

Rev. B 3-00 5k

# **GE Capacitors**

Capacitors for High Current, Power Semiconductor, and DC Applications

# GE Capacitors for High-Current, Power Semiconductor, and DC Applications

Capacitors for Power Electronics require special high-performance designs for the varied applications. This catalog describes capacitors for a number of demanding applications where high currents and/or high voltages are common. Given the special nature of these applications, care must be taken to ensure that the capacitors are correctly applied. Information is included to help with the more common application conditions. An Application Data Sheet is also provided to enlist the help of GE's Application Engineers. Please use this sheet if you need assistance or want to verify your own calculations.

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# **Capacitor Application Data Sheet**

To ensure correct selection of a capacitor for your application, please provide the information indicated below. This sheet may be duplicated or additional copies may be obtained from GE. Of particular importance are the voltage and current waveforms complete with values of voltage and current over a complete cycle.

Send this data to your local GE Sales Office or directly to:

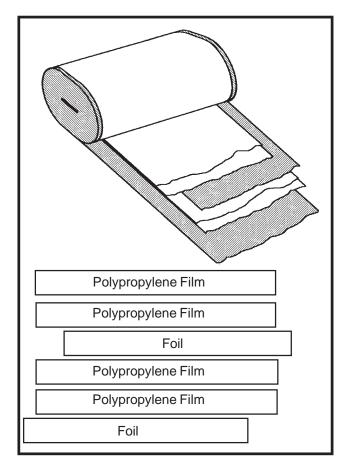
General Electric Company Transmission Systems 381 Broadway Fort Edward, NY 12828-1000, U.S.A. **Attn: Industrial Capacitor Sales** FAX: (518) 746-5524

#### PRIMARY INFORMATION (Essential)

Company Na	me	Tel No. (Incl. Country & City codes)	
Address		FAX No	
Person to co	ntact:_		
1. Application	n:		
2. Capacitano	ce:	Tolerance:	
3. Peak Volta	ge:	RMS Voltage:Voltage Reversal(%)	_
4. Peak Curre	ent:	RMS Current:	
		e: Duration:Freq. of Occurence:	
		petition Rate (Hz):Duty Cycle:	
			-
7. Ambient Te	empera	ature:Max.:Min.:	
8. Capacitor (	Charge	e Time:Discharge Time:	
9. Required C	Operati	ing Life (Hours):	
10.Waveform	s:		
	+		
Voltage	0 -		Time
	_		
	+		
Current	0		Time
	-		
SECONDA	RY IN	NFORMATION (Provide as Appropriate)	
11. Physical	Size Li	imitations:	
12. Mounting	Requi	irements:	
13. Applicable	e Spec	cifications:	
14. Type of C	ooling	g Available:	
15. Unusual A	Atmos	pheric Conditions:	
16. Other Spe	ecial R	equirements:	
17. Potential	Usage	::	

#### Film/Foil Electrode Construction

#### Film/Paper Foil Construction



Polypropylene Film
Paper
Foil
Polypropylene Film
Paper
Foil
Foil

GE's Foil Electrode capacitors are manufactured with sheets of high quality aluminum foil as the electrodes. The dielectric consists of two sheets of polypropylene film. The film is manufactured in GE's own Capacitor Materials Operation. It is specially designed with a rough surface to allow full impregnation by the dielectric fluid. The aluminum foil electrodes extend, one on each end of the capacitor roll, so that a solder connection can be made. Depending on the typical current for the type of capacitor, the internal connections from the roll ends to the terminals are either braided cables or tin-plated copper straps. This construction provides capacitors that are inherently capable of handling high RMS and peak currents.

**GE's Film/Paper/Foil** capacitors are manufactured with high grade film and foil, and capacitor grade kraft paper. They are typically high voltage DC rated and are treated with Geconol capacitor dielectric fluid. These capacitors are exposed foil construction for use in snubber and or DC filtering applications.

#### **DIELECTRIC FLUIDS**

All of GE's dielectric fluids are chosen for specific characteristics that match the other components in the capacitor dielectric system and the applications for which the capacitors are intended. Each fluid is based on one or two major constituents and blended with proprietary additives for optimum performance.

