		U_{TC} (BIL) 20/60kV					
50	3 × 3	3 × 4.4	D	340 × 125 × 315	129	18	E90.C31-302440
100	3 × 6.1	3 × 8.7	D	340 × 125 × 425	129	23	E90.C42-612440
150	3 × 9.1	3 × 13.1	D	340 × 125 × 425	129	23	E90.C42-912440
200	3 × 12.2	3 × 17.5	D	415 × 150 × 455	158	40	E90.G45-123440
250	3 × 15.2	3 × 21.9	C	415 × 150 × 455	158	40	E90.G45-153441
300	3 × 18.3	3 × 26.2	C	415 × 150 × 585	158	43	E90.G58-183440
U_N 7100V 50Hz		U_{TC} (BIL) 20/60kV					
50	3 × 3.2	3 × 4.1	D	340 × 125 × 315	129	18	E90.C31-322340
100	3 × 6.3	3 × 8.1	D	340 × 125 × 425	129	23	E90.C42-632340
130	3 × 8.2	3 × 10.5	D	415 × 150 × 455	129	23	E90.G45-822341
150	3 × 9.5	3 × 12.2	D	415 × 150 × 455	158	40	E90.G45-952340
200	3 × 12.6	3 × 16.3	D	415 × 150 × 455	158	40	E90.G45-133340
250	3 × 15.8	3 × 20.3	C	415 × 150 × 585	158	43	E90.G58-163340
260	3 × 16.4	3 × 21.1	C	415 × 150 × 585	158	43	E90.G58-163341
300	3 × 18.9	3 × 24.4	C	415 × 150 × 585	158	43	E90.G58-193340
400	3 × 25.2	3 × 32.5	C	415 × 150 × 840	158	63	E90.G84-253341

Other power and voltage ratings available on request.
Andere Leistungen und Nennspannungen auf Anfrage erhältlich.

MSD E90.***
3ph
7.2...12kV

Q_c (kvar)	C_N (μ F)	I_N (A)	temp.categ. Temp.klasse	L x B x H (mm)	a (mm)	m (kg)	order no. Bestell-Nr.
U_N 7200V 60Hz		U_{TC} (BIL) 20/60kV					
50	3 × 2.6	3 × 4	D	340 × 125 × 315	129	18	E90.C31-262440
100	3 × 5.1	3 × 8	D	340 × 125 × 425	129	23	E90.C42-512440
150	3 × 7.7	3 × 12	D	415 × 150 × 455	158	40	E90.G45-772440
200	3 × 10.2	3 × 16	D	415 × 150 × 455	158	40	E90.G45-103440
250	3 × 12.8	3 × 20	C	415 × 150 × 585	158	43	E90.G58-133440
300	3 × 15.4	3 × 24.1	C	415 × 150 × 585	158	43	E90.G58-153440
U_N 11000V 50Hz		U_{TC} (BIL) 28/75kV					
150	3 × 4	3 × 7.9	D	415 × 150 × 455	158	40	E90.G45-402341
200	3 × 5.3	3 × 10.5	D	415 × 150 × 455	158	40	E90.G45-532340
250	3 × 6.6	3 × 13.1	D	415 × 150 × 585	158	43	E90.G58-662340
400	3 × 10.5	3 × 21	C	415 × 150 × 840	158	63	E90.G84-113340
500	3 × 13.2	3 × 26.2	B	415 × 150 × 935	158	70	E90.G93-133340
U_N 12000V 50Hz		U_{TC} (BIL) 28/75kV					
134	3 × 3	3 × 6.4	D	415 × 150 × 455	158	40	E90.G45-302340
150	3 × 3.3	3 × 7.2	D	415 × 150 × 455	158	40	E90.G45-332340
200	3 × 4.4	3 × 9.6	D	415 × 150 × 455	158	40	E90.G45-442340
250	3 × 5.5	3 × 12	D	415 × 150 × 585	158	43	E90.G58-552341
267	3 × 5.9	3 × 12.8	D	415 × 150 × 585	158	43	E90.G58-592341
300	3 × 6.6	3 × 14.4	D	415 × 150 × 585	158	43	E90.G58-662341
334	3 × 7.4	3 × 16.1	C	415 × 150 × 715	158	53	E90.G71-742341
400	3 × 8.8	3 × 19.4	C	415 × 150 × 715	158	53	E90.G84-882340
500	3 × 11.1	3 × 24.1	B	415 × 150 × 935	158	70	E90.G93-113340
534	3 × 11.8	3 × 24.7	B	415 × 150 × 935	158	70	E90.G93-123340
U_N 12000V 60Hz		U_{TC} (BIL) 28/75kV					
150	3 × 2.8	3 × 7.2	D	415 × 150 × 455	158	40	E90.G45-282440
200	3 × 3.7	3 × 9.6	D	415 × 150 × 455	158	40	E90.G45-372440
250	3 × 4.6	3 × 12	D	415 × 150 × 585	158	43	E90.G58-462440
300	3 × 5.5	3 × 14.4	D	415 × 150 × 585	158	43	E90.G58-552440
400	3 × 7.4	3 × 19.4	C	415 × 150 × 715	158	53	E90.G71-742440



MSD E90.***

1ph

6...12 kV mains

for latest edition and updates
check www.powercapacitors.infoSingle phase Power Capacitors for star connection in 50 Hz mains
Einphasige Leistungskondensatoren für Sternverschaltung in 50 Hz-Netzen

Permitted operating voltages Zulässige Betriebsspannungen

24h	U_N
12h/d	$1.1 \times U_N$
30min/d	$1.15 \times U_N$
5min (200×)	$1.2 \times U_N$
1min (200×)	$1.3 \times U_N$
max. peak rating zulässiger Spitzenwert	$3 \times U_N$

Test voltage Prüfspannung

U_{IT}	$AC\ 2 \times U_N$
----------	--------------------

Inrush current Einschaltstrom max. $150 \times I_N$

Discharge resistor Entladewiderstand inside innen

<75V / <10min

 C_N tolerance Toleranz $\pm 5\%$

(other values on request_andere Werte auf Anfrage)

lower limit temperature -40°C
untere Grenztemperatur

Dissipation losses Verlustleistung

Dielectric Dielektrikum $< 0.20\ \text{W/kvar}$ Total capacitor Kondensator gesamt $< 0.25\ \text{W/kvar}$

Life expectancy Lebensdauer (permitted failure rate_bei einer Ausfallrate < 3%)

at temperature acc. to chart $> 100\ 000\ \text{h}$

bei Temperaturklasse lt. Tabelle

Overpressure switch changeover switch

Überdruckschalter Wechsler 4A/250V AC

Ambient conditions Aufstellungsort indoor innen

Height a.s.l. Höhe ü.NN (standard) 2000m

Q_C (kvar)	C_N (µF)	I_N (A)	temp.cat. Temp.klasse	L × B × H (mm)	m (kg)	order no. Bestell-Nr.	Q_{LC} (3ph) @ U_{mains} * (7% detuned_verdrosselt)
U_N 4160V 50Hz for U_{mains} 6...7.2kV				U_{TC} (BIL) 20/60kV		6kV 50Hz	
134	24.7	33.2	D	415 × 150 × 455	35	E90.645-253140	300 kvar
224	41.1	53.8	D	415 × 150 × 455	35	E90.645-413140	500 kvar
335	61.8	80.6	C	415 × 150 × 715	54	E90.671-623140	700 kvar
447	82.2	107.5	B	415 × 150 × 840	63	E90.684-823140	1000 kvar
559	102.9	134.4	B	415 × 150 × 980	72	E90.698-104140	1250 kvar
U_N 6930V 50Hz for U_{mains} 10...12kV				U_{TC} (BIL) 28/75kV		10kV 50Hz	
134	8.9	19.3	D	415 × 150 × 455	35	E90.645-902140	300 kvar
178	11.8	25.7	D	415 × 150 × 455	35	E90.645-123140	400 kvar
223	14.8	32.2	C	415 × 150 × 455	35	E90.645-153140	500 kvar
270	17.9	38.7	D	415 × 150 × 585	45	E90.658-183140	600 kvar
313	20.7	45.2	D	415 × 150 × 715	54	E90.671-213140	700 kvar
357	23.7	51.5	C	415 × 150 × 715	54	E90.671-243140	800 kvar
402	26.4	58	C	415 × 150 × 840	63	E90.684-273140	900 kvar
447	29.6	64.5	C	415 × 150 × 840	63	E90.684-303140	1000 kvar
491	32.6	70.9	C	415 × 150 × 980	73	E90.698-333140	1100 kvar
536	35.5	77.3	B	415 × 150 × 980	73	E90.698-363140	1200 kvar
U_N 7790V 50Hz for U_{mains} 11...12kV				U_{TC} (BIL) 28/75kV		11kV 50Hz	
140	7.35	18	D	415 × 150 × 455	35	E90.645-732140	300 kvar
233	12.2	29.9	C	415 × 150 × 455	35	E90.645-123141	500 kvar
350	18.35	44.9	C	415 × 150 × 715	54	E90.671-183140	750 kvar
466	24.5	59.8	B	415 × 150 × 840	63	E90.684-243140	1000 kvar
513	26.9	65.9	B	415 × 150 × 980	73	E90.698-273140	1100 kvar

* Note: The stage output is given for a set of three capacitors. It refers to the rated mains voltage and considers the connection with our 7% series reactors. Compare our reactor range on page 15.

* Anmerkung: Die Stufenleistung ist für ein Set aus drei Kondensatoren angegeben. Sie bezieht sich auf die angegebene Netzennspannung und geht von einer Serienschaltung mit unseren 7%-Filterkreisdrösslern aus. Vgl. unser Drösslortiment auf S.15.

DIMENSION DRAWINGS
MASSBILDER

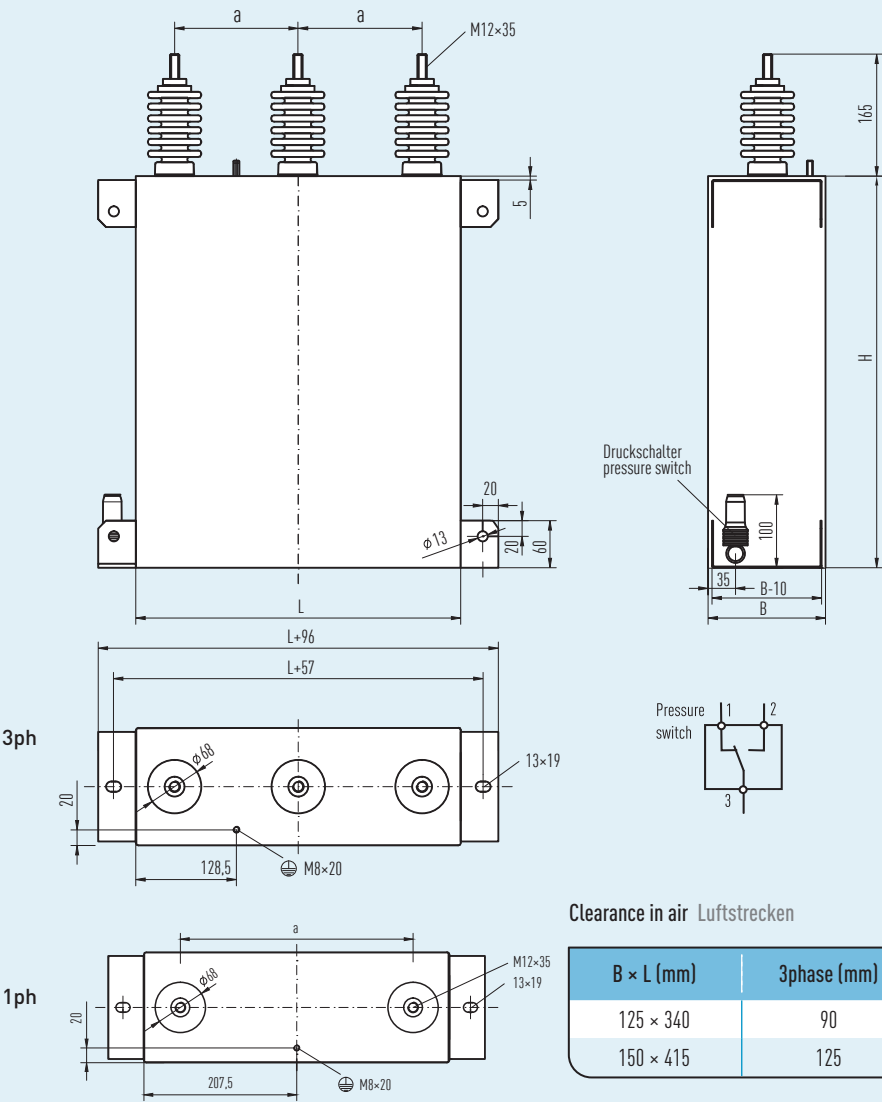
Enclosure steel, painted RAL 5019
Terminals ceramic insulators with
threaded stud M12 × 35
 I_{max} (Terminals) 100 A
Degree of protection IP 00
Humidity class C

Creepage distances 290mm
Clearance in air see drawing

Gehäusematerial Stahl, lackiert RAL 5019
Anschlüsse Keramikisolatoren mit
Gewindebolzen M12 × 35
 I_{max} (Anschlüsse) 100 A
Schutzgrad IP 00
Feuchtekategorie C

Kriechstrecken 290mm
Luftstrecken siehe Maßbild

Dimension drawing
Maßbild



Clearance in air Luftstrecken

B × L (mm)	3phase (mm)	1phase (mm)
125 × 340	90	130
150 × 415	125	130



The Most Efficient Protection Device: Pressure Switch

The failure of self-healing capacitors is usually accompanied by the thermal disintegration of dielectric material, causing a gradual rise of the internal pressure. The period during which such rise of pressure can happen ranges from several seconds to hours or days. Since the dissipation products of polypropylene contain explosive organic gasses, a controlled pressure relief into the surrounding atmosphere, e.g. through pressure disks or relief valves, may often be very hazardous. Another option – watching pressure seals for an early mechanical indication of upcoming trouble – may prove problematic as well since in order to be reliable, such optical monitoring would require high rates of maintenance which are usually not available in real life.

The pressure switch offered as standard for our capacitors in hermetical housing detects the rise of internal pressure and provides a signal which shall be used by an external safety circuit for immediate and irreversible de-activation of the capacitor. With its SPDT (Single Pole, Double Throw) change-over contact, the pressure switch can be used as an NO or NC option, and the signal may even be counter-monitored in order to rule out false alarm.

The switch is located on the top side and may point upwards or sideways if required by the customer's connection scheme. On capacitors with rated voltages above 12kV, the device is placed at the base of the case to avoid interference with adjacent life parts.

Die effizienteste Schutzeinrichtung: Druckschalter

Der Ausfall selbstheilender Kondensatoren geht in der Regel mit einer thermischen Zersetzung dielektrischer Materialien und einem schrittweisen Druckanstieg im Kondensatorinneren einher. Dies kann sich über einige Sekunden bis hin zu Stunden oder sogar Tage erstrecken. Da die Zersetzungsprodukte von Polypropylen explosive organische Gase enthalten, kann ein gezieltes Ablassen des Überdruckes in die umgebende Atmosphäre, zum Beispiel über Druckscheiben oder Überdruckventile, in vielen Situationen sehr riskant sein. Eine andere Option – das gezielte Beobachten von hermetischen Siegeln zum Zwecke einer frühzeitigen Erkennung aufkommender Probleme – erscheint ebenfalls schwer realisierbar, da eine solche optische Überwachung, um wirkungsvoll zu sein, sehr kurze Wartungszyklen erfordern würde, die in der Praxis kaum realisierbar sind.

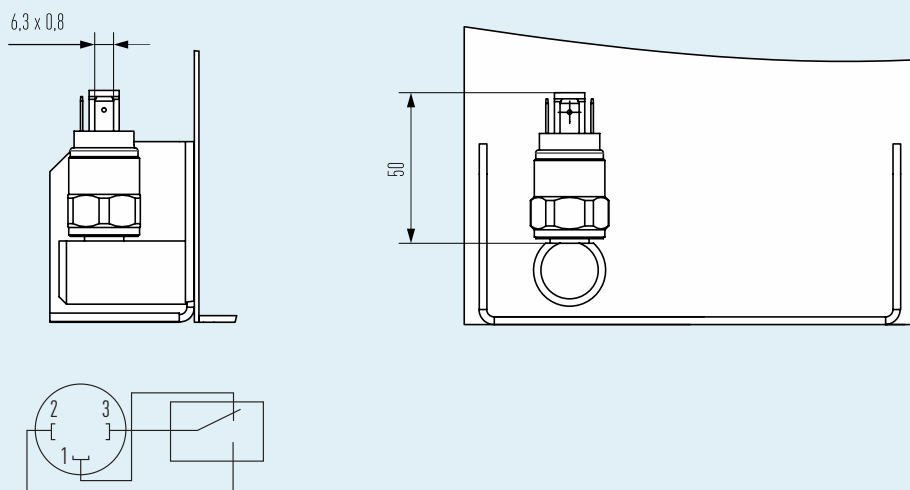
Der für unsere hermetischen Kondensatoren als Standard angebotene Druckschalter erkennt den Anstieg des Druckes im Kondensatorinneren und liefert ein Signal, welches durch eine externe Sicherheitsschaltung für die unverzügliche und irreversible Abschaltung des Kondensators genutzt werden kann. Mit seinem SPDT (Single Pole, Double Throw) Wechsler kann der Schalter als NO oder NC Schalter genutzt werden, und das Signal kann sogar gegengeprüft werden, um Fehlalarm auszuschließen.

Der Schalter wird auf der Oberseite des Kondensators angebracht und kann entweder senkrecht oder horizontal ausgerichtet werden. Bei Kondensatoren mit Nennspannungen über 12kV wird der Schalter am unteren Ende des Kondensators angebracht, um Beeinträchtigungen benachbarter spannungsführender Teile zu vermeiden.

Technical Data Technische Daten

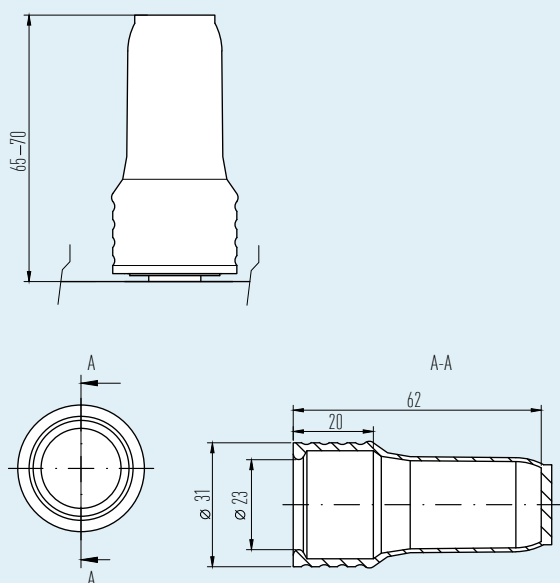
Material	stainless steel Edelstahl
Measuring principle Messprinzip	spring loaded diaphragm (rubber, optional: stainless steel) federgespanntes Diaphragma (Gummi, optional: Edelstahl)
Standard setting Standardeinstellung	0.5 bar (other values on request_andere Werte auf Anfrage)
Hysteresis Hysterese	ca. 0.5 bar
Shock resistance Stoßbeständigkeit	30 g
Vibration resistance (10...20000Hz) Vibrationsbeständigkeit (10...20000Hz)	10 g
Terminals Anschlüsse	6.3 x 0.8 mm tabs, stainless steel Flachstecker, Edelstahl
Internal contacts innere Kontakte	brass, silver or gold plated depending on intended monitoring voltage Messing, silber- oder goldbeschichtet (je nach geplanter Überwachungsspannung)
Rated switch power Schaltleistung	
inductive load induktive Last	max. 2A/250Vrms, 1A/24V DC
ohmic load ohmsche Belastung	max. 4A/250Vrms, 2A/24V DC

Dimension drawing
Maßbild



Accessories Zubehörteile

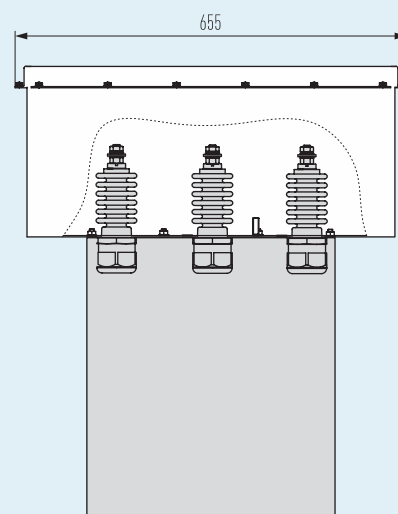
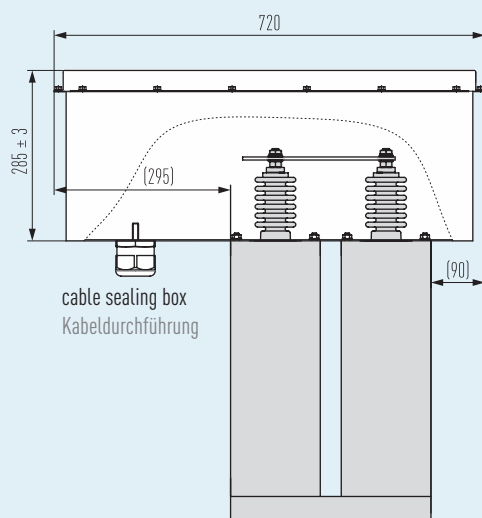
Dimension drawing
Maßbild



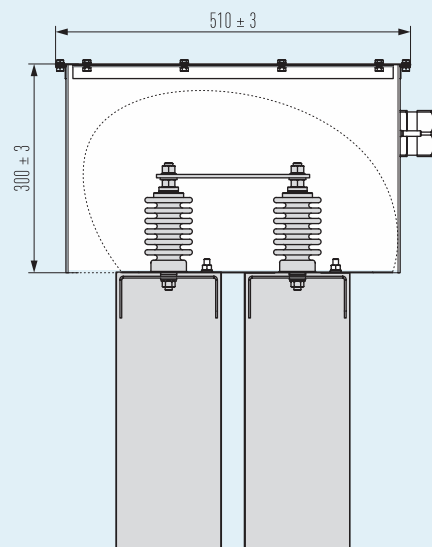
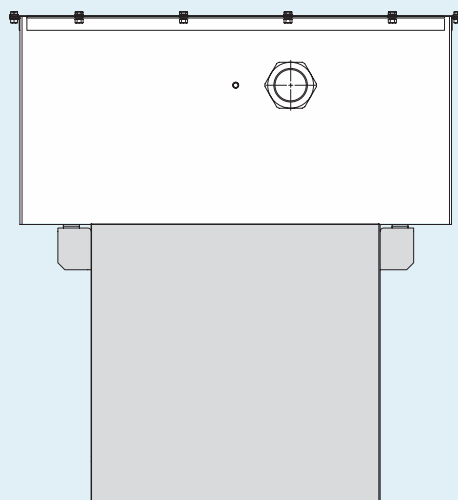
IP54 protective cap (NBR) Schutzkappe (Nitrilkautschuk)
Order No. Bestell-Nr. 07237.061-03.9

Protection Covers (Examples with two capacitors each)
Abdeckhauben (Beispiele mit jeweils zwei Kondensatoren)

IP 55 Protection cover for mains up to 7.2kV
IP 55 Abdeckung in Netzen bis 7.2kV



IP40 Indoor protection cover for mains up to 12kV
IP40 Abdeckung für Innenaufstellung in Netzen bis 12kV



Protection covers can be ordered along with corresponding capacitors only.
Schutzabdeckungen können nur im Set mit passenden Kondensatoren bestellt werden.



Detuning Reactors for Medium Voltage Capacitors

The growing use of power electronic devices is causing an increasing level of harmonic distortion in the electrical system which very often leads to problems with capacitor installations. This is the reason why more and more energy suppliers demand the installation of detuned capacitor systems.

A detuned capacitor system performs the function of power factor improvement whilst preventing any amplification of harmonic currents and voltages caused by resonance between capacitors and inductances in the electrical system.

By adding an appropriately rated series reactor to the power capacitor, both elements form a resonant circuit with a resonant frequency below the lowest order harmonic in the system (usually the 5th). All frequencies above this resonant frequency now see this circuit as inductive, hence eliminating the possibility of dangerous resonances being set up between the capacitors and system inductances provided the reactor has been dimensioned properly.

Durch die Serienschaltung von Filterkreisdrossel und Leistungskondensator wird ein Serienresonanzkreis gebildet. Drossel und Kondensator werden bewusst so aufeinander abgestimmt, dass die interne Resonanzfrequenz dieser Schaltung unterhalb der Frequenz der niedrigsten auftretenden Oberschwingung (in den meisten Fällen die fünfte) liegt. Da die Schaltung nun für alle Frequenzen oberhalb ihrer Resonanzfrequenz einen induktiven Charakter annimmt, ist auch die Gefahr einer Oberwellenresonanz zwischen Kompensationsanlage und Netzinduktivität (ausreichende Drosseldimensionierung vorausgesetzt) ausgeschlossen.

It has to be ensured, however, that capacitors with detuning reactors and non-detuned capacitors are never operated in the same mains. Such combination may cause unforeseeable interactions and equalising currents leading to damage and destruction of capacitors, reactors, and other components.

Our filter reactors are made of high-class transformer sheets and aluminium or copper band, or copper wires. They are dried and impregnated in a vacuum with environmentally friendly, low-styrole resin which ensures they can withstand high voltages, have low noise levels, and offer a long operating life. The reactors are provided with copper terminal lugs which are reliably connected with the aluminium band by a special, well-proven welding method.

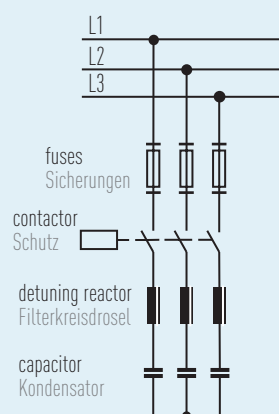
Every reactor is formed by a set of three individual single-phase units which can only be obtained in this set.

Filterkreisdrosseln für Mittelspannungs-Kondensatoren

Der ständig zunehmende Einsatz von Anwendungen aus der Leistungselektronik zieht einen wachsenden Oberwellengehalt in den Stromversorgungsnetzen nach sich, was häufig zu Problemen mit Kondensatoranlagen führt. Dies veranlasst immer mehr Energieversorgungsunternehmen, den Einsatz von verdrosselten Kondensatoren zu fordern.

Eine verdrosselte Kondensatoranlage erfüllt die Funktion der Blindleistungskompensation, reduziert aber gleichzeitig die Oberschwingungsbelastung des Netzes.

Installation of detuned (reactor-connected) capacitor Schaltbild zur Verdrosselung von Kondensatoren



Es muss jedoch sichergestellt werden, dass verdrosselte und unverdrosselte Kondensatoren niemals im selben Netz betrieben werden. Eine solche Kombination kann unkontrollierbare Wechselwirkungen und Ausgleichströme hervorrufen und zur Beschädigung von Kondensatoren, Drosseln und anderen Komponenten führen.

Unsere Filterkreisdrosseln werden mit hochwertigen Transformatorenblechen und Aluminium- oder Kupferband bzw. Kupferlackdraht hergestellt. Vakuumtrocknung und Imprägnierung mit umweltfreundlichem styrolarmem Harz garantieren eine hohe Spannungsfestigkeit, einen niedrigen Geräuschpegel und eine lange Lebensdauer. Die Drosseln sind mit seitlich herausgeführten Kupferlaschen versehen, welche durch ein spezielles, seit Jahren bewährtes Schweißverfahren zuverlässig mit dem Aluminiumband verbunden sind. Jede Drossel besteht aus einem Set von drei einphasigen Einheiten, welche nur in diesem Verbund erhältlich sind.



	U _N (kV)	step power Stufenleistung	matching capacitor passender Kondensator		Reactor (three single phase reactors are needed for each set) Drossel (drei einphasige Drosseln werden pro Set benötigt)						weight	order no.
		Q _{LC} (3ph) @ U _N (kvar)	C _{N(V)} (µF)	order no. (qty) Bestellnr. (Anzahl)	type designation Bezeichnung	winding Wicklung	L _N (mH)	I _{eff} (A)	L × W × H (mm)	Gewicht (kg)	order no. Bestellnummer	
7% 189Hz 1.8 I _N	3kV	75	3 × 24.6	E90.C42-253340 (×1)	FKD-MV 75/3-3-50-DIa-7%	Alu	28.8	16.9	200 × 220 × 265	25	468.159+C033A0 (×3)	
		100	3 × 32.9	E90.G45-333340 (×1)	FKD-MV 100/3-3-50-DIa-7%	Alu	21.5	22.6	200 × 231 × 265	30	4H0.160+C033A0 (×3)	
		150	3 × 49.1	E90.G45-493340 (×1)	FKD-MV 150/3-3-50-DIa-7%	Alu	14.4	33.9	280 × 216 × 370	47	4H5.218+C033A0 (×3)	
		200	3 × 65.8	E90.G59-663340 (×1)	FKD-MV 200/3-3-50-DIa-7%	Alu	10.8	45.2	280 × 233 × 370	64	4K0.230+C033A0 (×3)	
		225	3 × 73.7	E90.G58-743340 (×1)	FKD-MV 225/3-3-50-DIa-7%	Alu	9.6	50.8	280 × 233 × 370	67	4K2.230+C033A5 (×3)	
7% 189Hz 1.8 I _N	6kV	75	3 × 6.3	E90.C42-632340 (×1)	FKD-MV 75/3-6-50-DIa-7%	Cu	115	8.5	200 × 220 × 265	29	468.159-F032A0 (×3)	
		100	3 × 8.2	E90.G45-822340 (×1)	FKD-MV 100/3-6-50-DIa-7%	Cu	86.3	11.3	200 × 220 × 265	30	4H0.159-F032A0 (×3)	
		150	3 × 12.6	E90.G45-133340 (×1)	FKD-MV 150/3-6-50-DIa-7%	Cu	57.5	16.9	200 × 231 × 265	33	4H5.160-F032A0 (×3)	
		200	3 × 16.4	E90.G58-163340 (×1)	FKD-MV 200/3-6-50-DIa-7%	Alu	43.2	19.3	280 × 233 × 370	63	4K0.230+F033A0 (×3)	
		230	3 × 18.9	E90.G58-193340 (×1)	FKD-MV 230/3-6-50-DIa-7%	Alu	37.5	26	280 × 233 × 370	64	4K3.230+F033A0 (×3)	
		300	3 × 24.7	E90.G45-133340 (×2) or E90.G45-253140 (×3)	FKD-MV 300/3-6-50-DIa-7%	Alu	28.8	33.9	320 × 220 × 420	82	4L0.240+F033A0 (×3)	
		500	3 × 41.1	E90.G45-413140 (×3)	FKD-MV 500/3-6-50-DIa-7%	Alu	17.3	56.4	400 × 214 × 520	101	4N0.308+F033A0 (×3)	
		750	3 × 61.8	E90.G71-623140 (×3)	FKD-MV 750/3-6-50-DIa-7%	Alu	11.5	84.7	400 × 354 × 520	136	4R5.312+F033A0 (×3)	
		1000	3 × 82.2	E90.G84-823140 (×3)	FKD-MV 1000/3-6-50-DIa-7%	Alu	8.6	113	400 × 274 × 520	161	4U0.314+F033A0 (×3)	
		1250	3 × 102.9	E90.G98-104140 (×3)	FKD-MV 1250/3-6-50-DIa-7%	Alu	6.9	141.1	400 × 294 × 520	186	4U2.316+F033A5 (×3)	
1500	3 × 123.3	E90.G71-623140 (×6)	FKD-MV 1500/3-6-50-DIa-7%	Cu	5.8	169.3	400 × 294 × 520	256	4U5.316-F033A0 (×3)			
7% 189Hz 1.8 I _N	10kV	100	3 × 3	E90.G45-302340 (×1)	FKD-MV 100/3-10-50-DIa-7%	Cu	239	6.8	200 × 231 × 265	33	4H0.160-L032A0 (×3)	
		150	3 × 4.4	E90.G45-442340 (×1)	FKD-MV 150/3-10-50-DIa-7%	Cu	160	10.2	200 × 231 × 265	34	4H5.160-L032A0 (×3)	
		200	3 × 5.9	E90.G58-592340 (×1)	FKD-MV 200/3-10-50-DIa-7%	Cu	120	13.5	320 × 190 × 420	61	4K0.248-L032A0 (×3)	
		250	3 × 7.4	E90.G58-742340 (×1)	FKD-MV 250/3-10-50-DIa-7%	Cu	95.8	16.9	320 × 200 × 420	66	4K5.249-L032A0 (×3)	
		300	3 × 9	E90.G45-442340 (×2) or E90.G45-902140 (×3)	FKD-MV 300/3-10-50-DIa-7%	Cu	79.9	20.3	280 × 220 × 420	89	4L0.240-L032A0 (×3)	
		400	3 × 11.8	E90.G93-123340 (×1) or E90.G45-123140 (×3)	FKD-MV 400/3-10-50-DIa-7%	Alu	59.9	27.1	400 × 224 × 520	109	4M0.309+L033A0 (×3)	
		500	3 × 14.7	E90.G58-742340 (×2) or E90.G45-153140 (×3)	FKD-MV 500/3-10-50-DIa-7%	Alu	47.9	33.9	400 × 224 × 520	110	4N0.309+L033A0 (×3)	
		600	3 × 17.8	E90.G58-183140 (×3)	FKD-MV 600/3-10-50-DIa-7%	Alu	39.9	40.6	400 × 234 × 520	121	4P0.310+L033A0 (×3)	
		700	3 × 20.8	E90.G71-213140 (×3)	FKD-MV 700/3-10-50-DIa-7%	Alu	34.2	47.7	400 × 244 × 520	132	4R0.311+L033A0 (×3)	
		800	3 × 23.7	E90.G71-243140 (×3)	FKD-MV 800/3-10-50-DIa-7%	Alu	30	54.2	400 × 254 × 520	142	4S0.312+L033A0 (×3)	
		900	3 × 26.7	E90.G84-273140 (×3)	FKD-MV 900/3-10-50-DIa-7%	Alu	26.6	61	400 × 264 × 520	150	4T0.313+L033A0 (×3)	
		1000	3 × 29.7	E90.G84-303140 (×3)	FKD-MV 1000/3-10-50-DIa-7%	Alu	24	67.7	400 × 274 × 520	164	4U0.314+L033A0 (×3)	
		1100	3 × 32.7	E90.G98-333140 (×3)	FKD-MV 1100/3-10-50-DIa-7%	Alu	21.8	74.5	400 × 284 × 520	172	4U1.315+L033A0 (×3)	
		1200	3 × 35.4	E90.G98-363140 (×3)	FKD-MV 1200/3-10-50-DIa-7%	Alu	20	81.3	400 × 294 × 520	182	4U2.316+L033A0 (×3)	
		1300	3 × 38.4	E90.G71-213140 (×3) + E90.G58-183140 (×3)	FKD-MV 1300/3-10-50-DIa-7%	Alu	18.4	88.1	400 × 294 × 520	186	4U3.316+L033A0 (×3)	
		1500	3 × 44.4	E90.G71-243140 (×3) + E90.G71-213140 (×3)	FKD-MV 1500/3-10-50-DIa-7%	Cu	16	101.6	400 × 294 × 520	248	4U5.316-L033A0 (×3)	



for latest edition and updates
check www.powercapacitors.info

FKD-MV™

**50Hz
11 kV**

7%
189Hz
1.8 I_N

U _N (kV)	step power Stufenleistung	matching capacitor passender Kondensator		Reactor (three single phase reactors are needed for each set) Drossel (drei einphasige Drosseln werden pro Set benötigt)						weight	order no.
	Q _{LC} (3ph) @ U _N (kvar)	C _{N(M)} (μF)	order no. (qty) Bestellnr. (Anzahl)	type designation Bezeichnung	winding Wicklung	L _N (mH)	I _{eff} (A)	L × W × H (mm)	Gewicht (kg)	order no. Bestellnummer	
11kV	300	3 × 7.2	E90.645-732140 (×3)	FKD-MV 300/3-11-50-D1a-7%	Cu	96.6	18.5	320 × 220 × 420	90	4L0.240-M032A0 (×3)	
	500	3 × 12.3	E90.645-123140 (×3)	FKD-MV 500/3-11-50-D1a-7%	Alu	57.9	30.8	400 × 234 × 520	119	4N0.310+M033A0 (×3)	
	750	3 × 18.3	E90.671-183140 (×3)	FKD-MV 750/3-11-50-D1a-7%	Alu	38.7	46.2	400 × 264 × 520	152	4R5.313+M033A0 (×3)	
	1000	3 × 24.6	E90.684-243140 (×3)	FKD-MV 1000/3-11-50-D1a-7%	Alu	29	61.6	400 × 284 × 520	168	4U0.315+M033A0 (×3)	
	1100	3 × 27	E90.698-273140 (×3)	FKD-MV 1100/3-11-50-D1a-7%	Alu	26.4	67.7	400 × 294 × 520	182	4U1.316+M033A0 (×3)	
	1250	3 × 30.6	E90.671-183140 (×3) + E90.645-123140 (×3)	FKD-MV 1250/3-11-50-D1a-7%	Alu	23.2	77	400 × 294 × 520	183	4U2.316+M033A5 (×3)	
	1500	3 × 36.6	E90.671-183140 (×6)	FKD-MV 1500/3-11-50-D1a-7%	Cu	19.3	92.4	400 × 294 × 520	255	4U5.316-M033A0 (×3)	

Available on request: Detuning factors 5.67% and 14%, reactors for 60Hz mains, connection through cables.

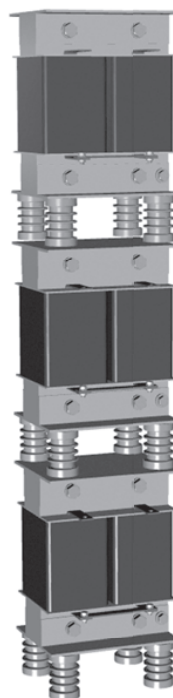
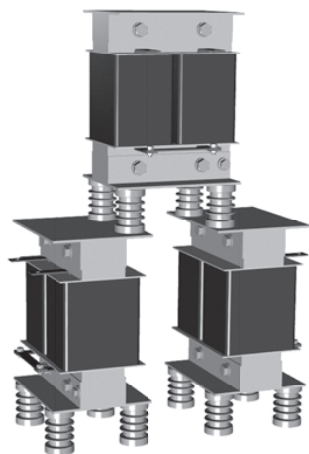
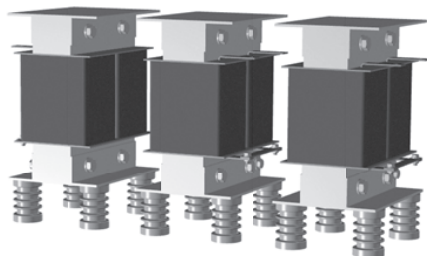
Auf Anfrage erhältlich: Verdrosselungsgrad 5,67% und 14%, Drosseln für 60Hz-Netze, Kabelanschluß.

EXAMPLES FOR ARRANGEMENT

ANORDNUNGSBEISPIELE

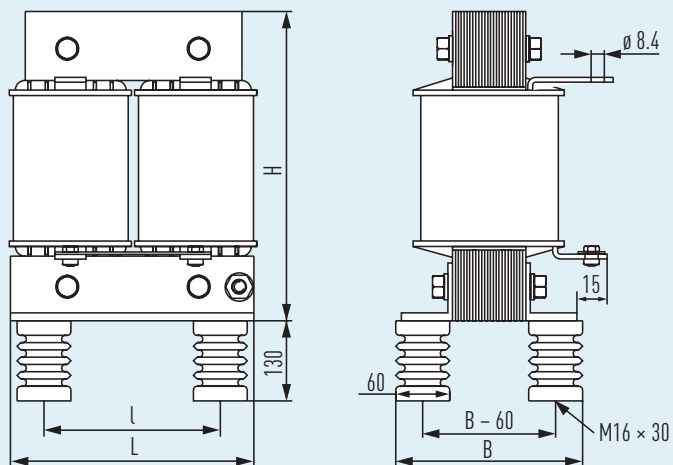
Thanks to their compact single-phase design, FKD-MV can be arranged flexibly in many different ways, making optimum use of the available space.

Dank ihres kompakten, einphasigen Designs können FKD-MV flexibel auf vielfältige Weise angeordnet werden, um vorhandenen Raum optimal zu nutzen.

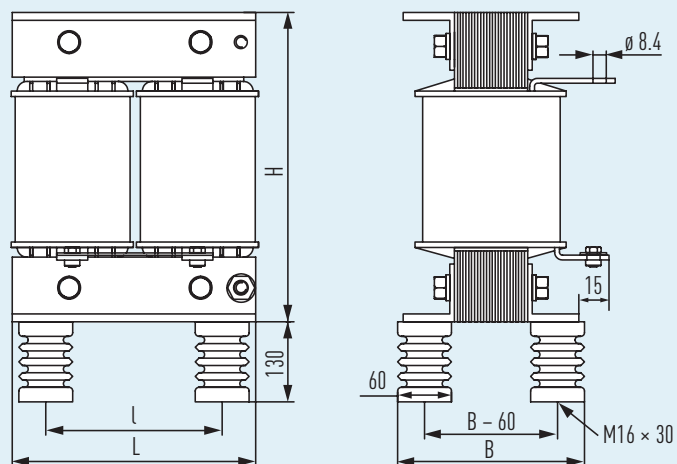


DIMENSION DRAWINGS MASSBILDER

Dimension drawing
Maßbild



with upper mounting bracket
mit oberem Montageblech



L	B	H	Drawing Abb.	l	b
200	220	265	1	125	160
200	231	265	1	125	171
280	216	360	2	176	156
280	231	360	2	176	171
280	263	360	2	176	203



Reactors for Inrush Protection, factory-matched for MSD™

Inrush protection reactors are designed to limit both the amount and frequency of the transient inrush currents which are typically occurring during the switching of capacitors in automatic multi-stage MV capacitor banks, or in fixed medium voltage capacitor banks connected in parallel to other fixed capacitor banks on the same switchgear bus. As such transient currents are posing a heavy stress on the capacitor, the line connection of inrush protection reactors helps reducing substantially the likelihood of capacitor failures.

Product Features

- Compact, low loss design with aluminium windings
- Simple to install: mounting insulator included
- Electrical connection by copper lugs
- Vacuum impregnation with PE resin to reduce noise and provide protection in harsh environments
- Indoor application only

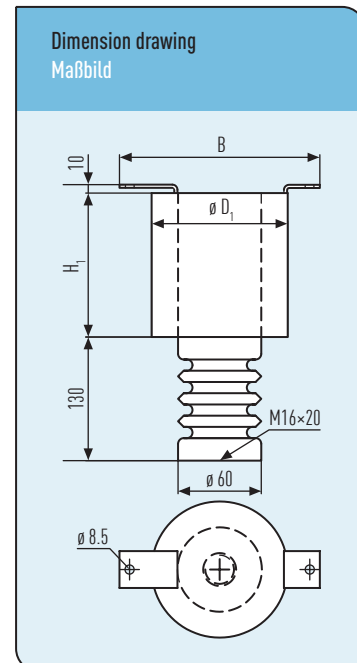
Drosseln zur Einschaltstrombegrenzung, die richtige Wahl für MSD™

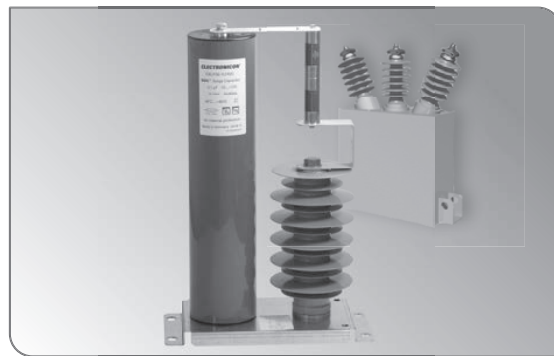
Strombegrenzungsdrosseln haben die Aufgabe, Höhe und Frequenz der Einschaltströme zu begrenzen, welche typischerweise während des Schaltens von Kondensatoren in mehrstufigen Mittelspannungsanlagen oder auch bei mehreren auf derselben Sammelschiene parallelgeschalteten Festkompensationen auftreten. Da solche Einschaltströme eine starke Belastung für den Kondensator darstellen, hilft die Verwendung von vorgeschalteten Strombegrenzungsdrosseln, die Ausfallhäufigkeit der Kondensatoren deutlich zu reduzieren.

Produkteigenschaften:

- Kompaktes, verlustarmes Design mit Aluminiumwicklung
- Einfache Montage dank integriertem Isolatorfuß
- Elektrischer Anschluß über Kupferlaschen
- Vakuumimprägnierung mit PE-Harz zur Geräuschminimierung und Schutz vor Umwelteinflüssen
- Für die Innenaufstellung bestimmt

denomination Bezeichnung	SBD 75µH / 36A / 12kV 40S.R21-750036/000	SBD 50µH / 50A / 12kV 40S.R21-500050/000	SBD 50µH / 100A / 12kV 40S.T28-500100/000
order code Bestell-Nr.			
$L_N (\pm 10\%)$	75µH	50µH	50µH
U_N	< 12kV	< 12kV	< 12kV
I_N	36A	50A	100A
$I_{rms (max)}$	47A	65A	130A
$\Theta_{ambient}$ (maximum)	40°C	40°C	40°C
m	2.4kg	2.5kg	6.2kg
terminal width	170mm	170mm	190mm
D_1	120mm	120mm	140mm
H_1	70mm	70mm	140mm
B	170mm	170mm	190mm
ground connection	M16 × 20mm	M16 × 20mm	M16 × 20mm





Who said it has to look like a surge capacitor?

Keeping with its tradition of completely dry products, ELECTRONICON has launched the first MV Surge Capacitor in self-healing technology. The DSC™ surge voltage protection capacitor („surge capacitor“) is the ideal solution for limiting transient overvoltages. In combination with the PD-free layout, the self-healing dielectric provides for extremely long operating life and highest operational safety. Thanks to the solid polyurethane filling, the DSC™ can be installed in any mounting position. Moreover, there are no liquids to threaten the environment or to be considered during disposal at the end of operational life.

With their uncomplicated terminals and the plastic housing, our surge capacitors do not only have a completely different optical appearance than traditional oil-filled ALLFILM capacitors, but also offer substantial savings in weight, space and cost. Consider this: a DSC™ 0.25µF / 12kV weighs 4.1kg compared to a whopping 15kg of market-common capacitors.

Utility model registered and protected by German Patent and Trade Mark Office (DPMA) under file no. 20 2010 009 760.6.

Surge Capacitors - a useful add-on, saving cost

Sooner or later in their operating life, medium voltage motors and transformers are confronted with transient overvoltages. These glitches are caused either by simple switching operations in the medium-voltage mains, or by atmospheric discharges. Such impulses are called „surge“ and have a rise time of no more than a few microseconds, exceeding a multiple of the rated mains voltage within that short period. The first winding turn of an electrical machine is stressed very heavily by the very steep voltage rise. This sole winding's thin insulation is then the only protection from a voltage breakdown and – hence – failure of the entire equipment.

Surge capacitors are able to smoothen voltage surges provoked by switching operations. The – properly sized – capacitance absorbs the major part of the electrical charge when the overvoltage occurs, and discharges it soon afterwards. Hereby the overvoltage is attenuated to ca. 10% of its maximum level. Simultaneously, this limits the rate of voltage rise, splitting the reduced overvoltage over substantially more winding turns than before; no winding insulation is overloaded by extreme overvoltages anymore.

Wer sagt, daß er wie ein Überspannungsschutzkondensator aussehen muß?

In bester Tradition ihrer Kondensatoren in Trockentechnologie präsentiert ELECTRONICON den ersten selbstheilenden Überspannungsschutzkondensator für Mittelspannungsanwendungen. Der DSC™ ist die passende Lösung zum Begrenzen transients Überspannungen. Das selbstheilende Dielektrikum sorgt in Verbindung mit einer teilentladungsfreien Dimensionierung für eine extrem hohe Lebensdauer und Funktionssicherheit. Dank seines trockenen Polyurethanvergusses kann der DSC™ in jeder Einbaulage verwendet werden. Außerdem können keine grundwassergefährdenden Flüssigkeiten austreten, auch bei der Entsorgung am Ende der Nutzungsdauer ist auf keine Flüssigkeiten Rücksicht zu nehmen. Durch die unkomplizierten Anschluss terminals und die Verwendung eines Kunststoffbehalters unterscheiden sich unsere Kondensatoren auch optisch von den herkömmlichen ölgefüllten Allfilm-Kondensatoren. Vergleichen Sie: Ein 0,25µF / 12kV DSC™ Kondensator wiegt nur 4,1kg im Vergleich zu wuchtigen 15kg eines marktüblichen Allfilm-ÜS-Kondensators.

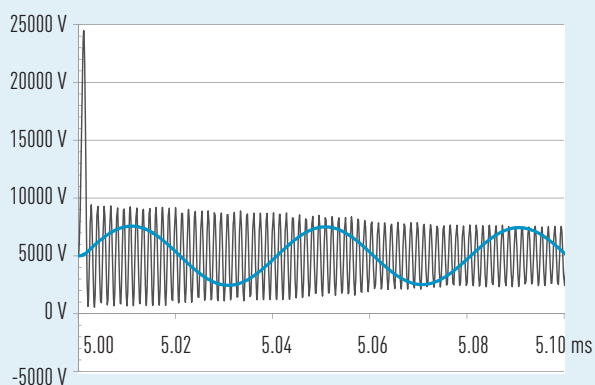
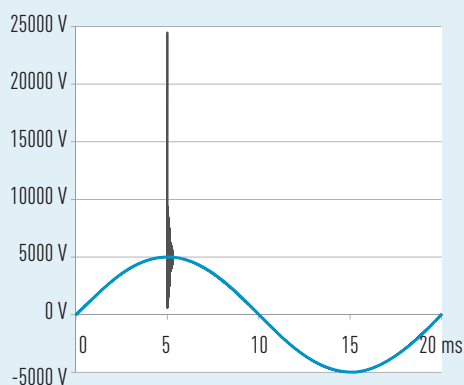
Die neuartige Lösung des DSC™ ist unter Nummer 20 2010 009 760.6 des DPMA Gebrauchsmustergeschützt.

Überspannungsschutzkondensatoren – ein nützlicher Zusatz, der Kosten spart

Mittelspannungsmotoren und -transformatoren werden während ihrer Lebensdauer früher oder später mit transienten Überspannungen belastet. Verursacht werden diese Störimpulse entweder durch einfache Schaltvorgänge in den Mittelspannungsnetzen oder durch atmosphärische Entladungen. Die als „surge“ bezeichneten Impulse besitzen Anstiegszeiten von maximal wenigen Mikrosekunden und übersteigen in dieser kurzen Zeit ein Vielfaches der Netzennennspannung. Durch den sehr hohen Spannungsgradienten wird die erste Windung einer elektrischen Maschine spannungsmäßig sehr stark belastet. Somit ist die dünne Isolation einer einzigen Windung der einzige Schutz vor einem Durchschlag und damit vor einem Ausfall des Betriebsmittels.

Überspannungsschutzkondensatoren sind in der Lage, einen durch Schaltvorgänge verursachten Spannungsstoß zu dämpfen und seinen Anstieg zu verzögern. Die ausreichend hohe Kapazität des Kondensators nimmt beim Auftreten der Überspannung den größten Teil der elektrischen Ladung auf und gibt sie kurz darauf wieder ab. Durch diesen Vorgang wird die Höhe der Überspannung auf etwa 10% ihres Maximums bedämpft. Dies begrenzt gleichzeitig den Spannungsgradienten, wodurch die reduzierte Überspannung sich zusätzlich auf viel mehr Windungen verteilt. Somit wird keine Windungsisolierung mehr durch extreme Überspannungen belastet.

Voltage shape Spannungskurve



Voltage shape with surge at an MV transformer. blue: line voltage with 0.25µF capacitor
Spannungskurve an einem MS-Transformator. blau: Netzspannung mit 0.25µF Kondensator

Surge capacitors are permanently connected to the mains and instantly available without any switching delays in the event of a fault situation. It is recommended to use additional overvoltage arresters for the damping of heavy current pulses of 100kA or more (as are typical for lightning discharges).

According to a study published on an IEEE-conference in 1995, the additional cost and space spent on surge capacitors are well worth the extra expense (approx. 15 - 20% of the motor cost): an alternative over-sizing of the initial motor or transformer windings for enhanced strength against transient over-voltages would require a bigger winding window which would imply a larger machine and a cost increase by approx. 35...50%.

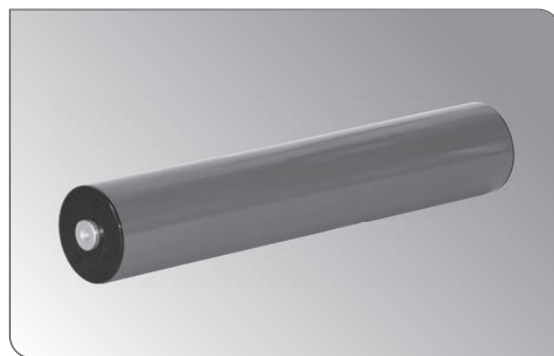
Ein Überspannungsschutzkondensator ist fest im Netz verschaltet. Dadurch steht seine Funktion permanent zur Verfügung. Er muß im Fehlerfall nicht erst zugeschaltet werden oder zünden, wodurch ein Zeitverzug eintreten würde. Zur Bedämpfung stromstarker Impulse von 100 kA und mehr, wie sie etwa bei Blitzenladungen auftreten, empfiehlt sich der zusätzliche Einsatz von Überspannungsableitern, i.d.R. an zentraler Stelle.

Nach einer 1995 auf einer IEEE-Konferenz veröffentlichten Studie lohnen sich die Mehrkosten für die Kondensatoren und den zusätzlichen Platzbedarf in der Anlage. Der finanzielle Mehraufwand liegt bei 15 - 20% der Motorkosten. Legt man alternativ die ersten Windungen eines Motors oder eines Transformators für die Belastung durch transiente Überspannungen aus, benötigt der Motor ein größeres Wickelfenster. Dies macht die Maschine größer und führt zu Mehrkosten von insgesamt 35 - 50%.

DSC™

3.3...17.5 kV_{rms}

for latest edition and updates
check www.powercapacitors.info



Dry surge capacitors

Trockene Überspannungsschutzkondensatoren



standard tested according to IEC 60871-1

can. plastic (UL94-V0)

dielectric material low-loss polypropylene, dry dielectric

filling material solid, based on vegetable oil, non -PCB

humidity class F

mounting position optional

internal protection none

discharge resistor internal: < 75V in < 2 min

fire load 40MJ/kg

degree of protection IP 00

clearance in air/

creepage distance D + L – 20 mm

C_N tolerance ±10%

permitted overvoltages

8h/d $1.10 \times U_N$

30min/d $1.15 \times U_N$

5min/d $1.20 \times U_N$

1min/d $1.30 \times U_N$

test voltage between terminals $2.15 \times U_N$ 50Hz (10s)

insulation quality 25000s

dissipation losses (capacitor) 0,2W / kvar

operating temperature -40°C / +60°C

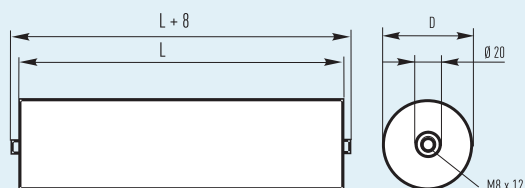
storing temperature -40°C / +70°C

statistical life expectancy > 150 000h

U _N (kV)	C _N (μF)	I _N (A)	I _s (kA)	U _s (kV)	D × L (mm)	m (kg)	order no. Bestell-Nr.
3,3	0,1	0,10	0,6	14	64 × 165	0,6	E93.L16-101R20
3,6	0,25	0,28	1,00	14	90 × 165	1,1	E93.P16-251R20
3,6	0,5	0,57	1,70	14	90 × 285	1,9	E93.P28-501R20
6,6	0,1	0,21	1,30	26	90 × 285	1,9	E93.P28-101R20
6,6	0,5	1,00	3,90	22	116 × 310	3,4	E93.R31-501R20
7,2	0,25	0,57	2,80	29	116 × 285	3,2	E93.R28-251R20
7,2	0,5	0,5	2,00	29	90 × 385	2,6	E93.P38-501R20
12	0,1	0,40	1,20	48	64 × 620	2,1	E93.L62-101R20
12	0,25	0,94	3,20	48	116 × 390	4,3	E93.R39-251R20
12	0,5	0,50	3,50	48	116 × 620	6,9	E93.R62-501R20
17,5	0,25	0,25	6,30	70	140 × 570	9,2	E93.S57-251R20
17,5	0,5	2,80	5,00	52	140 × 850	13,7	E93.S85-501R21

Dimension drawing

Maßbild



Rated Voltage U_N

Root mean square of the max. permissible value of sinusoidal AC voltage in continuous operation. Usually the rated mains voltage plus 10% over-voltage.

The rated voltage of the capacitors indicated in the data charts must not be exceeded even in cases of malfunction. Bear in mind that capacitors in detuned equipment are exposed to a higher voltage than that of the rated mains voltage; this is caused by the connection of detuning reactor and capacitor in series. Consequently, capacitors used with reactors must have a voltage rating higher than that of the regular mains voltage.

The voltage at a detuned capacitor's terminals can be calculated as follows:

U_{Netz} = Mains voltage Netzspannung
 U_C = Capacitor voltage Kondensatorspannung
 p = Detuning factor Verdrosselungsgrad

$$U_C = \frac{U_{\text{Netz}}}{\left(1 - \frac{p}{100\%}\right)}$$



Nennspannung U_N

Maximal zulässiger Effektivwert von sinusförmiger Wechselspannung im Dauerbetrieb. Entspricht i. d. R. der Netzennspannung zuzüglich 10% Spannungsüberhöhung.

Die Nennspannung der in den Datentabellen aufgeführten Kondensatoren darf – auch im Falle von Fehlfunktionen – nicht überschritten werden. Es muss auch beachtet werden, dass Kondensatoren in verdrosselten Anlagen aufgrund der Serienschaltung von Drossel und Kondensator einer höheren Spannung als der Netzennspannung ausgesetzt sind. Dementsprechend ist für verdrosselte Kondensatoren eine höhere Nennspannung zu wählen. Die im Falle einer Verdrosselung am Kondensator anliegende Spannung lässt sich wie folgt ermitteln:

Capacitor Voltage U_C

Required voltage strength of the capacitor. The series connection of capacitor and reactor causes a voltage rise at the capacitor terminals as described by the following formula which must be considered when selecting a capacitor for the application.

$U_N = 6000V$
 $p = 7\%$

$$U_C = \frac{U_N}{\left(1 - \frac{p}{100\%}\right)} = 6452V$$

Kondensatorspannung U_C

Geforderte Spannungsfestigkeit des Kondensators. Durch die Reihenschaltung von Drossel und Kondensator kommt es am Kondensator zu einer Spannungsüberhöhung wie folgt, welche bei der Wahl des Kondensators berücksichtigt werden muß.



The capacitor to be selected must have a voltage strength of at least $6452V + 10\% = 7100V$.

Der auszuwählende Kondensator muß eine Spannungsfestigkeit von mindestens $6452V + 10\% = 7100V$ besitzen.

Test Voltage Between Terminals U_{TT}

Routine test of all capacitors conducted at room temperature, prior to delivery. A further test with 80% of the test voltage stated in the data sheet may be carried out once at the user's location.

Prüfspannung Belag/Belag U_{TT}

Prüfspannung, mit der alle Kondensatoren als Stückprüfung zwischen den Anschlüssen vor der Auslieferung geprüft werden. Beim Anwender ist eine Wiederholung dieser Prüfung mit dem 0,8fachen Wert der Prüfspannung zulässig.



Insulation Level (BIL)

The first value describes the routine test of all capacitors between short-circuited terminals and case, conducted at room temperature. May be repeated at the user's location.

The second value refers to the lightning withstand voltage, tested in a special type test.

Isolationsspannung (BIL)

Der erste Wert beschreibt die Prüfspannung, mit der alle Kondensatoren zwischen den kurzgeschlossenen Anschlüssen und dem Gehäuse als Stückprüfung vor der Auslieferung geprüft werden. Beim Anwender ist eine Wiederholung dieser Prüfung zulässig.

Der zweite Wert beschreibt die im Rahmen einer Typprüfung geprüfte Blitzspannung.



Rated Inductance L_N



Inductance rating of the reactor, measured at rated current I_N , in mH (Milli-Henry). Mean value across the three phases.

Nenninduktivität L_N

Physikalische Kenngröße der Drossel gemessen bei Nennstrom I_N , in mH (Milli-Henry). Mittelwert über die drei Phasen.

Detuning Factor p



Ratio between the reactances of reactor X_L and corresponding capacitor X_C (in %).

Verdrosselungsgrad p

Prozentuales Verhältnis des Blindwiderstandes der Drossel X_L zum Blindwiderstand des nachgeschalteten Kondensators X_C :

$$p = 100\% \cdot \frac{X_L}{X_C}$$

The detuning factor determines the series resonance frequency between reactor and capacitor which in turn is important for the blocking and filtering effect.

Der Verdrosselungsgrad ist bestimmend für die Reihenresonanzfrequenz zwischen Drossel und Kondensator und damit für den Sperr- bzw. Filtereffekt.

Series Resonance Frequency f_r



$$f_r = f_N \cdot \sqrt{\frac{100\%}{p}}$$

Reihenresonanzfrequenz f_r

f_N = rated system frequency Netznennfrequenz

The standard reactors listed in this catalogue have been designed for a detuning factor of 7 % and a resonance frequency of 189 Hz.

Die in diesem Katalog aufgeführten Standarddrosseln sind für einen Verdrosselungsgrad von 7 % und eine Resonanzfrequenz von 189 Hz ausgelegt.

Rated Power Q_C



Reactive power resulting from the ratings of capacitance, frequency, and voltage.

Nennleistung Q_C

Blindleistung, die sich aus den Nennwerten von Kapazität, Frequenz und Spannung ergibt.

Rated Power of the Detuned System Q_{LC}



Care must be taken when stating the reactor power in order to avoid misunderstanding.

As a rule, the rated power of a reactor does not describe its real reactance but either the reactive power of the capacitor to be detuned, or the total output of the entire LC-circuit at rated system voltage U_N .

Nennleistung des verdrosselten Systems Q_{LC}

Die korrekte Angabe der Leistung ist sehr wichtig, um Mißverständnisse zu vermeiden.

In der Regel wird für die Bezeichnung der Nennleistung einer Drossel aus Vereinfachungsgründen nicht ihre eigene Blindleistung herangezogen, sondern entweder die Blindleistung des verdrosselten Kondensators oder die Leistung des mit dem verdrosselten Kondensator gebildeten LC-Resonanzkreises bei Netznennspannung U_N .

Current Rating I_N

RMS value of the current at rated voltage and frequency, excluding harmonic distortion, switching transients, and capacitance tolerance.

Maximum RMS Current Rating I_{max}

Maximum rms value of permissible current in continuous operation. All capacitors are rated $1.3 \times I_N$, allowing for the current rise from permissible voltage and capacitance tolerances as well as harmonic distortion. Higher rms values than stated in the data charts require adjustments in construction and are available on request.

Continuous currents that exceed these values will lead to a build-up of heat in the capacitor and – as a result – reduced lifetime or premature failure. Permanent excess current may even result in failure of the capacitor's safety mechanisms, i.e. bursting or fire.

Care must be taken not to exceed the maximum voltage and current ratings when installing capacitors in close-tuned or detuned equipment (see data sheets for maximum ratings). The thermal monitoring of reactors, or the use of overcurrent protection relays in the capacitor circuit is recommended to protect against overloads.

Pulse Current Strength I_S

Depending on construction and voltage rating, the design of our capacitors permits short term inrush currents of $150 \times I_N$ as standard. However, when switching capacitors in automatic capacitor banks without detuning reactors, higher loads are very often the case. This may have a negative effect on the operational life, especially of capacitors which are frequently connected and disconnected (e.g. primary stages).

We therefore strongly recommend the use of SBD reactors for limitation of the peak inrush currents.

RMS Current I_{eff}

Current load on the reactor in permanent operation, caused by the fundamental wave plus harmonics in the system. For all data given in this catalogue, we are assuming a 10% increase of the fundamental current, resulting from voltage tolerances as permitted by DIN EN 50160:

$$I_{eff} = \sqrt{I_1^2 + I_3^2 + I_5^2 + I_7^2 + \dots + I_n^2}$$

$$I_1 = 1.1 \cdot I_N$$

Nennstrom I_N

Effektivwert des Stroms bei Betrieb unter Nennspannung und -frequenz, ohne Berücksichtigung von Oberwellenanteilen oder Schaltspitzen, und Kapazitätstoleranzen.



Maximal zulässiger Effektivstrom I_{max}

Maximaler Effektivwert des im Dauerbetrieb zulässigen Stromes. Dieser Wert beträgt für alle Kondensatoren $1.3 \times I_N$ und beinhaltet die Stromerhöhungen, welche sich aus zulässigen Spannungs- und Kapazitätstoleranzen sowie Oberwellenanteilen ergeben. Höhere Werte sind auf Anfrage durch konstruktive Maßnahmen realisierbar.



Eine permanente Überschreitung dieser Werte führt zu einer erhöhten Eigenerwärmung des Kondensators und in der Folge zu einer verringerten Lebensdauer oder zum Ausfall des Kondensators. Eine dauerhafte starke Überlastung kann sogar zum Versagen der Sicherheitsmechanismen des Kondensators führen.

Es muss darauf geachtet werden, dass die maximalen Nennwerte von Strom und Spannung nicht überschritten werden, wenn Kondensatoren in verstimmten oder abgestimmten Filterkreisen installiert werden (Maximalwerte s. Datentabellen). Wir empfehlen die Wärmeüberwachung der Drosseln oder die Benutzung von Überstromschutzrelais zum Schutz vor Überbelastungen.

Stoßstromfestigkeit I_S

Je nach Bauform und Nennspannung sind unsere Kondensatoren für kurzzeitige Einschaltspitzenströme von $150 \times I_N$ geeignet. Es muss beachtet werden, dass oft höhere Belastungen auftreten, wenn Kondensatoren in unverdrosselten, geregelten Kompensationsanlagen geschaltet werden. Dies kann einen negativen Effekt auf die Einsatzdauer besonders jener Kondensatoren haben, die häufig zu- und abgeschaltet werden (z.B. erste Stufe).



Wir empfehlen dringend den Einsatz von SBD Drosseln zur Dämpfung der Einschaltspitzen.

Effektivstrom I_{eff}

Strombelastung der Drossel im Dauerbetrieb, hervorgerufen durch die Grundwelle zzgl. im Netz vorhandener harmonischer Oberwellen. Für alle Angaben in diesem Katalog wird dabei bereits eine 10%ige Überhöhung des Grundwellenstroms, resultierend aus den nach DIN EN 50160 zulässigen Spannungstoleranzen, angenommen:



Maximum Current Rating I_{lin} and Current Linearity



Maximum current, up to which the inductance of the reactor stays "linear", i.e. does not decrease by more than 5% below its rated inductance. This maximum current is specified in the data charts as a multiple K of the fundamental current:

$$I_{lin} = K \cdot I_N \quad (L_{lin} > 0.95 L_N !)$$

K overcurrent factor Überstromfaktor

Exceeding of I_{eff} or I_{lin} will lead to increased build-up of heat inside the reactor and may cause its thermal destruction.

Eine Überschreitung von I_{eff} oder I_{lin} führt zu einer erhöhten Eigenerwärmung der Drossel und kann zu ihrer thermischen Zerstörung führen.

Ambient Operating Conditions



The average useful life of a capacitor depends very much on the ambient temperatures it is operated at.

The permissible operating temperatures are defined by the temperature class stated on label which contains the lower limit temperature (-40°C for all ELECTRONICON power capacitors) and a letter, which describes the values of the upper limit temperatures.

For ELECTRONICON reactors, we specify climate category T40.

Under these conditions, the temperature of our low-loss reactors does not exceed 110°C which is of great advantage for the capacitors and all other components in the installation.

Please consult us prior to using the reactors under different ambient conditions.

All insulation materials used in our reactors comply with the requirements of insulation class B (135°C) as a minimum.

Capacitors Kondensatoren

temperature category Temperaturklasse	ambient temperature limits Umgebungstemperatur		
	Maximum	max. average over 24 hrs max. Mittelwert über 24 Stunden	max. average over 365 days max. Mittelwert über 365 Tage
B	45°C	35°C	25°C
C	50°C	40°C	30°C
D	55°C	45°C	35°C

Maximal zulässiger Strom I_{lin} und Stromlinearität

Maximaler Strom, bis zu dem sich die Nenninduktivität der Drossel „linear“ verhält, d.h. um nicht mehr als 5% abfällt. Dieser Maximalstrom wird für die Drosseln als Vielfaches K des Grundwellenstromes angegeben:

Betriebs- und Umgebungsbedingungen

Die mittlere Lebensdauer eines Kondensators hängt entscheidend davon ab, bei welchen Umgebungstemperaturen er betrieben wird.

Die zulässigen Umgebungstemperaturen für den Betrieb des Kondensators werden durch die Angabe seiner Temperaturklasse definiert. Diese beinhaltet die untere Grenztemperatur (bei allen ELECTRONICON Kondensatoren -40°C) sowie einen Buchstaben, welcher die Vorgaben für die oberen Temperaturgrenzen beschreibt.

Für ELECTRONICON Drosseln schreiben wir die Einsatzklasse T40 vor.

Unter diesen Einsatzbedingungen erwärmen sich unsere verlustarmen Drosseln auf nicht mehr als 110°C, was den Temperaturverhältnissen in der Kompensationsanlage und damit vor allem der Lebensdauer der Kondensatoren und aller anderen verwendeten Komponenten zugute kommt. Vor Einsatz der Drosseln bei abweichenden Umgebungsbedingungen bitten wir um Rücksprache.

Alle bei ELECTRONICON-Drosseln verwendeten Isolierstoffe genügen mindestens den Anforderungen der Isolierstoffklasse B (135°C).

Reactors Drosseln

T	40
climatic areas acc. to Klimagebiet nach DIN EN 50019	Ambient temperature acc. to Umgebungstemperatur nach DIN EN 60934/IEC 439-1
„Moderate climate“ „gemäßigtes Klima“	$-5 < \Theta_{ambient} < 40^\circ\text{C}$, $\varnothing 24h < 35^\circ\text{C}$

Important Remarks

General

Our catalogues outline the typical technical and mechanical characteristics of the listed capacitors. The stated values are based on reference type tests, as well as empirical and experimental experience. The real values of individual capacitors may differ within the stated, or commonly known, tolerances. Any information given in this catalogue therefore describes the components in general terms and does not constitute any guarantee of individual technical values.

It is the responsibility of the user to ensure by dedicated tests the suitability and safety of operation of our components under the conditions of his application. This also applies to any accessories offered by ELECTRONICON.

Safety

Safe operation of the capacitors can be expected only if all safety recommendations as well as electrical and thermal specifications as stated on the label, in the data sheets, catalogues and the accompanying mounting instructions are strictly observed, and recommended safety devices are used as intended. Please consider the "General Safety Recommendations" of the power capacitor manufacturers organized in the German ZVEI (www.electronicon.com/en/zvei).

The capacitors shall only be used for the intended application. ELECTRONICON will not indemnify or be responsible for any kind of damages to persons or property due to the improper application of any capacitors purchased from ELECTRONICON or its distributors.

Mind that electrical or mechanical misapplication of capacitors can become hazardous. Misapplied capacitors can explode or catch fire and cause bodily injury or property damage due to the expulsion of material or metal fragments.

Please consult the detailed instructions for mounting and application stated in our brochure „Application Notes“ and on the ELECTRONICON website: www.electronicon.com/en/an

If in doubt about how to connect, operate, or discharge a capacitor, consult ELECTRONICON engineering or our distributors.

Mounting And Cooling

The useful life of a capacitor may be reduced dramatically if exposed to excessive heat. Typically an increase in the ambient temperature of 7°C will halve the expected life of the capacitor. Make sure to obey the permitted operating temperatures.

To avoid overheating the capacitors must be allowed to cool unhindered and should be shielded from external heat sources. We recommend forced ventilation for all filter applications with reactors. Give approx. 20mm clearance around capacitors for natural or forced ventilation, and do not place them directly above or next to heat sources such as detuning or tuning reactors, bus bars, etc.

Wichtige Hinweise

Allgemeines

Unsere Kataloge beschreiben die typischen technischen und mechanischen Eigenschaften der aufgeführten Kondensatoren. Die angegebenen Werte basieren auf Referenztypprüfungen sowie empirischen und experimentellen Erfahrungswerten. Die tatsächlichen Werte einzelner Kondensatoren können innerhalb der angegebenen bzw. allgemein bekannter Toleranzen abweichen. Alle Angaben in diesem Katalog beschreiben daher die Komponenten im Allgemeinen und stellen keine Garantie für individuelle technische Werte dar.

Es liegt in der Verantwortung des Anwenders, durch gezielte Prüfungen die Eignung und Betriebssicherheit unserer Komponenten unter den konkreten Betriebsbedingungen seiner Anwendung sicherzustellen. Dies gilt ebenso für gegebenenfalls von ELECTRONICON angebotene Zubehörteile.

Sicherheit

Ein sicherer Betrieb der Kondensatoren ist nur zu erwarten, wenn alle Sicherheitsempfehlungen sowie elektrische und thermische Spezifikationen entsprechend Etikett, Datenblättern, Katalogen und beiliegenden Montageanleitungen eingehalten und die empfohlenen Sicherheitseinrichtungen bestimmungsgemäß verwendet werden. Bitte beachten Sie die „Allgemeinen Sicherheitsempfehlungen“ der im deutschen ZVEI organisierten Hersteller von Leistungskondensatoren (www.electronicon.com/zvei).

Die Kondensatoren dürfen ausschließlich für ihren Bestimmungszweck verwendet werden. ELECTRONICON übernimmt keine Verantwortung oder Haftung für Schäden an Personen oder Eigentum, welche aus unsachgemäßer Anwendung von Kondensatoren herrührt.

Elektrisch oder mechanisch fehlerhaft eingesetzte Kondensatoren können explodieren oder Feuer fangen. Austretende Materialien bzw. Metallteile können gesundheitliche und materielle Schäden verursachen.

