

## 一、交流电动机电容器的标准体系

交流电动机电容器的主要标准是由中国国家标准化管理委员会发布的GB/T 3667.1，等同于国际电工委员会（IEC）制定的IEC 60252-1。

我司主要在上述标准的基础上制定了各个型号交流电动机电容器的企业标准，以供内部引用。

另外，交流电动机电容器的部分标准术语也参考了其它电容器标准中的定义,不再一一列出。

以上，构成了交流电动机电容器的标准体系。

交流电动机电容器的标准体系如下：

## 一、The standard system of AC Motor Capacitors.

The main standards are GB/T 3667.1 , published by Standardization Administration of the people's republic of China.The standard is equal to IEC 60252-1, prepared by International Electrotechnical Commission(IEC).

According to the basic requirements of above standards, Faratronic made detailed standards of various AC moter capacitor type for internal use.

In additional, some terminologies are also reference to other capacitor standards, which will be not listed below.

The standard system of AC motor capacitors is made up of all above-standards.

Following please find the corresponding specification lists for AC moter capacitors.

标准号 (No.)	标 准 (Standards)
<b>GB/T 3667.1 (IEC 60252-1)</b>	第 1 部分：交流电动机电容器 Part 1: AC motor capacitor
	详细规范：Detail specification for each type



## 二、常用的标准术语

### 1、额定容量 $C_N$

设计电容时采用的电容值。

### 2、额定电压 $U_N$

设计电容时采用的交流电压的有效值。

### 3、额定频率 $f_N$

设计电容时采用的最高频率。

### 4、额定电流 $I_N$

在额定电压和频率下的交流电流的有效值。

### 5、电容器的损耗因素 $\tan \delta$

在规定频率的正弦波电压作用下，电容器的损耗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。

### 6、连续运行

在电容器正常寿命期内无时间限制的一种运行。

### 7、运行等级

在额定负荷条件、额定电压、规定温度和额定频率下的最短总寿命。

A级——30 000h

B级——10 000h

C级——3 000h

D级——1 000h

这些运行等级表示在电容器寿命期间实际故障不超过3%。

与电压相对应的电容器有不只一个运行等级。

### 8、最低允许电容器运行温度

在投入期间，电容器外壳外表面的允许最低温度。

### 9、最高允许电容器运行温度 $t_c$

在运行期间，电容器外壳外表面最热区域的允许最高温度。

### 10、安全防护等级

安全防护等级用下列4种代码中的一种来表示，并标志在电容器上。

(S3) 表示该类电容器使用安全膜结构设计；电容器失效时，剩余容量 $<1\% C_N$ ；并且是防火或防爆的。

## 二、Terminologies

### 1. Rated capacitance $C_N$

Capacitance value for which the capacitor has been designed.

### 2. Rated voltage $U_N$

r.m.s. value of the alternating voltage for which the capacitor has been designed.

### 3. Rated frequency $f_N$

Highest frequency for which the capacitor has been designed.

### 4. Rated current $I_N$

r.m.s. value of the alternating current at the rated voltage and frequency.

### 5. Loss factor of the capacitor $\tan \delta$

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.

### 6. Continuous operation

Operation with no time limit within the normal life of the capacitor.

### 7. Class of operation

The minimum total life for which the capacitor has been designed at rated duty, voltage, temperature and frequency

Class A——30 000h

Class B——10 000h

Class C——3 000h

Class D——1 000h

These classes of operation are intended to represent a true failure rate not exceeding 3 % during the life of the product.

A capacitor may have more than one class with corresponding voltages.

### 8. Minimum permissible capacitor operating temperature

Minimum permissible temperature on the outside of the case at the moment of switching on the capacitor.

### 9. Maximum permissible capacitor operating temperature $t_c$

Maximum permissible temperature of the hottest area of the outside of the capacitor case during operation.

### 10. Class of safety protection

Degree of safety protection identified by one of four codes to be marked on the capacitor.

(S3) indicates that the capacitor is of segmented film construction. This capacitor type is required to fail with low residual capacitance ( $<1\% C_N$ ) and has protection against fire and shock hazard.