#### **Dielectrol VII**

A Benzyl Toluene-based fluid, used for film/foil high current products.

# **SCR Commutation Capacitors**

#### A97F8600 / A97F8700 Series **600 to 1500 Volts Peak**

This family of capacitors is designed for high-current applications, such as (1) SCR commutation, (2) snubbers for SCRs, GTOs and other power semiconductors, and (3) for any other circuits where the combination of frequency and voltage results in high RMS currents. An Application Note is provided to assist in the proper use of these devices. It is strongly recommended that users refer to GE engineers for assistance if there are any questions as to the correct selection of capacitors. The A97F8600/ A97F8700 Series have an all-film dielectric and, due to the much lower dissipation factor, can handle much higher currents than the older film paper designs.

Advances in capacitor Dielectric technology have made paint unnecesary, in most cases. This along with GE's commitment to environmental programs has led to the elimination of painted cases in this product line. Removal of the paint has minimal affect on the RMS current ratings; see the standard ratings charts for proper application.



#### SPECIFICATIONS

Available Capacitance Range: 1 to 50 µF

Capacitance Tolerance: + 10%

Capacitance Variation with Temperature: ± 3% from -55 °C to +85 °C

Rated Voltage: See Ratings Tables. Rating is the Maximum Peak voltage

permissible in either polarity.

Rated Current: See Ratings Tables. The value given is for derating purposes

> only. Refer to the Application Note on Page 12 to determine the required derating. In no circumstances should the RMS

Current rating of the terminals be exceeded.

Operating Temperature: -40 °C to +75 °C

Storage Temperature: -55 °C to +90 °C

Operating Life: 40,000 hours with 95% survival with proper derating

Dissipation Factor: 0.02% maximum

Case Material/Finish: Oval Case & Cover: **Unpainted Aluminum** 

> Rectangular Case & Cover: **Unpainted Steel**

Terminations/Hardware: 1/4 - 20 screw thread studs (60 A RMS maximum)

> 3/8 - 16 screw thread studs (100 A RMS maximum) Case Styles C\* and D\* have 100-A terminals. Nut and washer hardware is supplied in bag

Dielectric Fluid: A97F8600/ A97F8700 series: Dielektrol VII

Internal Protection: These capacitors do not contain an internal protection

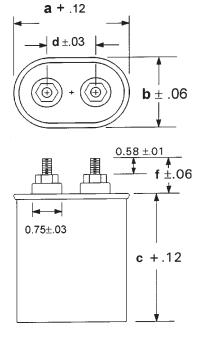
mechanism. The user is responsible for ensuring that the capacitors are correctly applied for safe use.

# **SCR Commutation Capacitors** (All Dimensions in Inches)

#### **STANDARD RATINGS \***

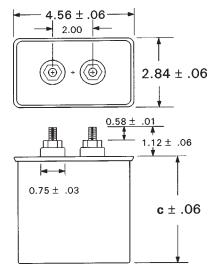
Capacitance (µF)	Catalog #	Case Style	Height c (in)	Current (A)	
600 Volts Peak	ζ				
2 5	A97F8670 A97F8671	A A	2.38 4.50	38 86	
10	A97F8672	С	4.25	136	
20 30	A97F8673 A97F8674	D D	5.25 7.25	235 339	
40 50	A97F8675 A97F8676	G G	5.18 6.25	414 610	
800 Volts Peak	800 Volts Peak				
1	A97F8677	А	2.62	28	
2	A97F8678	Α	3.50	47	
5	A97F8679	С	3.88	92	
10	A97F8680	С	5.75	158	
20	A97F8681	G	4.62	276	
25 30	A97F8682 A97F8683	G G	5.62 6.25	340 394	

### Case Styles A, C and D



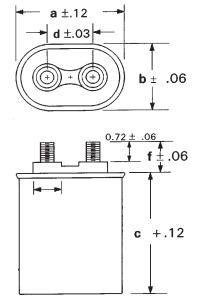
### \* ALL UNITS ARE <u>UNPAINTED</u> CASE & COVER