Bitte beachten Sie die detaillierten Anweisungen in unserer Broschüre „Anwendungshinweise“ sowie auf der Webseite von ELECTRONICON: www.electronicon.com/an

Bitte konsultieren Sie das Fachpersonal oder unsere Distributoren zu Fragen bezüglich Anschluss, Verwendung oder Entladung von Kondensatoren.

Montage und Kühlung

Die Lebensdauer eines Kondensators kann durch übermäßige Wärmeeinwirkung erheblich verringert werden. Im allgemeinen führt eine Erhöhung der Umgebungstemperatur um 7°C zu einer Verringerung der Lebensdauer des Kondensators um 50 %. Halten Sie die zugelassenen Betriebstemperaturen ein.

Um Überhitzung zu vermeiden, muß gewährleistet sein, daß die Kondensatoren auftretende Verlustwärme ungehindert abführen können und vor fremden Wärmequellen abgeschirmt werden. Insbesondere in Filtern ist in jedem Falle eine Zwangslüftung zu empfehlen. Zwischen und um Kondensatoren sollten etwa 20mm Platz für natürliche oder Zwangslüftung belassen werden. Bringen Sie den Kondensator nie direkt neben oder über Wärmequellen, wie Drosseln u. ä. an.



Protection against Overvoltages And Short Circuits:

Self-Healing Dielectric

All dielectric structures used in our power capacitors are „selfhealing“: In the event of a voltage breakdown the metal layers around the breakdown channel are evaporated by the temperature of the electric arc that forms between the electrodes. They are removed within a few microseconds and pushed apart by the pressure generated in the centre of the breakdown spot. An insulation area is formed which is reliably resistive and voltage proof for all operating requirements of the capacitor. The capacitor remains fully functional during and after the breakdown.

For voltages within the permitted testing and operating limits the capacitors are short-circuit- and overvoltage-proof. They are also proof against external short circuits as far as the resulting surge discharges do not exceed the specified surge current limits.

Limited Warranty

All our products are designed, manufactured, and tested with the highest care and workmanship. The satisfaction of our customers is our highest goal. We therefore warrant remedying any defect in the goods resulting from faulty design, materials or workmanship, which appears within 3 years from the date of sale.

This warranty does not cover defects due to improper use of the goods or operation at conditions exceeding the rated values stated in the catalogue or special data sheet. Nor does it cover defects due to faulty maintenance or incorrect installation, alterations or faulty repairs undertaken by the Buyer. Finally the warranty does not cover normal wear and tear or deterioration.

See our „General Conditions“ for details on Warranty and Product liability.

Schutz gegen Überspannungen und Kurzschlüsse:

Selbstheilendes Dielektrikum

Alle in unseren Leistungskondensatoren eingesetzten dielektrischen Strukturen sind selbstheilend. Im Falle eines Kurzschlusses (Spannungsdurchschlag) verdampfen die Metallbeläge um den Durchschlagpunkt herum infolge des Lichtbogens, der sich zwischen den Elektroden bildet. Binnen Mikrosekunden wird der Metaldampf vom Zentrum des Durchschlages weggedrückt. Auf diese Weise bildet sich eine isolierende belagfreie Zone um den Durchschlagpunkt. Der Kondensator bleibt während und nach dem Durchschlag voll funktionsfähig.

Für Spannungen innerhalb der zugelassenen Test- und Betriebsbedingungen sind die Kondensatoren kurzschluss- und überspannungssicher. Sie sind außerdem sicher gegen äußere Kurzschlüsse, sofern bei den dabei entstehenden Stoßentladungen die zugelassenen Stoßströme nicht überschritten werden.

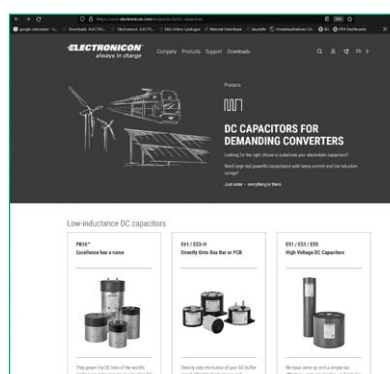
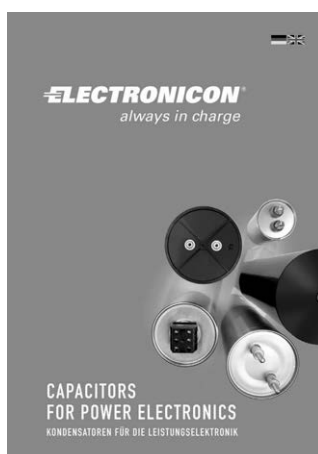
Gewährleistung

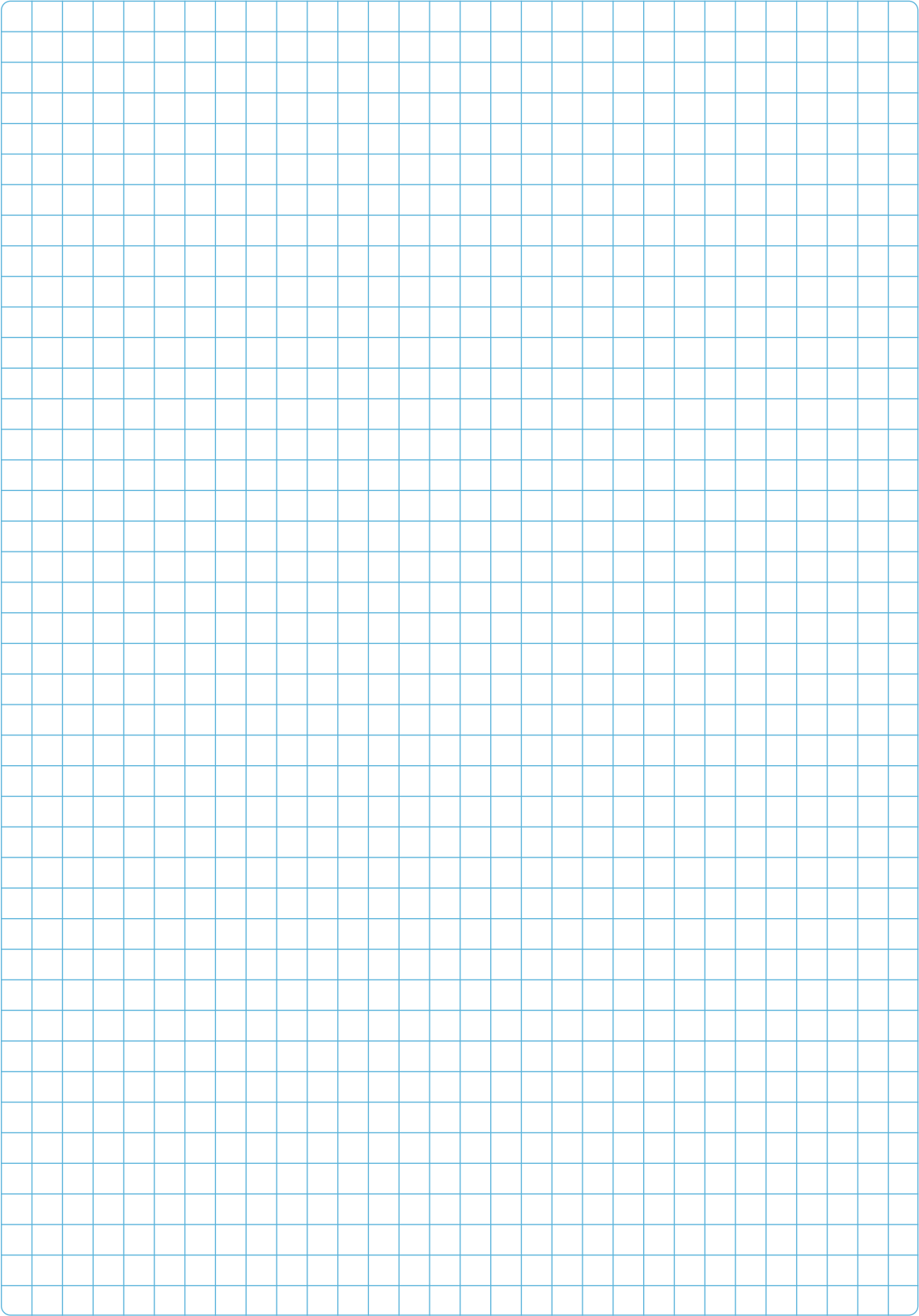
Alle unsere Erzeugnisse werden mit höchster Sorgfalt und Fachkenntnis entwickelt, hergestellt und geprüft. Die Zufriedenheit unserer Kunden ist unser höchstes Ziel. Wir verpflichten uns daher, jeden innerhalb von 3 Jahren ab Verkaufsdatum auftretenden Mangel an unseren Erzeugnissen zu beseitigen, welcher aus Fehlern in Design, Material oder Herstellung herrührt.

Diese Gewährleistung erstreckt sich nicht auf Defekte infolge unsachgemäßer Anwendung oder Betrieb außerhalb der nach Katalog oder Datenblatt zulässigen Einsatzbedingungen. Sie erfaßt ebensowenig Schäden aufgrund fehlerhafter Wartung, unsachgemäßer Montage, Änderungen oder unsachgemäßer Reparaturen durch den Käufer bzw. Anwender. Diese Gewährleistung betrifft auch nicht normale Abnutzung und Verschleiß.

Siehe unsere „Allgemeinen Geschäftsbedingungen“ für Details zu Gewährleistung und Produkthaftung.

Find more information and detailed instructions in our „Application Notes“ and on www.electronicon.com
Mehr Informationen und ausführliche Anweisungen finden Sie in unseren „Anwendungshinweisen“ und unter www.electronicon.com





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 $I_S = 400 \times I_N$



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Issue 03/2024



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HEAVY DUTY THREE PHASE AC FILTER CAPACITORS



HIGH-END FOR THE HEART OF YOUR AC FILTER

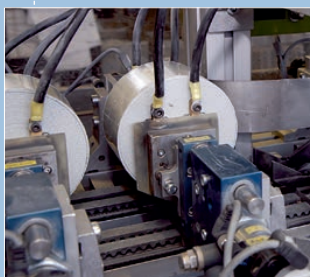
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Gera has been a centre of capacitor making since 1938. ELECTRONICON Kondensatoren GmbH which emerged from previous RFT/VEB ELEKTRONIK Gera in 1992, has become one of Europe's leading capacitor manufacturers supplying customers worldwide and being an open and competent partner for manufacturers and users of power factor correction equipment, for many manufacturers of drives, power electronics, home appliances, and for the lighting industry. Regular investments in advanced and environmentally sound technologies guarantee the highest levels in manufacture and quality to modern standards which are approved and monitored by leading certification authorities.



In today's globalised competition, we distinguish ourselves by

- Absolute reliability and safety of our products
- Close co-operation between manufacturer and client to meet both technical and commercial requirements
- Improvement and development of our technical expertise in capacitor design and manufacture, as well as film coating, with special attention paid to the MKPg-technology
- Early identification and incorporation of new trends and methods in the manufacturing of capacitors
- Flexibility and punctual fulfilment of our commercial obligations

Our experienced development engineers are competent and responsible for both implementing the latest technical trends applicable to our products and ensuring that our products adapt to the challenges of traditional and new markets.

The close and intense co-operation between the departments of Marketing & Sales, Research & Development, and Production has become the keystone of our success. ELECTRONICON is continually striving to establish a similarly close and interactive relationship with its distributors and direct clients both in home and overseas markets, to become not just one out of many suppliers, but your preferred partner for ideas and solutions.

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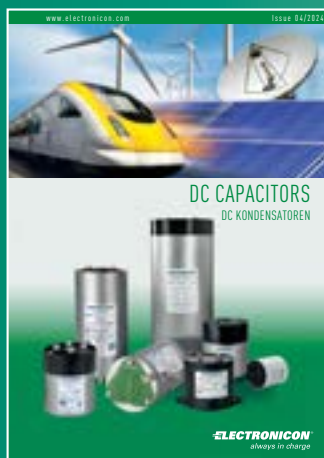


DC CAPACITORS

DC KONDENSATOREN



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CAPACITORS FOR POWER ELECTRONICS



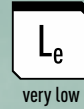
COMPONENTS FOR POWER FACTOR CORRECTION



DC CAPACITORS

DC KONDENSATOREN

E67 GA85	Extremely Low Inductance, Individual Protection Device, Climate Proof 4 - 10 Extrem niedrige Induktivität, eigene Sicherung, klimafest
E66 GA85	Low-inductance DC capacitors in sealed housing 11 Niederinduktive Zwischenkreiskondensatoren in dichtem Gehäuse
E50 PK16™	The Industrial Standard: Low Inductance and High Capacitance Density 12 - 21 Der Industriestandard: niedrige Induktivität und hohe Kapazitätsdichte
E80 PKmind®	Fit For SiC: Ultra-Low Inductance and Constant ESR 22 - 27 Ideal für SiC: Ultraniedrige Induktivität und konstanter ESR
E61	Directly Onto Bus Bar or PCB: High Currents and Low Inductance 28 - 34 Direkt auf Sammelschiene oder Leiterplatte: hohe Ströme und niedrige Induktivität



GA85 - EXTREMELY LOW INDUCTANCE, INDIVIDUAL PROTECTION DEVICE, CLIMATE PROOF EXTREM NIEDRIGE INDUKTIVITÄT, EIGENE SICHERUNG, KLIMAFEST





Extremely Low Self-Inductance and Reliable Protection: E67 GA85 Mesis®

Unwanted inductances may cause significant disturbances in high-current DC link circuits (so-called voltage overshoot). This may result in substantial damage.

This is countered on the one hand by perfecting the interconnection (sandwich busbars, which neutralize their own inductance to a large extent); on the other hand, the self-inductance of the capacitor plays a very important role as well. This challenge is all the greater in DC links with high switching frequencies or those with large capacitance requirements. The classic solution - very flat capacitors as close as possible to the bus bar - is only of limited use due to space and cost reasons.

The particularly low self-inductance and low-loss design of our new GA85 E67 DC capacitors take this problem into account. The version with two terminals offers self-inductances below 55 nH even with large capacitances in cases with a height of 280mm; with four terminals in crosswise arrangement, even 10 nH can be achieved in shorter cans. In a combination of several units, values previously unknown can be created.

The capacitors are tightly sealed by metallic cases and lids. They are therefore extremely well shielded against environmental influences such as moisture or contamination by harmful substances. Temporary condensation on these capacitors is just as permissible as IEC humidity tests under extreme conditions with 85% RH at 85°C.

The E67s are the world's first capacitors to feature our innovative Mesis® overpressure protection. Just like our BAM, which has been applied successfully for decades, this safety device responds mechanically to the internal rise of pressure that is usually associated with the failure of polypropylene capacitors. However, Mesis® manages without an external expansion of the housing. For the first time, capacitors can be installed firmly and connected to rigid, low-inductance bus bars without impairing the function of the fuse.

The signal of the overpressure protection can be used either on site or at a central detection system for the immediate disconnection of the circuit of one or more affected capacitors. There are many options with regard to interconnection (individually or in groups) and monitoring (with common control voltages up to 230 Vrms or 24V DC), so that almost all issues are taken into account.

This unique combination of the lowest self-inductance, shielding against environmental influences and reliable protection in the event of malfunctions, in connection with the well-known long-term stability of our SecuMet metallization, makes GA85 E67 Mesis® the ideal capacitor for safety and life-time sensitive applications, such as railway, marine and offshore installations.

Minimale Induktivität und zuverlässige Sicherung: E67 GA85 Mesis®

Unerwünschte Streuinduktivitäten können in Hochstromzwischenkreisen sehr deutliche Spannungsüberschwingungen verursachen (sogen. voltage overshooting). Dadurch sind beträchtliche Schäden möglich.

Dem begegnet man zum einen durch die Perfektionierung der Verschaltung (Sandwich-Sammelschienen, welche die eigene Induktivität zu großen Teilen neutralisieren); zum anderen spielt aber auch die Eigeninduktivität des Kondensators eine sehr bedeutsame Rolle. In Zwischenkreisen mit hohen Schaltfrequenzen oder solchen mit großem Kapazitätsbedarf ist diese Herausforderung umso größer. Die klassische Lösung – sehr flache Kondensatoren möglichst nahe an der Sammelschiene – kommt platz- und kostenbedingt nur begrenzt zum Tragen.

Die Zwischenkreiskondensatoren unserer neuen Baureihe GA85 E67 tragen diesem Problem durch eine besonders niedrige Eigeninduktivität und verlustarmen Aufbau Rechnung. Die Ausführung mit zwei Anschlüssen erzielt selbst bei großen Kapazitäten in Gehäusehöhen von 280mm Eigeninduktivitäten unter 55 nH; mit vier kreuzweise angeordneten Terminals können in kürzeren Bechern sogar 10 nH erreicht werden. In Kombination mehrerer Einheiten lassen sich damit bisher ungekannte Werte erzeugen.

Die Kondensatoren sind durch metallische Becher und Deckel dicht verschlossen und somit hervorragend gegen Umgebungseinflüsse wie Feuchtigkeit oder Verunreinigungen durch Schadstoffe abgeschirmt. So ist eine zeitweilige Btauung dieser Kondensatoren ebenso zulässig wie IEC-Feuchteprüfungen unter Extrembedingungen mit 85%RH bei 85°C.

Als weltweit erste Kondensatoren verfügen die E67er über unsere innovative Mesis® Überdrucksicherung. Genau wie unsere jahrzehntelang bewährten BAM-Sicherungen reagiert diese Sicherung mechanisch auf den inneren Druckanstieg, welcher in aller Regel mit dem Ausfall von Folienkondensatoren einhergeht. Mesis® kommt hierbei jedoch ohne äußerliche Verlängerung des Gehäuses aus. Erstmals lassen sich nun fest installierte gesicherte Kondensatoren mit starren, niederinduktiven Sammelschienen verschalten, ohne dabei die Funktion der Sicherung zu beeinträchtigen. Das Signal der Überdrucksicherung kann entweder vor Ort, oder an einer zentralen Erfassung für die sofortige Abschaltung des Zwischenkreises eines oder mehrerer betroffener Kondensatoren verwendet werden. Bezüglich Verschaltung (einzeln oder in Gruppen) und Auswertung (übliche Steuerspannungen von bis zu 230 Vrms oder 24 VDC) gibt es viele Freiheitsgrade, so dass nahezu alle Belange berücksichtigt sind.

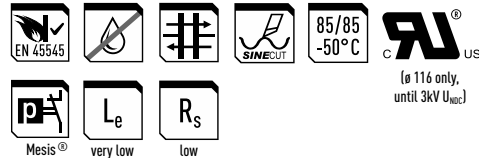
Diese einzigartige Kombination von niedrigster Eigeninduktivität, Abschirmung vor Umwelteinflüssen und zuverlässigem Schutz im Falle von Fehlfunktionen, in Verbindung mit der bekannten Langzeitstabilität unserer SecuMet-Metallisierung macht GA85 E67 Mesis® zum idealen Kondensator für sicherheits- und lebensdauersensible Einsatzfälle, wie z.B. Bahn-, Marine- und Offshore-Anwendungen.



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E67.***GA85 Mesis® DC 700...800V

**Low-inductance DC capacitors in sealed housing,
Mesis® Overpressure Switch**
**Niederinduktive Zwischenkreiskondensatoren in dichtem
Gehäuse, Mesis® Überdruckschalter**



Standards IEC 61881/61071, UL 810B,
EN 45545-2 (ext. plastic material äußere Kunststoffe HL3),
EN45545-3 (integrity Integrität E30)
IEC 61373:2010 (cat. 1, class B)
can Gehäuse aluminium
mounting position optional
Einbaulage beliebig
filling material neutral insulation gas (N₂)
Füllmittel neutrales Isoliergas (N₂)
protection Mesis® pressure switch
Sicherung Mesis® Überdruckschalter
fire load Brandlast 40 MJ/kg

C_N tolerance Toleranz ±10%; optional ±5%
tanδ₀ 2 × 10⁻⁴
limit temperatures Grenztemperaturen
θ_{min} -50°C
θ_{max} HOTSPOT +85°C¹
storing temperature Lagertemperatur -50°C ... +85°C
Life time Lebensdauer > 200 000 h
Failure rate Ausfallrate 100 FIT²

¹ endurance type test _Lebensdauertest: @ 80°C

² reference service period _Referenzbetriebsdauer 100.000 h, θ_{HOTSPOT} ≤ 70°C

Design W4						Design W6						
C _N (μF)	R _{th} (K/W)	R _s (mΩ)	I _{max} (A)	Î (kA)	L _e (nH)	R _s (mΩ)	I _{max} (A)	Î (kA)	L _e (nH)	D ₁ × L ₁ (mm)	m (kg)	order no. Bestell-Nr.
U _N 700V DC		U _r 200V		U _s 1050V		U _{TT} 1050V DC		U _{TC} 3300V AC/2s				
515	7.3	0.3	65	6.4	10	0.45	60	6.4	25	116 × 83	0.9	E67.R83-524W4/W60
1030	4.8	0.25	90	12.8	10	0.4	80	12.8	25	116 × 126	1.3	E67.R12-105W4/W60
1350	4.5	0.53	65	6.4	16	0.7	60	6.4	40	116 × 133	1.4	E67.R13-145W4/W60
1545	3.6	0.25	120	19.2	15	0.4	100	19.2	35	116 × 169	1.6	E67.R16-155W4/W60
2700	2.7	0.46	90	12.8	20	0.6	90	12.8	45	116 × 225	2.2	E67.R22-275W4/W60
3900	2.4	0.38	90	18.5	25	0.57	90	18.5	50	136 × 225	3	E67.S22-395W4/W60
4050	1.9	0.45	120	19.2	25	0.63	120	19.2	55	116 × 319	3.2	E67.R31-415W4/W60
5850	1.7	0.41	120	27.8	30	0.62	120	27.8	60	136 × 319	4.6	E67.S31-595W4/W60
U _N 800V DC		U _r 200V		U _s 1200V		U _{TT} 1200V DC		U _{TC} 3300V AC/2s				
385	7.3	0.3	65	5.6	10	0.43	60	5.6	25	116 × 83	0.9	E67.R83-394W4/W60
770	4.8	0.26	90	11.2	10	0.4	80	11.2	25	116 × 126	1.3	E67.R12-774W4/W60
1025	4.5	0.58	65	5.7	16	0.75	60	5.7	40	116 × 133	1.4	E67.R13-105W4/W60
1155	3.6	0.27	120	16.8	15	0.41	100	16.8	35	116 × 169	1.6	E67.R16-125W4/W60
2050	2.7	0.46	90	11.4	20	0.66	90	11.4	45	116 × 225	2.2	E67.R22-215W4/W60
2910	2.4	0.4	90	16.1	25	0.59	90	16.1	50	136 × 225	3	E67.S22-295W4/W60
3075	1.9	0.45	120	17.1	25	0.64	120	17.1	55	116 × 319	3.2	E67.R31-315W4/W60
4365	1.7	0.43	120	24.2	30	0.63	120	24.2	60	136 × 319	4.6	E67.S31-445W4/W60



E67.***GA85 Mesis®

DC

1000...1500V



C _N (μF)	R _{th} (K/W)	Design W4				Design W6				D ₁ × L ₁ (mm)	m (kg)	order no. Bestell-Nr.
		R _s (mΩ)	I _{max} (A)	Î (kA)	L _e (nH)	R _s (mΩ)	I _{max} (A)	Î (kA)	L _e (nH)			
U _N 1000V DC		U _r 200V		U _s 1500V		U _{TT} 1500V DC		U _{TC} 3600V AC/2s		E66: 950V DC		
300	7.3	0.32	65	5	10	0.46	60	5	25	116 × 83	0.9	E67.R83-304W4/W60
600	4.8	0.27	90	10	10	0.4	80	10	25	116 × 126	1.3	E67.R12-604W4/W60
780	4.5	0.64	65	4.9	16	0.81	60	4.9	40	116 × 133	1.4	E67.R13-784W4/W60
900	3.6	0.27	120	15	15	0.42	100	15	35	116 × 169	1.6	E67.R16-904W4/W60
1560	2.7	0.49	90	9.8	20	0.65	90	9.8	45	116 × 225	2.2	E67.R22-165W4/W60
2225	2.4	0.42	90	14.1	25	0.58	90	14.1	50	136 × 225	3	E67.S22-235W4/W60
2340	1.9	0.47	120	14.7	25	0.66	120	14.7	55	116 × 319	3.2	E67.R31-235W4/W60
3335	1.7	0.44	120	21.1	30	0.62	120	21.1	60	136 × 319	4.6	E67.S31-335W4/W60
U _N 1100V DC		U _r 250V		U _s 1650V		U _{TT} 1650V DC		U _{TC} 3840V AC/2s		E66: 1050V DC		
235	7.3	0.35	65	4.4	10	0.48	60	4.4	25	116 × 83	0.9	E67.R83-244W4/W60
470	4.8	0.29	90	8.8	10	0.41	80	8.8	25	116 × 126	1.3	E67.R12-474W4/W60
615	4.5	0.7	65	4.4	16	0.87	60	4.4	40	116 × 133	1.4	E67.R13-624W4/W60
705	3.6	0.28	120	13.2	15	0.43	100	13.2	35	116 × 169	1.6	E67.R16-714W4/W60
1230	2.7	0.52	90	8.8	20	0.68	90	8.8	45	116 × 225	2.2	E67.R22-125W4/W60
1755	2.4	0.44	90	12.5	25	0.62	90	12.5	50	136 × 225	3	E67.S22-185W4/W60
1845	1.9	0.49	120	13.2	25	0.68	120	13.2	55	116 × 319	3.2	E67.R31-185W4/W60
2630	1.7	0.45	120	18.7	30	0.65	120	18.7	60	136 × 319	4.6	E67.S31-265W4/W60
U _N 1300V DC		U _r 300V		U _s 1950V		U _{TT} 1950V DC		U _{TC} 4320V AC/2s		E66: 1200V DC		
175	7.3	0.39	65	3.8	10	0.52	60	3.8	25	116 × 83	0.9	E67.R83-184W4/W60
350	4.8	0.3	90	7.6	10	0.43	80	7.6	25	116 × 126	1.3	E67.R12-354W4/W60
525	3.6	0.29	120	11.4	15	0.44	100	11.4	35	116 × 169	1.6	E67.R16-534W4/W60
930	2.7	0.56	90	7.6	20	0.72	90	7.6	45	116 × 225	2.2	E67.R22-934W4/W60
1315	2.4	0.47	90	10.8	25	0.66	90	10.8	50	136 × 225	3	E67.S22-135W4/W60
1395	1.9	0.52	120	11.4	25	0.71	120	11.4	55	116 × 319	3.2	E67.R31-145W4/W60
1970	1.7	0.47	120	16.2	30	0.68	120	16.2	60	136 × 319	4.6	E67.S31-195W4/W60
U _N 1500V DC		U _r 300V		U _s 2250V		U _{TT} 2250V DC		U _{TC} 4800V AC/2s		E66: 1450V DC		
125	7.3	0.46	65	3.2	10	0.6	60	3.2	25	116 × 83	0.9	E67.R83-134W4/W60
250	4.8	0.34	90	6.4	10	0.46	80	6.4	25	116 × 126	1.3	E67.R12-254W4/W60
330	4.5	0.9	65	3.2	16	1.1	60	3.2	40	116 × 133	1.4	E67.R13-334W4/W60
375	3.6	0.32	110	9.6	15	0.46	100	9.6	35	116 × 169	1.6	E67.R16-384W4/W60
660	2.7	0.65	90	6.4	20	0.82	90	6.4	45	116 × 225	2.2	E67.R22-664W4/W60
960	2.4	0.51	90	9.4	25	0.71	90	9.4	50	136 × 225	3	E67.S22-964W4/W60
990	1.9	0.55	120	9.6	25	0.76	120	9.6	55	116 × 319	3.2	E67.R31-994W4/W60
1440	1.7	0.5	120	14.1	30	0.70	120	14.1	60	136 × 319	4.6	E67.S31-145W4/W60

Other values and dimensions available on request.
Andere Werte und Abmessungen auf Anfrage erhältlich.

For details of design W4 and W6 see page 40.
Für Details zu den Ausführungen W4 und W6 siehe S.40.

E67.***GA85 Mesis®

DC

1625...2200V

C _N (μF)	R _{th} (K/W)	Design W4				Design W6				D ₁ × L ₁ (mm)	m (kg)	order no. Bestell-Nr.
		R _s (mΩ)	I _{max} (A)	Î (kA)	L _e (nH)	R _s (mΩ)	I _{max} (A)	Î (kA)	L _e (nH)			
U _N 1625V DC		U _r 300V		U _s 2440V		U _{TT} 2440V DC		U _{TC} 5200V AC/2s		E66: 1500V DC		
110	7.3	0.45	65	3	10	0.59	60	3	25	116 × 83	0.9	E67.R83-114W4/W60
220	4.8	0.34	90	6	10	0.46	80	6	25	116 × 126	1.3	E67.R12-224W4/W60
280	4.5	0.98	65	2.9	16	1.1	60	2.9	40	116 × 133	1.4	E67.R13-284W4/W60
330	3.6	0.32	110	9	15	0.46	100	9	35	116 × 169	1.6	E67.R16-334W4/W60
560	2.7	0.66	90	5.8	20	0.82	90	5.8	45	116 × 225	2.2	E67.R22-564W4/W60
840	1.9	0.58	120	8.7	25	0.78	120	8.7	55	116 × 319	3.2	E67.R31-844W4/W60
U _N 1800V DC		U _r 400V		U _s 2700V		U _{TT} 2700V DC		U _{TC} 5520V AC/2s		E66: 1700V DC		
91	7.3	0.47	65	2.8	10	0.6	60	2.8	25	116 × 83	0.9	E67.R83-913W4/W60
182	4.8	0.35	90	5.6	10	0.47	80	5.6	25	116 × 126	1.3	E67.R12-184W4/W60
235	4.5	1	65	2.8	16	1.2	60	2.8	40	116 × 133	1.3	E67.R13-244W4/W60
273	3.6	0.32	110	8.4	15	0.46	100	8.4	35	116 × 169	1.6	E67.R16-274W4/W60
470	2.7	0.67	90	5.6	20	0.83	90	5.6	45	116 × 225	2.2	E67.R22-474W4/W60
670	2.4	0.55	90	8	25	0.74	90	8	50	136 × 225	3	E67.S22-674W4/W60
705	1.9	0.59	120	8.4	25	0.79	120	8.4	55	116 × 319	3.2	E67.R31-714W4/W60
1005	1.7	0.53	120	11.9	30	0.73	120	11.9	60	136 × 319	4.6	E67.S31-105W4/W60
U _N 2000V DC		U _r 550V		U _s 3000V		U _{TT} 3000V DC		U _{TC} 6000V AC/2s		E66: 1850V DC		
70	7.3	0.54	60	2.3	10	0.67	55	2.3	25	116 × 83	0.9	E67.R83-703W4/W60
140	4.8	0.36	90	4.6	10	0.51	80	4.6	25	116 × 126	1.3	E67.R12-144W4/W60
190	4.5	1.1	60	2.4	16	1.3	55	2.4	40	116 × 133	1.4	E67.R13-194W4/W60
210	3.6	0.33	110	6.9	15	0.48	100	6.9	35	116 × 169	1.6	E67.R16-214W4/W60
380	2.7	0.72	90	4.8	20	0.89	90	4.8	45	116 × 225	2.2	E67.R22-384W4/W60
550	2.4	0.59	90	7	25	0.78	90	7	50	136 × 225	3	E67.S22-554W4/W60
570	1.9	0.63	120	7.2	25	0.82	120	7.2	55	116 × 319	3.2	E67.R31-574W4/W60
825	1.7	0.55	120	10.4	30	0.76	120	10.4	60	136 × 319	4.6	E67.S31-834W4/W60
U _N 2125V DC		U _r 600V		U _s 3000V		U _{TT} 3000V DC		U _{TC} 6000V AC/2s		E66: 2000V DC		
415	1.9	-	-	-	-	1.2	60	4.5	55	116 × 271	2.5	E67.R27-424W60
U _N 2200V DC		U _r 600V		U _s 3300V		U _{TT} 3300V DC		U _{TC} 6480V AC/2s		E66: 2000V DC		
60	7.3	0.57	55	2.2	10	0.7	50	2.2	25	116 × 83	0.9	E67.R83-603W4/W60
120	4.8	0.4	80	4.4	10	0.52	80	4.4	25	116 × 126	1.3	E67.R12-124W4/W60
180	3.6	0.36	110	6.6	15	0.5	100	6.6	35	116 × 169	1.6	E67.R16-184W4/W60
330	2.7	0.76	90	4.6	20	0.92	80	4.6	45	116 × 225	2.2	E67.R22-334W4/W60
450	2.4	0.66	90	6.3	25	0.82	80	6.3	50	136 × 225	3	E67.S22-454W4/W60
495	1.9	0.65	120	6.9	25	0.85	100	6.9	55	116 × 319	3.2	E67.R31-504W4/W60



E67.*GA85 Mesis®**
DC
2450...4000V



C _N (μF)	R _{th} (K/W)	Design W4				Design W6				D ₁ × L ₁ (mm)	m (kg)	order no. Bestell-Nr.
		R _s (mΩ)	I _{max} (A)	Î (kA)	L _e (nH)	R _s (mΩ)	I _{max} (A)	Î (kA)	L _e (nH)			
U _N 2450V DC		U _r 600V		U _s 3675V		U _{TT} 3675V DC		U _{Tc} 7080V AC/2s		E66: 2250V DC		
46	7.3	0.64	55	1.9	10	0.78	50	1.9	25	116 × 83	0.9	E67.R83-463W4/W60
92	4.8	0.43	80	3.8	10	0.56	80	3.8	25	116 × 126	1.3	E67.R12-923W4/W60
138	3.6	0.38	110	5.7	15	0.52	100	5.7	35	116 × 169	1.6	E67.R16-144W4/W60
250	2.7	0.85	90	3.8	20	1	80	3.8	45	116 × 225	2.2	E67.R22-254W4/W60
360	2.4	0.67	90	5.6	25	0.86	80	5.6	50	136 × 225	3	E67.S22-364W4/W60
540	1.7	0.62	110	8.4	30	0.83	100	8.4	60	136 × 319	4.6	E67.S31-544W4/W60
U _N 2600V DC		U _r 600V		U _s 3900V		U _{TT} 3900V DC		U _{Tc} 7080V AC/2s		E66: 2400V DC		
39	7.3	0.45	55	3.7	10	0.55	50	3.7	25	116 × 83	0.9	E67.R83-393W4/W60
78	4.8	0.35	80	7.4	10	0.45	80	7.4	25	116 × 126	1.3	E67.R12-783W4/W60
105	4.5	0.85	50	3.6	16	1	50	3.6	40	116 × 133	1.4	E67.R13-114W4/W60
117	3.6	0.32	110	11.1	15	0.46	100	11.1	35	116 × 169	1.6	E67.R16-124W4/W60
210	2.7	0.55	90	7.2	20	0.75	80	7.2	45	116 × 225	2.2	E67.R22-214W4/W60
300	2.4	0.47	90	10.3	25	0.62	80	10.3	50	136 × 225	3	E67.S22-304W4/W60
315	1.9	0.52	110	10.8	25	0.72	100	10.8	55	116 × 319	3.2	E67.R31-324W4/W60
450	1.7	0.45	110	15.4	30	0.65	100	15.4	60	136 × 319	4.6	E67.S31-454W4/W60
U _N 3000V DC		U _r 600V		U _s 4500V		U _{TT} 4500V DC		U _{Tc} 7080V AC/2s		E66: 2850V DC		
28	7.3	0.46	45	3.2	10	0.59	45	3.2	25	116 × 83	0.9	E67.R83-283W4/W60
56	4.8	0.35	70	6.4	10	0.47	70	6.4	25	116 × 126	1.3	E67.R12-563W4/W60
70	4.5	0.9	45	2.8	16	1.1	45	2.8	40	116 × 133	1.4	E67.R13-703W4/W60
84	3.6	0.3	80	9.5	15	0.46	80	9.5	35	116 × 169	1.6	E67.R16-843W4/W60
140	2.7	0.61	70	5.7	20	0.8	70	5.7	45	116 × 225	2.2	E67.R22-144W4/W60
195	2.4	0.50	70	8	25	0.7	70	8	50	136 × 225	3	E67.S22-204W4/W60
210	2.2	0.51	80	8.2	25	0.76	80	8.2	55	116 × 319	3.2	E67.R31-214W4/W60
295	1.7	0.47	80	12	30	0.7	80	12	60	136 × 319	4.6	E67.S31-304W4/W60
U _N 4000V DC		U _r 800V		U _s 6000V		U _{TT} 6000V DC		U _{Tc} 7500V AC/2s				
63	3.1	-	-	-	-	1.7	60	3.4	50	116 × 225	2.2	E67.R22-633W60
95	2.2	-	-	-	-	1.3	80	5.1	65	116 × 319	3.2	E67.R31-953W60

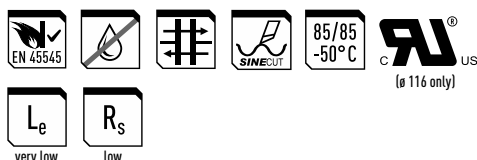




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E66.*GA85**
DC
700...2250V

Low-inductance DC capacitors in sealed housing
Niederinduktive Zwischenkreiskondensatoren in dichtem Gehäuse



As an option, capacitors of the GA85 series with a rated voltage of up to 2250 VDC are also available without the Mesis® safety device. Such capacitors are housed in standard aluminum cans with M12 mounting stud at the base.

All capacitance ratings, mechanical and electrical features remain as shown in the data charts of the E67 series, with the following exceptions:

1. The rated voltages change as shown in the data charts on pages 7-10.
2. The housing length L_1 is 6...8 mm shorter than the dimensions given in the chart for E67. See chart below.

Standards	IEC 61881/61071, UL 810B, EN 45545-2 (ext. plastic material äußere Kunststoffe HL3), EN45545-3 (integrity Integrität E30) IEC 61373:2010 (cat. 1, class B)
can Gehäuse	aluminium
mounting position	optional
Einbaulage	beliebig
filling material	neutral insulation gas (N_2)
Füllmittel	neutrales Isoliergas (N_2)
protection	none
Sicherung	keine
fire load Brandlast	40 MJ/kg

Optional sind Kondensatoren der Serie GA85 mit einer Nennspannung von bis zu 2250 VDC auch ohne die Mesis®-Sicherheitsvorrichtung erhältlich. Diese Kondensatoren sind in Standard-Aluminiumgehäusen mit einer M12-Bodenschraube untergebracht. Alle Nennkapazitäten sowie die mechanischen und elektrischen Eigenschaften entsprechen den Angaben in den Datentabellen der E67-Serie, mit folgenden Ausnahmen:

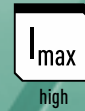
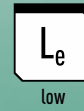
1. Nennspannungen ändern sich wie in Tabellen auf S.7-10 angezeigt.
2. Die Gehäuselänge L_1 ist 6...8 mm kürzer als die in der Tabelle für E67 angegebenen Maße. Siehe Tabelle unten.

C_N tolerance Toleranz	±10%; optional ±5%
$\tan\delta_0$	2×10^{-4}
limit temperatures Grenztemperaturen	
θ_{min}	-50°C
$\theta_{max \text{ HOTSPOT}}$	+85°C ¹
storing temperature Lagertemperatur	-50°C ... +85°C
Life time Lebensdauer	> 200 000 h
Failure rate Ausfallrate	50 FIT ²

¹ endurance type test _Lebensdauertest: @ 80°C

² reference service period _Referenzbetriebsdauer 100.000 h, $\theta_{HOTSPOT} \leq 70^\circ\text{C}$

GA85 E67 Mesis®		GA85 E66	
D x L_1	Order no. Bestell-Nr.	D x L_1	Order no. Bestell-Nr.
116 x 83	E67.R83-...	116 x 75	E66.R75-...
116 x 126	E67.R12-...	116 x 119	E66.R12-...
116 x 133	E67.R13-...	116 x 126	E66.R13-...
116 x 169	E67.R16-...	116 x 162	E66.R16-...
116 x 225	E67.R22-...	116 x 219	E66.R22-...
116 x 271	E67.R27-...	116 x 264	E66.R26-...
136 x 225	E67.S22-...	136 x 219	E66.S22-...
116 x 319	E67.R31-...	116 x 312	E66.R31-...
136 x 319	E67.S31-...	136 x 312	E66.S31-...



PK16™ – THE INDUSTRIAL STANDARD: LOW INDUCTANCE AND HIGH CAPACITANCE DENSITY

DER INDUSTRIESTANDARD: NIEDRIGE INDUKTIVITÄT UND HOHE KAPAZITÄTSDICHTE





PK16™ – ideal for your high-current DC-circuit

The PK16™ capacitor can be universally used for the assembly of low inductance DC buffer circuits and DC filters; with its high energy density it can replace banks of series-connected electrolytic capacitors as well as large film capacitors in rectangular cases.

The capacitance in a DC buffer circuit must be sufficiently sized to both handle the current and smoothen the occurring ripple voltages. The traditional use of series-/parallel-connected electrolytic capacitors offered large capacitance at seemingly low cost, however the low cost per microfarad is countered by the low current strength, the high sensitivity to voltage and current surges, as well as high risk of failures in the field, resulting in high maintenance cost.

Our advanced know-how in special capacitor film coating and many years of practical experience in designing and manufacturing capacitors have allowed us to design our PK16™ range with high capacitance density. With fivefold the current strength of conventional electrolytic capacitors, it is not necessary to reproduce the same capacitance in film technology in order to handle a given current.

Instead, the user now gets a superior technical solution within the same – or even less – space, offering

- superior voltage and current strength
- dramatic increase in operational life
- drastic reduction of failures
- minimization of power dissipation losses
- substantial reduction of self-inductance and series resistance
- more exact manufacturing tolerances
- elimination of sharing resistors

Thanks to its compact cylindrical aluminium can design this capacitor is ideal for both the electrical and mechanical requirements of high-speed IGBT converters.

Its robust terminals and the robust fixing stud allow for very simple and reliable mounting that unites lowest inductance and highest current strength. The particularly large clearance and creepage distances make this design suitable for a wide range of operating voltages. As a result, existing standard converter concepts can easily be adapted to new applications without having to change the principal construction and to re-approve the entire system.

PK16™ – Ideal für die hohen Ströme Ihres Zwischenkreises

Der PK16™ Kondensator lässt sich universell zum Aufbau niederinduktiver DC Zwischenkreise und für DC Filter einsetzen und kann mit seiner hohen Energiedichte sowohl Batterien seriengeschalteter Elektrolytkondensatoren als auch große quaderförmige Folienkondensatoren ersetzen.

Die Kapazität in einem DC-Zwischenkreis muß groß genug sein, um auftretende überlagerte Wechselspannungen zu glätten und entsprechende Rippleströme zu bewältigen. Die traditionelle Serien-/Parallelschaltung von Elektrolytkondensatoren bietet hohe Kapazität zu scheinbar niedrigen Kosten, jedoch steht den geringen Kosten je Mikrofarad eine niedrige Strombelastbarkeit, hohe Stoßstrom- und Spannungsempfindlichkeit sowie ein erhebliches Ausfallrisiko im Feld gegenüber, welches sich in hohen Wartungskosten niederschlägt.

Unser hochentwickeltes Know-How in der Metallisierung von Kondensatorfolien und langjährige praktische Erfahrungen in der Entwicklung und Herstellung von Kondensatoren ermöglichten uns die Schaffung unserer PK16™ Serie mit hoher Kapazitätsdichte. Dank fünffacher Stromfestigkeit gegenüber üblichen Elektrolytkondensatoren ist es nicht mehr notwendig, exakt die gleiche Kapazität in Folientechnologie zu erreichen, um einen gegebenen Strom zu bewältigen.

Statt dessen erhält der Anwender eine hochwertige technische Lösung mit gleichem oder vermindertem Platzbedarf und folgenden Vorteilen:

- höhere Spannungs- und Stromfestigkeit
- drastische Verlängerung der Lebensdauer
- bemerkenswerte Reduzierung von Ausfällen
- Minimierung der Verlustleistung
- erhebliche Verringerung der Eigeninduktivität und des Serienwiderstandes
- genauere Produktionstoleranzen
- Eliminierung von Symmetrierwiderständen

Mit seiner kompakten zylindrischen Bauform in Aluminiumgehäuse ist der Kondensator optimal an elektrische und mechanische Erfordernisse in schnelltaktenden IGBT Stromrichtern angepasst.

Die robusten Anschlusselemente und eine stabile Bodenbefestigung ermöglichen eine besonders einfache Montage, die niedrigste Induktivität und hohe Strombelastbarkeit miteinander vereinigt. Die außerordentlich großen Luft- und Kriechstrecken decken einen weiten Spannungsbereich ab, ohne dass dadurch die Bauform gewechselt werden müsste. Damit kann ein Standard-Stromrichterkonzept sehr viel flexibler auf unterschiedliche Anwendungen ausgerichtet werden, ohne neue Konstruktionen und damit neue Systemprüfungen erforderlich zu machen.

Important notice

Our MKP capacitors of the PK16™ series are made with self-healing dielectric. In the event of voltage breakdowns, caused by weak spots in the dielectric or high thermal/electrical load, the metal coating around the breakdown spot is vaporized within a few microseconds. As a result, the area around the breakdown spot is de-metalized, and the capacitor remains fully functional.

The release of energy during a regular self-healing breakdown, and the amount of gas generated in the process, are so small that even after thousands of such self-healing procedures there is no significant build-up of overpressure inside the capacitor.

The scenario of self-healing breakdown becomes less likely, or impossible, under high thermal or electrical overstress. The disintegration of the polypropylene dielectric may produce more or less amounts of gas accompanied by a build-up of internal pressure. Very frequent and large-scale occurrence of self-healing breakdowns (e.g., as a result of strong voltage overstrain) may cause a gradual rise of the internal pressure as well.

For the sake of lowest available self-inductance and maximum mounting comfort, the capacitors of our PK16™ range are not equipped with an integrated safety mechanism to disconnect them in the event of overload or failure. They should therefore not be operated beyond their rated values and be allocated in uncritical environment (non-inflammable materials) where build-up of pressure or even ignition of the polypropylene cannot cause consequential damage.

Wichtiger Hinweis

Alle in unseren PK16™-Kondensatoren verwendeten dielektrischen Strukturen sind selbstheilend. Im Falle eines Kurzschlusses (z. B. Spannungsdurchschlag an Schwachstellen im Dielektrikum, oder infolge starker thermischer/elektrischer Belastung) verdampfen binnen weniger Mikrosekunden die Metallbeläge rings um den Durchschlagspunkt und bilden eine belagfreie, isolierende Zone. Dabei bleibt der Kondensator voll funktionsfähig.

Die freigesetzte Energie während eines selbstheilenden Durchschlages und die dabei erzeugte Menge an Gas sind so gering, dass selbst nach tausenden solcher Selbstheilungsvorgänge kein nennenswerter Überdruck im Kondensatorinneren entsteht.

Der zuverlässige Ablauf selbstheilender Durchschläge kann jedoch durch hohe thermische oder elektrische Belastung beeinträchtigt oder verhindert werden. Sich zersetzendes Polypropylen erzeugt dann größere Mengen an Gas und der Innendruck im Kondensator steigt. Gleichmaßen können auch häufig und großflächig auftretende Durchschläge (z.B. infolge starker Überspannung) einen starken Anstieg des Innendrucks verursachen.

Zum Zwecke niedrigster Eigeninduktivität und maximalen Einbaukomforts verfügen die Kondensatoren unserer PK16™ Reihe nicht über einen internen Abschaltmechanismus für Fehlerfälle oder spannungsmäßige Überlastung. Sie sollten daher nicht außerhalb ihrer zulässigen Nennwerte betrieben und stets in unkritischer Umgebung (nichtentflammbare Materialien) platziert werden, wo Gasfreisetzung bzw. ein Entzünden des Dielektrikums keine schwerwiegenden Folgeschäden verursachen können.

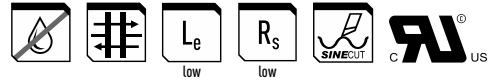


E50.***PK16™
DC
600V

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Low-inductance DC Capacitors
Niederinduktive Zwischenkreiskondensatoren



Standards..... IEC 61071, optional IEC 61881

UL 810

can Gehäuse..... aluminium/plastic, (UL94: V0)

mounting position..... optional

Einbaulage..... beliebig

filling material..... solid, based on vegetable oil, non-PCB

Füllmittel..... ausgehärtet, auf Pflanzenölbasis, PCB-frei

internal protection..... none

interne Sicherung..... keine

fire load Brandlast..... 40 MJ/kg

C_N tolerance Toleranz..... ±10%; optional ±5%

tanδ₀..... 2 × 10⁻⁴

limit temperatures Grenztemperaturen

θ_{min}..... -40°C

θ_{max} (HOTSPOT)..... +85°C¹

storing temperature Lagertemperatur..... -40°C ... +85°C

Life time Lebensdauer..... > 200 000 h

Failure rate Ausfallrate..... 50 FIT²

¹endurance type test_Lebensdauertest: Ø116 @80°C, Ø136 @75°C

²reference service life_Referenzbetriebsdauer 100000 h, θ_{HOTSPOT} ≤70°C

C _N (µF)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _S (kA)	E _N (Ws)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / Box Stk / Box
U _N 600V DC		U _I 100V		U _S 900V		U _{TT} 900V DC		U _{TC} 3300V AC/2s				
465	2.6	5.8	20	1.9	5.7	84	50	67 × 114	N4	0.4	E50.L11-474N40	10/FB2
555	1	6.7	40	3.8	11.4	100	30	85 × 85	NT	0.5	E50.N85-564NT0	10/FB12
680	1.1	6	40	3.8	11.5	122	40	85 × 95	NT	0.6	E50.N95-684NT0	10/FB12
780	1.6	5.2	30	3.7	11	140	60	85 × 110	NT	0.7	E50.N11-784NT0	10/FB10
930	1.4	4.7	40	3.8	11.5	167	35	85 × 120	NT	0.7	E50.N12-934NT0	10/FB10
1000	1.8	4.2	35	3.7	11	180	55	85 × 136	NT	0.8	E50.N13-105NT0	10/FB15
1110	0.84	3.8	80	7.6	22.9	200	40	85 × 150	NT	0.9	E50.N15-115NT1	5/FB8
1430	2.3	3.1	35	3.7	11.1	257	60	85 × 181	NT	1.2	E50.N18-145NT0	5/FB8
1450	0.82	3.1	80	10	29.9	261	45	100 × 155	N5	1.3	E50.Q15-155N57	3/FB8
2000	1.4	2.3	60	7.4	22	360	60	85 × 252	NT	1.6	E50.N25-205NT0	5/FB10
2070	0.62	2.5	90	14.2	42.7	373	40	116 × 155	NT	1.8	E50.R15-215NT0	3/FB8
2530	0.66	2.1	90	14.2	42.6	455	50	116 × 180	NT	2.1	E50.R18-255NT0	3/FB12
4000	0.58	1.3	120	20	60	720	70	116 × 295	NT	3.2	E50.R29-405NT0	3/FB15
4275	0.55	1.5	120	29	88	770	60	136 × 220	NT	3.4	E50.S22-435NT0	2/FB12
5060	0.72	1.1	120	28.4	85.2	911	85	116 × 340	NT	3.9	E50.R34-515NT0	3/FB15
7000	0.66	1	120	29	87	1260	70	136 × 335	NT	5.2	E50.S33-705NT0	2/FB15



Other values and dimensions available on request.
Andere Werte und Abmessungen auf Anfrage erhältlich.



E50.***PK16™
DC
700...900V

C _N (μF)	R _s (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _s (kA)	E _N (Ws)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / Box Stk / Box
U _N 700V DC		U _r 200V		U _s 1050V		U _{TT} 1050V DC		U _{TC} 3300V AC/2s				
410	1.1	6.7	40	3.3	9.9	100	30	85 × 85	NT	0.5	E50.N85-414NT0	10/FB12
585	1.7	5.2	30	3.2	9.6	143	60	85 × 110	NT	0.7	E50.N11-594NT0	10/FB10
650	1.2	4.4	40	3.6	10.8	159	50	100 × 110	N57	0.9	E50.Q11-654N57	6/FB15
820	0.87	3.8	80	6.6	19.7	201	40	85 × 150	NT	1	E50.N15-824NT0	5/FB8
1170	1.3	2.7	60	6.5	19.5	287	60	85 × 210	NT	1.25	E50.N21-125NT0	5/FB12
1530	0.64	2.5	90	12.3	36.8	375	45	116 × 155	NT	1.8	E50.R15-155NT0	3/FB8
1500	1.5	2.3	60	6.4	19	367	60	85 × 252	NT	1.6	E50.N25-155NT0	5/FB10
2120	0.69	1.8	60	11.7	35.1	519	50	116 × 215	NT	2.4	E50.R21-215NT0	3/FB12
2295	0.62	1.7	120	18.4	55.2	562	60	116 × 220	NT	2.5	E50.R22-235NT0	3/FB12
2920	0.59	1.3	100	23.4	70	715	70	116 × 295	NT	3.2	E50.R29-295NT0	3/FB15
3200	0.55	1.5	120	25	75	784	60	136 × 220	NT	3.4	E50.S22-325NT0	2/FB12
5200	0.68	1	120	25	75	1274	70	136 × 335	NT	5.2	E50.S33-525NT0	2/FB15
U _N 900V DC		U _r 200V		U _s 1350V		U _{TT} 1350V DC		U _{TC} 3360V AC/2s				
220	1	7.3	35	2.6	7.8	89	40	85 × 78	NT	0.5	E50.N78-224NT0	10/FB10
300	3.7	5.8	20	1.5	5	122	50	67 × 114	N4	0.4	E50.L11-304N40	10/FB2
340	0.85	5.2	60	5.6	16.8	138	60	85 × 110	NT	0.7	E50.N11-344NT0	10/FB10
350	1.1	6.7	40	3.0	9	142	30	85 × 85	NT	0.5	E50.N85-354NT0	10/FB12
450	1.8	5.2	30	2.8	8.4	182	60	85 × 110	NT	0.7	E50.N11-454NT0	10/FB10
590	0.81	4.2	80	6.1	18.3	239	40	85 × 136	NT	0.8	E50.N13-594NT0	5/FB8
610	1.1	3.7	60	5.6	16.8	247	40	85 × 155	NT	1	E50.N15-614NT0	5/FB8
700	0.89	3.8	80	6.1	18.3	284	30	85 × 150	NT	1	E50.N15-704NT0	5/FB8
1060	1.3	2.5	75	5.8	17.4	429	60	85 × 225	NT	1.35	E50.N22-115NT0	5/FB12
1095	0.94	3.1	65	5.7	17.1	443	35	116 × 125	NT	1.4	E50.R12-115NT0	6/FB10
1150	1.6	2.3	60	5.7	17.1	466	60	85 × 252	NT	1.6	E50.N25-125NT0	5/FB10
1170	0.66	2.5	100	10.7	32.1	474	40	116 × 155	NT	1.75	E50.R15-125NT0	3/FB8
1310	0.65	2.5	90	11.4	34.2	531	45	116 × 155	NT	1.75	E50.R15-135NT1	3/FB8
1740	1.2	2.1	65	5.7	17.1	705	50	116 × 180	NT	2.1	E50.R18-175NT0	3/FB8
2620	0.71	1.3	120	22.8	68.4	1061	75	116 × 290	NT	3.3	E50.R29-265NT0	3/FB15
2700	0.56	1.5	120	23.5	70.5	1094	60	136 × 220	NT	3.4	E50.S22-275NT0	2/FB12
3380	0.8	1.2	60	14.6	43.8	1368	70	136 × 280	NT	4.3	E50.S28-345NT0	2/FB10
4590	0.78	1	120	23.9	71.7	1859	85	136 × 335	NT	5.2	E50.S33-465NT0	2/FB15



E50.***PK16™

DC

1100...1200V



C_N (μ F)	R_s (m Ω)	R_{th} (K/W)	I_{max} (A)	$\hat{I}$ (kA)	I_s (kA)	E_N (Ws)	L_e (nH)	$D_1 \times L_1$ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / Box Stk / Box
U_N 1100V DC		U_r 250V		U_s 1650V		U_{TT} 1650V DC		U_{Tc} 3840V AC/2s				
200	3.5	5.8	30	1.5	5	121	50	67 × 114	N4	0.4	E50.L11-204N40	10/FB2
280	1.4	6	40	2.5	7.4	169	30	85 × 95	NT	0.6	E50.N95-284NT0	10/FB12
375	0.67	3.9	90	7.3	21.9	227	40	85 × 146	NT	0.9	E50.N14-384NT0	5/FB8
380	1.8	4.7	40	2.4	7.3	230	35	85 × 120	NT	0.7	E50.N12-384NT0	10/FB10
420	1.9	4.4	40	2.4	7.3	254	40	85 × 130	NT	0.8	E50.N13-424NT1	5/FB8
450	0.86	3.8	80	4.8	14.4	272	40	85 × 150	NT	1	E50.N15-454NT1	5/FB8
580	0.88	3.1	80	6.2	18.7	351	45	100 × 155	N5	1.3	E50.Q15-584N57	3/FB8
595	2.8	3.1	40	2.4	14.8	360	60	85 × 181	NT	1.2	E50.N18-604NT0	5/FB8
800	0.85	2.6	80	9	27	484	40	116 × 145	NT	0.97	E50.R14-804NT0	3/FB8
830	1.7	2.3	60	4.8	14.4	502	60	85 × 252	NT	1.6	E50.N25-834NT0	5/FB10
990	1.2	2.1	80	6.4	19.1	599	60	100 × 230	N5	1.9	E50.Q23-994N57	3/FB12
1100	1.4	2.1	65	4.5	13.5	666	40	116 × 180	NT	2.1	E50.R18-115NT0	3/FB12
1245	0.65	1.7	120	13.4	40.2	753	60	116 × 220	NT	2.5	E50.R22-125NT0	3/FB12
1660	0.71	1.3	120	17.9	53.6	1004	75	116 × 290	NT	3.2	E50.R29-175NT1	3/FB15
1750	1	1.4	95	8.9	26.7	1059	70	116 × 280	NT	3.2	E50.R28-185NT0	3/FB10
1850	0.57	1.5	120	20	60	1119	60	136 × 220	NT	3.4	E50.S22-195NT0	2/FB12
2200	1.1	1.1	90	9	27.1	1331	70	116 × 340	NT	3.5	E50.R34-225NT1	3/FB15
2500	0.86	1.2	60	12.7	38.1	1512	70	136 × 280	NT	4.3	E50.S28-255NT0	2/FB10
3100	0.79	1	120	20	60	1875	85	136 × 335	NT	5.2	E50.S33-315NT0	2/FB15
U_N 1200V DC		U_r 250V		U_s 1800V		U_{TT} 1800V DC		U_{Tc} 4080V AC/2s				
370	0.99	3.8	75	4.4	13.2	266	40	85 × 150	NT	0.9	E50.N15-374NT0	5/FB8
500	0.52	2.7	80	7.7	23.1	360	40	116 × 140	NT	1.6	E50.R14-504NT0	6/FB15
1035	0.69	1.7	120	12.3	37	745	60	116 × 220	NT	2.5	E50.R22-105NT0	3/FB12
1450	0.63	1.5	120	17.3	51.9	1044	60	136 × 220	NT	3.4	E50.S22-155NT0	2/FB12
2450	0.81	1	120	17.5	52.5	1764	85	136 × 335	NT	5.2	E50.S33-255NT0	2/FB15

Other values and dimensions available on request.
Andere Werte und Abmessungen auf Anfrage erhältlich.



E50.***PK16™
DC
1300...1800V

C _N (μF)	R _s (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _s (kA)	E _N (Ws)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / Box Stk / Box
U _N 1300V DC		U _r 300V		U _s 1950V		U _{TT} 1950V DC		U _{Tc} 4320V AC/2s				
145	1.4	6.7	40	1.9	5.8	123	40	85 × 85	NT	0.5	E50.N05-154NT0	10/FB12
215	1.8	5.2	30	2	6	182	60	85 × 110	NT	0.7	E50.N11-224NT0	10/FB10
250	1	4.2	60	4	12	211	40	85 × 136	NT	0.8	E50.N13-254NT0	10/FB15
270	2.5	4.2	40	2	10	228	40	85 × 136	NT	0.8	E50.N13-274NT0	10/FB15
300	2.4	4.2	40	2	6	234	40	85 × 136	NT	0.8	E50.N13-304NT0	10/FB15
360	1.2	3.2	75	3.9	11.7	304	50	85 × 176	NT	1.1	E50.N17-364NT0	5/FB8
430	1.3	2.8	75	3.9	11.8	363	55	85 × 200	NT	1.2	E50.N20-434NT0	5/FB12
500	0.52	2.7	80	7.5	22.5	423	40	116 × 140	NT	1.6	E50.R14-504NT1	6/FB15
560	1.8	2.3	60	4	12	473	60	85 × 252	NT	1.6	E50.N25-564NT0	5/FB10
645	0.6	2.3	80	7.3	21.9	545	40	116 × 165	NT	1.9	E50.R16-644NT0	3/FB8
760	0.71	2	70	7.6	22.8	642	45	116 × 190	NT	2.4	E50.R19-764NT0	3/FB12
825	0.68	1.7	120	11	32.9	697	60	116 × 220	NT	2.5	E50.R22-834NT0	3/FB12
1100	0.7	1.3	120	14.5	43.5	930	75	116 × 290	NT	3.3	E50.R29-115NT0	3/FB15
1200	0.64	1.5	120	15.9	47.7	1014	60	136 × 220	NT	3.4	E50.S22-125NT0	2/FB12
1460	1.2	1.1	90	7.3	21.9	1234	85	116 × 340	NT	3.9	E50.R34-155NT0	3/FB15
1680	0.91	1.2	60	10.5	31.5	1420	70	136 × 280	NT	4.3	E50.S28-175NT0	2/FB10
2000	0.82	1	120	15.9	47.7	1690	85	136 × 335	NT	5.2	E50.S33-205NT0	2/FB15
U _N 1500V DC		U _r 300V		U _s 2250V		U _{TT} 2250V DC		U _{Tc} 4800V AC/2s				
180	0.93	4.6	70	3.4	10.3	203	30	85 × 125	NT	0.8	E50.N12-184NT0	10/FB10
210	2.8	4.2	40	2	10	236	55	85 × 136	NT	0.8	E50.N13-214NT0	10/FB15
230	1.3	3.7	60	3.4	10.2	259	40	85 × 155	NT	1	E50.N15-234NT0	5/FB8
365	1.3	3.1	65	3.3	9.8	411	35	116 × 125	NT	1.4	E50.R12-374NT0	6/FB10
380	1.8	2.5	60	3.4	10.2	428	60	85 × 232	NT	1.5	E50.N23-384NT0	5/FB12
405	1.4	2.8	65	3.3	9.8	456	40	116 × 135	NT	1.5	E50.R13-414NT0	6/FB10
575	1.1	2.4	65	4.6	13.9	647	40	136 × 135	NT	2.1	E50.S13-584NT0	2/FB8
680	0.59	1.8	120	13	39.1	765	50	136 × 185	NT	2.9	E50.S18-684NT0	3/FB12
810	1	1.5	90	6.5	19.6	911	65	116 × 250	NT	2.9	E50.R25-814NT0	3/FB10
1095	0.89	1.1	120	9.8	29.3	1232	85	116 × 335	NT	3.8	E50.R33-115NT0	3/FB15
900	0.61	1.5	120	13.4	40.2	1012	60	136 × 220	NT	3.4	E50.S22-904NT0	2/FB12
1300	0.96	1.2	60	9.1	27.3	1463	70	136 × 280	NT	4.3	E50.S28-135NT0	2/FB10
1545	0.85	1	120	13.6	40.8	1721	85	136 × 335	NT	5.2	E50.S33-155NT0	2/FB15
U _N 1800V DC		U _r 400V		U _s 2700V		U _{TT} 2700V DC		U _{Tc} 5520V AC/2s				
120	2.6	5.2	30	1.5	5	194	60	85 × 110	NT	0.7	E50.N11-124NT0	10/FB10
275	1.9	2.5	60	2.9	8.7	446	60	85 × 232	NT	1.5	E50.N23-284NT0	5/FB12
390	2.2	2.1	40	2.6	7.8	632	50	116 × 180	NT	2.2	E50.R18-394NT0	3/FB12
630	1.2	1.4	90	5.4	16.2	1021	70	116 × 280	NT	3.2	E50.R28-634NT0	3/FB10
640	0.68	1.5	120	11.4	34.2	1037	60	136 × 220	NT	3.4	E50.S22-644NT0	2/FB12
920	1	1.2	60	7.8	23.4	1490	70	136 × 280	NT	4.3	E50.S28-924NT0	2/FB10
1085	0.88	1	120	11.6	34.8	1760	85	136 × 335	NT	5.2	E50.S33-115NT0	2/FB15



E50.***PK16™

DC

2000...2800V



C_N (μF)	R_s ($m\Omega$)	R_{th} (K/W)	I_{max} (A)	$\hat{I}$ (kA)	I_s (kA)	E_N (Ws)	L_e (nH)	$D_1 \times L_1$ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / Box Stk / Box
U_N 2000V DC		U_r 500V		U_s 3000V		U_{TT} 3000V DC		U_{TC} 6000 V AC/2s				
90	2.9	5.2	30	1.2	3.6	180	60	85 × 110	NT	0.7	E50.N11-903NT0	10/FB12
160	1	3.1	80	3.3	10	320	45	100 × 155	N5	1.3	E50.Q15-164N57	3/FB8
170	1.4	3.5	65	2.4	7.3	340	35	116 × 110	NT	1.4	E50.R11-174NT0	6/FB15
195	1.6	3.1	65	2.4	7.2	390	35	116 × 125	NT	1.4	E50.R12-204NT0	6/FB10
210	2.1	2.5	60	2.5	7.5	420	60	85 × 232	NT	1.5	E50.N23-214NT0	5/FB12
310	2.1	2.1	65	2.4	7.2	620	50	116 × 180	NT	2.1	E50.R18-314NT0	3/FB12
460	0.76	1.3	120	9.6	28.8	920	75	116 × 290	NT	3.3	E50.R29-464NT0	3/FB15
560	0.82	1.1	120	9.5	28.5	1120	85	116 × 340	NT	3.9	E50.R34-564NT1	3/FB15
480	0.71	1.5	120	9.7	29.1	960	60	136 × 220	NT	3.4	E50.S22-484NT0	2/FB12
700	1.1	1.2	60	6.7	20.1	1400	70	136 × 280	NT	4.3	E50.S28-704NT0	2/FB10
820	0.92	1	120	9.9	29.7	1640	85	136 × 335	NT	5.2	E50.S33-824NT0	2/FB15
U_N 2200V DC		U_r 600V		U_s 3300V		U_{TT} 3300V DC		U_{TC} 6480V AC/2s				
170	1.9	2.5	65	2.3	7	411	60	85 × 225	NT	1.4	E50.N22-174NT0	5/FB12
565	1.1	1.2	60	6	18	1367	70	136 × 280	NT	4.3	E50.S28-574NT0	2/FB10
665	0.95	1	120	8.9	26.7	1609	85	136 × 335	NT	5.2	E50.S33-674NT0	2/FB15
U_N 2600V DC		U_r 600V		U_s 3900V		U_{TT} 3900V DC		U_{TC} 7440V AC/2s				
95	2.9	3.2	40	1.9	5.8	321	60	85 × 176	NT	1.2	E50.N17-953NT0	5/FB8
175	1.6	2.1	65	3.6	10.7	592	40	116 × 180	NT	2.1	E50.R18-184NT0	3/FB8
270	0.66	1.5	120	14	43	913	60	136 × 220	NT	3.4	E50.S22-274NT0	2/FB12
350	1.2	1.1	90	7.2	21.5	1183	85	116 × 340	NT	3.9	E50.R34-354NT1	3/FB15
400	0.93	1.2	60	10	30	1352	70	136 × 280	NT	4.3	E50.S28-404NT0	2/FB10
465	0.82	1	120	15	45	1572	85	136 × 335	NT	5.2	E50.S33-474NT0	2/FB15
U_N 2800V DC		U_r 600V		U_s 4200V		U_{TT} 4200V DC		U_{TC} 7920V AC/2s				
100	1.7	2.5	60	3.5	10.5	392	60	85 × 232	NT	1.5	E50.N23-104NT0	5/FB12
245	0.66	1.5	120	14	42	960	60	136 × 220	NT	3.4	E50.S22-254NT0	2/FB12
420	0.82	1	120	14	42	1647	85	136 × 335	NT	5.2	E50.S33-424NT0	2/FB15

Other values and dimensions available on request.
Andere Werte und Abmessungen auf Anfrage erhältlich.



E50.***PK16™
DC
3000...3600V

C _N (μF)	R _s (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _s (kA)	E _N (Ws)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / Box Stk / Box
U _N 3000V DC		U _r 600V		U _s 4500V		U _{TT} 4500V DC		U _{Tc} 8400V AC/2s				
53	1.3	3.8	50	3.3	9.9	239	40	85 × 150	NT	1	E50.N15-533NT0	5/FB8
75	3.1	3.2	40	1.7	5.1	338	50	85 × 176	NT	1	E50.N17-753NT0	5/FB8
170	0.98	1.7	90	6.3	18.8	765	60	116 × 230	NT	2.6	E50.R23-174NT1	3/FB12
200	1.2	1.4	90	6	18.1	900	70	116 × 280	NT	3.2	E50.R28-204NT0	3/FB10
210	0.67	1.5	120	13	39	945	60	136 × 220	NT	3.4	E50.S22-214NT0	2/FB12
360	0.84	1	120	13	39	1620	85	136 × 335	NT	5.2	E50.S33-364NT0	2/FB15
U _N 3200V DC		U _r 700V		U _s 4800V		U _{TT} 4800V DC		U _{Tc} 8880V AC/2s				
37.5	1.3	3.8	50	2.7	8.1	192	40	85 × 150	NT	1	E50.N15-383NT0	5/FB8
66.5	1.7	2.5	60	2.8	8.4	340	60	85 × 232	NT	1.5	E50.N23-673NT0	5/FB12
170	0.68	1.5	120	12	36	870	60	136 × 220	NT	3.4	E50.S22-174NT0	2/FB12
240	1	1.2	60	8	24	1229	70	136 × 280	NT	4.3	E50.S28-244NT0	2/FB10
285	0.86	1	120	12	36	1459	85	136 × 335	NT	5.2	E50.S33-294NT0	2/FB15
U _N 3600V DC		U _r 850V		U _s 5400V		U _{TT} 5400V DC		U _{Tc} 9840V AC/2s				
30	2.5	4.7	35	1.4	4.1	194	35	85 × 120	NT	0.7	E50.N12-303NT0	10/FB10
32	1.3	3.8	50	2.4	7.2	207	40	85 × 150	NT	0.9	E50.N15-323NT0	5/FB8
40	3	3.9	40	1.4	4.3	259	40	85 × 146	NT	0.9	E50.N14-403NT0	5/FB8
165	0.95	1.1	120	7.5	22.6	1069	85	116 × 335	NT	3.9	E50.R33-174NT0	3/FB15
140	0.7	1.5	120	10.5	31.5	907	60	136 × 220	NT	3.4	E50.S22-144NT0	2/FB12
210	1.1	1.2	60	7	21	1361	70	136 × 280	NT	4.3	E50.S28-214NT0	2/FB10
250	0.88	1	120	11	33	1620	85	136 × 335	NT	5.2	E50.S33-254NT0	2/FB15





PK MIND® – FIT FOR SiC:

ULTRA-LOW INDUCTANCE AND CONSTANT ESR

IDEAL FÜR SiC:

**ULTRANIEDRIGE INDUKTIVITÄT UND
KONSTANTER ESR**





PKmind® – Inductance as low as it can get

Our new PKmind® series is based on the SecuMet™ films known from the classic PK16. It merges its outstanding properties - high capacitance density with excellent long-term stability, particularly compact design, high rms currents up to 100 A rms, minimized series resistance and excellent surge current strength - with the low inductance of our E67 and E61 series, optimized for future high-frequency applications.

Externally quite similar to the PK16, the new capacitors have been redesigned completely on the inside. Thanks to innovative wiring and the connection configuration familiar from our E67 and E61, they achieve self-inductances of between 9 and 15 nH. Their much lower series resistance reduces power losses substantially and allows for even higher rms currents per unit than before. This is particularly important at the high frequency currents of future SiC applications with components in the range of 50 kHz and more. Inductance-related disturbances and self-resonances inside the capacitors can be minimized this way.

PKmind's diameters of 85 and 100 mm and its height between 102 and 204 mm are aimed at compact DC links, which are combined from several capacitors. In such a configuration, the surface area of the aluminium cases, as well as the bottom side of the can provide ample opportunity for cooling. As with the traditional PK16, it is fixed by an M12 stud at the base. The four robust, low-inductance M6 terminals (10 mm internal thread) are locked against excessive torque.

Filled with cured polyurethane resin, the capacitors are environmentally friendly and can be mounted in any position. All capacitors in this series are designed for climate class T1. With their lower temperature limit of -40°C, they are suitable even for harsh environmental conditions.

Important notice

Our capacitors of the PKmind® series are made with self-healing dielectric. Self-healing breakdowns become less likely, or impossible, under high thermal or electrical overstress. The disintegration of the polypropylene dielectric may produce more or less amounts of gas accompanied by a build-up of internal pressure. Very frequent and large-scale occurrence of self-healing breakdowns (e.g., as a result of strong voltage overstrain) may cause a gradual rise of the internal pressure as well.

For the sake of lowest available self-inductance and maximum mounting comfort, the capacitors of our PKmind® range are not equipped with an integrated safety mechanism. They should therefore not be operated beyond their rated values and be allocated in uncritical environment (non-flammable materials) where the release of flammable organic gases or an ignition of the polypropylene cannot cause consequential damage.

PKmind® – Induktivität, so niedrig es geht

Unsere neue Baureihe PKmind® basiert auf den vom klassischen PK16 her bekannten SecuMet™-Folien. Sie verschmilzt dessen herausragende Eigenschaften - hohe Kapazitätsdichte mit vorzüglicher Langzeitstabilität, besonders kompakte Bauweise, hohe Effektivströme bis zu 100 A rms, minimierter Serienwiderstand und exzellente Stoßstromfestigkeit - mit der auf künftige Hochfrequenzanwendungen optimierten niedrigen Induktivität unserer Baureihen E67 und E61.

