1. 基本参数和术语

1-1. 额定电压

电容器设计时予以设定之工作电压，指该电容器在规定温度范围内操作时，可以连续施加于电容器端子间的最大直流电压或最大交流电压有效值或脉冲电压。

1-2. 耐压强度

电容器之耐压强度高于其额定电压，但只能在有限时间内施加。

1-3. 脉冲电压

脉冲电压之 RMS 有效值（VRMS）不可高于电容器之额定交流电压；脉冲电压之峰值（Vo-p）不可高于电容器之额定直流电压。

1-4. 脉冲上升梯度

表示电容器耐受快速之电压变化及相应之高电流峰值能力，取决于介质材料之特性、厚度及电容器结构。

1-5. 额定容值

指电容器包括理想电容与等效串联电阻之等效串联电路中的电容部分。

由于材料之介质常数与频率有关，容值会随着频率之上升至下降，该变化是可逆的。

1-6. 自愈性（仅针对金属化薄膜）

电容器的电特性在发生局部电介质击穿后迅速而基本地恢复到击穿前的值的过程。

金属化膜的金属镀层是通过真空蒸发的方法将金属沉积在薄膜上，厚度只有几十个纳米，当介质上存在弱点、杂质时，局部电击穿就可能发生，电击穿处的电弧放电所产生的能量足以使电击穿点邻近处的金属镀层蒸发，使击穿点与周围极板隔开，电容器电气性能即可恢复正常。

1. Basic parameters and terms

1-1. Rated voltage

Rated voltage is the working voltage of capacitor designing, referring to maximum DC voltage, maximum AC voltage RMS, or pulse voltage that can be continuously applied between the capacitor terminals when the capacitor is operated within the specified temperature range.

1-2. Withstand voltage strength

Withstand voltage strength of the capacitor is higher than its rated voltage, but it can only be applied in a limited period.

1-3. Pulse voltage

The RMS effective value (VRMS) of the pulse voltage cannot be higher than the rated AC voltage of the capacitor; The Vo-p of the pulse voltage cannot exceed the rated DC voltage of the capacitor.

1-4. Pulse rise gradient

Pulse rise gradient of capacitor shows the ability to withstand the peak of rapid voltage change and according high current, it depends on the characteristic and thickness of dielectric material and capacitor structure.

1-5. Rated capacitance

Rated capacitance means the portion of the capacitance in the equivalent series circuit of ideal capacitor and equivalent. Because the dielectric constant of the dielectric film is related to frequency, the capacitance will drop as the frequency rises. This change is reversible.

1-6. Self-healing (Only for metallized film capacitor)

Process by which the electrical prorerties of the capacitor.after a local breakdown of the dielectric,are rapidly and essentially restored to the values before the breakdown.

The metal coatings of the metallized film, which are vacuum-deposited directly onto the plastic film, have a thickness of only several tens nanometer. At weak points or impurities in the dielectric, a dielectric breakdown would occur. The energy released by the arc discharge in the breakdown channel is sufficient to totally evaporate the thin metal coating in the vicinity of the channel. The insulated region thus resulting around the former faulty area will cause the capacitor to regain its full operation ability.

1-7. 容值漂移

容值除可逆性变化外，也有不可逆变化，称为漂移。漂移之方向与程度主要取决于介质材料，随时间推移，漂移现象会逐渐减小并趋于稳定。

1-8. 介质损耗因素

电容器的介质材料在额定频率下的损耗常数。聚丙烯薄膜的典型介质损耗因素为 2×10^{-4}。

1-9. 电容器的损耗因素

在规定频率的正弦波电压作用下，电容器的有功功率除以电容器的无功功率，其值为等效串联电阻和容抗之比。

1-10. 绝缘电阻

电容器在充电停止后，该充电电压与流经介质及电容器外表面之漏电流之比值。

1-11. 等效串联电阻

表征电容器全部欧姆损耗的量值。

$$\mathrm{ESR}=\frac{\tan\delta}{2\Pi fc}$$

1-12. 电感量

取决于电容素子之结构设计及导电端子之长度与厚度，幅向导线型电容器之典型电感值为 1.0nH/1mm 导线长。

1-13. 阻抗

为其等效串联电阻与容抗之向量和。

1-14. 谐振频率

电容器的阻抗成为最小时的最低频率。其值为：

$$f_r={}^{1}\!/_{(2\Pi\times\sqrt{L_S\times C_R})}$$

1-7. Capacitance drift

Other than reversible change, capacitance of capacitor may appear some irreversible change, called drift. The orientation and degree of drift depend mainly on the dielectric material. As time goes by, drift phenomenon will gradually reduce and tend to be stable.

