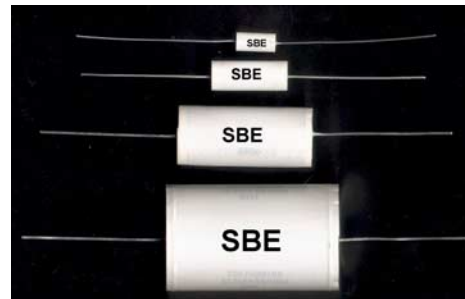




### Type 460M Axial Lead Round Profile Metallized Polyester Film Capacitors



### Specifications

**Capacitance Range:**

0.0047 to 100.0  $\mu$ F

**Capacitance Tolerance:**

$\pm$ 5% and  $\pm$ 10%, standard  
(other tolerances available)

**Voltage Rating:**

63 to 1000 VDC  
40 to 250 VAC

**Operating Temperature**

Units may be operated at full rated voltage from -55°C to +85°C.

**Voltage De-rating above +85°C:**

Units may be operated up to a maximum of +125°C provided the voltage is de-rated linearly to 50% of rated voltage at +125°C.

**Dissipation Factor:**

1.0% Maximum @ 1 KHz, +25°C

**Insulation Resistance:**

At +25°C: 10,000 M $\Omega$  for  $C \leq 1.0 \mu$ F  
10,000 M $\Omega$ - $\mu$ F for  $C > 1.0 \mu$ F

At +85°C: 1,000 M $\Omega$  for  $C \leq 1.0 \mu$ F  
1,000 M $\Omega$ - $\mu$ F for  $C > 1.0 \mu$ F

**Encapsulation:**

Wrapped with flame retardant polyester tape (meets UL510 specifications) and potted with flame retardant epoxy (meets UL94V-0 specifications).

**Lead Wire:**

Tinned Copper-Clad Steel for wire sizes:  
0.020 (0.5) diameter (#24 AWG)  
0.025 (0.6) diameter (#22 AWG)  
0.032 (0.8) diameter (#20 AWG)

Tinned Copper for wire sizes:  
0.040 (1.0) diameter (#18 AWG)

**Dielectric/Construction:**

Metallized Polyester film, single section design. Non-Inductively wound.

In addition to the information provided here SBE also offers complete design and manufacturing of specific capacitance values, custom form factors, special lead terminations, etc.

Dimensions are in inches, millimeters are in parenthesis.



## Introduction to SBE

### Who Are We

SB Electronics, Inc. *Designs* and *Manufactures* the most reliable film capacitor products for use in today's demanding applications. SBE, a former Sprague Electric company, was founded in 1986 following a management buyout. We manufacture the ubiquitous Orange Drop<sup>®</sup> and 192P Pacer<sup>®</sup> film capacitor lines, both of which have reliably served the industry since 1959!

SBE's expanding product offerings also include a wide range of Metallized and Film/Foil capacitors in both Radial and Axial leaded styles. We also bolstered our axial leaded product portfolio by purchasing several lines from Industrial/Midwec in 1999. You can find additional details regarding our purchase of Industrial/Midwec on our web site at: [www.SBElectronics.com](http://www.SBElectronics.com)

### Why choose SBE?

Our focus is on film capacitor products. SBE has the experience, technical expertise and supporting staff to design and deliver the film capacitor you need, when you need it.

High voltage, tight tolerance, demanding peak currents, high frequency; whatever your application, SBE can help you specify the *right* part. Our products are designed for life and reliably manufactured to provide the best electrical performance for your application.

Located in the pristine Green Mountains of Vermont, SBE benefits from a traditional "Vermont work ethic", which is comprised of hard work, pride in craftsmanship, dedication and attention to detail. Put our team to the test!

### Our Company Philosophy

SBE's Mission, Vision and Core Operating Values center around our critical success factors; which include comprehensive technical support, proven reliability, short manufacturing lead times, and dependable customer service that is second-to-none. SBE takes great pride in providing customer service that answers your questions completely and timely by friendly people that are pleasant to work with!

**SBE**, providing you with the ultimate in Performance, from Design to Delivery.

Orange Drop<sup>®</sup> and Pacer<sup>®</sup> are registered trademarks of SB Electronics, Inc.



### General Specifications

The 460M series is designed and manufactured for use in many demanding applications. They are non-inductively wound using some of the most reliable metallized polyester film available today. A wide range of capacitance values, voltage ratings, lead terminations and sizes offer the designer an array of options to best meet the form, fit and function requirements specified.

With complete design and manufacturing operations located at our Barre, Vermont facility, SBE's staff can provide the expertise needed to support your application, be it with a standard product found here, or a tailor designed part specific for your requirement. Regardless, SBE designs and manufactures film capacitors to outlast the products they are installed in. If you are in need of any further technical specifications or require any application assistance we will be pleased to assist you.

#### Operating Temperature Range:

Standard operating temperature range is  $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ . Units may be operated at the full rated voltage within this temperature range.

The 460M series may be operated up to a maximum temperature of  $+125^{\circ}\text{C}$ , however the voltage must be linearly de-rated to 50% of the full rated voltage at  $+125^{\circ}\text{C}$ .

#### Dielectric Withstanding Voltage:

Units shall withstand a DC potential of 150% of rated voltage applied between terminals for not more than 2 minutes.

#### Lead Bend Test:

After 3 consecutive  $180^{\circ}$  bends. No damage.

#### Lead Pull Test:

5 pounds (2.3 Kg) for one minute on lead axis. No damage.

#### Humidity Testing:

Units subjected to 95% relative humidity for 250 hours with no voltage applied at  $+40^{\circ}\text{C}$ . After 4 hours of drying, minimum product of insulation resistance and capacitance shall be  $5,000\text{ M}\Omega\text{-}\mu\text{F}$ , but need not exceed  $5,000\text{ M}\Omega$ .

#### DC Voltage Life Test:

500 hours at  $+85^{\circ}\text{C}$  at 125% of rated voltage. After test; capacitance shall not have changed by more than  $\pm 10\%$  of initial value, insulation resistance shall not have decreased by more than 50% of initial value and dissipation factor shall not have increased to more than 1.25%. In addition, there shall be no open or short circuits, and no sign of visible damage.

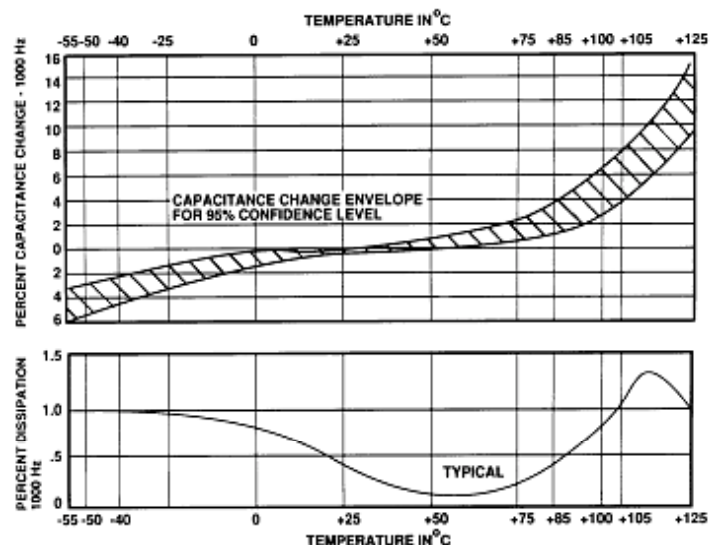
#### Dielectric Material/Construction:

The 460M series is manufactured using metallized polyester film as the dielectric. The capacitor element is non-inductively wound in a single section design.

Metallized polyester film utilizes a base film of polyester with a thin layer of aluminum vacuum deposited directly on the film as the electrode.

Metallized film exhibits a characteristic called "self-healing" or "self-clearing", which is the ability to remove a fault or short circuit in the dielectric film by vaporizing (from high current density) the metallization near the defect. The metallization is so thin that negligible film damage occurs during the clearing process. The vaporized metal oxidizes over time, aiding in the isolation of a fault area.

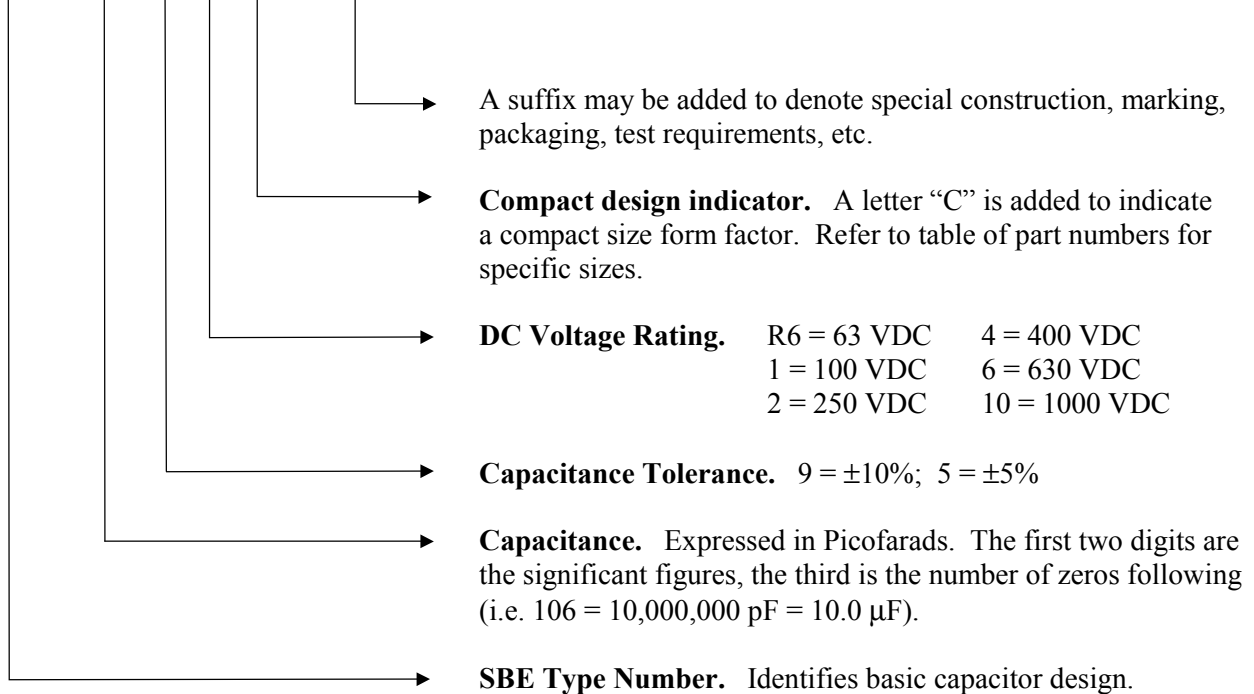
#### Typical Temperature Characteristics:





## Ordering/Part Number Information

**460M 106 9 2 C - XXX**



## Standard Marking Format

### Sample Marking on unit

SBE 460M[C]  
106K 250V  
0124

### Description

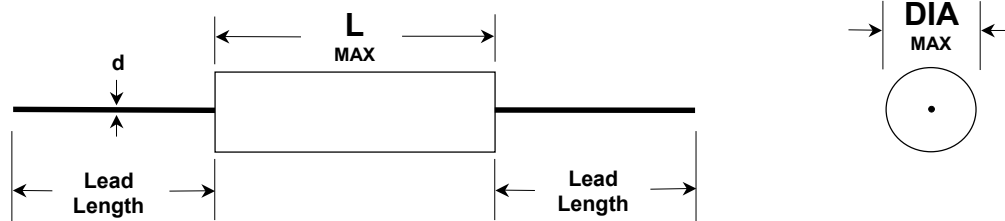
SBE - SB Electronics Identification  
460M - Type Number. 460MC indicates compact design.  
250V - DC Voltage Rating  
106K - Capacitance and Tolerance Code  
0124 - Weekly Date Code (i.e. 24th week of 2001)

### Tolerance codes per EIA standards

J  $\pm 5\%$   
K  $\pm 10\%$



**Dimension Outline**



**Lead Length Table**

L MAX dimension	Lead Length (Typical)
0.61 (15.5)	2.00 (50.8)
0.79 (20.1)	1.90 (48.3)
0.99 (25.1)	1.80 (45.7)
1.25 (31.8)	1.65 (41.9)
1.50 (38.1)	1.50 (38.1)
1.74 (44.2)	1.40 (35.6)
2.21 (56.1)	1.25 (31.8)

In all cases a MINIMUM lead length of 1.25 (31.8) will be met.

**Lead Wire Size and Additional Termination Options**

Standard lead wire sizes used in manufacturing range from 0.020 (0.5) diameter (#24 AWG) to 0.040 (1.0) diameter (#18 AWG). We can also provide a variety of other wire sizes and material (i.e. heavier gauges, insulated wire, tinned copper in smaller gauges, etc.). If the wire size or material listed on our standard items doesn't meet your requirements please contact us. We can accommodate your needs. We can also provide lug/tab terminations upon request. Please contact us with your specific requirements.



### Type 460M Sizes and Ratings – 63 VDC/40 VAC

Cap $\mu$ F	Base Part #	Standard Dimensions			Compact Dimensions <sup>1</sup>		
		L MAX	DIA MAX	Wire (d)	L MAX	DIA MAX	Wire (d)
0.22	460M2249R6	0.61 (15.5)	0.21 (5.3)	0.020 (0.5)			
0.27	460M2749R6	0.61 (15.5)	0.23 (5.8)	0.020 (0.5)			
0.33	460M3349R6	0.61 (15.5)	0.24 (6.1)	0.020 (0.5)			
0.39	460M3949R6	0.61 (15.5)	0.26 (6.6)	0.025 (0.6)			
0.47	460M4749R6	0.79 (20.1)	0.23 (5.8)	0.020 (0.5)	0.61 (15.5)	0.28 (7.1)	0.025 (0.6)
0.5	460M5049R6	0.79 (20.1)	0.23 (5.8)	0.020 (0.5)	0.61 (15.5)	0.29 (7.4)	0.025 (0.6)
0.56	460M5649R6	0.79 (20.1)	0.24 (6.1)	0.020 (0.5)	0.61 (15.5)	0.30 (7.6)	0.025 (0.6)
0.6	460M6049R6	0.79 (20.1)	0.25 (6.4)	0.020 (0.5)	0.61 (15.5)	0.31 (7.9)	0.025 (0.6)
0.68	460M6849R6	0.79 (20.1)	0.26 (6.6)	0.025 (0.6)	0.61 (15.5)	0.33 (8.4)	0.025 (0.6)
0.75	460M7549R6	0.79 (20.1)	0.27 (6.9)	0.025 (0.6)	0.61 (15.5)	0.34 (8.6)	0.025 (0.6)
0.82	460M8249R6	0.99 (25.1)	0.24 (6.1)	0.020 (0.5)	0.79 (20.1)	0.29 (7.4)	0.025 (0.6)
0.9	460M9049R6	0.99 (25.1)	0.25 (6.4)	0.020 (0.5)	0.79 (20.1)	0.30 (7.6)	0.025 (0.6)
1.0	460M1059R6	0.99 (25.1)	0.26 (6.6)	0.025 (0.6)	0.79 (20.1)	0.31 (7.9)	0.025 (0.6)
1.2	460M1259R6	0.99 (25.1)	0.28 (7.1)	0.025 (0.6)	0.79 (20.1)	0.33 (8.4)	0.025 (0.6)
1.5	460M1559R6	0.99 (25.1)	0.31 (7.9)	0.025 (0.6)	0.79 (20.1)	0.37 (9.4)	0.025 (0.6)
1.8	460M1859R6	0.99 (25.1)	0.34 (8.6)	0.025 (0.6)	0.79 (20.1)	0.40 (10.2)	0.032 (0.8)
2.0	460M2059R6	0.99 (25.1)	0.36 (9.1)	0.025 (0.6)	0.79 (20.1)	0.42 (10.7)	0.032 (0.8)
2.2	460M2259R6	0.99 (25.1)	0.37 (9.4)	0.025 (0.6)	0.79 (20.1)	0.44 (11.2)	0.032 (0.8)
2.5	460M2559R6	0.99 (25.1)	0.39 (9.9)	0.032 (0.8)	0.79 (20.1)	0.47 (11.9)	0.032 (0.8)
2.7	460M2759R6	0.99 (25.1)	0.41 (10.4)	0.032 (0.8)	0.79 (20.1)	0.48 (12.2)	0.032 (0.8)
3.0	460M3059R6	1.25 (31.8)	0.37 (9.4)	0.025 (0.6)	0.99 (25.1)	0.43 (10.9)	0.032 (0.8)
3.3	460M3359R6	1.25 (31.8)	0.39 (9.9)	0.032 (0.8)	0.99 (25.1)	0.45 (11.4)	0.032 (0.8)
3.6	460M3659R6	1.25 (31.8)	0.41 (10.4)	0.032 (0.8)	0.99 (25.1)	0.47 (11.9)	0.032 (0.8)
3.9	460M3959R6	1.25 (31.8)	0.42 (10.7)	0.032 (0.8)	0.99 (25.1)	0.48 (12.2)	0.032 (0.8)
4.0	460M4059R6	1.50 (38.1)	0.39 (9.9)	0.032 (0.8)	0.99 (25.1)	0.49 (12.4)	0.032 (0.8)
4.7	460M4759R6	1.50 (38.1)	0.42 (10.7)	0.032 (0.8)	0.99 (25.1)	0.53 (13.5)	0.032 (0.8)
5.0	460M5059R6	1.50 (38.1)	0.43 (10.9)	0.032 (0.8)	0.99 (25.1)	0.54 (13.7)	0.032 (0.8)
5.6	460M5659R6	1.50 (38.1)	0.45 (11.4)	0.032 (0.8)	0.99 (25.1)	0.57 (14.5)	0.032 (0.8)
6.0	460M6059R6	1.50 (38.1)	0.47 (11.9)	0.032 (0.8)	0.99 (25.1)	0.59 (15.0)	0.032 (0.8)
6.8	460M6859R6	1.50 (38.1)	0.49 (12.4)	0.032 (0.8)	0.99 (25.1)	0.63 (16.0)	0.032 (0.8)
7.0	460M7059R6	1.50 (38.1)	0.50 (12.7)	0.032 (0.8)	0.99 (25.1)	0.64 (16.3)	0.032 (0.8)
7.5	460M7559R6	1.50 (38.1)	0.52 (13.2)	0.032 (0.8)	0.99 (25.1)	0.66 (16.8)	0.032 (0.8)
8.0	460M8059R6	1.50 (38.1)	0.53 (13.5)	0.032 (0.8)	1.25 (31.8)	0.59 (15.0)	0.032 (0.8)
9.0	460M9059R6	1.50 (38.1)	0.56 (14.2)	0.032 (0.8)	1.25 (31.8)	0.62 (15.7)	0.032 (0.8)
10.0	460M1069R6	1.50 (38.1)	0.59 (15.0)	0.032 (0.8)	1.25 (31.8)	0.66 (16.8)	0.032 (0.8)
12.0	460M1269R6	1.50 (38.1)	0.64 (16.3)	0.032 (0.8)	1.25 (31.8)	0.72 (18.3)	0.032 (0.8)
15.0	460M1569R6	1.50 (38.1)	0.71 (18.0)	0.032 (0.8)	1.25 (31.8)	0.80 (20.3)	0.040 (1.0)
20.0	460M2069R6	1.50 (38.1)	0.82 (20.8)	0.040 (1.0)			
25.0	460M2569R6	1.50 (38.1)	0.91 (23.1)	0.040 (1.0)			
30.0	460M3069R6	1.50 (38.1)	0.99 (25.1)	0.040 (1.0)			
35.0	460M3569R6	1.50 (38.1)	1.07 (27.2)	0.040 (1.0)			
40.0	460M4069R6	1.50 (38.1)	1.14 (29.0)	0.040 (1.0)			
45.0	460M4569R6	1.50 (38.1)	1.21 (30.7)	0.040 (1.0)			
50.0	460M5069R6	1.50 (38.1)	1.27 (32.3)	0.040 (1.0)			
55.0	460M5569R6	1.50 (38.1)	1.34 (34.0)	0.040 (1.0)			
60.0	460M6069R6	1.50 (38.1)	1.39 (35.3)	0.040 (1.0)			
65.0	460M6569R6	1.50 (38.1)	1.45 (36.8)	0.040 (1.0)			
70.0	460M7069R6	1.50 (38.1)	1.50 (38.1)	0.040 (1.0)			
75.0	460M7569R6	1.50 (38.1)	1.55 (39.4)	0.040 (1.0)			
80.0	460M8069R6	1.50 (38.1)	1.60 (40.6)	0.040 (1.0)			
85.0	460M8569R6	1.50 (38.1)	1.65 (41.9)	0.040 (1.0)			