Äußerlich dem PK16 durchaus ähnlich, sind die neuen Kondensatoren im Innern ganz neu konzipiert. Dank innovativer Verschaltung und der von E67 und E61 bekannten Anschlusskonfiguration erreichen sie Eigeninduktivitäten zwischen 9 und 15 nH. Ihr wesentlich verringerter Serienwiderstand reduziert Leistungsverluste ganz erheblich und ermöglicht noch höhere Effektivströme pro Kondensator als zuvor. Dies ist besonders wichtig für die hochfrequenten Betriebsströme künftiger SiC-Anwendungen mit Anteilen im Bereich von 50 kHz und mehr. Induktivitätsbedingte Störungen und kondensatorinterne Eigenresonanzen können so minimiert werden.

Die Durchmesser 85 und 100 mm des PKmind® und seine Bauhöhen zwischen 102 und 204 mm zielen auf kompakte Zwischenkreise, welche aus mehreren Kondensatoren kombiniert sind. In einer solchen Konfiguration bietet die Oberfläche der Aluminiumgehäuse und des Becherbodens eine großzügige Möglichkeit zur Kühlung. Wie bei den traditionellen PK16 erfolgt die Befestigung über einen M12x16-Montagebolzen. Die vier robusten, niederinduktiven M6-Anschlüsse (10-mm-Innengewinde) sind gegen zu hohes Drehmoment verriegelt.

Die mit ausgehärtetem Polyurethanharz gefüllten Kondensatoren sind umweltfreundlich und können in jeder Position montiert werden. Alle Kondensatoren in dieser Baureihe sind für Klimaklasse T1 ausgelegt. Mit ihrer unteren Temperaturgrenze von bis zu -40°C eignen sie sich selbst für raue Anwendungsumgebungen.

Wichtiger Hinweis

Alle in unseren PKmind®-Kondensatoren verwendeten dielektrischen Strukturen sind selbstheilend. Der zuverlässige Ablauf selbstheilender Durchschläge kann jedoch durch hohe thermische oder elektrische Belastung beeinträchtigt oder verhindert werden. Sich zersetzendes Polypropylen erzeugt dann größere Mengen an Gas und der Innendruck im Kondensator steigt. Gleichermaßen können großflächig auftretende Durchschläge (z.B. infolge starker Überspannung) einen starken Anstieg des Innendrucks verursachen. Zum Zwecke niedrigster Eigeninduktivität und maximalen Einbaufortschritts verfügen die Kondensatoren der PKmind®-Reihe nicht über einen internen Abschaltmechanismus. Sie sollten daher nicht außerhalb ihrer zulässigen Nennwerte betrieben und stets in unkritischer Umgebung (nichtentflammbare Materialien) platziert werden, wo die Freisetzung entzündlicher organischer Gase bzw. eine Entzündung des Dielektrikums keine schwerwiegenden Folgeschäden verursachen können.

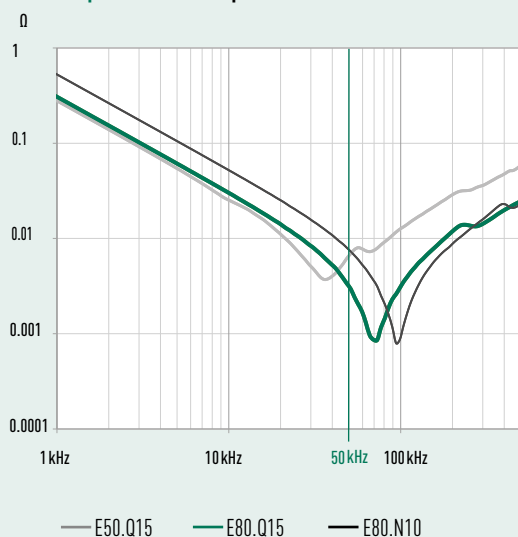
PKmind® vs. PK16™

Comparison of PKmind® E80.Q15-524NLO and a traditional PK16 of same size and rating. Thanks to the ultra-low inductance of 9 vs. 35nH, and excellent internal design, the auto-resonance frequency of PKmind® is more than double, and there are no further resonance points beyond 200 kHz. For SiC, the frequencies above 50kHz will be most essential.

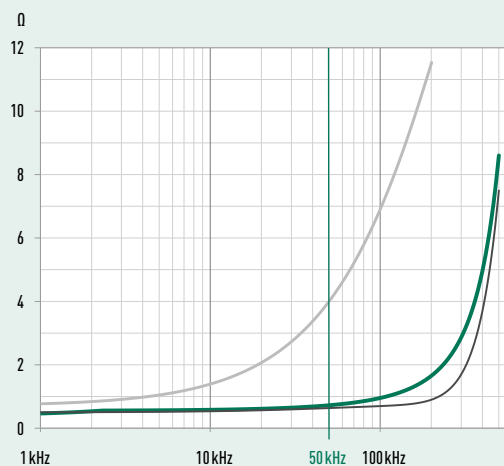
PKmind® vs. PK16™

PKmind® E80.Q15-524NLO und traditioneller PK16 gleicher Größe und Nennwerte im Vergleich. Dank ultraniedriger Induktivität von 9 gegenüber 35nH, und hervorragenden internen Designs liegt die Eigenresonanzfrequenz von PKmind® mehr als doppelt so hoch, und weist bis jenseits der 200 kHz keine weiteren Resonanzpunkte auf. Für SiC werden gerade die Frequenzen oberhalb 50 kHz am wichtigsten sein.

Impedance Impedanz $|Z| = f(f)$



Series Resistance Serienwiderstand



(Keysight Impedance Analyzer E4990A)

		Reference PK16™ E50.Q15-524N57	PKmind® E80.Q15-524NLO
Rated capacitance/voltage Nennkapazität/-spannung	C_N / U_N	520 μ F / 1100V	520 μ F / 1100V
Dimensions Abmessungen	$D_1 \times L_1$	$\varnothing 100 \times 155$ mm	$\varnothing 100 \times 155$ mm
Series resistance Serienwiderstand	R_s	0.7 m Ω	0.55 m Ω
Equivalent series resistance Ersatzwiderstand @ 10 kHz	ESR 10kHz	1 m Ω	0.58 m Ω
	ESR 100kHz	7 m Ω	1 m Ω
Rated current Nennstrom	I_{max}	80 A	100 A
Self-inductance Eigeninduktivität	L_e	35 nH	9 nH



Ultra-low-inductance DC capacitors
Extrem niederinduktive Zwischenkreiskondensatoren



Standards IEC 61071, optional IEC 61881
UL 810

can Gehäuse aluminium/plastic, (UL94: V0)

mounting position optional

Einbaulage beliebig

filling material solid PUR, based on plant oil

Füllmittel PUR ausgehärtet, auf Pflanzenölbasis

internal protection none

interne Sicherung keine

fire load Brandlast 40 MJ/kg

C_N tolerance Toleranz ±10%; optional ±5%

tanδ₀ 2 × 10⁻⁴

limit temperatures Grenztemperaturen

θ_{min} -40°C

θ_{max} (HOTSPOT) +85°C

storing temperature Lagertemperatur -40°C ... +85°C

Life time Lebensdauer > 200 000 h

Failure rate Ausfallrate 50 FIT¹

¹reference service life_Referenzbetriebsdauer 100 000 h, θ_{HOTSPOT} ≤ 70°C



C _N (μF)	R _s (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _s (kA)	E _N (Ws)	L _e (nH)	D ₁ × L ₁ (mm)	m (kg)	order no. Bestell-Nr.	pcs / Box Stk / Box
U_N 600V DC		U_r 100V		U_s 900V		U_{TT} 900V DC		U_{TC} 3300V AC/2s			
470	0.66	3.1	80	5.8	17.4	85	9	85 × 102	0.8	E80.N10-474NLO	10/FB10
650	0.63	3.1	80	8.1	24.3	117	9	100 × 102	1.1	E80.Q10-654NLO	6/FB10
840	0.87	3.8	80	5.8	17.4	151	10	85 × 155	1.1	E80.N15-844NLO	5/FB8
1030	0.99	3.3	80	5.8	17.4	185	12	85 × 181	1.3	E80.N18-105NLO	5/FB12
1200	0.75	3.1	100	8.2	24.6	216	9	100 × 155	1.5	E80.Q15-125NLO	3/FB8
1500	0.7	2.8	100	8.4	25.4	270	12	100 × 181	1.8	E80.Q18-155NLO	3/FB12
U_N 700V DC		U_r 200V		U_s 1050V		U_{TT} 1050V DC		U_{TC} 3300V AC/2s			
350	0.69	3.1	80	5.1	15.3	86	9	85 × 102	0.8	E80.N10-354NLO	10/FB10
490	0.65	3.1	80	7.1	21.3	120	9	100 × 102	1.1	E80.Q10-494NLO	6/FB10
630	0.91	3.8	80	5	15	154	10	85 × 155	1.1	E80.N15-634NLO	5/FB8
770	1	3.3	80	5	15	189	12	85 × 181	1.3	E80.N18-774NLO	5/FB12
900	0.78	3.1	100	7.2	21.6	221	9	100 × 155	1.5	E80.Q15-904NLO	3/FB8
1120	0.85	2.8	100	7.3	21.9	274	12	100 × 181	1.8	E80.Q18-115NLO	3/FB12
U_N 900V DC		U_r 200V		U_s 1350V		U_{TT} 1350V DC		U_{TC} 3360V AC/2s			
300	0.7	3.1	80	4.7	14.1	122	9	85 × 102	0.8	E80.N10-304NLO	10/FB10
440	0.65	3.1	80	6.9	20.7	178	9	100 × 102	1.1	E80.Q10-444NLO	6/FB10
530	0.9	3.8	80	4.6	13.8	215	10	85 × 155	1.1	E80.N15-534NLO	5/FB8
650	1.2	3.3	80	4.6	13.8	263	12	85 × 181	1.3	E80.N18-654NLO	5/FB12
780	0.6	3.1	100	6.8	20.4	316	9	100 × 155	1.5	E80.Q15-784NLO	3/FB8
955	0.75	2.8	100	6.8	20.4	387	12	100 × 181	1.8	E80.Q18-954NLO	3/FB12



C _N (μF)	R _s (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _s (kA)	E _N (Ws)	L _e (nH)	D ₁ × L ₁ (mm)	m (kg)	order no. Bestell-Nr.	pcs / Box Stk / Box
U_N 1100V DC		U_r 250V		U_s 1650V		U_{TT} 1650V DC		U_{Tc} 3840V AC/2s			
200	0.85	3.1	80	3.9	11.7	121	9	85 × 102	0.8	E80.N10-204NLO	10/FB10
290	0.5	3.1	80	5.6	16.8	175	9	100 × 102	1.1	E80.Q10-294NLO	6/FB10
370	1.2	3.8	80	4	12	224	10	85 × 155	1.1	E80.N15-374NLO	5/FB8
440	1.3	3.3	80	3.9	11.7	266	12	85 × 181	1.3	E80.N18-444NLO	5/FB12
520	0.55	3.1	100	5.6	16.8	315	9	100 × 155	1.5	E80.Q15-524NLO	3/FB8
650	0.7	2.8	100	5.7	17.1	393	12	100 × 181	1.8	E80.Q18-654NLO	3/FB12
U_N 1300V DC		U_r 300V		U_s 1950V		U_{TT} 1950V DC		U_{Tc} 4320V AC/2s			
130	0.9	3.1	80	3.1	9.3	110	9	85 × 102	0.8	E80.N10-134NLO	10/FB10
195	0.55	3.1	80	4.7	14.1	165	9	100 × 102	1.1	E80.Q10-194NLO	6/FB10
235	1.3	3.8	80	3.1	9.3	199	10	85 × 155	1.1	E80.N15-234NLO	5/FB8
290	1.4	3.3	80	3.2	9.6	245	12	85 × 181	1.3	E80.N18-294NLO	5/FB12
350	0.75	3.1	100	4.6	13.8	296	9	100 × 155	1.5	E80.Q15-354NLO	3/FB8
420	0.85	2.8	100	4.6	13.8	355	12	100 × 181	1.8	E80.Q18-424NLO	3/FB12
U_N 1600V DC		U_r 300V		U_s 2400V		U_{TT} 2400V DC		U_{Tc} 5040V AC/2s			
100	0.93	3.1	80	2.7	8.1	128	9	85 × 102	0.8	E80.N10-104NLO	10/FB10
140	0.6	3.1	80	3.8	11.4	179	9	100 × 102	1.1	E80.Q10-144NLO	6/FB10
180	1.2	3.8	80	2.7	8.1	230	10	85 × 155	1.1	E80.N15-184NLO	5/FB8
220	1.4	3.3	80	2.7	8.1	282	12	85 × 181	1.3	E80.N18-224NLO	5/FB12
250	0.84	3.1	100	3.7	11.1	320	9	100 × 155	1.5	E80.Q15-254NLO	3/FB8
300	0.93	2.8	100	3.7	11.1	384	12	100 × 181	1.8	E80.Q18-304NLO	3/FB12
U_N 2000V DC		U_r 500V		U_s 3000V		U_{TT} 3000V DC		U_{Tc} 6000V AC/2s			
71.5	0.6	4.7	65	2.6	7.8	143	9	100 × 102	1.1	E80.Q10-723NLO	6/FB10
130	1	3.3	70	2.6	7.8	260	10	100 × 155	1.5	E80.Q15-134NLO	3/FB8
165	1.1	3.2	70	2.7	8.1	330	12	100 × 181	1.8	E80.Q18-174NLO	3/FB12
U_N 2400V DC		U_r 600V		U_s 3600V		U_{TT} 3600V DC		U_{Tc} 6960V AC/2s			
50	0.55	4.7	65	4.8	14.4	144	9	100 × 102	1.1	E80.Q10-503NLO	6/FB10
95	0.7	3.3	70	4.8	14.4	274	10	100 × 155	1.5	E80.Q15-953NLO	3/FB8
115	0.8	3.2	70	4.7	14.1	331	12	100 × 181	1.8	E80.Q18-124NLO	3/FB12
140	0.88	2.5	70	4.8	14.4	403	20	100 × 204	2.0	E80.Q20-144NLO	3/FB12
U_N 2600V DC		U_r 600V		U_s 3900V		U_{TT} 3900V DC		U_{Tc} 7440V AC/2s			
44	0.55	4.7	65	4.4	13.2	149	9	100 × 102	1.1	E80.Q10-443NLO	6/FB10
84	0.75	3.3	70	4.5	13.5	284	10	100 × 155	1.5	E80.Q15-843NLO	3/FB8
105	0.85	3.2	70	4.5	13.5	355	12	100 × 181	1.8	E80.Q18-114NLO	3/FB12
125	0.9	2.5	70	4.5	13.5	423	20	100 × 204	2.0	E80.Q20-134NLO	3/FB12



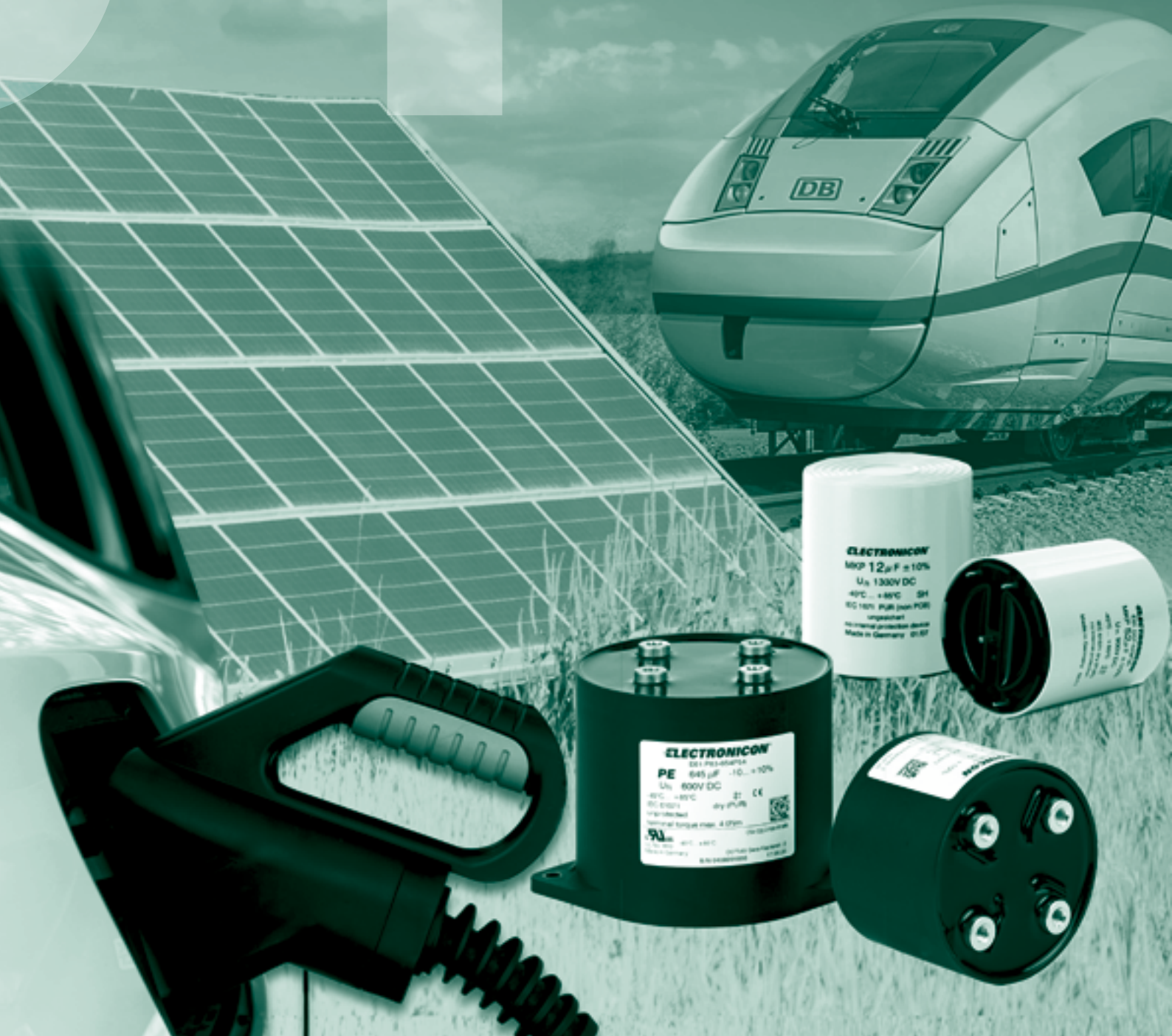


E61 – DIRECTLY ONTO BUS BAR OR PCB:

HIGH CURRENTS AND LOW INDUCTANCE

DIREKT AUF SAMMELSCHIENE ODER LEITERPLATTE:

HOHE STRÖME UND NIEDRIGE INDUKTIVITÄT



THE LOW-CAPACITANCE BUFFER CIRCUIT

DER KAPAZITÄTSARME ZWISCHENKREIS

3-Phase Frequency converters with Low-Capacitance DC-Link (LCDC)

Robots, elevators, assembly lines, processing centers, tooling machines – high process speed and further improvement of automation levels are unthinkable without frequency controlled AC drives. And it would not be possible to achieve the optimum operating characteristics at an economically feasible utilization level of available resources.

Most of the contemporary 3-phase frequency converters are working with a DC link, mainly using electrolytic capacitors to buffer the DC voltage. When selecting the electrolytic capacitors, the dominating criteria are the AC current load and the required operating life time. As a rule, this leads to the installation of large banks of electrolytic capacitors even though the large capacitance as such would not even be necessary for the buffering as such. These days, decentralized motors with integrated drive are becoming more and more popular. The advantages of this topology are more intelligent and flexible interconnection and control of the individual systems, as well as simplified and more convenient maintenance conditions. At the same time, developers are tasked to improve the technical performance of the electronic drives, reduce their mechanical dimensions and – of course – cost.



The „LCDC“ (DC buffer circuit with low, or small, capacitance) complies with all these requirements and has become possible with the high density DC film capacitors designed and manufactured by ELECTRONICON.

The capacitors of the E61 series are optimized for use in DC Link circuits with high rms and surge currents. The pin or screw terminals allow for direct integration into your printed circuit board or bus bar.

The winding is placed inside a flame retardant housing filled with solid resin (PUR). In order to minimize self-inductance and dimensions, the E61-capacitors are not equipped with an internal fail-safe device.

Capacitors with their comparably high fire load (appr. 40MJ/kg) do always bear a certain risk of collateral damage in the event of a failure. It is therefore necessary to place them in uncritical environment or integrate other proper measures of prevention.

Frequenzumrichter am 3-Netz mit kapazitätsarmem Zwischenkreis

Ob Roboter, Aufzüge, Fertigungsstraßen, Bearbeitungszentren, Werkzeugmaschinen – ohne frequenzgesteuerte Drehstromantriebe sind hohe Prozessgeschwindigkeiten und eine weitere Verbesserung des Automatisierungsgrades nicht zu erreichen. Ebenso wenig wäre es möglich, die optimale Betriebscharakteristik bei einem aus betriebswirtschaftlicher Sicht günstigen Einsatz der vorhandenen Mittel zu erreichen. Die meisten der heute eingesetzten 3-Phasen-Frequenzumrichter arbeiten mit einem Gleichspannungszwischenkreis. Zur Pufferung der Gleichspannung werden überwiegend Elektrolyt-Kondensatoren verwendet. Bei deren Dimensionierung sind die Wechselstrombelastung und die geforderte Lebensdauer die entscheidenden Kriterien. Dies führt zumeist zum Einsatz großer Batterien von Elektrolyt-Kondensatoren, obwohl die Gesamtkapazität zur Pufferung gar nicht benötigt wird. Zur Zeit gewinnen dezentral aufgestellte Motoren mit integriertem Antrieb immer mehr an Bedeutung. Die Vorteile dieser Topologie liegen in der flexibleren und intelligenteren Vernetzung und Ansteuerung der einzelnen Systeme, sowie in einem übersichtlicheren Wartungsaufwand. Einhergehend mit dieser Technologie werden an die Entwickler die Forderungen gestellt, die technische Performance der elektronischen Antriebe zu verbessern, die mechanischen Abmaße zu verkleinern und die Kosten zu reduzieren.

Eine Alternative, die allen diesen Forderungen gerecht wird, ist der „Niederkapazitive Gleichspannungszwischenkreis“, welcher dank der von ELECTRONICON entwickelten HD-DC-Kondensatoren möglich wurde.

E61-Kondensatoren sind optimal für die Anwendung in Gleichspannungszwischenkreisen mit hohen Effektiv- und Spitzenströmen. Die Pin- oder Schraub-Anschlüsse können zur direkten Montage auf der Leiterplatte oder Sammelschiene genutzt werden. Der Kondensatorwickel ist in einem flammhemmenden Gehäuse untergebracht und mit Harz vergossen. Die Forderung minimierter Eigeninduktivität und Gehäuseabmessungen lässt bei Kondensatoren dieser Bauart keinen integrierten Sicherheitsmechanismus zu.

Da Kondensatoren mit ihrer verhältnismäßig hohen Brandlast (ca. 40MJ/kg) im Fehlerfall stets ein gewisses Risiko für Folgeschäden bergen, ist es geboten, sie nur in unkritischer Umgebung oder in Verbindung mit zusätzlichen Vorbeugemaßnahmen zu installieren.

Example

Comparison between a DC link with electrolytic capacitors and film capacitors of our E61 series

(5kW drive, $\Theta_{\text{ambient}} = 70^{\circ}\text{C}$, target life time > 50.000 h):

Beispiel

Vergleich zwischen Gleichspannungszwischenkreisen mit Elektrolyt-Kondensatoren und solchen mit E61-Folienkondensatoren

(5kW Umrichter, $\Theta_{\text{Umgebung}} = 70^{\circ}\text{C}$, angestrebte Lebensdauer > 50.000 h):

	Elyt* 1300µF/450V	E61 48µF/900V
Circuitry		
ESR @ 300Hz	110 mΩ	4.3 mΩ
I_{rms} @ 300Hz	8 A	35 A
D × L	40 × 96 mm	50 × 57 mm
Volume per unit Volumen pro Einheit	120 cm ³	112 cm ³
Weight per unit Gewicht pro Einheit	170 g	120 g
Required quantity Benötigte Menge	6	1
Total volume installed Installiertes Gesamtvolumen	6 × 120 cm ³ = 720 cm ³	112 cm ³
Total weight installed Installiertes Gesamtgewicht	6 × 170 g = 1020 g	120 g

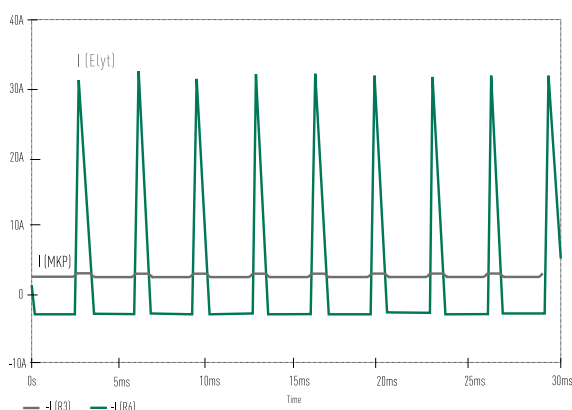
* example: market leading manufacturer
* Beispiel: marktführender Hersteller

Interactions with mains

The comparison of mains currents in the graphic to the right shows that the necessity for filtering is substantially reduced as well:

Netzrückwirkungen

Die in der Grafik zur rechten dargestellten Netzströme bedürfen hinsichtlich des erforderlichen Filteraufwandes sicher keines Kommentars:



Cost advantages

Presuming that the expenses for the sharing resistors and the charging circuit of the electrolytic capacitors equals more or less the cost of the additional buffering for the MKP circuit, we get a cost reduction by factor 5 when using MKP capacitors instead of electrolytic capacitors. This does not yet consider indirect savings by improved reliability of the final product, reduced power losses a.o.

Kostenvorteil

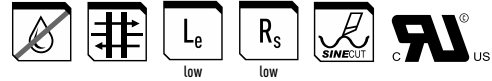
Veranschlagt man den Aufwand für Ladeschaltung und Symmetrierung der Elektrolytkondensatoren etwa genauso wie die nötige Pufferschaltung beim MKP-Zwischenkreis, so ergibt sich für MKP-Kondensatoren eine Kostenreduktion um Faktor 5 gegenüber Elko's, und das sogar ohne Berücksichtigung indirekter Einsparungen dank erhöhter Zuverlässigkeit, reduzierter Leistungsverluste u.ä.

E61.***
DC
500...900V

for latest edition and updates
check www.powercapacitors.info



Low-inductance DC capacitors Niederinduktive DC-Kondensatoren



Standards IEC 61071, optional IEC 61881, UL 810
can Gehäuse plastic Kunststoff (UL94: V0)
mounting position optional
Einbaulage beliebig
filling material solid, based on vegetable oil, non-PCB
Füllmittel ausgehärtet, auf Pflanzenölbasis, PCB-frei
internal protection none
interne Sicherung keine
fire load Brandlast 40 MJ/kg

C_N tolerance Toleranz ±10%
tanδ₀ 2 x 10⁻⁴
limit temperatures Grenzttemperaturen
θ_{min} ... θ_{max} -25°C ... +85°C
θ_{HOTSPOT} +85°C
storing temperature Lagertemperatur -40°C ... +85°C
Life time Lebensdauer > 200 000 h
Failure rate Ausfallrate 50 FIT
(reference service life_Referenzbetriebsdauer 100 000 h, θ_{HOTSPOT} <70°C)



C _N (μF)	R _s (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _s (kA)	E _N (Ws)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / Box Stk / Box
U_N 500V DC		U_s 750V		U_r 170V		U_{TT} 750V DC						
85	2	10.9	35	1.1	3.3	11.9	45	50 × 57	P3	0.12	E61.G57-853P3**	12 / FB4
195	3.4	7.4	25	1.1	3.3	24.4	66	50 × 95	P3	0.18	E61.G95-204P3**	12 / FB4
208	0.79	7.5	50	2.6	8	26	15	75 × 56	P5	0.3	E61.M56-214P5*	20 / FB2
260	5.2	6.1	30	1.1	3.3	32.5	110	50 × 120	P3	0.21	E61.G12-264P3**	12 / FB4
358	0.64	4.7	70	4	13	45	20	95 × 56	P5	0.48	E61.P56-364P5*	12 / FB4
542	0.57	3.1	80	8	26	68	25	95 × 83	P5	0.7	E61.P83-544P5*	12 / FB4
645	0.84	3.1	70	4	13	81	25	95 × 83	P5	0.7	E61.P83-654P5*	12 / FB4
U_N 700V DC		U_s 1050V		U_r 200V		U_{TT} 1050V DC						
58	1.9	10.9	30	0.9	2.7	14.2	45	50 × 57	P3	0.12	E61.G57-583P3**	12 / FB4
142	3.5	7.4	30	0.93	2.8	34.8	66	50 × 95	P3	0.18	E61.G95-144P3**	28 / FB4
154	0.85	7.5	50	2.2	7	38	15	75 × 56	P5	0.3	E61.M56-154P5*	20 / FB2
190	4.7	6.1	25	0.91	2.73	46.6	66	50 × 120	P3	0.21	E61.G12-194P3**	12 / FB4
265	0.67	4.7	65	4	11	65	20	95 × 56	P5	0.48	E61.P56-274P5*	12 / FB4
402	0.58	3.1	80	8	22	98	25	95 × 83	P5	0.7	E61.P83-404P5*	8 / FB2
480	0.89	3.1	70	4	11	118	25	95 × 83	P5	0.7	E61.P83-484P5*	8 / FB2
U_N 900V DC		U_s 1350V		U_r 200V		U_{TT} 1350V DC						
36	2.4	10.9	35	0.7	2.1	14.6	45	50 × 57	P3	0.12	E61.G57-363P3**	28 / FB4
45	2.1	10.9	35	0.8	2.4	18.2	45	50 × 57	P3	0.12	E61.G57-453P3**	28 / FB4
48	2.2	10.9	35	0.85	2.55	19.4	45	50 × 57	P3	0.12	E61.G57-483P3**	28 / FB4
112	4.1	7.4	32	0.84	2.52	43.7	66	50 × 95	P3	0.18	E61.G95-114P3**	12 / FB4
131	0.85	7.5	45	2.1	6.2	53	15	75 × 56	P5	0.3	E61.M56-134P5*	20 / FB2

*] 7 - without mounting brackets _ ohne Montagelasche
4 - with mounting brackets _ mit Montagelasche

**] Details design P3C and P30 see page 42
Details zu den Anschlüssen P3C und P30 siehe Seite 42

Other values and dimensions available on request.
Andere Werte und Abmessungen auf Anfrage erhältlich.



E61.***
DC
900...2600V

C _N (μF)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _S (kA)	W _N (Ws)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / Box Stk / Box
U _N 900V DC		U _S 1350V		U _r 260V		U _{TT} 1350V DC						
155	6	6.1	30	0.85	2.55	62.8	66	50 × 120	P3	0.21	E61.G12-164P3**	21 / FB2
226	0.69	4.7	65	3.6	10.7	92	20	95 × 56	P5	0.5	E61.P56-234P5*	21 / FB2
358	0.56	3.1	80	7.1	21.4	145	25	95 × 83	P5	0.7	E61.P83-364P5*	21 / FB2
409	0.94	3.1	70	3.6	10.7	166	25	95 × 83	P5	0.7	E61.P83-414P5*	21 / FB2
U _N 1100V DC		U _S 1650V		U _r 250V		U _{TT} 1650V DC						
30	2.8	10.9	20	0.64	1.92	18.2	45	50 × 57	P3	0.12	E61.G57-303P3**	28 / FB4
73	4.5	7.4	25	0.66	1.98	44	66	50 × 95	P3	0.18	E61.G95-733P3**	28 / FB4
83.5	1.01	7.5	40	1.6	5	51	15	75 × 56	P5	0.3	E61.M56-843P5*	20 / FB2
100	6.1	6.1	25	0.66	1.98	60.5	66	50 × 120	P3	0.21	E61.G12-104P3**	28 / FB4
144	0.76	4.7	60	2.8	8	87	20	95 × 56	P5	0.48	E61.P56-144P5*	28 / FB4
218	0.62	3.1	80	5.6	16	132	25	95 × 83	P5	0.7	E61.P83-224P5*	8 / FB2
260	1.05	3.1	65	2.8	8	157	25	95 × 83	P5	0.7	E61.P83-264P5*	8 / FB2
U _N 1300V DC		U _S 1950V		U _r 300V		U _{TT} 1950V DC						
12	4	10.9	20	0.38	1.14	10	45	50 × 57	P3	0.12	E61.G57-123P3**	21 / FB2
16.5	3	10.9	20	0.47	1.41	14	45	50 × 57	P3	0.12	E61.G57-173P3**	21 / FB2
40.5	5.7	7.4	25	0.49	1.47	34	66	50 × 95	P3	0.18	E61.G95-413P3**	21 / FB2
55	7.7	6.1	25	0.49	1.47	46	66	50 × 120	P3	0.21	E61.G12-553P3**	21 / FB2
56	1.13	7.5	40	1.3	4	47	15	75 × 56	P5	0.3	E61.M56-563P5*	20 / FB2
96	0.84	4.7	60	2.3	7	81	20	95 × 56	P5	0.48	E61.P56-963P5*	8 / FB2
145	0.65	3.1	75	4.6	14	123	25	95 × 83	P5	0.7	E61.P83-154P5*	8 / FB2
173	1.17	3.1	60	2.3	7	146	25	95 × 83	P5	0.7	E61.P83-174P5*	8 / FB2
U _N 2000V DC		U _S 3000V		U _r 500V		U _{TT} 3000V DC						
24	1.42	7.5	35	0.9	2.8	48	15	75 × 56	P5	0.3	E61.M56-243P5*	20 / FB2
41.5	1	4.7	50	1.6	5	83	20	95 × 56	P5	0.48	E61.P56-423P5*	12 / FB4
63	0.71	3.1	75	3.2	10	126	25	95 × 83	P5	0.7	E61.P83-633P5*	12 / FB4
72	1.48	3.1	55	1.5	5	144	25	95 × 83	P5	0.7	E61.P83-723P5*	12 / FB4
U _N 2200V DC		U _S 3300V		U _r 600V		U _{TT} 3300V DC						
18	1.62	7.5	35	0.8	2.3	44	15	75 × 56	P5	0.3	E61.M56-183P5*	20 / FB2
31	1.12	4.7	50	1.3	4	75	20	95 × 56	P5	0.48	E61.P56-313P5*	12 / FB4
50	0.73	3.1	70	3	10	121	25	95 × 83	P5	0.7	E61.P83-503P5*	12 / FB4
58	1.68	3.1	50	1.4	4	140	25	95 × 83	P5	0.7	E61.P83-583P5*	12 / FB4
U _N 2600V DC		U _S 3900V		U _r 600V		U _{TT} 3900V DC						
12	1.24	7.5	35	1.3	4	41	15	75 × 56	P5	0.3	E61.M56-123P5*	20 / FB2
21	0.89	4.7	50	2.2	7	71	20	95 × 56	P5	0.48	E61.P56-213P5*	12 / FB4



*) 7 - without mounting brackets _ ohne Montagelasche
4 - with mounting brackets _ mit Montagelasche

**) Details design P3C and P30 see page 42
Details zu den Anschlüssen P3C und P30 siehe Seite 42



E61.***

DC

3300...4000V



C _N (μF)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _S (kA)	E _N (Ws)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / Box Stk / Box
U _N 3300V DC		U _S 4950V		U _r 700V		U _{TT} 4950V DC						
7	1.42	7.5	30	1	3	38	15	75 × 56	P5	0.3	E61.M56-702P5*	20 / FB2
12.5	0.98	4.7	45	1.8	5	68	20	95 × 56	P5	0.48	E61.P56-133P5*	12 / FB4
24	1.39	3.1	50	1.8	5	131	25	95 × 83	P5	0.7	E61.P83-243P5*	12 / FB4
U _N 3600V DC		U _S 5400V		U _r 850V		U _{TT} 5400V DC						
6	1.52	7.5	25	0.9	2.8	39	15	75 × 56	P5	0.3	E61.M56-602P5*	20 / FB2
10	1.09	4.7	40	1.5	5	65	20	95 × 56	P5	0.48	E61.P56-103P5*	12 / FB4
20.5	1.48	3.1	45	1.6	5	133	25	95 × 83	P5	0.7	E61.P83-213P5*	12 / FB4
U _N 4000V DC		U _S 6000V		U _r 800V		U _{TT} 6000V DC						
3.5	1.92	7.5	25	0.7	2	28	15	75 × 56	P5	0.3	E61.M56-352P5*	20 / FB2
6.5	1.24	4.7	40	1.3	4	52	20	95 × 56	P5	0.48	E61.P56-652P5*	12 / FB4

*) 7 - without mounting brackets _ ohne Montagelasche

4 - with mounting brackets _ mit Montagelasche

ACCESSORIES, DIMENSION DRAWINGS

ZUBEHÖR, MASSZEICHNUNGEN





Holding Clamp for PK16™

To fulfill specific shock and vibration requirements, tall capacitors may not be sufficiently fixed by their mounting stud alone. Made from glass-fibre reinforced plastic (UL94-V0) with a brass thread, this clamp is designed to secure our GA85 and the 136mm diameter PK16 capacitors to each other and to the mounting surface. It provides additional stability during transport and operation. This construction has been tested successfully for compliance with railway shock and vibration standard IEC EN 61373.

The position of the holders can be arranged at will. Each capacitor should, however, be held by at least two, ideally by three or four clamps which should be allocated as symmetrically as possible. Achieve optimum stability by using the clamps for interlinking neighboring capacitor units.

Due to the internal temperature rise, capacitors are subject to slight expansion during operation. Use elastical plastic thread bars only for the link with the base plate to compensate for such expansion. 1m rods, washers and M8 full nuts can be provided as a kit along with the clamps.

Halteklammer für PK16™

Um speziellen Anforderungen an die Stoß- und Schwingungsbeständigkeit zu genügen, reicht bei hohen Kondensatoren die Befestigung mittels Bodenbolzen in manchen Fällen nicht aus. Diese Klammer aus glasfaserverstärktem Kunststoff (UL94-V0) mit Messinggewinde ist gedacht für die Verankerung unserer GA85 sowie der PK16-Kondensatoren des Durchmessers 136 mm, sowohl untereinander als auch mit dem Montageuntergrund. Sie schafft zusätzliche Stabilität für Transport und Betrieb. Die Konstruktion wurde erfolgreich nach IEC EN 61373 (Betriebsmittel von Bahnfahrzeugen – Prüfungen für Schwingen und Stoßen) getestet.

Die Position der Halter kann nach Belieben gestaltet werden. Jeder Kondensator sollte jedoch mindestens durch zwei, besser drei oder vier, möglichst symmetrisch angeordnete Klammern fixiert werden. Nutzen Sie für optimale Stabilität die Klammern, um benachbarte Kondensatoren miteinander zu verbinden.

Infolge Erwärmung dehnen sich Kondensatoren im Betriebszustand etwas aus. Verwenden Sie für die Verankerung in der Grundplatte ausschließlich elastische Zahnstangen aus Kunststoff, um eine solche Ausdehnung auszugleichen. 1-Meter-Zahnstangen, M8-Vollmuttern und Zahnscheiben können als Zubehör-set geliefert werden.

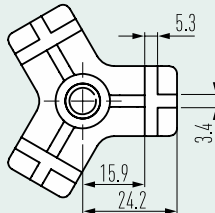
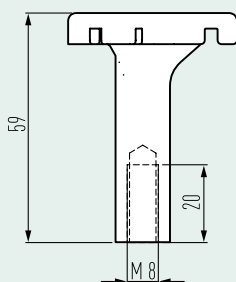
Description Beschreibung	Qty/set Menge/Set	order no. Bestell-Nr.
clamp Halter	10	E50.H03-10M8A8
full size nut Vollmutter M8	10	
toothed washer Zahnscheibe A 8.4	10	
threaded plastic rod Plastikzahnstange l = 1.0 m, M8, Polyamide 6.6	10	E50.GM8-PA1000

Required length of threaded rod Erforderliche Länge der Zahnstange:

$$L_{\text{rod}} = L_1 - 22\text{mm} + Y$$

L_{rod} Length of rod Länge der Zahnstange
 L_1 Length of capacitor case Gehäuselänge des Kondensators
 Y Thickness of mounting base Dicke der Montagebasis

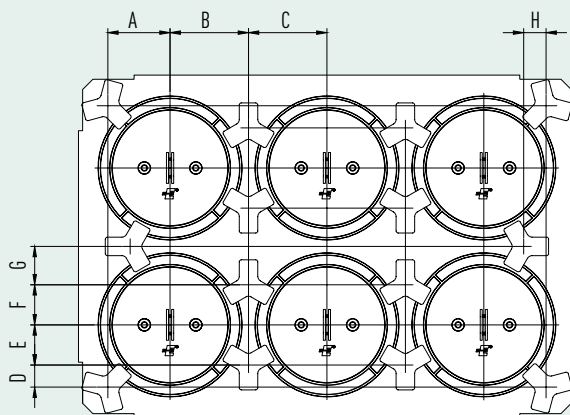
Drawings Maßbilder





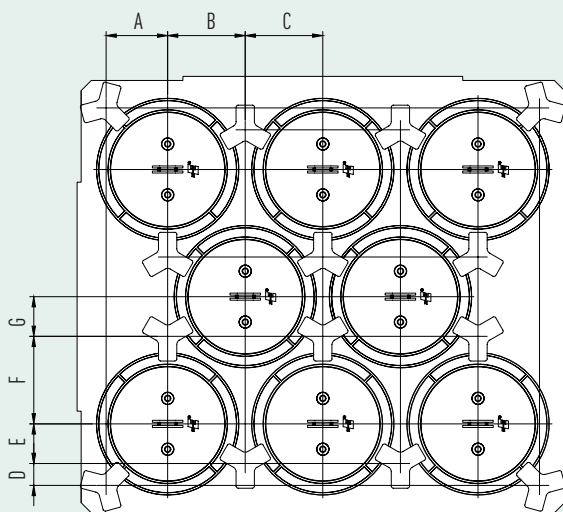
Suggested arrangements Einbauvorschläge (Design NT, Ø 136)

symmetrical installation symmetrische Anordnung



A	60.5
B	76.3
C	76.3
D	21.5
E	39
F	39
G	37.3
H	21.8

shifted installation versetzte Anordnung



A	60.5
B	76.3
C	76.3
D	21.5
E	39
F	86
G	39



Terminal Adapter

Customers who wish to connect their capacitors by male M8 terminals can upgrade our standard NT design by means of these adapters.

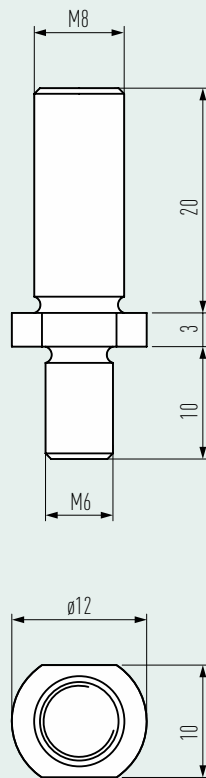
Please note: By inserting the adapters, the terminal level is elevated by 3mm.

Anschlussadapter M6x10-M8x20

Kunden, welche für ihre Anwendung Gewindebolzen mit M8 Außengewinde bevorzugen, können die Anschlüsse unserer Standardausführung NT mithilfe dieser Adapter nachrüsten.

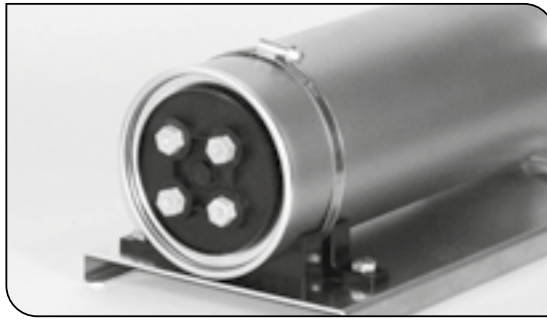
Bitte beachten Sie, daß die Anschlußebene hierbei um 3mm angehoben wird.

Drawings Maßbilder



Order no. Bestellnr. 200.050-A20970

material Material tinned brass Messing, verzinkt
 thread Gewinde $M6 \times 10 \text{ mm} / M8 \times 20 \text{ mm}$
 fixing torque Drehmoment 4 Nm
 max. rms current max. Effektivstrom 80 A



Holder for Horizontal Mounting

All cylindrical capacitors with diameter 116mm and 136mm can be mounted by means of this bracket on a flat vertical or horizontal surface.

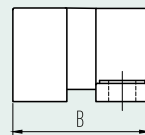
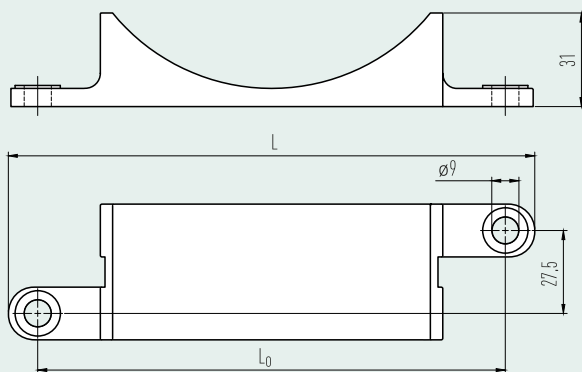
The bracket is made of glass fibre reinforced polyamide and comes as a set including a matching 9mm zinc-plated steel strap for fixation of the capacitor.

Halter für waagerechte Montage

Alle zylindrischen Kondensatoren mit Durchmesser 116mm und 136mm können mit Hilfe dieser Schelle auf einer senkrechten oder waagerechten Oberfläche montiert werden.

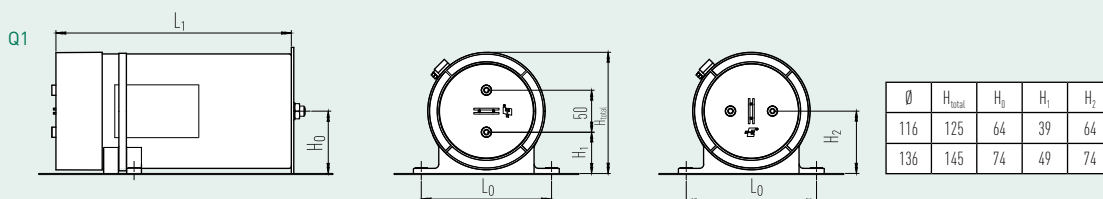
Der Halter ist aus glasfaserverstärktem Polyamid und wird inklusive passender 9mm-Schlauchschele aus verzinktem Stahl geliefert.

Drawings Maßbilder

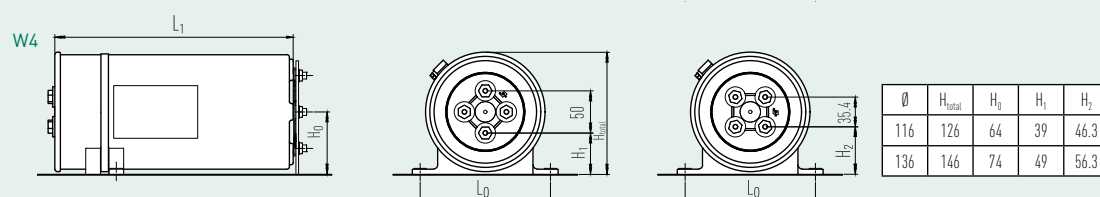


order no. Bestellnr.	Can size Bechergroße	L	B	L ₀
E50.H16-100000	Ø 116	159	45	135
E50.H36-100001	Ø 136	174	45	155

Series Baureihe E50 (PK16)



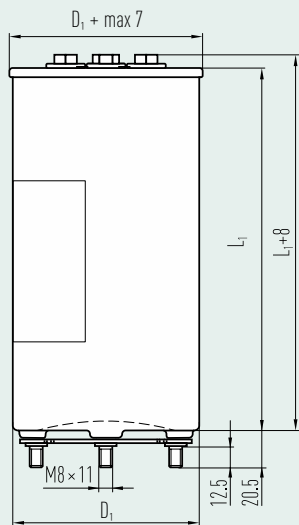
Series Baureihen E66...E68 (GA85)



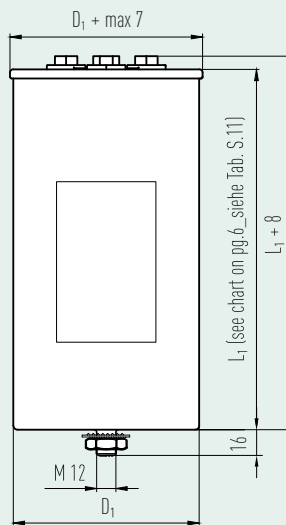


Design W4 / W6

E67

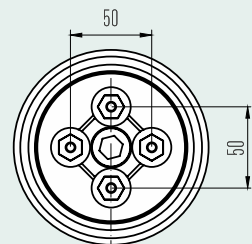


E66

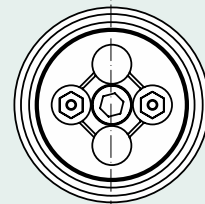


Principal circuit diagram W4
Prinzipschaltbild W4

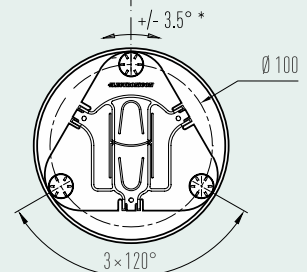
W4



W6



bottom view



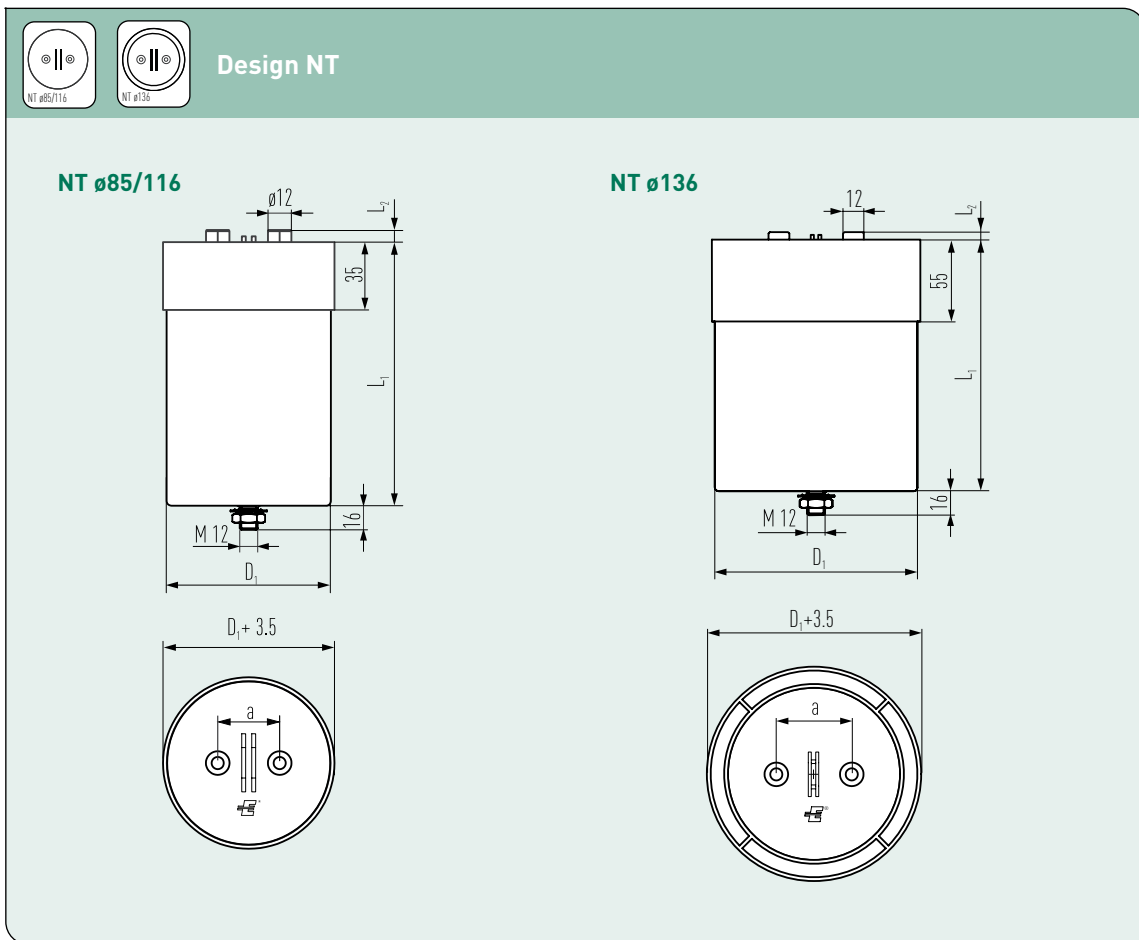
* Due to the manufacturing process, the position of the base screws in relation to the connections may deviate by up to 3.5° in both directions.
Fertigungsbedingt kann die Position der Bodenschrauben zu den Anschlüssen um bis zu 3,5° in beide Richtungen abweichen.

E67/E66 CAPACITORS

Can material	aluminium, filled with neutral gas (N ₂)
Lid	aluminium, folded edge
Terminals	plastic insulator (UL94: V0)
internal thread	iM6 × 12 mm (7.5 Nm), tinned brass with nickel barrier
I_{max} (Terminals)	120 A
Degree of protection	IP 00
K W4	25 mm
W6	33 mm
L W4	19.5 mm
W6	19.5 mm
Humidity Class	C, TX (IEC 62498-1)

E67/E66 KONDENSATOREN

Gehäusematerial	Aluminium, gefüllt mit neutralem Gas (N ₂)
Deckel	Aluminium, gebördelt
Anschlüsse	Kunststoffisolator (UL94: V0)
Innengewinde	iM6 × 12 mm (7,5 Nm) Messing verzinkt, mit Nickelsperrschicht
I_{max} (Anschlüsse)	120 A
Schutzgrad	IP 00
K W4	25 mm
W6	33 mm
L W4	19,5 mm
W6	19,5 mm
Feuchtekategorie	C, TX (IEC 62498-1)



E50 CAPACITORS WITH A CAN DIAMETER OF 85...136 mm

Can materialaluminium, filled with solid PU resin

Base mounting studM12

Lidplastic (UL94: V0)

Terminals.....internal thread iM6 × 10 mm (4 Nm),
tinned brass with nickel barrier

Degree of protectionIP 00

Humidity ClassT1 (IEC 62498-1)

E50 KONDENSATOREN MIT GEHÄUSEDURCHMESSER 85...136 mm

Gehäusematerial Aluminium, gefüllt mit ausgehärtetem
Polyurethanharz

Bodenschraube M12

Deckel Kunststoff (UL94: V0)

Anschlüsse..... Innengewinde iM6 × 10 mm (4 Nm),
Messing verzinkt, mit Nickelsperrschicht

Schutzgrad..... IP 00

Feuchtekategorie T1 (IEC 62498-1)

Design	K	L	L ₂	a	I _{max} (Terminals Anschlüsse)
NT ø85	36	20	6	32	90 A
NT ø116/136	45	35	5	50	120 A

N5 ø100



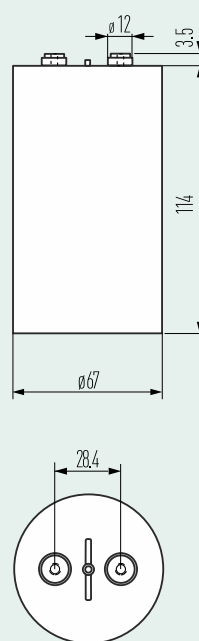
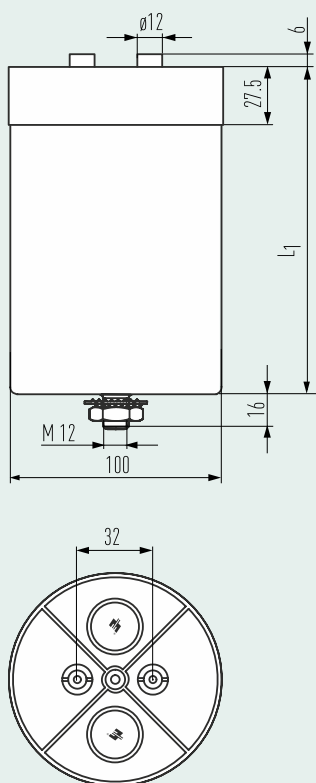
N4



Design N5



Design N4



E50 CAPACITORS WITH A CAN DIAMETER OF 100 mm

Can material:

- N5** aluminium, filled with solid
PU resin, plastic lid (UL94: V0)
- N4** plastic (UL94: V0), filled with solid
PU resin

Terminals internal thread, tinned brass with nickel barrier

- N5** iM6 × 10 mm (4 Nm)
- N4** iM5 × 6 mm (2 Nm)

Degree of protection IP 00

Humidity Class

- N5** T1 (IEC 62498-1)
- N4** G

E50 KONDENSATOREN MIT GEHÄUSEDURCHMESSER 100 mm

Gehäusematerial:

- N5** Aluminium, gefüllt mit ausgehärtetem
Polyurethanharz, Kunststoffdeckel (UL94: V0)
- N4** Kunststoff (UL94: V0), gefüllt mit ausgehärtetem
Polyurethanharz

Anschlüsse Innengewinde, Messing verzinkt, mit Nickelsperrschicht

- N5** iM6 × 10 mm (4 Nm)
- N4** iM5 × 6 mm (2 Nm)

Schutzgrad IP 00

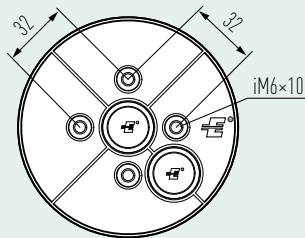
Feuchteklasse

- N5** T1 (IEC 62498-1)
- N4** G

Design	K	L	I _{max} (Terminals Anschlüsse)
N4	25	16	30 A
N5	36	20	80 A



Technical drawing of a square plate with a central hole and four corner holes. The drawing shows top and side views. Dimensions include: outer square side length $D_1 + 3.5$, central hole diameter $\varnothing 11$, corner hole diameter $\varnothing 11$, plate thickness 35, distance from corner to center hole L_1 , distance from corner to outer edge $L_1 + 6$, and distance from corner to center hole 16. A detail view of the corner hole shows an M12 thread.



Prinzipschaltbild



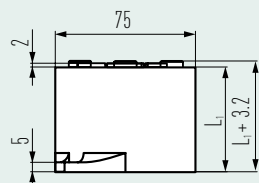
Gehäusematerial	Aluminium
Bodenschraube	M12
Deckel	Kunststoff UL94-V0
Anschlüsse	Messing verzinkt, Innengewinde iM6 × 10 mm (4Nm)
I_{max} (Anschlüsse)	120 A
Schutzgrad	IP 00
K	40 mm
L	20 mm
Feuchtekategorie	T1 (IEC 62498-1)



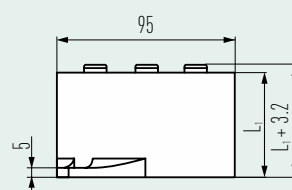
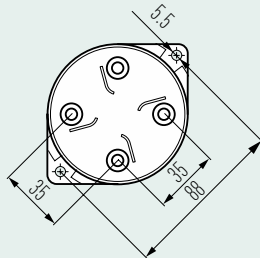
P57/P54



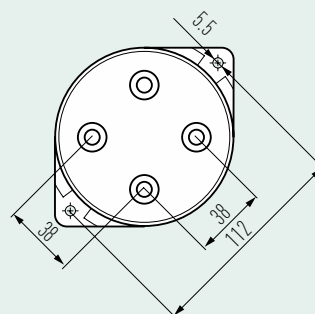
Design P54/P57



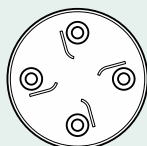
P54



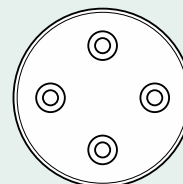
P54



P57



P57



Principal circuit diagram

Prinzipschaltbild

E61 CAPACITORS WITH A CAN DIAMETER OF 75...95 mm

Can material flame-retardant plastic, filled with PU resin
Fixing P57 can be fixed by terminals on PCB or bus bar

Terminals internal threads iM6 × 5mm,
 tinned brass with nickel barrier

I_{max} (Terminals) 40 A

Degree of protection IP 00

L ø 75 23 mm

L ø 95 26 mm

K 26 mm

Humidity class T1 (IEC 62498-1)

E61 KONDENSATOREN MIT DURCHMESSER 75...95 mm

Gehäusematerial flammhemmender Kunststoff, PU-Harzfüllung
Befestigung P57 mit Anschlüssen direkt auf Leiterplatte/
 Sammelschiene aufschraubbar

Anschlüsse Innengewinde iM6 × 5 mm,
 Messing verzinkt, mit Nickelsperrschicht

I_{max} (Anschlüsse) 40 A

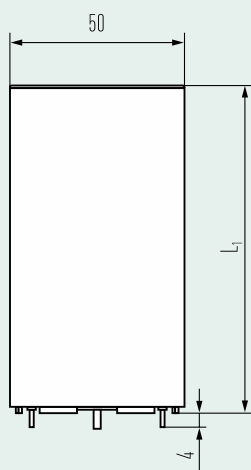
Schutzgrad IP 00

L ø 75 23 mm

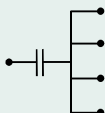
L ø 95 26 mm

K 26 mm

Feuchtklasse T1 (IEC 62498-1)



Prinzipschaltbild



Can material..... flame-retardant plastic (UL94: V0).
filled with solidified PUR resin

I_{m2V} (Terminals).....35 A

K..... 17.5 mm

Humidity class.....T1 (IEC 62498-1)

Gehäusematerial.....Flammhemmender Kunststoff (UL94: V0).
gefüllt mit ausgehärtetem Polyurethanharz

I_{max} (Anschlüsse) 35 A

K 17.5 mm

Feuchtekategorie T1 (IEC 62498-1)



Important Remarks

General

Our catalogues outline the typical technical and mechanical characteristics of the listed capacitors. The stated values are based on reference type tests, as well as empirical and experimental experience. The real values of individual capacitors may differ within the stated, or commonly known, tolerances. Any information given in this catalogue therefore describes the components in general terms and does not constitute any guarantee of individual technical values.

It is the responsibility of the user to ensure by dedicated tests the suitability and safety of operation of our components under the conditions of his application. This also applies to any accessories offered by ELECTRONICON.

Safety

Safe operation of the capacitors can be expected only if all safety recommendations as well as electrical and thermal specifications as stated on the label, in the data sheets, catalogues and the accompanying mounting instructions are strictly observed, and recommended safety devices are used as intended. Please consider the "General Safety Recommendations" of the power capacitor manufacturers organized in the German ZVEI (www.electronicon.com/en/zvei).

The capacitors shall only be used for the intended application. ELECTRONICON will not indemnify or be responsible for any kind of damages to persons or property due to the improper application of any capacitors purchased from ELECTRONICON or its distributors.

Mind that electrical or mechanical misapplication of capacitors can become hazardous. Misapplied capacitors can explode or catch fire and cause bodily injury or property damage due to the expulsion of material or metal fragments.

Please consult the detailed instructions for mounting and application stated in our brochure „Application Notes“ and on the ELECTRONICON website: www.electronicon.com/en/an

If in doubt about how to connect, operate, or discharge a capacitor, consult ELECTRONICON engineering or our distributors.

Mounting And Cooling

The useful life of a capacitor may be reduced dramatically if exposed to excessive heat. Typically an increase in the ambient temperature of 7°C will halve the expected life of the capacitor. Make sure to obey the permitted operating temperatures.

To avoid overheating the capacitors must be allowed to cool unhindered and should be shielded from external heat sources. We recommend forced ventilation for all filter applications with reactors. Give approx. 20mm clearance around capacitors for natural or forced ventilation, and do not place them directly above or next to heat sources such as detuning or tuning reactors, bus bars, etc.

Wichtige Hinweise

Allgemeines

Unsere Kataloge beschreiben die typischen technischen und mechanischen Eigenschaften der aufgeführten Kondensatoren. Die angegebenen Werte basieren auf Referenztypprüfungen sowie empirischen und experimentellen Erfahrungswerten. Die tatsächlichen Werte einzelner Kondensatoren können innerhalb der angegebenen bzw. allgemein bekannter Toleranzen abweichen. Alle Angaben in diesem Katalog beschreiben daher die Komponenten im Allgemeinen und stellen keine Garantie für individuelle technische Werte dar.

Es liegt in der Verantwortung des Anwenders, durch gezielte Prüfungen die Eignung und Betriebssicherheit unserer Komponenten unter den konkreten Betriebsbedingungen seiner Anwendung sicherzustellen. Dies gilt ebenso für gegebenenfalls von ELECTRONICON angebotene Zubehörteile.

Sicherheit

Ein sicherer Betrieb der Kondensatoren ist nur zu erwarten, wenn alle Sicherheitsempfehlungen sowie elektrische und thermische Spezifikationen entsprechend Etikett, Datenblättern, Katalogen und beiliegenden Montageanleitungen eingehalten und die empfohlenen Sicherheitseinrichtungen bestimmungsgemäß verwendet werden. Bitte beachten Sie die „Allgemeinen Sicherheitsempfehlungen“ der im deutschen ZVEI organisierten Hersteller von Leistungskondensatoren (www.electronicon.com/en/zvei).

Die Kondensatoren dürfen ausschließlich für ihren Bestimmungszweck verwendet werden. ELECTRONICON übernimmt keine Verantwortung oder Haftung für Schäden an Personen oder Eigentum, welche aus unsachgemäßer Anwendung von Kondensatoren herrührt.

Elektrisch oder mechanisch fehlerhaft eingesetzte Kondensatoren können explodieren oder Feuer fangen. Austretende Materialien bzw. Metallteile können gesundheitliche und materielle Schäden verursachen.

Bitte beachten Sie die detaillierten Anweisungen in unserer Broschüre „Anwendungshinweise“ sowie auf der Webseite von ELECTRONICON: www.electronicon.com/an

Bitte konsultieren Sie das Fachpersonal oder unsere Distributoren zu Fragen bezüglich Anschluss, Verwendung oder Entladung von Kondensatoren.

Montage und Kühlung

Die Lebensdauer eines Kondensators kann durch übermäßige Wärmeeinwirkung erheblich verringert werden. Im allgemeinen führt eine Erhöhung der Umgebungstemperatur um 7°C zu einer Verringerung der Lebensdauer des Kondensators um 50 %. Halten Sie die zugelassenen Betriebstemperaturen ein.

Um Überhitzung zu vermeiden, muß gewährleistet sein, daß die Kondensatoren auftretende Verlustwärme ungehindert abführen können und vor fremden Wärmequellen abgeschirmt werden. Insbesondere in Filtern ist in jedem Falle eine Zwangslüftung zu empfehlen. Zwischen und um Kondensatoren sollten etwa 20mm Platz für natürliche oder Zwangslüftung belassen werden. Bringen Sie den Kondensator nie direkt neben oder über Wärmequellen, wie Drosseln u. ä. an.

Protection against Overvoltages And Short Circuits: Self-Healing Dielectric

All dielectric structures used in our power capacitors are „selfhealing“: In the event of a voltage breakdown the metal layers around the breakdown channel are evaporated by the temperature of the electric arc that forms between the electrodes. They are removed within a few microseconds and pushed apart by the pressure generated in the centre of the breakdown spot. An insulation area is formed which is reliably resistive and voltage proof for all operating requirements of the capacitor. The capacitor remains fully functional during and after the breakdown.

For voltages within the permitted testing and operating limits the capacitors are short-circuit- and overvoltage-proof. They are also proof against external short circuits as far as the resulting surge discharges do not exceed the specified surge current limits.

Failure Rate

The failure probability of a component is a statistical value which is described by a log-normal distribution:

$$N = N_0 \times e^{-\lambda t}$$

λ is the failure rate, which alternatively is also stated as the so-called FIT-rate (FIT = Failures In Time = $\lambda \times 10^9$).

The failure rate is very closely linked with operating temperature and operating voltage of the capacitor. The FIT rates stated in this catalogue are related to the capacitor's rated voltage and a dielectric temperature (= HOTSPOT temperature) of 70°C.

The simultaneous operation of capacitors at highest permissible voltage and operating temperature should be avoided; otherwise, failure rates may increase beyond reasonable technical reliability.

The standard reference period for the failure rate statement is 100.000 hours. Please note that FIT rates can be altered or improved by technical adjustments. Please contact us for details.

The following diagram demonstrates the correlation between FIT rate, operating voltages and operating temperatures.

Schutz gegen Überspannungen und Kurzschlüsse: Selbstheilendes Dielektrikum

Alle in unseren Leistungskondensatoren eingesetzten dielektrischen Strukturen sind selbstheilend. Im Falle eines Kurzschlusses (Spannungsdurchschlag) verdampfen die Metallbeläge um den Durchschlagspunkt herum infolge des Lichtbogens, der sich zwischen den Elektroden bildet. Binnen Mikrosekunden wird der Metaldampf vom Zentrum des Durchschlages weggedrückt. Auf diese Weise bildet sich eine isolierende belagfreie Zone um den Durchschlagspunkt. Der Kondensator bleibt während und nach dem Durchschlag voll funktionsfähig.

Für Spannungen innerhalb der zugelassenen Test- und Betriebsbedingungen sind die Kondensatoren kurzschluss- und überspannungssicher. Sie sind außerdem sicher gegen äußere Kurzschlüsse, sofern bei den dabei entstehenden Stoßentladungen die zugelassenen Stoßströme nicht überschritten werden.

Ausfallrate

Die Ausfallwahrscheinlichkeit eines Bauelements ist eine statistische Größe, die mit Hilfe einer Normalverteilung beschrieben wird. Es gilt:

N = number of functional components after period t
Anzahl der nach der Zeit t intakten Bauelemente
 N_0 = total number of components at time $t = 0$
Gesamtzahl der Bauelemente zum Zeitpunkt $t = 0$
 λ = failure rate Ausfallrate

Dabei ist λ die Ausfallrate, die alternativ auch als FIT-Rate angegeben wird (FIT = $\lambda \times 10^9$)

Die Ausfallrate ist stark abhängig von der Temperatur und der Betriebsfeldstärke. Die FIT-Raten im Katalogsortiment beziehen sich auf 70°C Dielektrikumstemperatur (=Hotspot-Temperatur) und die Nennspannung des Kondensators.

Der Betrieb von Kondensatoren mit der höchsten zulässigen Spannung und der höchsten zulässigen Betriebstemperatur sollte vermieden werden, andernfalls können die Ausfallraten so hoch werden, dass keine technisch sinnvollen Zuverlässigkeiten mehr gewährleistet sind.

Der Wert für die Ausfallrate bezieht sich auf einen Referenzzeitraum von 100.000h. FIT-Raten können durch technische Anpassung der Kondensatoren beeinflusst und verbessert werden. Auskünfte hierzu erteilen wir auf Anfrage.

Das nachstehende Kurvendiagramm macht den Zusammenhang von FIT-Rate, Betriebsspannung und Betriebstemperatur deutlich.

50 FIT



100 FIT



Limited Warranty

All our products are designed, manufactured, and tested with the highest care and workmanship. The satisfaction of our customers is our highest goal. We therefore warrant remedying any defect in the goods resulting from faulty design, materials or workmanship, which appears within 2 years from the date of sale, unless agreed otherwise.

This warranty does not cover defects due to improper use of the goods or operation at conditions exceeding the rated values stated in the catalogue or special data sheet. Nor does it cover defects due to faulty maintenance or incorrect installation, alterations or faulty repairs undertaken by the Buyer. Finally the warranty does not cover normal wear and tear or deterioration.

See our „General Conditions“ for details on Warranty and Product liability.

Gewährleistung

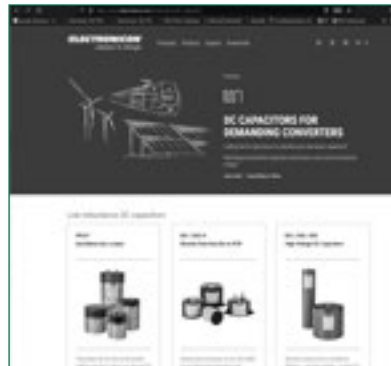
Alle unsere Erzeugnisse werden mit höchster Sorgfalt und Fachkenntnis entwickelt, hergestellt und geprüft. Die Zufriedenheit unserer Kunden ist unser höchstes Ziel. Wir verpflichten uns daher, sofern nicht anders vereinbart, jeden innerhalb von 2 Jahren ab Verkaufsdatum auftretenden Mangel an unseren Erzeugnissen zu beseitigen, welcher aus Fehlern in Design, Material oder Herstellung herrührt.

Diese Gewährleistung erstreckt sich nicht auf Defekte infolge unsachgemäßer Anwendung oder Betrieb außerhalb der nach Katalog oder Datenblatt zulässigen Einsatzbedingungen. Sie erfaßt ebensowenig Schäden aufgrund fehlerhafter Wartung, unsachgemäßer Montage, Änderungen oder unsachgemäßer Reparaturen durch den Käufer bzw. Anwender. Diese Gewährleistung betrifft auch nicht normale Abnutzung und Verschleiß.

Siehe unsere „Allgemeinen Geschäftsbedingungen“ für Details zu Gewährleistung und Produkthaftung.

Find more information and detailed instructions in our „Application Notes“ and on www.electronicon.com

Mehr Informationen und ausführliche Anweisungen finden Sie in unseren „Anwendungshinweisen“ und unter www.electronicon.com



NOTES
NOTIZEN

NOTES_NOTIZEN



APPLICATION NOTES AND GENERAL INFORMATION



ELECTRONICON®
always in charge



**CAPACITORS
FOR POWER ELECTRONICS**
KONDENSATOREN FÜR DIE LEISTUNGSELEKTRONIK

EXCELLENT EXPERIENCE IN CAPACITOR MAKING FOR OVER 80 YEARS

Gera has been a centre of capacitor making since 1938. ELECTRONICON Kondensatoren GmbH which emerged from previous RFT/VEB ELEKTRONIK Gera in 1992, has become one of Europe's leading capacitor manufacturers supplying customers worldwide and being an open and competent partner for manufacturers and users of power factor correction as well as industrial applications of power electronics, generation and transmission of green energy, traction, a.m.o. . Regular investments in advanced and environmentally sound technologies guarantee the highest levels in manufacture and quality to modern standards which are approved and monitored by leading certification authorities.