# Case Style G



Case Style	а	b	d	f
A	2.16	1.31	0.81	1.18
C	2.91	1.91	1.38	1.12
D	3.66	1.97	1.38	1.12
C*	2.91	1.91	1.25	0.91
D*	3.66	1.97	1.25	0.91

## Case Styles C\* and D\*



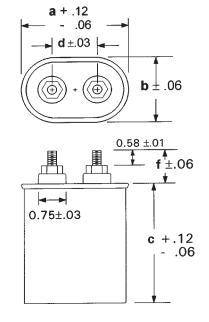
# **SCR Commutation Capacitors**

(All Dimensions in Inches)

#### **STANDARD RATINGS \***

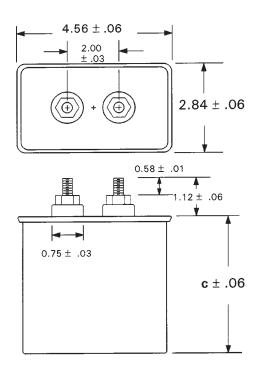
Capacitance (µF)	Catalog #	Case Style	Height c (in)	Current (A)	
1000 Volts Pea	ık				
2 3 5 5 10 10	A97F8614 A97F8615 A97F8616 A97F8617 A97F8618 A97F8619	A C C C* D D*	4.75 3.88 4.75 5.25 6.25 6.75	55 71 102 107 182 189	
1500 Volts Pea	1500 Volts Peak				
1 2 3 5 5	A97F8620 A97F8621 A97F8622 A97F8623 A97F8624 A97F8625	A C C C C* G	3.88 3.88 4.50 6.25 6.75 5.18	35 58 76 116 121 207	

#### Case Styles A, C and D



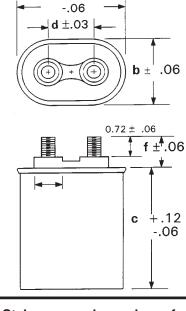
#### \* ALL UNITS ARE <u>UNPAINTED</u> CASE & COVER

# Case Style G



### Case Styles C\* and D\*

a +.12



Case Sty	le a	b	d	f	
A C D			0.81 1.38 1.38	1.18 1.12 1.12	
C* D*			1.25 1.25		

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# 97F7500 Series SCR Commutation Capacitors

#### 250 Volts Peak

The 97F7500 Series is a special purpose line designed for applications where a large micro-farad value at low voltage is required in a small size. The dielectric system is metallized polyester. Typical applications are in SCR chopper circuits and low-voltage ac filters. Refer to the Application Note on page 12 for assistance in the correct application of these capacitors.

Please note that previous offering of these capacitors was with painted cases, to improve heat dissipation. The units will no longer be painted as part of GE's committment to environmental programs. Please note the change in RMS current ratings from previous catalogs.



#### **SPECIFICATIONS**

Available Capacitance Range: 25 to 200 µF

**Capacitance Tolerance:** ± 10%

Capacitance Variation with Temperature: ±3% from -20 °C to +80 °C

Rated Voltage: 250 V Peak. The rating is the Maximum Peak voltage permis

sible in either polarity.

Rated Current: See Ratings Tables. The value given is for derating purposes

only.Refer to the Application Note on Page 12 to determine the required derating. In no circumstances should the RMS

current rating of the terminals be exceeded.

Operating Temperature: -40 °C to +70 °C

Storage Temperature: -55 °C to +90 °C

**Operating Life:** 40,000 hours with 95% survival with proper derating

**Dissipation Factor:** 0.6% maximum

Case Material/Finish: Oval Case & Cover: Aluminum

Unpainted case and cover

**Terminations:** 1/4 - 20 screw thread studs (60 A RMS maximum)

Dielectric Fluid: Dielektrol VI

Internal Protection:

These capacitors do not contain an internal protection

mechanism. The user is responsible for ensuring that the

capacitors are correctly applied for safe use.

