

# Metallized Polyester Film D.C Capacitor

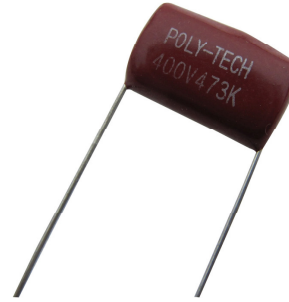
PC09 series are non-inductively wound with metallized polyester film as the dielectric/electrode with copper-clad steel leads and epoxy resin coating.

## Features

- \* Suitable for blocking by-pass and coupling of DC and signals to VHF range
- \* Widely used in filter, noise suppression and low pulse circuits
- \* Excellent self-healing property and long life
- \* Wide capacitance range, small size and light weight

## Specifications

- \* Reference Standard: GB7332 (IEC60384-2)
- \* Operation Temperature Range: -40°C to +85°C (40/85/21)
- \* Rating Voltage: 100V, 250V, 400V, 630VDC
- \* Capacitance Range: 0.01 - 10.0uF
- \* Capacitance Tolerance: 5%(J), 10%(K)
- \* Voltage Proof: 1.6 Ur (2s)
- \* Dissipation Factor:  $\leq 0.01$  Max AT 1KHZ & +20°C
- \* Insulation Resistance:  $U_r > 100VDC \geq 7500M\Omega$   $C_r \leq 0.33\mu f$  +20°C±5°C FOR 1 min  
 $U_r > 100VDC \geq 2500S$   $C_r > 0.33\mu f$  +20°C±5°C FOR 1 min  
 $U_r \leq 100VDC \geq 3750M\Omega$   $C_r \leq 0.33\mu f$  +20°C±5°C FOR 1 min  
 $U_r \leq 100VDC \geq 1250S$   $C_r > 0.33\mu f$  +20°C±5°C FOR 1 min