<sup>1</sup> Please refer to Ordering/Part Number page for specific part numbering details.



### Type 460M Sizes and Ratings – 100 VDC/63 VAC

Cap $\mu$ F	Base Part #	Standard Dimensions			Compact Dimensions <sup>1</sup>		
		L MAX	DIA MAX	Wire (d)	L MAX	DIA MAX	Wire (d)
0.15	460M15491	0.61 (15.5)	0.20 (5.1)	0.020 (0.5)			
0.18	460M18491	0.61 (15.5)	0.21 (5.3)	0.020 (0.5)			
0.22	460M22491	0.61 (15.5)	0.23 (5.8)	0.020 (0.5)			
0.27	460M27491	0.79 (20.1)	0.20 (5.1)	0.020 (0.5)	0.61 (15.5)	0.25 (6.4)	0.020 (0.5)
0.33	460M33491	0.79 (20.1)	0.22 (5.6)	0.020 (0.5)	0.61 (15.5)	0.27 (6.9)	0.025 (0.6)
0.39	460M39491	0.79 (20.1)	0.23 (5.8)	0.020 (0.5)	0.61 (15.5)	0.29 (7.4)	0.025 (0.6)
0.47	460M47491	0.99 (25.1)	0.22 (5.6)	0.020 (0.5)	0.61 (15.5)	0.31 (7.9)	0.025 (0.6)
0.5	460M50491	0.99 (25.1)	0.22 (5.6)	0.020 (0.5)	0.61 (15.5)	0.32 (8.1)	0.025 (0.6)
0.56	460M56491	0.99 (25.1)	0.23 (5.8)	0.020 (0.5)	0.61 (15.5)	0.34 (8.6)	0.025 (0.6)
0.6	460M60491	0.99 (25.1)	0.24 (6.1)	0.020 (0.5)	0.79 (20.1)	0.28 (7.1)	0.025 (0.6)
0.68	460M68491	0.99 (25.1)	0.25 (6.4)	0.020 (0.5)	0.79 (20.1)	0.29 (7.4)	0.025 (0.6)
0.75	460M75491	0.99 (25.1)	0.26 (6.6)	0.025 (0.6)	0.79 (20.1)	0.31 (7.9)	0.025 (0.6)
0.82	460M82491	0.99 (25.1)	0.27 (6.9)	0.025 (0.6)	0.79 (20.1)	0.32 (8.1)	0.025 (0.6)
0.9	460M90491	0.99 (25.1)	0.28 (7.1)	0.025 (0.6)	0.79 (20.1)	0.33 (8.4)	0.025 (0.6)
1.0	460M10591	1.25 (31.8)	0.26 (6.6)	0.025 (0.6)	0.79 (20.1)	0.35 (8.9)	0.025 (0.6)
1.2	460M12591	1.25 (31.8)	0.28 (7.1)	0.025 (0.6)	0.79 (20.1)	0.38 (9.7)	0.025 (0.6)
1.5	460M15591	1.25 (31.8)	0.31 (7.9)	0.025 (0.6)	0.79 (20.1)	0.42 (10.7)	0.032 (0.8)
1.8	460M18591	1.25 (31.8)	0.33 (8.4)	0.025 (0.6)	0.79 (20.1)	0.45 (11.4)	0.032 (0.8)
2.0	460M20591	1.25 (31.8)	0.35 (8.9)	0.025 (0.6)	0.79 (20.1)	0.47 (11.9)	0.032 (0.8)
2.2	460M22591	1.25 (31.8)	0.36 (9.1)	0.025 (0.6)	0.99 (25.1)	0.42 (10.7)	0.032 (0.8)
2.5	460M25591	1.25 (31.8)	0.39 (9.9)	0.032 (0.8)	0.99 (25.1)	0.44 (11.2)	0.032 (0.8)
2.7	460M27591	1.25 (31.8)	0.40 (10.2)	0.032 (0.8)	0.99 (25.1)	0.46 (11.7)	0.032 (0.8)
3.0	460M30591	1.25 (31.8)	0.42 (10.7)	0.032 (0.8)	0.99 (25.1)	0.48 (12.2)	0.032 (0.8)
3.3	460M33591	1.25 (31.8)	0.44 (11.2)	0.032 (0.8)	0.99 (25.1)	0.50 (12.7)	0.032 (0.8)
3.6	460M36591	1.25 (31.8)	0.46 (11.7)	0.032 (0.8)	0.99 (25.1)	0.52 (13.2)	0.032 (0.8)
3.9	460M39591	1.25 (31.8)	0.47 (11.9)	0.032 (0.8)	0.99 (25.1)	0.54 (13.7)	0.032 (0.8)
4.0	460M40591	1.50 (38.1)	0.44 (11.2)	0.032 (0.8)	0.99 (25.1)	0.55 (14.0)	0.032 (0.8)
4.7	460M47591	1.50 (38.1)	0.47 (11.9)	0.032 (0.8)	0.99 (25.1)	0.59 (15.0)	0.032 (0.8)
5.0	460M50591	1.50 (38.1)	0.48 (12.2)	0.032 (0.8)	0.99 (25.1)	0.61 (15.5)	0.032 (0.8)
5.6	460M56591	1.50 (38.1)	0.51 (13.0)	0.032 (0.8)	0.99 (25.1)	0.65 (16.5)	0.032 (0.8)
6.0	460M60591	1.50 (38.1)	0.52 (13.2)	0.032 (0.8)	1.25 (31.8)	0.58 (14.7)	0.032 (0.8)
6.8	460M68591	1.50 (38.1)	0.55 (14.0)	0.032 (0.8)	1.25 (31.8)	0.62 (15.7)	0.032 (0.8)
7.0	460M70591	1.50 (38.1)	0.56 (14.2)	0.032 (0.8)	1.25 (31.8)	0.62 (15.7)	0.032 (0.8)
7.5	460M75591	1.50 (38.1)	0.58 (14.7)	0.032 (0.8)	1.25 (31.8)	0.64 (16.3)	0.032 (0.8)
8.0	460M80591	1.50 (38.1)	0.60 (15.2)	0.032 (0.8)	1.25 (31.8)	0.66 (16.8)	0.032 (0.8)
9.0	460M90591	1.50 (38.1)	0.63 (16.0)	0.032 (0.8)	1.25 (31.8)	0.70 (17.8)	0.032 (0.8)
10.0	460M10691	1.74 (44.2)	0.60 (15.2)	0.032 (0.8)	1.50 (38.1)	0.66 (16.8)	0.032 (0.8)
12.0	460M12691	1.74 (44.2)	0.66 (16.8)	0.032 (0.8)	1.50 (38.1)	0.72 (18.3)	0.032 (0.8)
15.0	460M15691	1.74 (44.2)	0.73 (18.5)	0.032 (0.8)	1.50 (38.1)	0.80 (20.3)	0.040 (1.0)
20.0	460M20691	2.21 (56.1)	0.72 (18.3)	0.032 (0.8)	1.74 (44.2)	0.84 (21.3)	0.040 (1.0)
25.0	460M25691	2.21 (56.1)	0.81 (20.6)	0.040 (1.0)	1.74 (44.2)	0.93 (23.6)	0.040 (1.0)
30.0	460M30691	2.21 (56.1)	0.88 (22.4)	0.040 (1.0)	1.74 (44.2)	1.02 (25.9)	0.040 (1.0)
35.0	460M35691	2.21 (56.1)	0.95 (24.1)	0.040 (1.0)	1.74 (44.2)	1.10 (27.9)	0.040 (1.0)
40.0	460M40691	2.21 (56.1)	1.01 (25.7)	0.040 (1.0)	1.74 (44.2)	1.17 (29.7)	0.040 (1.0)
45.0	460M45691	2.21 (56.1)	1.07 (27.2)	0.040 (1.0)	1.74 (44.2)	1.24 (31.5)	0.040 (1.0)
50.0	460M50691	2.21 (56.1)	1.13 (28.7)	0.040 (1.0)			
55.0	460M55691	2.21 (56.1)	1.18 (30.0)	0.040 (1.0)			
60.0	460M60691	2.21 (56.1)	1.23 (31.2)	0.040 (1.0)			
65.0	460M65691	2.21 (56.1)	1.28 (32.5)	0.040 (1.0)			
70.0	460M70691	2.21 (56.1)	1.33 (33.8)	0.040 (1.0)			
75.0	460M75691	2.21 (56.1)	1.37 (34.8)	0.040 (1.0)			
80.0	460M80691	2.21 (56.1)	1.42 (36.1)	0.040 (1.0)			
85.0	460M85691	2.21 (56.1)	1.46 (37.1)	0.040 (1.0)			
90.0	460M90691	2.21 (56.1)	1.50 (38.1)	0.040 (1.0)			
95.0	460M95691	2.21 (56.1)	1.54 (39.1)	0.040 (1.0)			
100.0	460M10791	2.21 (56.1)	1.58 (40.1)	0.040 (1.0)			

