一、电子设备用薄膜电容器的标准体系

电子设备用固定电容器的标准体系是由基础标准，总规范，分规范，空白详细规范，以及详细规范（即企业标准）组成。或者说，企业标准是按总规范和分规范的基本要求，填写空白详细规范而成。

总规范规定了分规范和详细规范中使用的标准术语、检验程序和试验方法。分规范是按电容器的介质和结构分类的，它是对该类电容器规定优先额定值和特性，并从总规范中选择适当的质量评定程序、试验和测量方法，以及给出一般性能要求。空白详细规范是分规范的一种补充文件，它规定了详细规范的格式、编排和最基本的要求。

薄膜电容器的标准体系，举例如下：

一、The standard system of fixed plastic film capacitors for use in electronic equipment

The standard system of fixed plastic film capacitors for use in electronic equipment includes the foundational standard, generic specification, sectional specification, blankdetail specification and detail specification, or manufacturer specification. That is, a manufacturer specification is derived from blank detail specification according to the basic requirements of generic and sectional specifications. Generic specification specifies the terminology, inspection procedures and test methods applied in sectional and detail specifications. Sectional specification is classified according to the specific dielectric material and construction of capacitor, it prescribes preferred rating and characteristics and to select from generic specification the appropriate quality assessment procedures, tests and measuring methods and to give general performance requirements for this type of capacitor. Blank detail specification is a supplementary document to the sectional specification and contains requirements for style, layout and minimum contents of detail specifications.

Following please find the corresponding specification lists for plastic film capacitors.

标准号(No.)	标　准 (Standards)
GB/T 2693 (IEC 60384-1)	第 1 部分:总规范 **Part 1: Generic specification**
GB/T 7332 (IEC 60384-2)	第 2 部分：分规范：金属化聚乙烯对苯二甲酸酯膜介质直流固定电容器 **Part 2:Sectional specification: Fixed metallized polyethylene-terephthalate film dielectric d.c. capacitors**
GB/T 7333 (IEC 60384-2-1)	第 2-1 部分：空白详细规范：金属化聚乙烯对苯二甲酸酯膜介质直流固定电容器 评定水平 E 和 EZ **Part 2-1:Blank detail specification: Fixed metallized polyethylene-terephthalate film dielectric d.c. capacitors assessment levels E and EZ**
	注：聚乙烯对苯二甲酸酯膜以下简称聚酯薄膜 **Note:polyethylene-terephthalate film hereinafter referred to as Polyester Film**
	详细规范：**Detail specification for C25，C24，C23，C21，C22，C20，C92，C28**
GB/T 10188 (IEC 60384-13)	第 13 部分：分规范：金属箔式聚丙烯膜介质直流固定电容器 **Part 13: Sectional specification: Fixed polypropylene film dielectric metal foil d.c. capacitors**
GB/T 10189 (IEC 60384-13-1)	第 13-1 部分：空白详细规范：金属箔式聚丙烯膜介质直流固定电容器 评定水平 E 和 EZ **Part 13-1:Blank detail specification: Fixed polypropylene film dielectric metal foil d.c. capacitors assessment levels E and EZ**
	详细规范：**Detail specification for C13**
GB/T 6346.14 (IEC 60384-14)	第 14 部分：分规范：抑制电源电磁干扰用固定电容器 **Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains**
GB/T 6346.1401 (IEC 60384-14-1)	第 14-1 部分：空白详细规范：抑制电源电磁干扰用固定电容器 评定水平 D **Part 14-1:Blank detail specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains assessment level D**
	详细规范：**Detail specification for MKP62,MKP63,MKP64,MKP65,MKP66,MKP67,MKP61R,C4B,C4H,C4V**
GB/T 10190 (IEC 60384-16)	第 16 部分：分规范：金属化聚丙烯膜介质直流固定电容器 **Part 16: Sectional specification: Fixed metallized polypropylene film dielectric d.c. capacitors**
GB/T 10191 (IEC 60384-16-1)	第 16-1 部分：空白详细规范：金属化聚丙烯膜介质直流固定电容器 评定水平 E 和 EZ **Part 16-1:Blank detail specification: Fixed metallized polypropylene film dielectric d.c. capacitors assessment levels E and EZ**
	详细规范：**Detail specification for C30，C35，C82，C32，C37，C31，C14**
GB/T 14579 (IEC 60384-17)	第 17 部分：分规范：金属化聚丙烯膜介质交流和脉冲固定电容器 **Part 17: Sectional specification: Fixed metallized polypropylene film dielectric a.c. and pulse capacitors**
GB/T 14580 (IEC 60384-17-1)	第 17-1 部分：空白详细规范：金属化聚丙烯膜介质交流和脉冲固定电容器 评定水平 E 和 EZ **Part 17-1:Blank detail specification: Fixed metallized polypropylene film dielectric a.c. and pulse capacitors assessment levels E and EZ**
	详细规范：**Detail specification for C84，C33**
GB/T 15488 (IEC 60384-19)	第 19 部分：分规范：表面安装金属化聚乙烯对苯二甲酸酯膜介质直流固定电容器 **Part 19:Sectional specification: Fixed metallized polyethylene-terephthalate film dielectric surface mount d.c. capacitors**
GB/T 16467 (IEC 60384-19-1)	第 19-1 部分：空白详细规范：表面安装金属化聚乙烯对苯二甲酸酯膜介质直流固定电容器 评定水平 EZ **Part 19-1: Blank detail specification: Fixed metallized polyethylene-terephthalate film dielectric surface mount d.c.capacitors assessment level EZ**
	详细规范：**Detail specification for C57**

二、一些常用的标准术语

1. 上限类别温度

电容器设计所确定的能连续工作的最高环境温度。

2. 下限类别温度

电容器设计所确定的能连续工作的最低环境温度。

3. 额定温度

可以连续施加额定电压的最高环境温度。

4. 额定电压（U_R）

在下限类别温度和额定温度之间的任一温度下，可以连续施加在电容器上的最大直流电压或脉冲电压的峰值。

5. 类别电压（U_C）

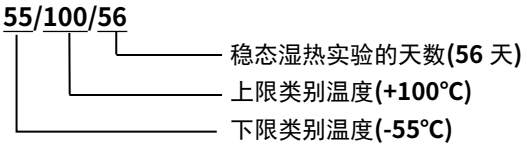
电容器在上限类别温度下可以连续施加在电容器上的最高电压。

6. 温度降额电压

温度降额电压是在额定温度和上限类别温度之间的任一温度下，可以连续施加在电容器上的最高电压。

7. 气侯类别

电容器所属的气侯类别用斜线分隔的三个数来表示（**IEC 60068-1：如：55/100/5**6）。



8. 损耗角正切（tanδ）

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。

二、Terminologies

1.Upper Category Temperature

The highest environmental temperature determined by capacitors design and in which capacitor may continuously work.

2.Lower Category Temperature

The lowest environmental temperature determined by capacitors design and in which capacitor may continuously work.

3.Rated Temperature

The highest environmental temperature in which capacitor applied continuously with the rated voltage.

