FILM CAPACITORS TECHNICAL INFORMATION

GLOSSARY OF ELECTRICAL CHARACTERISTICS

• Rated Capacitance	• Rated Frequency	• Lowest Operating Temperature
• Tolerance on rated Capacitance	• Resonance Frequency	• Cooling Air Temperature
• Rated Voltage	• Tangent of the loss angle	• Container Temperature rise
• RMS Voltage	• Dielectric dissipation factor	• Hot spot Temperature
• Ripple Voltage	• Equivalent Series Resistance	• Climatic category
• Non-recurrent Surge Voltage	• Self Inductance	• Insulation Resistance
• Insulation Voltage	• Thermal Resistance	• Self-healing
• Maximum Current	• Capacitor losses	
• Maximum Peak Current	• Operating Temperature	
• Maximum Surge Current	• Maximum Operating Temperature	

1. Rated Capacitance CN [µF]
Capacitance value for which the capacitor has been designed.

2. Tolerance on rated Capacitance
The deviation of actual measured capacitance from rated capacitance,
Tolerance on rated capacitance determines its application, values J = ±5% , K = ±10%

3. Rated Voltage VN [V DC]
Rated AC Voltage: maximum operating peak voltage of either polarity of a reversing type waveform.
Rated DC Voltage: maximum operating peak voltage of either polarity but of a non reversing type waveform for which the capacitor has been designed.
Reference Directives: IEC61071, GB/17702.

4 RMS Voltage
Root mean square of maximum value of sinusoidal AC voltage in continuous operation.

5. Ripple Voltage Vr
Peak-to-peak alternating component of the unidirectional voltage.

6. Non-recurrent Surge Voltage Vs
Peak voltage induced by a switching or any other disturbance of the system which is allowed for a limited number of times and for durations shorter than the basic period.

7. Insulation Voltage Vi
RMS value of the sine wave voltage designed for the insulation between terminals of capacitors to case or earth.
If not specified, the RMS value of the insulating voltage is equivalent to the rated voltage divided by square root of 2.

8. Maximum Current Imax
Maximum RMS current for continuous operation.

9. Maximum Peak Current I
Maximum peak current that can occur during continuous operation.
The value is the following: **I = CN x (dv/dt)**

10. Maximum Surge Current Is
Peak non-repetitive current induced by switching or any other disturbance of the system which is allowed for a limited number of times, for durations shorter than the basic period.

11. Rated Frequency
Frequency for which the capacitor has been designed.

12. Resonance Frequency
Lowest frequency at which the impedance of the capacitor is at minimum.
The value is the following: **Fr =1/(2 π root (L x C)**

13. Tangent of the loss angle tg δ
Ratio between the equivalent series resistance and the capacitive reactance of the capacitor at specified sinusoidal alternating voltage and frequency.

14. Equivalent Series Resistance ESR
Effective resistance which, if connected in series with an ideal capacitor of capacitance value equal to that of the capacitor in question, would have a power loss equals to active power dissipated in that capacitor under specified operating conditions.

15. Self Inductance Ls
Effective inductance which, if connected in series with an ideal capacitor of capacitance value equal to that of the capacitor in question, would have the resonance frequency equals to the resonance frequency in that capacitor.

16. Thermal Resistance Rth
A heat property and a measurement of a temperature difference by which a capacitor resists a heat flow. It shows the temperature difference when a unit of heat energy flows through a capacitor.
It is measured in units °C/W or °K/W.

17. Capacitor losses Pj
Active power dissipated in the capacitor.
The value is the following: $Pj = Irms^2 \times ESR$

18. Operating Temperature θo
Temperature of the hottest point on the case of the capacitor, when in thermal equilibrium.

19. Maximum Operating Temperature θmax
Highest temperature at which the capacitor may be energized.

20. Lowest Operating Temperature θmin
Lowest temperature at which the capacitor may be energized.

21. Cooling Air Temperature θamb
Temperature of the cooling air measured at the hottest position in bank, under steady-state conditions, in the mid between two units. If one unit is involved, it is the temperature measured at a point approximately 0.1m away from the capacitor container and two thirds of the height from its base.