<sup>1</sup> Please refer to Ordering/Part Number page for specific part numbering details.



### Type 460M Sizes and Ratings – 250 VDC/160 VAC

Cap $\mu$ F	Base Part #	Standard Dimensions			Compact Dimensions <sup>1</sup>		
		L MAX	DIA MAX	Wire (d)	L MAX	DIA MAX	Wire (d)
0.068	460M68392	0.61 (15.5)	0.19 (4.8)	0.020 (0.5)			
0.075	460M75392	0.61 (15.5)	0.20 (5.1)	0.020 (0.5)			
0.082	460M82392	0.61 (15.5)	0.20 (5.1)	0.020 (0.5)			
0.1	460M10492	0.61 (15.5)	0.22 (5.6)	0.020 (0.5)			
0.12	460M12492	0.61 (15.5)	0.24 (6.1)	0.020 (0.5)			
0.15	460M15492	0.79 (20.1)	0.21 (5.3)	0.020 (0.5)	0.61 (15.5)	0.26 (6.6)	0.025 (0.6)
0.18	460M18492	0.79 (20.1)	0.22 (5.6)	0.020 (0.5)	0.61 (15.5)	0.28 (7.1)	0.025 (0.6)
0.22	460M22492	0.79 (20.1)	0.24 (6.1)	0.020 (0.5)	0.61 (15.5)	0.30 (7.6)	0.025 (0.6)
0.27	460M27492	0.79 (20.1)	0.26 (6.6)	0.025 (0.6)	0.61 (15.5)	0.33 (8.4)	0.025 (0.6)
0.33	460M33492	0.99 (25.1)	0.25 (6.4)	0.020 (0.5)	0.79 (20.1)	0.29 (7.4)	0.025 (0.6)
0.39	460M39492	0.99 (25.1)	0.26 (6.6)	0.025 (0.6)	0.79 (20.1)	0.31 (7.9)	0.025 (0.6)
0.47	460M47492	0.99 (25.1)	0.28 (7.1)	0.025 (0.6)	0.79 (20.1)	0.33 (8.4)	0.025 (0.6)
0.5	460M50492	0.99 (25.1)	0.29 (7.4)	0.025 (0.6)	0.79 (20.1)	0.34 (8.6)	0.025 (0.6)
0.56	460M56492	0.99 (25.1)	0.31 (7.9)	0.025 (0.6)	0.79 (20.1)	0.36 (9.1)	0.025 (0.6)
0.6	460M60492	0.99 (25.1)	0.32 (8.1)	0.025 (0.6)	0.79 (20.1)	0.37 (9.4)	0.025 (0.6)
0.68	460M68492	0.99 (25.1)	0.33 (8.4)	0.025 (0.6)	0.79 (20.1)	0.39 (9.9)	0.032 (0.8)
0.75	460M75492	0.99 (25.1)	0.35 (8.9)	0.025 (0.6)	0.79 (20.1)	0.41 (10.4)	0.032 (0.8)
0.82	460M82492	0.99 (25.1)	0.36 (9.1)	0.025 (0.6)	0.79 (20.1)	0.43 (10.9)	0.032 (0.8)
0.9	460M90492	0.99 (25.1)	0.38 (9.7)	0.025 (0.6)	0.79 (20.1)	0.45 (11.4)	0.032 (0.8)
1.0	460M10592	1.25 (31.8)	0.35 (8.9)	0.025 (0.6)	0.99 (25.1)	0.40 (10.2)	0.032 (0.8)
1.2	460M12592	1.25 (31.8)	0.38 (9.7)	0.025 (0.6)	0.99 (25.1)	0.43 (10.9)	0.032 (0.8)
1.5	460M15592	1.25 (31.8)	0.42 (10.7)	0.032 (0.8)	0.99 (25.1)	0.48 (12.2)	0.032 (0.8)
1.8	460M18592	1.25 (31.8)	0.45 (11.4)	0.032 (0.8)	0.99 (25.1)	0.52 (13.2)	0.032 (0.8)
2.0	460M20592	1.50 (38.1)	0.43 (10.9)	0.032 (0.8)	0.99 (25.1)	0.55 (14.0)	0.032 (0.8)
2.2	460M22592	1.50 (38.1)	0.45 (11.4)	0.032 (0.8)	0.99 (25.1)	0.57 (14.5)	0.032 (0.8)
2.5	460M25592	1.50 (38.1)	0.48 (12.2)	0.032 (0.8)	0.99 (25.1)	0.61 (15.5)	0.032 (0.8)
2.7	460M27592	1.50 (38.1)	0.50 (12.7)	0.032 (0.8)	0.99 (25.1)	0.63 (16.0)	0.032 (0.8)
3.0	460M30592	1.50 (38.1)	0.52 (13.2)	0.032 (0.8)	1.25 (31.8)	0.58 (14.7)	0.032 (0.8)
3.3	460M33592	1.50 (38.1)	0.54 (13.7)	0.032 (0.8)	1.25 (31.8)	0.60 (15.2)	0.032 (0.8)
3.6	460M36592	1.50 (38.1)	0.57 (14.5)	0.032 (0.8)	1.25 (31.8)	0.63 (16.0)	0.032 (0.8)
3.9	460M39592	1.50 (38.1)	0.59 (15.0)	0.032 (0.8)	1.25 (31.8)	0.65 (16.5)	0.032 (0.8)
4.0	460M40592	1.74 (44.2)	0.54 (13.7)	0.032 (0.8)	1.25 (31.8)	0.66 (16.8)	0.032 (0.8)
4.7	460M47592	1.74 (44.2)	0.58 (14.7)	0.032 (0.8)	1.25 (31.8)	0.71 (18.0)	0.032 (0.8)
5.0	460M50592	1.74 (44.2)	0.60 (15.2)	0.032 (0.8)	1.25 (31.8)	0.74 (18.8)	0.032 (0.8)
5.6	460M56592	1.74 (44.2)	0.63 (16.0)	0.032 (0.8)	1.25 (31.8)	0.78 (19.8)	0.040 (1.0)
6.0	460M60592	1.74 (44.2)	0.65 (16.5)	0.032 (0.8)	1.25 (31.8)	0.81 (20.6)	0.040 (1.0)
6.8	460M68592	1.74 (44.2)	0.69 (17.5)	0.032 (0.8)	1.50 (38.1)	0.76 (19.3)	0.040 (1.0)
7.0	460M70592	1.74 (44.2)	0.70 (17.8)	0.032 (0.8)	1.50 (38.1)	0.77 (19.6)	0.040 (1.0)
7.5	460M75592	1.74 (44.2)	0.73 (18.5)	0.032 (0.8)	1.50 (38.1)	0.80 (20.3)	0.040 (1.0)
8.0	460M80592	1.74 (44.2)	0.75 (19.1)	0.032 (0.8)	1.50 (38.1)	0.82 (20.8)	0.040 (1.0)
9.0	460M90592	1.74 (44.2)	0.79 (20.1)	0.040 (1.0)	1.50 (38.1)	0.87 (22.1)	0.040 (1.0)
10.0	460M10692	1.74 (44.2)	0.83 (21.1)	0.040 (1.0)	1.50 (38.1)	0.92 (23.4)	0.040 (1.0)
12.0	460M12692	2.21 (56.1)	0.79 (20.1)	0.040 (1.0)	1.74 (44.2)	0.91 (23.1)	0.040 (1.0)
15.0	460M15692	2.21 (56.1)	0.87 (22.1)	0.040 (1.0)	1.74 (44.2)	1.01 (25.7)	0.040 (1.0)
20.0	460M20692	2.21 (56.1)	1.00 (25.4)	0.040 (1.0)	1.74 (44.2)	1.17 (29.7)	0.040 (1.0)
25.0	460M25692	2.21 (56.1)	1.12 (28.4)	0.040 (1.0)			
30.0	460M30692	2.21 (56.1)	1.22 (31.0)	0.040 (1.0)			
35.0	460M35692	2.21 (56.1)	1.32 (33.5)	0.040 (1.0)			
40.0	460M40692	2.21 (56.1)	1.41 (35.8)	0.040 (1.0)			
45.0	460M45692	2.21 (56.1)	1.49 (37.8)	0.040 (1.0)			
50.0	460M50692	2.21 (56.1)	1.57 (39.9)	0.040 (1.0)			
55.0	460M55692	2.21 (56.1)	1.65 (41.9)	0.040 (1.0)			

<sup>1</sup> Please refer to Ordering/Part Number page for specific part numbering details.



