# WRAP AND FILL SMALL SIZE
# POLYPHENYLENE SULFIDE DIELECTRIC FILM / FOIL CONSTRUCTION

TYPE 810P


## FEATURES

- Extended foil construction
- + 125°C rated
- Replacement for 610P polycarbonate capacitors
- Moisture resistant
- Low dissipation factor

**MAJOR APPLICATIONS:**
Oscillator, timing, coupling and decoupling at high frequency, filter circuits.

## PHYSICAL CHARACTERISTICS

**CONSTRUCTION:**
Non-inductive wound polyphenylene sulfide film and extended foil.

**CASE:**
Flame retardant tape wrap and epoxy endfill.

**LEAD MATERIAL:**
Solder coated solid wire.

**LEAD WIRE SIZES:**

| Case Dia. | Lead AWG |
|---|---|
| ≤ 0.327 | 0.025 (No. 22) |
| > 0.327 | 0.032 (No. 20) |

**LEAD STRENGTH:**
Capable of withstanding a five pound pull force on lead axis.

**MARKING:**
Dearborn trademark, type or catalog number, capacitance, tolerance and voltage.

## ELECTRICAL SPECIFICATIONS

**CAPACITANCE RANGE:** 0.001 µF to 1.0 µF

**DC VOLTAGE RATING:** 50 VDC to 400 VDC

**CAPACITANCE TOLERANCE:** ±20%, ±10%, ±5%

**OPERATING TEMPERATURE:** -55°C to +125°C

**VOLTAGE DERATING:** At +125°C, 50% of the +85°C rating

**DISSIPATION FACTOR:**
0.15% maximum when measured at 1kHz @ 25°C

**VOLTAGE TEST:** 200% of rated voltage for 1 minute

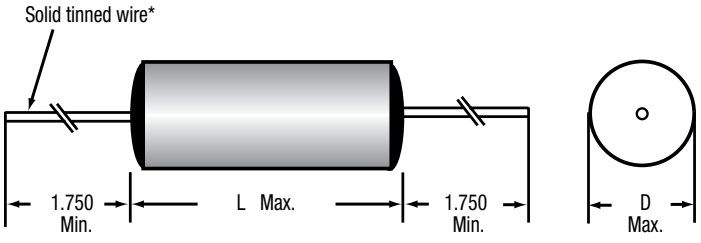
**INSULATION RESISTANCE:**
Measured at rated VDC after a 2 minute charge.

- At +25°C, 50,000 Megaohm-Microfarads, need not exceed 100,000 Megaohms
- At +85°C, 2,000 Megaohm-Microfarads, need not exceed 4,000 Megaohms
- At +125°C, 250 Megaohm-Microfarads, need not exceed 500 Megaohms

## MAXIMUM PULSE RISE TIME

| Capacitor Length (inch) | Rise Time dv / dt (V / µs) | | | |
|---|---|---|---|---|
| | 50 V | 100 V | 200 V | 400 V |
| 0.560 | 3200 | 3700 | 4400 | 6000 |
| 0.625 | 1300 | - | - | 3617 |
| 0.750 | 630 | 1200 | 1727 | 2900 |
| 1.000 | - | 680 | 1147 | 1636 |
| 1.062 | 470 | - | 1100 | 1500 |
| 1.250 | 440 | - | - | 1100 |
| 1.312 | - | 727 | - | 1000 |
| 1.562 | - | 433 | - | 900 |
| 1.812 | 270 | 368 | 578 | - |
| 2.062 | - | - | 442 | 612 |
| 2.312 | - | 300 | - | - |
| 2.562 | - | - | - | 491 |

## DIMENSIONS (in inches)




* Leads to be within ±0.062" of center line at egress, but not less than 0.031" from edge.