- In today's globalised competition, we distinguish ourselves by
- Absolute reliability and safety of our products
 - Close co-operation between manufacturer and client to meet both technical and commercial requirements
 - Improvement and development of our technical expertise in capacitor design and manufacture, as well as film coating, with special attention paid to the MKPg-technology
 - Early identification and incorporation of new trends and methods in the manufacturing of capacitors
 - Flexibility and punctual fulfilment of our commercial obligations

Our experienced development engineers are competent and responsible for both implementing the latest technical trends applicable to our products and ensuring that our products adapt to the challenges of traditional and new markets. The close and intense co-operation between the departments of Marketing & Sales, Research & Development, and Production has become the keystone of our success. ELECTRONICON constantly strives for similarly close and interactive relationships with her sales partners and direct customers at home and abroad, so that we are not just one of many suppliers, but your preferred partner for ideas and solutions.

ELECTRONICON®

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E-Mail: sales@electronicon.com, www.electronicon.com





E62-3ph AND 3HF

HEAVY DUTY THREE PHASE AC FILTER CAPACITORS



HIGH-END FOR THE HEART OF YOUR AC FILTER

ELECTRONICON®
always in charge

Choose the best capacitor
for any of your power electronics applications:

AC and DC capacitors with integrated safety mechanism
E62 AC/DC E62-3ph AC Filter E63 DC

Low-inductance capacitors
E50 PK16™ DC E53 AC/DC E61 DC

Low-inductance High-voltage capacitors
E51

AC and DC capacitors with large capacitance
E56 DC E59 AC/DC E70 AC E50.U SR17™ DC

CAPACITORS

ELECTRONICON®

always in charge

E62-3ph and 3HF: HEAVY DUTY THREE PHASE AC FILTER CAPACITORS

DREIPHASIGE AC FILTER-KONDENSATOREN





E62-3ph and 3HF High-End Capacitors for the Heart of your AC Filter

Our three-phase filter capacitors stand out by their high AC-voltage load capacity. They have been designed especially for heavy duty operation in extreme or sophisticated operating conditions, such as AC filtering and power factor correction in wind power and UPS applications, harmonic filtering in three-phase mains with high or unusual levels of harmonic distortion, a.m.o.

Thanks to their construction, they have a very low series resistance and a small self-inductance. Our basic design principle – preferring short winding elements with comparably large diameters – as well as the use of wavecut technology in many models, serves for high rms and surge current strength so important for all filter applications.

The three capacitor elements are connected in delta internally; the plant oil filling is environmentally friendly and serves for optimized heat dissipation and improved internal insulation. Many capacitors of the E62-3ph range are also available as completely dry option with nitrogen filling on request.

The finger-proof CAPAGRIP™ screw terminals of our E62-3ph series are rated IP20 and make for simple and reliable connections and easy addition of IP20-resistors or reactors for discharge.

Our new range E62-3HF is equipped with terminals optimized for the use in filters with very high harmonic frequencies of >1kHz.

The standard design has a long-term stable capacitance tolerance of $\pm 5\%$. Tighter tolerances are available on request.

Very good self-healing characteristics and the integrated overpressure protection (BAM™) ensure safe operation and controlled disconnection in the event of overload or failure at the end of operating life.

E62-3ph und 3HF High-End Kondensatoren für Ihren WechselspannungsfILTER

Unsere dreiphasigen Filterkondensatoren zeichnen sich durch hohe Wechselspannungsbelastbarkeit und Stoßspannungsfestigkeit aus. Sie wurden speziell für die Verwendung unter komplizierten Betriebsbedingungen entwickelt, wie sie zum Beispiel bei der Oberwellenfilterung in Dreiphasennetzen und beim Einsatz in Windkraftanlagen und USV auftreten.

Dank ihrer speziellen Konstruktion weisen sie besonders niedrige Serienwiderstände und geringe Eigeninduktivität auf. Unser grundlegendes Designprinzip – vorzugsweise flache Wickel mit verhältnismäßig großem Durchmesser – sowie die in vielen Modellen eingesetzte Wellenschnitt-Technologie ermöglichen die in Filteranwendungen so wichtige Festigkeit gegenüber hohen Effektiv- und Stoßströmen.

Die drei Kondensatorelemente sind intern im Dreieck verschaltet. Die umweltfreundliche Füllung mit Pflanzenöl sorgt für optimierte Ableitung der Verlustwärme und verbesserte Isolation. Viele Typen der E62-3ph Reihe sind auf Anfrage auch als komplett trockene Ausführung mit Stickstofffüllung erhältlich.

Die berührungsgeschützten CAPAGRIP™-Anschlüsse unserer E62-3ph Reihe mit Schutzgrad IP20 erleichtern die Montage und ermöglichen das einfache Hinzufügen von IP20-Entladewiderständen oder -drosseln.

Unsere neue Baureihe E62-3HF ist mit Anschlusselementen ausgestattet, die für den Gebrauch in Filtern mit sehr hohen Oberwellen von >1kHz optimiert wurden.

In der Standardausführung beträgt die Kapazitätstoleranz $\pm 5\%$. Engere Toleranzen sind auf Anfrage möglich.

Für einen sicheren Schutz bei Überlastung bzw. einen kontrollierten Ausfall am Ende der Lebensdauer sorgen die sehr gute Selbstheilfähigkeit sowie ein in den Kondensatoren integrierter Überdruck-Unterbrecher (BAM™).

E62 - 3ph
AC - Filter
640...750V AC

for latest edition and updates
check www.powercapacitors.info



Three phase AC-Filter Capacitors
Dreiphasige Wechselspannungs-Filterkondensatoren



Standards IEC 61071
optional IEC 61881
optional IEC 60831
UL810, CSA 22.2 No.190

can Gehäuse aluminium Aluminium
mounting position Einbaulage terminals pointing upwards stehend
filling material liquid, based on vegetable oil, non-PCB
optionally available with gas-filling
Füllmittel flüssig, auf Pflanzenölbasis, PCB-frei
optional auch mit Gasfüllung erhältlich
Internal protection break-action mechanism (BAM)
Interne Sicherung Überdrucksicherung
fire load Brandlast 40 MJ/kg
C_N tolerance Toleranz ±5%
tanδ₀ 2 x 10⁻⁴

operating temperatures Grenztemperaturen

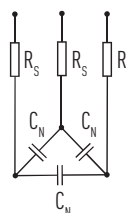
Θ_{min} ... Θ_{max} -50 ... +85°C
Θ_{HOTSPOT} ≤ 85°C

storing temperature Lagertemperatur -50 ... +85°C

statistical lifetime statistische Lebensdauer .. >200 000 h

Failure rate Ausfallrate 100 FIT

(reference service life_Referenzbetriebsdauer 100000 h, Θ_{HOTSPOT} ≤ 70°C)



Principal circuit diagram_Prinzipschaltbild



C _N (μF)	R _s (mΩ)	L _e (nH)	R _{th} (K/W)	I _{max} (A)	I _h (kA)	I _s (kA)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Box
U _N 640V AC		U _{rms} 450V		U _s 1380V		U _{BB} 1060V 50Hz AC / 2s		U _{BG} 3600V 50Hz AC / 2s			
3 × 24	3 × 1.5	110	6.3	3 × 16	0.67	2.01	60 × 151	D3	0.4	E62.K15-243D30	18 / FB7
3 × 33	3 × 1.2	90	4.7	3 × 56	0.9	2.7	75 × 164	L3	0.8	E62.M16-333L30	5 / FB8
3 × 40	3 × 1.2	130	4.7	3 × 56	1.1	3.3	75 × 164	L3	0.8	E62.M16-403L30	5 / FB8
3 × 46	3 × 1.1	110	4.1	3 × 56	1.3	3.9	85 × 164	L3	1	E62.N16-463L30	5 / FB8
3 × 51	3 × 1.1	140	4.1	3 × 56	1.4	4.2	85 × 164	L3	1	E62.N16-513L30	5 / FB8
3 × 57	3 × 0.8	120	3.7	3 × 56	1.6	4.8	95 × 164	L3	1.2	E62.P16-573L30	3 / FB8
3 × 68	3 × 0.5	120	3.7	3 × 56	1.9	5.7	95 × 164	L3	1.2	E62.P16-683L30	3 / FB8
3 × 80	3 × 0.5	100	3	3 × 56	2.6	7.8	116 × 164	L3	1.8	E62.R16-803L30	3 / FB8
3 × 100	3 × 0.4	100	3	3 × 56	3	9	116 × 164	L3	1.8	E62.R16-104L30	3 / FB8
3 × 135	3 × 0.55	130	2	3 × 80	2.3	5.9	116 × 245	M3	2.8	E62.R24-144M30	3 / FB12
3 × 154	3 × 0.6	145	2	3 × 80	1.9	5.7	100 × 280	M3	2.4	E62.Q28-154M30	3 / FB10
3 × 200	3 × 0.55	130	1.7	3 × 80	3.4	10.2	136 × 245	M3	3.8	E62.S24-204M30	2 / FB12

Other values and dimensions available on request.
Andere Werte und Abmessungen auf Anfrage erhältlich.

E62 - 3ph
AC - Filter
750...1130V AC

C _N (μF)	R _S (mΩ)	L _e (nH)	R _{th} (K/W)	I _{max} (A)	I _h (kA)	I _s (kA)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Bo×
U_N 750V AC		U_{rms} 530V		U_S 1610V		U_{BB} 1250V 50Hz AC / 2s		U_{BG} 3600V 50Hz AC / 2s			
3 × 23	3 × 1.2	100	4.7	3 × 56	0.86	2.58	75 × 164	L3	0.8	E62.M16-233L30	5 / FB8
3 × 29	3 × 1.2	130	4.1	3 × 56	1.1	3.3	85 × 164	L3	1	E62.N16-293L30	5 / FB8
3 × 30	3 × 1.2	120	4.1	3 × 56	1.1	3.3	85 × 164	L3	1	E62.N16-303L30	5 / FB8
3 × 38.4	3 × 0.65	120	3.7	3 × 56	1.4	4.2	95 × 164	L3	1.2	E62.P16-383L30	3 / FB8
3 × 48	3 × 0.75	100	3.1	3 × 56	1.8	5.4	100 × 164	L3	1.4	E62.Q16-483L30	3 / FB12
3 × 75	3 × 0.55	130	2	3 × 80	1.6	4.8	116 × 245	M3	2.8	E62.R24-753M30	3 / FB12
3 × 83	3 × 0.55	130	2	3 × 80	1.8	5.4	116 × 245	M3	2.8	E62.R24-833M30	3 / FB12
3 × 100	3 × 0.55	130	2	3 × 80	2	6	116 × 245	M3	2.8	E62.R24-104M30	3 / FB12
U_N 850V AC		U_{rms} 600V		U_S 1830V		U_{BB} 1420V 50Hz AC / 2s		U_{BG} 4800V 50Hz AC / 2s			
3 × 6.7	3 × 2	100	7.6	3 × 16	0.3	0.9	50 × 151	D3	0.3	E62.G15-672D30	21 / FB7
3 × 9	3 × 1.7	100	6.9	3 × 16	0.4	1.8	55 × 151	D3	0.4	E62.H15-902D30	18 / FB7
3 × 11	3 × 1.8	100	6.9	3 × 16	0.5	1.4	55 × 151	D3	0.4	E62.H15-113D30	18 / FB7
3 × 12	3 × 1.7	105	6.3	3 × 16	0.5	1.5	60 × 151	D3	0.5	E62.K15-123D30	18 / FB7
3 × 14	3 × 1.3	130	4.7	3 × 56	0.6	1.8	75 × 164	L3	0.8	E62.M16-143L30	5 / FB8
3 × 19	3 × 0.75	100	4.1	3 × 56	1.6	4.8	85 × 164	L3	1	E62.N16-193L30	5 / FB8
3 × 25	3 × 0.5	100	4.1	3 × 56	2.1	6.3	85 × 164	L3	1	E62.N16-253L30	3 / FB8
3 × 30	3 × 0.7	100	3.7	3 × 56	2.6	7.8	95 × 164	L3	1.2	E62.P16-303L30	3 / FB8
3 × 37.5	3 × 0.65	105	3.5	3 × 56	3	9	100 × 164	L3	1.4	E62.Q16-383L30	3 / FB8
3 × 50	3 × 0.35	120	2.5	3 × 80	3.5	10.5	116 × 196	M3	2.2	E62.R19-503M30	3 / FB8
3 × 86	3 × 0.65	130	2	3 × 56	1.9	5.7	116 × 245	L3	2.8	E62.R24-863L30	2 / FB12
U_N 1080V AC		U_{rms} 760V		U_S 2320V		U_{BB} 1800V 50Hz AC / 2s		U_{BG} 4800V 50Hz AC / 2s			
3 × 6.2	3 × 1.2	120	4.7	3 × 56	0.9	2.7	75 × 164	L3	0.8	E62.M16-622L30	5 / FB8
3 × 9.7	3 × 1.2	120	4.7	3 × 56	1.1	3.3	75 × 164	L3	0.8	E62.M16-972L30	5 / FB8
3 × 11	3 × 1.1	120	4.7	3 × 56	1.2	3.6	75 × 164	L3	0.8	E62.M16-113L30	5 / FB8
3 × 16.7	3 × 0.5	130	3.7	3 × 56	1.9	5.7	95 × 164	L3	1.2	E62.P16-173L30	3 / FB8
3 × 18	3 × 0.5	110	3.7	3 × 56	2	6	95 × 164	L3	1.2	E62.P16-183L30	3 / FB8
3 × 22	3 × 0.6	120	3.5	3 × 56	2.5	7.5	100 × 164	L3	1.5	E62.Q16-223L30	3 / FB8
3 × 27.6	3 × 0.4	120	3	3 × 56	3.1	9.3	116 × 164	L3	1.8	E62.R16-283L30	3 / FB8
3 × 33.4	3 × 0.4	110	3	3 × 56	3.6	10.8	116 × 164	L3	1.9	E62.R16-333L30	3 / FB8
3 × 55.7	3 × 0.4	130	2.1	3 × 56	5	15	136 × 196	L3	2.8	E62.S19-563L30	2 / FB12
3 × 55.7	3 × 0.7	130	2	3 × 80	3.3	9.9	116 × 245	M3	2.8	E62.R24-563M30	3 / FB12
U_N 1130V AC		U_{rms} 800V		U_S 2430V		U_{BB} 1890V 50Hz AC / 2s		U_{BG} 4800V 50Hz AC / 2s			
3 × 24.9	3 × 0.55	140	2.9	3 × 56	2.2	6.6	100 × 196	L3	1.6	E62.Q19-253L30	3 / FB12
3 × 33.4	3 × 0.55	130	2.5	3 × 56	1.9	5.7	95 × 245	L3	1.9	E62.P24-333L30	3 / FB12
3 × 41.5	3 × 0.6	140	2	3 × 56	2	6	100 × 280	L3	2.4	E62.Q28-423L30	3 / FB10
3 × 49	3 × 0.5	130	2	3 × 56	2.9	8.7	116 × 245	L3	2.8	E62.R24-493L30	3 / FB12

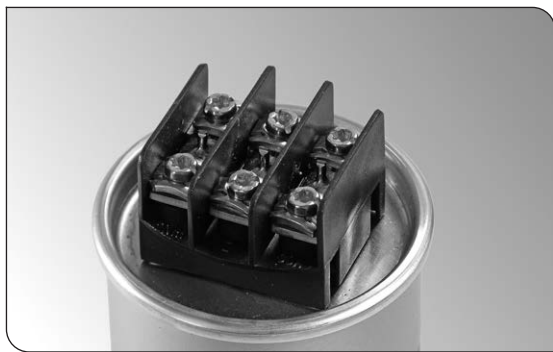


E62 - 3ph
AC - Filter
1200...1700V AC



C_N (μF)	R_s ($m\Omega$)	L_e (nH)	R_{th} (K/W)	I_{max} (A)	$\hat{I}$ (kA)	I_s (kA)	$D_1 \times L_1$ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Box
U_N 1200V AC		U_{rms} 850V		U_s 2580V		U_{BB} 2010V 50Hz AC / 2s		U_{B6} 4800V 50Hz AC / 2s			
3 × 2.5	3 × 1.8	100	7.6	3 × 16	0.33	1	50 × 151	D3	0.3	E62.G15-252D30	21 / FB7
3 × 3	3 × 1.7	100	7.6	3 × 16	0.43	1.3	50 × 151	D3	0.3	E62.G15-302D30	21 / FB7
3 × 4	3 × 1.6	100	7.6	3 × 16	0.5	1.5	50 × 151	D3	0.3	E62.G15-402D30	21 / FB7
3 × 8	3 × 1.3	120	4.7	3 × 56	1	3	75 × 164	L3	0.8	E62.M16-802L30	5 / FB8
3 × 12	3 × 1.1	120	4.1	3 × 56	1.5	4.5	85 × 164	L3	1.0	E62.N16-123L30	5 / FB8
3 × 23	3 × 0.5	110	3	3 × 56	2.8	8.4	116 × 164	L3	1.8	E62.R16-233L30	3 / FB8
3 × 25	3 × 0.4	130	3	3 × 56	2.8	8.4	116 × 164	L3	1.8	E62.R16-253L30	3 / FB8
3 × 33.4	3 × 0.55	130	2.3	3 × 56	2.1	6.3	100 × 245	L3	2.1	E62.Q24-333L30	3 / FB12
3 × 41.5	3 × 0.9	130	2	3 × 56	2.8	8.3	116 × 245	L3	2.8	E62.R24-413L30	3 / FB12
3 × 50	3 × 0.5	130	1.7	3 × 56	3.5	10.5	136 × 245	L3	3.8	E62.S24-503L30	2 / FB12
3 × 55.7	3 × 0.5	130	1.7	3 × 80	3.6	10.8	136 × 245	M3	3.8	E62.S24-563M30	2 / FB12
U_N 1400V AC		U_{rms} 1000V		U_s 3010V		U_{BB} 2370V 50Hz AC / 2s		U_{B6} 4800V 50Hz AC / 2s			
3 × 10	3 × 0.5	110	3	3 × 80	1.8	5.4	116 × 164	M3	1.8	E62.R16-103M30	3 / FB8
3 × 11	3 × 0.45	130	3	3 × 56	2	6	116 × 164	L3	2.1	E62.R16-113L30	3 / FB8
3 × 20	3 × 0.55	130	2.0	3 × 56	1.8	5.4	116 × 245	L3	2.8	E62.R24-203L30	3 / FB12
3 × 33	3 × 0.5	130	1.7	3 × 56	2.8	8.4	136 × 245	L3	3.8	E62.S24-333L30	2 / FB12
3 × 42	3 × 0.6	145	1.8	3 × 80	2.5	7.5	116 × 280	M3	3.2	E62.R28-423M30	3 / FB10
3 × 55.7	3 × 0.5	150	1.5	3 × 80	3.4	10	136 × 280	M3	4.4	E62.S28-563M30	2 / FB10
U_N 1700V AC		U_{rms} 1200V		U_s 3660V		U_{BB} 2840V 50Hz AC / 2s		U_{B6} 4800V 50Hz AC / 2s			
3 × 12	3 × 0.65	130	2.5	3 × 56	1.1	3.3	95 × 245	L3	1.9	E62.P24-123L30	3 / FB12
3 × 22	3 × 0.6	130	1.7	3 × 80	2.3	6.9	136 × 245	M3	3.8	E62.S24-223M30	2 / FB12

Other values and dimensions available on request.
Andere Werte und Abmessungen auf Anfrage erhältlich.



for latest edition and updates
check www.powercapacitors.info

E62 - 3HF
High Frequency
640V AC

Three phase AC Capacitors for High Filter Frequencies Dreiphasige Wechselspannungs-Kondensatoren für hohe Filterfrequenzen



Standards IEC 61071
optional IEC 61881
optional IEC 60831
UL810, CSA 22.2 No.190

can Gehäuse aluminium Aluminium
mounting position Einbaulage... terminals pointing upwards stehend
filling material liquid, based on vegetable oil, non-PCB
Füllmittel..... flüssig, auf Pflanzenölbasis, PCB-frei

Internal protection break-action mechanism (BAM)
Interne Sicherung Überdrucksicherung
fire load Brandlast 40 MJ/kg
C_N tolerance Toleranz ±5%
tan δ₀ 2 x 10⁻⁴

operating temperatures Grenztemperaturen

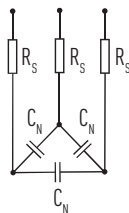
$\Theta_{min} \dots \Theta_{max}$ -50 ... +85°C
 $\Theta_{HOTSPOT}$ ≤ 85°C

storing temperature Lagertemperatur -50 ... +85°C

statistical lifetime statistische Lebensdauer... >200 000 h

Failure rate Ausfallrate 100 FIT

(reference service life_Referenzbetriebsdauer 100000 h, $\Theta_{HOTSPOT} \leq 70^\circ\text{C}$)



Principal circuit diagram_Prinzipschaltbild

C _N (μF)	R _s (mΩ)	L _e (nH)	R _{th} (K/W)	I _{max} (A)	I _h (kA)	I _s (kA)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Bo×
U _N 640V AC		U _{rms} 450V		U _s 1380V		U _{BB} 1060V 50Hz AC / 2s		U _{BG} 3600V 50Hz AC / 2s			
3 × 33	3 × 0.9	110	4.7	3 × 56	0.9	2.7	75 × 164	S4	0.8	E62.M16-333S40	5 / FB8
3 × 40	3 × 0.5	110	4.7	3 × 56	1.1	3.3	75 × 164	S4	0.8	E62.M16-403S40	5 / FB8
3 × 46	3 × 0.5	120	4.1	3 × 56	1.3	3.9	85 × 164	S4	1.0	E62.N16-463S40	5 / FB8
3 × 51	3 × 0.5	120	4.1	3 × 56	1.4	4.2	85 × 164	S4	1.0	E62.N16-513S40	5 / FB8
3 × 68	3 × 0.5	120	3.7	3 × 56	2	6	95 × 164	S4	1.2	E62.P16-683S40	3 / FB8
3 × 80	3 × 0.7	130	3.1	3 × 56	1.8	5.4	95 × 196	S4	1.5	E62.P19-803S40	3 / FB12
3 × 100	3 × 0.4	100	3	3 × 56	2.8	8.4	116 × 164	S4	1.8	E62.R16-104S40	3 / FB8
3 × 100	3 × 0.4	100	3	3 × 100	2.8	8.4	116 × 164	MB	1.8	E62.R16-104MB0	3 / FB8
3 × 200	3 × 0.5	130	1.7	3 × 100	3.3	10	136 × 245	MB	3.8	E62.S24-204MB0	2 / FB12



E62 - 3HF
High Frequency
750...1130V AC



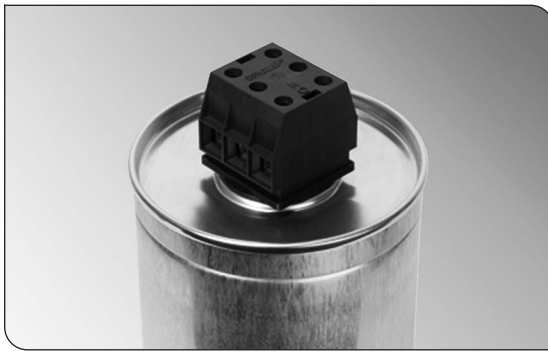
C _N (μF)	R _S (mΩ)	L _e (nH)	R _{th} (K/W)	I _{ma*} (A)	î (kA)	I _s (kA)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Bo*
U_N 750V AC		U_{rms} 530V		U_s 1610V		U_{BB} 1250V 50Hz AC / 2s		U_{BG} 3600V 50Hz AC / 2s			
3 × 16	3 × 0.9	100	5.4	3 × 39	0.6	1.8	65 × 164	Z3	0.6	E62.L16-163Z30	5 / FB8
3 × 23	3 × 0.5	110	4.7	3 × 39	0.85	2.5	75 × 164	S4	0.8	E62.M16-233S40	5 / FB8
3 × 30	3 × 0.7	120	4.1	3 × 56	1.1	3.3	85 × 164	S4	1	E62.N16-303S40	5 / FB8
3 × 38.5	3 × 0.7	125	3.7	3 × 56	1.4	4.2	95 × 164	S4	1.2	E62.P16-383S40	3 / FB8
3 × 48	3 × 0.5	130	3.5	3 × 56	1.7	5.1	100 × 164	S4	1.4	E62.Q16-483S40	3 / FB12
3 × 100	3 × 0.55	130	2	3 × 56	2	6	116 × 245	S4	2.8	E62.R24-104S40	3 / FB12
3 × 100	3 × 0.55	130	2	3 × 100	2	6	116 × 245	MB	2.8	E62.R24-104MB0	3 / FB12
U_N 850V AC		U_{rms} 600V		U_s 1830V		U_{BB} 1420V 50Hz AC / 2s		U_{BG} 4800V 50Hz AC / 2s			
3 × 9	3 × 0.8	100	5.8	3 × 39	0.8	2.4	60 × 164	Z3	0.5	E62.K16-902Z30	10 / FB8
3 × 11	3 × 0.9	100	5.4	3 × 39	1	3	65 × 164	Z3	0.6	E62.L16-113Z30	5 / FB8
3 × 12	3 × 0.9	100	5.4	3 × 39	1.1	3.3	65 × 164	Z3	0.6	E62.L16-123Z30	5 / FB8
3 × 14	3 × 0.5	120	4.7	3 × 39	1.2	3.6	75 × 164	S4	0.8	E62.M16-143S40	5 / FB8
3 × 19	3 × 0.5	120	4.1	3 × 56	1.7	5.1	85 × 164	S4	1	E62.N16-193S40	5 / FB8
3 × 25	3 × 0.6	120	3.7	3 × 56	2.2	6.6	95 × 164	S4	1.2	E62.P16-253S40	3 / FB8
3 × 30	3 × 0.7	110	3.7	3 × 56	2.6	7.8	95 × 164	S4	1.2	E62.P16-303S40	3 / FB8
3 × 37.5	3 × 0.45	110	3	3 × 56	3.2	9.6	116 × 164	S4	1.9	E62.R16-373S40	3 / FB8
3 × 72.5	3 × 0.5	130	2	3 × 56	3.6	10.8	116 × 245	S4	2.8	E62.R24-723S40	3 / FB12
3 × 100	3 × 0.5	130	1.7	3 × 100	5	15	136 × 245	MB	3.8	E62.S24-104MB0	2 / FB12
U_N 1080V AC		U_{rms} 760V		U_s 2320V		U_{BB} 1800V 50Hz AC / 2s		U_{BG} 4800V 50Hz AC / 2s			
3 × 11	3 × 1	110	4.7	3 × 39	1.2	3.6	75 × 164	S4	0.8	E62.M16-113S40	5 / FB8
3 × 18.4	3 × 0.5	125	3.7	3 × 56	1.9	5.7	95 × 164	S4	1.2	E62.P16-183S40	3 / FB8
3 × 22	3 × 0.5	130	3.1	3 × 56	2	6	95 × 196	S4	1.5	E62.P19-223S40	3 / FB12
3 × 27.6	3 × 0.4	120	3	3 × 56	3.1	9.3	116 × 164	S4	1.8	E62.R16-283S40	3 / FB8
3 × 55.7	3 × 0.4	130	2.1	3 × 56	5	15	136 × 196	S4	3	E62.S19-563S40	2 / FB12
3 × 55.7	3 × 0.5	130	2	3 × 100	3.1	9.3	116 × 245	MB	2.8	E62.R24-563MB0	2 / FB12
3 × 75	3 × 0.5	130	1.7	3 × 100	4.4	13.2	136 × 245	MB	3.8	E62.S24-753MB0	2 / FB12
U_N 1130V AC		U_{rms} 800V		U_s 2430V		U_{BB} 1890V 50Hz AC / 2s		U_{BG} 4800V 50Hz AC / 2s			
3 × 33.4	3 × 0.55	130	2.5	3 × 56	1.9	5.7	95 × 245	S4	1.9	E62.P24-333S40	3 / FB12
3 × 46	3 × 0.55	130	2	3 × 56	2.8	8.3	116 × 245	S4	2.8	E62.R24-463S40	3 / FB12
3 × 49	3 × 0.5	130	2	3 × 56	2.9	8.7	116 × 245	S4	2.8	E62.R24-493S40	3 / FB12

Other values and dimensions available on request.
Andere Werte und Abmessungen auf Anfrage erhältlich.

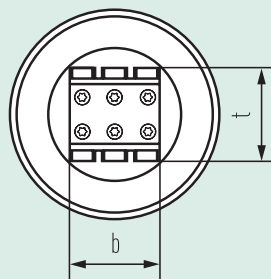
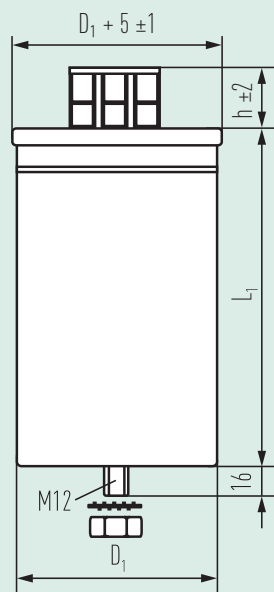
E62 - 3HF
High Frequency
1200...1400V AC

C_N (μF)	R_s ($m\Omega$)	L_e (nH)	R_{th} (K/W)	$I_{ma\kappa}$ (A)	$\hat{I}$ (kA)	I_s (kA)	$D_1 \times L_1$ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Bo×
U_N 1200V AC		U_{rms} 850V		U_S 2580V		U_{BB} 2010V 50Hz AC / 2s			U_{BG} 4800V 50Hz AC / 2s		
3 × 8	3 × 1	110	4.7	3 × 39	1	3	75 × 164	S4	0.8	E62.M16-802S40	5 / FB8
3 × 25	3 × 0.4	110	3.0	3 × 56	3.2	9.6	116 × 164	S4	1.8	E62.R16-253S40	3 / FB12
3 × 37.5	3 × 0.55	130	2.0	3 × 56	2.6	7.8	116 × 245	S4	2.8	E62.R24-373S40	3 / FB12
3 × 41.5	3 × 0.6	130	2.0	3 × 100	2.6	7.8	116 × 245	MB	2.8	E62.R24-413MB0	3 / FB12
3 × 55.7	3 × 0.5	130	1.7	3 × 100	3.6	10.8	136 × 245	MB	3.8	E62.S24-563MB0	2 / FB12
U_N 1400V AC		U_{rms} 1000V		U_S 3000V		U_{BB} 2370V 50Hz AC / 2s			U_{BG} 4800V 50Hz AC / 2s		
3 × 10	3 × 0.5	110	3.0	3 × 100	1.8	5.4	116 × 164	MB	1.8	E62.R16-103MB0	3 / FB12
3 × 33	3 × 0.55	130	1.7	3 × 100	2.8	8.4	136 × 245	MB	3.8	E62.S24-333MB0	2 / FB12
3 × 42	3 × 0.6	145	1.8	3 × 56	2.5	7.5	116 × 280	S4	3.1	E62.R28-423S40	3 / FB10





Design L / M CAPAGRIP™



CAPACITORS WITH A CAN DIAMETER OF 75...136 mm

Can material.....aluminium
Base mounting stud.....M12
Lid.....flanged aluminium (folded edge)
Humidity class.....C, TX (IEC 62498-1)
Degree of protection.....IP 20

Terminal L3

Contact..... $2 \times 25 \text{ mm}^2$, M5, TORX T20
Torque.....2.5...3 Nm
 I_{max}56 A
K.....16 mm
L.....16 mm

Terminal M3

Contact..... $2 \times 50 \text{ mm}^2$, M6, TORX T20
Torque.....3.2...3.7 Nm
 I_{max}104 A
K.....16 mm
L.....16 mm

KONDENSATOREN MIT EINEM GEHÄUSEDURCHMESSER VON 75...136

Gehäusematerial.....Aluminium
Bodenschraube.....M12
Deckel.....Aluminium, Bördelverschluss
Feuchtekategorie.....C, TX (IEC 62498-1)
Schutzgrad.....IP 20

Anschluss L3

Kontakte..... $2 \times 25 \text{ mm}^2$, M5, TORX T20
Drehmoment.....2.5...3 Nm
 I_{max}56 A
K.....16 mm
L.....16 mm

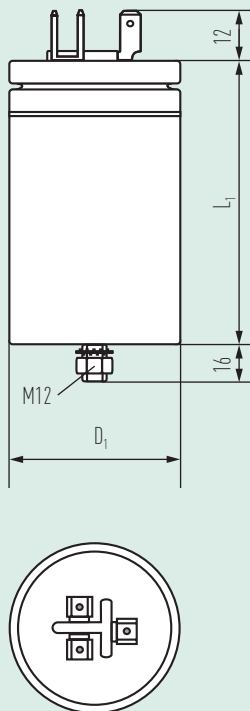
Anschluss M3

Kontakte..... $2 \times 50 \text{ mm}^2$, M6, TORX T20
Drehmoment.....3.2...3.7 Nm
 I_{max}104 A
K.....16 mm
L.....16 mm

	Design L3		Design M3	
	≤ Ø 100	≥ Ø 116	≤ Ø 100	≥ Ø 116
h	35	31	48	43
b	42	42	49	49
t	44	44	55	55



Design D3

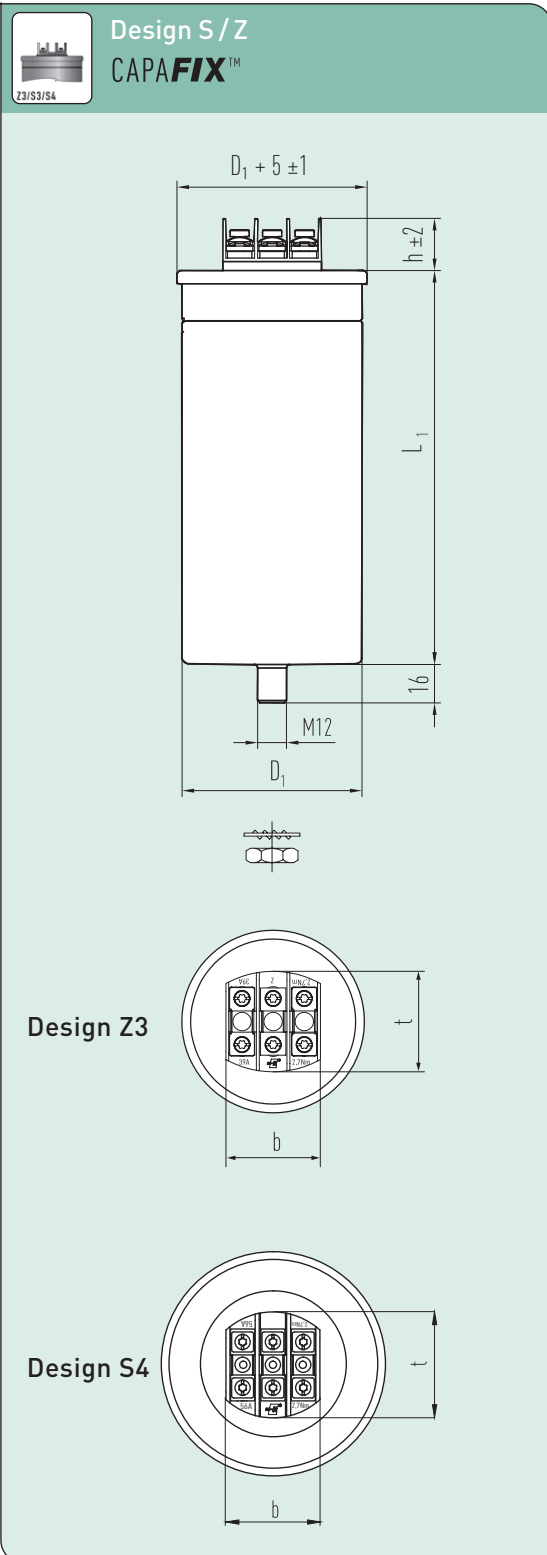
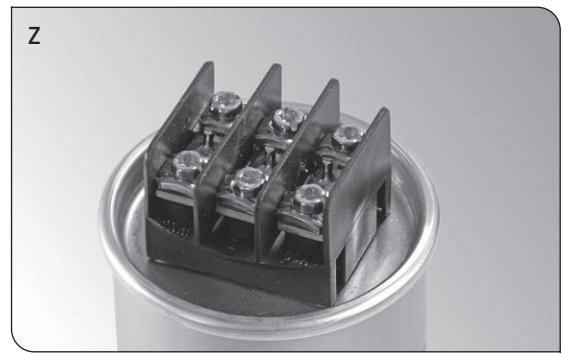


CAPACITORS WITH A CAN DIAMETER OF 50...75 mm

Can material	aluminium
Base mounting stud	M12
Lid	plastic with rubber sealing, flanged can
Terminals	dual tab connectors 6.3 x 0.8 mm (tinned brass, riveted)
I _{max} (Terminals)	16 A
Degree of protection	IP 00
L	7 mm
K	10 mm
Humidity class	T1 (IEC 62498-1)

KONDENSATOREN MIT EINEM GEHÄUSEDURCHMESSER VON 50...75

Gehäusematerial	Aluminium
Bodenschraube	M12
Deckel	Kunststoff, Bördelverschluss mit Gummidichtung
Anschlüsse	Doppelflachstecker 6.3 x 0.8 mm (Messing, verzinkt, genietet)
I _{max} (Anschlüsse)	16 A
Schutzgrad	IP 00
L	7 mm
K	10 mm
Feuchtekategorie	T1 (IEC 62498-1)



CAPACITORS WITH A CAN DIAMETER OF 60...116 mm

Can material.....aluminium
Base mounting studM12
Lid flanged.....aluminium (folded edge)
Humidity class.....C, TX (IEC 62498-1)
Degree of protectionIP 00

Terminal Z3

Contact.....2 × 10 mm², M4 TORX T20
Torque.....2...2.7 Nm
I_{max}.....39 A
K.....10 mm
L.....10 mm

Terminal S4

Contact.....2 × 16 mm², M5 TORX T20
Torque.....3.7 ... 4 Nm
I_{max}.....56 A
K.....11 mm
L.....11 mm

KONDENSATOREN MIT EINEM GEHÄUSEDURCHMESSER VON 60...116 mm

Gehäusematerial.....Aluminium
Bodenschraube.....M12
Deckel.....Aluminium, Bördelverschluss
Feuchtekategorie.....C, TX (IEC 62498-1)
Schutzgrad.....IP 00

Anschluss Z3

Kontakte.....2 × 10 mm², M4 TORX T20
Drehmoment.....2...2.7 Nm
I_{max}.....39 A
K.....10 mm
L.....10 mm

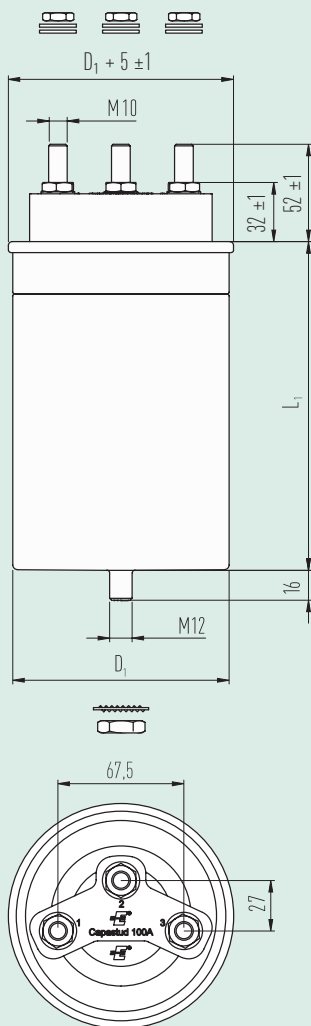
Anschluss S4

Kontakte.....2 × 16 mm², M5 TORX T20
Drehmoment.....3.7 ... 4 Nm
I_{max}.....56 A
K.....11 mm
L.....11 mm

	Design Z3	Design S4	
		≤ Ø 100	≥ Ø 116
h	22	23	18
b	41	47	47
t	43.5	53	35



Design MB



CAPACITORS WITH A CAN DIAMETER OF 116/136 mm

Can material	aluminium
Base mounting stud	M12
Lid	flanged aluminium (folded edge)
Humidity class	C
Degree of protection	IP 00
Terminals	brass stud M10
Torque	7.5...10 Nm
I _{max} (Terminals)	100 A
K	25 mm
L	20 mm

KONDENSATOREN MIT GEHÄUSEDURCHMESSER 116/136 mm

Gehäusematerial	Aluminium
Bodenschraube	M12
Deckel	Aluminium, Bördelverschluss
Feuchtekategorie	C
Schutzgrad	IP 00
Anschluss	Messingbolzen M10
Drehmoment	7.5...10 Nm
I _{max} (Anschlüsse)	100 A
K	25 mm
L	20 mm

ACCESSORIES ZUBEHÖR



Protection Covers for CAPAFIX™ S and Z

Separate snap-on covers are available for terminals of the CAPAFIX™ series for protection of the operator from accidental contact. This kind of protection is comparable with IP10 (solid objects up to 50 mm, e.g. accidental touch by hands); however as the cover is removable without the aid of tools, IP rating does not apply.



Schutzabdeckungen für CAPAFIX™ S und Z

Aufschnappbare Schutzabdeckungen sind separat für Kondensatoren mit CAPAFIX™ Anschlüssen erhältlich.

Sie dienen dem Schutz vor zufälliger Berührung, vergleichbar mit IP10 (feste Objekte bis 50 mm, Handrückenschutz); da die Abdeckung ohne Zuhilfenahme von Werkzeugen entfernbar ist, findet die IP-Klassifizierung jedoch keine Anwendung.

Order No. Bestell-Nr.

CAPAFIX™ S: 275.109-S40000

CAPAFIX™ Z: 275.109-Z00000



Holder for Horizontal Mounting

All cylindrical capacitors with diameter 116mm and 136mm can be mounted by means of this bracket on a flat vertical or horizontal surface.

The bracket is made of glass fibre reinforced polyamide and comes as a set including a matching 9mm zinc-plated steel strap for fixation of the capacitor.

As an alternative option, the capacitors can also be fixed by plastic cable ties (commercially available standard parts).

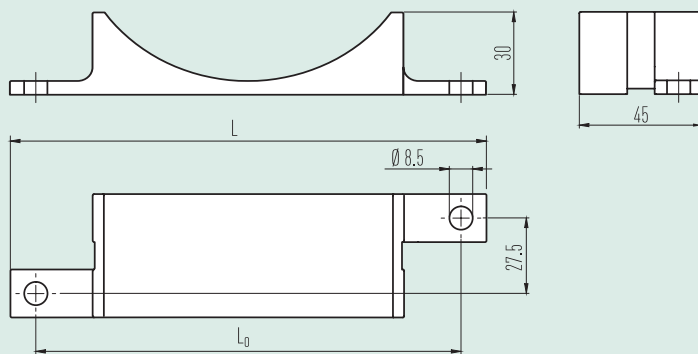
Halter für waagerechte Montage

Alle zylindrischen Kondensatoren mit Durchmesser 116mm und 136mm können mit Hilfe dieser Schelle auf einer senkrechten oder waagerechten Oberfläche montiert werden.

Der Halter ist aus glasfaserverstärktem Polyamid und wird inklusive passender 9mm-Schlauchschelle aus verzinktem Stahl geliefert.

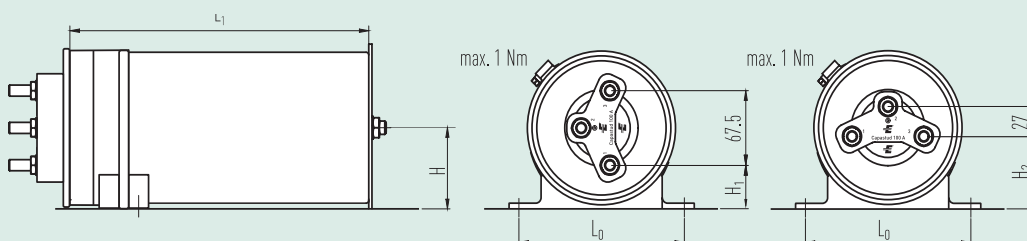
Alternativ können die Kondensatoren auch mit handelsüblichen Kunststoffkabelbindern befestigt werden.

Drawings Maßbilder



material Material glass fibre reinforced polyamide glasfaserverstärktes Polyamid

Example for MB design Beispiel für MB-Design



Example of horizontal mounting.
Beispiel für eine waagerechte Befestigung.

for Diameter für Durchmesser	L	L ₀	H	H ₁	H ₂	order no. (10 × mounting set) Bestell-Nr. (10 × Montage-Set)
116	159	135	64	30,3	56	E50.H16-100000
136	174	155	74	40,3	66	E50.H36-100001

Important Remarks

General

Our catalogues outline the typical technical and mechanical characteristics of the listed capacitors. The stated values are based on reference type tests, as well as empirical and experimental experience. The real values of individual capacitors may differ within the stated, or commonly known, tolerances. Any information given in this catalogue therefore describes the components in general terms and does not constitute any guarantee of individual technical values.

It is the responsibility of the user to ensure by dedicated tests the suitability and safety of operation of our components under the conditions of his application. This also applies to any accessories offered by ELECTRONICON.

Safety

Safe operation of the capacitors can be expected only if all safety recommendations as well as electrical and thermal specifications as stated on the label, in the data sheets, catalogues and the accompanying mounting instructions are strictly observed, and recommended safety devices are used as intended. Please consider the "General Safety Recommendations" of the power capacitor manufacturers organized in the German ZVEI (www.electronicon.com/en/zvei).

The capacitors shall only be used for the intended application. ELECTRONICON will not indemnify or be responsible for any kind of damages to persons or property due to the improper application of any capacitors purchased from ELECTRONICON or its distributors.

Mind that electrical or mechanical misapplication of capacitors can become hazardous. Misapplied capacitors can explode or catch fire and cause bodily injury or property damage due to the expulsion of material or metal fragments.

Please consult the detailed instructions for mounting and application stated in our brochure „Application Notes“ and on the ELECTRONICON website: www.electronicon.com/en/an

If in doubt about how to connect, operate, or discharge a capacitor, consult ELECTRONICON engineering or our distributors.

Mounting And Cooling

The useful life of a capacitor may be reduced dramatically if exposed to excessive heat. Typically an increase in the ambient temperature of 7°C will halve the expected life of the capacitor. Make sure to obey the permitted operating temperatures.

To avoid overheating the capacitors must be allowed to cool unhindered and should be shielded from external heat sources. We recommend forced ventilation for all filter applications with reactors. Give approx. 20 mm clearance around capacitors for natural or forced ventilation, and do not place them directly above or next to heat sources such as detuning or tuning reactors, bus bars, etc.

Wichtige Hinweise

Allgemeines

Unsere Kataloge beschreiben die typischen technischen und mechanischen Eigenschaften der aufgeführten Kondensatoren. Die angegebenen Werte basieren auf Referenztypprüfungen sowie empirischen und experimentellen Erfahrungswerten. Die tatsächlichen Werte einzelner Kondensatoren können innerhalb der angegebenen bzw. allgemein bekannter Toleranzen abweichen. Alle Angaben in diesem Katalog beschreiben daher die Komponenten im Allgemeinen und stellen keine Garantie für individuelle technische Werte dar.

Es liegt in der Verantwortung des Anwenders, durch gezielte Prüfungen die Eignung und Betriebssicherheit unserer Komponenten unter den konkreten Betriebsbedingungen seiner Anwendung sicherzustellen. Dies gilt ebenso für gegebenenfalls von ELECTRONICON angebotene Zubehörteile.

Sicherheit

Ein sicherer Betrieb der Kondensatoren ist nur zu erwarten, wenn alle Sicherheitsempfehlungen sowie elektrische und thermische Spezifikationen entsprechend Etikett, Datenblättern, Katalogen und beiliegenden Montageanleitungen eingehalten und die empfohlenen Sicherheitseinrichtungen bestimmungsgemäß verwendet werden. Bitte beachten Sie die „Allgemeinen Sicherheitsempfehlungen“ der im deutschen ZVEI organisierten Hersteller von Leistungskondensatoren (www.electronicon.com/en/zvei).

Die Kondensatoren dürfen ausschließlich für ihren Bestimmungszweck verwendet werden. ELECTRONICON übernimmt keine Verantwortung oder Haftung für Schäden an Personen oder Eigentum, welche aus unsachgemäßer Anwendung von Kondensatoren herrührt.

Elektrisch oder mechanisch fehlerhaft eingesetzte Kondensatoren können explodieren oder Feuer fangen. Austretende Materialien bzw. Metallteile können gesundheitliche und materielle Schäden verursachen.

Bitte beachten Sie die detaillierten Anweisungen in unserer Broschüre „Anwendungshinweise“ sowie auf der Webseite von ELECTRONICON: www.electronicon.com/an

Bitte konsultieren Sie das Fachpersonal oder unsere Distributoren zu Fragen bezüglich Anschluss, Verwendung oder Entladung von Kondensatoren.

Montage und Kühlung

Die Lebensdauer eines Kondensators kann durch übermäßige Wärmeeinwirkung erheblich verringert werden. Im allgemeinen führt eine Erhöhung der Umgebungstemperatur um 7°C zu einer Verringerung der Lebensdauer des Kondensators um 50 %. Halten Sie die zugelassenen Betriebstemperaturen ein.

Um Überhitzung zu vermeiden, muß gewährleistet sein, daß die Kondensatoren auftretende Verlustwärme ungehindert abführen können und vor fremden Wärmequellen abgeschirmt werden. Insbesondere in Filtern ist in jedem Falle eine Zwangslüftung zu empfehlen. Zwischen und um Kondensatoren sollten etwa 20 mm Platz für natürliche oder Zwangslüftung belassen werden. Bringen Sie den Kondensator nie direkt neben oder über Wärmequellen, wie Drosseln u. ä. an.

Failure Rate

The failure probability of a component is a statistical value which is described by a log-normal distribution:

$$N = N_0 \times e^{-\lambda t}$$

λ is the failure rate, which alternatively is also stated as the so-called FIT-rate (FIT = Failures In Time = $\lambda \times 10^9$).

The failure rate is very closely linked with operating temperature and operating voltage of the capacitor. The FIT rates stated in this catalogue are related to the capacitor's rated voltage and a dielectric temperature (= HOTSPOT temperature) of 70°C.

The simultaneous operation of capacitors at highest permissible voltage and operating temperature should be avoided; otherwise, failure rates may increase beyond reasonable technical reliability.

The standard reference period for the failure rate statement is 100.000 hours. Please note that FIT rates can be altered or improved by technical adjustments. Please contact us for details.

The following diagram demonstrates the correlation between FIT rate, operating voltages and operating temperatures.

Ausfallrate

Die Ausfallwahrscheinlichkeit eines Bauelements ist eine statistische Größe, die mit Hilfe einer Normalverteilung beschrieben wird. Es gilt:

N = number of functional components after period t
Anzahl der nach der Zeit t intakten Bauelemente

N_0 = total number of components at time $t = 0$
Gesamtzahl der Bauelemente zum Zeitpunkt $t = 0$

λ = failure rate Ausfallrate

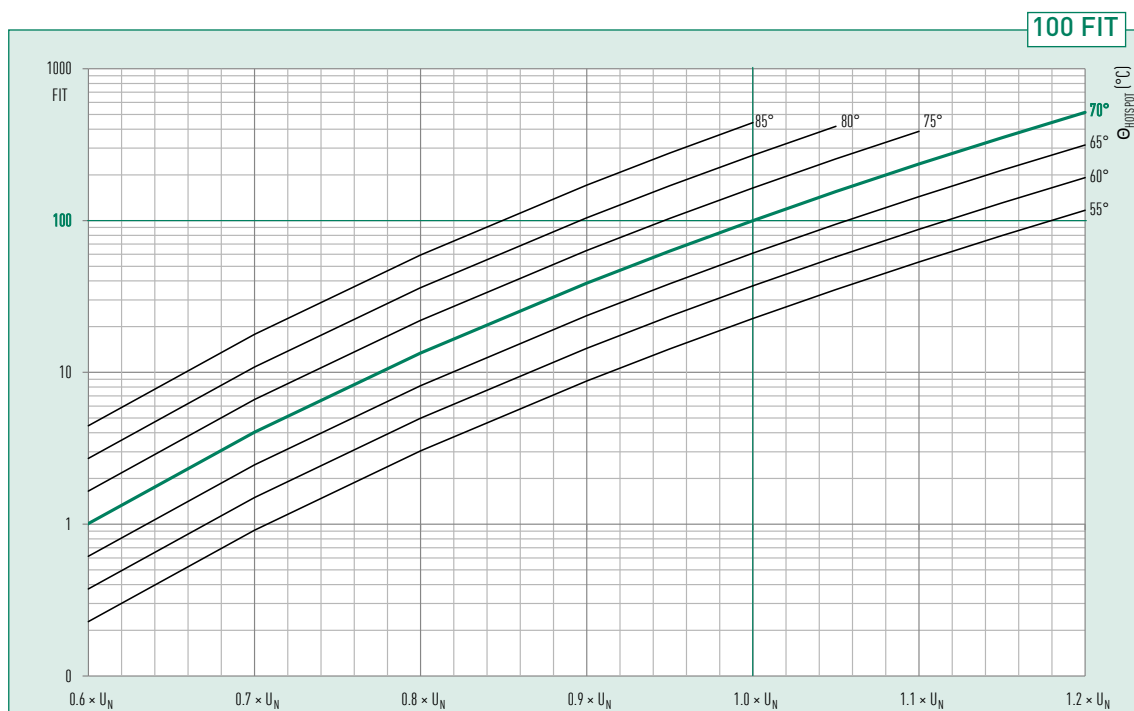
Dabei ist λ die Ausfallrate, die alternativ auch als FIT-Rate angegeben wird (FIT = $\lambda \times 10^9$)

Die Ausfallrate ist stark abhängig von der Temperatur und der Betriebsfeldstärke. Die FIT-Raten im Katalogsortiment beziehen sich auf 70°C Dielektrikumtemperatur (=Hotspot-Temperatur) und die Nennspannung des Kondensators.

Der Betrieb von Kondensatoren mit der höchsten zulässigen Spannung und der höchsten zulässigen Betriebstemperatur sollte vermieden werden, andernfalls können die Ausfallraten so hoch werden, dass keine technisch sinnvollen Zuverlässigkeiten mehr gewährleistet sind.

Der Wert für die Ausfallrate bezieht sich auf einen Referenzzeitraum von 100.000h. FIT-Raten können durch technische Anpassung der Kondensatoren beeinflusst und verbessert werden. Auskünfte hierzu erteilen wir auf Anfrage.

Das nachstehende Kurvendiagramm macht den Zusammenhang von FIT-Rate, Betriebsspannung und Betriebstemperatur deutlich.



Protection against Overvoltages And Short Circuits: Self-Healing Dielectric

All dielectric structures used in our power capacitors are „selfhealing“: In the event of a voltage breakdown the metal layers around the breakdown channel are evaporated by the temperature of the electric arc that forms between the electrodes. They are removed within a few microseconds and pushed apart by the pressure generated in the centre of the breakdown spot. An insulation area is formed which is reliably resistive and voltage proof for all operating requirements of the capacitor. The capacitor remains fully functional during and after the breakdown.

For voltages within the permitted testing and operating limits the capacitors are short-circuit- and overvoltage-proof. They are also proof against external short circuits as far as the resulting surge discharges do not exceed the specified surge current limits.

Functioning of the BAM™ (Break Action Mechanism)

In the event of overvoltage or thermal overload or ageing at the end of the capacitor's useful service life, an increasing number of self-healing breakdowns may cause rising pressure inside the capacitor. To prevent it from bursting, the capacitor is fitted with an obligatory „break action mechanism“ (BAM™). The BAM™ is based on attenuated spots at two, or all three of the connecting wires inside the capacitor.

All capacitors with diameters < 85 mm as well as some traditional models with large diameters are provided with BAM 1 mechanism. All new models with diameters ≥ 85 mm will be provided with BAM 2 mechanism. With rising pressure the case begins to expand, mainly by opening the folded crimp and pushing the lid upwards. As a result, the prepared connecting wires are separated at the attenuated spot, and the current path is interrupted irreversibly.

Schutz gegen Überspannungen und Kurzschlüsse: Selbstheilendes Dielektrikum

Alle in unseren Leistungskondensatoren eingesetzten dielektrischen Strukturen sind selbstheilend. Im Falle eines Kurzschlusses (Spannungsdurchschlag) verdampfen die Metallbeläge um den Durchschlagspunkt herum infolge des Lichtbogens, der sich zwischen den Elektroden bildet. Binnen Mikrosekunden wird der Metaldampf vom Zentrum des Durchschlages weggedrückt. Auf diese Weise bildet sich eine isolierende belagfreie Zone um den Durchschlagspunkt. Der Kondensator bleibt während und nach dem Durchschlag voll funktionsfähig.

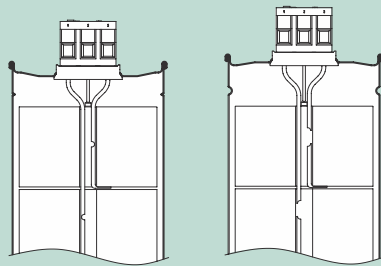
Für Spannungen innerhalb der zugelassenen Test- und Betriebsbedingungen sind die Kondensatoren kurzschluss- und überspannungssicher. Sie sind außerdem sicher gegen äußere Kurzschlüsse, sofern bei den dabei entstehenden Stoßentladungen die zugelassenen Stoßströme nicht überschritten werden.

Funktion der Abreißsicherung (BAM™)

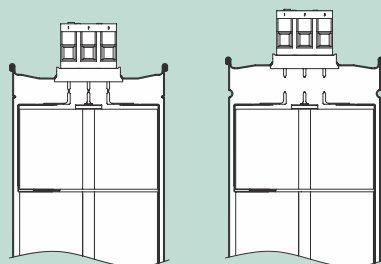
Bei spannungsmäßiger oder thermischer Überlastung bzw. am Ende der Lebensdauer kann durch zahlreiche Selbstheildurchschläge ein Überdruck im Kondensator entstehen. Um ein Bersten der Gehäuse zu verhindern, sind die Kondensatoren generell mit einer Überdruck-Abreißsicherung (BAM™) versehen. Diese Sicherung besteht aus einer Sollbruchstelle in zwei oder allen Anschlussdrähten.

Alle Kondensatoren mit Durchmesser < 75 mm sowie einige traditionelle Modelle mit größeren Durchmessern sind mit der BAM 1 Sicherung versehen. Alle neuen Modelle mit Durchmesser ≥ 85 mm werden mit BAM 2 Sicherung ausgestattet. Bei einem Überdruck im Kondensator verlängert sich das Gehäuse durch das Öffnen der gestauchten Sicke bzw. Wölbung des Metalldeckels und die Stromzufuhr zu den Kondensatorwickeln wird an den Sollbruchstellen irreversibel unterbrochen.

BAM 1



BAM 2



before activation



after activation

Limited Warranty

All our products are designed, manufactured, and tested with the highest care and workmanship. The satisfaction of our customers is our highest goal. We therefore warrant remedying any defect in the goods resulting from faulty design, materials or workmanship, which appears within 3 years from the date of sale.

This warranty does not cover defects due to improper use of the goods or operation at conditions exceeding the rated values stated in the catalogue or special data sheet. Nor does it cover defects due to faulty maintenance or incorrect installation, alterations or faulty repairs undertaken by the Buyer. Finally the warranty does not cover normal wear and tear or deterioration.

See our „General Conditions“ for details on Warranty and Product liability.

Gewährleistung

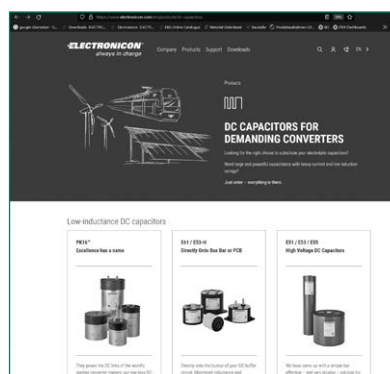
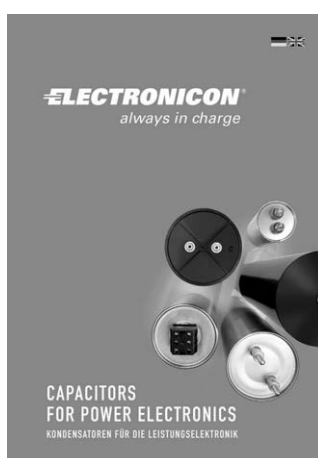
Alle unsere Erzeugnisse werden mit höchster Sorgfalt und Fachkenntnis entwickelt, hergestellt und geprüft. Die Zufriedenheit unserer Kunden ist unser höchstes Ziel. Wir verpflichten uns daher, jeden innerhalb von 3 Jahren ab Verkaufsdatum auftretenden Mangel an unseren Erzeugnissen zu beseitigen, welcher aus Fehlern in Design, Material oder Herstellung herrührt.

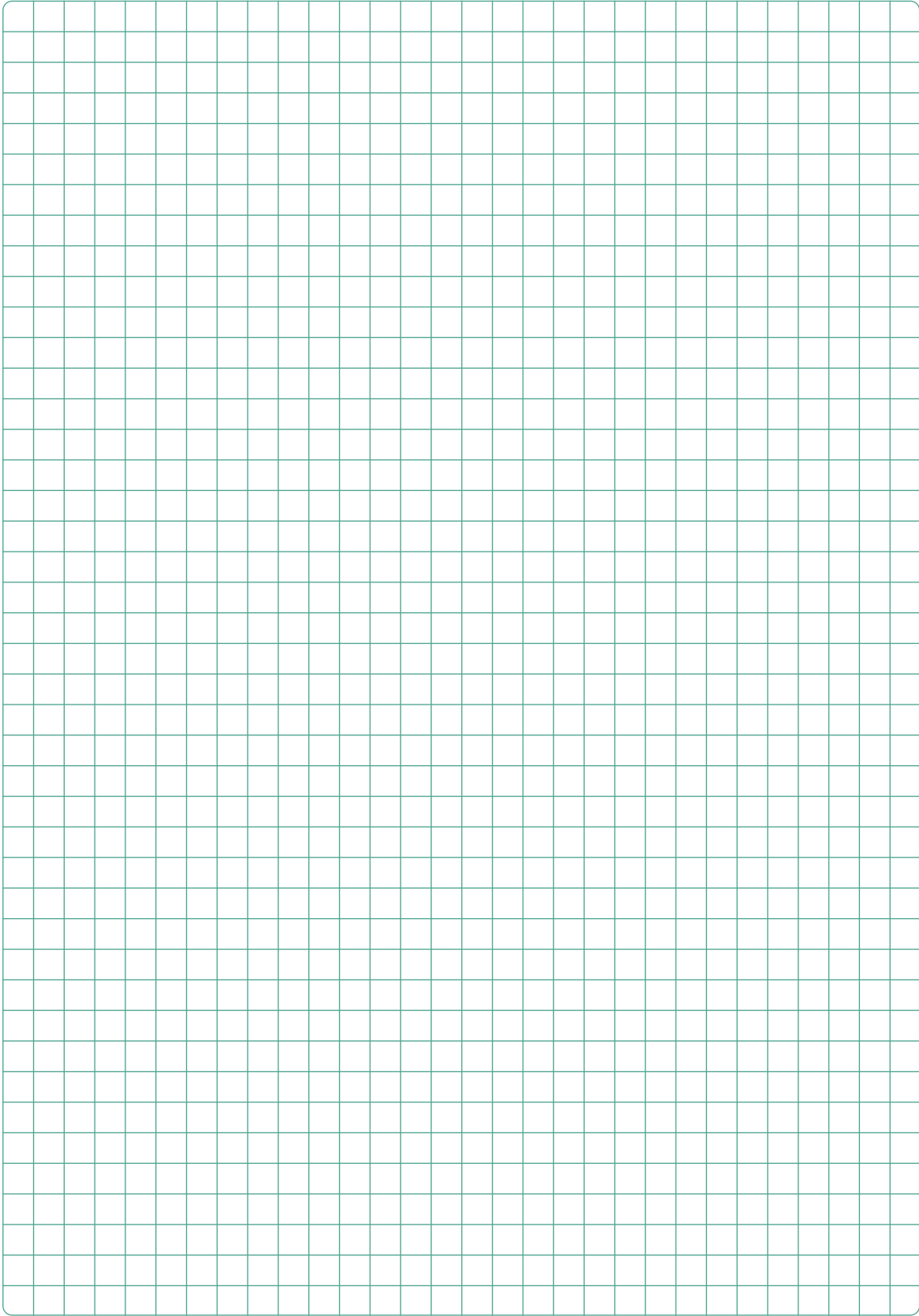
Diese Gewährleistung erstreckt sich nicht auf Defekte infolge unsachgemäßer Anwendung oder Betrieb außerhalb der nach Katalog oder Datenblatt zulässigen Einsatzbedingungen. Sie erfaßt ebenso wenig Schäden aufgrund fehlerhafter Wartung, unsachgemäßer Montage, Änderungen oder unsachgemäßer Reparaturen durch den Käufer bzw. Anwender. Diese Gewährleistung betrifft auch nicht normale Abnutzung und Verschleiß.

Siehe unsere „Allgemeinen Geschäftsbedingungen“ für Details zu Gewährleistung und Produkthaftung.

Find more information and detailed instructions in our „Application Notes“ and on www.electronicon.com

Mehr Informationen und ausführliche Anweisungen finden Sie in unseren „Anwendungshinweisen“ und unter www.electronicon.com





APPLICATION NOTES AND GENERAL INFORMATION



ELECTRONICON®
always in charge



**CAPACITORS
FOR POWER ELECTRONICS**
KONDENSATOREN FÜR DIE LEISTUNGSELEKTRONIK



des I_{max} und I_{eff}
dem errechneten

EXCELLENT EXPERIENCE IN CAPACITOR MAKING FOR OVER 80 YEARS

Gera has been a centre of capacitor making since 1938. ELECTRONICON Kondensatoren GmbH which emerged from previous RFT/VEB ELEKTRONIK Gera in 1992, has become one of Europe's leading capacitor manufacturers supplying customers worldwide and being an open and competent partner for manufacturers and users of power factor correction equipment, for many manufacturers of drives, power electronics, home appliances, and for the lighting industry. Regular investments in advanced and environmentally sound technologies guarantee the highest levels in manufacture and quality to modern standards which are approved and monitored by leading certification authorities.



In today's globalised competition, we distinguish ourselves by

- Absolute reliability and safety of our products
- Close co-operation between manufacturer and client to meet both technical and commercial requirements
- Improvement and development of our technical expertise in capacitor design and manufacture, as well as film coating, with special attention paid to the MKPg-technology
- Early identification and incorporation of new trends and methods in the manufacturing of capacitors
- Flexibility and punctual fulfilment of our commercial obligations

Our experienced development engineers are competent and responsible for both implementing the latest technical trends applicable to our products and ensuring that our products adapt to the challenges of traditional and new markets.

The close and intense co-operation between the departments of Marketing & Sales, Research & Development, and Production has become the keystone of our success. ELECTRONICON is continually striving to establish a similarly close and interactive relationship with its distributors and direct clients both in home and overseas markets, to become not just one out of many suppliers, but your preferred partner for ideas and solutions.

ELECTRONICON®

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Fon +49 365 / 734 61 00 • Fax +49 365 / 734 61 10
E-Mail: sales@electronicon.com, www.electronicon.com





E62 AND E64 HEAVY DUTY AC CAPACITORS



THE PERFECT CHOICE FOR YOUR AC/DC APPLICATION

ELECTRONICON®
always in charge

Choose the best capacitor for any of your power electronics applications:

AC and DC capacitors with integrated safety mechanism
E62 AC/DC E62-3ph AC Filter E63 DC

Low-inductance capacitors
E50 PK16™ DC E53 AC/DC E61 DC

Low-inductance High-voltage capacitors
E51

AC and DC capacitors with large capacitance
E56 DC E59 AC/DC E70 AC E50.U SR17™ DC

CAPACITORS

ELECTRONICON®

always in charge

E62 and E64

HEAVY DUTY AC CAPACITORS

FOR UNIVERSAL USE

WECHSELSPANNUNGSKONDENSATOREN
FÜR DEN UNIVERSELLEN EINSATZ





Your perfect choice for universal and heavy duty AC applications

In modern applications of power electronics, AC capacitors are among the most critical links in the chain of components when it comes to long operating life, safety and reliability of operation.

Decades of proprietary ELECTRONICON experience in metallizing capacitor films and designing high-end capacitors have created our very own Know-How, for instance in special metallizing patterns, our SINECUT™ slitting technology and optimized winding geometries. This enables us to design AC capacitors with a high specific ratio of capacitance to volume, high AC-voltage load capacity and outstanding suitability for high rms and surge currents.

The cylindrical capacitors of our universal AC series „E62“ are perfect for non-sinusoidal voltages and pulsed currents, e.g. as damping or commutation capacitors switched in parallel to thyristors, or connected in series with resistors (damping of undesirable voltage spikes during the switching of power semiconductors). They can be widely used as supporting, smoothing, and surge discharge capacitors, further in AC filters, a.m.o. The low loss factor of our MKP dielectric compensates to a large extent for the losses caused by the non-sinusoidal voltages. It goes without saying that all AC capacitors may as well be used for DC applications.

The E62s are housed in a hermetically sealed aluminium can which is filled with environmentally friendly plant oil as standard; optionally many of them can also be made available with a filling of inert gas. The gas filling is not only environmentally friendly, but also permits mounting in any position, while oil-filled capacitors should – for electrical as well as environmental considerations – always be mounted vertically.

The capacitors of the E64 range follow the same design principles as E62 but are particularly well-prepared for operation at high ambient temperatures: they can cope with Hotspot-temperatures of up to 100°C.

The excellent self-healing characteristics of our film metallization and the integrated overpressure protection (BAM™) ensure safe operation and controlled disconnection in the event of overload or failure at the end of operating life.

Die Erste Wahl für universelle und höchst anspruchsvolle Wechselspannungs-Anwendungen

In modernen Leistungselektronik-Anwendungen zählen AC Kondensatoren zu den kritischsten Komponenten im Bezug auf Lebensdauer, Sicherheit und Zuverlässigkeit.

Aus jahrzehntelanger ELECTRONICON-Erfahrung in der Entwicklung hochwertiger Kondensatoren und der Metallisierung von Kondensatorfolien ist unser eigenes Know-How erwachsen, das sich z.B. in speziellen Bedämpfungsmethoden, unserer SINECUT™ Schneidtechnologie und optimierten Wickelgeometrien widerspiegelt. Dieses Know-How ermöglicht uns die Entwicklung von Wechselspannungskondensatoren mit hohem spezifischen Kapazitäts-Volumen-Verhältnis, hoher Wechselspannungsbelastbarkeit und hervorragender Eignung für hohe Effektiv- und Stoßströme.

Die zylindrischen Kondensatoren unserer universellen AC Serie „E62“ sind ideal für den Einsatz bei nicht-sinusförmigen Spannungen und impulsförmigen Strömen, z.B. als Bedämpfungs- oder Kommutierungskondensatoren, geschaltet parallel zu Thyristoren oder in Serie zu Widerständen (zur Dämpfung unerwünschter Spannungsspitzen während des Schaltens von Leistungshalbleitern). Sie werden außerdem als Stütz-, Glättungs- und Stoßentladekondensatoren sowie in Wechselspannungsfiltren genutzt. Der geringe Verlustfaktor der von uns verwendeten Technologien vermag die Verluste weitgehend auszugleichen, welche durch die nicht-sinusförmigen Spannungen verursacht werden. Selbstverständlich taugen alle Wechselspannungskondensatoren auch für Gleichspannungsanwendungen.

Die E62er sind in einem hermetisch dicht verschlossenen Aluminiumbecher untergebracht, der normalerweise mit ökologisch unbedenklichem Pflanzenöl gefüllt ist; optional werden viele E62er Typen auch mit Gasfüllung angeboten. Die Gasfüllung ist nicht nur besonders umweltfreundlich, sondern ermöglicht den Einbau in beliebiger Lage, während ölgefüllte Kondensatoren aus elektrischen und umwelttechnischen Gründen stets vertikal eingebaut werden sollten.

Die Kondensatoren der E64 Reihe sind nach den selben Designprinzipien ausgelegt wie E62, jedoch besonders auf den Einsatz bei hohen Umgebungstemperaturen abgestimmt: sie kommen mit Hotspot-Temperaturen von bis zu 100°C zurecht.

Für einen sicheren Schutz bei Überlastung bzw. einen kontrollierten Ausfall am Ende der Lebensdauer sorgen die ausgezeichnete Selbstheilfähigkeit unserer Folie-Metallisierung sowie ein in den Kondensatoren integrierter Überdruckmechanismus (BAM™).