### Type 460M Sizes and Ratings – 400 VDC/200 VAC

Cap $\mu$ F	Base Part #	Standard Dimensions			Compact Dimensions <sup>1</sup>		
		L MAX	DIA MAX	Wire (d)	L MAX	DIA MAX	Wire (d)
0.022	460M22394	0.61 (15.5)	0.19 (4.8)	0.020 (0.5)			
0.027	460M27394	0.61 (15.5)	0.20 (5.1)	0.020 (0.5)			
0.033	460M33394	0.61 (15.5)	0.22 (5.6)	0.020 (0.5)			
0.039	460M39394	0.61 (15.5)	0.23 (5.8)	0.020 (0.5)			
0.047	460M47394	0.61 (15.5)	0.25 (6.4)	0.020 (0.5)			
0.05	460M50394	0.61 (15.5)	0.26 (6.6)	0.025 (0.6)			
0.056	460M56394	0.61 (15.5)	0.27 (6.9)	0.025 (0.6)			
0.062	460M62394	0.79 (20.1)	0.22 (5.6)	0.020 (0.5)	0.61 (15.5)	0.28 (7.1)	0.025 (0.6)
0.068	460M68394	0.79 (20.1)	0.23 (5.8)	0.020 (0.5)	0.61 (15.5)	0.29 (7.4)	0.025 (0.6)
0.075	460M75394	0.79 (20.1)	0.24 (6.1)	0.020 (0.5)	0.61 (15.5)	0.31 (7.9)	0.025 (0.6)
0.082	460M82394	0.79 (20.1)	0.25 (6.4)	0.020 (0.5)	0.61 (15.5)	0.32 (8.1)	0.025 (0.6)
0.1	460M10494	0.79 (20.1)	0.27 (6.9)	0.025 (0.6)	0.61 (15.5)	0.35 (8.9)	0.025 (0.6)
0.12	460M12494	0.99 (25.1)	0.25 (6.4)	0.020 (0.5)	0.79 (20.1)	0.29 (7.4)	0.025 (0.6)
0.15	460M15494	0.99 (25.1)	0.27 (6.9)	0.025 (0.6)	0.79 (20.1)	0.32 (8.1)	0.025 (0.6)
0.18	460M18494	0.99 (25.1)	0.29 (7.4)	0.025 (0.6)	0.79 (20.1)	0.35 (8.9)	0.025 (0.6)
0.22	460M22494	0.99 (25.1)	0.32 (8.1)	0.025 (0.6)	0.79 (20.1)	0.38 (9.7)	0.025 (0.6)
0.27	460M27494	0.99 (25.1)	0.35 (8.9)	0.025 (0.6)	0.79 (20.1)	0.42 (10.7)	0.032 (0.8)
0.33	460M33494	1.25 (31.8)	0.33 (8.4)	0.025 (0.6)	0.99 (25.1)	0.38 (9.7)	0.025 (0.6)
0.39	460M39494	1.25 (31.8)	0.36 (9.1)	0.025 (0.6)	0.99 (25.1)	0.41 (10.4)	0.032 (0.8)
0.47	460M47494	1.50 (38.1)	0.36 (9.1)	0.025 (0.6)	0.99 (25.1)	0.45 (11.4)	0.032 (0.8)
0.5	460M50494	1.50 (38.1)	0.37 (9.4)	0.025 (0.6)	0.99 (25.1)	0.46 (11.7)	0.032 (0.8)
0.56	460M56494	1.50 (38.1)	0.38 (9.7)	0.032 (0.8)	0.99 (25.1)	0.48 (12.2)	0.032 (0.8)
0.6	460M60494	1.50 (38.1)	0.39 (9.9)	0.032 (0.8)	0.99 (25.1)	0.50 (12.7)	0.032 (0.8)
0.68	460M68494	1.74 (44.2)	0.38 (9.7)	0.032 (0.8)	0.99 (25.1)	0.53 (13.5)	0.032 (0.8)
0.75	460M75494	1.74 (44.2)	0.40 (10.2)	0.032 (0.8)	0.99 (25.1)	0.55 (14.0)	0.032 (0.8)
0.82	460M82494	1.74 (44.2)	0.41 (10.4)	0.032 (0.8)	0.99 (25.1)	0.58 (14.7)	0.032 (0.8)
0.9	460M90494	1.74 (44.2)	0.43 (10.9)	0.032 (0.8)	0.99 (25.1)	0.60 (15.2)	0.032 (0.8)
1.0	460M10594	1.74 (44.2)	0.45 (11.4)	0.032 (0.8)	0.99 (25.1)	0.63 (16.0)	0.032 (0.8)
1.2	460M12594	1.74 (44.2)	0.49 (12.4)	0.032 (0.8)	1.25 (31.8)	0.60 (15.2)	0.032 (0.8)
1.5	460M15594	1.74 (44.2)	0.54 (13.7)	0.032 (0.8)	1.25 (31.8)	0.66 (16.8)	0.032 (0.8)
1.8	460M18594	1.74 (44.2)	0.59 (15.0)	0.032 (0.8)	1.25 (31.8)	0.72 (18.3)	0.032 (0.8)
2.0	460M20594	1.74 (44.2)	0.62 (15.7)	0.032 (0.8)	1.25 (31.8)	0.77 (19.6)	0.040 (1.0)
2.2	460M22594	1.74 (44.2)	0.64 (16.3)	0.032 (0.8)	1.25 (31.8)	0.80 (20.3)	0.040 (1.0)
2.5	460M25594	1.74 (44.2)	0.68 (17.3)	0.032 (0.8)	1.50 (38.1)	0.75 (19.1)	0.032 (0.8)
2.7	460M27594	1.74 (44.2)	0.71 (18.0)	0.032 (0.8)	1.50 (38.1)	0.78 (19.8)	0.040 (1.0)
3.0	460M30594	1.74 (44.2)	0.75 (19.1)	0.032 (0.8)	1.50 (38.1)	0.82 (20.8)	0.040 (1.0)
3.3	460M33594	1.74 (44.2)	0.78 (19.8)	0.040 (1.0)	1.50 (38.1)	0.86 (21.8)	0.040 (1.0)
3.6	460M36594	2.21 (56.1)	0.70 (17.8)	0.032 (0.8)	1.50 (38.1)	0.90 (22.9)	0.040 (1.0)
3.9	460M39594	2.21 (56.1)	0.73 (18.5)	0.032 (0.8)	1.50 (38.1)	0.93 (23.6)	0.040 (1.0)
4.0	460M40594	2.21 (56.1)	0.74 (18.8)	0.032 (0.8)	1.50 (38.1)	0.94 (23.9)	0.040 (1.0)
4.7	460M47594	2.21 (56.1)	0.80 (20.3)	0.040 (1.0)	1.50 (38.1)	1.02 (25.9)	0.040 (1.0)
5.0	460M50594	2.21 (56.1)	0.82 (20.8)	0.040 (1.0)	1.74 (44.2)	0.95 (24.1)	0.040 (1.0)
5.6	460M56594	2.21 (56.1)	0.87 (22.1)	0.040 (1.0)	1.74 (44.2)	1.01 (25.7)	0.040 (1.0)
6.0	460M60594	2.21 (56.1)	0.89 (22.6)	0.040 (1.0)	1.74 (44.2)	1.04 (26.4)	0.040 (1.0)
6.8	460M68594	2.21 (56.1)	0.95 (24.1)	0.040 (1.0)	1.74 (44.2)	1.11 (28.2)	0.040 (1.0)
7.0	460M70594	2.21 (56.1)	0.96 (24.4)	0.040 (1.0)	1.74 (44.2)	1.12 (28.4)	0.040 (1.0)
7.5	460M75594	2.21 (56.1)	1.00 (25.4)	0.040 (1.0)	1.74 (44.2)	1.16 (29.5)	0.040 (1.0)
8.0	460M80594	2.21 (56.1)	1.03 (26.2)	0.040 (1.0)	1.74 (44.2)	1.20 (30.5)	0.040 (1.0)
9.0	460M90594	2.21 (56.1)	1.09 (27.7)	0.040 (1.0)			
10.0	460M10694	2.21 (56.1)	1.14 (29.0)	0.040 (1.0)			
12.0	460M12694	2.21 (56.1)	1.25 (31.8)	0.040 (1.0)			
15.0	460M15694	2.21 (56.1)	1.40 (35.6)	0.040 (1.0)			
18.0	460M18694	2.21 (56.1)	1.53 (38.9)	0.040 (1.0)			
20.0	460M20694	2.21 (56.1)	1.61 (40.9)	0.040 (1.0)			

<sup>1</sup> Please refer to Ordering/Part Number page for specific part numbering details.