## DIMENSIONS

(uF)	100VDC					250VDC					400VDC					630VDC				
	W	H	T	P	D	W	H	T	P	D	W	H	T	P	D	W	H	T	P	D
0.01	13.5	9.00	4.0	10.0	0.6	13.5	9.0	4.0	10.0	0.6	13.5	9.0	4.0	10.0	0.6	13.5	9.0	4.0	10.0	0.6
0.015	13.5	9.5	4.0	10.0	0.6	13.5	9.5	4.0	10.0	0.6	13.5	9.5	4.5	10.0	0.6	13.5	9.5	4.5	10.0	0.6
0.022	13.5	9.5	4.5	10.0	0.6	13.5	10.0	4.5	10.0	0.6	13.5	10.0	5.0	10.0	0.6	13.5	10.0	5.0	10.0	0.6
0.033	13.5	10.0	4.5	10.0	0.6	13.5	10.0	4.5	10.0	0.6	13.5	10.0	5.0	10.0	0.6	13.5	11.0	5.5	10.0	0.6
0.039	13.5	10.0	5.0	10.0	0.6	13.5	10.0	5.0	10.0	0.6	13.5	10.0	5.5	10.0	0.6	13.5	11.5	6.0	10.0	0.6
0.047	13.5	10.0	5.0	10.0	0.6	13.5	10.0	5.0	10.0	0.6	13.5	10.5	5.5	10.0	0.6	14.0	13.0	6.0	10.0	0.6
0.056	13.5	10.0	5.0	10.0	0.6	13.5	10.0	5.0	10.0	0.6	13.5	11.0	5.5	10.0	0.6	14.0	13.5	6.5	10.0	0.6
0.068	13.5	10.5	5.5	10.0	0.6	13.5	10.5	5.5	10.0	0.6	13.5	11.0	6.0	10.0	0.6	14.0	14.0	7.0	10.0	0.6
0.082	13.5	10.5	5.5	10.0	0.6	13.5	10.5	5.5	10.0	0.6	13.5	11.5	6.0	10.0	0.6	14.0	15.0	8.5	10.0	0.8
0.1	13.5	10.5	5.5	10.0	0.6	13.5	10.5	5.5	10.0	0.6	14.0	13.0	6.0	10.0	0.6	19.5	13.0	6.5	15.0	0.8
0.12	13.5	10.5	5.5	10.0	0.6	13.5	10.5	5.5	10.0	0.6	14.0	13.5	7.0	10.0	0.6	19.5	13.5	7.0	15.0	0.8
0.15	13.5	11.0	6.0	10.0	0.6	14.0	11.0	6.0	10.0	0.6	14.0	14.0	7.5	10.0	0.6	19.5	14.5	7.5	15.0	0.8
0.18	14.0	11.5	6.5	10.0	0.6	14.0	11.5	6.5	10.0	0.6	14.0	14.5	8.0	10.0	0.6	19.5	15.0	8.0	15.0	0.8
0.22	14.0	13.0	6.5	10.0	0.6	14.0	13.0	6.5	10.0	0.6	14.0	15.5	9.0	10.0	0.6	24.5	14.5	7.5	20.0	0.8
0.27	14.0	13.5	7.0	10.0	0.6	14.0	13.5	7.0	10.0	0.6	14.0	16.5	9.5	10.0	0.8	24.5	15.0	8.5	20.0	0.8
0.33	14.0	13.5	7.0	10.0	0.6	19.5	13.0	6.5	15.0	0.6	19.5	14.5	8.0	15.0	0.8	24.5	16.0	9.0	20.0	0.8
0.39	14.0	14.0	7.5	10.0	0.6	19.5	13.5	7.0	15.0	0.8	19.5	15.5	8.5	15.0	0.8	24.5	16.5	10.0	20.0	0.8
0.47	14.0	14.5	8.0	10.0	0.6	19.5	14.0	7.0	15.0	0.8	19.5	16.0	9.0	15.0	0.8	30.5	16.0	9.5	26.5	0.8
0.56	14.0	15.0	8.5	10.0	0.6	19.5	14.5	7.5	15.0	0.8	19.5	16.5	10.0	15.0	0.8	30.5	17.0	10.0	26.5	0.8
0.68	19.5	14.0	7.5	15.0	0.6	19.5	15.0	8.0	15.0	0.8	19.5	17.5	11.0	15.0	0.8	30.5	19.0	10.5	26.5	0.8
0.82	19.5	14.5	8.0	15.0	0.6	19.5	15.5	9.0	15.0	0.8	19.5	18.5	11.5	15.0	0.8	30.5	19.5	11.5	26.5	0.8
1	19.5	15.5	8.5	15.0	0.8	24.5	15.0	8.5	20.0	0.8	24.5	18.5	10.0	20.0	0.8	30.5	20.5	12.5	26.5	0.8
1.2	19.5	16.0	9.0	15.0	0.8	24.5	16.0	9.0	20.0	0.8	24.5	19.5	11.0	20.0	0.8	31.0	22.0	13.5	26.5	0.8
1.5	19.5	17.0	10.0	15.0	0.8	24.5	17.5	9.5	20.0	0.8	24.5	20.5	12.5	20.0	0.8	31.0	24.5	14.5	26.5	0.8
1.8	19.5	18.0	11.0	15.0	0.8	24.5	18.5	10.0	20.0	0.8	24.5	22.0	13.5	20.0	0.8	31.0	26.0	16.0	26.5	0.8
2.2	24.5	18.0	9.5	20.0	0.8	32.0	19.0	9.0	27.5	0.8	32.0	21.0	12.5	27.5	0.8	31.0	27.5	17.5	26.5	1.0
2.7	24.5	19.0	10.5	20.0	0.8	32.0	20.0	10.0	27.5	0.8	32.0	23.0	13.0	27.5	0.8	-	-	-	-	-
3.3	31.0	18.5	10.0	26.5	0.8	32.0	21.0	11.0	27.5	0.8	32.0	24.5	14.5	27.5	1.0	-	-	-	-	-
3.9	31.0	19.5	11.0	26.5	0.8	32.0	22.0	12.0	27.5	0.8	32.0	25.5	16.0	27.5	1.0	-	-	-	-	-
4.7	31.0	21.5	11.5	26.5	0.8	32.0	23.0	13.0	27.5	1.0	33.0	27.5	17.5	27.5	1.0	-	-	-	-	-
5.6	31.0	22.5	12.5	26.5	0.8	32.0	24.0	14.0	27.5	1.0	-	-	-	-	-	-	-	-	-	-
6.8	31.0	23.5	13.5	26.5	1.0	32.0	25.5	15.5	27.5	1.0	-	-	-	-	-	-	-	-	-	-
10	31.0	26.5	16.5	26.5	1.0	36.0	27.5	17.5	31.5	1.0	-	-	-	-	-	-	-	-	-	-

## Technology Reference:

### 1. Operating Voltage:

#### 1.1 Rated voltage and operating voltage

In general application, operating voltage of film capacitor will not be allowed to over the rated voltage.