1-8. Dielectric dissipation factor

Constant dissipation factor of the dielectric material for all capacitors at their rated frequency. The typical loss factor of polypropylene film is 2×10-4.

1-9. Loss factor of the capacitor

The dissipation factor is ratio between reactive power of the impedance of the capacitor and effective power when capacitor is submitted to a sinusoidal voltage of specified frequency, it is that ratio between the equivalent series resistance and the capacitive reactance of a capacitor.

1-10. Insulation resistance

The insulation resistance is the ratio of this charging voltage with the leak current passing through the dielectric and external surface of capacitor.

1-11. Equivalent series resistance

The equivalent series resistance (ESR) represents all of the ohmic losses of the capacitor.

$$\mathrm{ESR}=\frac{\tan\delta}{2\Pi fc}$$

1-12. Inductance value

The inductance of a capacitor depends on the capacitance element of the structure design and the conductive terminals the length and thickness of the guide lines of capacitor is typical of the inductance value is 1.0 nH / 1mm lead length.

1-13. Impedance

Impedance of capacitor equals the vector sum of equivalent series resistance (ESR) and capacitive reactance.

1-14. Resonance frequency

Lowest frequency at which the impedance of the capacitor becomes minimum. The value is following:

$$f_r={}^{1}\!/_{(2\Pi\times\sqrt{L_S\times C_R})}$$

1-15. 环境温度

在稳定状态条件下，在电容器组最热区域的两个单元之间中途所测得的空气温度。

如果仅设计一单元，则指在离电容器外壳 10cm 且距其底部 2/3 高度处所测得的空气温度。

1-16. 最高温度

电容器可以运行的最高外壳温度。

1-17. 最低温度

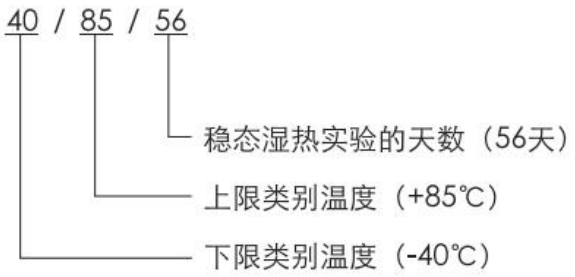
电容器可以运行的最低电介质温度。

1-18. 温度系数

电容器在规定的温度范围内容量随温度的变化率。

1-19. 气候类别

电容器所属的气候类别用斜线分隔的三个数来表示，如 40/85/56：



2. 使用薄膜电容器的注意事项

2-1. 工作电压

薄膜电容器的选用取决于施加的最高电压，并受施加的电压波形、电流波形、频率、环境温度(电容器表面温度)、电容量等因素的影响。使用前请先检查电容器两端的电压波形、电流波形和频率(在高频场合，允许电压随着电容器类型的不同而改变，详细资料请参阅说明书)是否在额定值内。

1-15. Ambient temperature

Temperature of the air measured at the hottest position of the capacitor, under steady-state conditions, midway between two units.

If only one unit is involved, it is the temperature of surrounding air, measured 10 cm away and at 2/3 of the case height of the capacitor under steady-state conditions.

1-16. Maximum operating temperature

Highest temperature of the dielectric at which the capacitor may be energized.

1-17. Minimum operating temperature

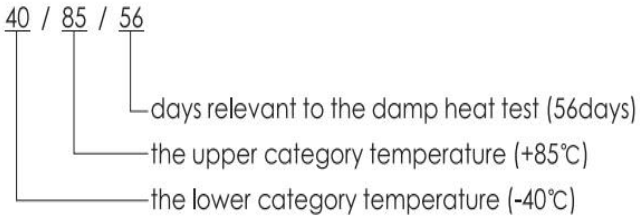
Lowest temperature of the dielectric at which the capacitor may be energized.

1-18. Temperature coefficient

The change rate of capacitance with temperature measured over a specified range of temperature.

1-19. Climate category

The climatic category which the capacitor belongs to is expressed in three numbers separated by slashes, e.g. 40/85/56.



2. Caution items in using plastic film capacitors

2-1. Operation voltage

The plastic film capacitor varies in the maximum applicable voltage depending on the applied voltage waveform, current waveform, frequency, ambient temperature (capacitor surface temperature), capacitance value, etc. Be sure to use capacitors within the specified values by checking the voltage waveform, current waveform,and frequency applied to them (In the application of high frequency, the permissible voltage varies with the type of the capacitor. Refer to the specification for detail).