TYPE 810P

# WRAP AND FILL SMALL SIZE
# POLYPHENYLENE SULFIDE DIELECTRIC FILM / FOIL CONSTRUCTION

## STANDARD RATINGS

| Capacitance | | Voltage Code 050 50 VDC | | Voltage Code 100 100 VDC | | Voltage Code 200 200 VDC | | Voltage Code 400 400 VDC | |
|---|---|---|---|---|---|---|---|---|---|
| µF | Code | D | L | D | L | D | L | D | L |
| 0.0010 | 102 | 0.260 | 0.560 | 0.260 | 0.560 | 0.260 | 0.560 | 0.260 | 0.560 |
| 0.0015 | 152 | 0.260 | 0.560 | 0.260 | 0.560 | 0.260 | 0.560 | 0.260 | 0.560 |
| 0.0022 | 222 | 0.260 | 0.560 | 0.260 | 0.560 | 0.260 | 0.560 | 0.327 | 0.560 |
| 0.0033 | 332 | 0.260 | 0.560 | 0.260 | 0.560 | 0.260 | 0.560 | 0.327 | 0.560 |
| 0.0047 | 472 | 0.327 | 0.560 | 0.327 | 0.560 | 0.327 | 0.560 | 0.312 | 0.625 |
| 0.0068 | 682 | 0.327 | 0.560 | 0.327 | 0.560 | 0.327 | 0.560 | 0.312 | 0.750 |
| 0.010 | 103 | 0.235 | 0.625 | 0.340 | 0.560 | 0.312 | 0.750 | 0.400 | 0.750 |
| 0.015 | 153 | 0.235 | 0.625 | 0.312 | 0.750 | 0.312 | 0.750 | 0.400 | 1.000 |
| 0.022 | 223 | 0.235 | 0.750 | 0.312 | 0.750 | 0.400 | 0.750 | 0.400 | 1.250 |
| 0.033 | 333 | 0.312 | 0.750 | 0.312 | 0.750 | 0.400 | 1.000 | 0.500 | 1.000 |
| 0.047 | 473 | 0.312 | 0.750 | 0.400 | 0.750 | 0.400 | 1.000 | 0.562 | 1.062 |
| 0.068 | 683 | 0.400 | 0.750 | 0.400 | 1.000 | 0.500 | 1.000 | 0.562 | 1.312 |
| 0.10 | 104 | 0.400 | 0.750 | 0.400 | 1.000 | 0.562 | 1.062 | 0.670 | 1.562 |
| 0.15 | 154 | 0.400 | 1.250 | 0.562 | 1.312 | 0.562 | 1.812 | 0.750 | 2.062 |
| 0.22 | 224 | 0.562 | 1.062 | 0.562 | 1.562 | 0.670 | 1.812 | 0.750 | 2.562 |
| 0.33 | 334 | 0.562 | 1.062 | 0.670 | 1.562 | 0.750 | 2.062 | 1.000 | 2.062 |
| 0.47 | 474 | 0.562 | 1.812 | 0.750 | 1.812 | 1.000 | 1.812 | 1.000 | 2.562 |
| 0.68 | 684 | 0.562 | 1.812 | 0.750 | 2.312 | - | - | - | - |
| 1.00 | 105 | 0.750 | 1.812 | 1.000 | 1.812 | - | - | - | - |

Additional capacitance values, voltages, and tolerances are available upon request.

TYPE 859P

# METAL-CASE HERMETICALLY-SEALED AC RATED METALIZED POLYPHENYLENE SULFIDE FILM CAPACITORS


## FEATURES

- Full rating at 85°C and 400Hz
- High stability, polycarbonate replacement
- Small size
- Low power dissipation
- Low dielectric absorption
- Meets the requirements of MIL-PRF-39022 / 12

**MAJOR APPLICATIONS:**
Motor run, speed control, filtering.

## PHYSICAL CHARACTERISTICS

**CONSTRUCTION:**
Non-inductive wound metalized polyphenylene sulfide.

**CASE:**
Hermetically sealed metal enclosure. Styles and dimensions are in Guide to Ordering section in the front of the catalog.

**LEAD MATERIAL:**
Solder coated solid wire.

**LEAD WIRE SIZES:**

| Case Dia. | Lead AWG |
|---|---|
| 0.312 | No. 20 |
| 0.400 and over | No. 18 |

**LEAD PULL:**
5 lbs (2.3 kg) for one minute. No physical damage.

**LEAD BEND:**
After three complete consecutive bends. No damage.

**MARKING:**
Dearborn trademark, type or catalog number, capacitance, tolerance and voltage.

## ELECTRICAL SPECIFICATIONS

**CAPACITANCE RANGE:**
0.01 µF to 10.0 µF

**AC VOLTAGE RANGE:**
80 VRMS to 440 VRMS at 400Hz

**CAPACITANCE TOLERANCE:**
±20%, ±10%, ±5%

**OPERATING TEMPERATURE:**
-55°C to +105°C

**VOLTAGE DERATING:**
At +105°C, 70% of +85°C rating

**DISSIPATION FACTOR:**
0.15% maximum when measured at 1kHz @ 25°C

**AC VOLTAGE TEST:**
140% of rated voltage for 2 minutes

**INSULATION RESISTANCE:**
Measurements made after a 2 minute charge at 200 VDC for AC ratings equal to or less than 330 VRMS and at 400 VDC for AC ratings greater than 330 VRMS.

