DATA SHEET

Capacitor for Power Electronics acc. to IEC 61071

- DRAFT-

Order code	E56.N88-266270
Application	DC capacitor for general use in power electronics also for nonsinusoidal voltages and currents with low self inductance
Standard	acc. to IEC 61071:2017

Characteristics

Rated capacitance	C_N		26000	µF ±10%
Rated d.c. Voltage	U_{NDC}		1300	V
Ripple voltage (peak - peak)	U_r		300	V
Non-recurrent surge voltage	u_s		1950	V
Rated energy	E_N		22000	Ws
Maximum permanent rms current	I_{max}		300	A
Maximum peak current	$\hat{I}$		120	kA
Maximum surge current	$\hat{I}_s$		350	kA
Series resistance	R_s		0.3	mΩ
Dielectric loss factor	$\tan\delta_o$	~	2	$x10^{-4}$
Self discharge time const.	$C \times R_{is}$	>	10000	s
Self inductance	L_e		120	nH [1]
Resonance frequency	f_{res}	~	3	kHz [1]

outline drawing

see drawing G56.N88-A26004 on next page

Maximum permissible voltage
(Maximum within one day)

30% of on-load duration	1430	V
30min	1500	V
5min	1560	V
1min	1690	V
100ms max. 1000 times per life-time	1950	V

Routine test voltages

Voltage test between terminals	U_{BB}	1950	V_{DC} / 10s
A.C. voltage test terminal/case	U_{BG}	3000	V_{rms} / 10s

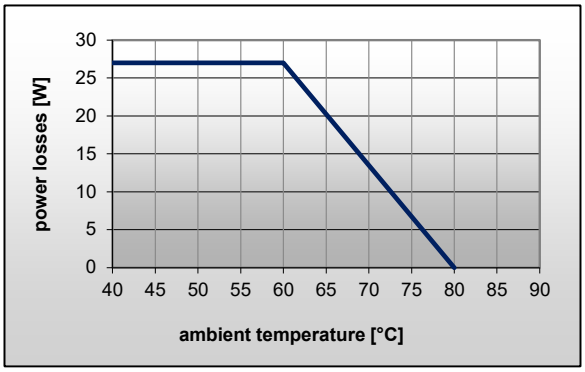
Dimensions[2]

Height of the case	**H**	880	mm
Length of the case	**L**	520	mm
Width of the case	**W**	175	mm
Clearance in air	**L**	32	mm
Creepage distance	**K**	60	mm
Terminal	**F4**	M16x40	mm

Thermal conditions

Lowest operating temperature	Θ_{min}		-25	°C
Maximum operating temperature	Θ_{max}		80	°C
Endurance type test temperature			65	°C
Thermal resistance	R_{th}		0.5	K/W [1]
Storage temperature	$\Theta_{storage}$		-40..+85	°C
Humidity class (see annex for remarks)			TX, C	
Statistical lifetime		>	100000	h
Failure rate		<	300	FIT
at $\Theta_{hotspot}$		≤	70	°C

permitted power losses during continuous operation [1]



Mechanical characteristics

Dielectric	DC - metallized polypropylene capacitor, self-healing
Construction	Stainless steel (1.4307) case, welded, brass terminals, plastic insulators (V0 UL94) CTI 600
Surface	brushed and treated weld
Protection	protected, overpressure switch for monitoring of the internal pressure (changeover contacts)
Impregnant	dry type, filled with solidified resin (Non PCB)
Terminal torque	max. Nm
Fire load	3000MJ
Approx weight	100kg