### Type 460M Sizes and Ratings – 630 VDC/220 VAC

Cap $\mu$ F	Base Part #	Standard Dimensions			Compact Dimensions <sup>1</sup>		
		L MAX	DIA MAX	Wire (d)	L MAX	DIA MAX	Wire (d)
0.0082	460M82296	0.61 (15.5)	0.19 (4.8)	0.020 (0.5)			
0.0091	460M91296	0.61 (15.5)	0.20 (5.1)	0.020 (0.5)			
0.01	460M10396	0.61 (15.5)	0.21 (5.3)	0.020 (0.5)			
0.012	460M12396	0.61 (15.5)	0.22 (5.6)	0.020 (0.5)			
0.015	460M15396	0.61 (15.5)	0.24 (6.1)	0.020 (0.5)			
0.018	460M18396	0.79 (20.1)	0.20 (5.1)	0.020 (0.5)	0.61 (15.5)	0.26 (6.6)	0.025 (0.6)
0.022	460M22396	0.79 (20.1)	0.21 (5.3)	0.020 (0.5)	0.61 (15.5)	0.28 (7.1)	0.025 (0.6)
0.027	460M27396	0.79 (20.1)	0.23 (5.8)	0.020 (0.5)	0.61 (15.5)	0.31 (7.9)	0.025 (0.6)
0.033	460M33396	0.79 (20.1)	0.25 (6.4)	0.020 (0.5)	0.61 (15.5)	0.33 (8.4)	0.025 (0.6)
0.039	460M39396	0.99 (25.1)	0.22 (5.6)	0.020 (0.5)	0.79 (20.1)	0.27 (6.9)	0.025 (0.6)
0.047	460M47396	0.99 (25.1)	0.24 (6.1)	0.020 (0.5)	0.79 (20.1)	0.29 (7.4)	0.025 (0.6)
0.05	460M50396	0.99 (25.1)	0.25 (6.4)	0.020 (0.5)	0.79 (20.1)	0.30 (7.6)	0.025 (0.6)
0.056	460M56396	0.99 (25.1)	0.26 (6.6)	0.025 (0.6)	0.79 (20.1)	0.31 (7.9)	0.025 (0.6)
0.062	460M62396	0.99 (25.1)	0.27 (6.9)	0.025 (0.6)	0.79 (20.1)	0.32 (8.1)	0.025 (0.6)
0.068	460M68396	0.99 (25.1)	0.28 (7.1)	0.025 (0.6)	0.79 (20.1)	0.34 (8.6)	0.025 (0.6)
0.075	460M75396	0.99 (25.1)	0.29 (7.4)	0.025 (0.6)	0.79 (20.1)	0.35 (8.9)	0.025 (0.6)
0.082	460M82396	0.99 (25.1)	0.30 (7.6)	0.025 (0.6)	0.79 (20.1)	0.37 (9.4)	0.025 (0.6)
0.1	460M10496	0.99 (25.1)	0.33 (8.4)	0.025 (0.6)	0.79 (20.1)	0.40 (10.2)	0.032 (0.8)
0.12	460M12496	0.99 (25.1)	0.36 (9.1)	0.025 (0.6)	0.79 (20.1)	0.44 (11.2)	0.032 (0.8)
0.15	460M15496	1.25 (31.8)	0.34 (8.6)	0.025 (0.6)	0.99 (25.1)	0.39 (9.9)	0.032 (0.8)
0.18	460M18496	1.25 (31.8)	0.37 (9.4)	0.025 (0.6)	0.99 (25.1)	0.43 (10.9)	0.032 (0.8)
0.22	460M22496	1.50 (38.1)	0.37 (9.4)	0.025 (0.6)	0.99 (25.1)	0.47 (11.9)	0.032 (0.8)
0.27	460M27496	1.50 (38.1)	0.40 (10.2)	0.032 (0.8)	0.99 (25.1)	0.52 (13.2)	0.032 (0.8)
0.33	460M33496	1.74 (44.2)	0.40 (10.2)	0.032 (0.8)	0.99 (25.1)	0.57 (14.5)	0.032 (0.8)
0.39	460M39496	1.74 (44.2)	0.43 (10.9)	0.032 (0.8)	0.99 (25.1)	0.62 (15.7)	0.032 (0.8)
0.47	460M47496	1.74 (44.2)	0.47 (11.9)	0.032 (0.8)	1.25 (31.8)	0.58 (14.7)	0.032 (0.8)
0.5	460M50496	1.74 (44.2)	0.48 (12.2)	0.032 (0.8)	1.25 (31.8)	0.59 (15.0)	0.032 (0.8)
0.56	460M56496	1.74 (44.2)	0.51 (13.0)	0.032 (0.8)	1.25 (31.8)	0.63 (16.0)	0.032 (0.8)
0.6	460M60496	1.74 (44.2)	0.52 (13.2)	0.032 (0.8)	1.25 (31.8)	0.65 (16.5)	0.032 (0.8)
0.68	460M68496	1.74 (44.2)	0.55 (14.0)	0.032 (0.8)	1.25 (31.8)	0.69 (17.5)	0.032 (0.8)
0.75	460M75496	1.74 (44.2)	0.58 (14.7)	0.032 (0.8)	1.25 (31.8)	0.72 (18.3)	0.032 (0.8)
0.82	460M82496	1.74 (44.2)	0.60 (15.2)	0.032 (0.8)	1.25 (31.8)	0.76 (19.3)	0.032 (0.8)
0.9	460M90496	1.74 (44.2)	0.63 (16.0)	0.032 (0.8)	1.25 (31.8)	0.79 (20.1)	0.040 (1.0)
1.0	460M10596	1.74 (44.2)	0.66 (16.8)	0.032 (0.8)	1.25 (31.8)	0.83 (21.1)	0.040 (1.0)
1.2	460M12596	2.21 (56.1)	0.62 (15.7)	0.032 (0.8)	1.50 (38.1)	0.80 (20.3)	0.040 (1.0)
1.5	460M15596	2.21 (56.1)	0.69 (17.5)	0.032 (0.8)	1.50 (38.1)	0.89 (22.6)	0.040 (1.0)
1.8	460M18596	2.21 (56.1)	0.75 (19.1)	0.032 (0.8)	1.50 (38.1)	0.97 (24.6)	0.040 (1.0)
2.0	460M20596	2.21 (56.1)	0.79 (20.1)	0.040 (1.0)	1.50 (38.1)	1.02 (25.9)	0.040 (1.0)
2.2	460M22596	2.21 (56.1)	0.82 (20.8)	0.040 (1.0)	1.74 (44.2)	0.96 (24.4)	0.040 (1.0)
2.5	460M25596	2.21 (56.1)	0.88 (22.4)	0.040 (1.0)	1.74 (44.2)	1.02 (25.9)	0.040 (1.0)
2.7	460M27596	2.21 (56.1)	0.91 (23.1)	0.040 (1.0)	1.74 (44.2)	1.06 (26.9)	0.040 (1.0)
3.0	460M30596	2.21 (56.1)	0.96 (24.4)	0.040 (1.0)	1.74 (44.2)	1.12 (28.4)	0.040 (1.0)
3.3	460M33596	2.21 (56.1)	1.00 (25.4)	0.040 (1.0)	1.74 (44.2)	1.17 (29.7)	0.040 (1.0)
3.6	460M36596	2.21 (56.1)	1.05 (26.7)	0.040 (1.0)	1.74 (44.2)	1.22 (31.0)	0.040 (1.0)
3.9	460M39596	2.21 (56.1)	1.09 (27.7)	0.040 (1.0)			
4.0	460M40596	2.21 (56.1)	1.10 (27.9)	0.040 (1.0)			
4.7	460M47596	2.21 (56.1)	1.19 (30.2)	0.040 (1.0)			
5.0	460M50596	2.21 (56.1)	1.23 (31.2)	0.040 (1.0)			
5.6	460M56596	2.21 (56.1)	1.30 (33.0)	0.040 (1.0)			
6.0	460M60596	2.21 (56.1)	1.34 (34.0)	0.040 (1.0)			
6.8	460M68596	2.21 (56.1)	1.43 (36.3)	0.040 (1.0)			
7.0	460M70596	2.21 (56.1)	1.45 (36.8)	0.040 (1.0)			
7.5	460M75596	2.21 (56.1)	1.50 (38.1)	0.040 (1.0)			
8.0	460M80596	2.21 (56.1)	1.54 (39.1)	0.040 (1.0)			
9.0	460M90596	2.21 (56.1)	1.64 (41.7)	0.040 (1.0)			

<sup>1</sup> Please refer to Ordering/Part Number page for specific part numbering details.