(S2) 表示该类电容器设计成失效时仅呈开路状态，并且是防火或防爆的。

注：等同于以前的P2。

(S1) 表示该类电容器失效时可呈开路状态或短路状态，并且是防火或防爆的。

注：等同于以前的P1。

(S0) 表示该类电容器无专门的故障保护。

注：等同于以前的P0。

## 11、容量温度系数 $\alpha$

电容器在规定的温度范围内容量随温度的变化率。通常以20℃时电容量为参考，用百万分之一每摄氏度 ( $10^{-6}/^{\circ}\text{C}$ ) 表示。 ( $10^{-6}/^{\circ}\text{C} = 1\text{ppm}/^{\circ}\text{C}$ )

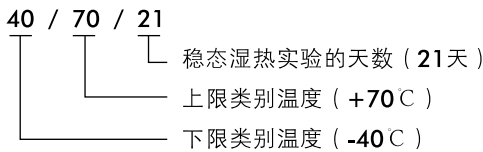
$$\alpha_i = \frac{C_i - C_0}{C_0(T_i - T_0)}$$

$C_i$ : 电容器在温度 $T_i$ 时容量

$C_0$ : 电容器在 $T_0(20 \pm 2)^{\circ}\text{C}$ 时的容量

## 12、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 (IEC 60068-1: 如: 40/70/21)。



## 13、绝缘电阻(IR)/时间常数(t)

绝缘电阻为电容器充电一分钟所加的直流电压和流经电容器的漏电流值的比值，单位为 $\text{M}\Omega$ 。时间常数为绝缘电阻和电容量的乘积，通常以秒表示，公式如下:  $t[s] = IR[\text{M}\Omega] \times C_N[\mu\text{F}]$

一般情况下，绝缘电阻用于描述小容量电容器的绝缘特性，时间常数用于描述大容量 (如:  $C_N > 0.33\mu\text{F}$ ) 电容器的绝缘特性。

## 14、自愈性(仅对金属化膜电容器)

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。

(S2) Indicates that the capacitor type has been designed to fail in the open-circuit mode only and is protected against fire or shock hazard.

Note: formerly referred to as P2

(S1) Indicates that the capacitor type may fail in the open-circuit or short-circuit mode and is protected against fire or shock hazard.

Note: formerly referred to as P1

(S0) Indicates that the capacitor type has no specific failure protection.

Note: formerly referred to as P0

## 11. Temperature coefficient of capacitance $\alpha$

The change rate of capacitance with temperature measured over a specified range of temperature. It is normally expressed in parts per million per Celsius degree ( $10^{-6}/^{\circ}\text{C}$ ) and referred to  $20^{\circ}\text{C}$ .

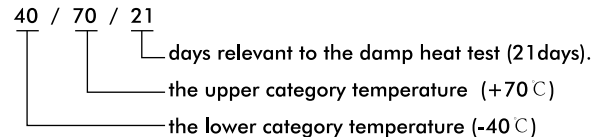
$$\alpha_i = \frac{C_i - C_0}{C_0(T_i - T_0)}$$

$C_i$ : Capacitance at temperature  $T_i$ .

$C_0$ : Capacitance at temperature  $T_0(20 \pm 2)^{\circ}\text{C}$ .

## 12. Climatic category

The climatic category which the capacitor belongs to is expressed in three numbers separated by slashes, (IEC 60068-1: example 40/70/21).



## 13. Insulation Resistance(IR) / Time Constant (t)

The insulation resistance is the ratio between an applied D.C. voltage and the resulting leakage current after a minute

of charge. It is expressed in  $\text{M}\Omega$ . The time constant is expressed in seconds with the following formula:  $t[s] = IR[\text{M}\Omega] \times C_N[\mu\text{F}]$

In general, Insulation resistance is used for describing smaller capacitance capacitors' insulation character, Time Constant for describing larger one's (example:  $C_N > 0.33\mu\text{F}$ ).

## 14. Self-healing (Only for metallized film capacitor)

The metal coatings of the metallized film, which are vacuum-deposited directly onto the plastic film, have a thickness of only several tens nm. 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.