4.Rate Voltage (U_R)

The maximum D.C. voltage or peak value of pulse voltage that can be applied continuously to capacitor at any temperature between lower category temperature and rated temperature.

5.Category Voltage (U_C)

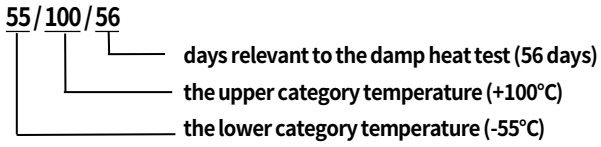
The maximum voltage that can be applied continuously to capacitor at upper category temperature.

6.Temperature Derated Voltage

The maximum voltage that can be applied continuously to capacitor at any temperature between rated temperature and upper category temperature.

7.Climatic category

The climatic category which the capacitor belongs to is expressed in three numbers separated by slashes,(IEC 60068-1:example 55/100/56).



8.Dissipation factor (tanδ)

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.

9. 容量温度系数(α)

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}/℃）表示。（10^{-6}/℃ = 1ppm/℃）

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

C_i：电容器在温度 T_i 时容量

C_0：电容器在 T_0(20±2)℃时的容量

9.Temperature coefficient of capacitance(α)

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}/℃）and referred to 20℃.

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

C_i: Capacitance at temperature T_i.

C_0: Capacitance at temperature T_0(20±2)℃.

10. 绝缘电阻(I.R.)/时间常数(t)

绝缘电阻为电容器充电一分钟后所加的直流电压和流经电容器的漏电流值的比值，单位为 MΩ。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：

$$t[s]=I.R.[M\Omega]\times C_N\ [\mu F]$$

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：$C_N > 0.33\mu F$）电容器的绝缘特性。

10.Insulation Resistance(I.R.) / Time Constant (t)

The insulation resistance is the ratio between an applied D.C. voltage and the resulting leakage current after a minute of charging. It is expressed in MΩ. The time constant is expressed in seconds with the following formula:

$$t[s]=I.R.[M\Omega]\times C_N\ [\mu F]$$

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

11. 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。

11.Self-healing(Only to 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、薄膜电容器的基本结构(Film capacitor basic construction)

电容器结构示意图(Different capacitor constructions)

C24(Cl23B),**C25**(CL25) **C21**(CL21),**C20**(CL20) **C22**(CL21X),**C23**(CL23) **C30**(CBB20),**C28**, **C92** **C31**(CBB21/A/B),**C57** **C42**(MKP62),**C44**(MKP64) **C4V**	**C14**(CBB81)	**C21**(CL21),**C31**(CBB21) **C26**(MKT61),**C29**	**C13**(CBB13)	**C4B**,**C45**(MKP65) **C4H**,**C43**(MKP63)
				—
	C82(MMKP82)	**C82**(MMKP82) **C84**(MMKP84)	**C84**(MMKP84)	—

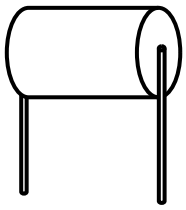
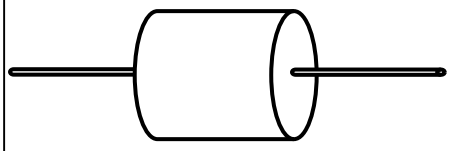
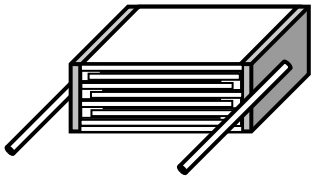
金属化薄膜
Metallized film

金属箔
Metal foil

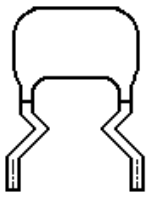
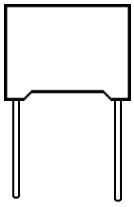
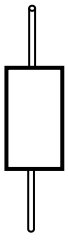
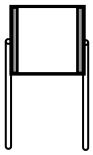
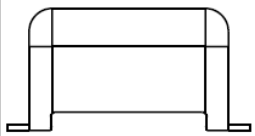
双面金属化膜
Double-sided metallized film

薄膜
Film

卷绕结构(Winding construction)

卷绕式径向产品 **(Wound capacitor,radial leads)**	卷绕式轴向产品 **(Wound capacitor, axial leads)**	叠片式产品 **(Stacked version capacitor)**
		

封装方式(Different seals)

浸渍型包封 **Dipped by epoxy resin**	盒式封装 **Sealed in box**	轴向 **Axial leads**	无包封 **Uncoated**	表面安装 **SMD**
				

四、典型特性、应用、以及特性曲线

1．典型特性

聚酯薄膜

- ◆ 工作温度范围宽
- ◆ 介电常数大
- ◆ 自愈特性好
- ◆ 容积比大
- ◆ 稳定性好

聚丙烯薄膜的特性

- ◆ 损耗极低
- ◆ 介质吸收系数低
- ◆ 绝缘电阻高
- ◆ 频率特性好
- ◆ 自愈特性好
- ◆ 稳定性很好

2. 典型应用

聚酯薄膜电容器

- ◆ 隔直和耦合
- ◆ 旁路
- ◆ 退耦
- ◆ 滤波
- ◆ 定时
- ◆ 低脉冲电路
- ◆ 振荡电路

聚丙烯薄膜电容器

- ◆ 高频脉冲应用
- ◆ 大电流场合
- ◆ 交流场合
- ◆ 高稳定的定时场合
- ◆ 开关电源系统和彩电行业
- ◆ 照明行业
- ◆ 工控行业
- ◆ 高 Q 滤波

四、Typical Properties, Applications and Typical graphs

1. Typical Properties

Polyester Film

- ◆ **Very wide operating temperature range**
- ◆ **High dielectric constant**
- ◆ **Excellent self-healing properties**
- ◆ **Very good ratio box size/capacitance**
- ◆ **Good stability**

Polypropylene Film

- ◆ **Very low dissipation factor**
- ◆ **Very low dielectric absorption**
- ◆ **Very high insulation resistance**
- ◆ **Good behaviour in frequency**
- ◆ **Excellent self-healing properties**
- ◆ **Very good stability**

2. Typical Applications

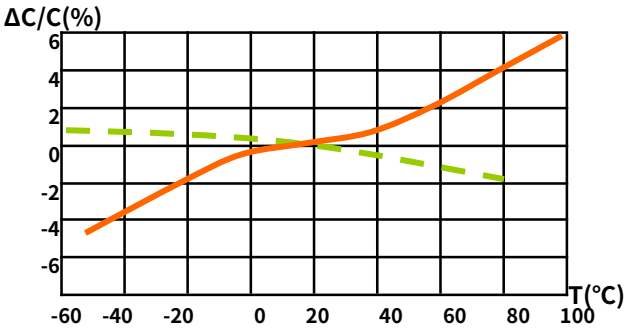
Polyester film capacitors

- ◆ **Blocking and Coupling**
- ◆ **By-passing**
- ◆ **Decoupling**
- ◆ **Filtering**
- ◆ **Timing**
- ◆ **Low pulse circuits**
- ◆ **Oscillator circuits**