### Type 460M Sizes and Ratings – 1000 VDC/250 VAC

Cap $\mu$ F	Base Part #	Standard Dimensions			Compact Dimensions <sup>1</sup>		
		L MAX	DIA MAX	Wire (d)	L MAX	DIA MAX	Wire (d)
0.0047	460M472910	0.61 (15.5)	0.20 (5.1)	0.020 (0.5)			
0.0056	460M562910	0.61 (15.5)	0.21 (5.3)	0.020 (0.5)			
0.0068	460M682910	0.61 (15.5)	0.23 (5.8)	0.020 (0.5)			
0.0075	460M752910	0.61 (15.5)	0.24 (6.1)	0.020 (0.5)			
0.0082	460M822910	0.61 (15.5)	0.25 (6.4)	0.020 (0.5)			
0.0091	460M912910	0.61 (15.5)	0.26 (6.6)	0.025 (0.6)			
0.01	460M103910	0.61 (15.5)	0.27 (6.9)	0.025 (0.6)			
0.012	460M123910	0.79 (20.1)	0.21 (5.3)	0.020 (0.5)	0.61 (15.5)	0.29 (7.4)	0.025 (0.6)
0.015	460M153910	0.79 (20.1)	0.23 (5.8)	0.020 (0.5)	0.61 (15.5)	0.32 (8.1)	0.025 (0.6)
0.018	460M183910	0.79 (20.1)	0.24 (6.1)	0.020 (0.5)	0.61 (15.5)	0.35 (8.9)	0.025 (0.6)
0.022	460M223910	0.99 (25.1)	0.22 (5.6)	0.020 (0.5)	0.79 (20.1)	0.26 (6.6)	0.025 (0.6)
0.027	460M273910	0.99 (25.1)	0.24 (6.1)	0.020 (0.5)	0.79 (20.1)	0.29 (7.4)	0.025 (0.6)
0.033	460M333910	0.99 (25.1)	0.26 (6.6)	0.025 (0.6)	0.79 (20.1)	0.31 (7.9)	0.025 (0.6)
0.039	460M393910	0.99 (25.1)	0.27 (6.9)	0.025 (0.6)	0.79 (20.1)	0.34 (8.6)	0.025 (0.6)
0.047	460M473910	0.99 (25.1)	0.30 (7.6)	0.025 (0.6)	0.79 (20.1)	0.37 (9.4)	0.025 (0.6)
0.05	460M503910	0.99 (25.1)	0.30 (7.6)	0.025 (0.6)	0.79 (20.1)	0.38 (9.7)	0.025 (0.6)
0.056	460M563910	0.99 (25.1)	0.32 (8.1)	0.025 (0.6)	0.79 (20.1)	0.40 (10.2)	0.032 (0.8)
0.062	460M623910	0.99 (25.1)	0.33 (8.4)	0.025 (0.6)	0.79 (20.1)	0.42 (10.7)	0.032 (0.8)
0.068	460M683910	0.99 (25.1)	0.35 (8.9)	0.025 (0.6)	0.79 (20.1)	0.43 (10.9)	0.032 (0.8)
0.075	460M753910	0.99 (25.1)	0.36 (9.1)	0.025 (0.6)	0.79 (20.1)	0.45 (11.4)	0.032 (0.8)
0.082	460M823910	0.99 (25.1)	0.38 (9.7)	0.025 (0.6)	0.79 (20.1)	0.47 (11.9)	0.032 (0.8)
0.1	460M104910	1.25 (31.8)	0.35 (8.9)	0.025 (0.6)	0.99 (25.1)	0.41 (10.4)	0.032 (0.8)
0.12	460M124910	1.25 (31.8)	0.38 (9.7)	0.032 (0.8)	0.99 (25.1)	0.45 (11.4)	0.032 (0.8)
0.15	460M154910	1.25 (31.8)	0.42 (10.7)	0.032 (0.8)	0.99 (25.1)	0.50 (12.7)	0.032 (0.8)
0.18	460M184910	1.25 (31.8)	0.46 (11.7)	0.032 (0.8)	0.99 (25.1)	0.55 (14.0)	0.032 (0.8)
0.22	460M224910	1.25 (31.8)	0.51 (13.0)	0.032 (0.8)	0.99 (25.1)	0.60 (15.2)	0.032 (0.8)
0.27	460M274910	1.50 (38.1)	0.50 (12.7)	0.032 (0.8)	1.25 (31.8)	0.56 (14.2)	0.032 (0.8)
0.33	460M334910	1.50 (38.1)	0.55 (14.0)	0.032 (0.8)	1.25 (31.8)	0.62 (15.7)	0.032 (0.8)
0.39	460M394910	1.50 (38.1)	0.59 (15.0)	0.032 (0.8)	1.25 (31.8)	0.67 (17.0)	0.032 (0.8)
0.47	460M474910	1.50 (38.1)	0.64 (16.3)	0.032 (0.8)	1.25 (31.8)	0.73 (18.5)	0.032 (0.8)
0.5	460M504910	1.50 (38.1)	0.66 (16.8)	0.032 (0.8)	1.25 (31.8)	0.76 (19.3)	0.032 (0.8)
0.56	460M564910	1.50 (38.1)	0.70 (17.8)	0.032 (0.8)	1.25 (31.8)	0.80 (20.3)	0.040 (1.0)
0.6	460M604910	1.50 (38.1)	0.72 (18.3)	0.032 (0.8)	1.25 (31.8)	0.82 (20.8)	0.040 (1.0)
0.68	460M684910	1.74 (44.2)	0.69 (17.5)	0.032 (0.8)	1.50 (38.1)	0.76 (19.3)	0.040 (1.0)
0.75	460M754910	1.74 (44.2)	0.72 (18.3)	0.032 (0.8)	1.50 (38.1)	0.80 (20.3)	0.040 (1.0)
0.82	460M824910	1.74 (44.2)	0.75 (19.1)	0.032 (0.8)	1.50 (38.1)	0.84 (21.3)	0.040 (1.0)
0.9	460M904910	1.74 (44.2)	0.79 (20.1)	0.040 (1.0)	1.50 (38.1)	0.87 (22.1)	0.040 (1.0)
1.0	460M105910	1.74 (44.2)	0.83 (21.1)	0.040 (1.0)	1.50 (38.1)	0.92 (23.4)	0.040 (1.0)
1.2	460M125910	1.74 (44.2)	0.90 (22.9)	0.040 (1.0)	1.50 (38.1)	1.00 (25.4)	0.040 (1.0)
1.5	460M155910	2.21 (56.1)	0.86 (21.8)	0.040 (1.0)	1.74 (44.2)	1.01 (25.7)	0.040 (1.0)
1.8	460M185910	2.21 (56.1)	0.94 (23.9)	0.040 (1.0)	1.74 (44.2)	1.10 (27.9)	0.040 (1.0)
2.0	460M205910	2.21 (56.1)	0.99 (25.1)	0.040 (1.0)	1.74 (44.2)	1.16 (29.5)	0.040 (1.0)
2.2	460M225910	2.21 (56.1)	1.03 (26.2)	0.040 (1.0)	1.74 (44.2)	1.21 (30.7)	0.040 (1.0)
2.5	460M255910	2.21 (56.1)	1.10 (27.9)	0.040 (1.0)			
2.7	460M275910	2.21 (56.1)	1.14 (29.0)	0.040 (1.0)			
3.0	460M305910	2.21 (56.1)	1.20 (30.5)	0.040 (1.0)			
3.3	460M335910	2.21 (56.1)	1.26 (32.0)	0.040 (1.0)			
3.6	460M365910	2.21 (56.1)	1.31 (33.3)	0.040 (1.0)			
3.9	460M395910	2.21 (56.1)	1.36 (34.5)	0.040 (1.0)			
4.0	460M405910	2.21 (56.1)	1.38 (35.1)	0.040 (1.0)			
4.7	460M475910	2.21 (56.1)	1.50 (38.1)	0.040 (1.0)			
5.0	460M505910	2.21 (56.1)	1.54 (39.1)	0.040 (1.0)			
5.5	460M555910	2.21 (56.1)	1.62 (41.1)	0.040 (1.0)			

<sup>1</sup> Please refer to Ordering/Part Number page for specific part numbering details.



**Maximum dV/dt Ratings (Volts/μsec)**

Refer to the tabulated data below for the maximum allowable pulse rise time (dV/dt) based on voltage rating and length/diameter dimensions. In addition, further detailed notes regarding pulse applications may be found on page 13.

**63 VDC**

**L MAX Dimension**

Diameter Range	0.61	0.79	0.99	1.25	1.50	1.74	2.21
< 0.28	7	6	5				
0.28-0.39	15	9	6	5	4		
0.40-0.49		13	8	6	5		
0.50-0.75			9	7	6		
> 0.75				7	6		

**100 VDC**

**L MAX Dimension**

Diameter Range	0.61	0.79	0.99	1.25	1.50	1.74	2.21
< 0.28	7	6	5	4			
0.28-0.39	17	11	7	5			
0.40-0.49		13	9	7	6		
0.50-0.75			12	8	6	5	4
> 0.75					6	5	4

**250 VDC**

**L MAX Dimension**

Diameter Range	0.61	0.79	0.99	1.25	1.50	1.74	2.21
< 0.28	15	9	8	8			
0.28-0.39	23	14	9	9			
0.40-0.49		19	13	10	8		
0.50-0.75			14	11	8	7	
> 0.75				11	8	7	5

**400 VDC**

**L MAX Dimension**

Diameter Range	0.61	0.79	0.99	1.25	1.50	1.74	2.21
< 0.28	28	16	13				
0.28-0.39	43	25	16	14	11	9	
0.40-0.49		34	22	18		10	
0.50-0.75			23	18	14		8
> 0.75				18	14	11	8

**630 VDC**

**L MAX Dimension**

Diameter Range	0.61	0.79	0.99	1.25	1.50	1.74	2.21
< 0.28	52	27	17				
0.28-0.39	80	41	36	22	18		
0.40-0.49		55	38			16	
0.50-0.75			39	28		17	13
> 0.75				29	22	18	13

**1000 VDC**

**L MAX Dimension**

Diameter Range	0.61	0.79	0.99	1.25	1.50	1.74	2.21
< 0.28	83	35	23				
0.28-0.39	133	57	37	30			
0.40-0.49		78	48	34			
0.50-0.75			51	36	27	23	
> 0.75				38	28	23	17



### Pulse Application Notes

The purpose of the information below is to highlight factors that should be understood and considered when evaluating metallized polyester film capacitors for pulse applications. We will start with some general information. First,

**A "pulse application" will be defined as any application where very substantial and rapid voltage changes occur across the capacitor at a relatively low duty ratio.**

It is also necessary to describe the construction (valid for other suppliers as well) of metallized film capacitors. To begin plain dielectric film is placed in a vacuum and a thin layer of metal alloy is deposited on it. The metallized film is wound into a cylinder so that a metallized edge extends on each end of the wound capacitor section. Both ends are then sprayed with small droplets of molten metal that adhere along, and make contact with, the metallization on the film. The wire lead is welded to this end spray. The end spray process does not result in a uniform connection to the metallization and there is some damage and connection loss at the edge of the film from the heat contained in the metal droplets.