E62 HC - HIGH CURRENT

AC
420V AC

for latest edition and updates
check www.powercapacitors.info



AC-Capacitors optimized for high rms currents
Wechselspannungskondensatoren für hohe Effektivströme



ALUS 10000 AFC

UL: up to_bis zu 1700V AC/1200V rms
CSA: up to_bis zu 850V AC/600V rms

Standards IEC 61071, UL810, CSA 22.2 No.190
optional IEC 61881

can Gehäuse aluminium Aluminium
mounting position Einbaulage... terminals pointing upwards stehend
filling material liquid, based on vegetable oil, non-PCB
Füllmittel flüssig, auf Pflanzenölbasis, PCB-frei

Internal protection break-action mechanism (BAM)
Interne Sicherung Überdrucksicherung
fire load Brandlast 40 MJ/kg

C_N tolerance Toleranz ±10% (optional ±5%)
tanδ₀ 2 x 10⁻⁴

operating temperatures Grenztemperaturen
Θ_{min} ... Θ_{max} -40 ... +85°C
(lower temperatures on request)
Θ_{HOTSPOT} ≤ 85°C

storing temperature Lagertemperatur -40 ... +85°C

statistical lifetime statistische Lebensdauer ... > 200 000 h

Failure rate Ausfallrate 100 FIT *

(reference interval_Referenzintervall 100000 h, Θ_{HOTSPOT} ≤ 70°C)

* FIT curve see pg. 31/32_FIT Kurve siehe Seite 31/32

C _N (μF)	U _N DC (V)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _S (kA)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Box
U _N 420V AC		U _{rms} 300V		U _S 1050V		U _{TT} 1050V DC		U _{TC} 3000V AC				
60	700	3.3	10.5	32	0.7	2.1	100	50 × 85	G1	0.18	E62.G85-603G10	21 / FB2
60	700	2.3	7.1	40	0.7	2.1	140	60 × 105	C68	0.32	E62.K10-603C68	10 / FB7
75	700	2.1	7.1	40	0.8	2.5	110	60 × 105	C68	0.31	E62.K10-753C68	10 / FB1
100	700	3.1	7.2	40	1.15	3.45	100	65 × 95	G1	0.33	E62.L95-104G10	10 / FB2
120	700	1	5.7	50	1.4	4.2	140	75 × 105	C6	0.5	E62.M10-124C60	8 / FB0
130	700	3.4	6.3	40	1.2	3.6	110	65 × 109	G1	0.4	E62.L10-134G10	10 / FB1
150	700	4.4	5.1	35	1.2	3.6	110	65 × 135	G1	0.5	E62.L13-154G10	10 / FB0
170	700	0.82	5	50	2	6	140	85 × 105	C6	0.6	E62.N10-174C60	10 / FB10
200	700	4.4	4.7	30	1.2	3.6	140	65 × 145	G1	0.5	E62.L14-204G10	10 / FB7
220	700	1.3	4.5	50	2.5	7.5	140	95 × 105	C6	0.8	E62.P10-224C60	6 / FB10
250	700	1.2	3	80	3	10	160	85 × 176	C6	1.2	E62.N17-254C60	5 / FB8
400	700	0.68	2.1	80	4.5	13.5	160	85 × 245	C6	1.5	E62.N24-404C60	5 / FB12
470	700	0.53	2.7	80	5.3	15.9	160	95 × 176	C6	1.3	E62.P17-474C60	3 / FB8
500	700	0.57	2.5	80	5.7	17.1	160	100 × 176	C6	1.5	E62.Q17-504C60	3 / FB8
540	700	0.9	1.9	80	6	18	170	95 × 245	C6	2.2	E62.P24-544C60	3 / FB12
2000	700	0.6	1	100	15	20	190	136 × 320	C6	4.9	E62.S32-205C60	2 / FB15



Other values, dimensions and terminal combinations available on request.
Andere Werte, Abmessungen und Anschlußkombinationen auf Anfrage erhältlich.

E62 HC - HIGH CURRENT
AC
500...680V AC

C _N (μF)	U _N DC (V)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _S (kA)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Box
U_N 500V AC		U_{rms} 360V		U_S 1260V		U_{TT} 1260V DC		U_{Tc} 3000V AC				
40	840	3.6	10.5	30	0.6	1.7	100	50 × 85	G1	0.18	E62.G85-403G10	21 / FB2
50	840	4.4	9.5	25	0.7	2.1	110	55 × 85	G1	0.21	E62.H85-503G10	18 / FB2
55	840	2.2	7.1	40	0.7	2.2	110	60 × 105	C68	0.31	E62.K10-553C68	10 / FB1
75	840	2.3	7.2	40	1	3	100	65 × 95	G1	0.33	E62.L95-753G10	10 / FB2
100	840	4.3	5.1	40	0.9	2.7	120	65 × 135	G1	0.5	E62.L13-104G10	10 / FB0
300	840	1.1	2.7	80	4.1	12.3	160	95 × 176	C6	1.3	E62.P17-304C60	3 / FB8
620	840	0.58	1.6	100	9	15	160	116 × 245	C6	2.7	E62.R24-624C60	3 / FB12
750	840	0.57	1.6	100	10	20	170	116 × 245	C6	2.7	E62.R24-754C60	3 / FB12
1000	840	0.56	1.3	100	14	20	170	136 × 245	C6	3.7	E62.S24-105C60	2 / FB12
1500	840	0.5	1	100	15	20	190	136 × 320	C6	4.9	E62.S32-155C60	2 / FB15
U_N 640V AC		U_{rms} 450V		U_S 1500V		U_{TT} 1500V DC		U_{Tc} 3000V AC				
15	1000	2.9	14.4	25	0.24	0.7	100	50 × 62	G1	0.14	E62.G62-153G10	21 / FB3
30	1000	3.9	10.5	33	0.5	1.4	100	50 × 85	G1	0.18	E62.G85-303G10	21 / FB2
41	1000	2.4	7.1	40	0.6	1.9	110	60 × 105	C68	0.31	E62.K10-413C68	10 / FB1
50	1000	3.4	7.2	40	0.8	2.4	100	65 × 95	G1	0.33	E62.L95-503G10	10 / FB2
68	1000	3.7	6.3	30	0.9	2.7	100	65 × 109	G1	0.4	E62.L10-683G10	10 / FB1
100	1000	0.53	4.4	80	3	9	100	85 × 120	C6	0.9	E62.N12-104C60	10 / FB15
140	1000	0.81	3.2	100	4	12	160	85 × 164	C6	1	E62.N16-144C60	5 / FB8
200	1000	0.7	2.7	80	3.5	10.5	160	95 × 176	C6	1.3	E62.P17-204C60	3 / FB8
250	1000	0.63	2.5	80	4	12	160	100 × 176	C6	1.5	E62.Q17-254C60	3 / FB8
350	1000	0.57	2.2	80	5.6	16.8	160	116 × 176	C6	2	E62.R17-354C60	3 / FB8
500	1000	0.6	1.6	100	7.8	20	170	116 × 245	C6	2.7	E62.R24-504C60	3 / FB12
750	1000	0.64	1.2	100	12	20	190	116 × 320	C6	3.5	E62.R32-754C60	3 / FB15
800	1000	0.63	1.3	100	12.8	20	170	136 × 245	C6	3.7	E62.S24-804C60	2 / FB12
1000	1000	0.62	1	100	15.6	20	190	136 × 320	C6	4.9	E62.S32-105C60	2 / FB15
U_N 680V AC		U_{rms} 480V		U_S 1680V		U_{TT} 1680V DC		U_{Tc} 3000V AC				
31	1120	2.6	7.1	40	0.6	1.7	110	60 × 105	C68	0.31	E62.K10-313C68	10 / FB1
100	1120	1.1	3.9	80	3	10	150	95 × 120	C6	0.9	E62.P12-104C60	6 / FB15
150	1120	0.95	3.2	80	5	14	150	116 × 124	C6	1.3	E62.R12-154C60	3 / FB15
200	1120	0.66	2.5	80	3.7	11.1	160	100 × 176	C6	1.5	E62.Q17-204C60	3 / FB8
280	1120	0.6	2.2	80	5.1	15.3	160	116 × 176	C6	2	E62.R17-284C60	3 / FB8
400	1120	0.6	1.6	100	7.3	20	170	116 × 245	C6	2.7	E62.R24-404C60	3 / FB12
600	1120	0.56	1.3	100	10.7	20	170	136 × 245	C6	3.7	E62.S24-604C60	2 / FB12
800	1120	0.63	1	100	14.8	20	190	136 × 320	C6	4.9	E62.S32-804C60	2 / FB15



E62 HC - HIGH CURRENT

AC

750...850V AC



C _N (μF)	U _N DC (V)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _S (kA)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Box
U _N 750V AC		U _{rms} 530V		U _S 1900V		U _{TT} 1890V DC		U _{TC} 3000V AC				
10	1260	3.1	14.4	20	0.4	1.2	110	50 × 62	G1	0.14	E62.G62-103G10	21 / FB3
20	1260	4.2	10.5	27	0.4	1.2	100	50 × 85	G1	0.18	E62.G85-203G10	21 / FB2
24	1260	2.9	7.1	40	0.5	1.4	110	60 × 105	C68	0.31	E62.K10-243C68	10 / FB1
33	1260	3.6	7.2	37	0.7	2	100	65 × 95	G1	0.33	E62.L95-333G10	10 / FB2
40	1260	5.6	6.3	30	0.7	2	120	65 × 109	G1	0.4	E62.L10-403G10	10 / FB1
60	1260	6.2	4.7	35	0.7	2	140	65 × 145	G1	0.5	E62.L14-603G10	10 / FB7
150	1260	0.7	2.5	80	3.1	9.3	160	100 × 176	C6	1.5	E62.Q17-154C60	3 / FB8
220	1260	0.61	2.2	80	4.5	13.5	160	116 × 176	C6	2	E62.R17-224C60	3 / FB8
330	1260	0.61	1.6	100	6.8	20	170	116 × 245	C6	2.7	E62.R24-334C60	3 / FB12
350	1260	0.59	1.6	100	6.8	20	160	116 × 245	C6	2.7	E62.R24-354C60	3 / FB12
500	1260	0.56	1.3	100	10.1	20	170	136 × 245	C6	3.7	E62.S24-504C60	2 / FB12
600	1260	0.64	1	100	12.4	20	190	136 × 320	C6	4.9	E62.S32-604C60	2 / FB15
U _N 850V AC		U _{rms} 600V		U _S 2100V		U _{TT} 2100V DC		U _{TC} 3000V AC				
15	1400	4.6	10.5	25	0.3	0.9	80	50 × 85	G1	0.18	E62.G85-153G10	21 / FB2
16	1400	4.5	10.5	30	0.4	1.1	100	50 × 85	G1	0.18	E62.G85-163G10	21 / FB2
19	1400	3.1	7.1	40	0.4	1.3	110	60 × 105	C68	0.31	E62.K10-193C68	10 / FB1
25	1400	3.9	7.2	40	0.6	1.7	100	65 × 95	G1	0.33	E62.L95-253G10	10 / FB2
30	1400	4.4	6.3	30	0.6	1.7	110	65 × 109	G1	0.4	E62.L10-303G10	10 / FB1
50	1400	5.6	4.7	25	0.6	1.8	120	65 × 145	G1	0.5	E62.L14-503G10	10 / FB7
80	1400	1.6	3	80	1.8	5	160	85 × 176	C6	1.2	E62.N17-803C60	5 / FB8
120	1400	0.74	2.7	80	2.7	8.2	160	95 × 176	C6	1.3	E62.P17-124C60	3 / FB8
130	1400	0.71	2.5	80	3	8.9	160	100 × 176	C6	1.5	E62.Q17-134C60	3 / FB8
180	1400	0.63	2.2	80	4.1	12.3	160	116 × 176	C6	2	E62.R17-184C60	3 / FB8
270	1400	0.62	1.6	100	6.2	18.6	170	116 × 245	C6	2.7	E62.R24-274C60	3 / FB12
400	1400	0.58	1.3	100	9.2	20	170	136 × 245	C6	3.7	E62.S24-404C60	2 / FB12
500	1400	0.4	1	100	11.4	20	190	136 × 320	C6	4.9	E62.S32-504C60	2 / FB15

Other values, dimensions and terminal combinations available on request.
Andere Werte, Abmessungen und Anschlußkombinationen auf Anfrage erhältlich.

E62 HC - HIGH CURRENT
AC
1000...1200V AC

C _N (μF)	U _N DC (V)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _S (kA)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Box
U _N 1000V AC		U _{rms} 720V		U _S 2500V		U _{TT} 2520V DC		U _{TC} 3500V AC				
4.7	1680	3.6	14.4	25	0.5	1.4	110	50 × 62	G1	0.14	E62.G62-472G10	21 / FB3
8	1680	4	10.5	26	0.46	1.38	120	50 × 85	G1	0.18	E62.G85-802G10	21 / FB2
10	1680	3.6	10.5	26	0.58	1.74	100	50 × 85	G1	0.18	E62.G85-103G10	21 / FB2
12	1680	3	9.5	30	0.7	2.1	110	55 × 85	G1	0.21	E62.H85-123G10	18 / FB1
13	1680	2.3	7.1	40	0.7	2.2	110	60 × 105	C68	0.31	E62.K10-133C68	10 / FB1
16	1680	3.3	7.2	40	0.95	2.9	110	65 × 95	G1	0.33	E62.L95-163G10	10 / FB2
18	1680	3.2	7.2	40	1	3	100	65 × 95	G1	0.33	E62.L95-183G10	10 / FB2
20	1680	1.2	5.7	50	1.2	3.5	140	75 × 105	C6	0.5	E62.M10-203C60	10 / FB15
28	1680	0.94	5	50	1.6	4.9	140	85 × 105	C6	0.6	E62.N10-283C60	10 / FB15
33	1680	0.85	4.5	50	1.9	5.7	140	95 × 105	C6	0.8	E62.P10-333C60	6 / FB15
68	1680	0.65	2.7	80	3.9	11.7	160	95 × 176	C6	1.3	E62.P17-683C60	3 / FB8
80	1680	0.61	2.5	80	4.6	13.8	160	100 × 176	C6	1.5	E62.Q17-803C60	3 / FB8
120	1680	0.54	2.2	80	7	20	160	116 × 176	C6	2	E62.R17-124C60	3 / FB8
180	1680	0.57	1.6	100	10.4	20	170	116 × 245	C6	2.7	E62.R24-184C60	3 / FB12
220	1680	0.64	1.2	100	14.2	20	180	116 × 320	C6	3.5	E62.R32-224C60	3 / FB15
250	1680	0.54	1.3	100	14.5	20	170	136 × 245	C6	3.7	E62.S24-254C60	2 / FB12
330	1680	0.61	1	100	15	20	190	136 × 320	C6	4.9	E62.S32-334C60	2 / FB15
U _N 1200V AC		U _{rms} 850V		U _S 3000V		U _{TT} 3000V DC		U _{TC} 4000V AC				
6.8	2000	3.7	10.5	33	0.5	1.5	100	50 × 85	G1	0.18	E62.G85-682G10	21 / FB2
9.5	2000	2.5	7.1	40	0.6	1.9	110	60 × 105	C68	0.31	E62.K10-952C68	10 / FB1
10	2000	3.7	7.2	40	0.7	2.1	100	65 × 95	G1	0.33	E62.L95-103G10	10 / FB2
15	2000	3.9	6.3	40	0.8	2.4	120	65 × 109	G1	0.4	E62.L10-153G10	10 / FB1
20	2000	4.7	5.1	30	0.8	2.4	120	65 × 135	G11	0.5	E62.L13-203G11	10 / FB0
30	2000	5.3	4.3	40	1	3	130	65 × 160	G1	0.6	E62.L16-303G10	10 / FB7
32	2000	0.79	4.2	50	2	6	140	100 × 105	C6	0.9	E62.Q10-323C60	6 / FB10
33	2000	1.3	3	80	2.2	7	160	85 × 176	C6	1.2	E62.N17-333C60	5 / FB8
40	2000	0.76	3	80	2.7	8.1	160	85 × 176	C6	1.2	E62.N17-403C60	5 / FB8
53	2000	1	2.1	80	4	11	160	85 × 245	C6	1.7	E62.N24-533C60	5 / FB12
68	2000	0.81	1.9	80	3.6	10.8	160	85 × 280	C6	1.8	E62.N28-683C60	5 / FB10
80	1900	1	1.9	80	5	15	170	95 × 245	C6	1.8	E62.P24-803C60	3 / FB12
100	2000	1	2.2	50	3.2	9.6	150	116 × 176	C6	2	E62.R17-104C60	3 / FB8
150	2000	1.4	1.4	100	8	20	180	116 × 280	C6	3.1	E62.R28-154C60	3 / FB10



E62 HC - HIGH CURRENT

AC

1350.....2000V AC



C _N (μF)	U _N DC (V)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _S (kA)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Box
U _N 1350V AC		U _{rms} 960V		U _S 3300V		U _{TT} 3375V DC		U _{TC} 4200V AC				
4	2250	5	10.5	26	0.3	1	120	50 × 85	G1	0.2	E62.G85-402G10	21 / FB2
5	2250	4.4	10.5	25	0.4	1.2	100	50 × 85	G1	0.18	E62.G85-502G10	21 / FB2
6.8	2250	4	9.5	25	0.5	1.6	110	55 × 85	G1	0.21	E62.H85-682G10	18 / FB1
10	2250	1.6	5.7	45	0.8	2.3	140	75 × 105	C6	0.5	E62.M10-103C60	8 / FB0
15	2250	1.2	5	50	1.1	3.3	120	85 × 105	C6	0.6	E62.N10-153C60	10 / FB10
16	2250	1.1	5	50	1.2	3.7	140	85 × 105	C6	0.6	E62.N10-163C60	10 / FB10
20	2250	0.96	4.5	50	1.5	4.6	140	95 × 105	C6	0.8	E62.P10-203C60	6 / FB10
22	2250	0.97	3.4	80	1.9	5.7	160	75 × 176	C6	0.8	E62.M17-223C60	5 / FB8
40	2250	0.71	2.7	80	3.1	9.3	160	95 × 176	C6	1.3	E62.P17-403C60	3 / FB8
47	2250	0.67	2.5	80	3.6	10.8	160	100 × 176	C6	1.5	E62.Q17-473C60	3 / FB8
68	2250	1	1.8	80	5	15	160	100 × 245	C6	2	E62.Q24-683C60	3 / FB12
68	2250	0.59	2.2	80	5.3	15.9	160	116 × 176	C6	2	E62.R17-683C60	3 / FB8
100	2250	0.6	1.6	100	7.7	20	170	116 × 245	C6	2.7	E62.R24-104C60	3 / FB12
150	2250	0.56	1.3	100	11.6	20	170	136 × 245	C6	3.7	E62.S24-154C60	2 / FB12
200	2250	0.62	1	100	15	20	190	136 × 320	C6	4.9	E62.S32-204C60	2 / FB15
U _N 1700V AC		U _{rms} 1200V		U _S 4200V		U _{TT} 4200V DC		U _{TC} 5000V AC				
4	2800	2.8	5.7	48	0.8	1.8	140	75 × 105	C6	0.5	E62.M10-402C60	8 / FB0
6.8	2800	1.8	5.7	46	0.7	2	140	75 × 105	C6	0.5	E62.M10-682C60	8 / FB0
10	2800	1.3	5	50	1	2.9	140	85 × 105	C6	0.6	E62.N10-103C60	10 / FB10
12	2800	1.2	4.5	50	1.2	3.5	140	95 × 105	C6	0.8	E62.P10-123C60	6 / FB10
12	2800	1.4	3.4	80	1.9	5.7	160	75 × 176	C6	0.8	E62.M17-123C60	5 / FB8
25	2800	0.8	2.7	80	2.4	7.3	160	95 × 176	C6	1.3	E62.P17-253C60	3 / FB8
30	2800	0.73	2.5	80	2.9	8.7	160	100 × 176	C6	1.5	E62.Q17-303C60	3 / FB8
40	2800	0.65	2.2	80	3.9	11.7	160	116 × 176	C6	2	E62.R17-403C60	3 / FB8
60	2800	0.64	1.6	100	5.8	17.4	170	116 × 245	C6	2.7	E62.R24-603C60	3 / FB12
90	2800	0.58	1.3	100	8.7	20	170	136 × 245	C6	3.7	E62.S24-903C60	2 / FB12
100	2800	0.94	1.2	100	8	20	190	136 × 280	C6	4.3	E62.S28-104C60	2 / FB10
125	2800	0.64	1	100	12.1	20	190	136 × 320	C6	4.9	E62.S32-134C60	2 / FB15
U _N 2000V AC		U _{rms} 1400V		U _S 5100V		U _{TT} 5100V DC		U _{TC} 5800V AC				
10	3400	2.1	3.4	40	1.2	3.5	170	75 × 176	C6	0.8	E62.M17-103C60	5 / FB8
15	3400	1.6	2.7	40	1	3.1	170	95 × 176	C6	1.3	E62.P17-153C60	3 / FB8
20	3400	1.3	2.5	50	2.3	7	160	100 × 176	C6	1.5	E62.Q17-203C60	3 / FB8
30	3400	1	2.2	50	3.6	10.8	160	116 × 176	C6	2	E62.R17-303C60	3 / FB8
40	3400	1.1	1.2	80	4.6	13.8	190	116 × 320	C6	3.5	E62.R32-403C60	3 / FB15
50	3400	0.88	1.3	100	9	20	170	136 × 245	C6	3.7	E62.S24-503C60	2 / FB12
54	3400	1.1	1.2	80	5.9	17.7	180	116 × 320	C6	3.5	E62.R32-543C60	3 / FB15
60	3400	1	1.2	100	6	18	180	116 × 320	C6	3.5	E62.R32-603C60	3 / FB15
90	3400	1	1	100	9.7	20	190	136 × 320	C6	4.9	E62.S32-903C60	2 / FB15

Other values, dimensions and terminal combinations available on request.
Andere Werte, Abmessungen und Anschlußkombinationen auf Anfrage erhältlich.



E62 HC - HIGH CURRENT
AC
2100....4000V AC

C _N (μF)	U _N DC (V)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _S (kA)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Box
U_N 2100V AC		U_{rms} 1500V		U_S 5400V		U_{TT} 5400V DC		U_{TC} 6200V AC				
13	3600	1.3	2.7	80	2.6	8	160	95 × 176	C6	1.3	E62.P17-133C60	3 / FB8
33	3600	1.2	1.9	80	3.3	9.9	150	116 × 205	C6	2.4	E62.R20-333C60	3 / FB12
40	3600	1.1	1.2	100	5.4	16.2	180	116 × 320	C6	3.5	E62.R32-403C60	3 / FB15
60	3600	1	1	100	7.9	20	190	136 × 320	C6	4.9	E62.S32-603C60	2 / FB15
70	3600	1.1	1	100	8	20	190	136 × 320	C6	4.9	E62.S32-703C60	2 / FB15
U_N 2400V AC		U_{rms} 1700V		U_S 6000V		U_{TT} 6000V DC		U_{TC} 6800V AC				
6.8	4000	2.5	3.4	40	0.9	2.8	160	75 × 176	C6	0.8	E62.M17-682C60	5 / FB8
10	4000	1.9	3	40	1.4	4.2	170	85 × 176	C6	1.2	E62.N17-103C60	5 / FB8
20	4000	1.6	2.2	50	2.7	8	160	116 × 176	C6	2	E62.R17-203C61	3 / FB8
22	4000	1.1	2.2	50	2.8	8.7	160	116 × 176	C6	2	E62.R17-223C60	3 / FB8
25	4000	0.59	1.9	80	5.6	16.8	160	136 × 176	C6	2.6	E62.S17-253C60	2 / FB8
33	4000	0.6	1.3	100	7.5	20	160	136 × 245	C6	3.7	E62.S24-333C60	2 / FB12
U_N 4000V AC		U_{rms} 2800V		U_S 7500V		U_{TT} 7500V DC		U_{TC} 8200V AC				
0.2	5000	5.1	5.7	16	0.7	2.2	150	75 × 105	CR	0.6	E62.M10-201CR0	5 / FB15
1	5000	3.9	5	40	0.8	2.4	150	75 × 120	CR	0.6	E62.M12-102CR0	10 / FB15
1.8	5000	2.7	4.4	40	1.4	4	150	85 × 120	CR	0.9	E62.N12-182CR0	5 / FB15
1.9	5000	2.6	3.9	40	1.4	4	150	95 × 120	CR	0.9	E62.P12-192CR0	6 / FB15
2.2	5000	2	3.9	40	1.7	5.1	150	95 × 120	CR	0.9	E62.P12-222CR0	6 / FB15
4.7	5000	1.2	2.3	40	3.7	11.1	170	95 × 205	CR	1.6	E62.P20-472CR0	3 / FB12
6	5000	0.8	1.9	80	4.7	14.1	160	116 × 205	CR	2.7	E62.R20-602CR0	3 / FB12
10	5000	2.6	1.4	50	6	18	180	116 × 280	CR	3.1	E62.R28-103CR0	3 / FB10



E62 TAB - FAST ON TERMINALS

AC

420.....500V AC

for latest edition and updates
check www.powercapacitors.info



AC-Capacitors for General Use

Wechselspannungskondensatoren (allgemeine Anwendung)



c **us** 10000 AFC Designs D1 and D2 only_Nur Maßbild D1 und D2
UL: up to_bis zu 930V AC/660V rms
CSA: up to_bis zu 850V AC/600V rms

Standards IEC 61071, UL810, CSA22.2 No.190
optional IEC 61881

can Gehäuse aluminium Aluminium
mounting position Einbaulage... terminals pointing upwards stehend
filling material liquid, based on vegetable oil, non-PCB
Füllmittel flüssig, auf Pflanzenölbasis, PCB-frei

Internal protection break-action mechanism (BAM)
Interne Sicherung Überdrucksicherung
fire load Brandlast 40 MJ/kg

C_N tolerance Toleranz ±10% (optional ±5%)
tanδ₀ 2 x 10⁻⁴

operating temperatures Grenztemperaturen

θ_{min} ... θ_{max} -40 ... +85°C
(lower temperatures on request)
θ_{HOTSPOT} ≤ 85°C

storing temperature Lagertemperatur -40 ... +85°C

statistical lifetime statistische Lebensdauer .. > 200 000 h

Failure rate Ausfallrate 100 FIT *

(reference interval_Referenzintervall 100000 h, θ_{HOTSPOT} ≤ 70°C)

* FIT curve see pg. 31/32_FIT Kurve siehe Seite 31/32



C _N (μF)	U _N DC (V)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	I _h (kA)	I _S (kA)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Box
U_N 420V AC		U_{rms} 300V		U_S 1050V		U_{TT} 1050V DC		U_{TC} 3000V AC				
35	700	4	13.9	16	0.4	1.2	80	40 × 81	D1	0.11	E62.E81-353D10	36 / FB3
50	700	3.3	12.2	16	0.57	1.71	80	45 × 81	D1	0.14	E62.F81-503D10	32 / FB3
75	700	2.7	9.5	16	0.75	2.6	80	55 × 85	D1	0.21	E62.H85-753D10	18 / FB3
90	700	2.5	8.7	16	1	3	80	60 × 85	D1	0.25	E62.K85-903D10	18 / FB3
U_N 500V AC		U_{rms} 360V		U_S 1260V		U_{TT} 1260V DC		U_{TC} 3000V AC				
20	840	5.4	13.8	16	0.3	0.8	80	40 × 81	D1	0.11	E62.E81-203D10	36 / FB3
33	840	3.7	12.2	16	0.5	1.4	80	45 × 81	D1	0.14	E62.F81-333D10	32 / FB3
60	840	2.8	8.7	16	0.8	2.5	80	60 × 85	D1	0.25	E62.K85-603D10	18 / FB3

Other values, dimensions and terminal combinations available on request.
Andere Werte, Abmessungen und Anschlußkombinationen auf Anfrage erhältlich.



E62 TAB - FAST ON TERMINALS

AC

640...850V AC

C _N (μF)	U _N DC (V)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _S (kA)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Box
U _N 640V AC		U _{rms} 450V		U _S 1500V		U _{TT} 1500V DC		U _{Tc} 3000V AC				
4	1000	5.9	25.6	10	0.2	0.6	60	30 × 58	D1	0.05	E62.C58-402D10	72 / FB4
4.7	1000	5.4	25.6	10	0.24	0.72	60	30 × 58	D1	0.05	E62.C58-472D10	72 / FB4
5	1000	4.9	25.6	10	0.26	0.8	60	30 × 58	E1	0.05	E62.C58-502E10	72 / FB4
10	1000	3.2	19.2	16	0.4	1.2	60	40 × 58	D1	0.08	E62.E58-103D10	36 / FB4
18	1000	4.8	13.8	16	0.29	0.87	80	40 × 81	D1	0.11	E62.E81-183D10	36 / FB3
22	1000	4.3	12.2	16	0.35	1.1	80	45 × 81	D1	0.14	E62.F81-223D10	32 / FB3
25	1000	4	12.2	16	0.4	1.2	80	45 × 81	D1	0.14	E62.F81-253D10	32 / FB3
40	1000	3.4	9.5	16	0.6	1.9	80	53 × 85	D1	0.21	E62.H85-403D10	18 / FB3
47	1000	2.9	8.7	16	0.8	2.3	80	60 × 85	D1	0.25	E62.K85-473D10	18 / FB3
100	1000	5.1	5	16	0.8	2.4	120	60 × 148	D1	0.45	E62.K14-104D10	18 / FB7
U _N 680V AC		U _{rms} 480V		U _S 1680V		U _{TT} 1680V DC		U _{Tc} 3000V AC				
3.3	1120	6.5	25.6	15	0.17	0.5	60	30 × 58	E1	0.05	E62.C58-332E10	72 / FB4
12	1120	5.8	13.8	16	0.2	0.7	80	40 × 81	D1	0.11	E62.E81-123D10	36 / FB3
20	1120	4.2	12.2	16	0.4	1.1	80	45 × 81	D1	0.14	E62.F81-203D10	32 / FB3
30	1120	3.3	9.5	16	0.5	1.6	80	55 × 85	D1	0.21	E62.H85-303D10	18 / FB3
33	1120	3.2	8.7	16	0.6	1.8	80	60 × 85	D1	0.25	E62.K85-333D10	18 / FB3
40	1120	3.3	7.2	16	0.7	2.1	120	65 × 95	D2	0.33	E62.L95-403D20	10 / FB1
46	1120	3.9	6.3	16	0.7	2.1	120	65 × 109	D2	0.4	E62.L10-463D20	10 / FB1
50	1120	3.7	6.3	16	0.7	2.2	120	65 × 109	D2	0.4	E62.L10-503D20	10 / FB1
60	1120	5	6	16	0.6	1.9	140	60 × 124	D1	0.4	E62.K12-603D10	18 / FB1
70	1120	6	5	16	0.6	1.9	140	60 × 148	D1	0.45	E62.K14-703D10	18 / FB7
U _N 750V AC		U _{rms} 530V		U _S 1900V		U _{TT} 1890V DC		U _{Tc} 3000V AC				
4.7	1200	11.1	18.3	10	0.22	0.66	60	30 × 81	E1	0.07	E62.C81-472E10	72 / FB3
6.8	1200	3.8	19.2	16	0.2	0.60	60	40 × 85	D1	0.08	E62.E58-682D10	36 / FB4
10	1200	6.1	13.8	16	0.45	1.35	110	40 × 81	D1	0.11	E62.E81-103D10	36 / FB3
15	1260	5.9	11.6	16	0.3	0.9	110	45 × 85	B2	0.14	E62.F85-153B20	21 / FB1
22	1260	3.5	8.7	16	0.5	1.5	120	60 × 85	D1	0.25	E62.K85-223D10	18 / FB3
33	750	11.4	6	16	0.4	1	120	50 × 148	D1	0.3	E62.G14-333D10	21 / FB0
70	1260	5.6	4.3	16	0.68	2	140	65 × 160	D2	0.6	E62.L16-703D20	10 / FB7
80	1200	5.3	3.7	20	0.78	2.3	130	75 × 160	D2	0.7	E62.M16-803D20	8 / FB7
U _N 850V AC		U _{rms} 600V		U _S 2100V		U _{TT} 2100V DC		U _{Tc} 3000V AC				
2	1200	8.1	25.6	10	0.18	0.5	60	30 × 58	E1	0.05	E62.C58-202E10	72 / FB4
2	1400	8.1	25.6	10	0.18	0.5	60	30 × 58	E4	0.07	E62.C58-202E40	72 / FB4
2.2	1200	7.5	25.6	10	0.2	0.6	60	30 × 58	E1	0.05	E62.C58-222E10	72 / FB4
2.2	1400	7.5	25.6	10	0.2	0.6	60	30 × 58	E4	0.07	E62.C58-222E40	72 / FB4
3.3	1200	13.8	18.3	10	0.1	0.3	80	30 × 81	E1	0.07	E62.C81-332E10	72 / FB3
3.3	1400	13.8	18.3	10	0.1	0.3	80	30 × 81	E4	0.08	E62.C81-332E40	72 / FB3
4	1200	11.7	18.3	10	0.18	0.5	80	30 × 81	E1	0.07	E62.C81-402E10	72 / FB3
4	1400	11.7	18.3	10	0.18	0.5	80	30 × 81	E4	0.08	E62.C81-402E40	72 / FB3
12	1400	6.2	12	16	0.3	0.8	110	45 × 85	B2	0.14	E62.F85-123B20	21 / FB1
15	1200	4.3	10	16	0.3	1	80	50 × 85	D1	0.18	E62.G85-153D10	21 / FB3
25	1200	3.6	7	16	0.6	1.7	120	65 × 95	D2	0.33	E62.L95-253D20	10 / FB1
55	1200	6	4.3	16	0.6	1.8	130	65 × 160	D2	0.6	E62.L16-553D20	10 / FB7
68	1200	5.4	3.7	16	0.74	2.2	100	75 × 160	D2	0.7	E62.M16-683D20	8 / FB7



E62 TAB - FAST ON TERMINALS

AC

1000....1200V AC



C _N (μF)	U _N DC (V)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _S (kA)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Box
U _N 1000V AC		U _{rms} 720V		U _S 2500V		U _{TT} 2520V DC		U _{TC} 3500V AC				
1.5	1200	5	25.6	10	0.3	0.9	60	30 × 58	E1	0.05	E62.C58-152E10	72 / FB4
1.5	1680	5	25.6	10	0.3	0.9	60	30 × 58	E4	0.07	E62.C58-152E40	72 / FB4
3	1200	7.2	18.3	10	0.35	1.05	80	30 × 81	E1	0.07	E62.C81-302E10	72 / FB3
3	1680	7.2	18.3	10	0.35	1.05	80	30 × 81	E4	0.07	E62.C81-302E40	72 / FB3
5	1200	5	14	16	0.6	1.8	80	40 × 81	D1	0.11	E62.E81-502D10	36 / FB3
6.8	1200	4.1	12.2	16	0.8	2.4	80	45 × 81	D1	0.14	E62.F81-682D10	32 / FB3
8	1200	3.7	12.2	16	0.46	1.38	80	45 × 81	D1	0.14	E62.F81-802D10	32 / FB3
8	1680	5	11.6	16	0.5	1.4	110	45 × 85	B2	0.14	E62.F85-802B20	21 / FB1
15	1200	2.7	8.7	16	0.9	2.6	110	60 × 85	D1	0.25	E62.K85-153D10	18 / FB3
20	1200	2.8	7.2	16	1.7	5.1	120	65 × 95	D2	0.33	E62.L95-203D20	10 / FB1
38	1200	4.8	4.3	20	1	3	140	65 × 160	D2	0.6	E62.L16-383D20	10 / FB7
53	1200	4.3	3.7	20	1.4	4.2	130	75 × 160	D2	0.7	E62.M16-533D20	8 / FB7
U _N 1200V AC		U _{rms} 850V		U _S 2100V		U _{TT} 2580V DC		U _{TC} 4000V AC				
0.1	1200	12.7	25.6	8	0.1	0.3	60	30 × 58	E1	0.05	E62.C58-101E10	72 / FB4
0.15	1200	10.4	25.6	8	0.1	0.3	60	30 × 58	E1	0.05	E62.C58-151E10	72 / FB4
0.22	1200	7.5	25.6	10	0.2	0.6	60	30 × 58	E1	0.05	E62.C58-221E10	72 / FB4
0.33	1200	6.5	25.6	10	0.2	0.6	60	30 × 58	E1	0.05	E62.C58-331E10	72 / FB4
0.47	1200	8.2	25.6	10	0.2	0.6	60	30 × 58	E1	0.05	E62.C58-471E10	72 / FB4
0.5	1200	5.9	25.6	10	0.16	0.48	60	30 × 58	E1	0.05	E62.C58-501E10	72 / FB4
0.5	1900	5.9	25.6	10	0.16	0.5	60	30 × 58	E4	0.07	E62.C58-501E40	50 / FB4
0.68	1200	6.6	25.6	10	0.22	0.7	60	30 × 58	E1	0.05	E62.C58-681E10	72 / FB4
1	1200	6	25.6	10	0.25	0.8	60	30 × 58	E1	0.05	E62.C58-102E10	72 / FB4
1	2000	6	25.6	10	0.25	0.8	60	30 × 58	E4	0.07	E62.C58-102E40	50 / FB4
1.2	1200	5.6	25.6	10	0.28	0.8	60	30 × 58	E1	0.05	E62.C58-122E10	72 / FB3
1.5	1200	9.9	18.3	10	0.23	0.7	60	30 × 81	E1	0.07	E62.C81-152E10	72 / FB3
2	1200	8.7	18.3	10	0.25	0.8	60	30 × 81	E1	0.07	E62.C81-202E10	72 / FB3
2	2000	8.7	18.3	10	0.25	0.8	60	30 × 81	E4	0.09	E62.C81-202E40	50 / FB2
2.2	1200	11.1	16	10	0.2	0.6	90	30 × 93	E1	0.08	E62.C93-222E10	72 / FB3
2.2	2000	11.1	16	10	0.2	0.6	90	30 × 93	E4	0.08	E62.C93-222E40	50 / FB2
3.3	2000	4	14.4	16	0.8	2.4	80	50 × 62	B2	0.15	E62.G62-332B20	21 / FB2
4	1200	5.2	13.8	16	0.3	0.9	80	40 × 81	D1	0.11	E62.E81-402D10	36 / FB3
4.7	1200	4.7	13.8	16	0.42	1.3	60	40 × 81	D1	0.11	E62.E81-482D10	36 / FB3
5.75	1200	3.8	10.5	16	0.5	1.5	80	50 × 85	D1	0.18	E62.G85-582D10	21 / FB3
6.8	1200	3.7	10.5	16	0.5	1.5	80	50 × 85	D1	0.18	E62.G85-682D10	21 / FB3
10	1200	3.1	8.7	16	0.7	2.1	80	60 × 85	D1	0.25	E62.K85-103D10	18 / FB3
15	1200	4.7	6.5	16	0.6	1.8	100	55 × 124	D1	0.3	E62.H12-153D10	18 / FB1
22	1200	5.4	4.9	16	1.2	3.6	100	60 × 151	D1	0.4	E62.K15-223D10	18 / FB0
30	1200	4.5	4.3	16	1	3	130	65 × 160	D2	0.6	E62.L16-303D20	10 / FB7
33	1200	4.8	3.7	16	0.93	2.79	120	75 × 160	D2	0.7	E62.M16-333D20	8 / FB7
40	1200	4.5	3.7	16	1.2	3.6	130	75 × 160	D2	0.7	E62.M16-403D20	8 / FB7

Other values, dimensions and terminal combinations available on request.
Andere Werte, Abmessungen und Anschlußkombinationen auf Anfrage erhältlich.

C _N (μF)	U _N DC (V)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _S (kA)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Box
U_N 1350V AC		U_{rms} 960V		U_S 3300V		U_{TT} 3375V DC		U_{TC} 4200V AC				
1.5	2250	9.9	18.3	10	0.23	0.7	80	30 × 81	E4	0.09	E62.C81-152E40	50 / FB2
4	2250	6	11.6	16	0.32	1	130	45 × 85	B2	0.14	E62.F85-402B20	21 / FB1
U_N 1700V AC		U_{rms} 1200V		U_S 4200V		U_{TT} 4200V DC		U_{TC} 5000V AC				
0.33	2200	6.5	25.6	10	0.2	0.6	60	30 × 58	E4	0.07	E62.C58-331E40	50 / FB4
0.47	2800	8.2	25.6	10	0.2	0.6	60	30 × 58	E4	0.07	E62.C58-471E40	50 / FB4
0.68	2800	16.1	18.3	10	0.2	0.6	80	30 × 81	E4	0.09	E62.C81-681E40	50 / FB2
1	2800	11.5	18.3	10	0.2	0.6	80	30 × 81	E4	0.09	E62.C81-102E40	50 / FB2
1	2800	5.8	16	16	0.4	1.2	150	45 × 62	B2	0.1	E62.F62-102B20	21 / FB3
1.5	2800	6.4	11.6	16	0.5	1.5	120	45 × 85	B2	0.14	E62.F85-152B20	21 / FB1
2.2	2800	7.3	11.6	10	0.2	0.6	80	45 × 85	B2	0.14	E62.F85-222B20	21 / FB1
2.5	2800	6.8	11.6	16	0.2	0.7	120	45 × 85	B2	0.14	E62.F85-252B20	21 / FB1
3.3	2800	5.9	10.5	16	0.3	1	120	50 × 85	B2	0.17	E62.G85-332B20	21 / FB1
4.7	2800	5	9.5	16	0.5	1.4	120	55 × 85	B2	0.21	E62.H85-472B20	18 / FB2
8.2	2800	8.9	5.4	16	0.4	1.1	190	55 × 151	B2	0.4	E62.H15-822B20	12 / FB8
U_N 2100V AC		U_{rms} 1500V		U_S 4800V		U_{TT} 4800V DC		U_{TC} 6200V AC				
0.1	3200	12.7	25.6	9	0.1	0.3	60	30 × 58	E4	0.07	E62.C58-101E40	50 / FB4
0.15	3200	10.4	25.6	9	0.1	0.3	60	30 × 58	E4	0.07	E62.C58-151E40	50 / FB4
0.22	2900	7.5	25.6	10	0.2	0.6	60	30 × 58	E4	0.07	E62.C58-221E40	50 / FB4
0.22	3200	6.8	16	16	0.15	0.45	100	45 × 62	B2	0.1	E62.F62-221B20	21 / FB3
0.47	3200	5.7	16	16	0.4	1.2	100	45 × 62	B2	0.1	E62.F62-471B21	21 / FB3
0.68	3200	4.7	14.4	16	0.5	1.5	100	50 × 62	B2	0.15	E62.G62-681B20	21 / FB2
1	3600	7.4	9.4	16	0.8	2.4	140	45 × 105	B2	0.18	E62.F10-102B21	21 / FB1
1.5	3600	5.7	7.7	16	1.2	3.6	120	55 × 105	B2	0.26	E62.H10-152B20	18 / FB0
2	3500	5.9	9.4	16	0.8	2.25	120	45 × 105	B2	0.18	E62.F10-202B20	21 / FB1
U_N 2400V AC		U_{rms} 1700V		U_S 6000V		U_{TT} 6000V DC		U_{TC} 6800V AC				
2	4000	5.6	8.5	16	0.5	1.5	120	50 × 105	B2	0.24	E62.G10-202B20	21 / FB0
2.2	4000	5	7.4	16	0.5	1.5	120	55 × 105	B2	0.26	E62.H10-222B20	18 / FB0
4	4000	7.5	5.4	16	0.6	1.8	190	55 × 151	B2	0.4	E62.H15-402B20	12 / FB8
U_N 4000V AC		U_{rms} 2800V		U_S 7500V		U_{TT} 7500V DC		U_{TC} 8200V AC				
0.1	5000	9.6	12.2	16	0.4	1.2	100	45 × 81	B2	0.14	E62.F81-101B20	21 / FB1
0.15	5000	7	12.2	16	0.5	1.5	90	45 × 81	B2	0.14	E62.F81-151B20	21 / FB1
0.22	5000	14.5	9.4	16	0.4	1.3	140	45 × 105	B2	0.18	E62.F10-221B21	21 / FB1
0.22	5000	6.9	7.1	16	0.7	2.1	140	60 × 105	CD	0.3	E62.K10-221CD0	10 / FB0
0.33	5000	14	9.4	16	0.3	0.9	140	45 × 105	B2	0.18	E62.F10-331B20	21 / FB1
0.39	5000	12.3	9.4	16	0.3	0.9	140	45 × 105	B2	0.18	E62.F10-391B20	21 / FB1
0.47	5000	10.8	9.4	16	0.37	1.1	140	45 × 105	B2	0.18	E62.F10-471B20	21 / FB1
0.5	5000	10.4	9.4	16	0.5	1.5	140	45 × 105	B2	0.18	E62.F10-501B20	21 / FB1
0.68	5000	8.5	7.7	16	0.5	1.5	120	55 × 105	B2	0.26	E62.H10-681B20	18 / FB0
1.5	4000	5.2	4.2	16	1.4	4.2	140	75 × 140	CD	0.6	E62.M14-152CD0	5 / FB8
2	4000	5.1	3.7	16	1.4	4.2	140	85 × 140	CD	0.8	E62.N14-202CD0	5 / FB8



E62 TAB - FAST ON TERMINALS

AC

5000V AC



C _N (μF)	U _N DC (V)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _S (kA)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Box
U _N 5000V AC		U _{rms} 3500V		U _S 7500V		U _{TT} 8750V						
0.1	5000	14.9	9.4	16	0.4	1.1	140	45 × 105	B2	0.18	E62.F10-101B20	21 / FB1
0.15	5000	12.9	9.4	16	0.44	1.4	140	45 × 105	B2	0.18	E62.F10-151B20	21 / FB1
0.22	5000	14.5	9.4	16	0.44	1.4	140	45 × 105	B2	0.18	E62.F10-221B20	21 / FB1
0.33	5000	8.7	6.2	16	0.73	2.19	140	60 × 120	CD	0.3	E62.K12-331CD0	18 / FB7
0.47	5000	7.1	6.2	16	0.92	2.76	140	60 × 120	CD	0.3	E62.K12-471CD0	18 / FB7
0.68	5000	8.9	5.3	16	0.94	2.82	140	60 × 140	CD	0.4	E62.K14-681CD0	12 / FB8
1	5000	6.5	4.2	16	1.39	4.17	140	75 × 140	CD	0.6	E62.M14-102CD0	5 / FB8
1.5	5000	4.8	3.7	16	2.08	6.24	140	85 × 140	CD	0.8	E62.N14-152CD0	5 / FB8
2	5000	3.9	3.4	16	2.77	8.31	140	95 × 140	CD	1	E62.P14-202CD0	3 / FB8

Other values, dimensions and terminal combinations available on request.
Andere Werte, Abmessungen und Anschlußkombinationen auf Anfrage erhältlich.



for latest edition and updates
check www.powercapacitors.info

E64HT - HIGH TEMPERATURE AC 420V AC

AC-Capacitors for high operating temperatures

Wechselspannungskondensatoren für hohe Einsatztemperaturen



according to standards..... IEC 61071, UL810 (protected 10000 AFC)
gemäß der Standards..... (UL-approved version available on request),
optional IEC 61881

can Gehäuse..... aluminium Aluminium

mounting position Einbaulage... terminals pointing upwards stehend

filling material..... liquid, based on vegetable oil, non-PCB

Füllmittel..... flüssig, auf Pflanzenölbasis, PCB-frei

Internal protection..... break-action mechanism (BAM)

Interne Sicherung..... Überdrucksicherung

fire load Brandlast..... 40 MJ/kg

C_N tolerance Toleranz..... 10% $\pm$ 5%
 $\tan \delta_0$ 2×10^{-4}

operating temperatures Grenztemperaturen

Θ_{min} -40

$\Theta_{HOTSPOT}$ 420V AC: <100°C

640V AC: <95°C

storing temperature Lagertemperatur..... -40 ... +100°C

statistical lifetime statistische Lebensdauer .. > 100 000 h

Failure rate..... see FIT diagrams pg.31/32

Ausfallrate..... siehe FIT-Diagramme S.31/32

C_N (μ F)	U_N DC (V)	R_s (m Ω)	R_{th} (K/W)	I_{max} (A)	$\hat{I}$ (kA)	I_s (kA)	L_e (nH)	$D_1 \times L_1$ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Box
U_N 420V AC		U_{rms} 300V		U_{TT} 645V _{rms}		U_{Tc} 3000V AC						
8	420	8.4	25.6	9	0.15	0.45	60	30 × 58	E1	0.05	E64.C58-300815	72/FB4
9	420	7.7	25.6	9	0.17	0.51	60	30 × 58	E1	0.05	E64.C58-300915	72/FB4
10	420	7.2	25.6	10	0.19	0.57	60	30 × 58	E1	0.05	E64.C58-301015	72/FB4
11	420	6.7	25.6	10	0.21	0.63	60	30 × 58	E1	0.05	E64.C58-301115	72/FB4
12	420	6.3	25.6	11	0.23	0.69	60	30 × 58	E1	0.05	E64.C58-301215	72/FB4
22.5	420	7.1	13.8	13	0.31	0.93	80	40 × 78	D1	0.11	E64.E78-482225	36/FB3
30	420	8.3	12	13	0.33	0.99	90	40 × 93	D1	0.11	E64.E93-403025	36/FB3
32	420	5.7	12.2	15	0.45	1.35	80	45 × 78	D1	0.14	E64.F78-403225	32/FB3
35	420	7.5	12	14	0.38	1.14	90	40 × 93	D1	0.11	E64.E93-403525	36/FB3
40	420	10.7	9.4	13	0.32	0.96	100	40 × 119	D1	0.17	E64.E19-404025	36/FB1
45	420	6.4	9.1	16	0.49	1.47	100	50 × 98	D1	0.19	E64.G98-404525	21/FB2
50	420	9.2	8.3	15	0.40	1.2	100	45 × 119	D1	0.2	E64.F19-405025	32/FB1
60	420	5.5	8.3	16	0.65	1.95	100	55 × 98	D1	0.2	E64.H98-406025	18/FB2
65	420	7.8	7.2	16	0.52	1.56	100	50 × 124	D1	0.3	E64.G24-406525	21/FB1
70	420	7.5	7.2	16	0.56	1.68	100	50 × 124	D1	0.3	E64.G24-407025	21/FB1
75	420	9.4	5.9	16	0.5	1.5	120	50 × 148	D1	0.35	E64.G48-407525	21/FB0
80	420	6.9	6.5	16	0.64	1.92	120	55 × 124	D1	0.3	E64.H24-408025	18/FB1
85	420	8.7	5.5	16	0.56	1.68	120	55 × 148	D1	0.4	E64.H48-408525	18/FB0
90	420	8.4	5.5	16	0.59	1.77	120	55 × 148	D1	0.4	E64.H48-409025	18/FB0
100	420	6.1	6	16	0.8	2.4	120	60 × 124	D1	0.45	E64.K24-410025	18/FB1
110	420	7.5	4.9	16	0.72	2.16	120	60 × 148	D1	0.5	E64.K48-411025	18/FB0
120	420	7.1	4.9	16	0.79	2.37	120	60 × 148	D1	0.5	E64.K48-412025	18/FB0
125	420	7	4.9	16	0.82	2.46	120	60 × 148	D1	0.5	E64.K48-412525	18/FB0
130	420	6.8	4.9	16	0.85	2.55	120	60 × 148	D1	0.5	E64.K48-413025	18/FB0



E64HT - HIGH TEMPERATURE

AC

640V AC



C _N (μF)	U _N DC (V)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _S (kA)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	order no. Bestell-Nr.	pcs / box Stk / Box
U _N 640V AC		U _{rms} 450V		U _S 970V		U _{Tc} 3000V AC						
3	640	8.2	30.7	8	0.11	0.33	60	30 × 48	E1	0.05	E64.C48-500315	72 / FB6
5	640	9.4	25.6	8	0.13	0.39	60	30 × 58	E1	0.05	E64.C58-500515	72 / FB4
6	640	12.2	21.8	8	0.12	0.36	80	30 × 68	E1	0.06	E64.C68-500615	72 / FB4
7	640	10.8	21.8	8	0.14	0.42	80	30 × 68	E1	0.06	E64.C68-500715	72 / FB4
8	640	13.5	18.3	8	0.13	0.39	80	30 × 81	E1	0.07	E64.C81-500815	72 / FB3
14	640	8.8	13.8	12	0.23	0.69	80	40 × 78	D1	0.11	E64.E78-501425	36 / FB3
16	640	8	13.8	13	0.26	0.78	80	40 × 78	D1	0.11	E64.E78-501625	36 / FB3
18	640	7.4	13.8	13	0.3	0.9	80	40 × 78	D1	0.11	E64.E78-501825	36 / FB3
25	640	8.4	10.6	14	0.32	0.96	90	45 × 93	D1	0.15	E64.F93-502525	36 / FB3
30	640	7.4	10.6	15	0.38	1.14	90	45 × 93	D1	0.15	E64.F93-503025	32 / FB3
35	640	10.6	8.3	14	0.33	0.99	100	45 × 119	D1	0.20	E64.F19-503525	32 / FB1
40	640	9.6	8.3	14	0.35	1.05	100	45 × 119	D1	0.20	E64.F19-504025	32 / FB1
50	640	8.3	7.2	16	0.47	1.41	100	50 × 124	D1	0.30	E64.G24-505025	21 / FB1
60	640	6.9	6	16	0.64	1.92	100	60 × 124	D1	0.45	E64.K24-606025	18 / FB1
65	640	8.5	4.9	16	0.57	1.71	100	60 × 148	D1	0.50	E64.K48-606525	18 / FB0
80	640	7.6	4.7	16	0.71	2.13	100	65 × 148	D2	0.55	E64.L48-608025	10 / FB0

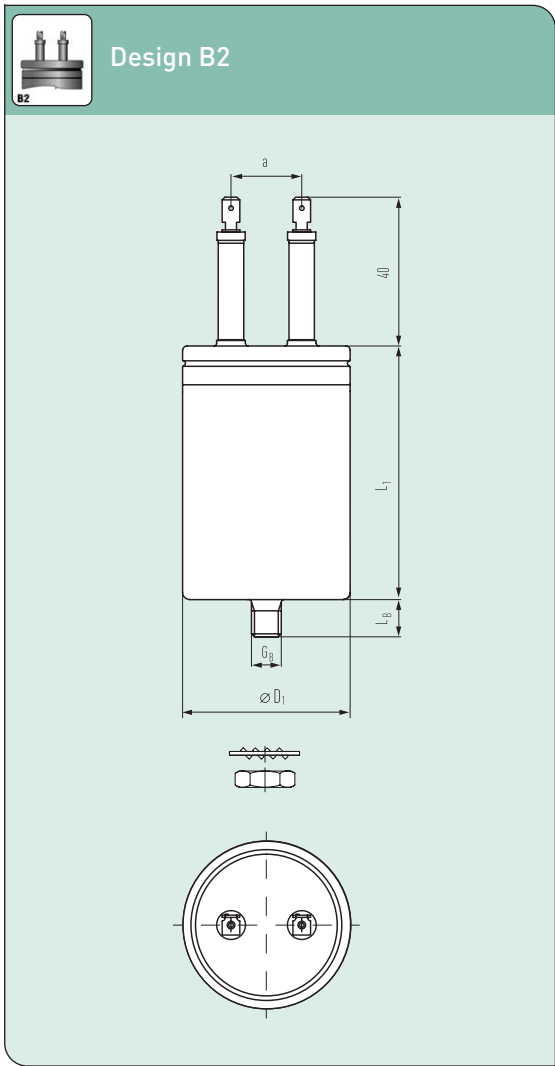
Other values, dimensions and terminal combinations available on request.

Andere Werte, Abmessungen und Anschlußkombinationen auf Anfrage erhältlich.

ACCESSORIES, DIMENSION DRAWINGS

ZUBEHÖR, MASSZEICHNUNGEN





CAPACITORS WITH A CAN DIAMETER OF 45...55 mm

- Can material aluminium
- Base mounting stud see chart
- Lid brass with rubber sealing, flanged can
- Terminals single tab (tinned brass) 6.3×0.8 mm on soldered ceramic bushing
- I_{max} (Terminals) 16 A
- Degree of protection IP 00
- Humidity class T1 (IEC 62498-1)

KONDENSATOREN MIT EINEM GEHÄUSEDURCHMESSER VON 45...55 mm

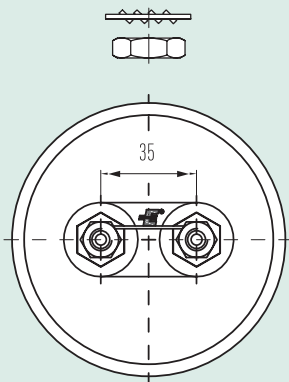
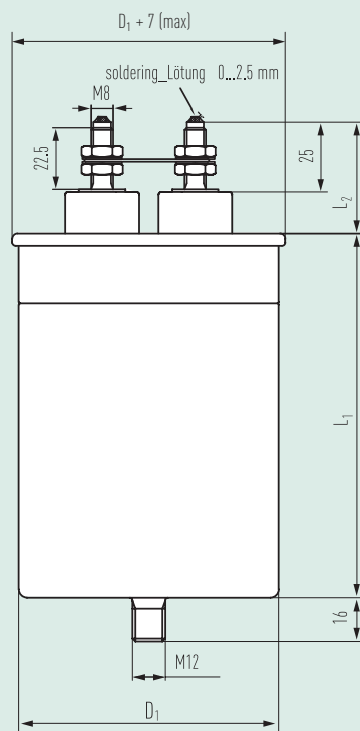
- Gehäusematerial Aluminium
- Bodenschraube siehe Tabelle
- Deckel Messing, Bördelverschluss mit Gummidichtung
- Anschlüsse Flachstecker (Messing, verzinkt) 6.3×0.8 mm auf eingelöteter Keramikdurchführung
- I_{max} (Anschlüsse) 16 A
- Schutzgrad IP 00
- Feuchtekategorie T1 (IEC 62498-1)

D_1	L_B	G_B	a	K	L
45	10	M8	19	20	9
50	16	M12	26	20	16
55	16	M12	26	20	16

C6/C68



Design C6/C68



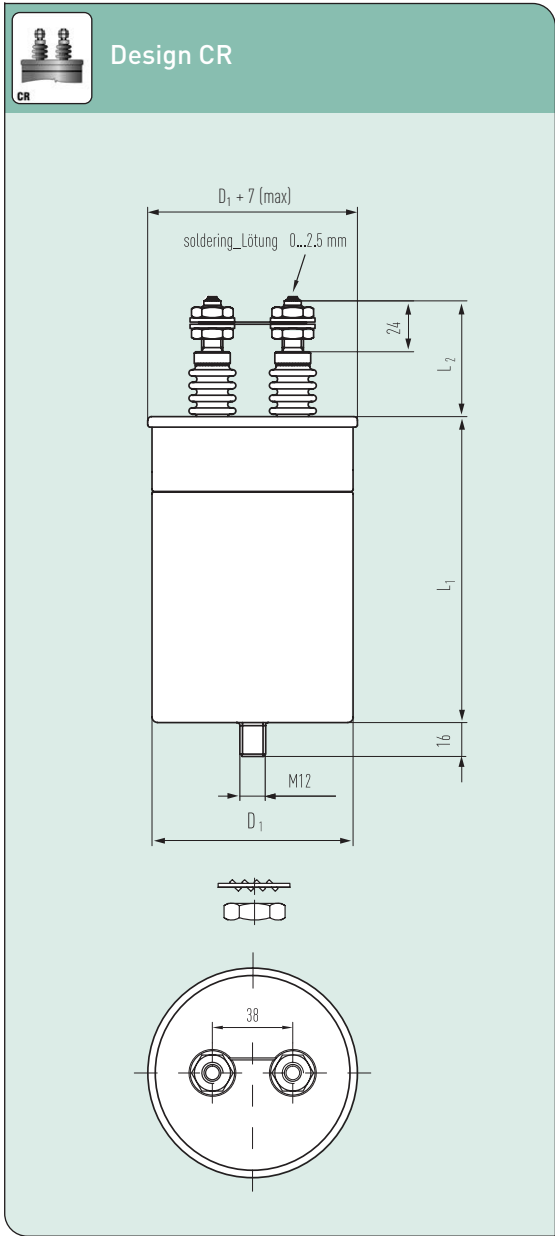
CAPACITORS WITH A CAN DIAMETER OF 60...136 mm

Can materialaluminium
 Base mounting studM12
 Lid.....flanged aluminium (folded edge)
 Terminal C6.....brass stud M10 on soldered plastic bushing
 Torque7...9 Nm
 I_{max} (Terminals)100 A
 Terminal C68.....brass stud M8 on soldered plastic bushing
 Torque3...4 Nm
 I_{max} (Terminals)50 A
 Degree of protectionIP 00
 Humidity class.....C, TX (IEC 62498-1)

KONDENSATOREN MIT EINEM GEHÄUSEDURCHMESSER VON 60...136 mm

Gehäusematerial Aluminium
 Bodenschraube..... M12
 Deckel Aluminium, Bördelverschluss
 Anschlüsse C6 Messingbolzen M10 auf eingelöteter Kunststoffdurchführung
 Drehmoment 7...9 Nm
 I_{max} (Anschlüsse) 100 A
 Anschlüsse C68 Messingbolzen M8 auf eingelöteter Kunststoffdurchführung
 Drehmoment 3...4 Nm
 I_{max} (Anschlüsse) 50 A
 Schutzgrad..... IP 00
 Feuchtekategorie C, TX (IEC 62498-1)

D_1	L_2	L	K
60	41	19	23
65	41	19	23
75	41	15	25
85	41	15	25
95	41	15	25
100	41	15	25
116	37	15	25
136	36	15	25



CAPACITORS WITH A CAN DIAMETER OF 75...136 mm

- Can material aluminium
- Base mounting stud M12
- Lid flanged copper (folded edge)
- Terminals brass stud M10 on soldered ceramic bushing
- Torque 7...9 Nm
- I_{max} (Terminals) 100 A
- Degree of protection IP 00
- K 54 mm
- L 17 mm
- Humidity class C, TX (IEC 62498-1)

KONDENSATOREN MIT EINEM GEHÄUSEDURCHMESSER VON 75...136 mm

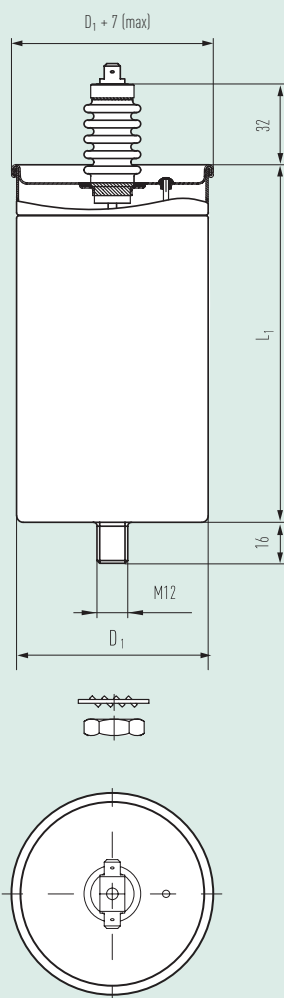
- Gehäusematerial Aluminium
- Bodenschraube M12
- Deckel Kupfer, Bördelverschluss
- Anschlüsse Messingbolzen M10 auf eingelöteter Keramikdurchführung
- Drehmoment 7...9 Nm
- I_{max} (Anschlüsse) 100 A
- Schutzgrad IP 00
- K 54 mm
- L 17 mm
- Feuchtekategorie C, TX (IEC 62498-1)

D_1	L_2
75	56
85	56
95	56
100	56
116	54
136	51

CD



Design CD



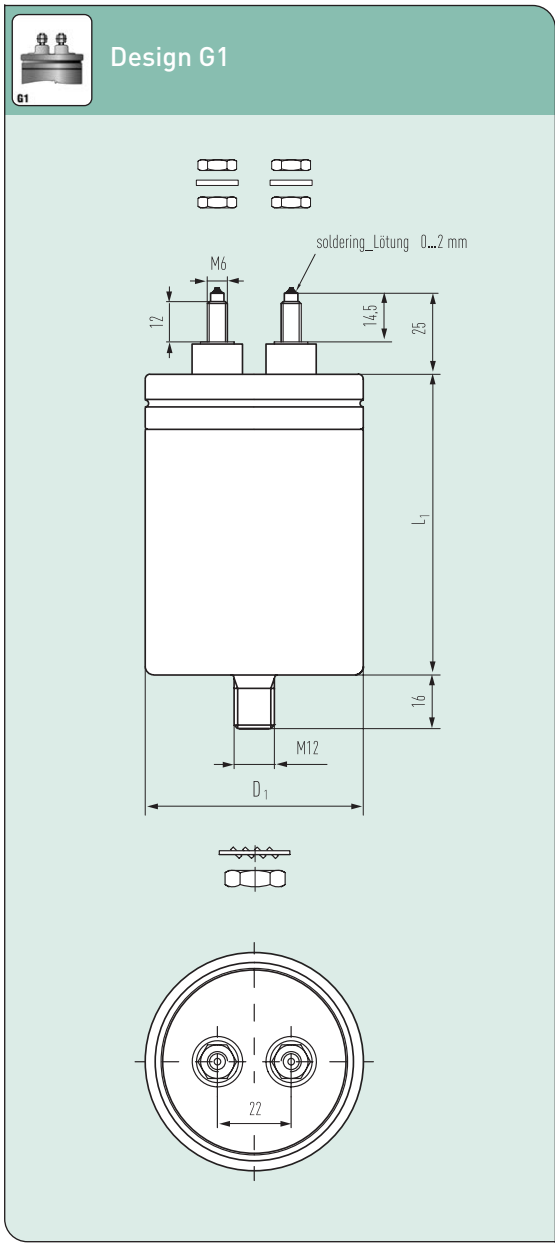
CAPACITORS WITH A CAN DIAMETER OF 60...95 mm

Can material	aluminium
Base mounting stud	M12
Lid	flanged copper (folded edge)
Terminals	dual tab (tinned brass) 6.3 × 0.8 mm
I _{max} (Terminals)	16 A
Degree of protection	IP 00
K	54 mm
L	35 mm
Humidity class	C, TX (IEC 62498-1)

KONDENSATOREN MIT EINEM GEHÄUSEDURCHMESSER VON 60...95 mm

Gehäusematerial	Aluminium
Bodenschraube	M12
Deckel	Kupfer, Bördelverschluss
Anschlüsse	Doppelflachstecker (Messing, verzinkt) 6.3 × 0.8 mm
I _{max} (Anschlüsse)	16 A
Schutzgrad	IP 00
K	54 mm
L	35 mm
Feuchteklasse	C, TX (IEC 62498-1)





CAPACITORS WITH A CAN DIAMETER OF 50/55/65 mm

Can material	aluminium
Base mounting stud	M12
Lid	plastic with rubber sealing, flanged can
Terminals	brass stud M6 on integrated plastic bushing
Torque	1.5...2 Nm
I _{max} (Terminals)	40 A
Degree of protection	IP 00
L	10
Humidity class	T1 (IEC 62498-1)

KONDENSATOREN MIT EINEM GEHÄUSEDURCHMESSER VON 50/55/65 mm

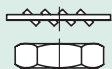
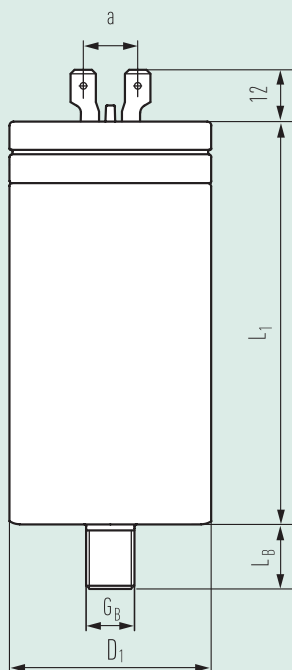
Gehäusematerial	Aluminium
Bodenschraube	M12
Deckel	Kunststoff, Bördelverschluss mit Gummidichtung
Anschlüsse	Messingbolzen M6 auf integrierter Kunststoffdurchführung
Drehmoment	1.5...2 Nm
I _{max} (Anschlüsse)	40 A
Schutzgrad	IP 00
L	10
Feuchtekategorie	T1 (IEC 62498-1)

D ₁	K
50	15
55	16
65	21

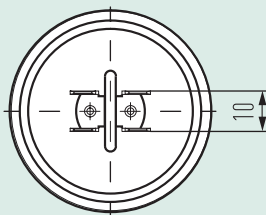




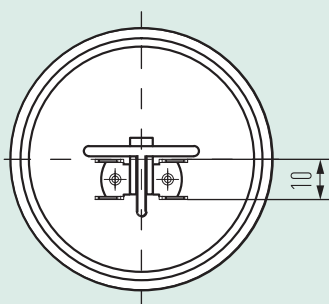
Design D1/D2



D1



D2



D1 CAPACITORS WITH A CAN DIAMETER OF 40...60 mm

D2 CAPACITORS WITH A CAN DIAMETER OF 65...75 mm

Can material aluminium

Base mounting stud see chart

Lid plastic with rubber sealing, flanged can

Terminals dual tab connectors 6.3×0.8 mm
(tinned brass, riveted)

I_{max} (Terminals) 16 A

Degree of protection IP 00

Humidity class T1 (IEC 62498-1)

D1 KONDENSATOREN MIT GEHÄUSEDURCHMESSER 40...60 mm

D2 KONDENSATOREN MIT GEHÄUSEDURCHMESSER 65...75 mm

Gehäusematerial Aluminium

Bodenschraube siehe Tabelle

Deckel Kunststoff, Bördelverschluss mit
Gummidichtung

Anschlüsse Doppelflachstecker 6.3×0.8 mm
(Messing, verzinkt, genietet)

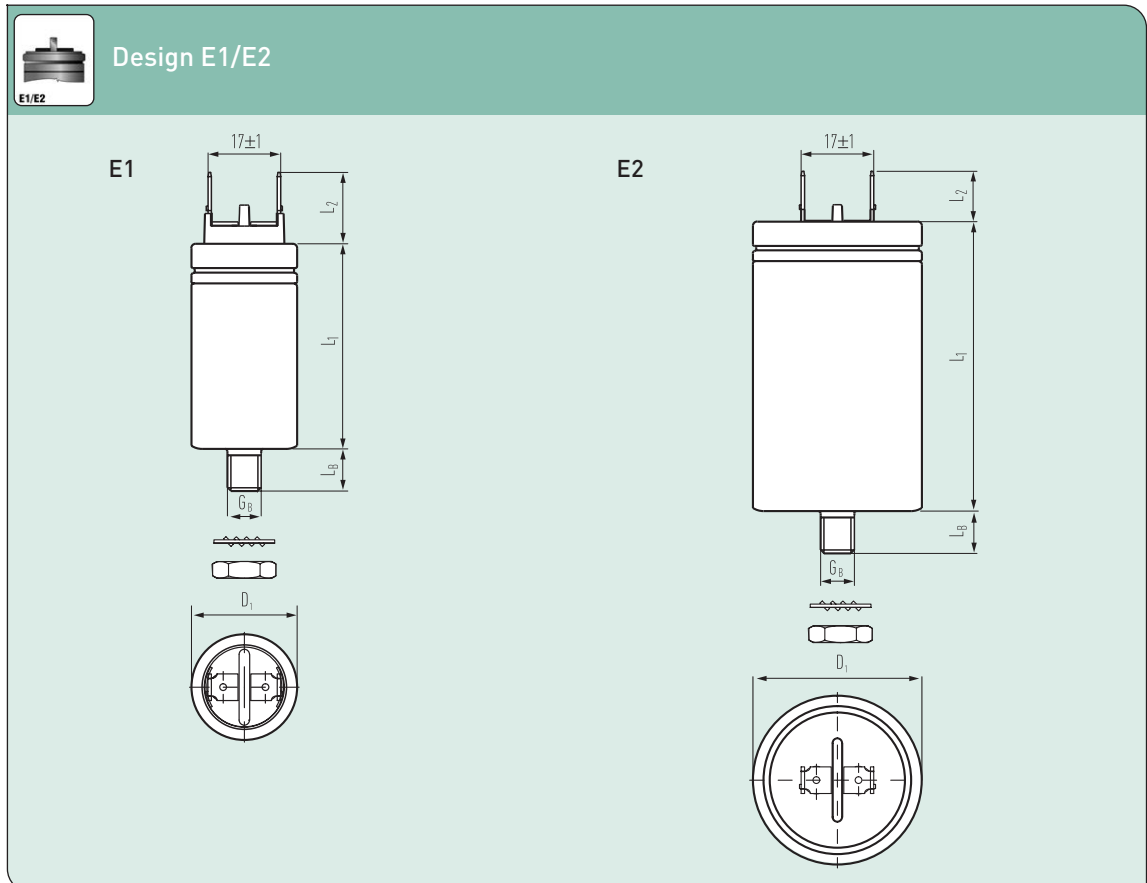
I_{max} (Anschlüsse) 16 A

Schutzgrad IP 00

Feuchteklasse T1 (IEC 62498-1)

D_1	a	G_b	L_b	K	L
40	13.5	M8	10	9	6.5
45	13.5	M8	10	10	6.5
50	13.5	M12	16	10	6.5
55	13.5	M12	16	10	6.5
60	13.5	M12	16	10	6.5
65	16.5	M12	16	10	8
75	16.5	M12	16	10	8





E1 CAPACITORS WITH A CAN DIAMETER OF 30 mm

E2 CAPACITORS WITH A CAN DIAMETER OF 40...65 mm

Can material	aluminium
Base mounting stud	see chart
Lid	plastic (UL94: V0)
Terminals	tab connector 6.3×0.8 mm (tinned brass, riveted)
I_{max} (Terminals)	16 A
Degree of protection	IP 00
Humidity class	T1 (IEC 62498-1)

E1 KONDENSATOREN MIT GEHÄUSEDURCHMESSER 30 mm

E2 KONDENSATOREN MIT GEHÄUSEDURCHMESSER 40...65 mm

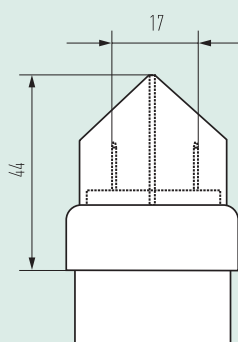
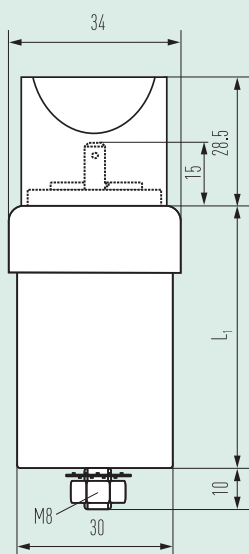
Gehäusematerial	Aluminium
Bodenschraube	siehe Tabelle
Deckel	Kunststoff (UL94: V0)
Anschlüsse	Flachstecker 6.3×0.8 mm (Messing, verzinkt, genietet)
I_{max} (Anschlüsse)	16 A
Schutzgrad	IP 00
Feuchteklasse	T1 (IEC 62498-1)

D_1	L_2	G_B	L_B	K	L
30	15	M8	10	9	7.5
40...45	11	M8	10	9	7.5
50...65	11	M12	16	9	7.5

E4



Design E4



CAPACITORS WITH A CAN DIAMETER OF 30 mm

Extended clearance and creepage distances by special plastic insulating top (UL 94 : V0)

Can material	aluminium
Base mounting stud	M8
Lid	plastic (UL94: V0) with rubber sealing, flanged can
Terminals	tab connectors 6.3 × 0.8 mm (tinned brass, riveted)
I _{max} (Terminals)	16 A
Degree of protection	IP 00
K	40 mm
L	30 mm
Humidity class	T1 (IEC 62498-1)

KONDENSATOREN MIT EINEM GEHÄUSEDURCHMESSER VON 30 mm

Verlängerte Kriech- und Luftstrecken durch fest verbundenen speziellen Isolieraufsatz aus Kunststoff (UL 94 : V0)

Gehäusematerial	Aluminium
Bodenschraube	M8
Deckel	Kunststoff (UL94: V0), Bördelverschluss mit Gummidichtung
Anschlüsse	Flachstecker 6.3 × 0.8 mm (Messing, verzinkt, genietet)
I _{max} (Anschlüsse)	16 A
Schutzgrad	IP 00
K	40 mm
L	30 mm
Feuchteklasse	T1 (IEC 62498-1)

ACCESSORIES
ZUBEHÖR

ACCESSORIES_ZUBEHÖR





Holder for Horizontal Mounting

All cylindrical capacitors with diameter 116mm and 136mm can be mounted by means of this bracket on a flat vertical or horizontal surface.