### 三、使用薄膜电容器的注意事项:

#### 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)、电容量等因数的影响。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。

#### 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 $I=C \times dV/dt$ 。

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。

#### 3、谐波

谐波指的是电源中相对于50Hz或60Hz的多次正弦电流和电压波形。谐波主要由电网中的变频器、电子驱动器、焊机和UPS等电子设备负载引起。谐波会造成电容器的过电压、过电流:

##### 1.过电压

过电压会加速聚丙烯介质老化,缩短电容器寿命。一般来说,在额定电压之上,电容器电压每升高8%,电容器寿命会减半。同时,过电压会导致电容器局部放电强度加大,导致聚丙烯介质介电性能劣化,甚至突发性的击穿。

##### 2.过电流

过电流会使电容器损耗功率大幅增加,引起电容器异常发热,导致热击穿,严重缩短电容器寿命。

综上所述,谐波对电容器的危害十分严重,在电容器的使用过程中,所采用的电网必须符合国标GB/T 14549《电能质量 公用电网谐波》的相关规定。

#### 4、因薄膜振动产生的嗡鸣声

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。

### 三、Caution items in using plastic film capacitors

#### 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. For detail see the specification)

#### 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, temperature rise in it will occur and may cause deterioration of withstanding voltage, even lead to break 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.

#### 3. Harmonics

Harmonics are sinusoidal voltages and currents with frequencies that are multiples of a 50 Hz or 60 Hz power supply frequency. Harmonics result from the operation of electrical loads with non-linear voltage current characteristics. They are mainly caused by loads operated with modern electronic devices, such as converters, electrical drives, welding machines and uninterruptible power supplies (UPS).

Harmonics may cause overvoltage, overcurrent.

##### 1. Overvoltage

Overvoltage will accelerate aging of polypropylene film, which will reduce capacitor's life.

Generally speaking, overvoltage of 8% cuts life expectancy in half. At the same time, it will enhance local discharge, causing electric property worse, even suddenly broken down.

##### 2. Overcurrent

Overcurrent will add loss power, which will bring thundering heat inside capacitor, even hot-breaking down. It will reduce capacitor's life.

In a word, harmonics are seriously harmful. Therefore, when use capacitor, applied supply net must accord with GB/T 14549: Quality of electric energy supply, harmonics in public supply network or other IEC standards.

#### 4. 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 wave-form 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 to capacitor.

## 5、表面温升 ( $\Delta T$ )

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。

## 6、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。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。

## 7、贮存条件

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

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

温度：-40 °C 到35 °C

湿度：年平均值不超过70% RH

全年任意30天不超过80% RH

贮存时间：不超过12个月（从产品包装或产品本体上的日期算起）

## 四、绿色产品

### RoHS符合性

在此产品目录中的法拉公司的产品均符合RoHS指令和《电子信息产品污染控制管理办法》的要求。

## 五、客户订购指南

请尽量提供以下信息：

1. 额定电容量及允许偏差
2. 电压：包括额定电压、工作电压、纹波电压、非周期冲击电压等
3. 电流：包括最大电流、工作电流、最大峰值电流、最大冲击电流等
4. 频率：包括工作频率、脉冲频率、纹波电压的频率等
5. 工作环境：如温度范围、湿度、海拔等
6. 产品尺寸：如直径、高度或长度、宽度、高度等
7. 端子类型：如螺栓式、接线片、插片式等
8. 安全要求：如阻燃、防爆等
9. 预期寿命：在给定的工作条件下的预期寿命
10. 安装方式：如底部螺栓、中部卡圈、安装耳等
11. 其它：如果要使用该产品于交流滤波或其它场合，请事先联系我们的技术工程师。

## 5. Surface overtemperature ( $\Delta T$ )

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.

## 6. Humid ambient

If used for a long time in a humid ambient, the capacitor might absorb humidity and oxidise 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 an increase of capacitor losses.

## 7. Storage conditions

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

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

Temperature: -40 °C to 35 °C

Humidity: Average per year  $\leq 70\%RH$ ; For 30 full days randomly distributed throughout the year  $\leq 80\%RH$

Storage time:  $\leq 12$  months (from the date marked on the capacitor's body or the label glued to the package)

## 四、Green Products

### RoHS Compliance

Faratronic products in the catalogue are RoHS Compliant.