During application the capacitor current must be shared by all the minute connection points of the metal end spray to the metallization of the film. Since the actual contacts between the metal end spray and the metallization are relatively few and tiny, and the contact is made to a very thin layer of metallization, the current density at each contact is enormous. If the peak current rises past a certain point the metallization vaporizes adjacent to the connections with the highest current density. Since these connection points are now gone, the remaining connection points must carry more current. After a finite number of pulses the capacitor becomes an open circuit.

**Therefore when metallized film capacitors are used in pulse applications the overriding concern is the peak current during a voltage transition.**

Because it is very difficult to measure fast current pulses directly, maximum pulse current is usually specified by  $dV/dt$  of voltage waveforms across the capacitor.  $I = C * dV/dt$ . There are several factors that determine pulse current capability. To begin with, as the diameter of a unit increases so do the number of connection points between the end spray and film metallization. Thus, for the same capacitance and voltage rating, a "short, fat" [rather than a "long, skinny"] capacitor will have better pulse current capability. The longer, thinner designs are also prone to more process damage explaining why in general very small diameter metallized capacitors have VERY low  $dV/dt$  ratings!

In addition, if a proposed capacitor application falls within the maximum  $dV/dt$  specified then the application must be checked to ensure the power dissipation [temperature rise] is within the allowable limit. For this purpose it is useful to consider each voltage transition as  $1/2$  cycle of a cosine waveform. The period would be defined by "mentally fitting" the cosine wave to the actual rise/fall time. Determine the frequency by doubling the peak-to-peak time observed from the cosine approximation. Although appearing to be a loose method to use for analysis, it produces surprisingly useful results when compared to behavior in an application. This method of analysis is applicable to any kind of capacitor used for a pulse application. Contact us for the analysis details.

To avoid reliability issues in any application the total voltage transition between the most positive and negative peak [including ringing] over one waveform period should not exceed 2.828 times the rated AC voltage. In addition, the highest voltage peak across the capacitor should not exceed the DC voltage rating.

Also of interest is the fact that metallized polyester film capacitors have higher  $dV/dt$  ratings than comparable metallized polypropylene because the film does not sustain as much damage by the hot metal end spray or the heat generated at lead welding. For pulse applications with very low duty ratios and slow repetition rates they may be the best choice. However, because polyester dielectric loss is so high they are not suitable for large voltage swings at high repetition rate applications.

**If our standard capacitor  $dV/dt$  ratings do not meet the needs of your application please contact us. There are several options available to substantially improve the allowable  $dV/dt$ .**

SBE is very conscious of maintaining metallized film capacitor pulse capability. Every lot is sample checked at four times the rated  $dV/dt$  for 1000 pulses [Exceptions do exist]. We encourage you to contact us to further discuss your pulse application to assure you specify the *right* part!



### AC Voltage Application Notes

Many requests are received regarding the permissible AC voltage/frequency capability of metallized polyester film capacitors, because they are smaller and appear to have a temperature advantage when compared with metallized polypropylene capacitors of similar capacitance and voltage rating. It has also been asked why we do not publish these curves in our catalog as do some other capacitor suppliers. The information below will help to address this question. This information is not presented as a detailed analysis, but rather to highlight some of the issues that need to be considered when using metallized polyester film capacitors in AC applications.

There is no such thing as a "perfect" film capacitor dielectric. All have their unique "pros" and "cons". As an example, polypropylene film has many advantages: it behaves very uniformly and predictably over temperature and frequency allowing suggested operating limits to be calculated and plotted. It has very low dielectric losses. Its voltage withstand per unit thickness is the highest of all capacitor films. However, polypropylene has a maximum temperature limit of +105°C. It also has a low dielectric constant, which results in a larger physical size for a given capacitance and voltage rating when compared with most other film dielectrics. Therefore the reduced size and perceived temperature advantage of metallized polyester film capacitors are strong motivators to consider their use.

For metallized polypropylene film capacitors the increase in dissipation factor associated with increasing frequency is determined by the ohmic losses of the lead wires and the metallization alloy deposited on the film. The dielectric losses are very small and do not change. This behavior lends itself to spreadsheet analysis to create performance curves that conservatively represent real behavior in applications. Defining the capacitor application thermal environment enables scaling these performance curves as required.

Defining the voltage/frequency capability of polyester film capacitors is particularly more complicated because:

- **Polyester film dielectric losses are usually more than an order of magnitude higher than for polypropylene film, and**
- **Polyester film losses are a very strong function of frequency and temperature.**

These film losses are high enough to completely dominate ohmic losses in polyester capacitors. More important, the DF behavior with temperature and with frequency are transcendental functions that cannot be modeled easily with a spreadsheet.

If you refer to the general specifications page (page 3), you will find at the lower right a typical Dissipation Factor vs. Temperature graph for polyester film at 1KHz. Note that as you move above +50°C the DF starts to climb. For large enough AC voltages the increasing losses with temperature can result in thermal runaway. It can also be seen that for AC applications the +125°C internal hot spot temperature limit is extremely misleading. It is very difficult to use the temperature range between +85°C and +125°C for AC applications because the allowable AC voltage drops so fast with increasing temperature!

The DF vs. Temperature behavior changes drastically with frequency. Upon request we can provide graphs of DF vs. Temperature for several frequencies, and describe an iterative method for providing a "starting point" for polyester capacitor performance evaluation in an AC application. It will be left in the hands of the product design engineer to do the temperature rise tests under worst case electrical and thermal conditions to verify that a proposed polyester capacitor is indeed suitable for that specific application.

Since a very small ambient temperature change can result in a large increase in DF, the polyester capacitor behavior can be VERY sensitive to the application thermal environment. That environment can be so variable that in our opinion publishing generally applicable performance curves would be very misleading!

However we also realize that despite the information presented above there are many AC applications where polyester capacitors represent the best solution from a size, cost, and electrical performance perspective.

We hope you find this information useful in your design process, and we welcome technical discussions on the suitability of any type of film capacitor for your application.



**Notes**



**SBE designs and manufactures a wide variety of Film Capacitors. Please contact us today for additional details!**

### Radial Lead Film Capacitors, Orange Drop®

#### POLYPROPYLENE – FILM/FOIL

Series	Capacitance	DC Voltage	AC Voltage	Features
715P	.001 to .47 $\mu$ F	100 to 2000	70 to 500	Tolerance to $\pm$ 1%, excellent Polystyrene sub.
716P	.001 to 1.0 $\mu$ F	100 to 2000	70 to 500	Solid copper leads, high performance
716P High Volt.	.00022 to .033 $\mu$ F	1000 to 2000	450 to 500	Compact size, extremely low D.F.
715P/717P	.00047 to .015 $\mu$ F	1800 to 2000	800 to 1000	dV/dt to 104 KV/ $\mu$ sec, tolerances to $\pm$ 1%
773P	.001 to .01 $\mu$ F	1600	700 to 750	Ideal for demanding ballast applications
778P/779P	.00047 to .033 $\mu$ F	630	400	Peak current over 450 Amps, low ESR

#### POLYPROPYLENE – METALLIZED

725M	.01 to 4.7 $\mu$ F	160 to 630	100 to 250	Compact size, low ESR/ESL
727M	.001 to 2.2 $\mu$ F	400 to 2000	300 to 600	AC applications
757M	.001 to .01 $\mu$ F	1600	700	High AC voltage for electronic ballast

#### POLYESTER – FILM/FOIL

225P	.001 to 1.0 $\mu$ F	100 to 600	70 to 200	Over 40 years of proven reliability
418P	.001 to 1.0 $\mu$ F	100 to 1000	70 to 200	High peak current, temp rating to +125°C

#### POLYESTER – METALLIZED

425M	.012 to 12.0 $\mu$ F	100 to 630	63 to 250	Compact size, various lead spacings
427M	.01 to 2.2 $\mu$ F	up to 1000	up to 480	AC applications

#### R-C NETWORKS

Series	Cap/Resistor	DC Voltage	AC Voltage	Features
288P	.1/.22/.47 $\mu$ F 47/100/470 Ohm	400	250	Metallized Polyester Film Cap. 1/2 watt carbon comp resistor
298P	.047/.1 $\mu$ F 47/100/470 Ohm	500	330	Polyester Film/Foil Cap. 1/2 watt carbon comp resistor

### Axial Lead Film Capacitors

#### POLYPROPYLENE – METALLIZED

Series	Capacitance	DC Voltage	AC Voltage	Features
760M/761M	.01 to 60.0 $\mu$ F	160 to 630	100 to 250	High Power
762M/763M	.01 to 2.2 $\mu$ F	up to 2000	up to 600	AC applications

#### POLYPROPYLENE – FILM/FOIL

770P	.00047 to .68 $\mu$ F	100 to 600	70 to 200	Excellent capacitance stability
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#### POLYESTER – METALLIZED

460M/461M	.0047 to 100.0 $\mu$ F	63 to 1000	40 to 250	Various sizes, wide range of cap values
462M/463M	.01 to 2.2 $\mu$ F	up to 1000	up to 480	AC applications

#### POLYESTER – FILM/FOIL

192P Pacer®	.0001 to .39 $\mu$ F	80 to 600	55 to 200	Small size, available on Tape & Reel
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Orange Drop® and Pacer® are registered trademarks of SB Electronics, Inc.