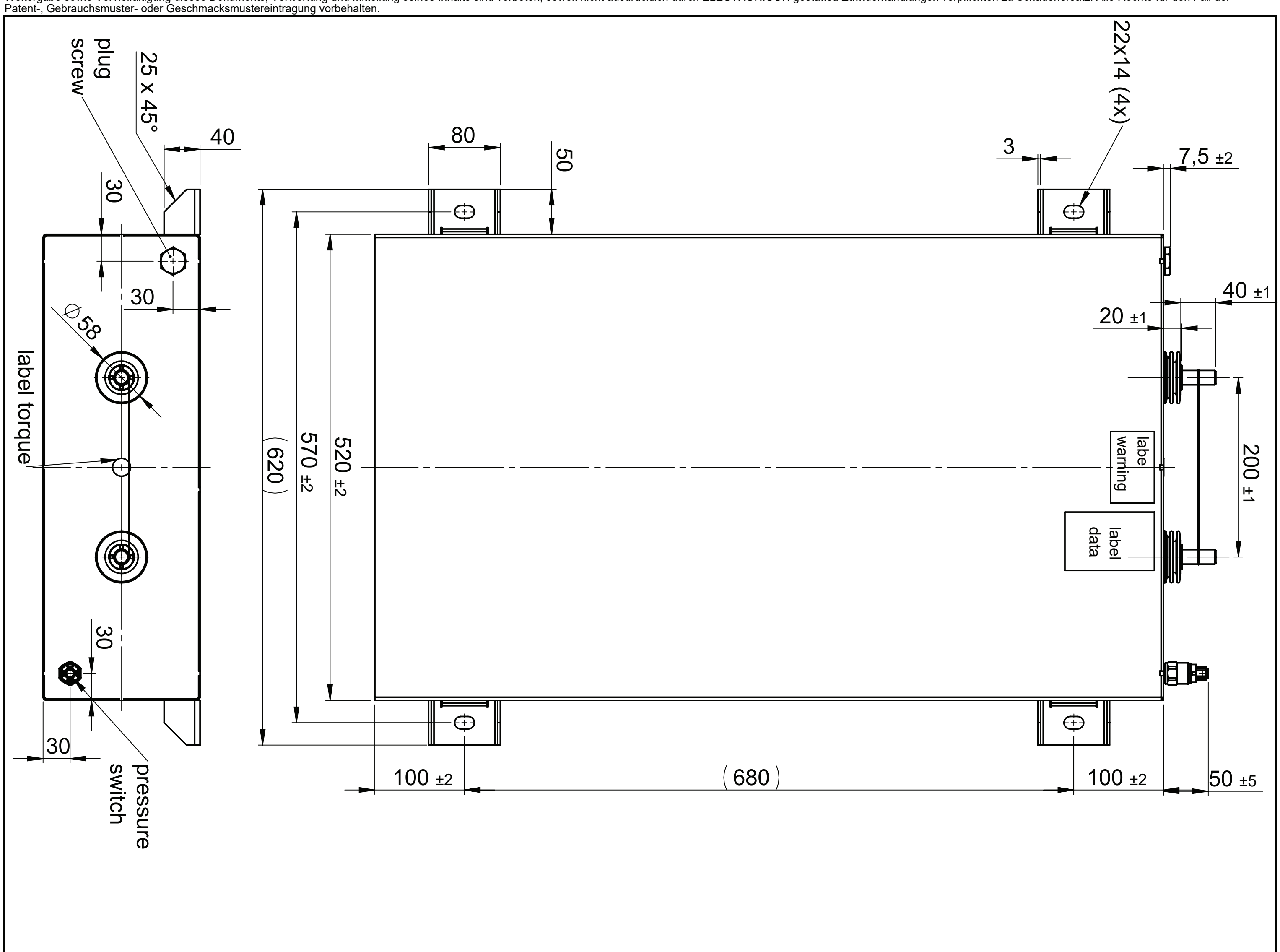
1) Calculated value. Exact values can be verified by dedicated type test.