## 五、Guide for customer ordering

Please provide following information as possible as you can

1. Rated capacitance and tolerance
2. Voltage: including rated voltage, working voltage, ripple voltage, non-recurrent surge voltage etc
3. Current: including maximum current, working current, maximum peak current, maximum surge current etc.
4. Frequency: including working frequency, pulse frequency, frequency of ripple voltage etc.
5. Working environment: for example, temperature range, humidity, altitude etc.
6. Dimensions: for example, diameter, height or length, width, height etc.
7. Terminal form: for example, stud, lug, tab, etc.
8. Safety: for example, flame resistance, anti-explosion etc.
9. Expected lifetime: under given working conditions.
10. Fixed style: for example, bottom-stud, middle-clip, mounting ears etc.
11. Others: If use these AC motor capacitor in AC filter or other applications, please contact with our technical engineers.



## 六、产品编码说明 Part number system

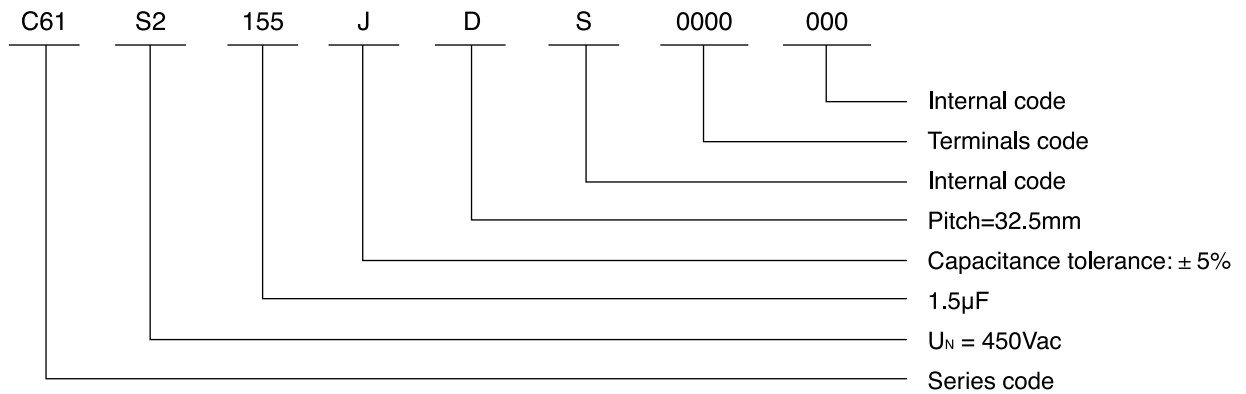
### ■ 18位产品代码如下：

The 18 digits part number is formed as follow:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
C	1	3															

第1~3位	型号代码	Digit 1 to 3	Series code
第4~5位	额定电压 (参见table 1)	Digit 4 to 5	Rated voltage(refer to table 1)
第6~8位	标称容量 $105=10 \times 10^5\text{pF}=1.0\mu\text{F}$	Digit 6 to 8	Rated capacitance value $105=10 \times 10^5\text{pF}=1.0\mu\text{F}$
第9位	容量偏差 $J=\pm 5\%, K=\pm 10\%$	Digit 9	Capacitance tolerance $J=\pm 5\%, K=\pm 10\%$
第10位	引线脚距(参见table 2) (适用于C61引线式)	Digit 10	Pitch (refer to table2) (for C61 tinned wire)
第10位	外形尺寸代码 (参照各个系列的说明)	Digit 10	Dimension code (related to each series)
第11位	内部特征码	Digit 11	Internal use
第12~15位	引出端代码 (参照各个系列的说明)	Digit 12 to 15	Terminals code (related to each series)
第16~18位	内部特征码	Digit 16 to 18	Internal use

### ■ 例如 for example



### ■ Table 1 额定电压代码 Rated voltage code

	A	B	C	D	E	F	G	H	J	K	L	M	N
1			16	20				50	63			1100	
2	100	125	160	200	250	315	400	500	630	800	120		
	P	Q	R	S	T	U	V	W	X	Y			
1	240	300	330	440	540	600	700	850	900				
2	275	305	350	450	520		760						

说明：参考日本JIS标准，字母加数字表示交流，数字加字母表示直流，例如A2表示100Vac，2A表示100Vdc  
Exemplation: Refer to JIS standard, Letter and then number indicate AC, but number and then Letter indicate DC, for example ,2A indicate 100Vdc, A2 indicate 100Vac.

### ■ Table 2 脚距代码 Pitch code

Code	9	A	B	C	D	F	H	M	R
Pitch	22.5	25.0	27.5	30	32.5	37.5	42.5	52.5	62.5