- At +25°C, 50,000 Megaohm-Microfarads, need not exceed 100,000 Megaohms
- At +85°C, 10,000 Megaohm-Microfarads, need not exceed 50,000 Megaohms
- At +105°C, 2,000 Megaohm-Microfarads, need not exceed 10,000 Megaohms

# METAL-CASE HERMETICALLY-SEALED AC RATED METALIZED POLYPHENYLENE SULFIDE FILM CAPACITORS

## STANDARD RATINGS

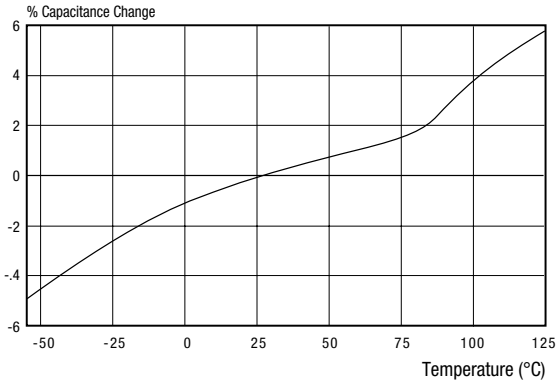
| Capacitance | | Low Voltage Range 80 VRMS to 165 VRMS | | | | Intermediate Voltage Range | | | | High Voltage Range 390 VRMS to 440 VRMS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| µF | Code | 400Hz VRMS 85°C | Voltage Code | Inches | | 400Hz VRMS 85°C | Voltage Code | Inches | | 400Hz VRMS 85°C | Voltage Code | Inches | |
| | | | | D | L* | | | D | L* | | | D | L* |
| 0.010 | 103 | - | - | - | - | 330 | 330 | 0.312 | 0.875 | 440 | 440 | 0.312 | 1.125 |
| 0.012 | 123 | - | - | - | - | 330 | 330 | 0.400 | 0.875 | 440 | 440 | 0.400 | 1.125 |
| 0.015 | 153 | - | - | - | - | 330 | 330 | 0.400 | 0.875 | 440 | 440 | 0.400 | 1.125 |
| 0.018 | 183 | - | - | - | - | 330 | 330 | 0.400 | 0.875 | 440 | 440 | 0.400 | 1.125 |
| 0.022 | 223 | - | - | - | - | 330 | 330 | 0.400 | 0.875 | 440 | 440 | 0.400 | 1.125 |
| 0.027 | 273 | - | - | - | - | 330 | 330 | 0.400 | 1.125 | 440 | 440 | 0.400 | 1.375 |
| 0.033 | 333 | - | - | - | - | 330 | 330 | 0.400 | 1.125 | 440 | 440 | 0.400 | 1.375 |
| 0.039 | 393 | 165 | 165 | 0.312 | 0.875 | 330 | 330 | 0.400 | 1.125 | 440 | 440 | 0.562 | 1.125 |
| 0.047 | 473 | 165 | 165 | 0.312 | 0.875 | 330 | 330 | 0.400 | 1.125 | 440 | 440 | 0.562 | 1.125 |
| 0.056 | 563 | 165 | 165 | 0.312 | 0.875 | 330 | 330 | 0.400 | 1.375 | 440 | 440 | 0.562 | 1.375 |
| 0.068 | 683 | 165 | 165 | 0.312 | 0.875 | 330 | 330 | 0.400 | 1.375 | 440 | 440 | 0.562 | 1.375 |
| 0.082 | 823 | 165 | 165 | 0.312 | 0.875 | 330 | 330 | 0.500 | 1.125 | 440 | 440 | 0.562 | 1.625 |
| 0.10 | 104 | 165 | 165 | 0.312 | 0.875 | 330 | 330 | 0.500 | 1.125 | 440 | 440 | 0.562 | 1.625 |
| 0.12 | 124 | 165 | 165 | 0.312 | 1.125 | 330 | 330 | 0.562 | 1.375 | 435 | 435 | 0.670 | 1.625 |
