

Order code: E56.M40-474230
Application: MKP-DC capacitor for general use in power electronics also for nonsinusoidal voltages and currents with low self inductance
Standard: acc. to IEC 61071:2007

Characteristics

Rated capacitance	C_N	470 µF ±10%	outline drawing
Rated d.c. voltage	U_N	4400 V d.c.	
Ripple voltage	U_r	1000 V	See drawing G56.Mxx-A23001 on page 2
Insulation voltage	U_i	3500 V	
Non-recurrent surge voltage	u_s	6600 V	
Rated energy	W_N	4500 Ws	
Maximum current	I_{max}	200 A	
Maximum peak current	î	10 kA	
Maximum surge current	I_s	90 kA	
Series resistance	R_s	0,4 mΩ	
Tangent of the loss angle	tanδ_o	2 x10 ⁻⁴	
Self discharge time const.	C x R_{is}	10000 s	
Self inductance	Le	~ 120 nH	
Resonance frequency	f_r	~ 21 kHz	

Thermal conditions

Lowest operating temperature	Θ_{min}	-25 °C
Maximum operating temperature	Θ_{max}	70 °C
Thermal resistance	R_{th}	0,6 K/W
Maximum power loss	P_{max}	at Θ_{amb}
	25 W	55 °C
	16 W	60 °C
	8 W	65 °C
	0 W	70 °C
Storage temperature	Θ_{storage}	-40...+85 °C
Humidity class		C

Service life

Load duration 100000 h
 at Θ_{hotspot} ≤70 °C
 Failure quota 300 FIT

Test data

Voltage test between terminals **U_{BB}** 6600 V DC/10s
 A.C. voltage test terminal/container **U_{BG}** 8000 V AC/10s

Maximum permissible voltage

(Maximum within one day)
 30% of on-load duration 4840V
 30min 5060V
 5min 5280V
 1min 5720V
 100ms 6600V