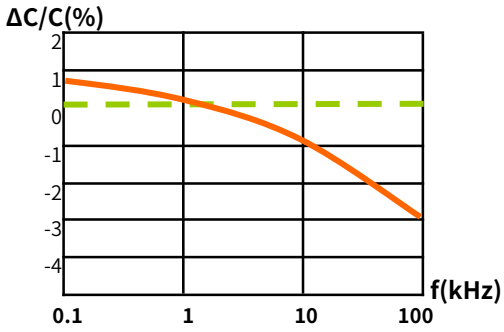
Polypropylene film capacitors

- ◆ **High frequency,pulse applications**
- ◆ **High current**
- ◆ **A.C. applications**
- ◆ **Timing with high stability**
- ◆ **SMPS and TV set.**
- ◆ **Lighting**
- ◆ **Industrial**
- ◆ **Filtering high Q**

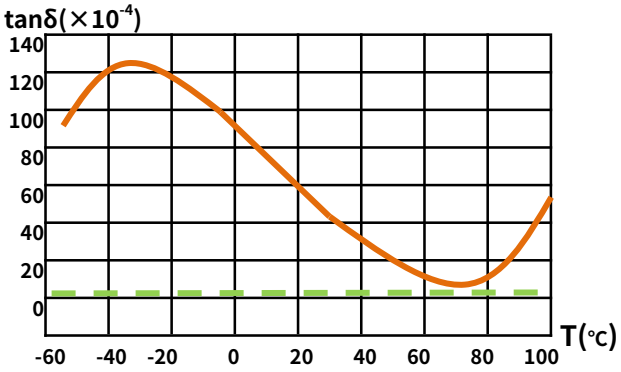
3. 特性曲线　Typical graphs



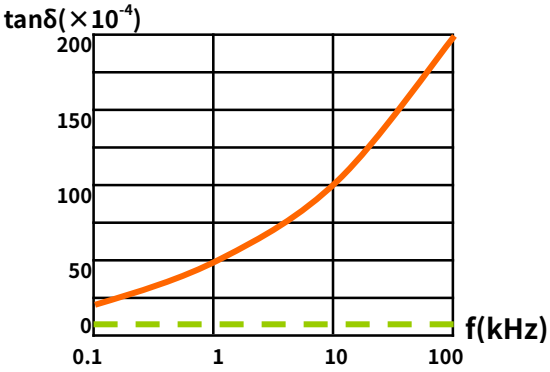
Capacitance vs. temperature at 1kHz



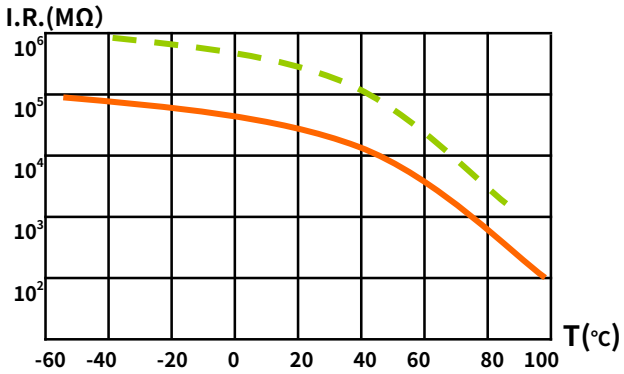
Capacitance vs. frequency (Room temperature)



Dissipation factor vs. temperature at 1kHz



Dissipation factor vs. frequency (Room temperature)



I.R. vs. temperature

聚丙烯薄膜（Polypropylene Film）

聚酯薄膜　（Polyester Film）

五、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。**C22、C35、C37** 系列电容不适合用于交流场合。

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。

工作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。

在高频或高脉冲条件下使用的电容器，我们推荐聚丙烯膜电容器或 **C24** 叠片式电容器。

3. 各种波形的有效值换算关系

不同的波形有效值按下面的公式计算。

五、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).C22,C35,C37 series isn’t suitable for AC applications.

2.Operating Current

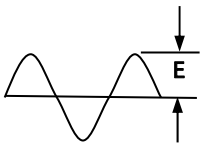
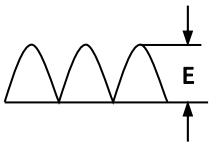
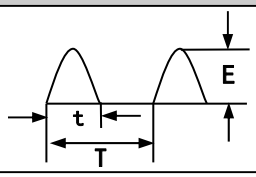
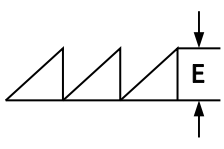
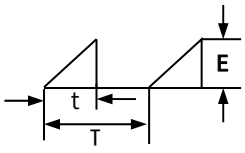
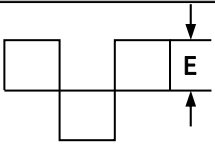
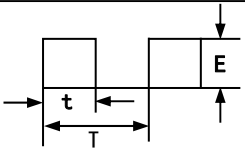
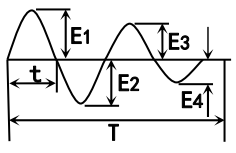
The pulse (or AC) current flowing through the capacitor is expressed as: I=C×dV/dt.

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 operating 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. Under the application of high frequency or high pulse ,we recommend to use the polypropylene film capacitor or C24 stacked capacitor.

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	$E\sqrt{t/T}$	$\sqrt{\frac{t}{2T}(E_1^2+E_2^2+E_3^2+E_4^2)}$

4. 抑制电源电磁干扰用电容器

4. 1 当在电源跨线电路中使用电容器来消除噪音时，不仅仅只有正常电压，还会有异常脉冲电压（如闪电）发生，这可能会导致电容器冒烟或者起火。所以，跨线电容器其安全标准在不同国家有严格规定。请使用经过安全认证型电容器。

不允许将直流电容器用作跨线电容器。

4. 2 X 类抑制电源电磁干扰用电容器

适用于在电容器失效时不会导致电击危险的场合，分为 X1、X2 二个类别（参见下表）。

4. 3 Y 类抑制电源电磁干扰用电容器

适用于在电容器失效时会导致电击危险的场合，分为 Y1、Y2、Y4 等三个类别（参见下表）。

4.Capacitor for electromagnetic interference suppression of AC power supply

4.1 When using a capacitor across-the-line as means for prevention of noise, not only the supply voltage is always applied, but also abnormal surge such as lighting is applied, which may lead to smoking or firing. Therefore, the across-the-line capacitor is strictly regulated in safety standard in each country. Please use the approved products which conform to corresponding safety standards of different countries.

The DC capacitor will not be used in across-in-line circuit.

4.2 Capacitor for electromagnetic interference suppression of AC power supply (Class X)

It is suitable for being used in situation where failure of the capacitor could not lead to danger of electric shock，classified as class X1 andX2（refer to the table below).

4.3 Capacitor for electromagnetic interference suppression of AC power supply (Class Y)

It is suitable for being used in situation where failure of the capacitor could lead to danger of electric shock, classified as class Y1,Y2 and Y4（refer to the table below).