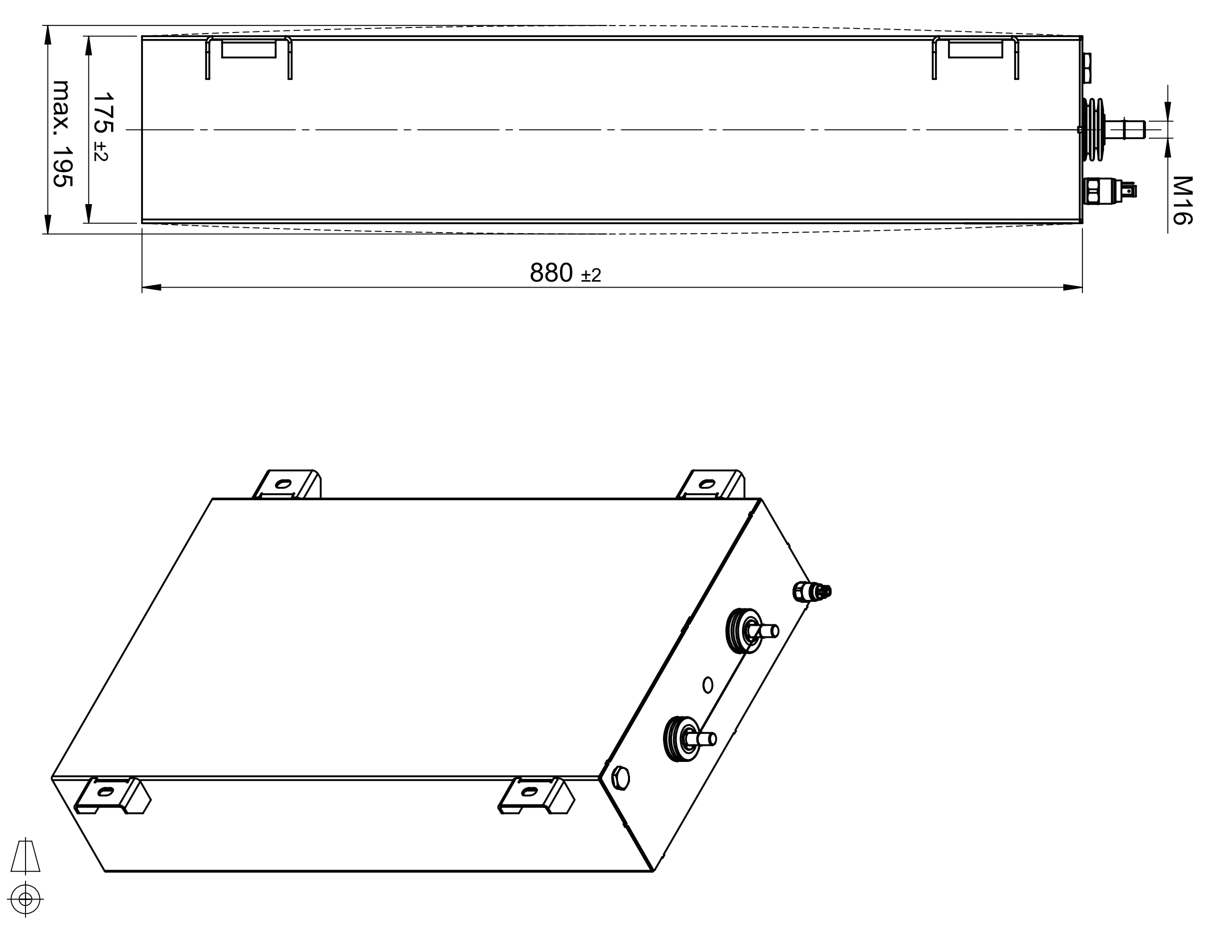
2) Draft. Exact dimensions and tolerances to be confirmed after completion of design and construction.

We reserve the right to make technical changes without prior notice. No liability can be assumed for the accuracy of data.

©2022 ELECTRONICON Kondensatoren GmbH, Keplerstrasse 2, 07549 Gera, Germany
Fon: +49 365 7346-100, Fax: -110, email: sales@electronicon.com

The reproduction, distribution and utilization of this document as well as the communication of its contents to others without express authorization by ELECTRONICON is prohibited. Offenders will be held liable for the payment of damages. All rights reserved in the event of the grant of a patent, utility model or design.
Weitergabe sowie Vervielfältigung dieses Dokuments, Verwertung und Mitteilung seines Inhalts sind verboten, soweit nicht ausdrücklich durch ELECTRONICON gestattet. Zuwiderhandlungen verpflichten zu Schadenersatz. Alle Rechte für den Fall der Patent-, Gebrauchsmuster- oder Geschmacksmustereintragung vorbehalten.





Index	Änderung/amendment	date	name
-001	EK6/22	29.07.2022	He

Gewicht/weight [g] 20277.74

ELECTRONICON
Kondensatoren GmbH · Keplerstraße 2 · D-07549 Gera / Germany

	date	name
Bearb.	29.07.2022	Henkel

Tolerierung nach ISO 8015
tolerance acc. to ISO 8015

Grenzabweichung/tolerances
EN ISO 13920-BE

Maßstab/scale 1:5 (1:7)

Werkstoff/material

Benennung/description
PEC 520x175x880
2x F4 M16x40 a=200
pressure switch

Zeichnung-Nr./drawing no.
G56.N88-A26004

Ers. f.
Ers. d.

Blatt/page 1 von 1
1 Bl.
Format A3

General

Our data sheets outline the typical technical and mechanical characteristics of the described capacitor. 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 data sheet therefore describes the component in general terms and does not constitute any guarantee of individual technical values.