Dimensions

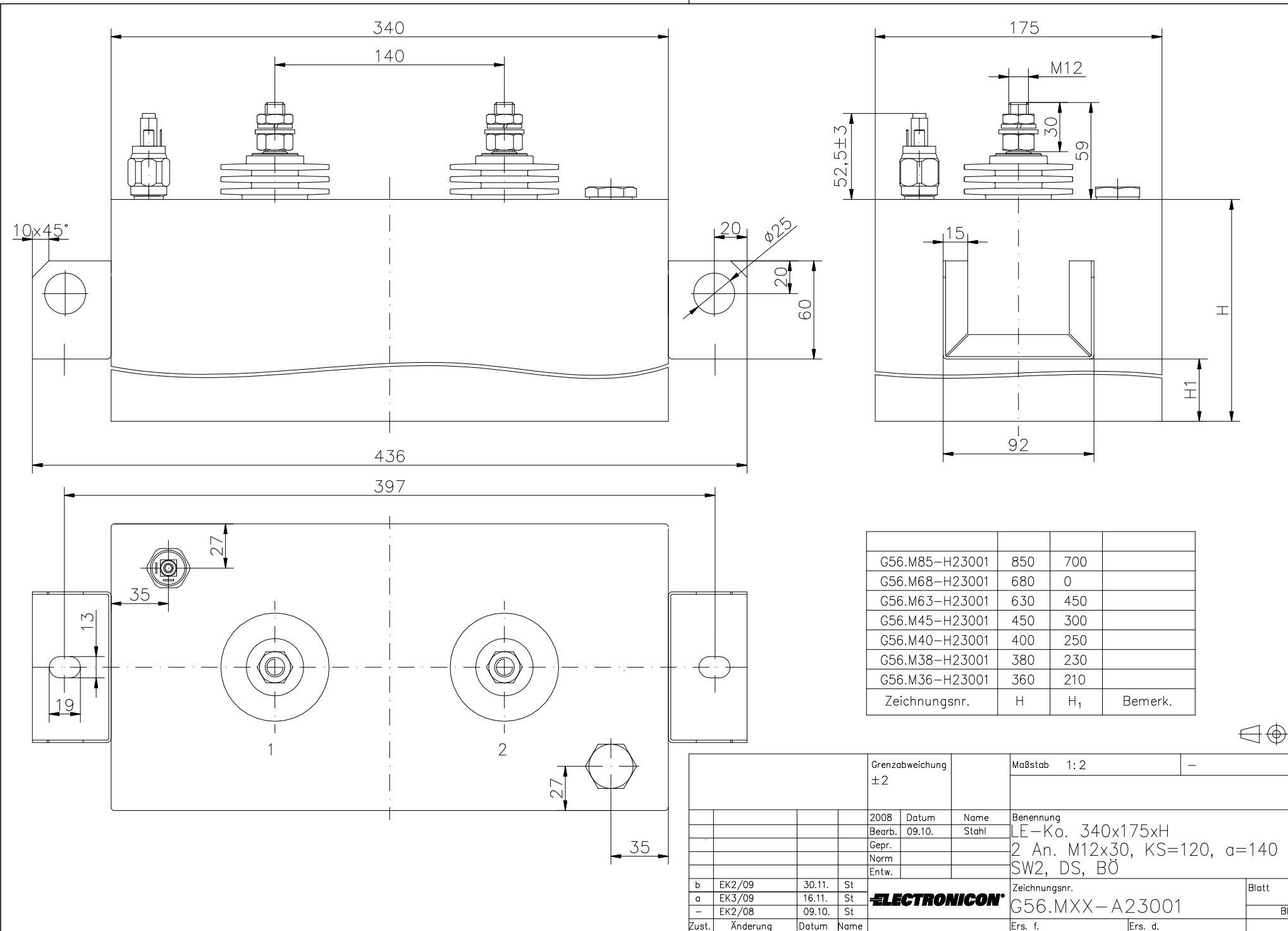
Height of the case	H	400 mm
Length of the case	L	340 mm
Width of the case	B	175 mm
Distance of terminals	a	140 mm
Height of the brackets	H₁	250 mm
Clearance in air	L	45 mm
Creepage distance	K	125 mm

Approx weight 28 kg

Mechanical characteristics

Construction MKP-DC - metallized polypropylene capacitor, self-healing, metallic case
 Protection pressure switch for monitoring of the internal pressure (opener)
 Impregnant dry type, resin moulded (Non PCB)
 Fire load 850MJ

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G56.M85-H23001	850	700	
G56.M68-H23001	680	0	
G56.M63-H23001	630	450	
G56.M45-H23001	450	300	
G56.M40-H23001	400	250	
G56.M38-H23001	380	230	
G56.M36-H23001	360	210	
Zeichnungsnr.	H	H ₁	Bemerk.

				Grenzabweichung ± 2		Maßstab 1: 2		-	
				2008	Datum	Name	Benennung		
				Bearb.	09.10.	Stahl	LE-Ko. 340x175xH		
						2 An. M12x30, KS=120, a=140			
						SW2, DS, BÖ			
						Zeichnungsnr.		Blatt	
						G56.MXX-A23001		Bl.	
Zust.	Änderung	Datum	Name	Ers. f.		Ers. d.			



Capacitors for Power Electronics in hermetical metal case, rectangular shape

acc. to IEC EN 61071 and IEC EN 61881

Mounting and Operating Instructions / Definitions

Mounting Location/Cooling

The capacitors do not contain liquid fillings and can be mounted in any position without restrictions.

The useful life of a capacitor depends very much on the average operating temperature. The expected temperature rise of the capacitors can be calculated based on the technical data from this data sheet. The capacitors must be operated in such way that the maximum hotspot temperature stated in the data sheet is not exceeded even under the most critical ambient conditions. If attenuating circumstances give cause for doubt, special type tests should be conducted.

It should be noted that the internal heat balance of large capacitors is only reached after a couple of hours.