| 0.15 | 154 | 165 | 165 | 0.312 | 1.125 | 330 | 330 | 0.562 | 1.375 | 435 | 435 | 0.670 | 1.625 |
| 0.18 | 184 | 165 | 165 | 0.400 | 0.875 | 330 | 330 | 0.562 | 1.625 | 430 | 430 | 0.670 | 1.875 |
| 0.22 | 224 | 165 | 165 | 0.400 | 0.875 | 330 | 330 | 0562 | 1.625 | 430 | 430 | 0.670 | 1.875 |
| 0.27 | 274 | 165 | 165 | 0.400 | 1.125 | 330 | 330 | 0.562 | 1.875 | 425 | 425 | 0.750 | 2.375 |
| 0.33 | 334 | 165 | 165 | 0.400 | 1.125 | 330 | 330 | 0.562 | 1.875 | 425 | 425 | 0.750 | 2.375 |
| 0.39 | 394 | 165 | 165 | 0.400 | 1.375 | 330 | 330 | 0.670 | 1.625 | 410 | 410 | 1.000 | 1.875 |
| 0.47 | 474 | 165 | 165 | 0.400 | 1.375 | 330 | 330 | 0.670 | 1.625 | 410 | 410 | 1.000 | 1.875 |
| 0.56 | 564 | 165 | 165 | 0.562 | 1.125 | 320 | 320 | 0.750 | 1.875 | 390 | 390 | 1.000 | 2.375 |
| 0.68 | 684 | 165 | 165 | 0.562 | 1.125 | 320 | 320 | 0.750 | 1.875 | 390 | 390 | 1.000 | 2.375 |
| 0.82 | 824 | 165 | 165 | 0.562 | 1.375 | 300 | 300 | 0.750 | 2.125 | - | - | - | - |
| 1.0 | 105 | 165 | 165 | 0.562 | 1.375 | 300 | 300 | 0.750 | 2.125 | - | - | - | - |
| 1.5 | 155 | 155 | 155 | 0.562 | 1.625 | 265 | 265 | 1.000 | 1.875 | - | - | - | - |
| 2.0 | 205 | 150 | 150 | 0.670 | 1.625 | 215 | 215 | 1.000 | 2.625 | - | - | - | - |
| 2.2 | 225 | 150 | 150 | 0.670 | 1.625 | 215 | 215 | 1.000 | 2.625 | - | - | - | - |
| 2.5 | 255 | 145 | 145 | 0.670 | 1.875 | - | - | - | - | - | - | - | - |
| 3.0 | 305 | 140 | 140 | 0.750 | 1.875 | - | - | - | - | - | - | - | - |
| 3.3 | 335 | 140 | 140 | 0.750 | 1.875 | - | - | - | - | - | - | - | - |
| 4.0 | 405 | 135 | 135 | 0.750 | 2.125 | - | - | - | - | - | - | - | - |
| 4.7 | 475 | 130 | 130 | 0.750 | 2.375 | - | - | - | - | - | - | - | - |
| 5.0 | 505 | 130 | 130 | 0.750 | 2.375 | - | - | - | - | - | - | - | - |
| 6.8 | 685 | 110 | 110 | 1.000 | 1.875 | - | - | - | - | - | - | - | - |
| 8.0 | 805 | 100 | 100 | 1.000 | 2.125 | - | - | - | - | - | - | - | - |
| 9.0 | 905 | 090 | 090 | 1.000 | 2.375 | - | - | - | - | - | - | - | - |
| 10.0 | 106 | 080 | 080 | 1.000 | 2.625 | - | - | - | - | - | - | - | - |