Custom-made capacitors are designed to the best of our knowledge, based on the specifications and additional information received from the customer. The phrase “According to customer specification” means that such custom-designed capacitors are based on the parameters of the specification with the exception of deviations declared officially by ELECTRONICON in writing (e.g. by CbC-protocol). ELECTRONICON cannot be held responsible for failures arising out of operation under circumstances unknown at the time of design.

It is the responsibility of the user to ensure the safety of operation, as well as the suitability of our components and provided accessory parts under the specific operating conditions of his application, by proper evaluation and dedicated tests.

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 (https://www.electronicon.com/en/downloads/application-notes-and-general-information). ELECTRONICON cannot accept responsibility for whatever damage may arise out of a non-observance.

MOUNTING AND OPERATING INSTRUCTIONS / DEFINITIONS

Mounting Location/Cooling

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. 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.

As a rule, the user has to ensure by his own type test in the application that the permitted maximum hotspot temperature of the capacitor is not exceeded even at worst ambient and operating conditions. If required, we can provide special type test samples with integrated temperature sensors (as standard: PT100). It should be noted that the internal heat balance of large capacitors is only reached after a couple of hours.

! The following recommendations apply if a type test in the application is not possible:

Natural convection cooling: leave 40 to 80mm clearance between and around the capacitors*; ensure sufficient spacing above the capacitors for unhindered air convection.

Forced air cooling: Leave 30 to 40mm clearance between the capacitors*. The cooling air shall have unimpeded access to the entire lateral surface.

The installation of the capacitors directly next to or above heat sources, such as reactors, shall be avoided.

**Mind that, even though the capacitors are filled with a solid resin, the capacitor width may increase at the large side of the case by up to 10mm during operation (if not specified otherwise in the drawing or data sheet).*

Mounting Orientation

The capacitors do not contain liquid fillings and can be mounted in any orientation without restrictions. However, please mind that the mounting orientation may be restricted by mechanical reasons (e.g. bracket design, bracket position, case material and thickness, etc.).

Shock and Vibration Stress

Most of all, shock and vibration stresses affect the fixing elements and terminals. They must therefore be checked and tested in the real mounting position with cables, bus bars, brackets etc. attached.
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, semi-sinusoidal - test Ea 5g ,11ms / 6 shocks acc. to IEC 60068-2-27

©2022 ELECTRONICON Kondensatoren GmbH, Keplerstrasse 2, 07549 Gera, Germany
Fon: +49 365 7346-100, Fax: -110, email: sales@electronicon.com

Connection

Our patented terminal design allows for the repair and exchange of damaged insulator bodies. Due to the special sealing mechanism, it is possible that the insulator would respond to rotating force, e.g. during movement of the ring nut, by turning itself out of position.

- In the intended application of the capacitors, there is no need for fastening or unfastening the ring nuts. Avoid any manipulation of the ring nuts unless explicitly agreed with ELECTRONICON for repair purposes.
- Circular movement of the insulator may deform, rupture or displace the silicone seal and impair the insulating and sealing functions of the bushing. Always hold the insulator in position during any fastening or unfastening of the ring nut!

Mind that plastic parts may be subject to a certain settlement under tension; it is quite likely that the insulator as well as other parts “relax” slightly after their installation in production. This has been considered by our fastening torques during assembly. Please consult us in advance if planning to install a goods inwards inspection of the terminal or insulator torque.

Attention:

! Make sure to lock screws or nuts by adequate means against loosening. Connecting cables must be fixed between two nuts and secured against swinging or vibrating during transport and operation.

! Use standardized non-magnetic parts for fastening cables or bus bars to avoid inductive heating of the terminals. We recommend using nuts and screws either nickel-plated, or tinned with nickel barrier coating, to protect against electrochemical corrosion and the formation of whiskers.

! Capacitor terminals shall not be used as distribution points for cables or bus bars.

Recommended torque for screw connections (if not otherwise specified in the drawing or data sheet):

Terminal thread	Recommended torque
M5	1.5…2 Nm
M6	2.3…3 Nm
M8	3.8…5 Nm
M10	6.8…9 Nm
M12	10…14 Nm
M16	19…25 Nm

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 contain discharge resistors as standard!**

Earthing

In order to prevent floating voltage potentials between terminals and case which could cause problems when exceeding the capacitor’s rated insulation voltage, metallic cases shall be earthed. Where such earthing is impossible, the case must at least be set to a defined potential within the operating voltage range of the capacitor.
Depending on their construction, capacitors can be earthed either at a special mounting stud or at designated uncoated zones on the mounting brackets.