2-2. 工作电流

通过电容器的脉冲(或交流)电流等于电容量 C 与电压上升速率的乘积，即 I=C×dV/dt。

由于电容器存在损耗，在高频或高脉冲条件下使用时，通过电容器的脉冲(或交流)电流会使电容器自身发热而有温升，将会有热击穿(冒烟、起火)的危险。因此，电容器安全使用条件不仅受额定电压(或类别电压)的限制，而且受额定电流的限制。

额定电流被认为是由击穿模式决定的脉冲电流(峰值电流，即由 dV/dt 指标所限制的)和连续电流(以峰峰值或有效值表示)组成，当使用时，需确认这两个电流都在允许范围之内。

2-3. 各种波形的有效值换算

不同的波形有效值按下面的公式计算。

2-2. Operating current

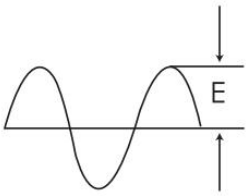
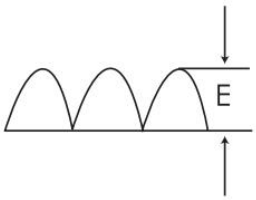
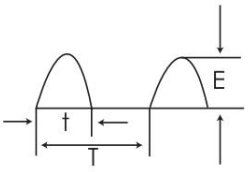
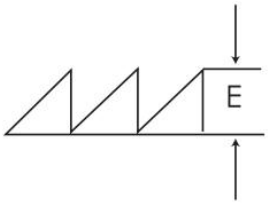
The pulse (or AC) current flowing through the capacitor is expressed as: $I = C \times dV/dt$

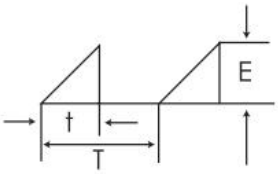
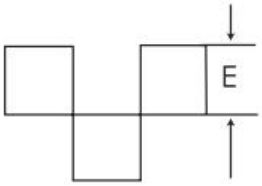
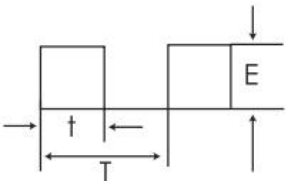
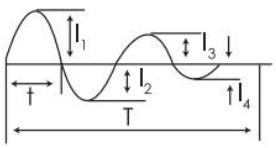
Due to the fact that dissipation factor of the capacitor will generate the internal heat under the application of high frequency or high pulse current, This leads to the temperature rising and also causes the danger of breaking down (smoking or firing). Therefore, the safety use of capacitor must be within the rated voltage (or category voltage) and the permissible current.

The rated current must be considered by dividing into pulse current (peak current) and continuous current (rms current) depending on the break down mode, and when using, should make sure the both currents are within the permissible values.

2-3. Calculation of rms in various waveforms

In each waveform, calculate the rms value in the following formula.

种类(type)	1	2	3	4
波形 (waveform)				
有效值 (rms)	$E/\sqrt{2}$	$E/\sqrt{2}$	$E/\sqrt{t/(2T)}$	$E/\sqrt{3}$

种类(type)	5	6	7	8
波形 (waveform)				
有效值 (rms)	$E/\sqrt{t/3T}$	E	$E/\sqrt{t/T}$	$\sqrt{\frac{1}{2}(I_1^2 + I_2^2 + I_3^2 + I_4^2)}$

2-4. 电容器充放电

由于电容器充放电电流取决于电容量和电压上升速率的乘积，即使是低电压充放电，也可能产生大的瞬间充放电电流，这可能会导致电容器性能的损害，比如说短路或开路。当进行充放电时，请根据电压串联限流电阻(20~1000Ω/V)，将充放电电流限制在规定的范围内。

当多个薄膜电容器并联进行耐电压测试或寿命测试时，请为每个电容器串联一个限流电阻(20~1000Ω/V)。详见电容器标准。另外，在用手操作电容器之前必须对电容器进行充分放电，否则电容器内部残存的能量可能会对操作人员产生致命的伤害。

2-5. 因薄膜震动产生的嗡鸣声

电容器的嗡鸣声是由于电容器薄膜受到两电极间库仑力的作用，产生的振动而发出的声音。施加的电压和频率波形失真越严重，所产生的嗡鸣声越大。但这种嗡鸣声对电容器不会产生任何破坏作用。