# 97F7500 Series SCR Commutation Capacitors

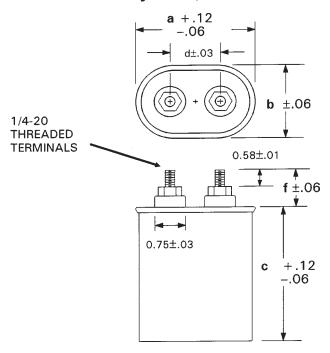
(All Dimensions in Inches)

#### STANDARD RATINGS

Capacitance	Catalog #	Case	Height	Current
(µF)		Style	c (in)	(A)**
250 Volts Peak	<			
50	97F7520	0000	3.12	27
100	97F7514		3.50	45
125	97F7513		4.25	55
150	97F7512		4.75	64

<sup>\* \*</sup> NOTE ALL RMS CURRENT RATINGS ARE FOR UNPAINTED UNITS.

#### Case Styles A, C and D



Case Style	а	b	d	f
A	2.16	1.31	0.81	1.18
C	2.91	1.91	1.38	1.12
D	3.66	1.97	1.38	1.12
C*	2.91	1.91	1.25	0.91
D*	3.66	1.97	1.25	0.91

# **A28F5000 Series Snubbers Capacitors**

#### 1000 and 2000 Volts Peak/ Max DC

The A28F5000 series of Snubber Capacitors are designed for use in power semiconductor circuits to protect the semiconductor by limiting the rate of voltage rise. The dielectric system is polypropylene and paper with foil electrodes. The RMS currents encountered in these circuits are usually low; however, the peak currents are very high. Refer to the Application Data for correct application of these capacitors.

#### **SPECIFICATIONS**

Available Capacitance Range: 0.05 to 2 µF

**Capacitance Tolerance:** ± 10%

Capacitance Variation with Temperature: ±3% from -30 °C to +80 °C

Rated Voltage: See Ratings Table. The rating is the Maximum Peak voltage

permissible in either polarity.

Rated Current: See Ratings Tables. The value given is for derating purposes

only. Refer to the Application Note on Page 12 to determine the required derating. In no circumstances should the 10 Amp RMS Current rating of the eyelet terminals be exceeded. For 1/4-20 threaded terminals, full current less

any derating may be applied.

Operating Temperature: -40 °C to +70 °C

Storage Temperature: -55 °C to +90 °C

Operating Life: 40,000 hours with 95% survival with proper derating

**Dissipation Factor:** 0.3% maximum

Case Material/Finish: Aluminum Case with Steel Cover for eyelet terminal designs;

Aluminum case with Aluminum Cover for \*Threaded

terminals.

**Terminations:** 0.125-in. Solder Eyelets (10 Amp RMS maximum) & 1/4-20

screw thread studs (60 A RMS maximum) For threaded terminal designs, nut and washer hardware is supplied in bag

Dielectric Fluid: A28F5500 Series Dielektrol VII

A28F5600 Series Dielektrol VII

**Internal Protection:** Internal Pressure Sensitive Interrupter for eyelet designs.

Threaded terminal designs do not contain an internal protection mechanism. The user is responsible for ensuring

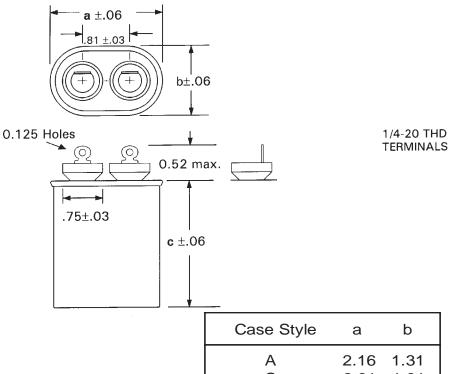
that the capacitors are correctly applied for safe use

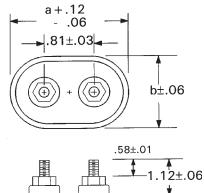
# **A28F5000 Series Snubber Capacitors**

(All Dimensions in Inches)