Failure to comply with these conditions may lead to drastic reduction of the expected life of the capacitor, or in the worst case failure of the safety mechanisms and rupture of the capacitor.

! Give at least 80 mm clearance between the capacitors for natural or 40mm for forced ventilation. Do never place the capacitors directly above or next to heat sources such as reactors, etc.

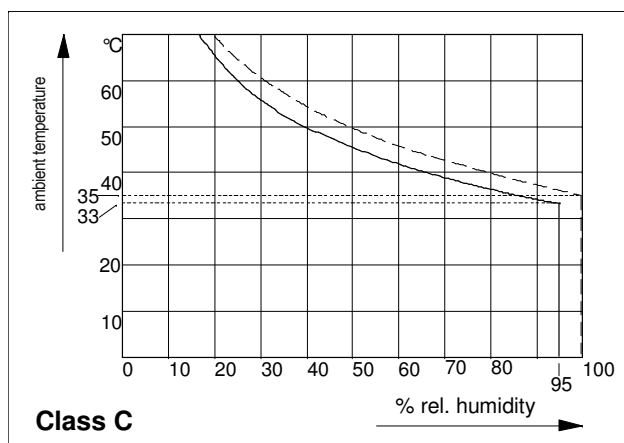
Connection

Recommended torque for screw connections:

M8	5 Nm
M10	9 Nm
M12	14 Nm
M16	25 Nm

Condensation, Humidity

The specified limits of humidity must not be exceeded even during storage of the capacitors.



humidity class C

max. relative humidity
95% annual means,
100% occasionally,
condensation permitted

limits of relative humidity vs. ambient temperature

Discharge

If there is no discharge of the capacitors provided by external circuits, the capacitors should be provided with discharge resistors. In any event, the poles of the capacitors must be short-circuited before being touched. Note that capacitors with nominal voltages above 750Vac or 2000Vdc in particular may regenerate new voltage at their terminals after having been short-circuited just for short periods. This condition results from the internal series connection of the capacitor elements and will be avoided by storing them permanently short-circuited.

! Attention ! The capacitors for power electronics are not provided with internal discharge resistors as standard !

Earthing

Depending on their construction, capacitors with a metal case must be earthed at a designated mounting stud or at the uncoated zones of the mounting brackets.

Shock and Vibration Stress

Most of all, shock and vibration stresses are affecting the fixing elements and the terminals. They must therefore be checked and tested in the original mounting position.

The capacitors with a weight of up to 100kg comply with the following test standards:

- sinusoidal oscillation - test Fc 5..100Hz floating, 2g/amplitude 7.5mm / 10 cycles acc. to IEC 60068-2-6
- shock, semisinusoidal -test Ea 5g ,11ms / 6 shocks acc. to IEC 60068-2-27

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SAFETY IN OPERATION**Protection Against Overvoltages and External Short Circuits:**

The capacitors are self-healing and regenerate themselves after breakdowns of the dielectric. For voltages within the permitted testing and operating maximum the capacitors are overvoltage-proof. They are also proof against external short circuits as far as the resulting surge discharges do not exceed the specified current limits (I_S).

Hazards of Explosion

Capacitors consist mainly of polypropylene (up to 50%), i.e. their energy content is relatively high. As a result of internal faults or external overload (e.g. temperature, overvoltage, harmonic distortion) which can lead to the disintegration of the polypropylene dielectric, they may build up substantial amounts of explosive gasses leading to rising pressure inside. To prevent rupture and explosion, the capacitors are provided with a pressure sensor that enables reliable monitoring of the internal pressure and safe disconnection in the event of malfunctioning.

! Attention! Capacitors with activated pressure switch must not be re-commissioned even after the internal pressure would have reduced again.

The monitoring circuit has to be designed in such way that the capacitors are locked against re-connection.