Additional capacitance values, voltages, and tolerances are available upon request.

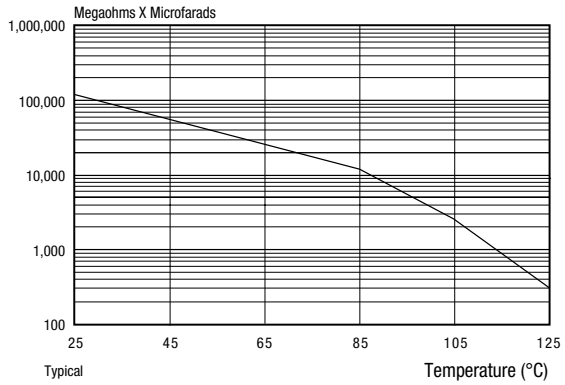
* The dimensions tabulated above are for styles 02, 04, and 13. Subtract 0.062" from the length for styles 01, 03, and 12.

## TYPICAL CHARACTERISTICS

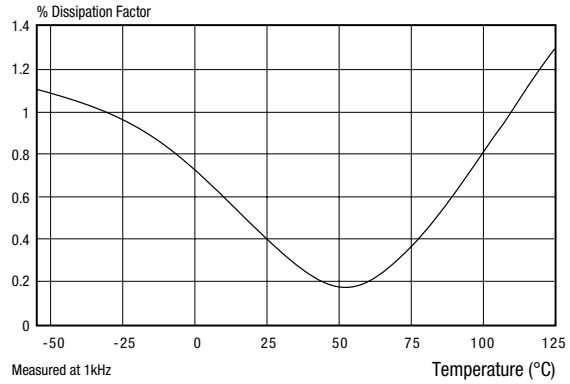
### CAPACITANCE CHANGE VS. TEMPERATURE



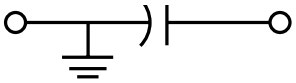

### INSULATION RESISTANCE VS. TEMPERATURE




### DISSIPATION FACTOR VS. TEMPERATURE

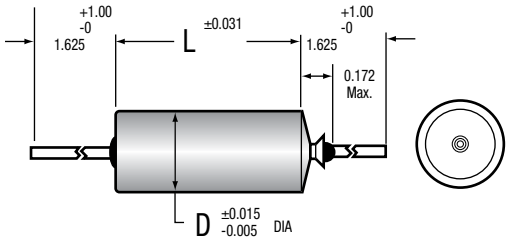


## SECTION GROUNDED TO CASE

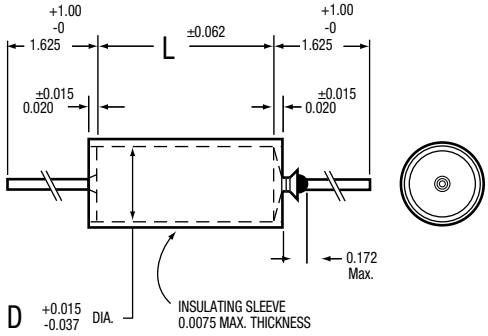


### DIMENSIONS (in inches)

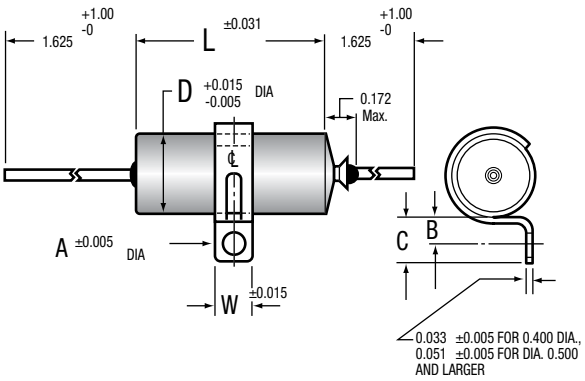
#### CASE STYLE 01



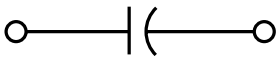

#### CASE STYLE 03




#### CASE STYLE 12

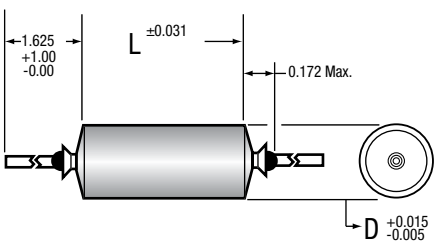



## SECTION INSULATED FROM CASE

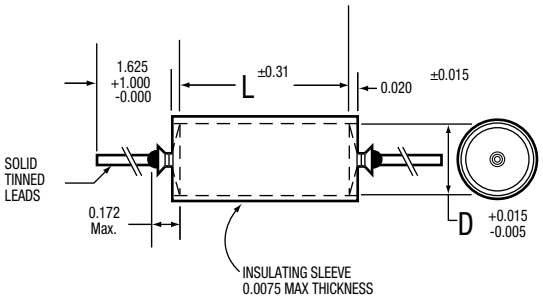


### DIMENSIONS (in inches)

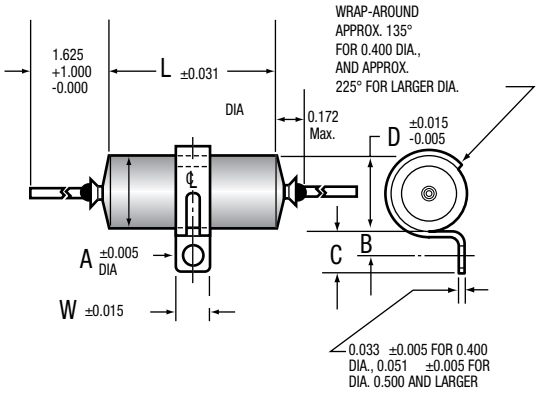
#### CASE STYLE 02




#### CASE STYLE 04




#### CASE STYLE 13




The length of grounded styles is 0.062" shorter than the length shown in tabulations in the catalog.