## **Standard Ratings**

Capacitance (µF)	Catalog #	Case Style	Height c (in)	Current (A)	
1000 Volts Pea	k / Max DC				
.5	A28F5502	А	2.12	6	
1.0	A28F5503	A	2.12	7	
2.0	A28F5504	A	2.88	11	
2000 Volts Pea	2000 Volts Peak / Max DC				
.05	A28F5600	Α	2.12	2	
.10	A28F5601	A	2.12	3	
.10	A28F5615	A *	2.12	3	
.25	A28F5602	A	2.12	4	
.25	A28F5605	A *	2.12	4	
.50	A28F5603	A	2.88	7	
.50	A28F5606	A *	2.88	7	
1.0	A28F5604	A	4.50	12	
1.0	A28F5607	A *	4.50	12	
2.0	A28F5688	c	4.25	17	
2.0	A28F5608	C *	4.25	17	
* D	enotes 1/4-20 t	hreaded	terminal styles	5	

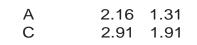




c + .12/

- .06

.75±.03



# **Application Data for SCR and Snubbers Capacitors**

#### For use with capacitor series: A97F8600/ A97F8700

This Application Note is designed to allow users to select the correct capacitor for two common conditions encountered in power electronic circuits:

- (a) Sinusoidal waveform
- (b) Squarewave.

For applications that do not fit into either of these categories, please contact your GE sales representative for assistance.

To select the correct capacitor proceed as follows:

- 1. Determine the following:
  - (1) Microfarad value required
  - (2) Peak voltage
  - (3) RMS current
  - (4) Current pulsewidth
  - (5) Capacitor ambient temperature.
- Select a capacitor with the correct 2. capacitance and a peak voltage equal to or greater than the application voltage.
- 3. Apply the correction factors on the opposite page for Current Pulsewidth and Ambient Temperature to the 55 °C RMS Current Rating of the selected capacitor.

If the "corrected" RMS current value is equal to or greater than the RMS current of the application, the capacitor is suitable. If not, a capacitor with a higher current rating must be selected. This can be done by choosing a higher voltage capacitor. Note that the Ambient Temperature: 65°C All-FilmA 97F8600 series has the highest current ratings.

Note: In no case should the actual RMS current exceed the limit of the capacitor terminals.

#### Example No. 1

Capacitance: 10 mF

Voltage: 200 Vac RMS 3 kHz

Sinewave

Ambient Temperature: 65 °C

Peak Voltage  $= 200 \text{ x} \sqrt{2} = 283 \text{ Volts}$ 

RMS Current =  $2p \times 3000 \times 10 \times 10 - 6 \times 200$ 

= 37.7 A

Current Pulsewidth = 166 µs

The A97F8672 has a current rating of 136 A. Applying the correction factors for a 166 ms pulsewidth and a 65 °C ambient:

> RMS current rating =  $136 \times 0.56 \times 0.75$ = 57.1 A

This capacitor is satisfactory. Note the terminal limit of 60 amps.

#### Example No. 2

Capacitance: 5 µF

Voltage: 60 Vac RMS 16.6 kHz

Sinewave

Ambient T emperature: 65°C

 $=60\sqrt{2} = 85 \text{ V}$ Peak Voltag

RMS current  $= 20 \times 16,600 \times 5 \times 10^{-6} \times 60$ 

= 31.3 A

Current Pulsewidth  $= 30 \mu s$ 

The A97F8671 is rated 86 amps which becomes 80.6A with the correction factors. This is more than adequate. Again, note the 60-A terminal limitation.

#### Example No. 3

Capacitance: 20 uF

Voltage: 600 Vpeak unidirectional

squarewave

Frequency: 200 Hz Rise Time: 60 µs Fall Time: 60 µs

Peak Voltage 600 V

CDV 20 x 10<sup>-6</sup> x 600 l peak = -6 = 313 A0 64t 0.64 x 60 x 10

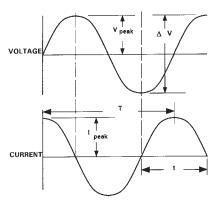
 $I \text{ rms} = 313 \sqrt{60 \times 10^{-6} \times 200} = 32.4 \text{ A}$ 

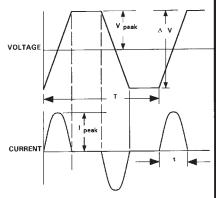
Current Pulsewidth = 60 ms

The A97F8673 has a peak voltage rating of 600 V and a current rating of 235 A. The correction factor for 65°C is 0.75, and for a 60 µs pulsewidth it is 0.90. Thus its current rating in this application is  $235 \times 0.80 \times 0.90 = 158.6 \text{ A}$ ; adequate for the application. Again, note the 60A terminal limitation.