22. Container Temperature rise delta θcase
Difference between the temperature of the hottest point of the container and the temperature of the cooling air.

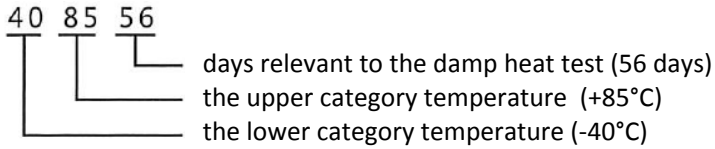
24. Hot spot Temperature θhs

Temperature at the hottest spot inside the capacitor.

The value is the following: **θhs = θamb + Pj x Rth**

25. Climatic category

The climatic category of capacitor is expressed with mìnimum and maximum operating temperature and damp heat severity, such as 40/85/56:



26. Insulation Resistance IR [mΩ]

The insulation resistance is the ratio between an applied DC voltage and the resulting leakage current.

The insulation resistance is usually indicated with time constant (T) and the time constant in seconds with the following formula: **T = IR x CN**

27. Self-healing

It is only applicable to metallized film capacitor.

Self-healing means the ability that the electrical properties of the capacitor are rapidly restored after a local breakdown of the dielectric.

The electrode of metallized film capacitor is the metal coating of the metallized film, which are vacuum-deposited directly onto the plastic film, its thickness is only few tens nm.

When a weak point or some impurities are found in the dielectric, a dielectric breakdown might occur.

The energy released by the arc discharge in the breakdown channel rapidly evaporate the thin metal coating near the channel; the insulated region thus resulting around the former faulty area will cause the capacitor to regain its full operation ability.

28. Failure rate

Failure rate indicates the failure probability of the capacitors in unit time after a certain point, while the capacitors have not failed before the certain point.

The unit is FIT and it is defined as 1 FIT = 1 / (10^9 hours), that is one failure in one billion hours.

For example: 10000 capacitors work good, at given conditions for 10000 hours with 10 capacitors failed:

ʎ = 10 / (10000 x 10000) = 100 FIT

29. Expected Lifetime

Expected Lifetime is a statistical value calculated on the basis of experience and on theoretical evaluations, it depends on the applied voltage and the hot spot temperature during operation.

For example:

capacitors used in DC-Link circuits will have an expected lifetime of probable 100000 hours at rated voltage an 70°C hot spot temperature.

A rough evaluation for the expected capacitor lifetime can be indicated as the following figure:

10% increase of the voltage, half long lifetime lose, also 10% increase of hot spot, half long lifetime lose.

GUIDELINES FOR PLASTIC FILM CAPACITORS

CAUTIONS

- The plastic film capacitor varies in the maximum applicable voltage depending on the applied voltage, current, frequency and operational environment.
- In general, although flame retardant shell or flame retardant epoxy is used in the coating and incapsulating of the plastic film capacitor, a continuous high temperature will break the coating layer of the plastic case and may lead to melting and firing of the capacitor element.

WAREHOUSE STORE

- The capacitors should not be stored in ambient with high temperature and high humidity, the following conditions must be respected:

Temperature: ≤ 35°C, Humidity: ≤ 80% RH (no dew allowed on the capacitor)

- Capacitors may not be stored in corrosive atmospheres, such as sulfides, acids, lye, salts, organic solvents or other corrosive substances.
- When unchanging primal package, it should not be stored more than 24 months (please check the datecode on the capacitor's label).

WHEN MAKING AN ORDER

Please provide the following information at best:

- Applications: transducers, welding machines, induction heating machines,
- Application situation: DC-Link, IGBT snubber, resonance, etc.
- Rated capacitance and tolerance,
- Voltage: working voltage, ripple voltage, non-recurrent surge voltage, etc.
- Current: maximum current pulse current, etc.
- Frequency: working frequency, pulse frequency, etc.
- Working environment: environment temperature, humidity, coaling mode, etc.
- Installation dimensions: external dimensions, terminal type, etc.