类别 Class	使用时的峰值脉冲电压 kV Peak pulse voltage in service(kV)	应　用 Application	耐久性实验前施加的峰值脉冲电压 U_P(kV) Peak impulse voltage,Up, before endurance test (kV)
X1	＞2.5，≤4.0	高脉冲应用 High pulse application	$C_N \leq 1.0\mu F$, 4.0 $C_N > 1.0\mu F$, $4/\sqrt{C_N}$
X2	≤2.5	一般用途 General purpose	$C_N \leq 1.0\mu F$, 2.5 $C_N > 1.0\mu F$, $2.5/\sqrt{C_N}$

类别 Class	额定电压 Rated Voltage(Vac)	耐久性实验前施加的峰值脉冲电压 U_P(kV) Peak impulse voltage Up before endurance test (kV)
Y1	≤500	8.0
Y2	≥150，≤500	$C_N \leq 1.0\mu F$, 5.0; $C_N > 1.0\mu F$, $5/\sqrt{C_N}$
Y4	＜150	2.5

类别 Class	额定电压 Rated Voltage(Vac)	耐电压 Voltage Proof	
		引线之间 Terminal to terminal	极壳之间 Terminal to case
X1、 X2	≤1 000	4.3 U_R (d.c.)	2 U_R + 1 500 V(a.c.)with a minimum of 2 000 V(a.c.)
Y1	≤500	4 000 V(a.c.)	4 000 V(a.c.)
Y2	≥150，≤500	U_R + 1 200 V(a.c.) with a minimum of 1 500 V (a.c.) [1)]	2 U_R + 1 500 V(a.c.)with a minimum of 2 000 V(a.c.)[1)]
Y4	<150	900 V (a.c.) [1)]	900 V (a.c.) [1)]

[1)] Y2 类和 Y4 类电容器的逐批试验，交流试验电压可以用规定交流电压 1.5 倍的直流电压代替。
For lot-by-lot tests of Class Y2 and Y4-capacitors, the a.c. test voltage may be replaced by a d.c. voltage of 1.5 times the prescribed a.c. voltage.

5. 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，请串联一个 20Ω/V~1 000Ω/V 或更高的限流电阻，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 20Ω/V~1 000Ω/V 或更高的限流电阻。详见电容器标准。

5.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 to 1 000Ω/V or more to limit current.

When connecting multiple film capacitors in parallel in withstand voltage test or life test, connect a resistance of 20Ω/V to 1 000Ω/V or more in series to each capacitor.(For detail see the specification).

6. 因薄膜振动产生的翁鸣声

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。

6.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.

7. 表面温升（△T）

7.1 当电容器用于交流及脉冲场合时，流经电容器的电流使其发热，如果发热量过大，会导致电容器短路甚至燃烧。所以流经电容器的电流不能超过产品目录所规定的最大数值及电容器在加载时监测温升就显得尤为必要。

7.2 测量电容器表面温升的方法如图 1，被测试电容器必须施加交流（工作频率）、脉冲电压。

7．Surface overtemperature （△T）

7.1 When capacitor is used in A.C. or pulse applications, the current that flows through the capacitor makes it heat up. If the capacitor heats up too much it might deteriorate causing a short circuit or fire. The limits described in the catalogue are not exceeded and it's necessary to check temperature on the capacitor when it's working.

7.2 Method for determining the surface overtemperature of the capacitor is showed in fig.1. The capacitor being tested must be supplied by A.C. or pulse voltage and frequency.

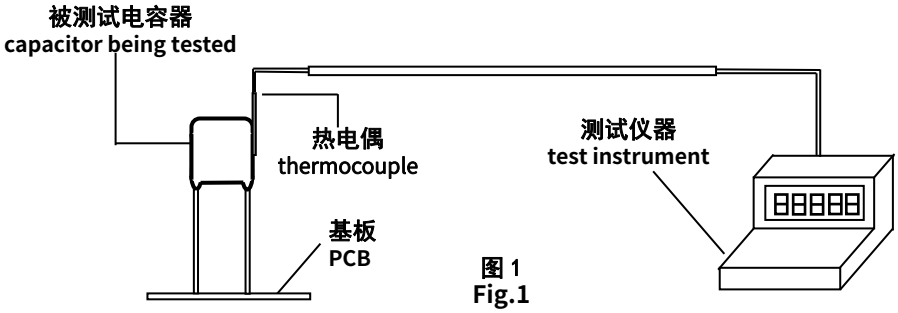
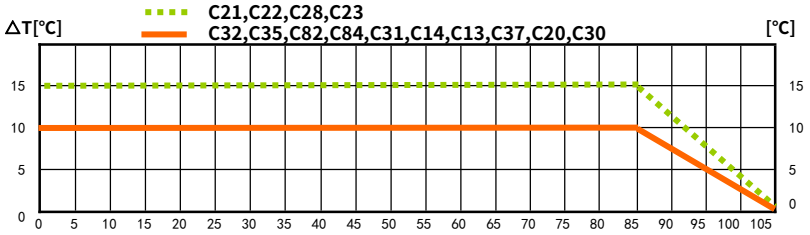
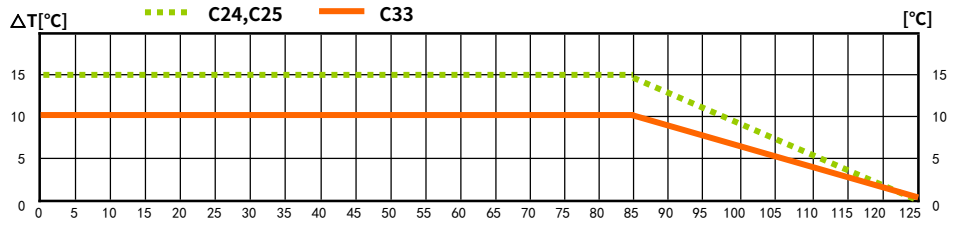
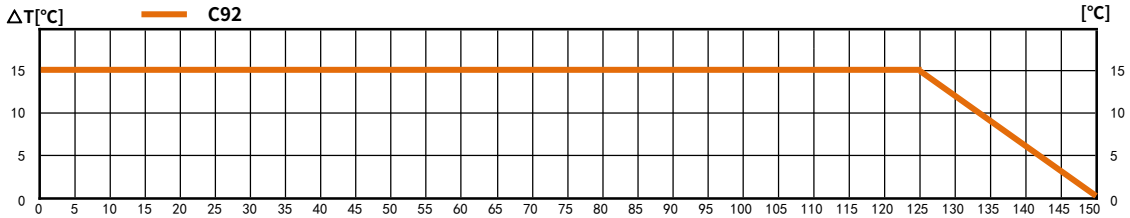


图 1
Fig.1

7.3 各型号电容表面允许的最大温升 **Maximum self temperature rise for all series**







注：如果有超出要求的请联系我们技术工程师。

Note：If you need the temperature more than above, please contact our engineers.

8. 阻燃性

尽管在薄膜电容器外封装中使用了耐火性阻燃材料--阻燃环氧树脂或塑壳，但外部的持续高温或火焰仍可使电容器芯子变形而产生外封装破裂，导致电容器芯子熔化或燃烧。

对于抑制电源电磁干扰电容器，要求的阻燃类别等级为 **B**。当电容器体积小于 **1750mm^3** 时，阻燃类别等级为 **C** 也是允许的。

8.Passive flammability

Although flame retardation epoxy resin or plastic case is used in the coating or encapsulating of plastic film capacitor, continuous outer high temperature or firing will break the coating layer or plastic case of the capacitor ,and may lead to melting and firing of the capacitor element.