#### SINEWAVE CONDITIONS

#### SQUAREWAVE CONDITIONS





I = Current (Amperes)

V = Voltage (Volts)

C = Capacitance (Farads)

f = Frequency (Hertz)

t = Current

Pulsewidth (Seconds)

T = Period (Seconds)

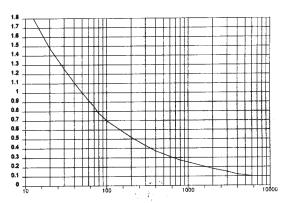
$$lpeak = \frac{pc}{2t} DV = \frac{CDV}{0.64}$$

$$Vpeak = \sqrt{2} V rms$$

Irms = 
$$\sqrt{2 \left[ \text{lpeak } \sqrt{\frac{\text{ft}}{2}} \right]} 2 = \sqrt{\text{ft Ipeak}}$$

#### **CORRECTION FACTOR FOR CURRENT PULSEWIDTH**

**RMS CURRENT** CORRECTION **FACTOR** 

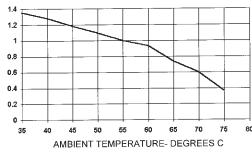


CURRENT PULSEWIDTH (µs)

#### **CORRECTION FACTOR FOR** AMBIENT TEMPERATURE

**RMS CURRENT CORRECTION FACTOR** 

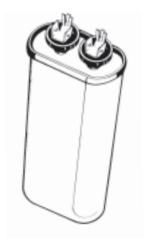
CURRENT PULSEWIDTH (µs)



**AMBIENT TEMPERATURE- DEGREES C** 

# **General Purpose DC Capacitors** 1500, and 2500 Volts Peak

This line of General Purpose DC Capacitors is made with film/paper technology for 1500V and 2500V ratings. These capacitors are typically used in DC filters at voltages above those served by electrolytic type construction.



#### **SPECIFICATIONS**

Available Capacitance Range: 0.1 to 50 µF

**Capacitance Tolerance:** 26F Series: ±10%

Capacitance Variation with Temperature: ±5% from -40 °C to +70 °C

Rated Voltage: See Ratings Tables. The rating is the Maximum Peak dc

voltage.

Ripple Voltage: The RMS ripple voltage should not exceed the following

percentages of the rated voltage for these frequencies:

Frequency	% of Rated Voltage
60 Hz	30
120 Hz	20
400 Hz	14
1,000 Hz	8
10,000 Hz	1

Operating Temperature: -30 °C to +70 °C

Storage Temperature: -55 °C to +90 °C

**Operating Life:** 60,000 hours with 94% survival with proper derating

**Dissipation Factor:** 0.3% maximum

Case Material/Finish: Aluminum Case (NO PAINT)

**Terminations:** (2) 0.25 x 0.031 inch quick connect blades, and one fork

blade per terminal

Dielectric Fluid: Dielektrol VII

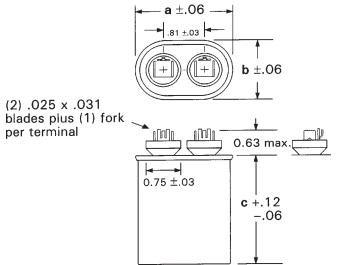
Internal Protection: Pressure Sensitive Interrupter