Environment for Operation and Storage

Capacitors shall be stored and operated in dry environment and in conformance with the specified climatic class. Do not expose capacitors to rain or direct sun. Do not store or operate capacitors in, or close to, aggressive environments and corrosive atmosphere, e.g. acids, sulphide, chlorine/chlorides, salt mist, etc.

Avoid the deposition of dust and dirt on the capacitors which may obstruct the creepage distances between terminals.

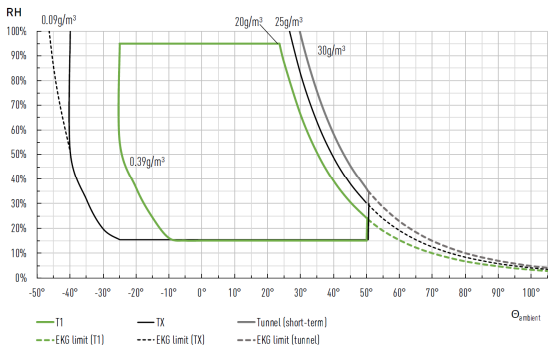
Principally, capacitors made of metallized polypropylene do not have a limited shelf life if stored properly. However please note that capacitors in non-hermetical housing may suffer from humidity and other environmental factors if left unused for a long period. Please consult us if in doubt about the condition of your capacitors after long storage or storage under doubtful circumstances. The specified limits of humidity must not be exceeded during operation and storage of the capacitors.

©2022 ELECTRONICON Kondensatoren GmbH, Keplerstrasse 2, 07549 Gera, Germany
Fon: +49 365 7346-100, Fax: -110, email: sales@electronicon.com

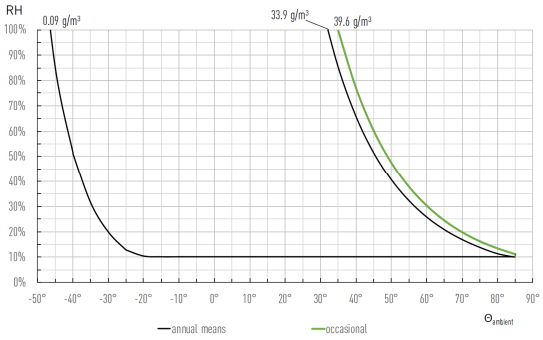
Environmental Conditions

The humidity class (T1 or TX) stated in the data sheet is based on railway standard IEC 62498-1. These values shall not be exceeded during storage and operation. Additionally, our in-house climatic classes “G” and “C” describe special application conditions which go beyond the specifications of IEC 62498-1.
The classes refer to the atmospheric conditions of the operating environment. Separately, the limits for the hotspot temperature as stated in the catalogues or data sheets must never be exceeded. The humidity values are based on long-year empirical experience and are hard to be simulated by specific accelerated tests. Please consult us if in doubt about the suitability of our components for specific ambient conditions.

Humidity Classes TX/T1 acc. to IEC 62498 1



Humidity Class C



Appearance, Protection from Corrosion

Despite careful handling and strict quality control, traces of production and handling may be left on the surface of the capacitors. Superficial flaws such as slight scratches, colour variations of the material, finger prints, small dents or slight unevenness of the surface do not represent a fault and cannot be accepted as a reason for rejects or claims under warranty. Note that the welding seams of stainless steel cases without shot-blasting have been cleaned and treated by electrochemical and mechanical procedures to restore the anti-corrosive functions of the stainless steel. Colour changes caused by this procedure are entirely normal. They are irrelevant for function, safety and reliability of the capacitor and cannot be accepted as a reason for rejects or claims under warranty.

Recommended Repair-Treatment in case of scratches or stains on the capacitor surface:

A. Painted steel case: Scratches in the paint may result in loss of anti-corrosive protection. Clean the scratch and seal by paint or lacquer.
B. Shot-blasted stainless-steel case: Aggressive substances such as acids or salts, including human sweat, may cause superficial stains/corrosion. Clean off the pollution and treat with non-abrasive stainless-steel care spray.
C. Unpainted stainless-steel case: Apply non-abrasive stainless-steel care spray to clean off stains, fingerprints or other pollution.
D. Painted or unpainted aluminium case: Treatment of scratches is not mandatory. Remove aggressive substances such as acids or salts and treat with aluminium spray.