For interference suppression capacitors, the preferred category is B. But for components smaller than 1750mm^3, passive flammability category C is permitted.

阻燃类别(Category of flammability)	针对电容器体积范围（mm^3）施加火焰时间（s）				最大燃烧时间(s)
	体积≤250	250＜体积≤500	500＜体积≤1750	1750＜体积	
A	15	30	60	120	3
B	10	20	30	60	10
C	5	10	20	30	30

9. 几种特殊工作环境

9.1 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，从而引起电容值下降、损耗值增加。在 AC 应用情况下，如果超出下表的条件，影响将会更严重，对详细的信息请联系我们技术工程师。

9．Special working conditions

9.1 Humid ambient

If used for a long time in a humid ambient, the capacitor might absorb humidity and oxidize the electrodes causing breakage of the capacitor. If case of AC application, high humidity would increase the corona effect . This phenomenon causes a drop in the capacitance value. In case of working condition in AC application more severe than following table, please contact our engineers for detailed information.

	Working Temperature	Relative Humidity
Average for year	25℃	70%
2 weeks continuously	30℃	90%

9.2 PCB 板组装：灌胶

如果电容器有被灌树脂，下列的情况将可能会发生：

a. 树脂里的溶剂可能会影响电容器的特性；

b. 在聚合过程中产生的热将会损坏电容器。

9.3 PCB 板组装：红胶固化

因为过高的温度会有可能损害电容器，我们建议产品的插件动作在红胶固化工序后进行。当必须提前时，请评估所使用的红胶固化温度曲线是否适合插件产品。

10. 焊接建议

为达到更好的可焊性，我们建议遵照下列的标准。

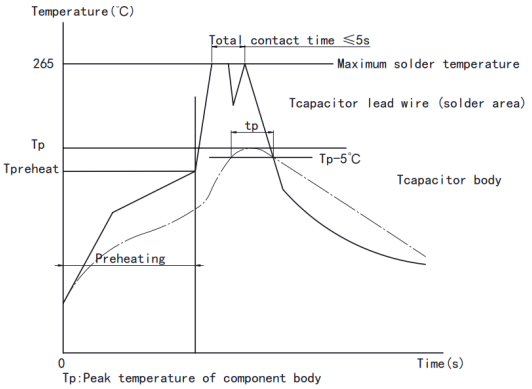
10.1 最大焊接温度

10.1.1 手动焊接

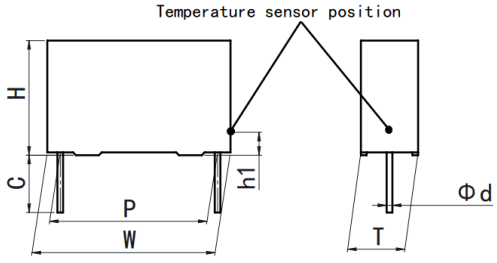
最高温度：**350℃**，时间：**3s**

10.1.2 波峰焊

波峰焊工艺过程中有较多因素对薄膜电容器受热有影响，如：预热温度、预热时间、锡炉温度、过锡炉时间、其他热源影响等。



因为过热有可能会损害电容器，我们建议关注电容器最高温度以及耐热时间，用热电偶检测电容本体最高温度 Tp（测量位置参考下图）



9.2 PCB Assembling : Filling with Resin

If the capacitor is placed in resin, the following situations might occur:

a. The solvent contained the resin might deteriorate the characteristics of the capacitor;

b. The heat generated during the polymerizations might damage the capacitor.

9.3 PCB Assembling: Adhesive curing oven

Because the high temperature of adhesive curing will damage the capacitors, so we suggest that leaded parts must be fixed after the adhesive curing process . When must be ahead , please estimate if the curing curve is suitable for capacitors.

10.Soldering suggestions

In order to obtain a good solderability, we suggest to observe the following rules.

10.1 Max soldering temperature

10.1.1 Manual soldering

Max. temperature:350℃, time:3s

10.1.2 Wave soldering

There are many factors affecting the heating of film capacitor during the wave soldering process, such as: preheating temperature, preheating time, soldering temperature, soldering time, other heat sources influence and so on.

The typical soldering profile is as below:

Because overheating could damage the capacitor, we recommend paying attention to the maximum capacitor temperature and heating time, use temperature sensor to detect the maximum capacitor body temperature

测温点位置 Temperature sensor position(Tcapacitor body)	电容器引线侧的外壳表面，电容距离 PCB 板高度：h1=2 mm~3mm 的位置 The capacitor body surface of lead side, capacitor height position from PCB: h1=2 mm~3mm		
焊接过程电容本体最高耐热温度 Maximum capacitor body temperature T_p(℃)	OPP film P≤15mm	OPP film P>15mm	PET film
	115	120	125
焊接过程电容引脚最高耐热温度 Maximum capacitor lead wire temperature(℃)	265	265	265
焊接过程电容本体最长耐热时间 Maximum capacitor body heating time tp=T_p-5℃	30s		

10.2 如果需要焊接两次，第二焊接必须等到电容器恢复到常温。

10.3 插件产品仅适合做波峰焊接。

11. 贮存条件

11.1 由于大气中存在氢氯化物、氢硫化物、硫酸物质等，所以产品贮存在大气中，必须注意引出端的可焊性会变差。

11.2 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℃ 到 35℃；

湿度：年平均值不超过 70% RH

全年任意 30 天不超过 80% RH

引线式产品贮存时间（从产品包装或产品本体上的日期算起）：

散装产品（塑料袋包装）：不超过 24 个月。

径编和排列产品：不超过 12 个月。

SMD 产品贮存时间（从产品包装或产品本体上的日期算起）：不超过 12 个月。

11.3 SMD 产品作业条件：打开包装袋后，最佳生产时间和环境：72h 以内，温度<30℃，湿度<60%RH；如超出 72h，应及时放置在湿度<10%RH 的干燥柜内保存；再次作业时也应遵守此规则。建议在回流焊前对产品进行如下干燥处理：将产品包装袋拆开，敞开在鼓风干燥箱内(55℃±5℃，湿度<10%RH，72 h 以上)进行干燥，降低产品受潮影响。当产品受潮时，请与我司工程师联系处理方式。

六、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。

七、在订购或索要样品之前，请尽可能多地提供以下信息：

1. 额定工作电压：DC，AC；
2. 电容量及电容量允许偏差：J、K、M 等；
3. 最终产品种类：开关电源、绿色照明、变频器、UPS、车载电源、充电桩等等；
4. 用途或电路图：直流回路、交流脉冲回路，电源跨线噪音抑制电路、高稳定性电路、DC-link、DC-filter、降压、PFC 等等；
5. 使用条件：脉冲峰值，频率，波形，电流等等；
6. 使用温度；
7. 外形尺寸：电容器本体尺寸，引出线尺寸等等；
8. 形状：包封形式（浸渍型、盒式等），引出线（直脚、成型、编带等等）；
9. 安全性：当电容器短路或开路时对其他部件的影响，当其它部件或电路工作异常时对电容器的影响
10. 焊接条件：SMD、引线式；
11. 安装方式：PCB 板、绝缘引线等。

10.2 If re-working or dipping twice is necessary, it should be done after the capacitor returns to the normal temperature.