The bracket is made of glass fibre reinforced polyamide and comes as a set including a matching 9mm zinc-plated steel strap for fixation of the capacitor.

As an alternative option, the capacitors can also be fixed by plastic cable ties (commercially available standard parts).

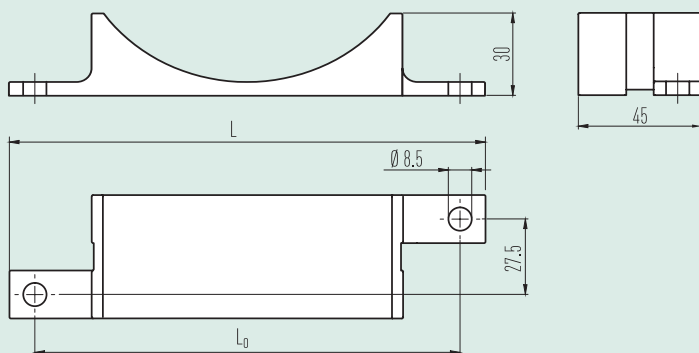
Halter für waagerechte Montage

Alle zylindrischen Kondensatoren mit Durchmesser 116mm und 136mm können mit Hilfe dieser Schelle auf einer senkrechten oder waagerechten Oberfläche montiert werden.

Der Halter ist aus glasfaserverstärktem Polyamid und wird inklusive passender 9mm-Schlauchschelle aus verzinktem Stahl geliefert.

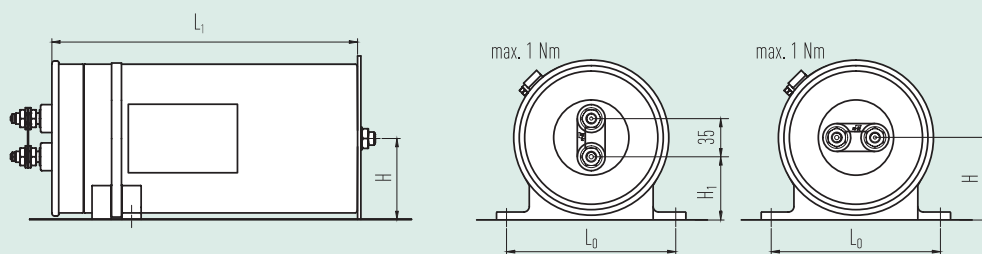
Alternativ können die Kondensatoren auch mit handelsüblichen Kunststoffkabelbindern befestigt werden.

Drawings Maßbilder



material Material glass fibre reinforced polyamide glasfaserverstärktes Polyamid

Example for C6 design Beispiel für C6-Design



Example of horizontal mounting.
Beispiel für eine waagerechte Befestigung.

for Diameter für Durchmesser	L	L ₀	H	H ₁	order no. (10 × mounting set) Bestell-Nr. (10 × Montage-Set)
116	159	135	64	47	E50.H16-100000
136	174	155	74	57	E50.H36-100001

Important Remarks

General

Our catalogues outline the typical technical and mechanical characteristics of the listed capacitors. The stated values are based on reference type tests, as well as empirical and experimental experience. The real values of individual capacitors may differ within the stated, or commonly known, tolerances. Any information given in this catalogue therefore describes the components in general terms and does not constitute any guarantee of individual technical values.

It is the responsibility of the user to ensure by dedicated tests the suitability and safety of operation of our components under the conditions of his application. This also applies to any accessories offered by ELECTRONICON.

Safety

Safe operation of the capacitors can be expected only if all safety recommendations as well as electrical and thermal specifications as stated on the label, in the data sheets, catalogues and the accompanying mounting instructions are strictly observed, and recommended safety devices are used as intended. Please consider the "General Safety Recommendations" of the power capacitor manufacturers organized in the German ZVEI (www.electronicon.com/en/zvei).

The capacitors shall only be used for the intended application. ELECTRONICON will not indemnify or be responsible for any kind of damages to persons or property due to the improper application of any capacitors purchased from ELECTRONICON or its distributors.

Mind that electrical or mechanical misapplication of capacitors can become hazardous. Misapplied capacitors can explode or catch fire and cause bodily injury or property damage due to the expulsion of material or metal fragments.

Please consult the detailed instructions for mounting and application stated in our brochure „Application Notes“ and on the ELECTRONICON website: www.electronicon.com/en/an

If in doubt about how to connect, operate, or discharge a capacitor, consult ELECTRONICON engineering or our distributors.

Mounting And Cooling

The useful life of a capacitor may be reduced dramatically if exposed to excessive heat. Typically an increase in the ambient temperature of 7°C will halve the expected life of the capacitor. Make sure to obey the permitted operating temperatures.

To avoid overheating the capacitors must be allowed to cool unhindered and should be shielded from external heat sources. We recommend forced ventilation for all filter applications with reactors. Give approx. 20mm clearance around capacitors for natural or forced ventilation, and do not place them directly above or next to heat sources such as detuning or tuning reactors, bus bars, etc.

Wichtige Hinweise

Allgemeines

Unsere Kataloge beschreiben die typischen technischen und mechanischen Eigenschaften der aufgeführten Kondensatoren. Die angegebenen Werte basieren auf Referenztypprüfungen sowie empirischen und experimentellen Erfahrungswerten. Die tatsächlichen Werte einzelner Kondensatoren können innerhalb der angegebenen bzw. allgemein bekannter Toleranzen abweichen. Alle Angaben in diesem Katalog beschreiben daher die Komponenten im Allgemeinen und stellen keine Garantie für individuelle technische Werte dar.

Es liegt in der Verantwortung des Anwenders, durch gezielte Prüfungen die Eignung und Betriebssicherheit unserer Komponenten unter den konkreten Betriebsbedingungen seiner Anwendung sicherzustellen. Dies gilt ebenso für gegebenenfalls von ELECTRONICON angebotene Zubehörteile.

Sicherheit

Ein sicherer Betrieb der Kondensatoren ist nur zu erwarten, wenn alle Sicherheitsempfehlungen sowie elektrische und thermische Spezifikationen entsprechend Etikett, Datenblättern, Katalogen und beiliegenden Montageanleitungen eingehalten und die empfohlenen Sicherheitseinrichtungen bestimmungsgemäß verwendet werden. Bitte beachten Sie die „Allgemeinen Sicherheitsempfehlungen“ der im deutschen ZVEI organisierten Hersteller von Leistungskondensatoren (www.electronicon.com/zvei).

Die Kondensatoren dürfen ausschließlich für ihren Bestimmungszweck verwendet werden. ELECTRONICON übernimmt keine Verantwortung oder Haftung für Schäden an Personen oder Eigentum, welche aus unsachgemäßer Anwendung von Kondensatoren herrührt.

Elektrisch oder mechanisch fehlerhaft eingesetzte Kondensatoren können explodieren oder Feuer fangen. Austretende Materialien bzw. Metallteile können gesundheitliche und materielle Schäden verursachen.

Bitte beachten Sie die detaillierten Anweisungen in unserer Broschüre „Anwendungshinweise“ sowie auf der Webseite von ELECTRONICON: www.electronicon.com/an

Bitte konsultieren Sie das Fachpersonal oder unsere Distributoren zu Fragen bezüglich Anschluss, Verwendung oder Entladung von Kondensatoren.

Montage und Kühlung

Die Lebensdauer eines Kondensators kann durch übermäßige Wärmeeinwirkung erheblich verringert werden. Im allgemeinen führt eine Erhöhung der Umgebungstemperatur um 7°C zu einer Verringerung der Lebensdauer des Kondensators um 50 %. Halten Sie die zugelassenen Betriebstemperaturen ein.

Um Überhitzung zu vermeiden, muß gewährleistet sein, daß die Kondensatoren auftretende Verlustwärme ungehindert abführen können und vor fremden Wärmequellen abgeschirmt werden. Insbesondere in Filtern ist in jedem Falle eine Zwangslüftung zu empfehlen. Zwischen und um Kondensatoren sollten etwa 20mm Platz für natürliche oder Zwangslüftung belassen werden. Bringen Sie den Kondensator nie direkt neben oder über Wärmequellen, wie Drosseln u. ä. an.

Failure Rate

The failure probability of a component is a statistical value which is described by a log-normal distribution:

$$N = N_0 \times e^{-\lambda t}$$

λ is the failure rate, which alternatively is also stated as the so-called FIT-rate (FIT = Failures In Time = $\lambda \times 10^9$).

The failure rate is very closely linked with operating temperature and operating voltage of the capacitor. The FIT rates stated in this catalogue are related to the capacitor's rated voltage and a dielectric temperature (= HOTSPOT temperature) of 70°C.

The simultaneous operation of capacitors at highest permissible voltage and operating temperature should be avoided; otherwise, failure rates may increase beyond reasonable technical reliability.

The standard reference period for the failure rate statement is 100.000 hours. Please note that FIT rates can be altered or improved by technical adjustments. Please contact us for details.

The following diagram demonstrates the correlation between FIT rate, operating voltages and operating temperatures.

Ausfallrate

Die Ausfallwahrscheinlichkeit eines Bauelements ist eine statistische Größe, die mit Hilfe einer Normalverteilung beschrieben wird. Es gilt:

N = number of functional components after period t
Anzahl der nach der Zeit t intakten Bauelemente

N_0 = total number of components at time $t = 0$
Gesamtzahl der Bauelemente zum Zeitpunkt $t = 0$

λ = failure rate Ausfallrate

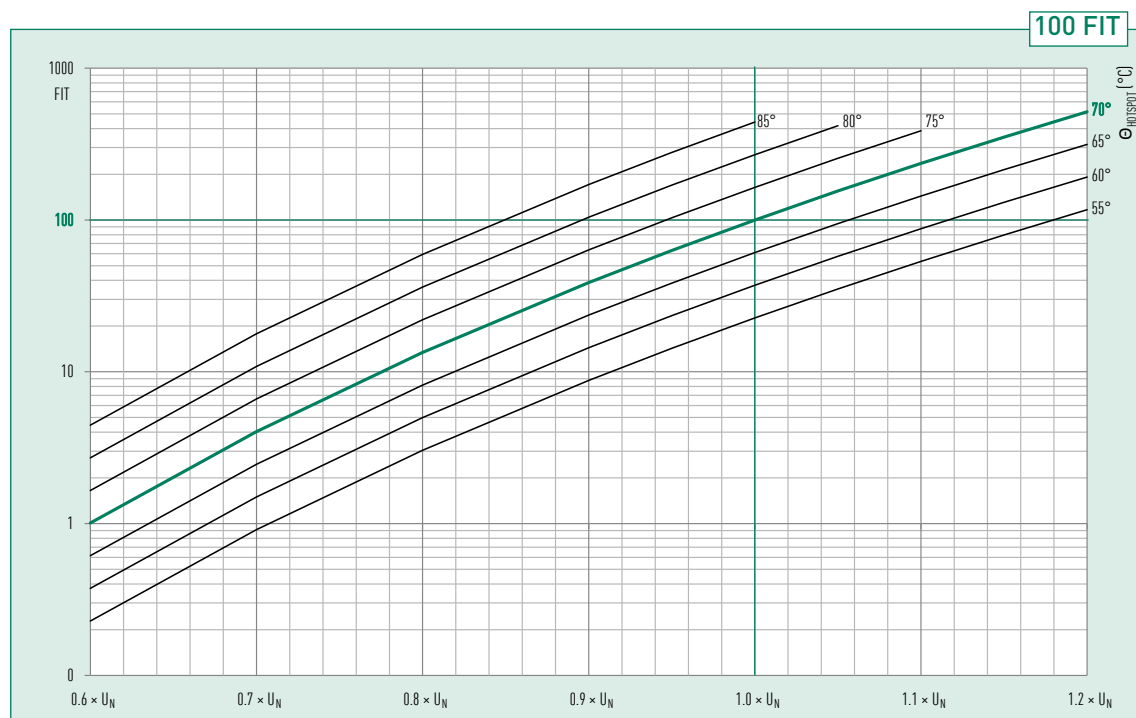
Dabei ist λ die Ausfallrate, die alternativ auch als FIT-Rate angegeben wird (FIT = $\lambda \times 10^9$)

Die Ausfallrate ist stark abhängig von der Temperatur und der Betriebsspannung. Die FIT-Raten im Katalogsortiment beziehen sich auf 70°C Dielektrikumtemperatur (=Hotspot-Temperatur) und die Nennspannung des Kondensators.

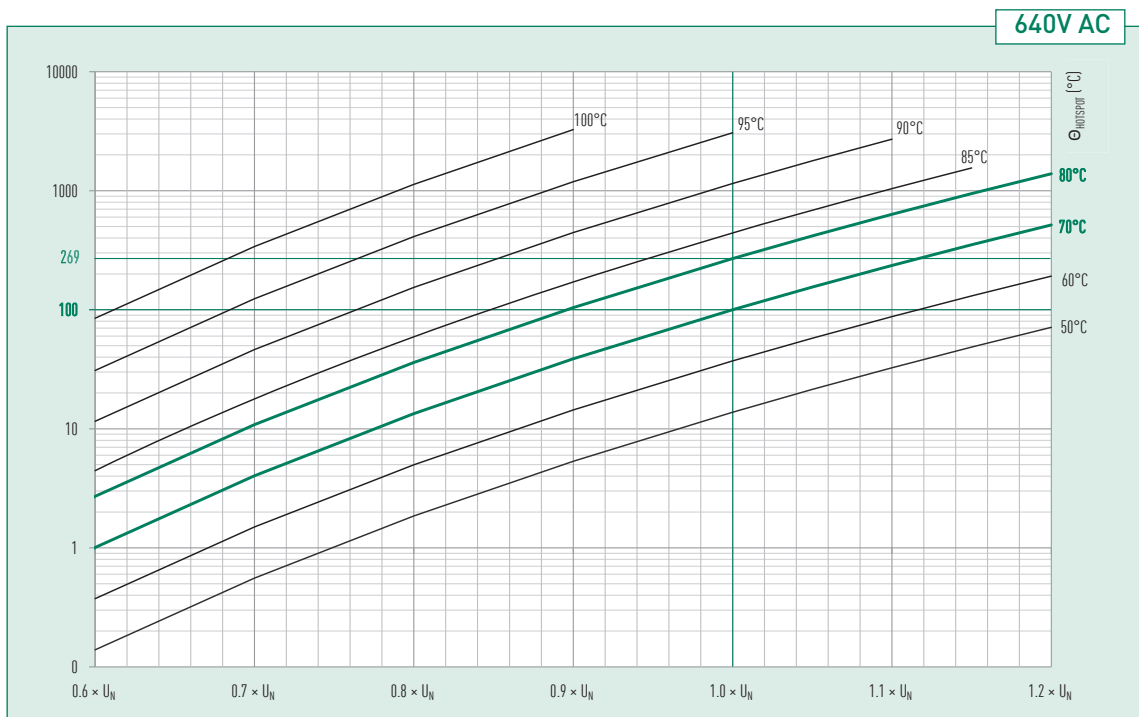
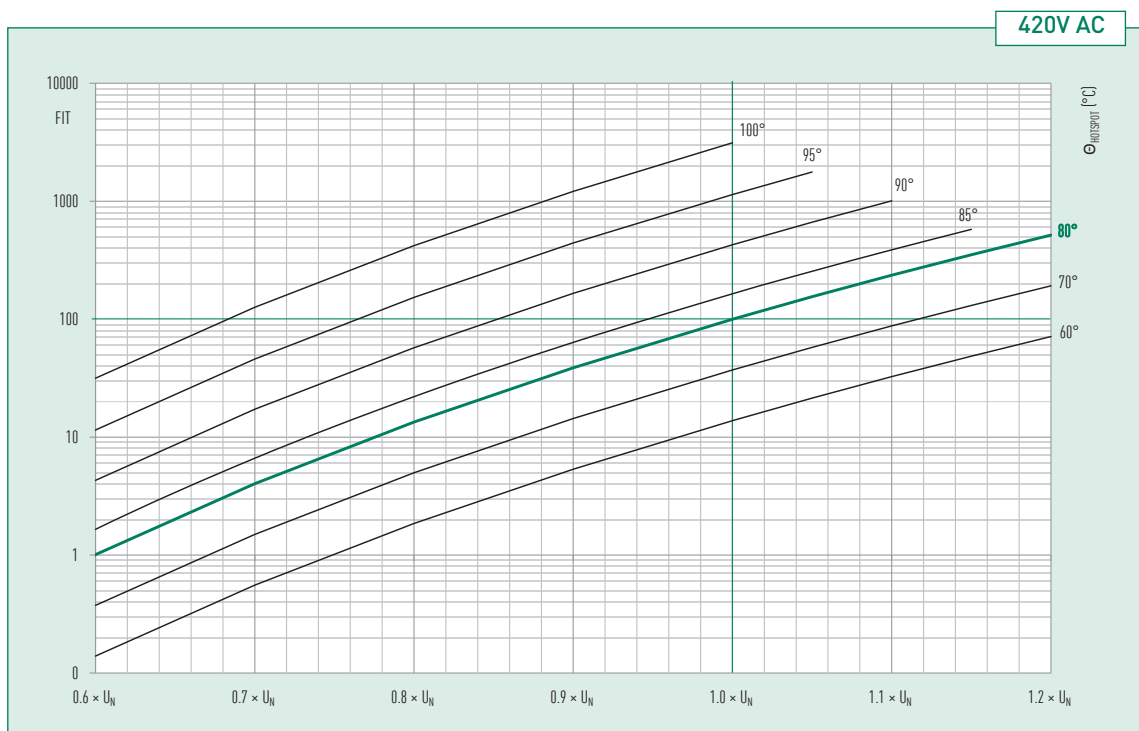
Der Betrieb von Kondensatoren mit der höchsten zulässigen Spannung und der höchsten zulässigen Betriebstemperatur sollte vermieden werden, andernfalls können die Ausfallraten so hoch werden, dass keine technisch sinnvollen Zuverlässigkeiten mehr gewährleistet sind.

Der Wert für die Ausfallrate bezieht sich auf einen Referenzzeitraum von 100.000h. FIT-Raten können durch technische Anpassung der Kondensatoren beeinflusst und verbessert werden. Auskünfte hierzu erteilen wir auf Anfrage.

Das nachstehende Kurviendiagramm macht den Zusammenhang von FIT-Rate, Betriebsspannung und Betriebstemperatur deutlich.



FIT-Diagrams for E64 HT
FIT-Diagramm für E64 HT



Functioning of the BAM™ (Break Action Mechanism)

In the event of overvoltage or thermal overload or ageing at the end of the capacitor's useful service life, an increasing number of selfhealing breakdowns may cause rising pressure inside the capacitor.

To prevent it from bursting, the capacitor is fitted with an obligatory „break action mechanism“ (BAM™).

The BAM™ is based on an attenuated spot at one or both of the connecting wires inside the capacitor. With rising pressure the case begins to expand, mainly by opening the folded crimp and pushing the lid upwards. As a result, the prepared connecting wire is separated at the attenuated spot, and the current path is interrupted irreversibly.

Funktion der Abreißsicherung (BAM™)

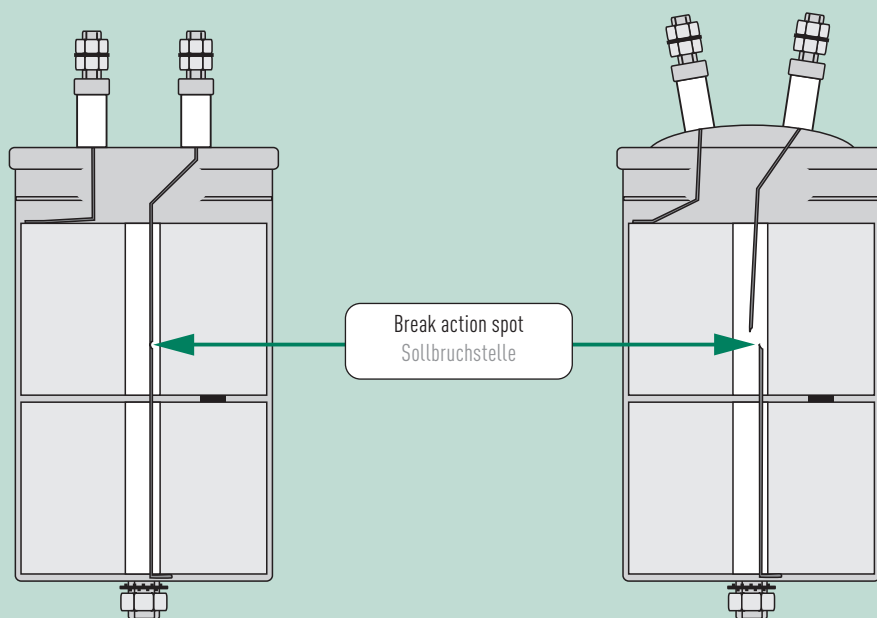
Bei spannungsmäßiger oder thermischer Überlastung bzw. am Ende der Lebensdauer kann durch zahlreiche Selbstheilungsdurchschläge ein Überdruck im Kondensator entstehen.

Um ein Bersten der Gehäuse zu verhindern, sind die Kondensatoren generell mit einer Überdruck-Abreißsicherung (BAM™) versehen.

Diese Sicherung besteht aus einer Sollbruchstelle in einem oder beiden Anschlussdrähten. Bei einem Überdruck im Kondensator verlängert sich das Gehäuse durch das Öffnen der gestauchten Sicke bzw. Wölbung des Metalldeckels und die Stromzufuhr zu den Kondensatorwickeln wird an den Sollbruchstellen irreversibel unterbrochen.

Principle of the break action mechanism (exemplaric sketch)

Prinzip der Überdruck-Abreißsicherung (Prinzipskizze)



Capacitor before functioning of the BAM

Kondensator vor dem Abschalten durch die Überdruck-Abreißsicherung

Capacitor after functioning of the BAM

Kondensator nach dem Abschalten durch die Überdruck-Abreißsicherung

Protection against Overvoltages And Short Circuits: Self-Healing Dielectric

All dielectric structures used in our power capacitors are „selfhealing“: In the event of a voltage breakdown the metal layers around the breakdown channel are evaporated by the temperature of the electric arc that forms between the electrodes. They are removed within a few microseconds and pushed apart by the pressure generated in the centre of the breakdown spot. An insulation area is formed which is reliably resistive and voltage proof for all operating requirements of the capacitor. The capacitor remains fully functional during and after the breakdown.

For voltages within the permitted testing and operating limits the capacitors are short-circuit- and overvoltage-proof. They are also proof against external short circuits as far as the resulting surge discharges do not exceed the specified surge current limits.

Warning:

It has to be noted that this safety system can act properly only within the permitted limits of loads and overloads. The simple presence of a safety mechanism does not mean that catastrophic failures are completely impossible. Strong overvoltages, permanent external heat, and heavy current overload, e.g. during harmonic resonances may cause sudden, uncontrollable rise of temperature and pressure inside the can which may not leave sufficient time for the BAM™ to act properly, and result in explosion and fire.

For more detailed information, please consult our “Application Notes” and the „General Safety Advice for Power Capacitors” issued by the German Electrical and Electronic Manufacturer’s Association (ZVEI).

Limited Warranty

All our products are designed, manufactured, and tested with the highest care and workmanship. The satisfaction of our customers is our highest goal. We therefore warrant remedying any defect in the goods resulting from faulty design, materials or workmanship, which appears within 3 years from the date of sale.

This warranty does not cover defects due to improper use of the goods or operation at conditions exceeding the rated values stated in the catalogue or special data sheet. Nor does it cover defects due to faulty maintenance or incorrect installation, alterations or faulty repairs undertaken by the Buyer. Finally the warranty does not cover normal wear and tear or deterioration.

See our „General Conditions” for details on Warranty and Product liability.

Schutz gegen Überspannungen und Kurzschlüsse: Selbstheilendes Dielektrikum

Alle in unseren Leistungskondensatoren eingesetzten dielektrischen Strukturen sind selbstheilend. Im Falle eines Kurzschlusses (Spannungsdurchschlag) verdampfen die Metallbeläge um den Durchschlagspunkt herum infolge des Lichtbogens, der sich zwischen den Elektroden bildet. Binnen Mikrosekunden wird der Metaldampf vom Zentrum des Durchschlages weggedrückt. Auf diese Weise bildet sich eine isolierende belagfreie Zone um den Durchschlagspunkt. Der Kondensator bleibt während und nach dem Durchschlag voll funktionsfähig.

Für Spannungen innerhalb der zugelassenen Test- und Betriebsbedingungen sind die Kondensatoren kurzschluss- und überspannungssicher. Sie sind außerdem sicher gegen äußere Kurzschlüsse, sofern bei den dabei entstehenden Stoßentladungen die zugelassenen Stoßströme nicht überschritten werden.

Warnung:

Es ist zu beachten, daß dieses Sicherungsprinzip nur innerhalb der zulässigen Be- und Überlastungsgrenzen zuverlässig wirken kann. Die Existenz eines Sicherheitsmechanismus an sich bedeutet nicht, dass gewaltsame Ausfälle gänzlich ausgeschlossen werden können. Starke Überspannungen, andauernde äußere Wärmeeinwirkung sowie starke Überstrombelastung, z.B. während Oberwellenresonanzen, können plötzlichen unkontrollierten Temperatur- und Druckanstieg im Kondensatorinnern hervorrufen, welche der Überdrucksicherung nicht ausreichend Zeit zum ordnungsgemäßen Abschalten lassen und zur Explosion bzw. Entzündung führen können.

Für detailliertere Informationen konsultieren Sie bitte unsere ausführliche Broschüre „Anwendungshinweise” sowie die „Allgemeinen Sicherheitshinweise für Leistungskondensatoren” des ZVEI.

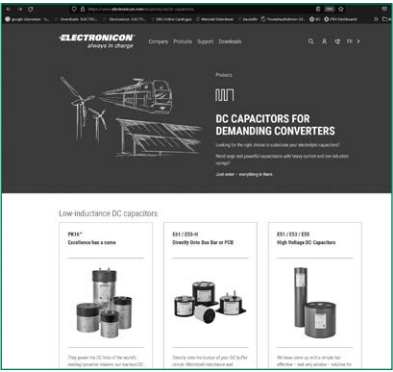
Gewährleistung

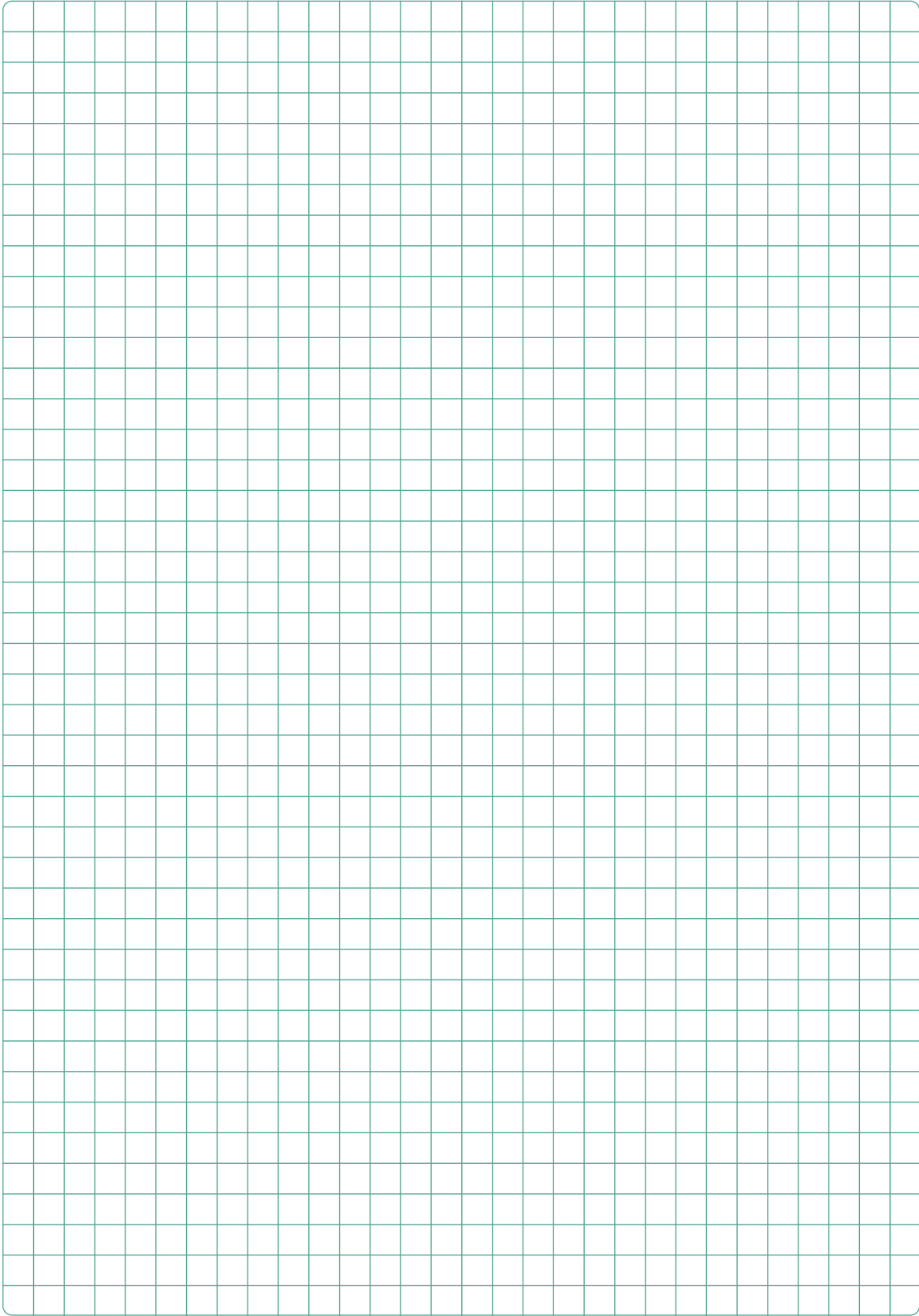
Alle unsere Erzeugnisse werden mit höchster Sorgfalt und Fachkenntnis entwickelt, hergestellt und geprüft. Die Zufriedenheit unserer Kunden ist unser höchstes Ziel. Wir verpflichten uns daher, jeden innerhalb von 3 Jahren ab Verkaufsdatum auftretenden Mangel an unseren Erzeugnissen zu beseitigen, welcher aus Fehlern in Design, Material oder Herstellung herrührt.

Diese Gewährleistung erstreckt sich nicht auf Defekte infolge unsachgemäßer Anwendung oder Betrieb außerhalb der nach Katalog oder Datenblatt zulässigen Einsatzbedingungen. Sie erfaßt ebensowenig Schäden aufgrund fehlerhafter Wartung, unsachgemäßer Montage, Änderungen oder unsachgemäßer Reparaturen durch den Käufer bzw. Anwender. Diese Gewährleistung betrifft auch nicht normale Abnutzung und Verschleiß.

Siehe unsere „Allgemeinen Geschäftsbedingungen” für Details zu Gewährleistung und Produkthaftung.

Find more information and detailed instructions in our „Application Notes“ and on www.electronicon.com
Mehr Informationen und ausführliche Anweisungen finden Sie in unseren „Anwendungshinweisen“ und unter www.electronicon.com





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PEC APPLICATION NOTES / ANWENDUNGSHINWEISE



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EXCELLENT EXPERIENCE IN CAPACITOR MAKING FOR OVER 80 YEARS

Gera has been a centre of capacitor making since 1938. ELECTRONICON Kondensatoren GmbH which emerged from previous RFT/VEB ELEKTRONIK Gera in 1992, has become one of Europe's leading capacitor manufacturers supplying customers worldwide and being an open and competent partner for manufacturers and users of power factor correction equipment, for many manufacturers of drives, power electronics, home appliances, and for the lighting industry. Regular investments in advanced and environmentally sound technologies guarantee the highest levels in manufacture and quality to modern standards which are approved and monitored by leading certification authorities.



In today's globalised competition, we distinguish ourselves by

- Absolute reliability and safety of our products
- Close co-operation between manufacturer and client to meet both technical and commercial requirements
- Improvement and development of our technical expertise in capacitor design and manufacture, as well as film coating, with special attention paid to the MKPg-technology
- Early identification and incorporation of new trends and methods in the manufacturing of capacitors
- Flexibility and punctual fulfilment of our commercial obligations

Our experienced development engineers are competent and responsible for both implementing the latest technical trends applicable to our products and ensuring that our products adapt to the challenges of traditional and new markets.

The close and intense co-operation between the departments of Marketing & Sales, Research & Development, and Production has become the keystone of our success. ELECTRONICON is continually striving to establish a similarly close and interactive relationship with its distributors and direct clients both in home and overseas markets, to become not just one out of many suppliers, but your preferred partner for ideas and solutions.

ELECTRONICON®

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E-Mail: sales@electronicon.com, www.electronicon.com





E51/E53/E55

AC/DC FILM CAPACITORS



HIGH VOLTAGES, HEAVY CURRENTS, AND LOW INDUCTANCE

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for any of your power electronics applications:

AC and DC capacitors with integrated safety mechanism
E62 AC/DC E62-3ph AC Filter E63 DC

Low-inductance capacitors
E50 PK16™ DC E53 AC/DC E61 DC

Low-inductance High-voltage capacitors
E51

AC and DC capacitors with large capacitance
E56 DC E59 AC/DC E70 AC E50.U SR17™ DC

CAPACITORS

ELECTRONICON®

always in charge

E51/E53/E55 AC/DC

LOW-INDUCTANCE FILM CAPACITORS

NIEDERINDUKTIVE FOLIENKONDENSATOREN





E51 High voltage, low inductance, long-term safe operation

In power electronics in general, but particularly in low inductance buffer circuits with higher voltages and in discharge circuits, the call for capacitors with low inductance poses problems. Traditional high voltage capacitors are filled with oil, and the generous bushings required for clearance/creepage as well as internal safety mechanisms add substantially to the self-inductance of the capacitor.

Based on decades of proprietary experience in metallizing capacitor films, ELECTRONICON has created a range of high voltage capacitors in self-healing technology, using the opportunities of special metallizing patterns. Despite the high voltage ratings, our E51 range is made in dry technology and without expensive bushings. For the sake of optimised self-inductance, the E51s are made without safety mechanism; by clever internal design they can be laid out and rated in such manner that partial dielectric discharges and consequential risk of failures in the customer's application are reduced to a minimum.

General remark

As a rule, DC capacitors with high voltage rating contain several capacitances connected in series. In certain applications, e.g. in the case of uninterrupted - or only briefly interrupted - continuous DC load, this may require the use of sharing resistors in order to avoid shifts of potential.

The capacitors of the E51 series are not equipped with internal sharing resistors as standard. Please consult us in such cases if your application requires continuous load with high DC voltages for long periods of time.

E51 Hohe Spannungen, niedrige Induktivitäten, Langzeitbetrieb ohne Ausfälle

In der Leistungselektronik im allgemeinen, speziell in niederinduktiven Zwischenkreisen höherer Spannungen und in Entladeschaltungen ist die Forderung nach niederinduktiven Kondensatoren mit Problemen verbunden: Traditionelle Hochspannungskondensatoren sind mit Öl gefüllt, und die für die Luft- und Kriechstrecken großzügig auszulegenden Anschlussisolatoren wie auch der interne Sicherheitsmechanismus tragen wesentlich zur Eigeninduktivität des Kondensators bei.

Basierend auf jahrzehntelanger eigener Erfahrung bei der Metallisierung von Kondensatorfolien hat ELECTRONICON unter Nutzung spezieller Metallisierungsarten eine Reihe von Hochspannungskondensatoren in selbstheilender Technologie geschaffen. Trotz der hohen Spannungsnennwerte wird die E51 Reihe in trockener Technologie und ohne aufwändige Anschlüsse gefertigt. Im Interesse einer optimierten niedrigen Eigeninduktivität werden die E51er ohne Sicherheitsmechanismus gebaut; durch ein ausgeklügeltes Design können sie so ausgelegt und bemessen werden, dass dielektrische Teilentladungen und das resultierende Ausfallrisiko in der Anwendung des Kunden auf ein Minimum reduziert werden.

Allgemeiner Hinweis

DC-Kondensatoren mit hohen Nennspannungen enthalten in der Regel in Serie geschaltete Kapazitäten. In bestimmten Anwendungsfällen, z.B. bei ununterbrochener oder nur kurzzeitig unterbrochener DC-Dauerbelastung kann dies den Einsatz von Symmetrierwiderständen erforderlich machen, um Potentialverschiebungen zu vermeiden.

Die Kondensatoren der Baureihe E51 sind standardmäßig nicht mit internen Symmetrierwiderständen ausgerüstet. Bitte konsultieren Sie uns in solchen Fällen, wenn Ihre Anwendung über längere Zeiträume hinweg eine durchgehende Belastung mit hohen DC-Spannungen vorsieht.



E53/E55

All in one: High rms and surge currents combined with low self-inductance

Basically, the design of our E53 capacitors is very similar to E51. Using sophisticated metallizing patterns, our SINECUT™ slitting technology, and clever winding geometries, the E53 series has a particularly low series resistance and high pulse strength. Therefore they are especially suited for the damping of GTO thyristors and low-inductance buffer circuits with high rms currents. Their very low self-inductance makes them also suitable for use in high-current applications with medium frequencies.

Along with their very good ratio of capacitance to volume, the capacitors of the E51 and E53 product families do also have high pulse strength and very good self-healing characteristics without loss or shift of capacitance. The capacitors of our E55 series, which are very similar in design and electrical features, have been optimized particularly for large capacitances at high operating voltages.

All the capacitors described above are housed in flame-retardant plastic cans (V0) and filled with solid resin. Special care has been taken both in terms of design and conservative electrical rating to ensure reliable operation even under tough environmental conditions. Connection is usually made through robust axial terminals with internal thread. The E53H-range is based on the same construction and technology principles but allows for radial connection through robust studs with M8 thread; it has two brackets at the base of the can which make for convenient mounting.

Important notice

Our capacitors series are made with self-healing dielectric. Self-healing breakdowns become less likely, or impossible, under high thermal or electrical overstress. The disintegration of the polypropylene dielectric may produce considerable amounts of gas accompanied by a build-up of internal pressure. Very frequent and large-scale occurrence of self-healing breakdowns (e.g., as a result of strong voltage overstrain) may cause a gradual rise of the internal pressure as well.

For the sake of lowest available self-inductance and maximum mounting comfort, the capacitors of our E51/E53/E55 ranges are not equipped with an integrated safety mechanism. They should therefore not be operated beyond their rated values and be allocated in uncritical environment (non-flammable materials) where the release of flammable organic gases or an ignition of the polypropylene cannot cause consequential damage.

E53/E55

Alles in einem: hohe Effektiv- und Spitzenströme UND geringe Eigeninduktivität

Kondensatoren der E53-Reihe zeichnen sich durch einen besonders geringen Serienwiderstand und hohe Stoßstromfestigkeit aus. Durch die Nutzung einzigartiger Metallisierungsmuster, unsere SINECUT™ Schneidtechnologie und ausgeklügelte Wickelgeometrien eignen sie sich besonders zum Bedämpfen von GTO-Thyristoren und in Zwischenkreisen mit hohen Effektivströmen. Ihre sehr niedrige Eigeninduktivität ermöglicht darüber hinaus auch den Einsatz in Hochstrom-Anwendungen im mittleren Frequenzbereich.

Neben ihrem günstigen Verhältnis von Kapazität und Volumen zeichnen sich die Kondensatoren der E51- und E53-Produktfamilien durch eine sehr hohe Stoßstromfestigkeit und exzellente Selbstheilfähigkeit ohne Kapazitätsverluste oder -verschiebungen aus. Die in Aufbau und Eigenschaften sehr ähnlichen E55-Kondensatoren sind auf große Kapazitäten bei gleichzeitig hohen Spannungswerten optimiert.

Alle o.a. Kondensatoren sind in flammhemmenden Gehäusen (V0) untergebracht und mit Harz vergossen. Sowohl im Design als auch in der konservativen elektrischen Auslegung wurde großer Wert auf zuverlässiges Funktionieren auch unter schwierigen Umgebungsbedingungen gelegt. Der elektrische Anschluss wird über robuste axiale Anschlüsse mit Innengewinde hergestellt. Die E53H-Reihe basiert auf gleichem Aufbau und technologischen Prinzipien, erlaubt jedoch einen radialen Anschluss mittels M8-Gewinde; zwei Montagelaschen am Becherboden gewährleisten eine bequeme Befestigung.

Wichtiger Hinweis

Alle in unseren Kondensatoren verwendeten dielektrischen Strukturen sind selbstheilend. Der zuverlässige Ablauf selbstheilender Durchschläge kann jedoch durch hohe thermische oder elektrische Belastung beeinträchtigt oder verhindert werden. Sich zersetzendes Polypropylen erzeugt dann größere Mengen an Gas und der Innendruck im Kondensator steigt. Gleichermaßen können großflächig auftretende Durchschläge (z.B. infolge starker Überspannung) einen starken Anstieg des Innendrucks verursachen. Zum Zwecke niedrigster Eigeninduktivität und maximalen Einbaukomforts verfügen die Kondensatoren der E51/E53/E55-Reihen nicht über einen internen Abschaltmechanismus. Sie sollten daher nicht außerhalb ihrer zulässigen Nennwerte betrieben und stets in unkritischer Umgebung (nichtentflammbare Materialien) platziert werden, wo die Freisetzung entzündlicher organischer Gase bzw. eine Entzündung des Dielektrikums keine schwerwiegenden Folgeschäden verursachen können.

E51
DC
2300...3800V DC

for latest edition and updates
check www.powercapacitors.info



Axial Low-inductance DC-Capacitors
Niederinduktive Gleichspannungskondensatoren in axialer Bauform



Standards IEC 61071, optional IEC 61881
can Gehäuse plastic Kunststoff (UL94: V0)

mounting position optional
Einbaulage beliebig
filling material solid, based on vegetable oil, non-PCB
Füllmittel ausgehärtet, auf Pflanzenölbasis, PCB-frei

Internal protection none
Interne Sicherung keine
fire load Brandlast 40 MJ/kg

C_N tolerance Toleranz ±10% (optional ±5%)
tanδ₀ 2 × 10⁻⁴

operating temperatures Grenztemperaturen
Θ_{min} ... Θ_{max} -25 ... +70°C
Θ_{HOTSPOT} ≤ 70°C

storing temperature Lagertemperatur -40 ... +85°C
Failure rate Ausfallrate 50 FIT

(reference interval_Referenzintervall 100000 h, Θ_{HOTSPOT} ≤ 70°C)



U _N DC (V)	C _N (μF)	U _r (V)	U _s (V)	U _{IT} DC (V)	R _s (mΩ)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _s (kA)	L _e (nH)	D ₁ × L ₁ (mm)	m (kg)	order no. Bestell-Nr.	pcs_Stk / Box
U_N 2300V ... 2700V DC														
2300	80	400	4100	3795	1.3	3.6	50	4	13	80	64 × 355	1.2	E51.L35-803R20	10/FB15
2300	170	400	4100	3450	0.6	2.4	90	6	17	100	90 × 355	2.4	E51.P35-174R20	5/FB15
2700	40	500	4050	4455	0.85	2.55	40	5	15	20	140 × 125	2	E51.S12-403R20	4/FB12
U_N 3000V ... 3800V DC														
2550	10	600	3825	3825	0.47	4.9	100	3.6	10.8	80	90 × 170	1.1	E51.P17-103R20	10/FB15
3000	18	600	4500	4950	0.62	5.5	65	2.8	8.4	80	90 × 150	1.1	E51.P15-183R21	10/FB10
3000	80	700	4500	4950	1.9	3.2	60	3.2	9.6	60	90 × 255	1.7	E51.P25-803R20	5/FB12
3000	84	600	4500	4950	1.3	3.4	60	3.2	9.6	50	90 × 245	1.6	E51.P24-843R20	5/FB12
3000	145	600	4500	4500	0.94	2.6	80	5.6	16.8	50	116 × 245	2.7	E51.R24-154R20	3/FB12
3000	320	600	4500	4500	1	1.7	75	8.5	25.5	50	140 × 320	5.2	E51.S32-324R20	2/FB12
3100	86	500	5600	5115	1.5	2.4	65	4.5	13	100	90 × 355	2.4	E51.P35-863R20	5/FB15
3200	15	700	4800	5280	2.3	5.8	35	1	3	50	64 × 200	0.7	E51.L20-153R20	10/FB8
3200	33	700	4800	5280	0.7	4.1	70	2.5	7.5	50	90 × 200	1.3	E51.P20-333R20	5/FB8
3400	56	1000	5100	5610	5.2	3.2	20	1.4	4.2	60	90 × 255	1.7	E51.P25-563R20	5/FB12
3500	50	600	5250	5775	1	2.3	70	4.5	13.5	80	90 × 355	2.4	E51.P35-503R20	5/FB15
3500	500	600	5250	5250	1.2	0.75	100	13.9	41.7	200	140 × 710	11.5	E51.S71-504R20	5/FB22
3600	80	600	5400	5940	0.71	2.6	90	6	18	40	116 × 245	2.7	E51.R24-803R20	3/FB12
3600	220	800	5400	5400	0.6	1.1	40	4.4	13.2	40	140 × 300	5	E51.S30-224R20	2/FB12
3800	6	600	5700	5700	1.7	13.8	10	0.97	2.91	50	90 × 60	0.4	E51.P60-602R20	10/FB2

Other values and dimensions available on request
Andere Werte und Abmessungen auf Anfrage erhältlich

E51
DC
4000...9350V DC



U_N DC (V)	C_N (μ F)	U_f (V)	U_s (V)	U_{TT} DC (V)	R_s (m Ω)	R_{th} (K/W)	I_{max} (A)	$\hat{I}$ (kA)	I_s (kA)	L_e (nH)	$D_1 \times L_1$ (mm)	m (kg)	order no. Bestell-Nr.	pcs_Stk / Box
U_N 4000V ... 6300V DC														
4000	16	2850	6000	6600	1.1	3.1	30	3.8	11.4	100	140 × 170	2.7	E51.S17-163R20	2/FB8
4000	215	800	6000	6000	0.7	0.95	100	11.9	35.7	60	140 × 565	9	E51.S56-224R20	4/FB22
4200	8	800	6300	6930	4.3	8.3	15	0.69	2.07	60	64 × 138	0.5	E51.L14-802R20	10/FB0
4200	45	800	6300	6930	1.6	2.4	50	4.2	12.6	80	90 × 355	2.4	E51.P35-453R20	5/FB15
4400	8	950	6600	7260	4.2	6.5	20	0.85	2.55	60	64 × 180	0.6	E51.L18-802R20	10/FB8
4450	1	1100	6675	6675	4.6	9.7	20	0.7	2.2	20	64 × 120	0.5	E51.L12-102R20	10/FB0
4500	25	950	6750	7430	0.98	4.6	50	3.1	9.3	60	90 × 188	1.3	E51.P18-253R20	5/FB15
4500	300	850	6750	6750	1.1	0.75	100	16.5	49.5	200	140 × 710	11.5	E51.S71-304R20	4/FB22
4600	2	1500	6900	7590	1.9	2.7	35	1.7	5.1	20	90 × 110	0.8	E51.P11-202R20	10/FB8
4950	5	1200	7425	7425	0.45	4.8	100	3.5	10.5	15	140 × 110	1.8	E51.S11-502R20	4/FB12
5000	4.55	1000	7500	8250	6.5	7.8	15	0.47	1.41	60	64 × 150	0.5	E51.L15-462R20	10/FB0
5600	0.1	1100	8400	8400	6.4	11.64	10	0.42	1.26	20	64 × 100	0.4	E51.L10-101R20	10/FB1
6000	30	700	9000	9000	2.3	3.2	30	2.1	6.3	80	116 × 200	2.2	E51.R20-303R20	3/FB8
6000	82	1200	9000	9000	2.2	1.56	35	4	12	100	140 × 340	5.5	E51.S34-823R20	2/FB12
6200	6.8	1200	9300	9300	10	4.6	20	0.6	2	50	64 × 255	0.9	E51.L25-682R20	10/FB12
6200	15	1200	9300	9300	4.6	3.2	35	1.5	4.5	50	90 × 255	1.7	E51.P25-153R20	5/FB12
6300	20	1200	9450	9450	6.8	2.4	25	1.8	8	100	90 × 355	2.4	E51.P35-203R20	5/FB15
6300	51.25	1250	9450	9450	2.7	1.5	40	4.3	20	80	140 × 355	5.7	E51.S35-513R20	2/FB12
U_N 7700V ... 9350V DC														
7700	0.5	3950	11550	11550	3.9	7.1	20	0.54	1.62	60	64 × 165	0.6	E51.L16-501R20	10/FB7
8000	5	1400	12000	12000	1.7	3.76	50	1.8	5	80	90 × 220	1.5	E51.P22-502R20	5/FB8
8000	10	1400	12000	12000	2.3	2.59	50	1.9	6	100	90 × 320	2.2	E51.P32-103R20	5/FB12
8000	39	1400	12000	12000	3.9	1.5	40	2.7	8.1	100	140 × 355	5.7	E51.S35-393R20	2/FB12
8500	1	1400	12750	12750	4.1	5	25	1.7	5.1	50	90 × 160	1.1	E51.P16-102R20	10/FB15
9300	9	1500	13950	13950	8	2.4	20	1	4	100	90 × 355	2.4	E51.P35-902R20	5/FB15
9300	25	1500	13950	13950	2.7	1.5	40	4	11	100	140 × 355	5.7	E51.S35-253R20	2/FB12
9350	10	1500	14025	14025	6.6	2.3	10	1.3	3.9	100	90 × 355	2.4	E51.P35-103R20	5/FB15



E51

DC

10000...40000V DC

for latest edition and updates
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U _N DC (V)	C _N (μF)	U _r (V)	U _s (V)	U _{II} DC (V)	R _s (mΩ)	R _{th} (K/W)	I _{max} (A)	$\hat{I}$ (kA)	I _s (kA)	L _e (nH)	D ₁ × L ₁ (mm)	m (kg)	order no. Bestell-Nr.	pcs_Stk / Box
U_N 10000V ... 40000V DC														
10000	0.25	2000	15000	15000	15.2	7.1	10	1.1	3.3	80	64 × 165	0.6	E51.L16-251R20	10/FB7
11000	21	2300	16500	16500	2.6	1.5	35	3	9	100	140 × 355	5.7	E51.S35-213R20	2/FB12
12000	0.2	1400	18000	18000	4.2	4.6	26	0.5	1.4	120	64 × 255	0.9	E51.L25-201R20	10/FB12
12000	24	2100	18000	18000	4.2	0.95	25	4.2	12.6	60	140 × 565	9	E51.S56-243R20	4/FB22
12500	0.22	2100	18750	18750	14	5.8	14	0.5	1.4	80	64 × 200	0.7	E51.L20-221R20	10/FB8
12500	0.25	2100	18750	18750	14	5.8	14	0.5	1.5	80	64 × 200	0.7	E51.L20-251R20	10/FB8
12500	1	2100	18750	18750	3.6	3.2	35	2	6	100	116 × 200	2.2	E51.R20-102R20	3/FB8
13000	0.25	3000	19500	19500	17.7	4.1	10	0.6	1.7	100	64 × 285	1	E51.L28-251R20	10/FB12
14000	10	2400	21000	21000	2.4	1.5	40	4.3	12.9	120	140 × 355	5.7	E51.S35-103R20	2/FB12
15000	1	3600	22500	22500	15.1	4.1	15	0.49	1.47	100	64 × 285	1	E51.L28-102R20	10/FB12
15000	2	3600	22500	22500	7.2	2.9	20	1.1	3.3	200	90 × 285	1.9	E51.P28-202R20	5/FB12
15000	3	3600	22500	22500	3.7	0.7	20	5.4	16.2	200	140 × 710	11.5	E51.S71-302R20	4/FB22
15000	10	3600	22500	22500	2.7	1.4	40	3.8	11.4	120	140 × 385	6.2	E51.S38-103R20	4/FB0
15000	15	3600	22500	22500	2.8	1.2	40	4.6	13.8	120	140 × 460	7.4	E51.S46-153R20	4/FB22
20000	1.25	4000	30000	30000	11.7	2.3	20	0.9	2.7	100	90 × 355	2.4	E51.P35-132R20	5/FB15
20000	1.5	4000	30000	30000	10.4	2.3	34	1.8	5.4	100	90 × 355	2.4	E51.P35-152R20	5/FB15
20000	2	4000	30000	30000	10	1.84	20	1.3	3.9	100	90 × 450	3	E51.P45-202R20	6/FB23
20000	5	4000	30000	30000	2.5	1.9	25	2.7	8.1	100	140 × 285	4.6	E51.S28-502R20	2/FB12
20000	10	4000	30000	30000	4.8	0.9	25	2.8	8.4	60	140 × 565	9.1	E51.S56-103R20	4/FB22
20000	20	4000	30000	30000	6.6	0.6	25	3.1	9.3	240	140 × 850	13.8	E51.S85-203R20	4/FB25
25000	10	4600	37500	37500	3.9	0.75	35	4.3	12.9	200	140 × 710	11.5	E51.S71-103R20	4/FB22
30000	1	4800	45000	45000	11	1.9	20	1	3	80	90 × 450	2.9	E51.P44-102R20	6/FB37
30000	5	4800	45000	45000	7	0.75	35	2.8	8.4	200	140 × 710	11.5	E51.S71-502R20	4/FB22
31250	6.67	5900	46875	46875	5.3	0.68	25	3.6	10.8	200	140 × 785	12.7	E51.S78-672R20	4/FB25
35000	0.2	5600	52500*	52500*	13.4	1.9	20	1	3	80	90 × 435	2.9	E51.P44-201R20	6/FB37
35000	5	4800	52500**	52500**	5.5	0.68	25	3.2	9.6	200	140 × 785	12.7	E51.S78-502R20	4/FB25
40000	2.2	8700	60000	60000	5.3	0.84	35	2.8	8.4	180	140 × 630	10.2	E51.S63-222R20	4/FB22

* additional test_Zusatzprüfung 14500V_{rms}/10s** additional test_Zusatzprüfung 16500V_{rms}/10s

Other values and dimensions available on request

Andere Werte und Abmessungen auf Anfrage erhältlich



1050...3400V AC / 3200...4750V DC

Axial Low-inductance AC/DC-Capacitors

Niederinduktive Wechsel-/Gleichspannungskondensatoren
in axialer Bauform

Standards IEC 61071, optional IEC 61881

can Gehäuse plastic Kunststoff (UL94: V0)

mounting position Einbaulage... optional beliebig

filling material solid, based on vegetable oil, non-PCB

Füllmittel ausgehärtet, auf Pflanzenölbasis, PCB-frei

Internal protection none

Interne Sicherung keine

fire load Brandlast 40 MJ/kg

 C_N tolerance Toleranz $\pm 10\%$ (optional $\pm 5\%$) $\tan \delta_0$ 2×10^{-4}

operating temperatures Grenztemperaturen

 $\Theta_{\min} \dots \Theta_{\max}$ $-25 \dots +70^\circ\text{C}$ Θ_{HOTSPOT} $\leq 70^\circ\text{C}$ storing temperature Lagertemperatur $-40 \dots +85^\circ\text{C}$

Failure rate Ausfallrate 100 FIT

(reference interval_Referenzintervall 100000 h, $\Theta_{\text{HOTSPOT}} \leq 70^\circ\text{C}$)

U_N AC (V)	U_N DC (V)	C_N (μF)	U_{rms} (V)	U_s (V)	U_{IT} (V)	R_s (m Ω)	R_{th} (K/W)	I_{max} (A)	$\hat{I}$ (kA)	I_s (kA)	L_e (nH)	$D_1 \times L_1$ (mm)	m (kg)	order no. Bestell-Nr.	pcs_Stk / Box
U_N 1050V ... 2900V AC					U_{rms} 750V ... 2050 V										
1050	3200	6	750	4800	5280 (DC)	0.44	4.9	100	2.7	8.1	30	90 × 170	1.1	E51.P17-602R20	10/FB15
1300	1850	4.7	920	2775	3080 (DC)	2.6	9.7	10	1.1	3.3	60	64 × 120	0.4	E51.L12-472R20	10/FB0
1530	2500	4	1080	3750	4125 (DC)	1.7	5.9	50	1.8	5.4	50	64 × 138	0.5	E51.L14-402R10	10/FB0
1750	3000	4	1250	4500	4950 (DC)	0.99	4	80	4.8	12	20	90 × 145	1	E51.P14-402R20	10/FB10
2450	3750	1.5	1750	5625	6190 (DC)	0.66	3.8	80	3	9	15	116 × 60	0.8	E51.R60-152R20	12/FB12
2450	6000	2	1700	9000	9900 (DC)	2.8	5.9	45	1.5	4.4	60	90 × 140	0.9	E51.P14-202R20	10/FB10
2500	6000	1	1770	9000	9000 (DC)	3.2	6.4	28	0.98	2.94	30	90 × 130	0.9	E51.P13-102R20	10/FB12
2500	7000	2	1770	10500	11500 (DC)	2.8	5.52	25	1.3	3.9	25	90 × 150	1	E51.P15-202R20	10/FB10
2550	3200	1	1800	4800	5483 (DC)	1.8	9.7	40	2	5	40	64 × 120	0.5	E51.L12-102R21	10/FB0
2600	3800	0.75	1850	5700	5700 (DC)	4.1	4.1	45	1.35	3.1	15	64 × 100	0.3	E51.L10-751R21	10/FB1
2600	3800	1.5	1850	5700	5700 (DC)	1.8	2.9	70	3.1	7.4	15	90 × 100	0.7	E51.P10-152R21	10/FB8
2700	4400	4	1910	6600	6600 (DC)	0.62	5.8	90	2.2	7	15	116 × 110	1.5	E51.R11-402R20	6/FB12
2900	2900	0.6	2050	4350	6860 (DC)	3.9	4.1	15	0.69	2.1	30	64 × 100	0.3	E51.L10-601R21	10/FB1
2900	3000	3	2050	7500	8250 (DC)	0.74	5.8	80	2	6	15	116 × 110	1.5	E51.R11-302R20	6/FB12
U_N 3000V ... 3400V AC					U_{rms} 2100V ... 2400 V										
3000	3000	0.47	2100	6450	6450 (DC)	3.2	11.6	15	1.1	3.3	60	64 × 100	0.34	E51.L10-471R20	10/FB1
3000	3250	5	2200	7000	5000 (AC)	3.8	2.5	10	2	6	80	116 × 260	2.7	E51.R26-502R20	3/FB12
3200	3400	0.47	2250	9750	9750 (DC)	7.4	9.7	20	0.5	1.5	60	64 × 120	0.4	E51.L12-471R20	10/FB0
3200	3400	0.5	2260	10920	10920 (DC)	5	9	25	0.62	1.86	60	64 × 130	0.4	E51.L13-501R20	10/FB0
3200	3400	0.68	2250	8175	9000 (DC)	4.6	9.7	20	1	2.94	60	64 × 120	0.5	E51.L12-681R20	10/FB0
3250	3700	0.75	2300	4875	4875 (AC)	4.9	7.1	20	0.92	2.76	100	64 × 165	0.6	E51.L16-751R20	10/FB7
3400	4000	1.8	2400	6000	7310 (DC)	3.7	4.1	25	1.5	4.5	60	90 × 200	1.3	E51.P20-182R21	5/FB8
3400	4700	2.2	2400	6000	8050 (DC)	2.6	4.1	25	2.2	6.6	60	90 × 200	1.3	E51.P20-222R20	5/FB8
3400	4750	4.8	2400	6000	7310 (DC)	1.5	3.2	35	2.1	6	100	116 × 200	2.2	E51.R20-482R21	3/FB8



E51
AC/DC

3500...4950V AC / 4950...21000V DC

for latest edition and updates
check www.powercapacitors.info



Axial Low-inductance AC/DC-Capacitors
Niederinduktive Wechsel-/Gleichspannungskondensatoren
in axialer Bauform



Standards IEC 61071, optional IEC 61881

can Gehäuse plastic Kunststoff (UL94: V0)

mounting position Einbaulage... optional beliebig

filling material solid, based on vegetable oil, non-PCB

Füllmittel ausgehärtet, auf Pflanzenölbasis, PCB-frei

Internal protection none

Interne Sicherung keine

fire load Brandlast 40 MJ/kg

C_N tolerance Toleranz ±10% (optional ±5%)
tanδ₀ 2 × 10⁻⁴

operating temperatures Grenztemperaturen

Θ_{min} ... Θ_{max} -25 ... +70°C

Θ_{HOTSPOT} ≤ 70°C

storing temperature Lagertemperatur -40 ... +85°C

Failure rate Ausfallrate 100 FIT

(reference interval_Referenzintervall 100000 h, Θ_{HOTSPOT} ≤ 70°C)



U _N AC (V)	U _N DC (V)	C _N (μF)	U _{rms} (V)	U _S (V)	U _{TT} (V)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	I _h (kA)	I _S (kA)	L _e (nH)	D ₁ × L ₁ (mm)	m (kg)	order no. Bestell-Nr.	pcs_Stk / Box
U_N 3500V ... 3700V AC					U_{rms} 2500V ... 2600 V										
3500	4950	0.15	2500	5250	9900 (DC)	2.2	9.7	20	0.4	1.1	60	64 × 120	0.4	E51.L12-151R20	10/FB0
3500	5000	0.22	2500	9000	9000 (DC)	4.8	9.7	20	0.7	2.1	60	64 × 120	0.4	E51.L12-221R20	10/FB0
3500	5100	0.33	2500	9000	9000 (DC)	3	9.7	20	0.98	2.94	60	64 × 120	0.5	E51.L12-331R20	10/FB0
3500	5100	0.5	2500	9000	9000 (DC)	5.6	9.7	20	1	3	60	64 × 120	0.4	E51.L12-501R20	10/FB0
3500	5200	0.68	2500	7500	7500 (DC)	4.9	3.2	40	0.76	2.28	15	64 × 130	0.4	E51.L13-681R20	10/FB0
3500	5500	1.25	2500	9000	9900 (DC)	2.2	6.4	45	1.4	4.2	60	90 × 130	0.9	E51.P13-132R20	10/FB12
3500	6000	1.5	2500	9000	9000 (DC)	2.2	6.4	45	1.5	4.4	60	90 × 130	0.9	E51.P13-152R20	10/FB12
3550	6500	0.73	2500	7800	8410 (DC)	4.6	3.2	20	0.86	2.58	20	64 × 130	0.4	E51.L13-731R20	10/FB0
3650	7000	0.1	2575	7500	8635 (DC)	7.4	5.3	20	0.4	1.3	15	64 × 78	0.3	E51.L78-101R20	10/FB2
3700	7500	1.5	2600	5600	8000 (AC)	3.6	3	15	2.2	6.6	100	90 × 285	1.9	E51.P28-152R20	5/FB12
U_N 4000V ... 4950V AC					U_{rms} 2825V ... 3500 V										
4000	8900	0.3	2825	6000	5500 (DC)	10.4	4.2	5	0.78	2.34	100	64 × 275	0.9	E51.L27-301R70	10/FB12
4550	8900	0.22	3200	10920	10920 (DC)	8.9	9	15	0.34	1.02	60	64 × 130	0.4	E51.L13-221R20	10/FB0
4550	10000	0.33	3200	10920	10920 (DC)	6.7	9	20	0.46	1.38	60	64 × 130	0.4	E51.L13-331R20	10/FB0
4550	13800	2	3200	10920	10920 (DC)	1.3	1.7	55	2.4	7.2	60	116 × 130	1.4	E51.R13-202R20	6/FB12
4700	15000	1	3200	7050	6880 (AC)	3.8	3	10	2.2	6.6	100	90 × 275	1.8	E51.P27-102R20	5/FB12
4750	15000	1	2200	10000	7000 (AC)	5.2	2.3	10	1.5	4	80	90 × 355	2.4	E51.P35-102R20	5/FB15
4920	15000	3.75	3480	12300	12300 (DC)	1.3	2.7	15	4.8	14.4	100	140 × 200	3.2	E51.S20-382R20	2/FB8
4950	15560	0.25	3500	9000	11710 (DC)	5	7.1	15	1.15	3.45	100	64 × 165	0.6	E51.L16-251R21	10/FB7
4950	21000	0.5	3500	10000	8500 (AC)	6	4.2	10	1	2.5	100	64 × 275	0.9	E51.L27-501R70	10/FB12

Other values and dimensions available on request
Andere Werte und Abmessungen auf Anfrage erhältlich



5000...21250V AC / 5000...50000V DC

U_N AC (V)	U_N DC (V)	C_N (μF)	U_{rms} (V)	U_S (V)	U_{TT} (V)	R_S (mΩ)	R_{th} (K/W)	I_{max} (A)	$\hat{I}$ (kA)	I_S (kA)	L_e (nH)	$D_1 \times L_1$ (mm)	m (kg)	order no. Bestell-Nr.	pcs_Stk / Box
U_N 5000V ... 6500V AC					U_{rms} 3500V ... 4600 V										
5000	21250	0.47	3500	7500	11825 (DC)	5.8	5.5	16	1	3	40	64 × 210	0.7	E51.L21-471R20	10/FB8
5000	10000	0.5	3540	15000	10000 (DC)	5.7	4.1	25	1	3	50	90 × 200	1.3	E51.P20-501R20	5/FB8
5100	5100	1.6	3600	9500	7100 (AC)	3	2.3	25	3	12	60	116 × 285	3	E51.R28-162R20	6/FB12
5100	5100	2.4	3600	10965	10965 (DC)	3	4.1	35	1.4	4.2	60	90 × 200	1.3	E51.P20-242R21	5/FB8
5200	5200	1.1	3700	7800	12300 (DC)	3.1	4.1	20	1.7	5.1	60	90 × 200	1.3	E51.P20-112R20	5/FB8
5200	7350	1.3	3700	11025	12300 (DC)	8.7	3.28	10	1.2	3.6	150	64 × 355	1.2	E51.L35-132R20	10/FB15
5500	5500	1.5	3900	8250	11825 (DC)	5.2	3	25	2	6	80	90 × 275	1.8	E51.P27-152R21	5/FB12
6000	6000	0.35	4250	9000	12500 (DC)	3.7	5.02	10	1.8	5.4	50	90 × 160	1.1	E51.P16-351R20	10/FB15
6300	9000	0.125	4455	13500	10000 (DC)	5.5	7.1	20	0.79	2.37	100	64 × 165	0.7	E51.L16-131R20	10/FB7
6300	9000	0.14	4500	13500	10000 (DC)	17.6	5.8	14	0.31	0.93	50	64 × 200	0.7	E51.L20-141R20	10/FB8
6500	6500	4	4600	9500	14000 (DC)	1.7	1.5	12	7	21	150	140 × 355	6	E51.S35-402R20	2/FB12
U_N 7000V ... 9500V AC					U_{rms} 5000V ... 6700 V										
7000	7000	0.018	5000	10000	8750 (AC)	17	5.5	5	0.3	1	40	64 × 210	0.8	E51.L21-180R20	10/FB8
7100	13000	0.25	5000	19500	10000 (DC)	17.7	4.1	10	0.6	1.7	100	64 × 285	1	E51.L28-251R21	10/FB12
7500	7500	1.33	5300	11250	16125 (DC)	3.9	1.5	10	2.5	7.5	100	140 × 355	5.7	E51.S35-132R20	2/FB12
8900	8900	0.1	6300	13500	10000 (DC)	8.5	6	15	0.8	2.3	50	64 × 210	0.7	E51.L21-101R20	10/FB8
8900	8900	0.24	6300	13350	10000 (DC)	5	3.8	20	2	6	60	90 × 215	1.4	E51.P21-241R20	5/FB8
9500	15000	0.5	6700	22500	10000 (DC)	5.5	2.51	10	2.7	8.1	80	90 × 330	2.2	E51.P33-501R20	5/FB15
U_N 10000V ... 21250V AC					U_{rms} 7070V ... 15000 V										
10000	10000	0.5	7070	15000	21500 (DC)	7.2	1.44	10	1	3	100	90 × 355	2.4	E51.P35-501R20	5/FB15
13800	13800	0.04	9760	20700	20700 (AC)	38	3	0.3	0.32	0.96	150	64 × 385	1.3	E51.L38-041R20	10/FB15
14150	30000	1	10000	45000	45000 (DC)	5.7	0.7	10	4.9	14.7	200	140 × 710	11.5	E51.S71-102R20	4/FB22
15000	15000	0.006	10600	22500	26250 (AC)	67	2	5	0.3	1	120	64 × 570	2	E51.L57-600R20	8/FB31
15000	15000	0.0072	10600	22500	26250 (AC)	56	2	5	0.35	1.05	120	64 × 570	2	E51.L57-720R20	8/FB31
15000	15000	0.009	10600	22500	26250 (AC)	45	2	5	0.43	1.29	120	64 × 570	2	E51.L57-900R20	8/FB31
15560	15560	0.03	11000	23340	10000 (DC)	19.2	4.2	0.3	0.51	1.53	100	64 × 275	0.9	E51.L27-300R20	10/FB12
20000	26000	0.3	14000	30000	43000 (DC)	3.1	1.8	10	8	20	100	116 × 355	4	E51.R35-301R20	3/FB15
20000	50000	0.5	14140	60000	45850 (AC)	6.2	0.8	10	8.5	20	200	140 × 710	11.5	E51.S71-501R20	4/FB22
21000	21000	0.004	15000	31500	33000 (AC)	0.97	1.4	1	0.3	0.8	150	64 × 810	2.8	E51.L81-040R20	10/FB25
21250	21250	1	15000	31875	45690 (DC)	46	0.68	2	5.2	15.6	200	140 × 785	12.7	E51.S78-102R20	4/FB25



**Axial Low-inductance AC/DC-Capacitors**
Niederinduktive Wechsel-/Gleichspannungskondensatoren
in axialer Bauform

Standards IEC 61071, UL810, CSA 22.2 No.190
optional IEC 61881

can Gehäuse plastic Kunststoff (UL94: V0)

mounting position Einbaulage... optional beliebig

filling material solid, based on vegetable oil, non-PCB

Füllmittel ausgehärtet, auf Pflanzenölbasis, PCB-frei

Internal protection none

Interne Sicherung keine

fire load Brandlast 40 MJ/kg



C_N tolerance Toleranz ±10% (optional ±5%)

self-inductance Eigeninduktivität L_e ca. 15 nH

tanδ₀ 2 × 10⁻⁴

operating temperatures Grenztemperaturen

Θ_{min} ... Θ_{max} -40 ... +85°C

Θ_{HOTSPOT} ≤ 85°C

storing temperature Lagertemperatur -40 ... +85°C

Failure rate Ausfallrate 100 FIT

(reference interval_Referenzintervall 100000 h, Θ_{HOTSPOT} ≤ 70°C)

C _N (μF)	U _N DC (V)	U _S (nH)	U _{TT} (K/W)	R _S (mΩ)	L _e (nH)	R _{th} (K/W)	I _{max} (A)	I _h (kA)	I _S (kA)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	L/K (mm)	order no. Bestell-Nr.	pcs_Stk / Box
U_N 280V AC U_{rms} 200V															
50	550	825	825	0.8	15	8.5	60	0.83	2.49	55 × 56	T1	0.2	97	E53.H56-503T10	15/FB6
100	550	825	825	0.35	15	6.3	80	1.7	5	75 × 56	T2	0.3	111	E53.M56-104T20	10/FB2
200	550	825	825	0.2	15	4.9	80	3.3	9.9	95 × 56	T2	0.5	131	E53.P56-204T20	10/FB2
250	550	825	825	0.15	15	4.5	80	4.1	12.3	105 × 56	T2	0.6	141	E53.Q56-254T20	10/FB2
270	550	825	825	0.15	15	4.1	100	3.3	10	115 × 56	T2	0.8	151	E53.R56-274T20	12/FB9
380	550	825	825	0.31	15	2.3	100	3	10	115 × 100	T2	1.4	195	E53.R10-384T20	6/FB8
U_N 350V AC U_{rms} 250V															
28	700	1050	1050	0.65	15	9.9	55	0.68	2.1	55 × 48	T1	0.2	89	E53.H48-283T11	15/FB6
33	700	1050	1050	0.95	15	8.5	55	0.68	2.04	55 × 56	T1	0.2	97	E53.H56-333T10	15/FB6
120	700	1050	1050	0.25	15	2.7	80	3.1	9.3	95 × 56	T2	0.5	131	E53.P56-124T20	10/FB2
200	700	1050	1050	0.2	15	4.1	100	3.1	10	115 × 56	T2	0.8	151	E53.R56-204T20	12/FB9
30	900	1350	1350	0.85	15	8.5	60	0.68	2.1	55 × 56	T1	0.2	97	E53.H56-303T10	15/FB6
60	900	1350	1350	0.41	15	6.3	80	1.4	4.1	75 × 56	T2	0.3	111	E53.M56-603T20	10/FB2
100	900	1350	1350	0.25	15	4.9	80	2.3	6.8	95 × 56	T2	0.5	131	E53.P56-104T20	10/FB2
120	900	1350	1350	0.2	15	4.5	100	2.8	8.4	105 × 56	T2	0.6	141	E53.Q56-124T20	10/FB2
140	900	1350	1350	0.2	15	4.1	100	3.1	10	115 × 56	T2	0.8	151	E53.R56-144T20	12/FB9
265	900	1350	1350	0.35	15	2.3	100	3	9	115 × 100	T2	1.4	195	E53.R10-274T20	6/FB8
12	1100	1650	1650	1.7	15	8.5	40	0.4	1.2	55 × 56	T1	0.2	97	E53.H56-123T10	15/FB6
15	1100	1650	1650	1.1	15	8.5	40	0.5	1.5	55 × 56	T1	0.2	97	E53.H56-153T10	15/FB6
25	1100	1650	1650	0.71	15	6.3	70	0.83	2.5	75 × 56	T2	0.3	111	E53.M56-253T20	10/FB2
50	1100	1650	1650	0.34	15	4.9	80	1.7	5	95 × 56	T2	0.5	131	E53.P56-503T20	10/FB2
60	1100	1650	1650	0.35	15	4.5	100	2	6	105 × 56	T2	0.6	141	E53.Q56-603T20	10/FB2
80	1100	1650	1650	0.21	15	4.1	100	3	10	115 × 56	T2	0.8	151	E53.R56-803T20	12/FB9
175	1100	1650	1650	0.41	15	2.3	100	2.6	8	115 × 100	T2	1.4	195	E53.R10-184T20	6/FB9
8	1400	2100	2100	2	15	8.5	38	0.33	1	55 × 56	T1	0.2	97	E53.H56-802T10	10/FB6
16	1400	2100	2100	0.85	15	6.3	60	0.65	1.95	75 × 56	T2	0.3	111	E53.M56-163T20	10/FB2
30	1400	2100	2100	0.46	15	4.9	80	1.2	3.7	95 × 56	T2	0.5	131	E53.P56-303T20	10/FB2
40	1400	2100	2100	0.4	15	4.5	100	1.7	5.1	105 × 56	T2	0.6	141	E53.Q56-403T20	10/FB2
50	1400	2100	2100	0.27	15	4.1	100	2.2	10	115 × 56	T2	0.8	151	E53.R56-503T20	12/FB9
110	1400	2100	2100	0.52	15	2.3	100	2	6	115 × 100	T2	1.4	195	E53.R10-114T20	6/FB9