If used beyond the rating, it may induce insulation breakdown of the film and cause short circuit. In a metallized capacitor which has a self-healing action, short circuit or other failure may not occur immediately after application of a voltage, but the insulation resistance is lowered, and may lead to smoke or fire depending on the circuit conditions. If a capacitor of DC rating is used in an AC circuit, the maximum operating voltage is limited by heat generation or electric discharged. The maximum operating voltage converted to AC varies with each type, Please consult us for detail or refer to the table below:

DC rated voltage	AC maximum working voltage (50/60Hz)	
	Metallized polyester Film Capacitor	Metallized Polypropylene Film Capacitor
50V	32VAC	-
63V	40VAC	-
100V	63VAC	63VAC
200V	100VAC	100VAC
250V	125VAC	125VAC
400V	200VAC	200VAC
630V	250VAC	250VAC
1250V	500VAC	500VAC

#### 1.2 Operating temperature and operating voltage

In film capacitors, the usable upper limit temperature (the capacitor surface temperature) is determined by the type of dielectric. When used beyond the rated upper limit temperature (usable upper limit temperature), it is necessary to voltage derate the in certain types (models), while other types (models) cannot be used beyond the rated upper limit temperature, and therefore when using beyond the rated upper limit temperature.

Rated upper limit temperature, usable upper limit temperature, and derating of usable upper limit temperature by types in DC use.

Dielectric	Rated upper limit temperature	Usable upper limit temperature	Usable upper limit voltage
Polyester	85°C	105°C	rated voltage x 75%
Polypropylene	85°C	85°C	rated voltage x 50%
Polyester	85°C	105°C	rated voltage x 75%
Polypropylene	70°C	70°C	rated voltage x 50%
Polyester / Polypropylene	85°C	85°C	rated voltage
PPS	85°C	85°C	rated voltage

Note 1: \* Upper limit temperature usable continuously at DC rated voltage, include a capacitor own temperature rise value.

\* Usable upper limit temperature continuously by derating of DC rated voltage including a capacitor own temperature rise value

\* Usable upper limit temperature: Upper limit voltage usable continuously by upper limit temperature.

Note 2: \* When using at high frequency, however the capacitor has its own temperature rise and hence the derating ratio cannot be applied.

And also, the ambient temperature and the self-temperature rise should be both taken into account. If the capacitor is subject to rms or pulse currents higher than those admitted, make sure the operating temperature (ambient temperature plus self temperature rise) will not exceed the rated upper temperature.

Capacitor Type	Allowable self temperature rise
Polyester / Metallized polyester film capacitor	within 10°C
Polypropylene / Metallized polypropylene film capacitor	within 5°C

### 1.3 Rated voltage and capacitance value

Generally, in film capacitors, as the capacitance value is increased, the withstand voltage performance is decreased. In the case of capacitance range exceeding 0.1uF of polypropylene capacitor, use within the following voltage:

Cap.value (uF)	Rated voltage				
	50VDC	100VDC	200VDC	400VDC	630VDC
0.11 ~ 0.12	49V	98V	195V	390V	615V
0.13 ~ 0.15	47V	95V	190V	380V	600V
0.16 ~ 0.18	46V	93V	185V	370V	585V
0.20 ~ 0.22	45V	90V	180V	360V	570V
0.24 ~ 0.27	44V	88V	175V	350V	-
0.30 ~ 0.33	42V	85V	170V	340V	-
0.36 ~ 0.39	41V	83V	165V	320V	-
0.43 ~ 0.47	40V	80V	160V	300V	-

### 1.4 Rated voltage and frequency

When using at high frequency, the dissipation factor (tan δ) increases, there is a risk of thermal runaway (smoke or fire) due to self heat generation in the capacitor. Derate the rated voltage according to the example below:

- \* derating example of rated voltage - capacitor used: PC16 (0.22uf 250Vdc)
- operating frequency: 30KHz (sine wave)
- permissible current (entry value by specification): 30KHz, 2.7A rms
- usable upper limit voltage: 60HZ 150V rms; 30KHz 65V rms

$$V = \frac{I}{2 \pi f c} = \frac{2.7}{2 \times 3.14 \times 30 \times 10^3 \times 0.22 \times 10^{-6}} = 65Vrms$$

Therefore, the rated voltage at sine wave 30KHz is lowered to 65V rms (derating ratio 57%), as compared with AC rated voltage of 150V rms at commercial frequency.