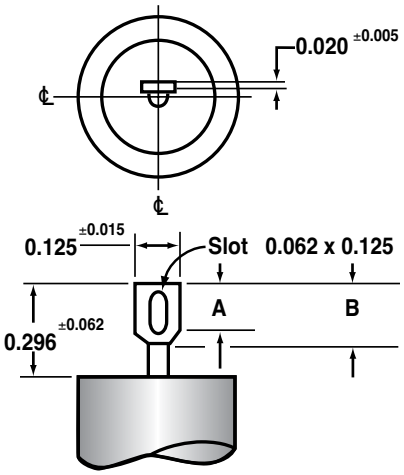
# GUIDE TO ORDERING

## BRACKET DIMENSIONS (Style 12 & 13 / in inches)

| D | W | A | B | C |
|---|---|---|---|---|
| 0.400 | 0.250 | 0.144 | 0.187±0.015 | 0.312±0.031 |
| 0.500 | 0.500 | 0.156 | 0.250±0.031 | 0.437±0.062 |
| 0.562 | 0.500 | 0.156 | 0.250±0.031 | 0.437±0.062 |
| 0.670 | 0.500 | 0.156 | 0.250±0.031 | 0.437±0.062 |
| 0.750 | 0.500 | 0.156 | 0.250±0.031 | 0.437±0.062 |
| 1.000 | 0.500 | 0.156 | 0.250±0.031 | 0.437±0.062 |

*Based on 1 in. = 25.4 mm

## TYPICAL TAB TERMINAL DIMENSIONS




Dwg. No A-9525

A = 0.156 ± 0.015" (3.96 ± 0.38 mm)

B = 0.187 ± 0.015" (4.75 ± 0.38 mm)

Tab Terminal available only on case diameters equal to or greater than 0.400 inches.

T1 & T3 styles are supplied with one tab terminal on the insulated end and a ground lead on the opposite end.

# ORDERING TABLES

## METAL CASE

EXAMPLE:

**218P 223 X9 100 S 02**

### CATALOG NUMBERING SYSTEM

**Case style**

**Terminal:** S = Wire leads T = Soldering tab*.

**DC Voltage rating:** Expressed in volts.
See standard ratings charts for voltage code.

**Capacitance Tolerance:** X0 = ±20%
X9 = ±10%
X5 = ±5%
X2 = ±2%

**Capacitance:** Expressed in picofarads, the first two digits are significant figures; the third is the number of zeros following. See standard ratings tables for capacitance code.

**Dearborn type number:** Identifies the basic capacitor.

* Soldering tabs are available only on case diameters equal to or greater then 0.400 inches.

## WRAP AND FILL

EXAMPLE:

**430P 183 X9 100 X F**

### CATALOG NUMBERING SYSTEM

**"F"** applies only to "ROHS" compliant parts.

**Terminal:** No suffix required unless specified on applicable specification sheet (Terminal style).

**DC Voltage rating:** Expressed in volts.
See standard ratings charts for voltage code.

**Capacitance Tolerance:** X0 = ±20%
X9 = ±10%
X5 = ±5%
X2 = ±2%

**Capacitance:** Expressed in picofarads, the first two digits are significant figures; the third is the number of zeros following. See standard ratings tables for capacitance code.

**Dearborn type number:** Identifies the basic capacitor.

# PROPERTIES OF DIELECTRIC FILMS

## POLYESTER (Polyethylene Terephtalate, P.E.T.)

Capacitors with smaller dimensions can be manufactured due to the high dielectric constant and excellent electrical performance of this film. Metalized polyester capacitors also have outstanding self-healing properties.

## POLYPROPYLENE (P.P.)

This film features very low dielectric losses, low dielectric adsorption, high dielectric strength, very high insulating strength and a practically linear temperature coefficient in all temperature ranges.

All these properties make this film suitable for the manufacturing of power electronics capacitors.

However, the operating temperature is limited to 105°C.

## POLYPHENYLENE SULFIDE (P.P.S.)

The properties of this film are as follows: very low dielectric losses, low temperature coefficient, high stability of the capacitance value, resistant to humidity and a high melting point. This material is suited for surface mounted precision capacitors (SMD). This film also has high temperature advantages and can be used for temperature up to 150°C.