Other values and dimensions available on request

Andere Werte und Abmessungen auf Anfrage erhältlich

C _N (μF)	U _N DC (V)	U _s (nH)	U _{TT} (K/W)	R _s (mΩ)	L _e (nH)	R _{th} (K/W)	I _{max} (A)	I _h (kA)	I _s (kA)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	L/K (mm)	order no. Bestell-Nr.	pcs_Stk / Box
U _N 700V AC		U _{rms} 500V													
4.7	1700	2550	2550	1.1	15	8.5	45	0.5	1.6	55 × 56	T1	0.2	97	E53.H56-472T10	15/FB6
10	1700	2550	2550	0.6	15	6.3	80	1.1	3.5	75 × 56	T2	0.3	111	E53.M56-103T20	10/FB2
16	1700	2550	2550	0.37	15	4.9	80	1.8	5.5	95 × 56	T2	0.5	131	E53.P56-163T20	10/FB2
20	1700	2550	2550	0.26	15	4.5	100	2.3	7	105 × 56	T2	0.6	141	E53.Q56-203T20	10/FB2
22	1700	2550	2550	0.27	15	4.5	100	2.5	7.5	105 × 56	T2	0.6	141	E53.Q56-223T20	10/FB2
33	1700	2550	2550	0.2	15	4.1	100	3.5	10	115 × 56	T2	0.8	151	E53.R56-333T20	12/FB9
68	1700	2550	2550	0.35	15	2.3	100	3.1	9.3	115 × 100	T2	1.4	195	E53.R10-683T20	6/FB8
3.3	2000	3000	3000	1.6	15	8.5	40	0.42	1.2	55 × 56	T1	0.2	97	E53.H56-332T10	15/FB6
8	2000	3000	3000	0.65	15	6.3	80	1	3	75 × 56	T2	0.3	111	E53.M56-802T20	10/FB2
14	2000	3000	3000	0.35	15	4.9	80	1.8	5.5	95 × 56	T2	0.5	131	E53.P56-143T20	10/FB2
16	2000	3000	3000	0.3	15	4.2	100	2	6	105 × 56	T2	0.6	141	E53.Q56-163T20	10/FB2
18	2000	3000	3000	0.3	15	4.2	100	2.3	7	105 × 56	T2	0.6	141	E53.Q56-183T20	10/FB2
24	2000	3000	3000	0.21	15	4.1	100	3	10	115 × 56	T2	0.8	151	E53.R56-243T20	12/FB9
52.5	2000	3000	3000	0.39	15	2.3	100	2.8	8	115 × 100	T2	1.4	205	E53.R10-533T20	6/FB9
2.5	2250	3375	3375	1.8	15	8.5	40	0.37	1.1	55 × 56	T1	0.2	97	E53.H56-252T10	15/FB6
4	1900	2850	2850	1.1	15	6.3	80	1.1	3	75 × 56	T2	0.3	111	E53.M56-402T20	10/FB2
5	2250	3375	3375	0.61	15	6.3	80	0.8	2.3	75 × 56	T2	0.3	111	E53.M56-502T20	10/FB2
6	2250	3375	3375	0.76	15	6.3	80	0.88	2.6	75 × 56	T2	0.3	111	E53.M56-602T20	10/FB2
10	2250	3375	3375	0.44	15	4.9	80	1.5	4.5	95 × 56	T2	0.5	131	E53.P56-103T20	10/FB2
12	2250	3375	3375	0.37	15	4.5	100	2.5	7	105 × 56	T2	0.6	141	E53.Q56-123T20	10/FB2
15	2250	3375	3375	0.27	15	4.5	100	2.1	6.2	105 × 56	T2	0.6	141	E53.Q56-153T20	10/FB2
18	2250	3375	3375	0.25	15	4.1	100	2.6	10	115 × 56	T2	0.8	151	E53.R56-183T20	12/FB9
40	2250	3375	3375	0.45	15	2.3	100	2.4	7	115 × 100	T2	1.4	195	E53.R10-403T20	6/FB9
1.5	2800	4200	4200	2.4	15	8.5	32	0.27	1.35	55 × 56	T1	0.2	97	E53.H56-152T10	15/FB6
3.3	2800	4200	4200	1.1	15	6.3	60	0.6	3	75 × 56	T2	0.3	111	E53.M56-332T20	10/FB2
5	2200	3300	3300	0.78	15	4.9	80	2	6	95 × 56	T2	0.5	131	E53.P56-502T20	10/FB2
6.8	2800	4200	4200	0.55	15	4.9	80	1.2	6	95 × 56	T2	0.5	131	E53.P56-682T20	10/FB2
7.5	2800	4200	4200	0.5	15	4.9	80	1.5	7.5	95 × 56	T2	0.5	131	E53.P56-752T20	10/FB2
8	2800	4200	4200	0.45	15	4.5	100	1.5	7.5	105 × 56	T2	0.6	141	E53.Q56-802T20	10/FB2
10	2800	4200	4200	0.35	15	4.5	100	1.8	9	105 × 56	T2	0.6	141	E53.Q56-103T20	10/FB2
12	2800	4200	4200	0.29	15	4.1	100	2.2	12	115 × 56	T2	0.8	151	E53.R56-123T20	12/FB9
25	2800	4200	4200	0.57	15	2.3	100	1.9	6	115 × 100	T2	1.4	195	E53.R10-253T20	6/FB8



E53

AC/DC

1050V AC / 2200...5000V DC



C _N (μF)	U _N DC (V)	U _S (nH)	U _{TT} (K/W)	R _S (mΩ)	L _e (nH)	R _{th} (K/W)	I _{max} (A)	Î (kA)	I _S (kA)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	L/K (mm)	order no. Bestell-Nr.	pcs Stk / Box
U_N 1050V AC U_{rms} 750V															
4.7	2200	3300	3300	0.83	15	4.9	80	1.5	4.5	95 × 56	T2	0.5	131	E53.P56-472T20	10/FB2
22	2200	3300	3300	0.15	15	2.3	100	3.9	11.7	115 × 100	T2	1.4	195	E53.R10-223T20	6/FB8
8	2200	3300	3300	0.48	15	4.1	100	2.5	8	115 × 56	T2	0.8	151	E53.R56-802T20	12/FB9
1	2550	3825	3825	3.4	15	8.5	40	0.35	1.75	55 × 56	T1	0.2	97	E53.H56-102T10	15/FB6
1.5	3200	4800	4800	1.8	15	4.9	80	0.7	2	95 × 56	T2	0.5	131	E53.P56-152T21	10/FB2
2	2800	4200	4200	1.6	15	6.3	60	0.8	2.3	75 × 56	T2	0.3	111	E53.M56-202T20	10/FB2
2.5	2450	3675	3675	1.4	15	6.3	75	0.9	4.5	75 × 56	T2	0.3	111	E53.M56-252T20	10/FB2
3	2900	4350	4350	1	15	4.9	80	1.2	3.6	95 × 56	T2	0.5	131	E53.P56-302T21	10/FB2
4	2550	3825	3825	0.85	15	4.9	80	1.5	7.5	95 × 56	T2	0.5	131	E53.P56-402T20	10/FB2
4.5	2800	4200	4200	0.69	15	4.5	100	1.8	5	105 × 56	T2	0.6	141	E53.Q56-452T20	10/FB2
5	2550	3825	3825	0.68	15	4.5	100	1.8	9	105 × 56	T2	0.6	141	E53.Q56-502T20	10/FB2
6	2550	3825	3825	0.59	15	4.5	100	2.2	11	105 × 56	T2	0.6	141	E53.Q56-602T20	10/FB2
7	2550	3825	3825	0.51	15	4.1	100	3	12	115 × 56	T2	0.8	151	E53.R56-702T20	12/FB9
1	3850	5775	5775	2.3	15	6.3	50	0.5	1.6	75 × 56	T2	0.3	111	E53.M56-102T20	10/FB2
2.2	3200	4800	4800	1.2	15	4.9	60	1	3	95 × 56	T2	0.5	131	E53.P56-222T20	10/FB2
U_N 1400V AC U_{rms} 1000V															
8	3600	5400	5400	0.52	15	2.3	100	2.3	6.9	115 × 100	T2	1.4	195	E53.R10-802T20	6/FB8
10	3600	5400	5400	0.94	15	2.3	100	2.5	7.5	115 × 100	T2	1.4	195	E53.R10-103T20	6/FB8
1	2550	3825	3825	1.2	15	8.5	20	0.7	2.2	55 × 56	T1	0.2	97	E53.H56-102T11	15/FB6
1.16	2450	3675	3675	1.2	15	8.5	20	0.7	2.2	55 × 56	T1	0.2	97	E53.H56-122T10	15/FB6
4.2	2450	3675	3675	0.32	15	4.9	80	2.6	8	95 × 56	T2	0.5	131	E53.P56-422T20	10/FB2
5.2	2450	3675	3675	0.26	15	4.5	100	3	10	105 × 56	T2	0.6	141	E53.Q56-522T20	10/FB2
U_N 2100V AC U_{rms} 1500V															
0.22	3750	5625	5625	4.7	15	8.5	20	0.5	1.5	55 × 56	T1	0.2	97	E53.H56-221T10	15/FB6
0.33	3750	5625	5625	3.9	15	8.5	20	0.5	1.6	55 × 56	T1	0.2	97	E53.H56-331T10	15/FB6
0.47	3750	5625	5625	2.9	15	8.5	20	0.7	2.1	55 × 56	T1	0.2	97	E53.H56-471T10	15/FB6
1.1	3750	5625	5625	1.2	15	6.3	60	1.6	5	75 × 56	T2	0.3	111	E53.M56-112T20	10/FB2
1.7	3750	5625	5625	0.8	15	4.9	80	2.5	8	95 × 56	T2	0.5	131	E53.P56-172T20	10/FB2
2	3750	5625	5625	0.64	15	4.1	100	3	10	115 × 56	T2	0.8	151	E53.R56-202T20	12/FB9
2.15	3750	5625	5625	0.64	15	4.5	100	3	10	105 × 56	T2	0.6	141	E53.Q56-222T20	10/FB2
2.7	3750	5625	5625	0.51	15	4.1	100	4	12	115 × 56	T2	0.8	151	E53.R56-272T20	12/FB9
3	5000	7500	7500	1.2	15	2.3	125	2.1	6.3	115 × 100	T2	1.4	195	E53.R10-302T21	6/FB8
4	4450	6675	6675	1	15	2.3	125	2.5	7.5	115 × 100	T2	1.4	195	E53.R10-402T21	6/FB8

Other values and dimensions available on request

Andere Werte und Abmessungen auf Anfrage erhältlich



2450...4000V AC / 4000...7200V DC

C _N (μF)	U _N DC (V)	U _S (nH)	U _{TT} (K/W)	R _S (mΩ)	L _e (nH)	R _{th} (K/W)	I _{max} (A)	$\hat{I}$ (kA)	I _S (kA)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	L/K (mm)	order no. Bestell-Nr.	pcs_Stk / Box
U_N 2450V AC U_{rms} 1750V															
0.12	4000	6000	6000	5.8	15	8.5	20	0.3	0.9	55 × 56	T1	0.2	97	E53.H56-121T10	15/FB6
0.33	4000	6000	6000	1.2	15	4.5	100	1.3	4	105 × 56	T2	0.6	141	E53.Q56-331T20	10/FB2
0.5	4000	6000	6000	0.85	15	4.5	100	1.6	5	105 × 56	T2	0.6	141	E53.Q56-501T20	10/FB2
0.5	5600	8400	8400	7.6	15	4.9	20	0.4	1.3	55 × 97	T1	0.3	138	E53.H97-501T10	18/FB3
0.2	5600	8400	8400	12.3	15	4.9	35	1.2	3.6	55 × 97	T2	0.3	132	E53.H97-201T20	18/FB3
0.22	7200	10800	10800	13.7	15	4.9	25	0.2	0.7	55 × 97	T1	0.3	138	E53.H97-221T10	18/FB3
0.25	7200	10800	10800	12.1	15	4.9	25	0.3	0.8	55 × 97	T1	0.3	138	E53.H97-251T11	18/FB3
0.047	7200	10800	10800	13.4	15	4.9	20	0.3	0.9	55 × 97	T1	0.3	138	E53.H97-470T10	18/FB3
U_N 4000V AC U_{rms} 2800V															
0.1	5000	7500	7500	9.3	15	4.9	20	0.45	1.35	55 × 97	T1	0.3	138	E53.H97-101T10	18/FB3



E53 H/E55

DC

600...1100V DC

for latest edition and updates
check www.powercapacitors.info**Low-inductance DC-Capacitors**
Niederinduktive Gleichspannungskondensatoren**Standards** IEC 61071, UL810, CSA 22.2 No.190
optional IEC 61881**can Gehäuse** plastic Kunststoff (UL94: V0)**mounting position Einbaulage**... optional beliebig**filling material** solid, based on vegetable oil, non-PCB**Füllmittel** ausgehärtet, auf Pflanzenölbasis, PCB-frei**Internal protection** none**Interne Sicherung** keine**fire load Brandlast** 40 MJ/kg**C_N tolerance Toleranz** ±10% (optional ±5%)**tanδ₀** 2 × 10⁻⁴**operating temperatures Grenztemperaturen****Θ_{min} ... Θ_{max}** -40 ... +85°C**Θ_{HOTSPOT}** ≤ 85°C**storing temperature Lagertemperatur** -40 ... +85°C**Failure rate Ausfallrate** 50 FIT(reference interval_Referenzintervall 100000 h, Θ_{HOTSPOT} ≤ 70°C)

C _N (μF)	U _{ripple} (V)	U _S (V)	U _{TT} (V)	R _S (mΩ)	R _{th} (K/W)	I _{max} (A)	I _h (kA)	I _S (kA)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	L/K (mm)	order no. Bestell-Nr.	pcs St / Box
U_N 600V DC			U_S 900V			U_{TT} 900V DC									
200	100	900	900	0.75	6.1	60	3.3	9.9	30	85 × 51	H4/H5	0.4	29 / 29	E53.N51-204H4/H50	8/FB6
280	100	900	900	0.85	4.8	60	3.5	10.5	35	85 × 64	H4/H5	0.5	29 / 29	E53.N64-284H4/H50	8/FB4
400	100	900	900	1.1	4.1	60	3.3	10	40	85 × 76	H4/H5	0.5	29 / 29	E53.N76-404H4/H50	8/FB4
U_N 700V DC			U_S 1050V			U_{TT} 1050V DC									
150	160	1050	1050	0.7	6.1	60	2.9	8.7	30	85 × 51	H4/H5	0.4	29 / 29	E53.N51-154H4/H50	8/FB6
200	160	1050	1050	0.92	4.8	60	2.9	8.7	35	85 × 64	H4/H5	0.5	29 / 29	E53.N64-204H4/H50	8/FB4
300	160	1050	1050	1.2	4.1	60	2.9	8.7	40	85 × 76	H4/H5	0.5	29 / 29	E53.N76-304H4/H50	8/FB4
400	200	1050	1050	1.2	3.1	60	2.6	7.8	60	85 × 100	H4/H5	0.7	29 / 29	E53.N10-404H4/H50	8/FB2
U_N 900V DC			U_S 1350V			U_{TT} 1350V DC									
57	200	1350	1350	2.2	8.5	45	0.9	2.7	15	55 × 56	T1	0.2	97	E55.H56-573T10	15/FB6
130	200	1350	1350	1.1	6.1	60	2.7	8	30	85 × 51	H4/H5	0.4	29 / 29	E53.N51-134H4/H50	8/FB6
150	160	1350	1350	1	4.8	60	2.5	7.5	35	85 × 64	H4/H5	0.5	29 / 29	E53.N64-154H4/H50	8/FB4
200	200	1350	1350	0.63	5.2	80	3	9	15	95 × 56	T2	0.5	126	E55.P56-204T21	10/FB2
260	200	1350	1350	1.3	4.1	60	2.7	8.1	40	85 × 76	H4/H5	0.5	29 / 29	E53.N76-264H4/H50	8/FB4
250	280	1350	1350	0.35	4.5	100	4	12	15	105 × 56	T2	0.6	141	E55.Q56-254T20	10/FB2
U_N 1100V DC			U_S 1650V			U_{TT} 1650V DC									
75	200	1650	1650	1	6.1	60	2	6.1	30	85 × 51	H4/H5	0.4	29 / 29	E53.N51-753H4/H50	8/FB6
100	250	1650	1650	0.9	4.8	60	2	6.2	35	85 × 64	H4/H5	0.5	29 / 29	E53.N64-104H4/H50	8/FB4
150	200	1650	1650	1.5	4.1	75	2	6.1	40	85 × 76	H4/H5	0.5	29 / 29	E53.N76-154H4/H50	8/FB4

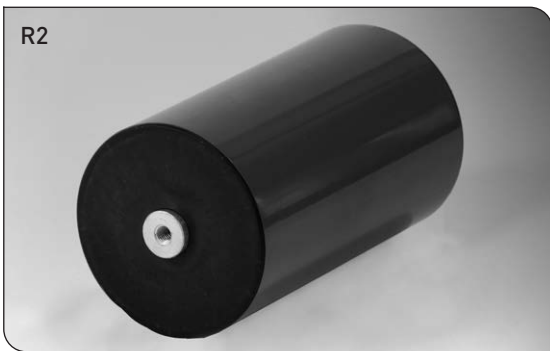
Other values and dimensions available on request
Andere Werte und Abmessungen auf Anfrage erhältlich

C _N (μF)	U _{ripple} (V)	U _s (V)	U _{TT} (V)	R _s (mΩ)	R _{th} (K/W)	I _{max} (A)	I _h (kA)	I _s (kA)	L _e (nH)	D ₁ × L ₁ (mm)	Design Maßbild	m (kg)	L/K (mm)	order no. Bestell-Nr.	pcs_Stk / Box
U_N 1300V DC		U_s 1950V		U_{TT} 1950V DC											
50	300	1950	1950	1.1	6.1	70	1.6	4.8	30	85 × 51	H4/H5	0.4	29 / 29	E53.N51-503H4/H50	8/FB6
50	400	1950	1950	0.98	6.3	65	2.4	7.2	15	75 × 56	T2	0.3	111	E55.M56-503T20	10/FB2
90	400	1950	1950	0.55	4.9	80	4.3	13	15	95 × 56	T2	0.5	131	E55.P56-903T20	10/FB2
97	300	1950	1950	1.3	4.1	60	1.5	4.5	30	85 × 76	H4/H5	0.5	29 / 29	E53.N76-973H4/H50	8/FB6
100	240	1950	1950	1.5	4.1	60	1.6	4.8	40	85 × 76	H4/H5	0.5	29 / 29	E53.N76-104H4/H50	8/FB4
U_N 1500V DC		U_s 2250V		U_{TT} 2250V DC											
32	280	2100	2100	1.1	6.1	60	1.2	3.6	30	85 × 51	H4/H5	0.4	29 / 29	E53.N51-323H4/H50	8/FB6
40	350	2250	2250	0.94	6.1	60	1.4	4.2	30	85 × 51	H4/H5	0.4	29 / 29	E53.N51-403H4/H50	8/FB6
50	280	2250	2250	1.5	4.8	60	1.4	4.2	35	85 × 64	H4/H5	0.5	29 / 29	E53.N64-503H4/H50	8/FB4
75	280	2250	2250	2	4.1	70	1.4	4.2	40	85 × 76	H4/H5	0.5	29 / 29	E53.N76-753H4/H50	8/FB4
85	280	2250	2250	1.9	4.1	70	1.6	5	40	85 × 76	H4/H5	0.5	29 / 29	E53.N76-853H4/H50	8/FB4
100	480	2100	2100	0.34	4.1	100	2.8	8	15	115 × 56	T2	0.8	151	E55.R56-104T20	12/FB9
U_N 1800V DC		U_s 2700V		U_{TT} 2700V DC											
22	600	2700	2700	1.5	6.3	40	1.6	4.8	15	75 × 56	T2	0.3	111	E55.M56-223T20	10/FB2
30	400	2700	2700	0.73	6.1	60	1.3	3.9	30	85 × 51	H4/H5	0.4	29 / 29	E53.N51-303H4/H50	8/FB6
38	400	2700	2700	2	4.8	55	1.2	4	35	85 × 64	H4/H5	0.5	29 / 29	E53.N64-383H4/H50	8/FB4
60	400	2700	2700	2.1	4.1	50	1.3	3.9	40	85 × 76	H4/H5	0.5	29 / 29	E53.N76-603H4/H50	8/FB4
U_N 2000V DC		U_s 3000V		U_{TT} 3000V DC											
12	300	3000	3000	2.1	6.3	46	0.4	1.3	15	75 × 56	T2	0.3	111	E55.M56-123T20	10/FB2
30	400	3000	3000	1.3	4.8	55	1.1	3.3	35	85 × 64	H4/H5	0.5	29 / 29	E53.N64-303H4/H50	8/FB4
43	400	3000	3000	1.8	4.1	50	1	3	40	85 × 76	H4/H5	0.5	29 / 29	E53.N76-433H4/H50	8/FB4
50	650	3000	3000	0.55	4.1	100	4.1	12.3	15	115 × 56	T2	0.8	151	E55.R56-503T20	12/FB9
U_N 2200V DC		U_s 3300V		U_{TT} 3300V DC											
35	600	3300	3300	2	4.1	50	0.94	2.82	40	85 × 76	H4/H5	0.5	29 / 29	E53.N76-353H4/H50	8/FB4
U_N 2800V DC		U_s 4200V		U_{TT} 4200V DC											
13	800	3600	3600	1.6	4.9	80	0.81	2.43	15	95 × 56	T2	0.5	131	E55.P56-133T20	10/FB2
18	900	4200	4200	0.6	4.5	90	4.5	13.5	15	105 × 56	T2	0.6	141	E55.Q56-183T20	10/FB2

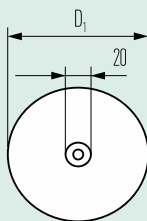
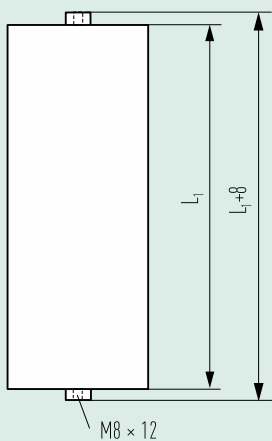




R2



Design R2

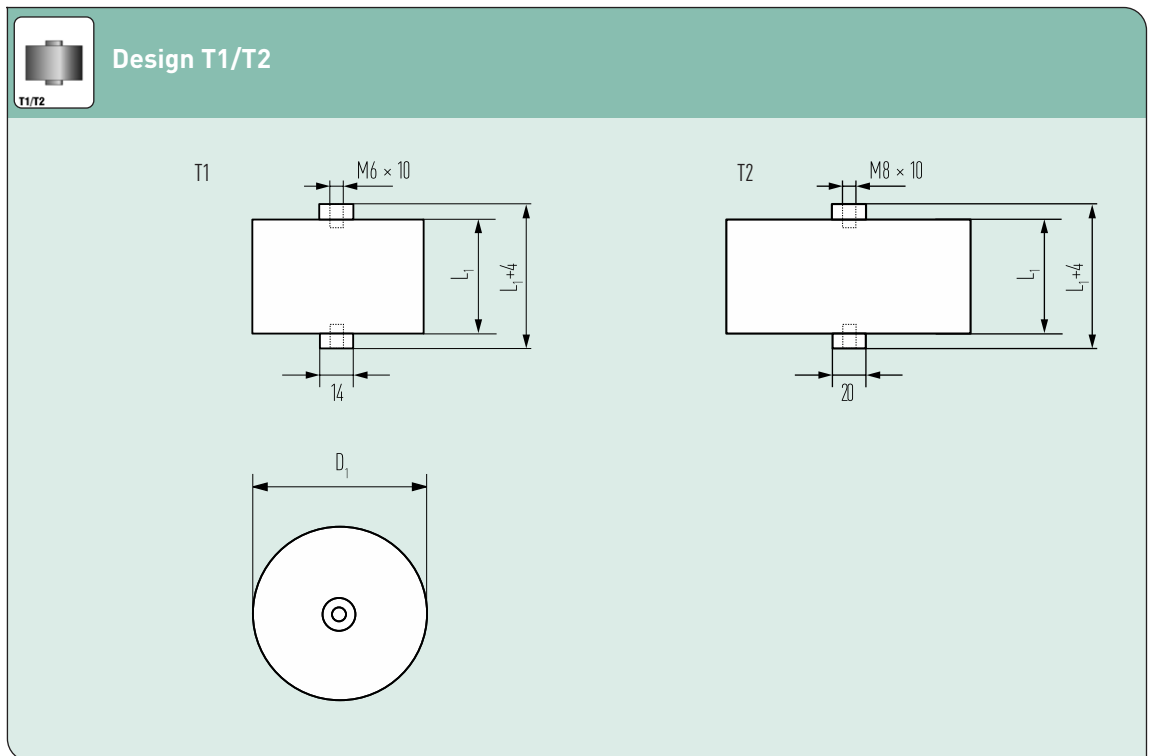


CAPACITORS WITH A CAN DIAMETER OF 64, 90, 116, 140 mm

Can material plastic can, filled with solid PUR resin
 Terminals brass, axial thread M8 × 12 mm
 I_{max} (Terminals) 100 A
 Degree of protection IP 00
 K/L ($L_1 + D_1 - 20$ mm)
 Humidity class T1 (IEC 62498-1)

KONDENSATOREN MIT GEHÄUSEDURCHMESSER 64, 90, 116, 140 mm

Gehäusematerial Kunststoff, gefüllt mit ausgehärtetem
 Polyurethanharz
 Anschlüsse Messing, axiales Schraubgewinde M8 × 12
 mm
 I_{max} (Anschlüsse) 100 A
 Schutzgrad IP 00
 K/L ($L_1 + D_1 - 20$ mm)
 Feuchtekategorie T1 (IEC 62498-1)



T1 CAPACITORS WITH A CAN DIAMETER OF 55...60 mm

T2 CAPACITORS WITH A CAN DIAMETER OF 75...115 mm

Can material plastic can, filled with solid PUR resin

Terminals brass, axial thread

T1 M6 × 10 mm

T2 M8 × 10 mm

I_{max} (Terminals)

T1 60 A

T2 100 A

Degree of protection IP 00

K/L see data charts

Humidity class G, T3 (IEC 62498-1)

T1 KONDENSATOREN MIT GEHÄUSEDURCHMESSER 55...60 mm

T2 KONDENSATOREN MIT GEHÄUSEDURCHMESSER 75...115 mm

Gehäusematerial Kunststoff, gefüllt mit ausgehärtetem
Polyurethanharz

Anschlüsse Messing, axiales Schraubgewinde

T1 M6 × 10 mm

T2 M8 × 10 mm

I_{max} (Anschlüsse)

T1 60 A

T2 100 A

Schutzgrad IP 00

K/L siehe Datentabellen

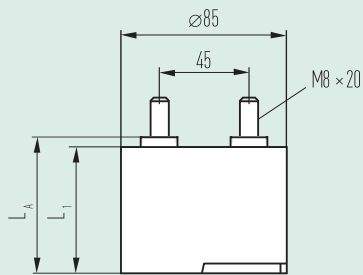
Feuchtekategorie G, T3 (IEC 62498-1)

H4

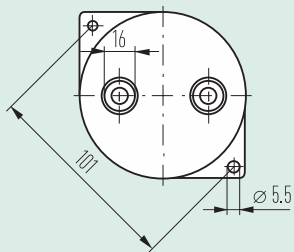
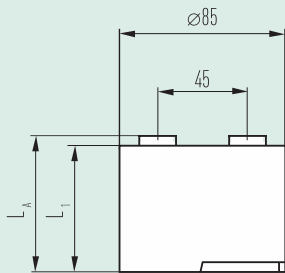


Design H4/H5

H4



H5



H4/H5 CAPACITORS WITH A CAN DIAMETER OF 85 mm

Can material plastic can, filled with solid PUR resin

Fixing lateral mounting brackets

Terminals

H4 brass, threaded studs M8 × 20 mm

H5 brass, internal thread iM8 × 8 mm

I_{max} (Terminals) 100 A

Degree of protection IP 00

K/L see data charts

Humidity class G, T3 (IEC 62498-1)

H4/H5 KONDENSATOREN MIT GEHÄUSEDURCHMESSER 85 mm

Gehäusematerial Kunststoff, gefüllt mit ausgehärtetem
Polyurethanharz

Befestigung seitliche Montagelaschen

Anschlüsse

H4 Messing, Gewindebolzen M8 × 20 mm

H5 Messing, Innengewinde iM8 × 8 mm

I_{max} (Anschlüsse) 100 A

Schutzgrad IP 00

K/L siehe Datentabellen

Feuchteklasse G, T3 (IEC 62498-1)

Important Remarks

General

Our catalogues outline the typical technical and mechanical characteristics of the listed capacitors. The stated values are based on reference type tests, as well as empirical and experimental experience. The real values of individual capacitors may differ within the stated, or commonly known, tolerances. Any information given in this catalogue therefore describes the components in general terms and does not constitute any guarantee of individual technical values.

It is the responsibility of the user to ensure by dedicated tests the suitability and safety of operation of our components under the conditions of his application. This also applies to any accessories offered by ELECTRONICON.

Safety

Safe operation of the capacitors can be expected only if all safety recommendations as well as electrical and thermal specifications as stated on the label, in the data sheets, catalogues and the accompanying mounting instructions are strictly observed, and recommended safety devices are used as intended. Please consider the "General Safety Recommendations" of the power capacitor manufacturers organized in the German ZVEI (www.electronicon.com/en/zvei).

The capacitors shall only be used for the intended application. ELECTRONICON will not indemnify or be responsible for any kind of damages to persons or property due to the improper application of any capacitors purchased from ELECTRONICON or its distributors.

Mind that electrical or mechanical misapplication of capacitors can become hazardous. Misapplied capacitors can explode or catch fire and cause bodily injury or property damage due to the expulsion of material or metal fragments.

Please consult the detailed instructions for mounting and application stated in our brochure „Application Notes“ and on the ELECTRONICON website: www.electronicon.com/en/an

If in doubt about how to connect, operate, or discharge a capacitor, consult ELECTRONICON engineering or our distributors.

Mounting And Cooling

The useful life of a capacitor may be reduced dramatically if exposed to excessive heat. Typically an increase in the ambient temperature of 7°C will halve the expected life of the capacitor. Make sure to obey the permitted operating temperatures.

To avoid overheating the capacitors must be allowed to cool unhindered and should be shielded from external heat sources. We recommend forced ventilation for all filter applications with reactors. Give approx. 20 mm clearance around capacitors for natural or forced ventilation, and do not place them directly above or next to heat sources such as detuning or tuning reactors, bus bars, etc.

Wichtige Hinweise

Allgemeines

Unsere Kataloge beschreiben die typischen technischen und mechanischen Eigenschaften der aufgeführten Kondensatoren. Die angegebenen Werte basieren auf Referenztypprüfungen sowie empirischen und experimentellen Erfahrungswerten. Die tatsächlichen Werte einzelner Kondensatoren können innerhalb der angegebenen bzw. allgemein bekannter Toleranzen abweichen. Alle Angaben in diesem Katalog beschreiben daher die Komponenten im Allgemeinen und stellen keine Garantie für individuelle technische Werte dar.

Es liegt in der Verantwortung des Anwenders, durch gezielte Prüfungen die Eignung und Betriebssicherheit unserer Komponenten unter den konkreten Betriebsbedingungen seiner Anwendung sicherzustellen. Dies gilt ebenso für gegebenenfalls von ELECTRONICON angebotene Zubehörteile.

Sicherheit

Ein sicherer Betrieb der Kondensatoren ist nur zu erwarten, wenn alle Sicherheitsempfehlungen sowie elektrische und thermische Spezifikationen entsprechend Etikett, Datenblättern, Katalogen und beiliegenden Montageanleitungen eingehalten und die empfohlenen Sicherheitseinrichtungen bestimmungsgemäß verwendet werden. Bitte beachten Sie die „Allgemeinen Sicherheitsempfehlungen“ der im deutschen ZVEI organisierten Hersteller von Leistungskondensatoren (www.electronicon.com/zvei).

Die Kondensatoren dürfen ausschließlich für ihren Bestimmungszweck verwendet werden. ELECTRONICON übernimmt keine Verantwortung oder Haftung für Schäden an Personen oder Eigentum, welche aus unsachgemäßer Anwendung von Kondensatoren herrührt.

Elektrisch oder mechanisch fehlerhaft eingesetzte Kondensatoren können explodieren oder Feuer fangen. Austretende Materialien bzw. Metallteile können gesundheitliche und materielle Schäden verursachen.

Bitte beachten Sie die detaillierten Anweisungen in unserer Broschüre „Anwendungshinweise“ sowie auf der Webseite von ELECTRONICON: www.electronicon.com/an

Bitte konsultieren Sie das Fachpersonal oder unsere Distributoren zu Fragen bezüglich Anschluss, Verwendung oder Entladung von Kondensatoren.

Montage und Kühlung

Die Lebensdauer eines Kondensators kann durch übermäßige Wärmeeinwirkung erheblich verringert werden. Im allgemeinen führt eine Erhöhung der Umgebungstemperatur um 7°C zu einer Verringerung der Lebensdauer des Kondensators um 50 %. Halten Sie die zugelassenen Betriebstemperaturen ein.

Um Überhitzung zu vermeiden, muß gewährleistet sein, daß die Kondensatoren auftretende Verlustwärme ungehindert abführen können und vor fremden Wärmequellen abgeschirmt werden. Insbesondere in Filtern ist in jedem Falle eine Zwangslüftung zu empfehlen. Zwischen und um Kondensatoren sollten etwa 20 mm Platz für natürliche oder Zwangslüftung belassen werden. Bringen Sie den Kondensator nie direkt neben oder über Wärmequellen, wie Drosseln u. ä. an.

Protection against Overvoltages And Short Circuits: Self-Healing Dielectric

All dielectric structures used in our power capacitors are „selfhealing“: In the event of a voltage breakdown the metal layers around the breakdown channel are evaporated by the temperature of the electric arc that forms between the electrodes. They are removed within a few microseconds and pushed apart by the pressure generated in the centre of the breakdown spot. An insulation area is formed which is reliably resistive and voltage proof for all operating requirements of the capacitor. The capacitor remains fully functional during and after the breakdown.

For voltages within the permitted testing and operating limits the capacitors are short-circuit- and overvoltage-proof. They are also proof against external short circuits as far as the resulting surge discharges do not exceed the specified surge current limits.

Failure Rate

The failure probability of a component is a statistical value which is described by a log-normal distribution:

$$N = N_0 \times e^{-\lambda t}$$

λ is the failure rate, which alternatively is also stated as the so-called FIT-rate (FIT = Failures In Time = $\lambda \times 10^9$).

The failure rate is very closely linked with operating temperature and operating voltage of the capacitor. The FIT rates stated in this catalogue are related to the capacitor's rated voltage and a dielectric temperature (= HOTSPOT temperature) of 70°C.

The simultaneous operation of capacitors at highest permissible voltage and operating temperature should be avoided; otherwise, failure rates may increase beyond reasonable technical reliability.

The standard reference period for the failure rate statement is 100.000 hours. Please note that FIT rates can be altered or improved by technical adjustments. Please contact us for details.

The following diagrams demonstrate the correlation between FIT rate, operating voltages and operating temperatures.

Schutz gegen Überspannungen und Kurzschlüsse: Selbstheilendes Dielektrikum

Alle in unseren Leistungskondensatoren eingesetzten dielektrischen Strukturen sind selbstheilend. Im Falle eines Kurzschlusses (Spannungsdurchschlag) verdampfen die Metallbeläge um den Durchschlagpunkt herum infolge des Lichtbogens, der sich zwischen den Elektroden bildet. Binnen Mikrosekunden wird der Metaldampf vom Zentrum des Durchschlages weggedrückt. Auf diese Weise bildet sich eine isolierende belagfreie Zone um den Durchschlagpunkt. Der Kondensator bleibt während und nach dem Durchschlag voll funktionsfähig.

Für Spannungen innerhalb der zugelassenen Test- und Betriebsbedingungen sind die Kondensatoren kurzschluss- und überspannungssicher. Sie sind außerdem sicher gegen äußere Kurzschlüsse, sofern bei den dabei entstehenden Stoßentladungen die zugelassenen Stoßströme nicht überschritten werden.

Ausfallrate

Die Ausfallwahrscheinlichkeit eines Bauelements ist eine statistische Größe, die mit Hilfe einer Normalverteilung beschrieben wird. Es gilt:

N = number of functional components after period t

Anzahl der nach der Zeit t intakten Bauelemente

N_0 = total number of components at time $t = 0$

Gesamtzahl der Bauelemente zum Zeitpunkt $t = 0$

λ = failure rate Ausfallrate

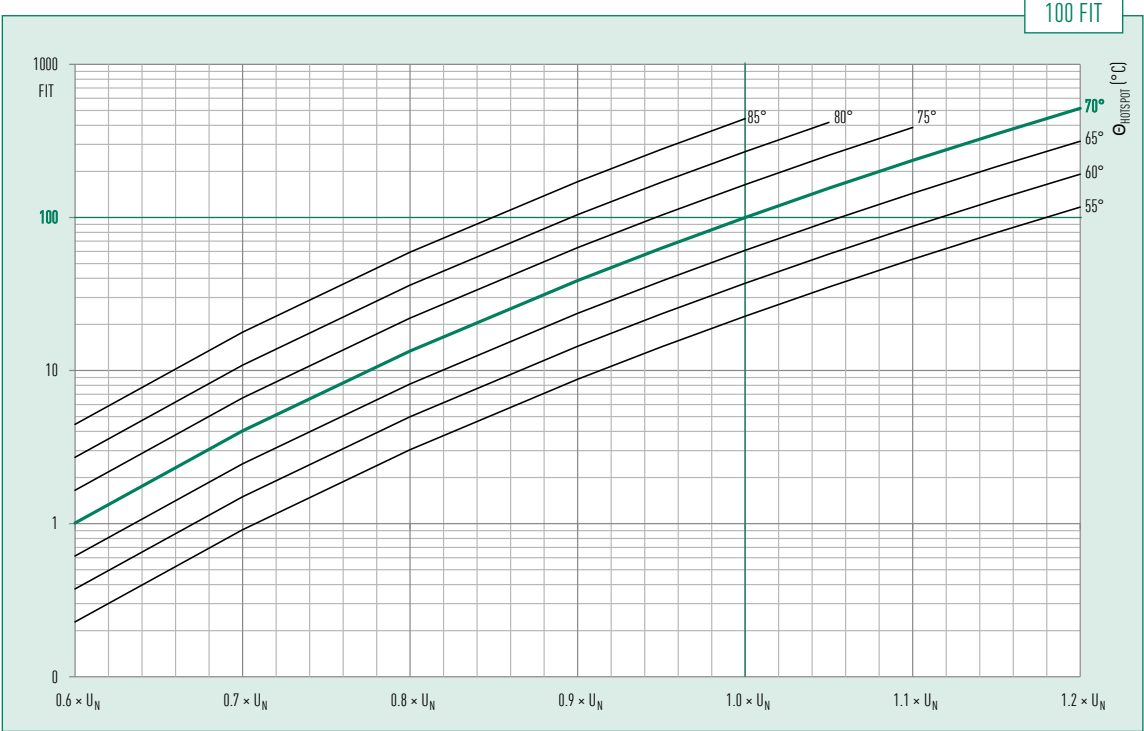
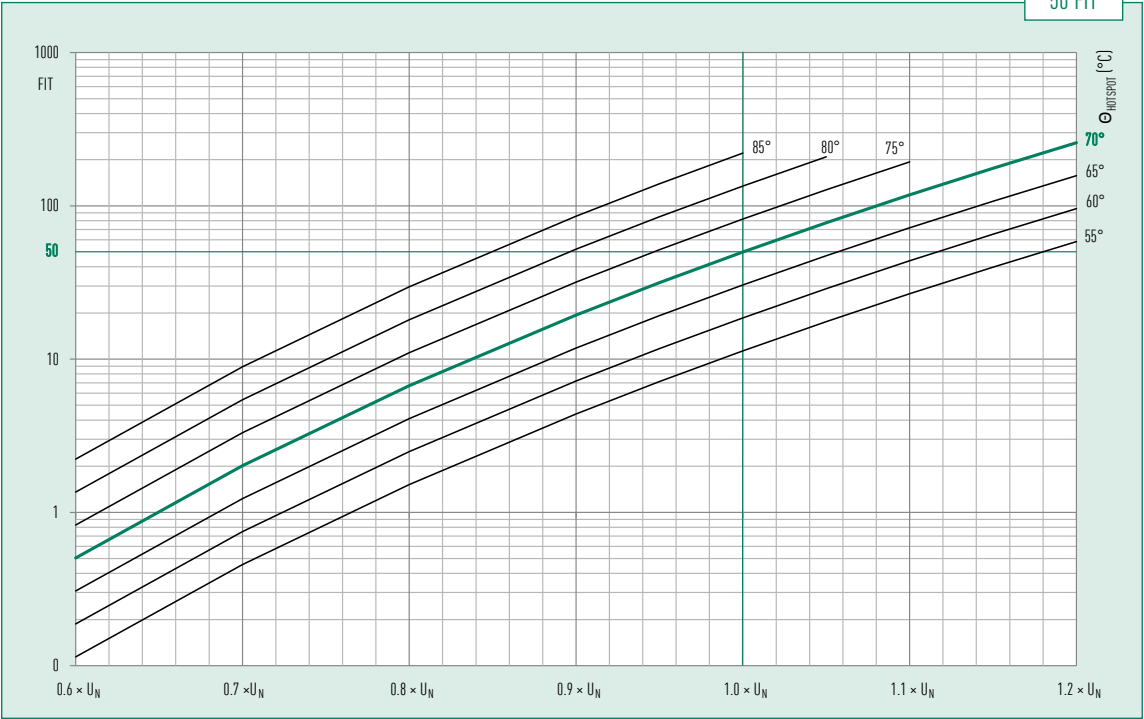
Dabei ist λ die Ausfallrate, die alternativ auch als FIT-Rate angegeben wird (FIT = $\lambda \times 10^9$)

Die Ausfallrate ist stark abhängig von der Temperatur und der Betriebsfeldstärke. Die FIT-Raten im Katalogsortiment beziehen sich auf 70°C Dielektrikumtemperatur (=Hotspot-Temperatur) und die Nennspannung des Kondensators.

Der Betrieb von Kondensatoren mit der höchsten zulässigen Spannung und der höchsten zulässigen Betriebstemperatur sollte vermieden werden, andernfalls können die Ausfallraten so hoch werden, dass keine technisch sinnvollen Zuverlässigkeiten mehr gewährleistet sind.

Der Wert für die Ausfallrate bezieht sich auf einen Referenzzeitraum von 100.000h. FIT-Raten können durch technische Anpassung der Kondensatoren beeinflusst und verbessert werden. Auskünfte hierzu erteilen wir auf Anfrage.

Die nachstehenden Kurvendiagramme machen den Zusammenhang von FIT-Rate, Betriebsspannung und Betriebstemperatur deutlich.



Limited Warranty

All our products are designed, manufactured, and tested with the highest care and workmanship. The satisfaction of our customers is our highest goal. We therefore warrant remedying any defect in the goods resulting from faulty design, materials or workmanship, which appears within 2 years from the date of sale, unless agreed otherwise.

This warranty does not cover defects due to improper use of the goods or operation at conditions exceeding the rated values stated in the catalogue or special data sheet. Nor does it cover defects due to faulty maintenance or incorrect installation, alterations or faulty repairs undertaken by the Buyer. Finally the warranty does not cover normal wear and tear or deterioration.

See our „General Conditions“ for details on Warranty and Product liability.

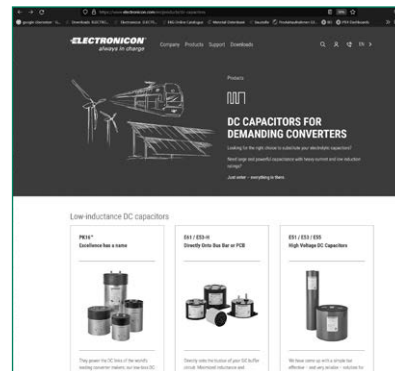
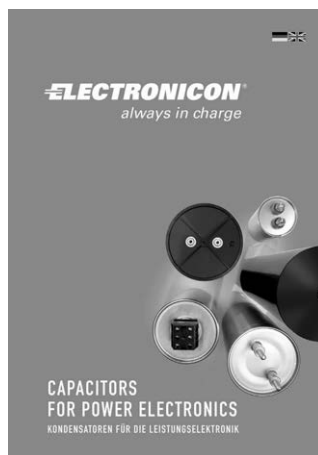
Gewährleistung

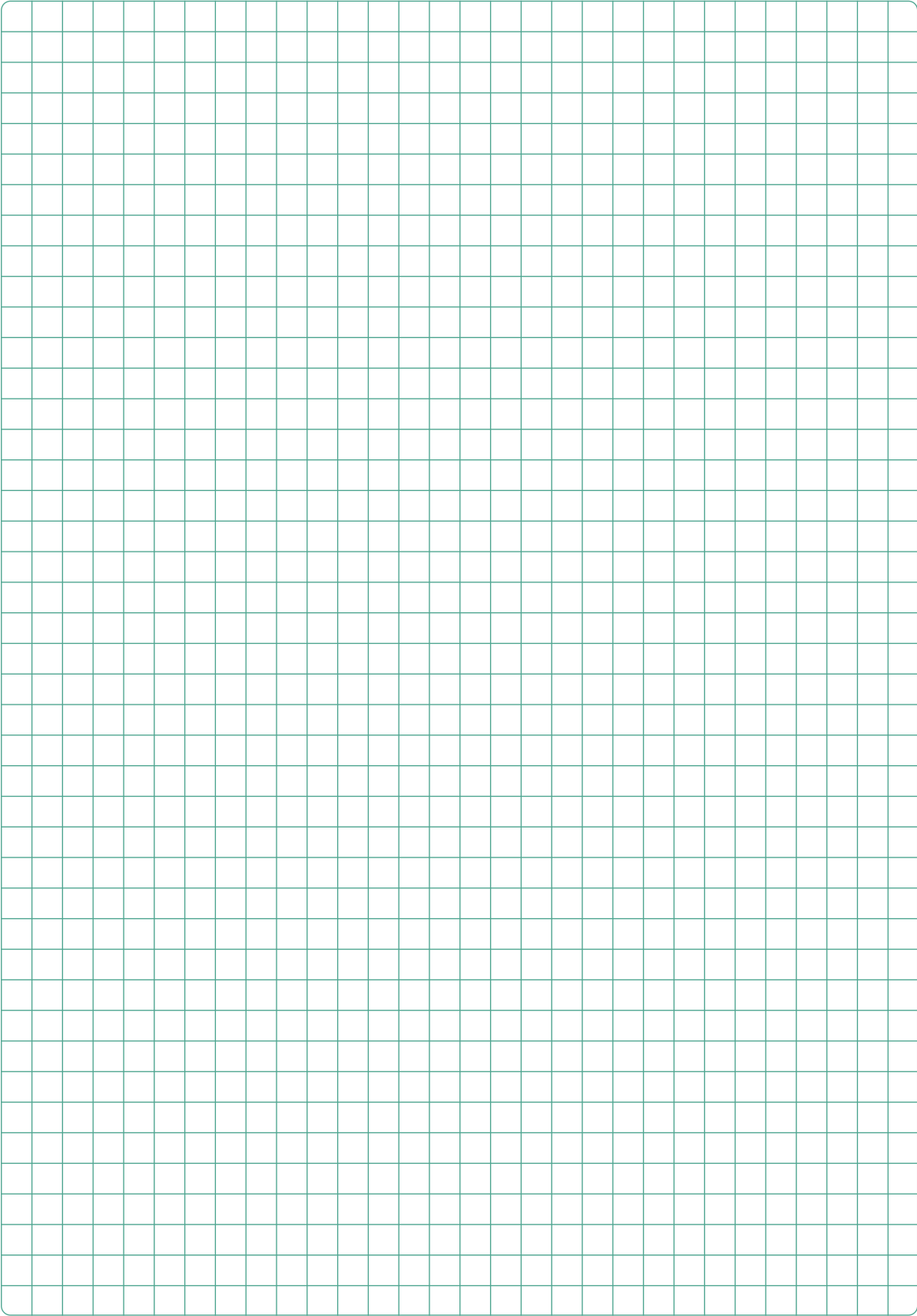
Alle unsere Erzeugnisse werden mit höchster Sorgfalt und Fachkenntnis entwickelt, hergestellt und geprüft. Die Zufriedenheit unserer Kunden ist unser höchstes Ziel. Wir verpflichten uns daher, sofern nicht anders vereinbart, jeden innerhalb von 2 Jahren ab Verkaufsdatum auftretenden Mangel an unseren Erzeugnissen zu beseitigen, welcher aus Fehlern in Design, Material oder Herstellung herrührt.

Diese Gewährleistung erstreckt sich nicht auf Defekte infolge unsachgemäßer Anwendung oder Betrieb außerhalb der nach Katalog oder Datenblatt zulässigen Einsatzbedingungen. Sie erfaßt ebenso wenig Schäden aufgrund fehlerhafter Wartung, unsachgemäßer Montage, Änderungen oder unsachgemäßer Reparaturen durch den Käufer bzw. Anwender. Diese Gewährleistung betrifft auch nicht normale Abnutzung und Verschleiß.

Siehe unsere „Allgemeinen Geschäftsbedingungen“ für Details zu Gewährleistung und Produkthaftung.

Find more information and detailed instructions in our „Application Notes“ and on www.electronicon.com
Mehr Informationen und ausführliche Anweisungen finden Sie in unseren „Anwendungshinweisen“ und unter www.electronicon.com





www.electronicon.com Issue 12/2023



E57 / E59 / SR17™
AC AND DC CAPACITORS
WITH LARGE CAPACITANCES



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ELECTRONICON
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DC CAPACITORS
DC KONDENSATOREN



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CAPACITORS FOR POWER ELECTRONICS

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COMPONENTS FOR POWER FACTOR CORRECTION

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KEY COMPONENTS FOR POWER FACTOR CORRECTION
IN 50Hz MAINS

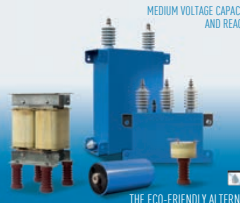


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MEDIUM VOLTAGE CAPACITORS
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**CAPACITORS
FOR POWER ELECTRONICS**
KONDENSATOREN FÜR DIE LEISTUNGSELEKTRONIK

EXCELLENT EXPERIENCE IN CAPACITOR MAKING FOR OVER 80 YEARS

Gera has been a centre of capacitor making since 1938. ELECTRONICON Kondensatoren GmbH which emerged from previous RFT/VEB ELEKTRONIK Gera in 1992, has become one of Europe's leading capacitor manufacturers supplying customers worldwide and being an open and competent partner for manufacturers and users of power factor correction as well as industrial applications of power electronics, generation and transmission of green energy, traction, a.m.o. . Regular investments in advanced and environmentally sound technologies guarantee the highest levels in manufacture and quality to modern standards which are approved and monitored by leading certification authorities.



In today's globalised competition, we distinguish ourselves by

- Absolute reliability and safety of our products
- Close co-operation between manufacturer and client to meet both technical and commercial requirements
- Improvement and development of our technical expertise in capacitor design and manufacture, as well as film coating, with special attention paid to the MKPg-technology
- Early identification and incorporation of new trends and methods in the manufacturing of capacitors
- Flexibility and punctual fulfilment of our commercial obligations

Our experienced development engineers are competent and responsible for both implementing the latest technical trends applicable to our products and ensuring that our products adapt to the challenges of traditional and new markets. The close and intense co-operation between the departments of Marketing & Sales, Research & Development, and Production has become the keystone of our success. ELECTRONICON constantly strives for similarly close and interactive relationships with her sales partners and direct customers at home and abroad, so that we are not just one of many suppliers, but your preferred partner for ideas and solutions.

ELECTRONICON®

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Fon +49 365 / 734 61 00 • Fax +49 365 / 734 61 10
E-Mail: sales@electronicon.com, www.electronicon.com





E57 / E59 / SR17™

AC AND DC CAPACITORS
WITH LARGE CAPACITANCES



STANDARD OR SPECIAL – YOUR CHOICE

ELECTRONICON®
always in charge

Choose the best capacitor for any of your power electronics applications:

AC and DC capacitors with integrated safety mechanism

E62 AC/DC E62-3ph AC Filter E63 DC

Low-inductance capacitors

E50 PK16™ DC E53 AC/DC E61 DC E67 Mesis®

Low-inductance High-voltage capacitors

E51

AC and DC capacitors with large capacitance

E59 AC/DC E70 AC E50.U SR17™ DC

CAPACITORS

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E59/SR17™

HEAVY CURRENT CAPACITORS FOR TRACTION, AUTOMOTIVE AND OTHER APPLICATIONS

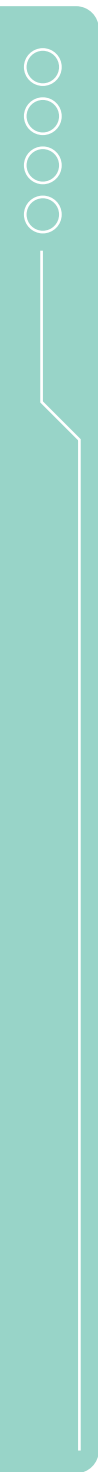
STARKSTROMKONDENSATOREN FÜR TRAKTION, ELEKTROMOBILITÄT UND
ANDERE ANWENDUNGEN

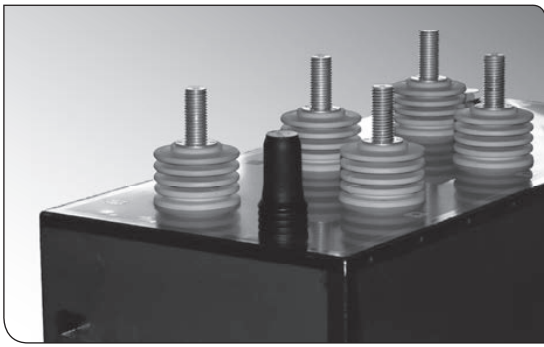
E57

LOW-INDUCTANCE CAPACITORS IN PLASTIC HOUSING

NIEDERINDUKTIVE KONDENSATOREN IM KUNSTSTOFFGEHÄUSE







Standard range or special design – large capacitances right as you will

Thanks to the special kind of films and coating patterns used in our E59-capacitors, clever winding geometries and refined internal construction, they combine large capacitance, very small self-inductance and high surge current sustaining capability (up to 1200kA) as well as the possibility of high rms currents (up to 1000A). Our standard sizes cover a capacitance range from 40000µF/500V and 53000µF/900V DC up to 1450µF 5000V DC. Custom-tailored designs can accommodate substantially higher ratings of capacitance and voltage: we can implement voltages up to 17kV AC/12kVrms and 25kV DC; the exact capacitance ratings depend on the user's specific requirements (see diagrams).

Instead of flat pack windings, our capacitance is formed by homogeneous cylindrical windings, avoiding the mechanical stress and instabilities at the edges of flat packs. The capacitors are housed in aluminium or steel cases and filled with solid resin which makes them absolutely dry and leakage-proof, and completely insensitive to mechanical shocks and vibration. Their size and shape, as well as terminals and fixing can be adapted to the individual requirements of our customers.

Special terminals allow for substantial reduction of the self-inductance which can be further minimized by construction adjustments if required. At the same time, the capacitors are extremely overvoltage-proof. They are especially suited for DC-link circuits of converters, tuned filter circuits and such like.

ELECTRONICON has long since abandoned segmented metallization in favour of its advanced SecuMet™ technology. Hence even at high operating temperatures, and after numerous self-healing dielectric breakdowns, the capacitance remains stable. An integrated pressure switch can be used for external monitoring of the internal pressure. It signals 0.5 atmospheres of pressure rise by opening (or optionally: closing) the contact, allowing for safe external disconnection in the event of overload or failure at the end of operating life.

Your Ideas - Our design

Very often, your application calls for specially adapted capacitors in terms of electrical performance, physical shape, mechanical fixation, and connection terminals. Please discuss your specification with our sales team or use the enquiry form for capacitors on our website at www.electronicon.com/en/support. The results of our joint research and development may become your specific part, confidential and not available to any third party.

Custom-designed to meet your requirements. Just ask.

Standard-Reihe oder spezielles Design – Große Kapazitäten ganz nach Ihren Wünschen

Die Kondensatoren der Serie E59 vereinen dank der in ihnen eingesetzten besonderen Folien, Beläge und Wickelgeometrien sowie ausgefeiltem Innenaufbau große Kapazität, niedrige Eigeninduktivität und hohe Stoßstromfestigkeit (bis zu 1200kA) sowie die Möglichkeit hoher Effektivströme (bis zu 1000A). Unsere Standardbaugrößen umfassen einen Kapazitätsbereich von 40000µF/500V DC bzw. 53000µF/900V DC bis 1450µF 5000V DC. In speziell auf die Anforderungen unserer Kunden abgestimmte Bauformen sind Spannungen bis 17kV AC/12kV rms und 25kV DC realisierbar; die dabei erreichbaren Kapazitätswerte sind abhängig von den detaillierten Anforderungen des Anwenders (vgl. Diagramme).

Anstelle von Flachwickel-Paketen bilden wir die Kapazität mittels homogener zylindrischer Wickel, unter Vermeidung der für Flachwickel typischen starken mechanischen Beanspruchung und Instabilität an den Knickstellen. Die Kondensatoren sind wahlweise in Stahl- oder Aluminiumgehäusen untergebracht und mit ausgehärtetem Harz gefüllt, dadurch vollkommen trocken und auslaufsicher sowie unempfindlich gegenüber mechanischen Stößen und Vibrationen. Größe und Form sowie Anschlüsse und Befestigungsart können den jeweiligen Forderungen unserer Kunden individuell angepasst werden.

Durch spezielle Flachanschlüsse wird die Eigeninduktivität deutlich reduziert und kann auf Kundenwunsch durch weitere konstruktive Anpassungen zusätzlich minimiert werden. Die Kondensatoren sind darüber hinaus außergewöhnlich überspannungsfest. Damit eignen sie sich besonders für Saug- und Zwischenkreise von Umrichtern, Filterkreise u.ä.

ELECTRONICON hat schon vor langem zugunsten ihrer innovativen SecuMet™ Technologie auf die traditionelle Segmentmetallisierung verzichtet. Dadurch bleibt die Kapazität unserer Kondensatoren auch bei hohen Betriebstemperaturen und nach verstärkten Selbstheilvorgängen nahezu konstant. Ein integrierter Druckschalter spricht bei 0,5 bar Druckerhöhung an und öffnet (optional: schließt) einen Kontakt; damit ermöglicht er die zuverlässige Überwachung des Innendrucks und eine sichere Abschaltung bei Überlastung bzw. Ausfall am Ende der Lebensdauer.

Ihre Ideen - unser Design

Häufig verlangt Ihre Anwendung in Bezug auf elektrische Leistungsfähigkeit, physische Form, Befestigung oder Anschluss nach speziell angepassten Komponenten. Bitte besprechen Sie Ihre Spezifikation mit unserem Vertrieb oder nutzen Sie unser Anfrageformular unter www.electronicon.com/support. Die Ergebnisse unserer gemeinsamen Arbeit können zu Ihrem speziellen Produkt werden, vertraulich und Dritten unzugänglich.

Maßgeschneidert nach Ihren Wünschen. Fragen Sie einfach.



The Most Efficient Protection Device: Pressure Switch

The failure of self-healing capacitors is usually accompanied by the thermal disintegration of dielectric material, causing a gradual rise of the internal pressure. The period during which such rise of pressure can happen ranges from several seconds to hours or days. Since the dissipation products of polypropylene contain explosive organic gasses, a controlled pressure relief into the surrounding atmosphere, e.g. through pressure disks or relief valves, may often be very hazardous. Another option – watching pressure seals for an early mechanical indication of upcoming trouble – may prove problematic as well since in order to be reliable, such optical monitoring would require high rates of maintenance which are usually not available in real life.

The pressure switch offered as standard for our capacitors in hermetical housing detects the rise of internal pressure and provides a signal which shall be used by an external safety circuit for immediate and irreversible de-activation of the capacitor. With its SPDT (Single Pole, Double Throw) change-over contact, the pressure switch can be used as an NO or NC option, and the signal may even be counter-monitored in order to rule out false alarm.

The switch is located on the top side and may point upwards or sideways if required by the customer's connection scheme. On capacitors with rated voltages above 12kV, the device is placed at the base of the case to avoid interference with adjacent live parts.

Die effizienteste Schutzeinrichtung: Druckschalter

Der Ausfall selbstheilender Kondensatoren geht in der Regel mit einer thermischen Zersetzung dielektrischer Materialien und einem schrittweisen Druckanstieg im Kondensatorinneren einher. Dies kann sich über einige Sekunden bis hin zu Stunden oder sogar Tage erstrecken. Da die Zersetzungsprodukte von Polypropylen explosive organische Gase enthalten, kann ein gezieltes Ablassen des Überdruckes in die umgebende Atmosphäre, zum Beispiel über Druckscheiben oder Überdruckventile, in vielen Situationen sehr riskant sein. Eine andere Option – das gezielte Beobachten von hermetischen Siegeln zum Zwecke einer frühzeitigen Erkennung aufkommender Probleme – erscheint ebenfalls schwer realisierbar, da eine solche optische Überwachung, um wirkungsvoll zu sein, sehr kurze Wartungszyklen erfordern würde, die in der Praxis kaum realisierbar sind.

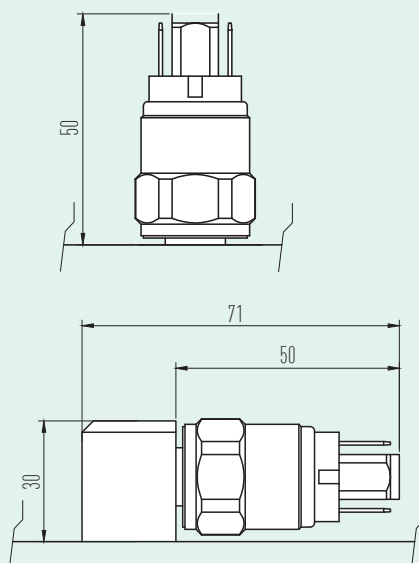
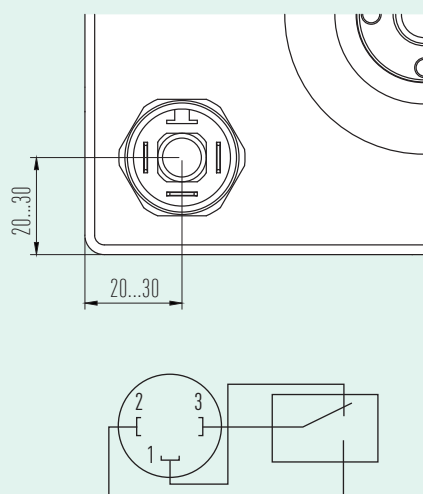
Der für unsere hermetischen Kondensatoren als Standard angebotene Druckschalter erkennt den Anstieg des Druckes im Kondensatorinneren und liefert ein Signal, welches durch eine externe Sicherheitsschaltung für die unverzügliche und irreversible Abschaltung des Kondensators genutzt werden kann. Mit seinem SPDT (Single Pole, Double Throw)-Wechsler kann der Schalter als NO oder NC Schalter genutzt werden, und das Signal kann sogar gegengeprüft werden, um Fehlalarm auszuschließen.

Der Schalter wird auf der Oberseite des Kondensators angebracht und kann entweder senkrecht oder horizontal ausgerichtet werden. Bei Kondensatoren mit Nennspannungen über 12kV wird der Schalter am unteren Ende des Kondensators angebracht, um Beeinträchtigungen benachbarter spannungsführender Teile zu vermeiden.

TECHNICAL DATA TECHNISCHE DATEN

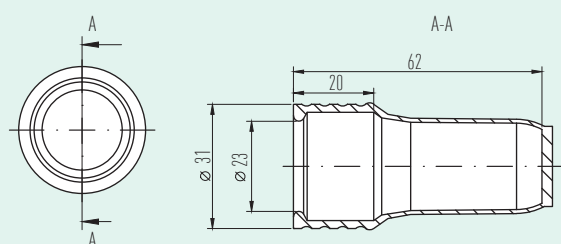
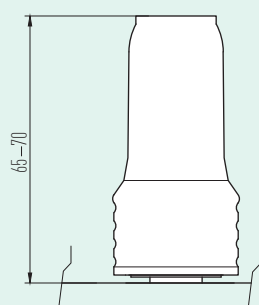
Material	stainless steel Edelstahl
Measuring principle Messprinzip	spring loaded diaphragm (rubber, optional: stainless steel) federgespanntes Diaphragma (Gummi, optional: Edelstahl)
Standard setting Standardeinstellung	0.5 bar (other values on request) (andere Werte auf Anfrage)
Hysteresis Hysterese	ca. 0.15 bar
Shock resistance Stoßbeständigkeit	30g
Vibration resistance (10...20000Hz) Vibrationsbeständigkeit (10...20000Hz)	10g
Terminals Anschlüsse	6.3 × 0.8 mm tabs, stainless steel Flachstecker, Edelstahl
Internal contacts innere Kontakte	brass, silver or gold plated depending on intended monitoring voltage Messing, silber- oder goldbeschichtet (je nach geplanter Überwachungsspannung)
Rated switch power Schaltleistung	
inductive load induktive Last	max. 2A/250Vrms, 1A/24V DC
ohmic load ohmsche Belastung	max. 4A/250Vrms, 2A/24V DC

Dimension Drawings Maßbilder



Accessories Zubehörteile

Dimension Drawings Maßbilder



IP54 protective cap (NBR) Schutzkappe (Nitrilkautschuk)
Order No. Bestell-Nr. 07237.061-03.9

E59.***

AC/DC

200V...17kV AC/500V...25kV DC

Custom designed AC/DC capacitors in rectangular case
Kundenspezifische AC/DC-Kondensatoren in eckigem Gehäuse



TECHNICAL DATA TECHNISCHE DATEN

Standards	IEC 61071, optional IEC 61881, customer standards kundenspezifische Standards
Available voltages Verfügbare Nennspannungen U_N	500...25000V DC 200...17000V AC
insulation level Isolationspegel BIL	up to 28/75 kV
insulation quality Isolationsgüte $C \times R_{is}$	>25000 s
rms current Effektivstrom I_{max}	up to 1000A
surge current Stoßstrom I_s	up to 1200kA
capacitance layout Kapazitätsanordnung	single, double, multiple as per customer request einzeln, zwei- oder mehrfach nach Kundenforderung
C_N tolerance Toleranz	±10% (lower tolerances on request_engere Toleranzen auf Anfrage)
self inductance Eigeninduktivität L_g	ca. 20...200 nH (other values on request_andere Werte auf Anfrage)
dielectric loss factor Verlustfaktor Dielektrikum $\tan\delta_0$	2×10^{-4}
storage temperature Lagertemperatur	-55 ... +85°C
operating temperatures Grenztemperaturen	
$\theta_{min} \dots \theta_{max}^*$	-55 ... +85°C
$\theta_{HOTSPOT}$	≤ 85°C
* ambient temperature_Umgebungstemperatur	
Humidity Luftfeuchte	≤ 95% (Climatic class Klimaklasse C)
Altitude a.s.l. Höhe ü.N.N.	≤ 4000m

Statistical life expectancy statistische Lebensdauer	>200 000 h
Failure rate Ausfallrate *	300 FIT (lower values on request_niedrigere Werte auf Anfrage)

* valid for a reference period of 100 000 hours_gültig für einen Betrachtungszeitraum von 100 000 Stunden

can Gehäuse	stainless steel/aluminium Edelstahl/Aluminium
insulation agent Füllmittel	solid polyurethane, non-PCB ausgehärtet, Polyurethan, PCB-frei
mounting position Einbaulage	optional beliebig
fire load Brandlast	35 MJ/kg
protection Sicherung	pressure switch for external monitoring of the internal pressure (hermetical construction only) Druckschalter zur externen Überwachung des Innendrucks (nur hermetische Gehäuseversionen)

Material options

Our capacitors are available with enclosures made of

- 1.5mm stainless steel, shot-blasted, painted or untreated*
- 2mm aluminium, painted or untreated
- 1.5mm steel, painted

(*welding seams brushed against corrosion)

If not specified otherwise, holding brackets are offered as shown in the drawings below.

Materialvarianten

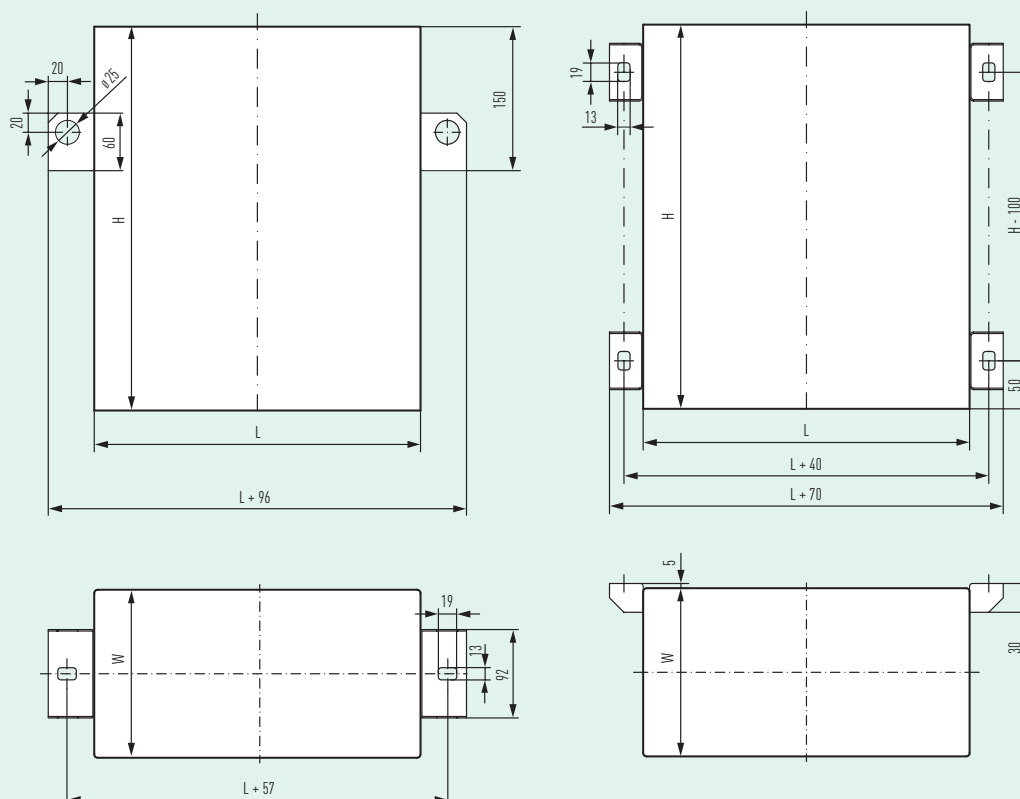
Unsere Kondensatoren können in den folgenden Materialvarianten geliefert werden:

- 1.5mm Edelstahl, gestrahlt, lackiert oder unbehandelt*
- 2mm Aluminium, lackiert oder unbehandelt
- 1.5mm Stahl, lackiert

(*Schweißnähte gegen Korrosion gebürstet)

Befestigungslaschen werden, falls nicht anders gewünscht, angeboten wie nachstehend aufgeführt.

Fixing Brackets Befestigungsoptionen



E59.***

AC/DC

200V...17kV AC/500V...25kV DC

Selection Charts

All our capacitors are designed individually according to the customer's requirements related to capacitance, connection and case material. The following diagrams show the biggest capacitance option available per case size. Case designs and terminal options can be selected on the following pages, or specified individually by the customer. Please discuss your specification with our sales team or use the enquiry form for power electronics capacitors on our website at www.electronicon.com/enquiry.