Note:
Due to the nature of PU resin filling, the housing walls may detach from the solidified resin in some spots, eventually resulting in hollow sounds. This does not pose any risk for function, reliability or safety of the capacitor and cannot be accepted as a reason for rejects or claims under warranty.

FIT RATE (Failures In Time)

The FIT rate reflects the probability of failures during the operating period under selected operating conditions. Any failure rate of a capacitor is very closely linked with the operating temperature and the applied operating voltage. As standard, the FIT rates stated in our data sheets are assuming a capacitor hotspot temperature of 70°C and operation at rated voltage. Unless stated otherwise, they are related to a reference operating interval of t=100,000 hours. After the reference interval, the capacitors will continue operating; however the probability of failures may change and the FIT rate may rise.

! Note: The FIT rate cannot give information about the individual lifespan or the expected moment of failure of a capacitor. Service cycles may be calculated based on the so-called MTBF value (mean time between failures): MTBF = 10^9/FIT.

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

CE identification

The capacitors are marked „CE“ when both of the following criteria apply:

- They conform to standard IEC / DIN EN 61071.
- At least one of the AC or DC voltage ratings does not exceed 1500V.

©2022 ELECTRONICON Kondensatoren GmbH, Keplerstrasse 2, 07549 Gera, Germany
Fon: +49 365 7346-100, Fax: -110, email: sales@electronicon.com

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 occasional 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% of the weight), 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.

Capacitor energy > 30kJ

If energy values exceed 30 kJ per capacitor unit, it is assumed that, in event of failure, the risk will increase if there is an uncontrolled release of this energy. This poses an additional hazard potential in systems containing several capacitor units due to possible avalanche effects.

Fire load

The capacitor dielectric and the PUR-resin have a fire load of ca. 40 MJ/kg.
Appropriate extinguishing agents are: dry powder, CO_2, foam

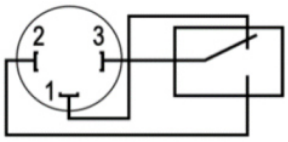
Pressure Switch

Capacitors which are not actively monitored by the electronics of the application can be provided with a pressure switch to prevent rupture and explosion. The pressure sensor enables reliable monitoring of the internal pressure and its signal can be used for 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.

The standard switch with silver plated contacts can be used for the following signal currents (please consult us for information related to the special version with gold plated contacts).

type of load	maximum monitoring voltage	permitted monitoring current
inductive load (e.g. coupling relais)	AC 250V rms	3mA … 2A
	DC 24V	3mA … 1A
ohmic (e.g. SPS input, acoustic signal)	AC 250V rms	3mA … 4A (1A lamp load)
	DC 250V	3mA … 0.1A
	DC 24V	3mA … 2A (1A lamp load)



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.

ENVIRONMENTAL COMPATIBILITY

Our capacitors do not contain PCB, solvents, or any other toxic or banned materials. They do not contain hazardous substances acc. to «Chemische Verbotsverordnung» (based on European Directive 2003/53/EC and Council Directive 76/769/EEC). The capacitors are 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, REACH and SVHC directives.

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

The filling materials contain solidified polyurethane mixtures based on vegetable oil. The capacitors can be disposed of in accordance with European waste catalogue (EWC) No. 16 02 16 (“Components removed from discarded equipment other than those mentioned in 16 02 15”).
Caution: When touching or disposing capacitors, please consider that even after days and weeks these capacitors may still be charged with high voltages!

©2022 ELECTRONICON Kondensatoren GmbH, Keplerstrasse 2, 07549 Gera, Germany
Fon: +49 365 7346-100, Fax: -110, email: sales@electronicon.com

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 non-reversing 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 100 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.

Voltage test between terminals U_{BB}
Routine test of all capacitors conducted at room temperature, prior to delivery. A further test with 90% 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 for one time only.

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) $\hat{i}_S$
Maximum current that may occur non-repetitively and briefly in the event of a fault.

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 rises at the hotspot due to dissipation losses. This temperature rise relates to the surrounding air in a distance of ca. 10cm from the case surface.

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 E_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.

©2022 ELECTRONICON Kondensatoren GmbH, Keplerstrasse 2, 07549 Gera, Germany
Fon: +49 365 7346-100, Fax: -110, email: sales@electronicon.com