## PROPERTIES OF METALIZED FILM CAPACITORS

The metalized film consists of an extremely thin layer (some hundredths µm) of zinc or aluminum deposited by evaporation under vacuum on the dielectric. The nature, thickness and geometry of the metalized layer modify the properties of the capacitors, especially as far as permissible peak or effective current is concerned.

Metalized film capacitors are smaller than film-foil capacitors.

Self-healing is a fundamental property of these capacitors. When a dielectric breakdown occurs between the metal layers, due to a dielectric failure, an electrical arc causes local vapor deposition of the metallization which results in an insulating metallic oxide. Thus regenerated, the capacitor is once again operational.

The self-healing operation generally requires only a very small amount of energy (5 to 15 µJoules) and is performed in several µseconds (< 50). However, a minimum amount of energy is required below which self-healing operations are unpredictable. This energy is calculated in relation to the capacitance value and the load voltage: $E = 1 / 2\ CV^2$.

## PROPERTIES OF FILM–FOIL CAPACITORS

Film Foil capacitors are especially recommended to meet high voltage or current and / or power stresses.

The thickness of the metal foil enables the reduction of the series resistance and improves the general performance of the capacitors. These improvements are made to the detriment of the volume of the capacitor which also loses its self-healing properties. Composite dielectrics combine films of different types with complementary specific characteristics.

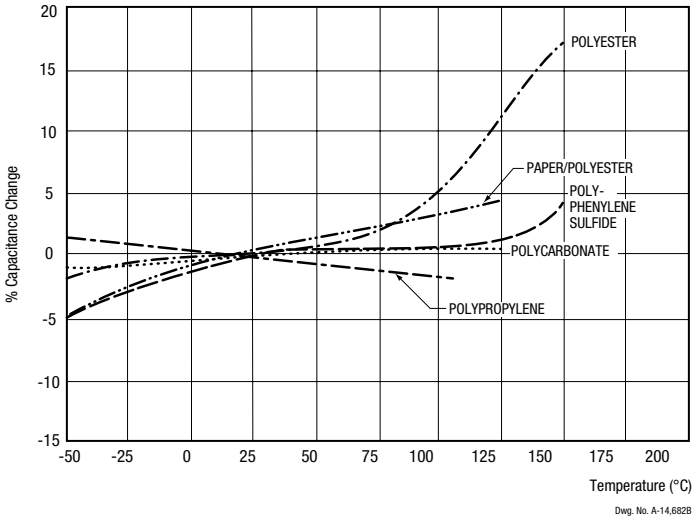
For high voltage and power electronics applications, these capacitors are usually impregnated with impregnating fluids or solid substances.

## CAPACITOR PERFORMANCE VS. TEMPERATURE

The capacitors' performance versus temperature essentially depends upon the dielectric type.

The figure below shows ranges of operating temperatures.

### % OF CAPACITANCE CHANGE VS. TEMPERATURE (°C)

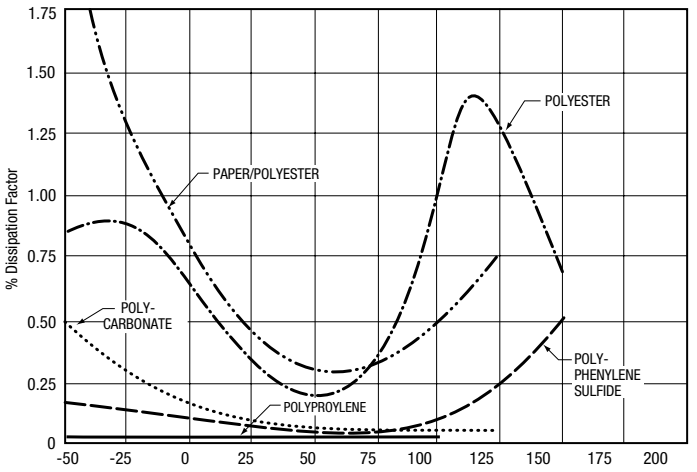



Dwg. No. A-14,682B

Important differences affect the laws governing the changes of the main electrical characteristics.