Characteristics of the pressure switch

Type	opening switch (overpressure)
Load capacity	max 5A/250V~ / 0.25A/250V -
Connection	tab connectors 6.3mm

It must be ensured, by appropriate measures, that the capacitors do not form any hazard to their environment in the event of failure or malfunction of the safety mechanism.

Fire load

The capacitor dielectric and the PUR-resin have a fire load of appr. 40MJ/kg.
Appropriate extinguishing agents are: dry powder, CO₂, foam

ENVIRONMENTAL COMPATIBILITY / DISPOSAL

Our capacitors do not contain PCB, solvents, or any other toxic or banned materials. They do not contain hazardous substances acc. to «Chemische Verbotverordnung» (based on European guidelines 2003/53/EG and 76/769/ EWG), «Gefahrstoffverordnung» (GefStoffV) and «Bedarfsgegenstaendeverordnung (BedGgStV)».

Not classified as «dangerous goods» acc. 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 used properly.

The capacitors comply with the specifications of the ROHS directive.

Disposal

The filling materials contain solidified polyurethane mixtures based on vegetable oil.

We recommend disposing of the capacitors through professional recycling centres for electric/electronic waste.

Consult your national rules and restrictions for waste and disposal.

European Waste Catalogue: 080404

DEFINITIONS**Rated capacitance C_N**

Capacitance value rated at 20 °C / 50 Hz.

Rated Voltage U_N

The maximum or peak voltage of either polarity of a reversing or nonreversing type wave form for which the capacitor has been designed and rated (unlike other standards for AC capacitors, the rated voltage is not the rms value).

Non repetitive peak (surge) voltage U_S

Voltages beyond the rated voltage induced by switching or faults of the system or any part of it. Maximum count 1000 times with a duration of not more than 50 ms each.

rms voltage U_{eff}

Root mean square of the max. permissible value of sinusoidal AC voltage in continuous operation.

Ripple voltage U_r

The peak-to-peak alternating component of the unidirectional voltage.

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Voltage test 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.

Maximum current I_{max}

Maximum rms value of permissible current in continuous operation. The values given in the data sheets are related to either the specified maximum power dissipation or the current limits of the connection terminals.

Peak current \hat{I}

Maximum permitted repetitive current amplitude during continuous operation.

Non-repetitive peak current (surge) I_s

Maximum current that may occur non-repetitively and briefly in the event of a fault. Maximum count 1000 times with a duration of not more than 50 ms each.

Equivalent series resistance R_s

Equivalent resistance representing the sum of all Ohmic resistances occurring inside the capacitor. Essential for calculation of the current dependent losses.

Self-inductance L_e

Represents the sum of all inductive elements which are – for mechanical and construction reasons – contained in any capacitor.

Resonant frequency f_{res}

The capacitance and self-inductance of any capacitor form a series resonant circuit. Above the resonant frequency, the inductive part of this LC-circuit prevails. The capacitor would then behave as an inductor.

Dielectric dissipation factor $\tan\delta_0$

Constant dissipation factor of the dielectric material for all capacitors in their rated frequency.

Thermal resistance R_{th}

The thermal resistance indicates by how many degrees the capacitor temperature at the hotspot rises in relation to the dissipation losses.

Maximum power dissipation P_{max}

Maximum permitted power dissipation for the capacitor's operation at a certain ambient temperature.

Ambient temperature Θ_u

Temperature of the surrounding air, measured 10 cm away and at 2/3 of the case height of the capacitor.

Lower category temperature Θ_{min}

Lowest permissible ambient temperature at which a capacitor may be used.

Upper category temperature Θ_{max}

Highest permissible capacitor temperature during operation, i.e. temperature at the hottest point of the case.

Hotspot temperature $\Theta_{HOTSPOT}$

Temperature at the hottest spot inside the capacitor.

Rated energy contents W_N

Energy stored in the capacitor when charged at rated voltage.

Clearance in air L

The shortest distance between conducting parts of the terminals or between terminals and case.

Creepage distance K

The shortest distance along an insulated surface between conducting parts of the terminals or between terminals and case.