10.3 Plug parts only suitable for wave soldering.

11．Storage conditions:

11.1 It must be noted that the solderability of the terminals may be deteriorated when stored in an atmosphere filled with moisture, dust, or areactive oxidizing gas.(hydrogen chloride, hydrogen sulfide, sulfuricacid,etc.)

11.2 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 ≤ 70%RH; For 30 full days randomly distributed throughout the year≤80%RH

Storage time for tinned lead wire:(from the date marked on the capacitor's body or the label glued to the package):

Bulk(packed with plastic bag): ≤24 months;

Taping and line up: ≤12 months;

Storage time for SMD(from the date marked on the capacitor's body or the label glued to the package): ≤12 months.

11.3 The permanence conditions for SMD: after opening the packing bag, the best produce time and surroundings is in 72h,temperature <30°C, humidity <60%RH; If more than 72 h, it should be kept in the <10%RH drying cabinet in a timely manner, and the rules should be followed during the next production. Suggest that dry the product before the reflow: open the packing bag in the drying box (55°C±5°C, the humidity <10%RH, more than 72 h), reduce the bad probability due to damp.When the product is damp, please contact our engineer.

六、Green Products

RoHS Compliance

Faratronic products in the catalogue are RoHS Compliant.

七、When placing an order or inquiring sample, please specify the following, as much as you can.

1.Rated voltage: DC, AC.

2.Capacitance value and capacitance tolerance: J, K, M etc.

3.Finished product: Switching power, Green lighting,Transducer, UPS, Vehicular power,Charging pile etc.

4.Application or circuit diagram: DC circuit, AC pulse circuit,interface noise suppression circuit, high stability circuit DC-link,DC-filter, capacitive divider,PFC etc.

5.Condition of operation: pulse peak, frequency, waveform, current etc.

6.Operating temperature.

7.Dimensions: body, lead space, etc.

8.Shape: enclosure(dip, case, etc), lead wire(straight, crimped, taping etc).

9.Safety: Influence to the other component, when the capacitor gets short-circuited or open. Influence to the capacitor, when the other component or the circuit works irregularly.

10.Welding condition:SMD or tinned-lead-wire type.

11.Fixed style:PCB,insulated lead wire etc.

八、引线式产品的包装方式 Packing for tinned-wire capacitors

1．塑料外壳电容器径向编带说明 Taping specification for box-type capacitor

■ 外形图 Outline Drawing

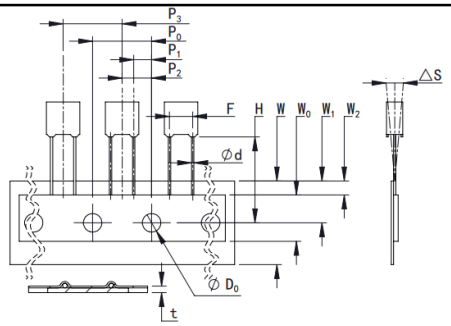


图 1 Fig.1 引出线间距 P=5.0、7.5mm

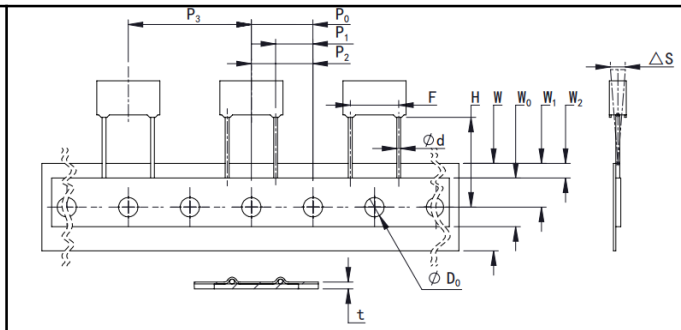


图 2 Fig.2 引出线间距 P=10.0、15.0mm

■ 编带尺寸表 Taping Dimensions(mm)

技术指标名称	代号	尺寸				
		P=5.0	P=7.5	P=10.0	P=15.0	误差
编带类型	—	图 1 Fig 1	图 1 Fig 1	图 2 Fig2	图 2 Fig 2	——
Part number Digit12-15	Ammo-pack	A201	A301	A405	A605	
电容器间距	P_3	12.7	12.7	25.4	25.4	±1.0
送带孔距	P_0^*	12.7	12.7	12.7	12.7	±0.3
引出线位置	P_1	3.85	2.6	7.7	5.2	±0.7
电容器本体位置	P_2	6.35	6.35	12.7	12.7	±1.3
引出线间距	F^{**}	5.0	7.5	10.0	15.0	+0.6 -0.1
电容器侧面倾斜	△S	0	0	0	0	±2.0
电容器底部至带孔中心距离	H^{***}	18.5	18.5	18.5	18.5	±0.5
纸带宽度	W	18.0	18.0	18.0	18.0	+1.0 -0.5
胶带纸宽度	W_0	8min (T2.5/3.5)	10min	10min	10min	——
送带孔位置	W_1	9.0	9.0	9.0	9.0	±0.5
胶带纸位置	W_2	3max	3max	3max	3max	——
送带孔直径	D_0	4.0	4.0	4.0	4.0	±0.2
编带总厚度	t	0.7	0.7	0.7	0.7	±0.2

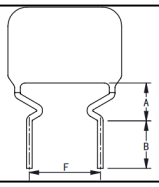
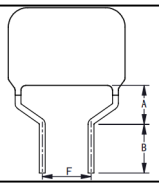
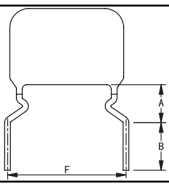
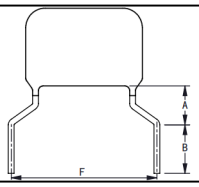
Note: * P_0=15mm is also available; * P_0=15mm 是可行的
**F can be other lead spacing; **F 可以是其他间距
***H=16.5mm is available; ***H=16.5mm 是可行的
If you need other taping, please contact us.如果需要其它编带，请联系我们。

■ 包装数量 Packing Quantity

Pitch (mm)	Box thinkness T(mm)	Ammo-pack (pcs/box)
5.0	2.5	2 800
	3.5	2 100
	4.5	1 700
	5.0	1 500
	6.0	1 200
	7.5	1 000
7.5	3.5	2 100
	4.0	1 900
	5.0	1 500
	6.0	1 200
10.0/ 15.0	4.0	900
	5.0	700
	6.0	600
	7.0	500
	7.5	480
15.0	8.0	450
	8.5	420
	10.0	250
	11.0	220