2-6. 表面温升

当电容器中通过持续电流时，热量累积会使电容器内部温度升高。当温度超出允许的热点温度时，可能会导致电容器短路甚至燃烧。因此，流经电容器的电流不允许超过产品目录所规定的最大数值，而且有必要监测电容器加载时的温升。

2-7. 高湿环境

如果长时间使用在高湿环境下，电容器可能会吸收潮气、电极被氧化，导致电容器损坏。如果是在 AC 条件下使用，高湿环境将会加剧电晕的影响，从而引起电容量下降，损耗增加。

2-4. Charging and discharging

Because the charging and discharging current of capacitor is obtained by the product of voltage rise rate (dV/dt) and capacitance, low voltage charging and discharging may also cause deterioration of capacitor such as shorting and open due to sudden charging and discharging current.
When charging and discharging, pass though a resistance of 20Ω/V to1000Ω/V or more to limit current.
When multiple film capacitors which are connected in parallel are undergoing withstand voltage test or life test,connect a resistor valued at 20Ω/V to1000Ω/V or more in series to each capacitor. (Refer to the specification for more details). In addition,capacitors must be discharged with resistors before handling.If the capacitor doesn't discharge resistor inside, there will be residual heat inside which maybe cause danger to the operator's life.

2-5. Buzzing noise

Any buzzing noise produced by capacitor is caused by the vibration of the film due to the coulomb force that is generated between the electrodes with opposite poles. If the waveform with a high distortion rate or frequency is applied across the capacitor, the buzzing noise will become louder. But the buzzing noise is of no damage of capacitor.

2-6. Surface over temperature

When continuing current flows through the capacitor, the temperature inside the capacitor will rise, induced by accumulated heat. If the temperature exceeds allowed hot-spot temperature, it might cause a short circuit or fire. The limits described in the catalogue are not exceeded and it’s necessary to check the temperature on the capacitor surface when it works.

2-7. Humid ambient

If used for a long time in a humid ambient, the capacitor might absorb humidity and oxdise the electrodes causing breakage of the capacitor. If case of AC application, high humidity would increase the corona effect. This phenomenon causes a drop of capacitance and a increase capacitor losses.

2-8. 储存条件

(1) 电容器不能储存在腐蚀性的空气环境中，特别是存在氢化物、硫化物、酸、碱、盐、有机溶剂或类似物质时。

(2) 产品不能暴露在高温和高湿状态下，必须保存在以下环境中：（在不拆开原包装的基础上）

温度：-40℃～+35℃

湿度：年平均值不超过 70%RH，全年任意 30 天不超过 80%RH。

储存时间：不超过 24 个月（从产品包装或产品本体上的日期计算）。

2-9. 在订购或索要样品之前，请尽可能提供一下信息

(1) 额定工作电压：DC、AC 或其他。

(2) 电容量及允许误差。

(3) 应用场景：电视机、显示器、开关电源等。

(4) 应用电路：直流回路、交流脉冲回路、跨线、降压、谐振、滤波等。

(5) 使用条件：脉冲峰值、频率、波形、电流、温度等。

(6) 外形尺寸及形状：电容器尺寸、引线长度、包封型或盒装型、编带等。

(7) 安全性：当开路或短路时，电容器与其他元器件是否相互影响。

2-8. Storage conditions

(1) Capacitors may not be stored in corrosive atmospheres, particularly not when chlorides, sulfides, acids, lye, salts, organic solvents or similar substances are present.

(2) It shouldn't be located in particularly high temperature and high humidity, it must submit to the following conditions (unchanging primal package) :

Temperature: -40℃～+35℃

Humidity: The annual average value shall not exceed 70%RH, and the average value for any 30 days of one year shall not exceed 80%RH.

Storage time: ≤ 24 months (from the date marked on the capacitors' body or the label glued to the package).

2-9. Please provide the following information as much as possible before ordering or requesting samples.

(1) Rated voltage: AC; DC or others

(2) Capacitance and tolerance

(3) Application scenarios: TV; display; switching power supply etc.

(4) Application circuit: DC circuit; AC pulse circuit; interlines circuit; reduction voltage circuit; resonance circuit; filter circuit etc.

(5) Application conditions: pulse peak value; frequency; waveform; current; temperature etc.

(6) Dimension and shape: dimension of capacitor; length of lead; epoxy encapsulation or box-type; taping etc.

(7) Safety: When open or short circuit, whether the capacitor and other components affect each other.