Notes: \* use the peak value (Vo-p) of the pulse voltage applied to both ends of the capacitor within the DC rating.

- \* when using at high frequency: measure the self heating temperature rise value of the capacitor, and make sure it is within the specified limit.
- \* protective means for safety should be required in case a voltage over the rated voltage (permissible voltage) may be applied to the capacitor due to abnormal action such as trouble elsewhere in the circuit.

## 2. Permissible current

Film capacitors are low in internal impedance, and hence a very large current may flow depending on the circuit. In particular, when turning power switch in and off, make sure a very high pulse current may flow. when a current exceeding the permissible range flows into capacitor, it can caused the capacitances value to deteriorate or an open circuit, temperature rise occurs due to self heat generation, this cause can deterioration of withstand voltage and result in short circuit, possibly leading to smoke or fire.

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

### 2.1 Permissible current and operating frequency

The film capacitor varies in the frequency characteristic of dissipation factor (tanδ) depending on the dielectric materials, and hence the permission rms current for same operating frequency differs depending on the capacitor type. In particular, when operating at high frequency, the dissipation factor(tan δ) increase, and when using over the permissible current, it may thermal runaway, possibly leading to smoke or firm.

### 2.2 Permissible current and pulse current

The pulse permissible current is obtained by the product of dv/dt (V/μs) value that is entering to the specification and capacitance (uF),  $I = C \times dv/dt$

The dv/dt (V/μs) value of a film capacitor is determined by the element structure. The dv/dt value of the non-inductively film capacitor is mainly determined by the lead spacing (element width) and element sectional area. In the metallized type, in particular, the internal evaporated electrode and external take out electrode are connected by metallized contact (metal spraying), and hence due caution is needed because the upper limit dv/dt value is low.

### 3. Operating temperature

#### 3.1 Own temperature

When the film capacitor is used in an AC circuit, especially in high frequency application, the capacitor generates heat by itself from the flowing current. If the self heat generation is large, the capacitor may deteriorate, and smoke or fire may occur. Check the self heating temperature rise value in actual conditions of use, and use within the limit specified. When measuring the own temperature rise value in indoor and windfree capacitor being tested must be supplied by the working AC or pulse voltage and frequency.

#### 3.2 Operating temperature

The operating temperature range of film capacitor varies with the dielectric material (type of film), and the usable temperature range is specified in each model.

It must be noted, however, that the temperature range mentioned in the catalogue is the surface temperature of the film capacitor, not the ambient temperature of the capacitor.

In actual use, make sure the sum of the ambient temperature + capacitor's self heating temperature rise value (within specified value), that is, the capacitor surface temperature is within the rated operating temperature range.

#### Caution:

When used above the rated operating temperature range, dissipation factor ( $\tan\delta$ ) increases, and the self heat generation may exceed the permissible value, possibly causing deterioration of dielectric film, short circuit, fire or smoke. If there is a cooling plate of other part or any resistance heated to high temperature near the film capacitor, it may be locally heated, exceeding the operating temperature range, smoke or fire may be caused. (check the capacitor surface temperature at the heat source side)

### 4. Other cautions

#### 4.1 Charging and discharged

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 charged and discharging pass through a resistance of  $20\Omega/V$  to  $1000\Omega/V$  or more to limit current. When connecting multiple film capacitors in parallel in withstand voltage test or life test, connect a resistance of  $20\Omega/V$  to  $1000\Omega/V$  or more in series to each capacitor.

#### 4.2 Flame retardation

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.

#### 4.3 Environments of use

\* When used for a long period in humid environments, the elements absorb moisture through the coating with the passing of time. Water is low in insulation resistance, and oxidizes the electrode (evaporated film and metallized contact) and leads to trouble

\* When using in an oxidizing gas such as hydrogen chloride, hydrogen sulfide and sulfurous acid, the evaporated film or metallized contact (zinc compound) may result in smoke or fire, avoid such atmosphere.

#### 4.4 Cautions for mounting

The heat resisting temperature of the film capacitor varies with the type of electric film, structure of the capacitor, manufacturing method, etc. when mounting, set the mounting temperature so that the capacitor inside (element) temperature will be lower than the mounting heat resisting temperature given below:

Dielectric	Mounting heat resisting temperature
Polypropylene	110°C
Polyester	160°C
PPS	170°C