2．浸渍型电容器包装说明 Packing for dipped-type capacitor

2. 1 浸渍型电容器引出线成型形状 Lead kinked for dipped-type capacitor

代号 Code	I	II	III	IV
成型形状 Forming shape				
适用范围 Applicable range	P ≥ F		P < F	
	0mm≤P-F≤3mm	3mm<P-F≤8mm	3mm<F-P≤5mm	0mm<F-P≤3mm
尺寸标准 Dimension standard	A≤5.0mm；B=4.5mm±0.5mm;F 允许偏差为±0.8mm（The permissible tolerance of 'F' is±0.8mm）			

2. 2 浸渍型电容器径向编带说明 Taping for dipped-type capacitor

■ 外形图 Outline Drawing

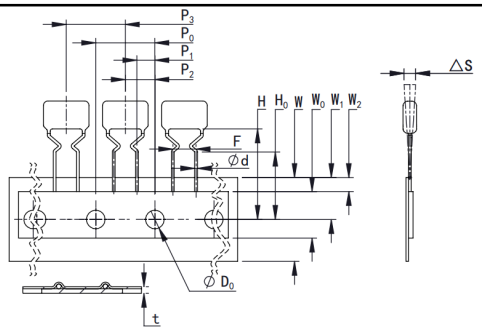


图 1 Fig.1

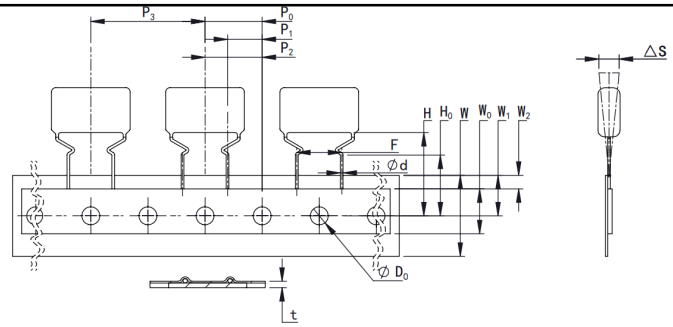


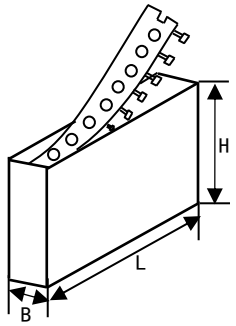
图 2 Fig.2

■ 编带尺寸表 Taping Dimensions(mm)

技术指标名称	代号	尺 寸				
		P=5.0	P=7.5	P=10.0	P=15.0	误差
编带类型	—	Fig.1	Fig.1	Fig. 2	Fig. 2	——
Part number Digit12-15	Ammo-pack	A21A	A31A	A41E	A61E	
电容器间距	P_3	12.7	12.7	25.4	25.4	±1.0
送带孔距	P_0	12.7	12.7	12.7	12.7	±0.3
引出线位置	P_1	3.85	2.60	7.7	5.2	±0.7
电容器本体位置	P_2	6.35	6.35	12.7	12.7	±1.3
成型间距	F**	5.0	7.5	10.0	15.0	+0.8 -0.2
电容器侧面倾斜	ΔS	0	0	0	0	±2.0
电容器高度	H	20.0	20.0	20.0	20.0	±1.0
弯脚高度	H_0	16.0	16.0	16.0	16.0	±0.5
纸带宽度	W	18.0	18.0	18.0	18.0	+1.0 -0.5
胶带纸宽度	W_0	10min	10min	10min	10min	——
送带孔位置	W_1	9.0	9.0	9.0	9.0	+0.75 -0.5
胶带纸位置	W_2	3max	3max	3max	3max	——
送带孔直径	D_0	4.0	4.0	4.0	4.0	±0.3
编带总厚度	t	0.7	0.7	0.7	0.7	±0.2

Note: * P_0=15mm is also available; *P_0=15mm 是可行的
** F can be other lead spacing; ** F 可以是其他间距的

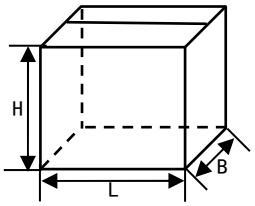
3. 3 径向编带包装箱尺寸 (Box size for Ammo-pack)



L=335±3
B=55/50±3
H=265/350±3

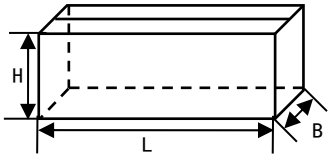
3. 包装箱尺寸 Packing in bulk（mm）

3. 1 散装外包装箱尺寸 (Out packing box for bulk)



L=375±5
B=375±5
H=265±5

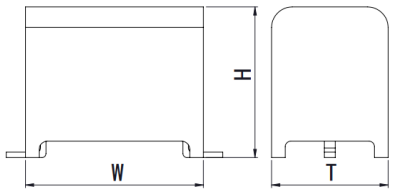
3. 2 散装内包装箱尺寸 (Inner packing box for bulk)



L=355±3
B=175±3
H=118±3

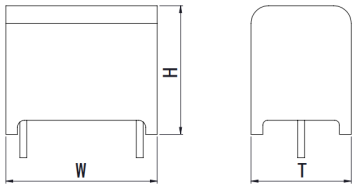
九、表面安装电容器 SMD Capacitor

■ SMD 产品外型图 Outline drawing



W±0.4, H±0.4, T±0.4

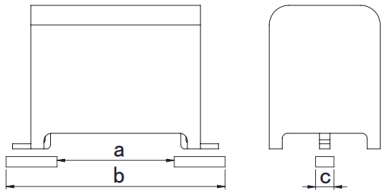
a



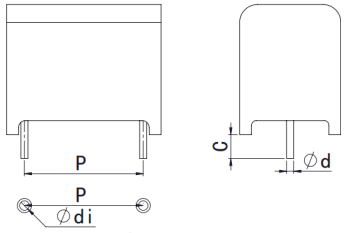
W±0.4, H±0.4, T±0.4

b

■ 安装尺寸图 Layout



a



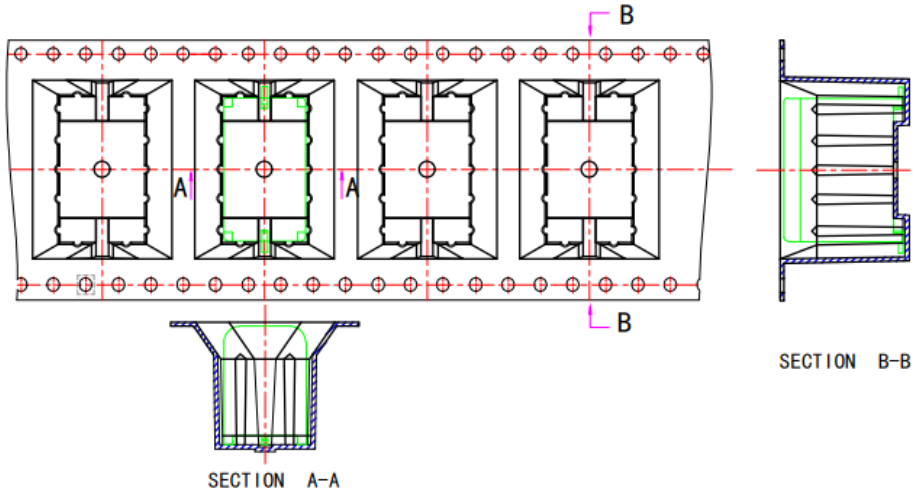
b

注:产品外形 a 图和 b 图的不同只有引线成型不一样。
Note:The difference in the outline drawing between figure a and figure b is that the lead forming.