#### **STANDARD RATINGS**

Capacitance (µF)	Catalog #	Case Style	Height c (in)				
1500 Volts Pea	1500 Volts Peak						
1 2 4 5 6 8 10	A26F7500 A26F7501 A26F7502 A26F7503 A26F7504 A26F7505 A26F7506	A A C C C C D	2.12 3.12 3.12 3.88 4.25 5.25 5.25				
2500 Volts Peak							
0.1 0.25 0.5 1.0 2.0 4.0	A26F7515 A26F7516 A26F7517 A26F7576 A26F7519 A26F7520	A A A A C	2.12 2.12 2.12 3.12 4.25 4.25				

# **General Purpose DC Capacitors**

(All Dimensions in Inches)



Case Style	а	b
А	2.16	1.31
В	2.69	1.56
С	2.91	1.91
D	3.66	1.97

# Mounting Hardware

# (All Dimensions in Inches)

# FOOTED BRACKETS FOR OVAL CASE STYLES

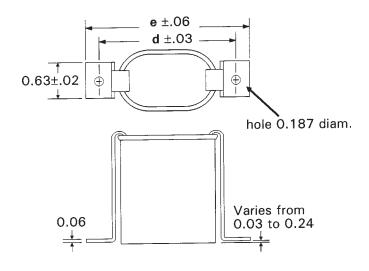
#### (2 per Capacitor)

For the proper bracket, match the capacitor case height to the case height shown next to the bracket part

Case Height	Bracket Part Number		
2.12	302C920000210		
2.38	302C920000200		
2.62	302C920000200		
2.88	302C920000113		
3.12	302C920000179		
3.50	302C920000119		
3.88	302C920000115		
4.25	302C920000122		
4.50	302C920000211		
4.75	302C920000116		
5.25	302C920000153		
5.50	302C920000233		
5.75	302C920000209		
6.25	302C920000152		
6.75	302C920000213		
7.25	302C920000214		

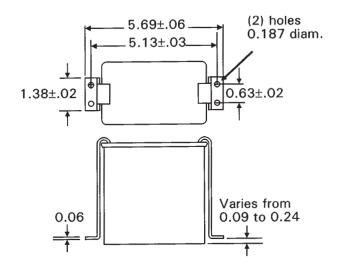
# FOOTED BRACKETS FOR RECTANGULAR CASE STYLE G (2 per Capacitor)

Bracket Part Number			
302C920000189			
302C920000190			
302C920000207			
302C920000194			
302C920000196			



Case Style	d	е
**A	2.56	3.00
В	3.13	3.56
С	3.38	3.81
D	4.13	4.56

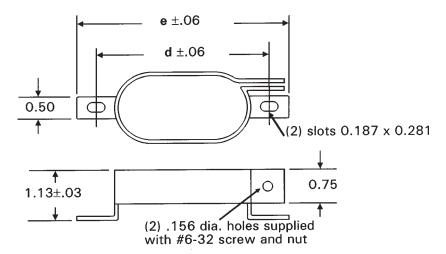
\*\* Cannot be used on "A" base size units with threaded terminals (Aluminum covers).



# **Mounting Hardware**

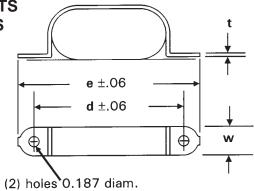
(All Dimensions in Inches)

UNIVERSAL WRAPAROUND BRACKETS FOR OVAL CASE STYLES



Case Style	Bracket Part number	d	e
A B C	128A2244AC021 128A2244AB025 128A2244AB022 128A2244AB023	3.27 3.44	3.13 3.70 3.88 4.63

WRAPAROUND BRACKETS FOR OVAL CASE STYLES



Case Style	Bracket Part Number	d	е	w	t
A	9827065000021	2.56	2.94	0.50	0.02
B	9827065000031	3.06	3.50	0.63	0.02
C	614A301000061	3.31	3.81	0.75	0.03
D	614A301000051	4/06	4.56	0.75	0.03

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CL04A310M1 GPS1BSAE RT1F BRLL20 CL08A300M6 GPS1BHAH GPS1BSAH RT1V GPS1BSAL GPAC20LRA RT1K RT1M

CL10A300M6 GPS1BHAK CL02A301T6 CL00D301TD CL07A300M6 CL01A301TJ CL01A310TJ CL02D301TD CL03A300M6 RT1L

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