They are highlighted by the following curves:

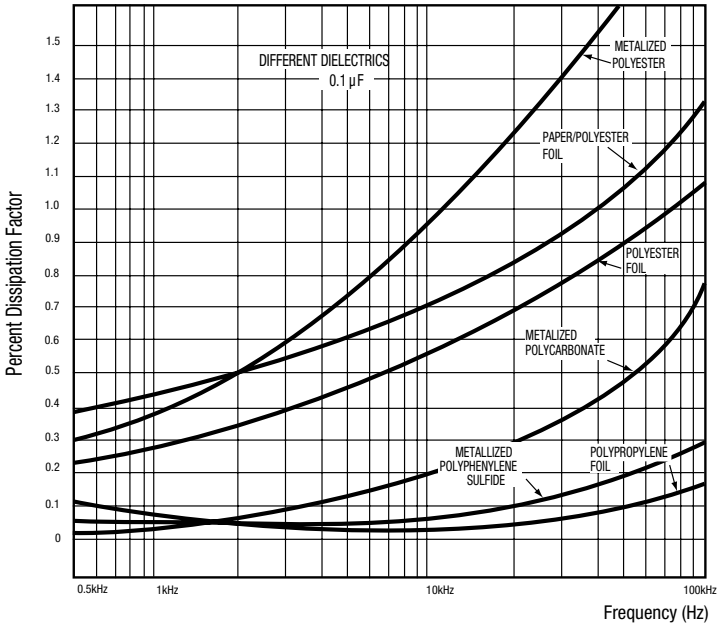
### % OF DISSIPATION FACTOR (DF) VS. TEMPERATURE (°C)




Dwg. No. A-14,683C

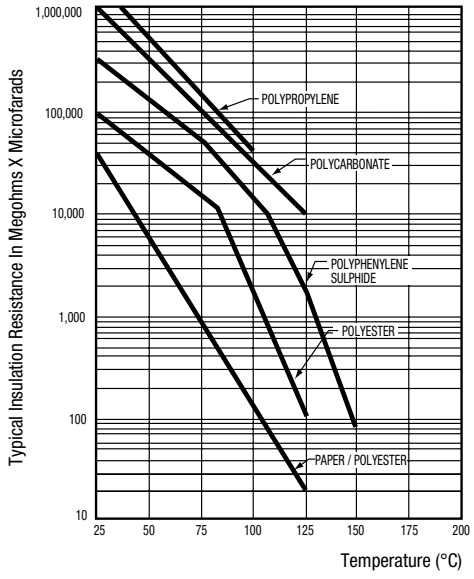
# PROPERTIES OF DIELECTRIC FILMS

## % OF DISSIPATION FACTOR (DF) VS. FREQUENCY (HZ)



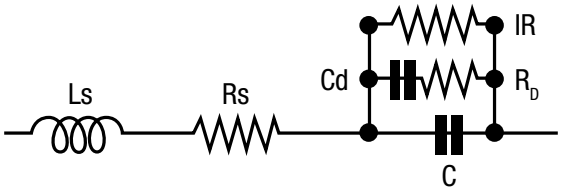

Dwg. No. A-14,684B

## IR VS. TEMPERATURE (°C)




Dwg. No. A-14,687B

## A REAL CAPACITOR MAY BE REPRESENTED BY THE FOLLOWING DIAGRAM:




| | |
|---|---|
| Series Inductance | Ls |
| Resistance of metal foil & connections | Rs |
| Insulation Resistance | IR |
| Dielectric Absorption | Cd |
| Resistance equivalent to the dielectric losses | $R_D$ |
| Capacitance | C |

Resistive terms generate temperature rises when the capacitors carry AC current ($I_{rms}$). Depending upon the frequency range, they may be more or less preponderant.

### THE EQUIVALENT SERIES RESISTANCE (ESR) IS THE SUM OF THE FOLLOWING TERMS:

$$ESR = Rs + DF / C\omega + 1 \ / \ IR\ C^2\ \omega^2$$

When the frequency increases, the term $1 / IRC^2\omega^2$ becomes rapidly insignificant.

For plastic dielectrics, losses remain constant within a wide range of frequencies and the affect of the term: $DF / C\omega$ decreases: $ESR = Rs + DF / C\omega$

The metal foil and the connections are designed to obtain a resistance value (Rs) as low as possible. This value is dependent on the capacitors' technology and geometry.

Inductance (Ls) also disturbs the equation of the capacitors at high frequencies.

### IMPEDANCE (Z) IS STATED AS FOLLOWS:

$$Z = Rs^2 + (Ls\omega - 1 / C\omega)^2$$

When frequency increases, the affect of Ls will gradually cancel the capacitance component of the capacitors until it reaches the resonance frequency where:

$$Z = Rs \text{ and } LC\omega^2 = 1$$