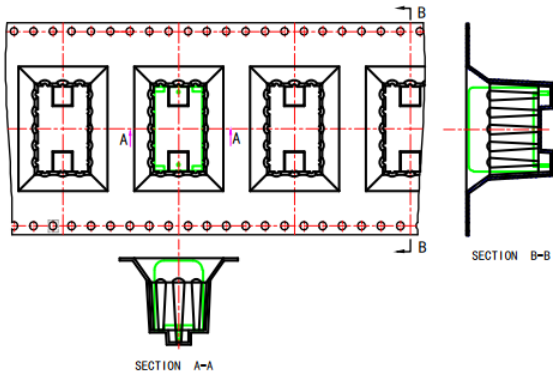
■ 安装尺寸表 Recommended PCB layout (mm)

图号 Figure No.	尺寸代码 Dimension Code		5235	7028	7032	7036	7040	7046	A544
	产品尺寸 Dimension	W	13.0	17.5	17.5	17.5	17.5	17.5	26.5
		T	8.5	7.0	8.0	9.0	10.0	11.5	11.0
a	安装尺寸 Layout	a	8.4	13.4	13.4	13.4	13.4	13.4	25.5
		b	17.8	22.3	22.3	22.3	22.3	22.3	32.1
		c	1.6	1.6	1.6	1.6	1.6	1.6	1.6
b	安装尺寸 Layout	W	13.0	17.5					
		P	10.0	15.0					
		di	1.0	1.0					

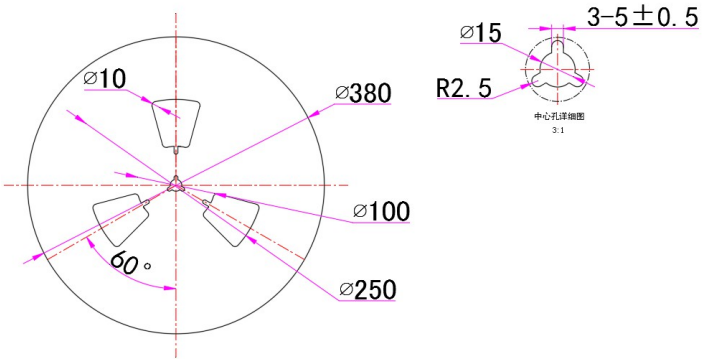
■包装方式 Packing



编带a Taping a



编带 b Tapingb



收卷盘 Packaging

十、产品编码说明 Part number system

■ 15 位产品代码如下：

The 15 digits part number is formed as follow:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
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 2）	Digit 4 to 5	Rated voltage(refer to table 2)
第 6~8 位	标称容量	Digit 6 to 8	Rated capacitance value
	举例：103=10×10³pF=0.01μF		for example: 103=10×10³pF=0.01μF
第 9 位	容量偏差	Digit 9	Capacitance tolerance
	G=±2%， H =±3%, J=±5%		G=±2%， H =±3%, J=±5%
	K=±10%, M=±20%		K=±10%, M=±20%
第 10 位	引线脚距 P（参见 table 3）	Digit 10	Pitch(refer to table 3)
	（引线式产品）		(for tinned-lead-wire type)
第 10 位	对于 SMD 是包装代码，参照其系列说明	Digit 10	Packaging code(related to SMD series)
第 11 位	内部特征码	Digit 11	Internal use
第 12~15 位	引线加工和包装代码（参见 table 4）	Digit 12 to 15	Lead form and packaging code(refer to table 4)
	（引线式产品）		(for tinned-lead-wire type)
第 12~15 位	对于 SMD 是安装尺寸代码，参照其系列说明	Digit 12 to 15	Layout code(related to SMD series)

■ 例如 for example

C24 1J 102 J 2 0 A201 000

- 000 — Internal code
- A201 — Ammo-pack
- 0 — Internal code
- 2 — Pitch=5.0
- J — Capacitance tolerance
- 102 — 0.001uF
- 1J — U_R = 63V
- C24 — Series code

■ Table 1 型号代码对照 Series Code

代码 Code	型号 Type	代码 Code	型号 Type	代码 Code	型号 Type	代码 Code	型号 Type
C13	CBB13	C25	CL25	C40	MKP61R	C4R	MKP62+R
C14	CBB81	C26	MKT61	C42	MKP62	C82	MMKP82
C20	CL20	C30	CBB20	C43	MKP63	C84	MMKP84
C21	CL21	C31	CBB21	C44	MKP64		
C22	CL21X	C32	MKP21	C45	MKP65		
C23	CL23	C33	MKP23	C46	MKP66		
C24	CL23B	C35	MKP25	C47	MKP67		

■ Table 2 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		
3	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	1200	1400	
	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						
3	280	310		480									

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**

Explanation: 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 3 脚距代码 Pitch code

Code	0	2	3	4	5	6	8	9	A	B
Pitch	axial	5.0	7.5	10	12.5	15	20	22.5	25.0	27.5
Code	C	D	F	H	M	R				
Pitch	30	32.5	37.5	42.5	52.5	62.5				

（以上表格中不包括 **CBB13,CBB11,CL11** 和精密电容的脚距代码）

(The pitch code of CBB13,CBB11,CL11 and precision cap aren't included in the above table.)

■ Table 4 引线加工和包装代码 Lead form and packaging code

第 12 位 Digit 12		第 13 位 Digit 13		第 14 位 Digit 14		第 15 位 Digit 15	
代码 Code	说明 explanation	代码 Code	说明 explanation	代码 Code	说明 explanation	代码 Code	说明 explanation
A	弹带包装 ammo-pack	2 3 4 6	F=5.0mm F=7.5mm F=10.0mm F=15.0mm	0 1	表示直脚 straight 表示弯脚 kinked	1	产品在连续的两个载带孔之间each cap. between two consecutive holes P3=12.7mm,H=18.5mm (For pitch=5.0/7.5mm)
						5	P3=25.4mm;H=18.5mm (For pitch=10.0/15mm)
						A	产品在连续的两个载带孔之间 each cap. among two consecutive holes P3=12.7mm,H=20.0mm (For pitch=5.0/7.5mm)
						E	P3=25.4mm;H=20.0mm (For pitch=10.0/15.0mm)
							(Detail information refer to page 16 and 17)
F	引线成型 lead kinked (in bulk)	2 3 4 6	F=5.0mm F=7.5mm F=10.0mm F=15.0mm	0	B=4.5mm (the length of B)	0	B 的长度偏差±0.5mm B Length tolerance ±0.5mm
C or Y	散装切脚 straight lead or cut lead (in bulk)	代码 Code	说明 explanation			0	引线长度偏差±0.5mm 或标准长度 Length tolerance ±0.5mm(or standard length)
		00	标准的引线长度(16mm min) standard lead length				
		45	引线长度 4.5mm lead length 4.5mm				