Note: These diagrams show approximate values only. The exact amount of capacitance per case size depends on multiple factors such as

- Details of the required case dimensions
- Sub-division into partial capacitances
- Current ratings
- Voltage ratings
- Reactive power (AC capacitors)
- Ambient conditions

Auswahldiagramme

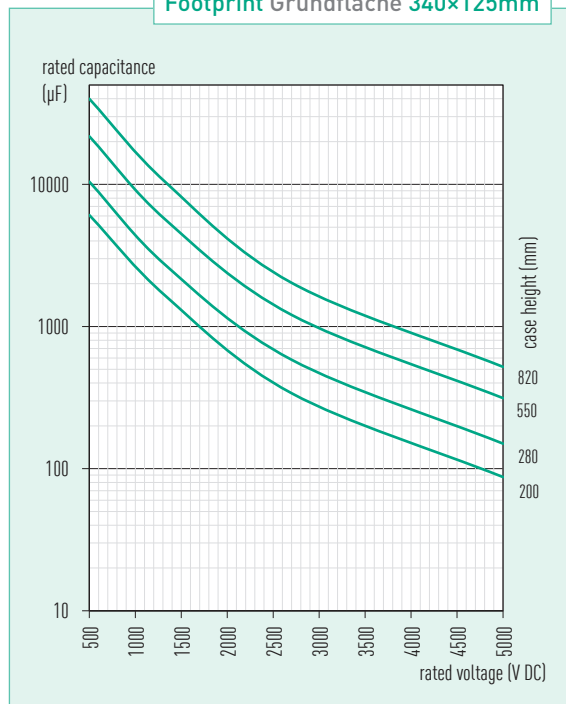
Die konkrete Ausführung für den gewünschten Kapazitätswert, die Anschlussform und das Bechermaterial wird je nach Kundenwunsch individuell gestaltet. Die Diagramme auf den folgenden Seiten zeigen die jeweils maximal mögliche Kapazität je Gehäusegröße. Auf den nachfolgenden Seiten können verschiedene Gehäuseformen und Anschlußoptionen gewählt werden. Bitte besprechen Sie Ihre Spezifikation mit unserem Vertrieb oder nutzen Sie unser Anfrageformular für Leistungselektronikkondensatoren unter www.electronicon.de/anfrage.

Achtung: Diese Diagramme zeigen nur ungefähre Werte. Der genau realisierbare Kapazitätswert pro Gehäuse hängt von mehreren Faktoren ab, wie

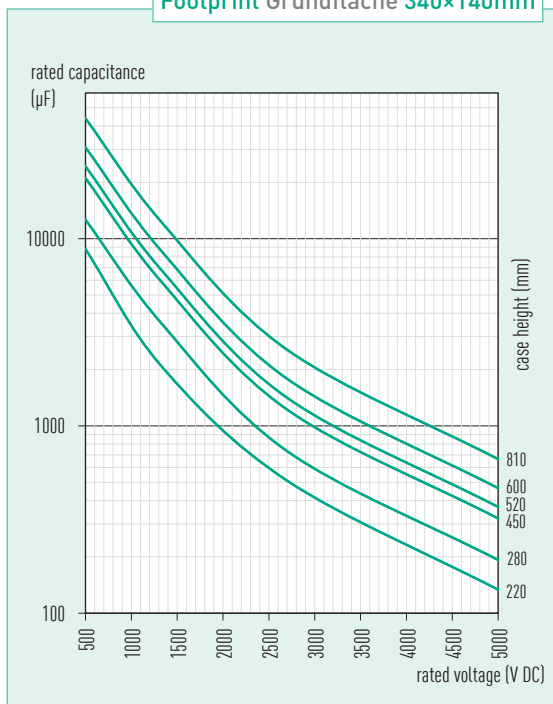
- Details der geforderten Gehäuseabmessungen
- Unterteilung in Teilkapazitäten
- Nennstrom
- Nennspannung
- Blindleistung (Wechselspannungsanwendungen)
- Umgebungsbedingungen

DC Capacitors Gleichspannungskondensatoren

Footprint Grundfläche 340×125mm



Footprint Grundfläche 340×140mm

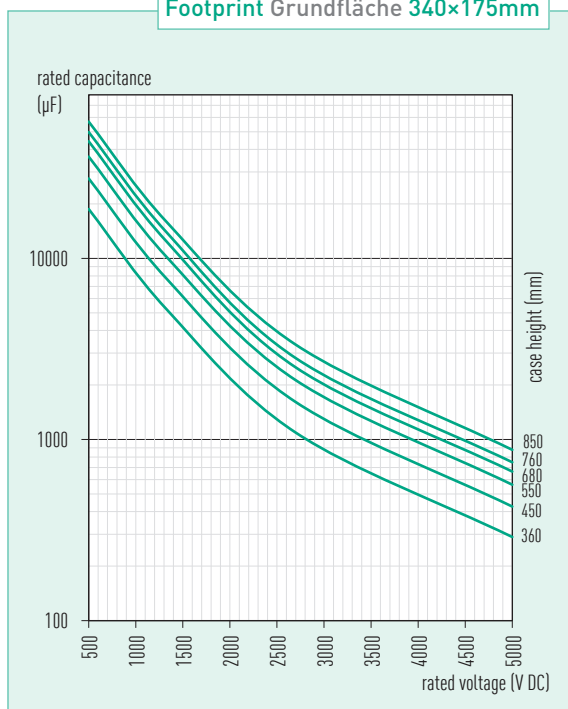


E59.***

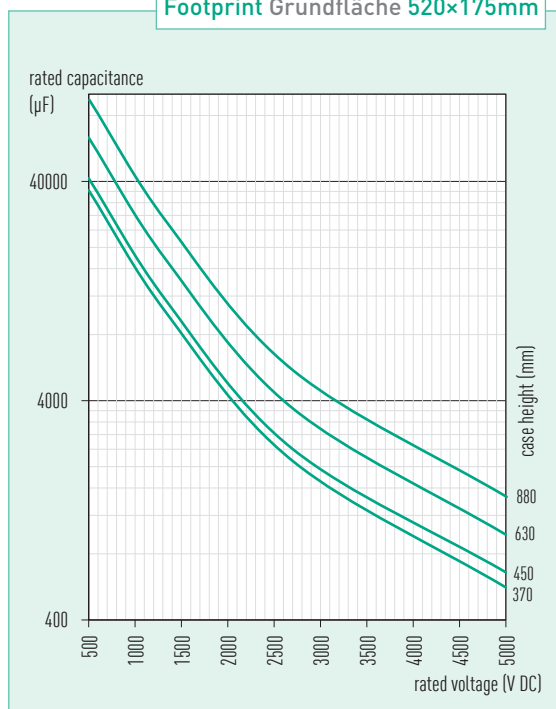
AC/DC

200V...17kV AC/500...25kV DC

Footprint Grundfläche 340×175mm



Footprint Grundfläche 520×175mm



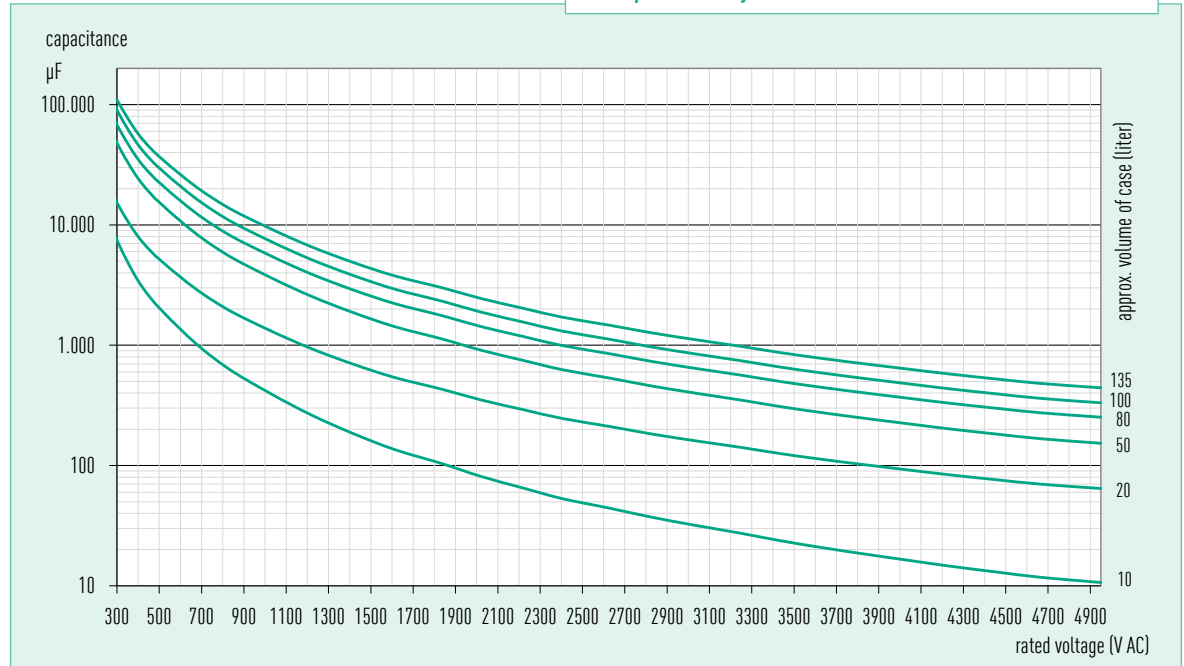
E59.***

AC/DC

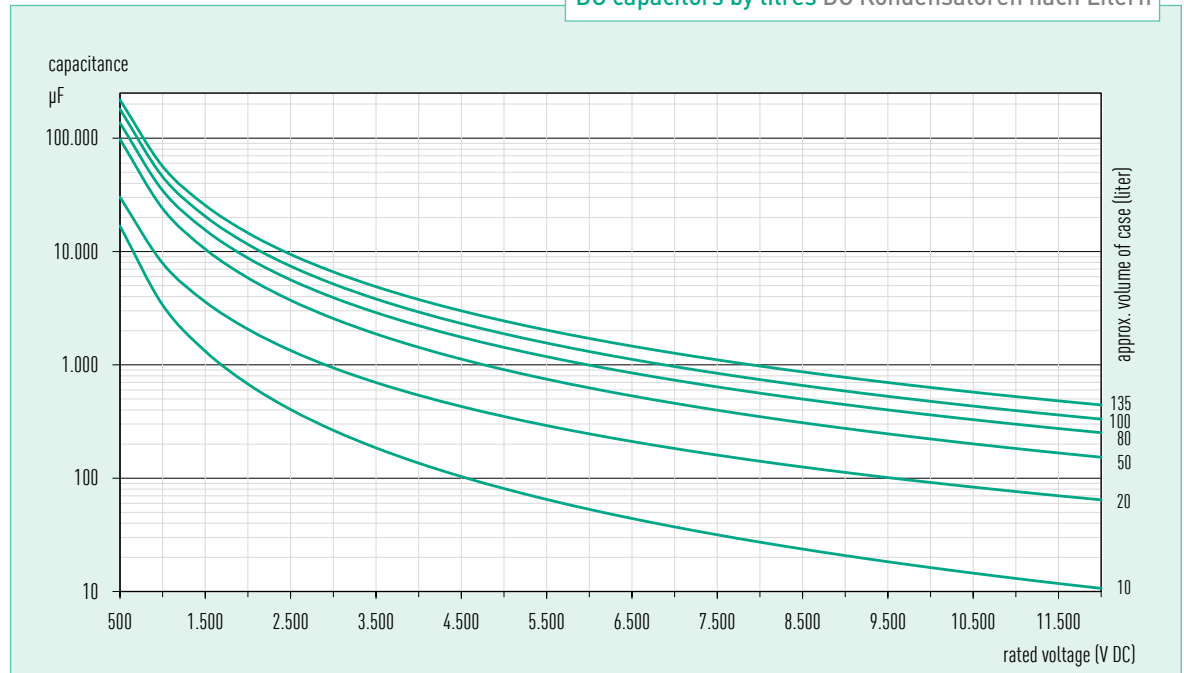
200V...17kV AC/500V...25kV DC

The following diagrams serve as an orientation of capacitance per volume when none of our standard footprints are acceptable.
Die folgenden Diagramme dienen als Orientierung, wenn keine unserer Standardgrößen akzeptabel sind.

AC capacitors by litres AC Kondensatoren nach Litern

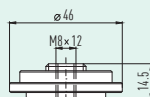
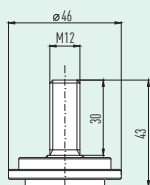


DC capacitors by litres DC Kondensatoren nach Litern

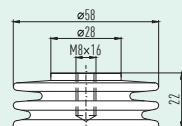
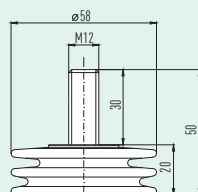


Terminal Options Anschlussvarianten

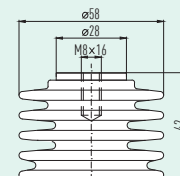
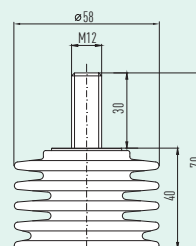
F1 (external and internal screw threads)



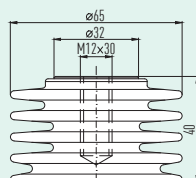
F4 (external and internal screw threads)



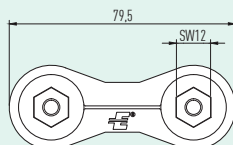
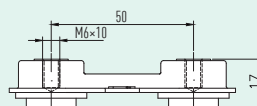
F5 (external and internal screw threads)



F6 (external and internal screw threads)



F8 (internal screw threads)



Type	creepage Kriechstrecke	clearance Luftstrecke	thread Gewinde	I _{max} *
F1	26 mm	17 mm	M12 × 30mm iM8 × 12mm	250 A 100 A
F4	60 mm	32 mm	M12 × 30mm M16 × 40mm iM8 × 16mm	250 A 315 A 100 A
F5	129 mm	51 mm	M12 × 30mm M16 × 40mm iM8 × 16mm	250 A 315 A 100 A
F6	140 mm	51 mm	iM12 × 30mm	250 A
F8	34 mm	22 mm	iM6 × 10mm	63 A

* rms, permanent (Terminals_Anschlüsse)

E57.***
DC

E57 Designed to match: Custom-tailored DC capacitors optimized for use with standard IGBT modules

Our E57 range comprises standard as well as custom-tailored solutions which can be adapted to the specific geometrical and electrical requirements of your application environment.

Connection is made through brass terminals or copper bars which may vary in number, size and position according to your specifications.

The UL:V0 plastic case houses compact and stable cylindrical windings, connected in parallel for maximum current strength and lowest possible self-inductance; it is filled with polyurethane resin, covered by a layer of UL94:V0 compliant resin protecting the winding package from humidity.

Our highly reliable SecuMet™ film guarantees secure self-healing properties even under the most demanding operating conditions. Some of our E57 capacitors can be operated at ambient temperatures up to 105°C and are therefore suitable for usage in automotive and other critical applications.

Important notice

Our capacitors are made with self-healing dielectric. Self-healing breakdowns become less likely, or impossible, under high thermal or electrical overstress. The disintegration of the polypropylene dielectric may produce more or less amounts of gas accompanied by a build-up of internal pressure. Very frequent and large-scale occurrence of self-healing breakdowns (e.g., as a result of strong voltage overstrain) may cause a gradual rise of the internal pressure as well.

For the sake of lowest available self-inductance and maximum mounting comfort, the capacitors of our E57 range are not equipped with an integrated safety mechanism, and a pressure switch cannot be used for capacitors in a plastic housing.

They should therefore not be operated beyond their rated values and be allocated in uncritical environment (non-flammable materials) where the release of flammable organic gases or an ignition of the polypropylene cannot cause consequential damage.

E57 Kundenspezifische DC-Kondensatoren, optimiert für den Einsatz mit Standard- IGBT-Modulen

Unsere E57-Reihe bietet sowohl Standardlösungen als auch spezielle Designs, welche sich den geometrischen und elektrischen Anforderungen Ihrer Anwendung anpassen.

Der Anschluß erfolgt über Messinganschlüsse oder Kupferlaschen, welche je nach Ihrer Spezifikation in Anzahl, Größe und Position variieren.

Das UL:V0-Kunststoffgehäuse beherbergt kompakte und formstabile Rundwickel, parallelgeschaltet für höchste Stromfestigkeit und minimale Eigeninduktivität. Für Schutz vor Umwelteinflüssen und Flammenschutz sorgen die PU-Harz-Füllung und ein UL94:V0-gerechtes Deckharz.

Unsere hochzuverlässige SecuMet™-Folie garantiert eine ordnungsgemäße Selbstheilung auch unter extremsten Einsatzbedingungen. So können einige unserer E57 Kondensatoren bei Umgebungstemperaturen von bis zu 105°C betrieben werden und eignen sich damit auch für Anwendungen der Automobilbranche und anderer kritischer Bereiche.

Wichtiger Hinweis

Alle in unseren Kondensatoren verwendeten dielektrischen Strukturen sind selbstheilend. Der zuverlässige Ablauf selbstheilender Durchschläge kann jedoch durch hohe thermische oder elektrische Belastung beeinträchtigt oder verhindert werden. Sich zersetzendes Polypropylen erzeugt dann größere Mengen an Gas und der Innendruck im Kondensator steigt. Gleichermaßen können großflächig auftretende Durchschläge (z.B. infolge starker Überspannung) einen starken Anstieg des Innendrucks verursachen.

Zum Zwecke niedrigster Eigeninduktivität und maximalen Einbaukomforts verfügen die Kondensatoren der E57-Reihe nicht über einen internen Sicherheitsmechanismus, und die Verwendung eines Druckschalters ist für Kondensatoren im Kunststoffgehäuse nicht möglich.

Sie sollten daher nicht außerhalb ihrer zulässigen Nennwerte betrieben und stets in unkritischer Umgebung (nichtentflammbare Materialien) platziert werden, wo die Freisetzung entzündlicher organischer Gase bzw. eine Entzündung des Dielektrikums keine schwerwiegenden Folgeschäden verursachen können.





DC capacitors in rectangular plastic case
DC-Kondensatoren in eckigem Kunststoffgehäuse

Standards IEC 61071:2007,
optional: IEC 61881:2010

can Gehäuse	Plastic (UL94:V0)
terminals	copper kupfer
mounting position Einbaulage	optional beliebig
filling material Füllmittel	PUR (solid fest)

internal protection interne Sicherungnone keine

fire load Brandlast 40 MJ/kg



C_N tolerance Toleranz	$\pm 10\%$
$\tan \delta_0$	2×10^{-4}

operating temperatures Betriebstemperaturen

$\theta_{\min}$... $\theta_{\max}$ -40 ... 105°C

θ_{HOTSPOT} $\leq 70^{\circ}\text{C} \dots 105^{\circ}\text{C}$
(see derating curve_siehe Kurve "Derating")

Humidity Class Feuchtekategorie.....T1 (IEC 62498-1)

storing temperature Lagertemperatur -40 ... +105°C

statistical lifetime statistische Lebensdauer> 100 000h

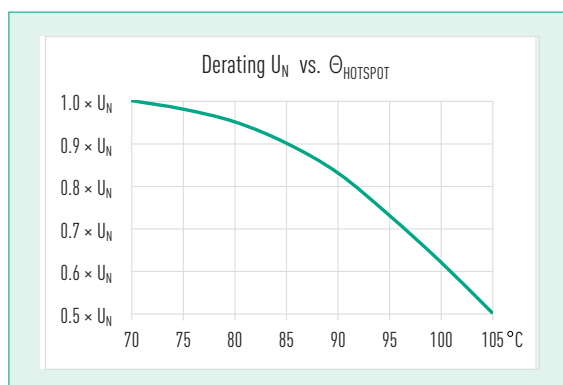
failure rate Ausfallrate.....100 FIT

(reference service period_Referenzbetriebsdauer 100000 h, $\theta_{\text{HOTSPOT}} \leq 70^{\circ}\text{C}$)

U _N DC (V)	C _N (µF)	U _r (V)	U _s (V)	U _{BB} DC (V)	R _s (mΩ)	R _{th} (K/W)	I _{max} A	î kA	I _s kA	L _e nH	m (kg)	order no. Bestell-Nr.
500	800	50	750	750	0.4	3	90	2.5	15	35	1.2	E57.A07-804020
700	650	50	1050	1050	0.5	3	80	2.5	15	35	1.2	E57.A07-654020
900	450	100	1350	1350	0.5	3	80	2.5	15	35	1.2	E57.A07-454020
1000	350	100	1500	1500	0.5	3	80	2.5	15	35	1.2	E57.A07-354020
1250	240	100	1875	1875	0.6	3	75	2.5	11	95	1.2	E57.A07-244020
1300	220	100	1950	1950	0.6	3	75	2.5	11	95	1.2	E57.A07-224020
1400	180	100	2100	2100	0.5	3	80	2.5	10	35	1.2	E57.A07-184020

Other ratings and terminal options available on request.

Andere Nennwerte und Anschlussvarianten auf Anfrage erhältlich.

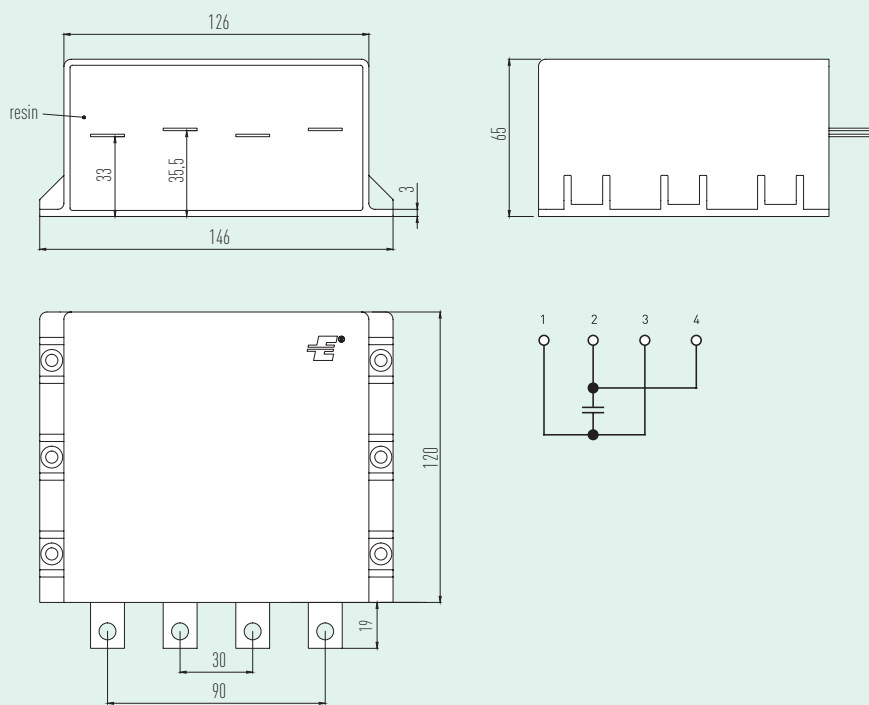




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E57.A07
DC
500 ... 1400V DC

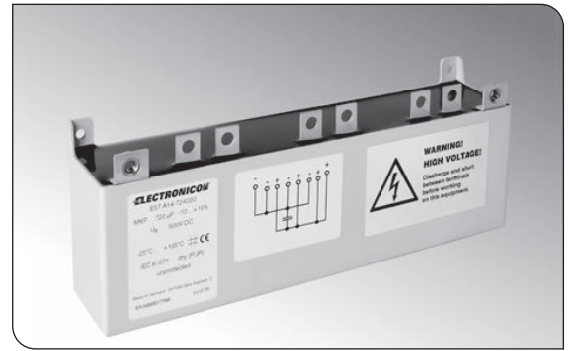
Dimension Drawings Maßbilder



Can material glas-fibre reinforced plastic, UL94-V0
Fixing holes brass sleeve Ø 5mm
Terminals tinned copper bars
I_{max} (Terminals) 45 A
Degree of Protection IP00

Gehäusematerial glasfaserverstärkter Kunststoff UL94-V0
Befestigungslöcher Messinghülse Ø 5 mm
Anschlüsse Kupferlaschen, verzinkt
I_{max} (Anschlüsse) 45 A
Schutzgrad IP00

E57.A14
DC
500...1300V DC



DC capacitors in rectangular plastic case
DC-Kondensatoren in eckigem Kunststoffgehäuse

Standards IEC 61071:2007,
optional: IEC 61881:2010

can Gehäuse Plastic (UL94-V0)
terminals copper kupfer
mounting position Einbaulage optional beliebig
filling material Füllmittel PUR (solid fest)

internal protection interne Sicherung none keine

fire load Brandlast 40 MJ/kg



C_N tolerance Toleranz $\pm 10\%$
 $\tan \delta_0$ 2×10^{-4}

operating temperatures Betriebstemperaturen

$\theta_{min} \dots \theta_{max}$ $-40 \dots 105^\circ\text{C}$
 $\theta_{HOTSPOT}$ $\leq 70^\circ\text{C} \dots 105^\circ\text{C}$
(see derating curve_siehe Kurve "Derating")

Humidity Class Feuchtekategorie T1 (IEC 62498-1)

storing temperature Lagertemperatur $-40 \dots +105^\circ\text{C}$

statistical lifetime statistische Lebensdauer $> 100\,000\text{h}$

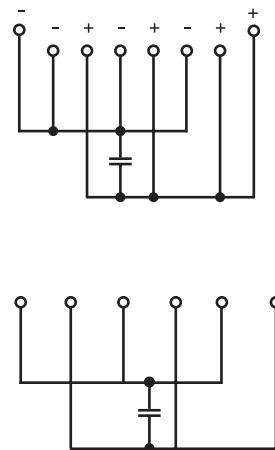
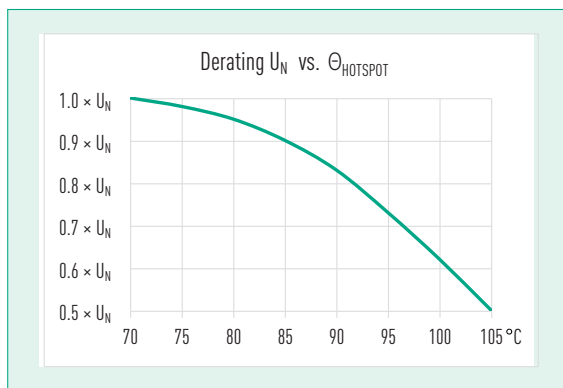
failure rate Ausfallrate 100 FIT

(reference service period_Referenzbetriebsdauer 100000 h, $\theta_{HOTSPOT} \leq 70^\circ\text{C}$)

U_N DC (V)	C_N (μF)	U_r (V)	U_s (V)	U_{BB} DC (V)	R_s (m Ω)	R_{th} (K/W)	I_{max} A	$\hat{I}$ kA	I_s kA	L_e nH	m (kg)	order no. Bestell-Nr.
450	550	50	600	675	0.6	2.8	120	2	8	15	1.2	E57.A14-554010
500	720	50	600	750	0.6	2.8	120	1.1	3.3	25	1.2	E57.A14-724010
900	410	50	1350	1350	0.6	2.8	120	2	8	25	1.2	E57.A14-414010
1300	200	100	1950	1950	0.6	2.2	120	2	8	25	1.2	E57.A14-204010

Other ratings and terminal options available on request.

Andere Nennwerte und Anschlussvarianten auf Anfrage erhältlich.



Additional in and output terminals can be added on request.

Zusätzliche Ein- und Ausgangsklemmen können auf Anfrage hinzugefügt werden.

Can material glas-fibre reinforced plastic, UL94-V0

Terminals tinned copper bars

I_{max} (Terminals) 45 A

Degree of Protection IP00

Gehäusematerial glasfaserverstärkter Kunststoff UL94-V0

Anschlüsse Kupferlaschen, verzinkt

I_{max} (Anschlüsse) 45 A

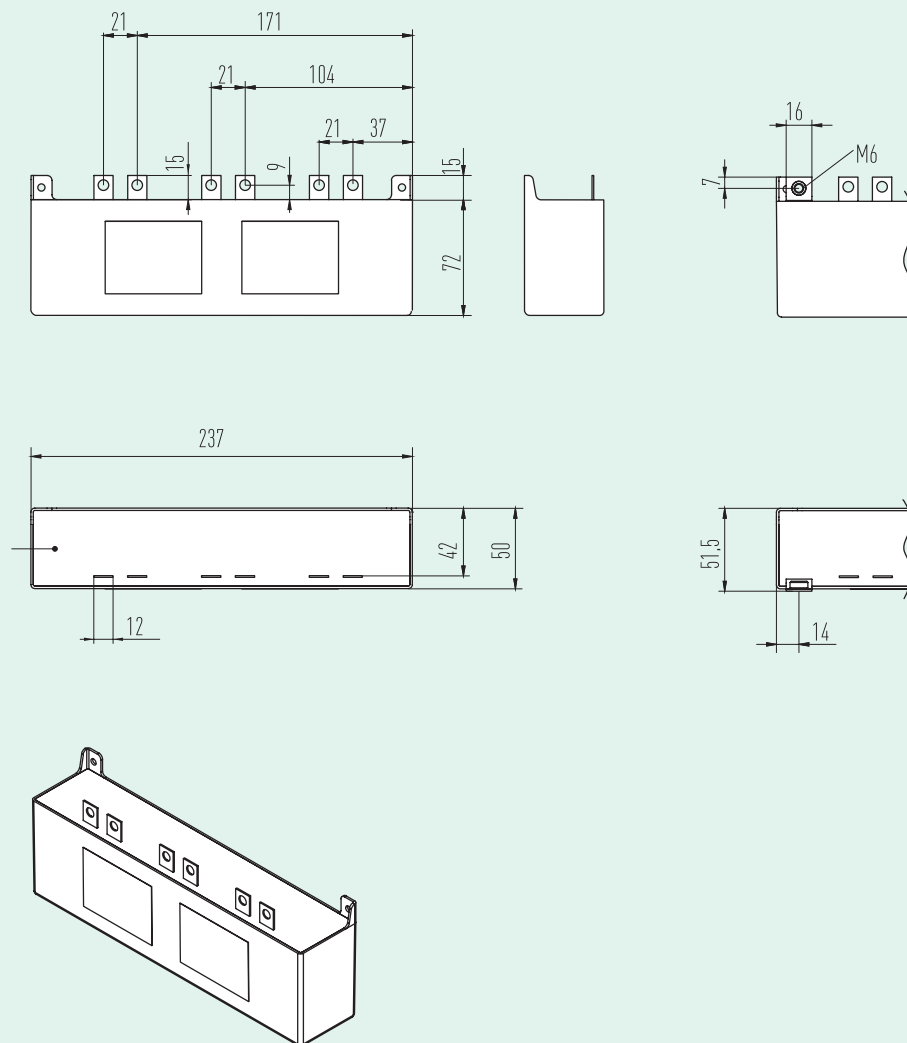
Schutzgrad IP00



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E57.A14
DC
500 ... 1300V DC

Dimension Drawings Maßbilder



E57.A12 (Substitute LNK-P5X)

DC
650 ... 4200V DC



DC capacitors compatible with ICAR LNK-P5X
DC-Kondensatoren kompatibel mit ICAR LNK-P5X

Standards IEC 61071:2007
optional: IEC 61881:2010
can Gehäuse Plastic (UL94:V0)
mounting position Einbaulage optional beliebig
filling material Füllmittel PUR (solid fest)
internal protection interne Sicherung none keine
fire load Brandlast 40 MJ/kg

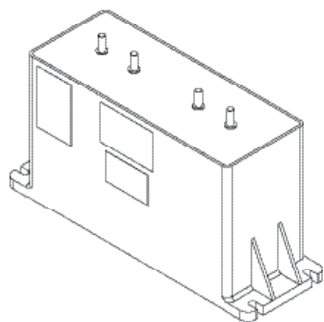


C_N tolerance Toleranz $\pm 10\%$
 $\tan \delta_0$ 2×10^{-4}
operating temperatures Betriebstemperaturen
 $\theta_{min} \dots \theta_{max}$ $-25 \dots 85^\circ\text{C}$
 $\theta_{HOTSPOT}$ $\leq 85^\circ\text{C}$
Humidity Class Feuchteklasse T1 (IEC 62498-1)
storing temperature Lagertemperatur $-40 \dots +85^\circ\text{C}$
statistical lifetime statistische Lebensdauer $> 100\,000\text{h}$
failure rate Ausfallrate 100 FIT
(reference service period_Referenzbetriebsdauer 100000 h, $\theta_{HOTSPOT} \leq 70^\circ\text{C}$)

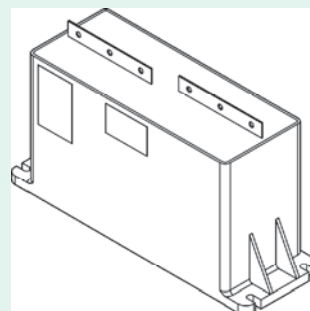
U_N DC (V) $\leq$	C_N (μF)	U_R (V)	U_S (V)	U_{BB} DC (V)	R_S (m Ω)	R_{th} (K/W)	I_{max} (A)	$\hat{I}$ (kA)	I_S (kA)	L_e (nH)	m (kg)	order no. Bestell-Nr.
650	10000	100	975	975	0.2	1.3	300	10	40	40	16	E57.A12-1060xx
800	8000	150	1200	1200	0.3	1.3	200	10	40	40	16	E57.A12-8050xx
900	5000	200	1350	1350	0.34	1.3	150	10	40	40	16	E57.A12-5050xx
1000	4000	200	1500	1500	0.26	1.3	210	10	40	40	16	E57.A12-4050xx
1100	5500	200	1650	1650	0.25	1.3	250	30	80	45	16	E57.A12-5550xx
1200	4500	200	2000	1800	0.31	1.3	210	10	40	40	16	E57.A12-4550xx
1300	3600	200	1950	1950	0.31	1.3	200	10	40	40	16	E57.A12-3650xx
1750	2150	200	2625	2625	0.31	1.3	200	10	40	40	16	E57.A12-2150xx
2100	1500	200	3600	3300	0.35	1.3	200	10	40	40	16	E57.A12-1551xx
2200	1300	200	3600	3300	0.35	1.3	200	10	40	30	16	E57.A12-1350xx
2600	900	200	3900	3900	0.35	1.3	180	8	35	40	16	E57.A12-9040xx
3000	700	170	4500	4500	0.38	1.3	200	7	30	40	16	E57.A12-7040xx
3200	500	200	4800	4800	0.38	1.3	200	7	30	40	16	E57.A12-5040xx

Other ratings and terminal options available on request.
Andere Nennwerte und Anschlussvarianten auf Anfrage erhältlich.

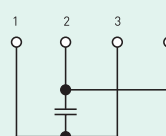
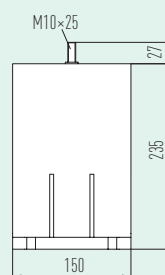
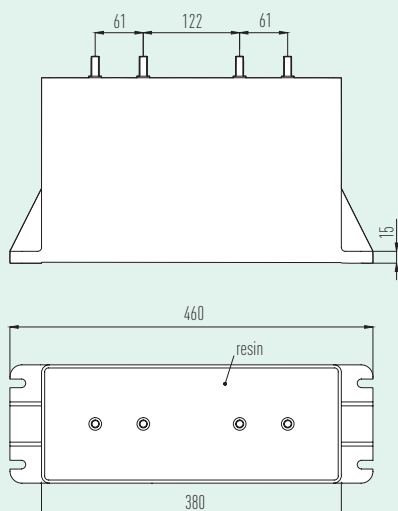
xx = 20



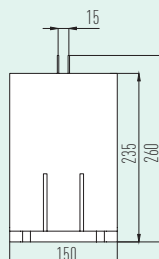
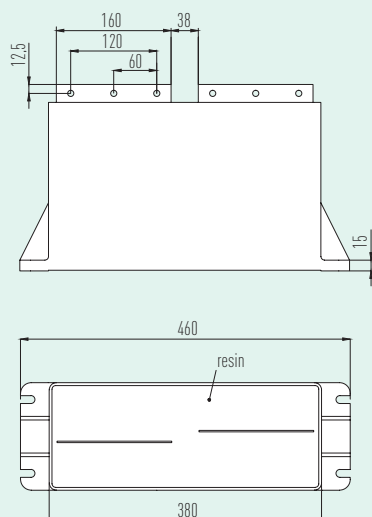
xx = 10



Dimension Drawings Maßbilder

xx = 20

Clearance in air Luftstrecke 45 mm
Creepage distance Kriechstrecke 45 mm

xx = 10

Clearance in air Luftstrecke 38 mm
Creepage distance Kriechstrecke 38 mm

Can material glas-fibre reinforced plastic, UL94-V0
 Terminals **xx=10** tinned copper bars
 xx=20 threaded studs, tinned brass M10 × 25
 $I_{\max}$ (Terminals) **xx=10** 300 A
 xx=20 160 A
 Degree of Protection IP00

Gehäusematerial glasfaserverstärkter Kunststoff UL94-V0
 Anschlüsse **xx=10** Kupferschienen, verzinkt
 xx=20 Gewindebolzen, Messing verzinkt M10 × 25
 $I_{\max}$ (Terminals) **xx=10** 300 A
 xx=20 160 A
 Schutzgrad IP00

DC
700...2100V DC



C_N tolerance Toleranz $\pm 10\%$
 $\tan \delta_0$ 2×10^{-4}

operating temperatures Betriebstemperaturen

$\vartheta_{\min}$... $\vartheta_{\max}$ -40 ... 85°C

$\vartheta_{\text{HOTSPOT}}$ $\leq 85^\circ\text{C}$

Humidity Class Feuchtklasse T1 (IEC 62498-1)

storing temperature Lagertemperatur -40 ... +85°C

statistical lifetime statistische Lebensdauer > 100 000h

failure rate Ausfallrate..... 100 FIT

(reference service period Referenzbetriebsdauer 100000 h, $\theta_{\text{HOTSPOT}} \leq 70^\circ\text{C}$)[illegible]

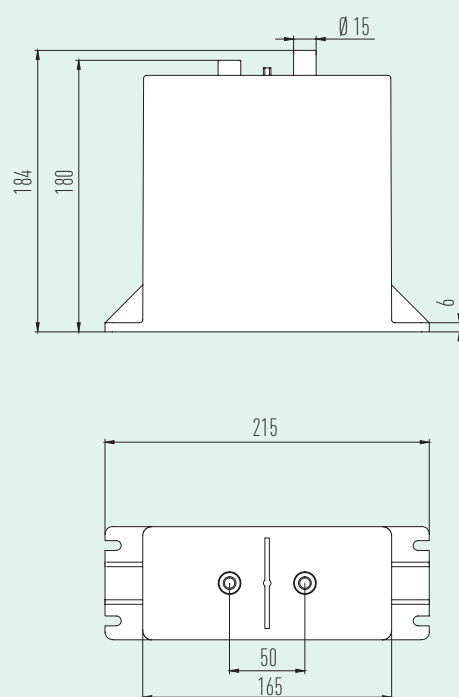
Andere Nennwerte und Anschlussvarianten auf Anfrage erhältlich.



E57.A40 (Substitute LNK-P7X)

DC
700...2100V DC

Dimension Drawings Maßbilder



Clearance in air Luftstrecke 35 mm
Creepage distance Kriechstrecke 45 mm

Can material..... glass-fibre reinforced plastic, UL94-A0
Terminals..... tinned brass, internal thread M8 × 10
I_{max} (Terminals) 160 A
Degree of Protection IP00

Gehäusematerial glasfaserverstärkter Kunststoff UL94-A0
Anschlüsse Messing verzinkt, Innengewinde M8 × 10
I_{max} (Terminals) 160 A
Schutzgrad IP00



CYLINDRICAL TRACTION CAPACITORS

The dedicated retrofit for SIEMENS B25353

The capacitors of our SR17™ series were developed especially for the maintenance of older traction converters manufactured in the 1970s...1990s. By consequent development of our well-proven MKP-technologies, we managed to place self-healing DC-capacitors with very high energy density and stability of capacitance into can dimensions smaller than, or identical to, those of the traditional MP-capacitors (SIEMENS/EPCOS codes B25353), which makes them ideal drop-in replacements for maintenance and retrofit programs. Moreover, the low-loss polypropylene dielectric and the large safety margins permit a far higher AC ripple load than available with the conventional MP-capacitors.

Our SR17™ are housed in a hermetical stainless steel cylinder. As opposed to the oil-filled MP-models, these are filled with an eco-friendly solid resin which not only makes them safe against leakage of liquids but also insensitive to the shocks and vibrations common in traction applications. The same applies to their robust plastic insulators.

As a result, the SR17™ is not just new, but far more reliable, durable and less sensitive than the capacitor it replaces.

ZYLINDRISCHE BAHNKONDENSATOREN

Der passende Ersatz für SIEMENS B25353

Die Kondensatoren unserer SR17™ Serie wurden speziell für den Ersatzteilbedarf älterer Bahnumrichter aus den 1970er... 1990er Jahren entwickelt. Durch konsequente Weiterentwicklung bewährter MKP-Technologien können wir selbstheilende Gleichspannungskondensatoren mit sehr hoher Energiedichte und Kapazitätskonstanz in identische oder sogar geringere Gehäuseabmessungen platzieren als die traditionellen MP-Kondensatoren (SIEMENS/EPCOS Serie B25353), womit sie eine ideale Alternative für Instandhaltungs- und Austauschvorhaben darstellen. Durch das verlustarme Polypropylen Dielektrikum und die überaus großzügige Auslegung ist darüber hinaus eine wesentlich höhere Wechselspannungsbelastung als bei konventionellen MP-Kondensatoren möglich.

Die SR17™ sind in hermetisch dichten rostfreien Stahlzylindern untergebracht. Im Gegensatz zu den ölfüllten MP-Modellen sind sie mit umweltfreundlichem ausgehärteten Harz vergossen und dadurch nicht nur auslaufsicher, sondern auch unempfindlich gegen bahntypische Stöße und Vibrationen.

Dies gilt auch für die robusten Kunststoffisolatoren. Die SR17™ sind folglich nicht nur neu, sondern auch zuverlässiger, unempfindlicher und langlebiger als der Kondensator, den sie ersetzen.





for latest edition and updates
check www.powercapacitors.info

E50.U*** SR17™ DC 750...3600V DC

SR17™ DC Capacitors for Traction Applications SR17™ Gleichspannungskondensatoren für

Standards IEC 61071, IEC 61881

can Gehäuse stainless steel with welded lid
Edelstahl, eingeschweißter Deckel

mounting position Einbaulage... optional beliebig

filling material no liquids (PUR, non-PCB)

Füllmittel kein flüssiger Füllstoff, PU-Harz (PCB-frei)

internal protection none

interne Sicherung keine

fire load Brandlast 35 MJ/kg



C_N tolerance Toleranz ±10 / ±5

tanδ₀ 2 × 10⁻⁴

operating temperatures Grenztemperaturen

θ_{min} ... θ_{max} -40 ... +85°C

θ_{HOTSPOT} ≤ 85°C

storing temperature Lagertemperatur -40 ... +85°C

statistical lifetime statistische Lebensdauer > 200 000h

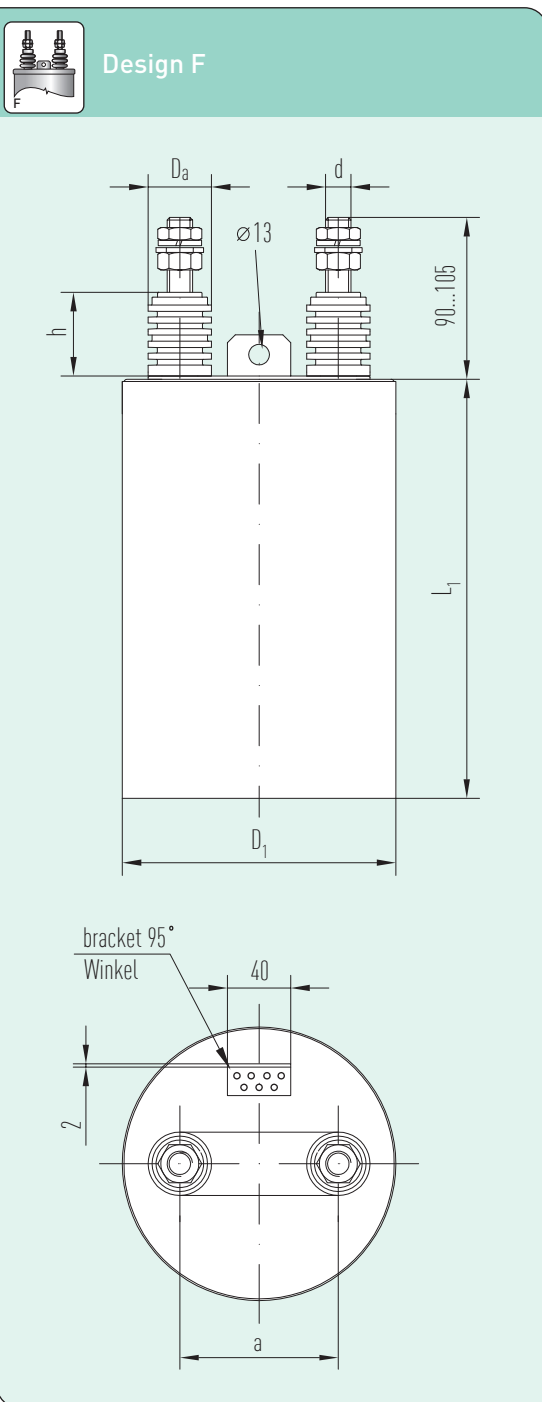
failure rate Ausfallrate DC 50 FIT

(reference service period_Referenzbetriebsdauer 150000 h, θ_{HOTSPOT} ≤ 70°C)

U _N DC (V)	C _N (μF)	U _r (V)	U _s (V)	U _{BB} (VDC/10s)	U _{BG} (VAC/10s)	R _{th} (K/W)	I _{max} (A)	İ (kA)	I _s (kA)	R _s (mΩ)	L _e (nH)	D ₁ × L ₁ (mm)	Design	m (kg)	order no. Bestell-Nr.
750	2550	200	1125	1130	4000	0.33	200	44	132	0.4	200	172 × 800	F7	21	E50.U80-255F70
1200	500	400	1800	1800	6000	0.9	120	23.2	60	0.3	120	172 × 300	F7	9	E50.U30-504F71
1200	1100	300	1800	1800	3000	0.5	200	17.5	52.5	0.42	120	172 × 518	F5	14	E50.U52-115F50
1200	1300	300	1800	1800	6000	0.5	200	19	57	0.41	120	172 × 518	F5	14	E50.U52-135F50
1200	1670	300	1800	1800	4000	0.33	200	32	96	0.41	200	172 × 800	F7	21	E50.U80-175F70
1300	1560	300	2000	1950	3000	0.5	200	22.8	68.4	0.44	120	172 × 518	F5	14	E50.U52-165F50
1600	725	500	2400	2400	12000	0.57	200	20	60	0.36	120	172 × 450	F5	12	E50.U45-734F50
1600	880	500	2400	2400	5000	0.5	150	16.1	48.3	0.7	120	172 × 518	F7	14	E50.U52-884F70
1600	1310	500	2400	2400	6500	0.33	200	29.4	105	0.41	200	172 × 800	F7	21	E50.U80-135F70
1600	1460	500	2400	2400	12000	1.9	200	10	110	0.45	200	172 × 800	F7	21	E50.U80-155F70
1800	757	180	2700	2700	5500	0.6	200	30	90	0.38	120	172 × 450	F5	12	E50.U45-764F51
2000	350	500	3000	3000	4200	0.86	200	19	58	0.35	120	172 × 300	F7	9	E50.U30-354F70
2100	430	550	3200	3150	4000	0.5	200	22.9	68.7	0.38	120	172 × 518	F5	14	E50.U52-434F50
2200	770	560	3300	3300	6000	1.9	200	26	80	0.4	120	172 × 800	F5	21	E50.U80-774F50
2300	230	500	3500	3450	4200	0.86	200	10	50	0.45	120	172 × 300	F7	9	E50.U30-234F70
2400	280	500	3600	3600	6000	0.5	200	17.1	51.3	0.3	120	172 × 518	F5	14	E50.U52-284F50
2650	443	450	4000	3975	11000	2.3	120	25	150	0.5	75	172 × 650	F3	17	E50.U65-444F31
2650	457	450	4000	3975	11000	2.3	120	25	150	0.5	75	172 × 650	F3	17	E50.U65-464F30
2650	630	450	4000	3975	11000	2.3	120	34	200	0.4	100	172 × 650	F3	17	E50.U65-634F30
3600	132	1000	5400	5400	7000	0.5	200	20.3	60.9	0.37	120	172 × 518	F7	14	E50.U52-134F70



E50.U*** SR17™
DC
750...3600V DC



CAPACITORS WITH A CAN DIAMETER OF 142 and 172 mm

Can material..... stainless steel with welded lid

Terminal torque

F3 (M12)..... 14 Nm

F5/F7 (M16)..... 25 Nm

I_{max} (Terminals)

M12..... 80 A

M16..... 200 A

Degree of protection..... IP 00

K..... 43 mm

L..... 30 mm

Humidity class..... C, TX (IEC 62498-1)

KONDENSATOREN MIT GEHÄUSEDURCHMESSER 142 und 172 mm

Gehäusematerial..... Edelstahl, eingeschweißter Deckel

Anschlußdrehmoment

F3 (M12)..... 14 Nm

F5/F7 (M16)..... 25 Nm

I_{max} (Anschlüsse)

M12..... 80 A

M16..... 200 A

Schutzgrad..... IP 00

K..... 43 mm

L..... 30 mm

Feuchtekategorie..... C, TX (IEC 62498-1)

Design	h
F3/F5	30
F7	53

D_1	a (± 2)
172.5	100
142	60
116	60

Important Remarks

General

Our catalogues outline the typical technical and mechanical characteristics of the listed capacitors. The stated values are based on reference type tests, as well as empirical and experimental experience. The real values of individual capacitors may differ within the stated, or commonly known, tolerances. Any information given in this catalogue therefore describes the components in general terms and does not constitute any guarantee of individual technical values.

It is the responsibility of the user to ensure by dedicated tests the suitability and safety of operation of our components under the conditions of his application. This also applies to any accessories offered by ELECTRONICON.

Safety

Safe operation of the capacitors can be expected only if all safety recommendations as well as electrical and thermal specifications as stated on the label, in the data sheets, catalogues and the accompanying mounting instructions are strictly observed, and recommended safety devices are used as intended. Please consider the "General Safety Recommendations" of the power capacitor manufacturers organized in the German ZVEI (www.electronicon.com/en/zvei).

The capacitors shall only be used for the intended application. ELECTRONICON will not indemnify or be responsible for any kind of damages to persons or property due to the improper application of any capacitors purchased from ELECTRONICON or its distributors.

Mind that electrical or mechanical misapplication of capacitors can become hazardous. Misapplied capacitors can explode or catch fire and cause bodily injury or property damage due to the expulsion of material or metal fragments.

Please consult the detailed instructions for mounting and application stated in our brochure „Application Notes“ and on the ELECTRONICON website: www.electronicon.com/en/an

If in doubt about how to connect, operate, or discharge a capacitor, consult ELECTRONICON engineering or our distributors.

Mounting And Cooling

The useful life of a capacitor may be reduced dramatically if exposed to excessive heat. Typically an increase in the ambient temperature of 7°C will halve the expected life of the capacitor. Make sure to obey the permitted operating temperatures.

To avoid overheating the capacitors must be allowed to cool unhindered and should be shielded from external heat sources. We recommend forced ventilation for all filter applications with reactors. Give approx. 20mm clearance around capacitors for natural or forced ventilation, and do not place them directly above or next to heat sources such as detuning or tuning reactors, bus bars, etc.

Wichtige Hinweise

Allgemeines

Unsere Kataloge beschreiben die typischen technischen und mechanischen Eigenschaften der aufgeführten Kondensatoren. Die angegebenen Werte basieren auf Referenztypprüfungen sowie empirischen und experimentellen Erfahrungswerten. Die tatsächlichen Werte einzelner Kondensatoren können innerhalb der angegebenen bzw. allgemein bekannter Toleranzen abweichen. Alle Angaben in diesem Katalog beschreiben daher die Komponenten im Allgemeinen und stellen keine Garantie für individuelle technische Werte dar.

Es liegt in der Verantwortung des Anwenders, durch gezielte Prüfungen die Eignung und Betriebssicherheit unserer Komponenten unter den konkreten Betriebsbedingungen seiner Anwendung sicherzustellen. Dies gilt ebenso für gegebenenfalls von ELECTRONICON angebotene Zubehörteile.

Sicherheit

Ein sicherer Betrieb der Kondensatoren ist nur zu erwarten, wenn alle Sicherheitsempfehlungen sowie elektrische und thermische Spezifikationen entsprechend Etikett, Datenblättern, Katalogen und beiliegenden Montageanleitungen eingehalten und die empfohlenen Sicherheitseinrichtungen bestimmungsgemäß verwendet werden. Bitte beachten Sie die „Allgemeinen Sicherheitsempfehlungen“ der im deutschen ZVEI organisierten Hersteller von Leistungskondensatoren (www.electronicon.com/zvei).

Die Kondensatoren dürfen ausschließlich für ihren Bestimmungszweck verwendet werden. ELECTRONICON übernimmt keine Verantwortung oder Haftung für Schäden an Personen oder Eigentum, welche aus unsachgemäßer Anwendung von Kondensatoren herrührt.

Elektrisch oder mechanisch fehlerhaft eingesetzte Kondensatoren können explodieren oder Feuer fangen. Austretende Materialien bzw. Metallteile können gesundheitliche und materielle Schäden verursachen.

Bitte beachten Sie die detaillierten Anweisungen in unserer Broschüre „Anwendungshinweise“ sowie auf der Webseite von ELECTRONICON: www.electronicon.com/an

Bitte konsultieren Sie das Fachpersonal oder unsere Distributoren zu Fragen bezüglich Anschluss, Verwendung oder Entladung von Kondensatoren.

Montage und Kühlung

Die Lebensdauer eines Kondensators kann durch übermäßige Wärmeeinwirkung erheblich verringert werden. Im allgemeinen führt eine Erhöhung der Umgebungstemperatur um 7°C zu einer Verringerung der Lebensdauer des Kondensators um 50 %. Halten Sie die zugelassenen Betriebstemperaturen ein.

Um Überhitzung zu vermeiden, muß gewährleistet sein, daß die Kondensatoren auftretende Verlustwärme ungehindert abführen können und vor fremden Wärmequellen abgeschirmt werden. Insbesondere in Filtern ist in jedem Falle eine Zwangslüftung zu empfehlen. Zwischen und um Kondensatoren sollten etwa 20mm Platz für natürliche oder Zwangslüftung belassen werden. Bringen Sie den Kondensator nie direkt neben oder über Wärmequellen, wie Drosseln u. ä. an.



Failure Rate

The failure probability of a component is a statistical value which is described by a log-normal distribution:

$$N = N_0 \times e^{-\lambda t}$$

λ is the failure rate, which alternatively is also stated as the so-called FIT-rate (FIT = Failures In Time = $\lambda \times 10^9$).

The failure rate is very closely linked with operating temperature and operating voltage of the capacitor. The FIT rates stated in this catalogue are related to the capacitor's rated voltage and a dielectric temperature (= HOTSPOT temperature) of 70°C.

The simultaneous operation of capacitors at highest permissible voltage and operating temperature should be avoided; otherwise, failure rates may increase beyond reasonable technical reliability.

The standard reference period for the failure rate statement is 100.000 hours. Please note that FIT rates can be altered or improved by technical adjustments. Please contact us for details.

The following diagram demonstrates the correlation between FIT rate, operating voltages and operating temperatures.

Ausfallrate

Die Ausfallwahrscheinlichkeit eines Bauelements ist eine statistische Größe, die mit Hilfe einer Normalverteilung beschrieben wird. Es gilt:

N = number of functional components after period t
Anzahl der nach der Zeit t intakten Bauelemente

N_0 = total number of components at time $t = 0$
Gesamtzahl der Bauelemente zum Zeitpunkt $t = 0$

λ = failure rate Ausfallrate

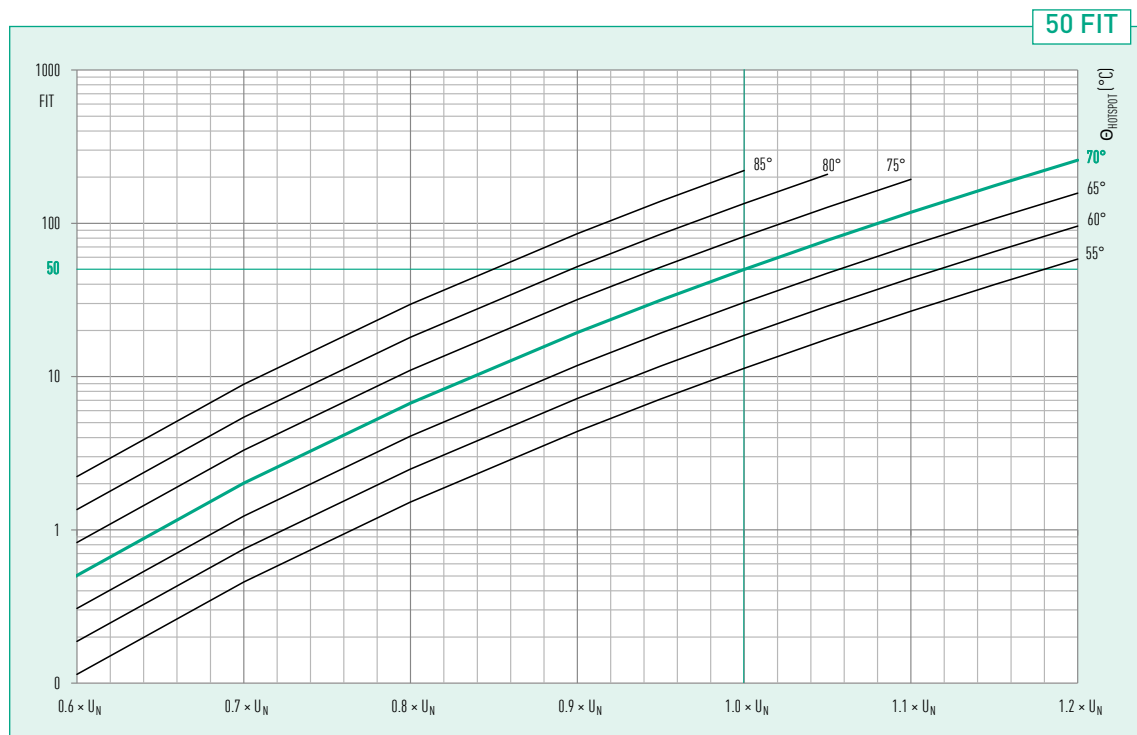
Dabei ist λ die Ausfallrate, die alternativ auch als FIT-Rate angegeben wird (FIT = $\lambda \times 10^9$)

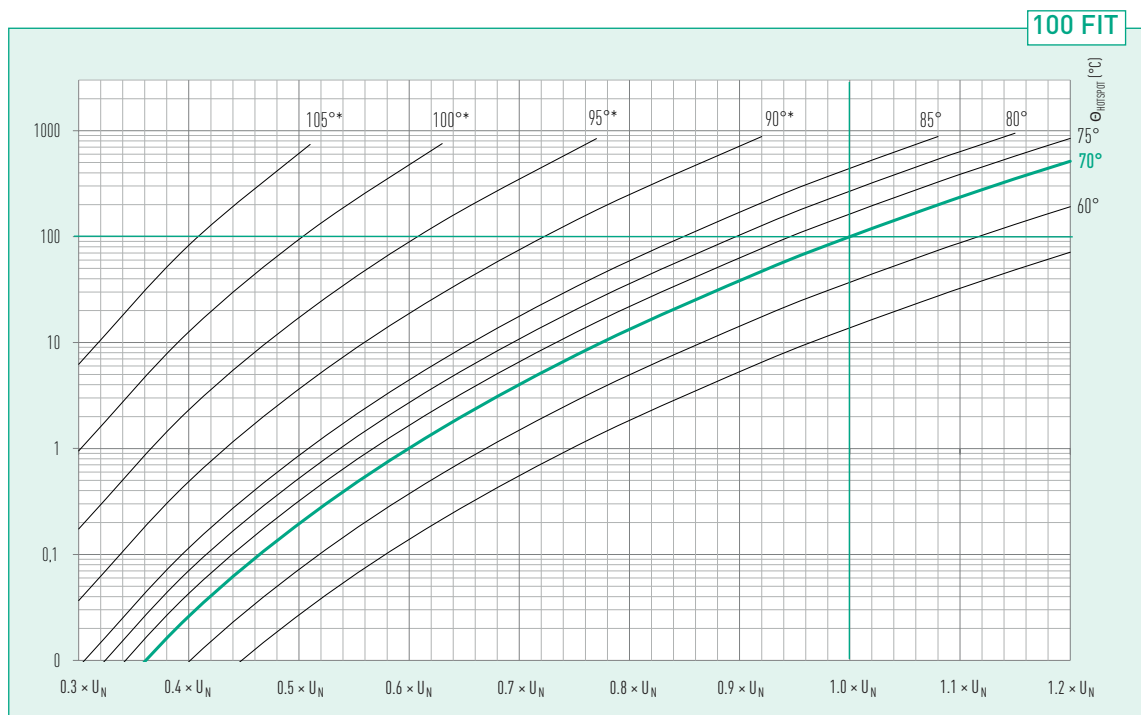
Die Ausfallrate ist stark abhängig von der Temperatur und der Betriebsfeldstärke. Die FIT-Raten im Katalogsortiment beziehen sich auf 70°C Dielektrikumstemperatur (=Hotspot-Temperatur) und die Nennspannung des Kondensators.

Der Betrieb von Kondensatoren mit der höchsten zulässigen Spannung und der höchsten zulässigen Betriebstemperatur sollte vermieden werden, andernfalls können die Ausfallraten so hoch werden, dass keine technisch sinnvollen Zuverlässigkeiten mehr gewährleistet sind.

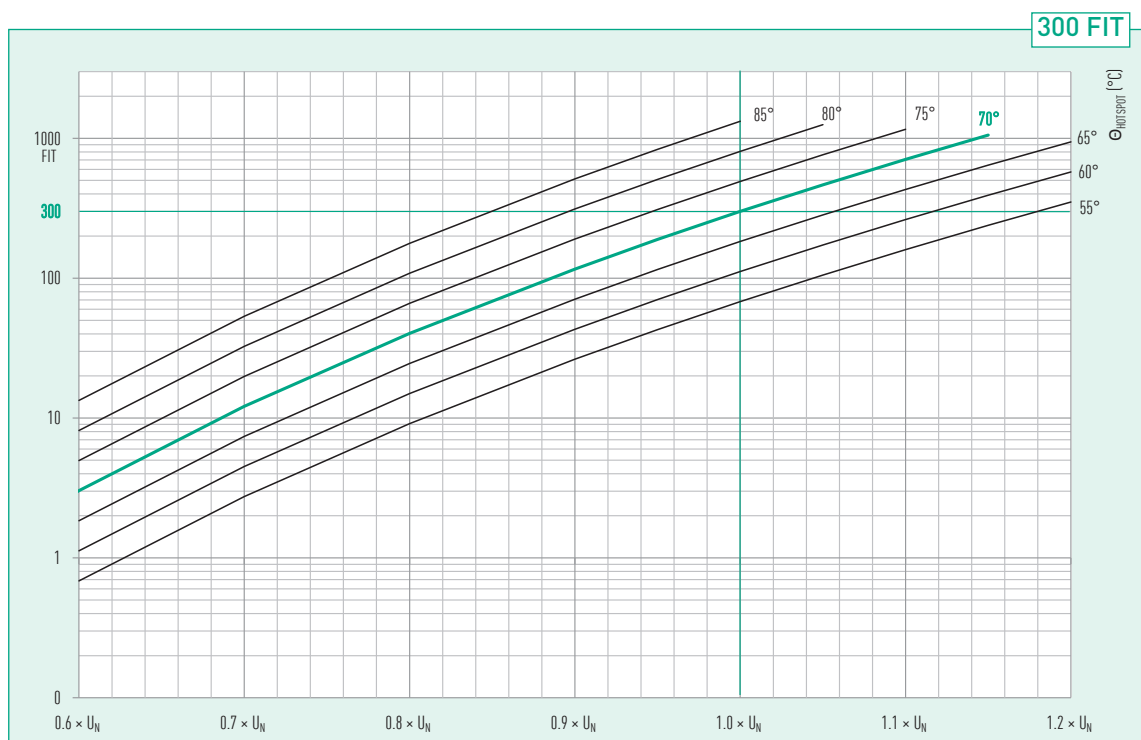
Der Wert für die Ausfallrate bezieht sich auf einen Referenzzeitraum von 100.000h. FIT-Raten können durch technische Anpassung der Kondensatoren beeinflusst und verbessert werden. Auskünfte hierzu erteilen wir auf Anfrage.

Das nachstehende Kurvendiagramm macht den Zusammenhang von FIT-Rate, Betriebsspannung und Betriebstemperatur deutlich.





* applicable only to items with proper temperature rating_nur zutreffend für Kondensatoren mit entsprechendem Temperaturbereich



Protection against Overvoltages And Short Circuits: Self-Healing Dielectric

All dielectric structures used in our power capacitors are „selfhealing“: In the event of a voltage breakdown the metal layers around the breakdown channel are evaporated by the temperature of the electric arc that forms between the electrodes. They are removed within a few microseconds and pushed apart by the pressure generated in the centre of the breakdown spot. An insulation area is formed which is reliably resistive and voltage proof for all operating requirements of the capacitor. The capacitor remains fully functional during and after the breakdown.

For voltages within the permitted testing and operating limits the capacitors are short-circuit- and overvoltage-proof. They are also proof against external short circuits as far as the resulting surge discharges do not exceed the specified surge current limits.

Limited Warranty

All our products are designed, manufactured, and tested with the highest care and workmanship. The satisfaction of our customers is our highest goal. We therefore warrant remedying any defect in the goods resulting from faulty design, materials or workmanship, which appears within 3 years from the date of sale.

This warranty does not cover defects due to improper use of the goods or operation at conditions exceeding the rated values stated in the catalogue or special data sheet. Nor does it cover defects due to faulty maintenance or incorrect installation, alterations or faulty repairs undertaken by the Buyer. Finally the warranty does not cover normal wear and tear or deterioration.

See our „General Conditions“ for details on Warranty and Product liability.

Schutz gegen Überspannungen und Kurzschlüsse: Selbstheilendes Dielektrikum

Alle in unseren Leistungskondensatoren eingesetzten dielektrischen Strukturen sind selbstheilend. Im Falle eines Kurzschlusses (Spannungsdurchschlag) verdampfen die Metallbeläge um den Durchschlagspunkt herum infolge des Lichtbogens, der sich zwischen den Elektroden bildet. Binnen Mikrosekunden wird der Metaldampf vom Zentrum des Durchschlages weggedrückt. Auf diese Weise bildet sich eine isolierende belagfreie Zone um den Durchschlagspunkt. Der Kondensator bleibt während und nach dem Durchschlag voll funktionsfähig.

Für Spannungen innerhalb der zugelassenen Test- und Betriebsbedingungen sind die Kondensatoren kurzschluss- und überspannungssicher. Sie sind außerdem sicher gegen äußere Kurzschlüsse, sofern bei den dabei entstehenden Stoßentladungen die zugelassenen Stoßströme nicht überschritten werden.

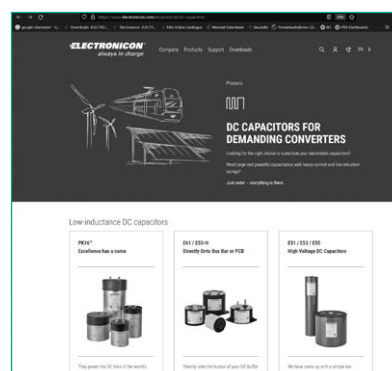
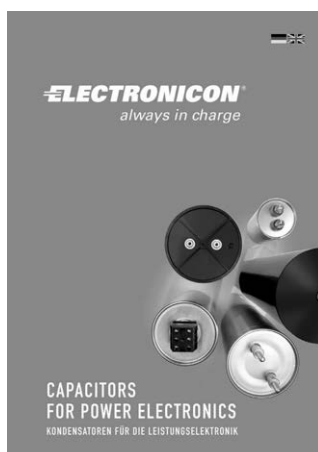
Gewährleistung

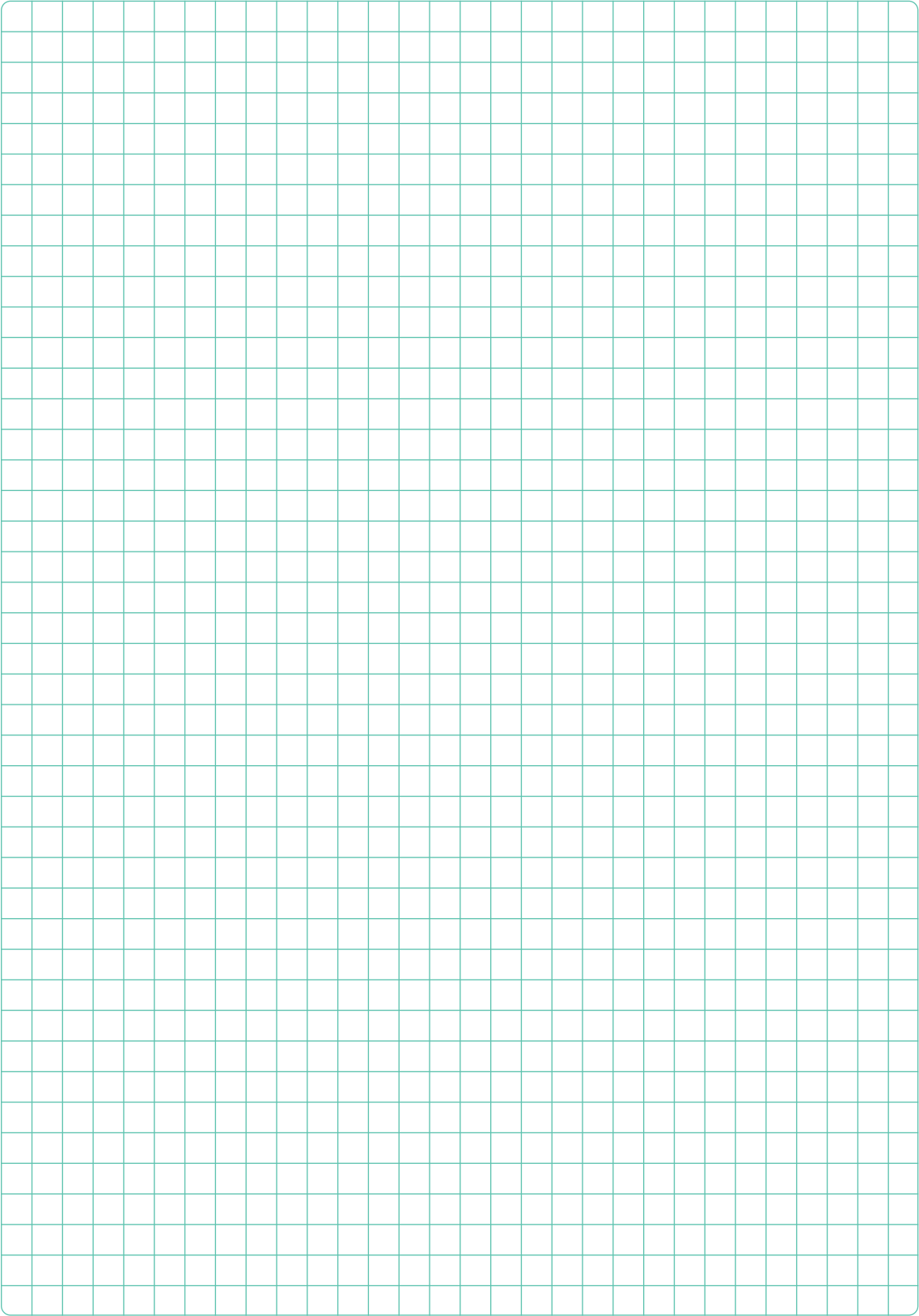
Alle unsere Erzeugnisse werden mit höchster Sorgfalt und Fachkenntnis entwickelt, hergestellt und geprüft. Die Zufriedenheit unserer Kunden ist unser höchstes Ziel. Wir verpflichten uns daher, jeden innerhalb von 3 Jahren ab Verkaufsdatum auftretenden Mangel an unseren Erzeugnissen zu beseitigen, welcher aus Fehlern in Design, Material oder Herstellung herrührt.

Diese Gewährleistung erstreckt sich nicht auf Defekte infolge unsachgemäßer Anwendung oder Betrieb außerhalb der nach Katalog oder Datenblatt zulässigen Einsatzbedingungen. Sie erfaßt ebensowenig Schäden aufgrund fehlerhafter Wartung, unsachgemäßer Montage, Änderungen oder unsachgemäßer Reparaturen durch den Käufer bzw. Anwender. Diese Gewährleistung betrifft auch nicht normale Abnutzung und Verschleiß.

Siehe unsere „Allgemeinen Geschäftsbedingungen“ für Details zu Gewährleistung und Produkthaftung.

Find more information and detailed instructions in our „Application Notes“ and on www.electronicon.com
Mehr Informationen und ausführliche Anweisungen finden Sie in unseren „Anwendungshinweisen“ und unter www.electronicon.com





APPLICATION NOTES AND GENERAL INFORMATION



ELECTRONICON®
always in charge



**CAPACITORS
FOR POWER ELECTRONICS**
KONDENSATOREN FÜR DIE LEISTUNGSELEKTRONIK

des I_{max} und I_{eff}
s dem errechneten

EXCELLENT EXPERIENCE IN CAPACITOR MAKING FOR OVER 80 YEARS

Gera has been a centre of capacitor making since 1938. ELECTRONICON Kondensatoren GmbH which emerged from previous RFT/VEB ELEKTRONIK Gera in 1992, has become one of Europe's leading capacitor manufacturers supplying customers worldwide and being an open and competent partner for manufacturers and users of power factor correction as well as industrial applications of power electronics, generation and transmission of green energy, traction, a.m.o. Regular investments in advanced and environmentally sound technologies guarantee the highest levels in manufacture and quality to modern standards which are approved and monitored by leading certification authorities.



In today's globalised competition, we distinguish ourselves by

- Absolute reliability and safety of our products
- Close co-operation between manufacturer and client to meet both technical and commercial requirements
- Improvement and development of our technical expertise in capacitor design and manufacture, as well as film coating, with special attention paid to the MKPg-technology
- Early identification and incorporation of new trends and methods in the manufacturing of capacitors
- Flexibility and punctual fulfilment of our commercial obligations

Our experienced development engineers are competent and responsible for both implementing the latest technical trends applicable to our products and ensuring that our products adapt to the challenges of traditional and new markets. The close and intense co-operation between the departments of Marketing & Sales, Research & Development, and Production has become the keystone of our success. ELECTRONICON constantly strives for similarly close and interactive relationships with her sales partners and direct customers at home and abroad, so that we are not just one of many suppliers, but your preferred partner for ideas and solutions.

ELECTRONICON®

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