



CPD 513

Rev. B

3-00 5k

GE Capacitors

***Capacitors for High Current,
Power Semiconductor,
and DC Applications***

GE TD&IS

Transmission, Distribution & Industrial Systems, Fort Edward, NY 12828

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.

Table of Contents

	Page	Description
Application Data Sheet	2	Sheet for submitting data to GE for review
Descriptive Information	3	General Information on capacitor construction
SCR Commutation Capacitors	4	High and very high-current applications, such as SCR commutation, SCR and GTO snubbers, and high-frequency AC circuits
Metallized Polyester SCR Capacitors	7	High microfarad per unit volume designs for up to 250 V peak. Used in high-frequency chopper circuits
Snubber Capacitors Power	9	Medium current snubber capacitors for Semiconductor circuits
Application Data for SCR and Snubber Capacitors	11	Derating information for Current Pulsewidth and Temperature. Worked examples for common conditions
General Purpose DC Capacitors	13	DC Capacitors for voltages up to 2500 V
Mounting Hardware	15	Brackets for mounting capacitors

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 Name _____ Tel No. (Incl. Country & City codes) _____

Address _____ FAX No. _____

Person to contact: _____

1. Application: _____

2. Capacitance: _____ Tolerance: _____

3. Peak Voltage: _____ RMS Voltage: _____ Voltage Reversal(%) _____

4. Peak Current: _____ RMS Current: _____

5. Transient Voltage: _____ Duration: _____ Freq. of Occurrence: _____

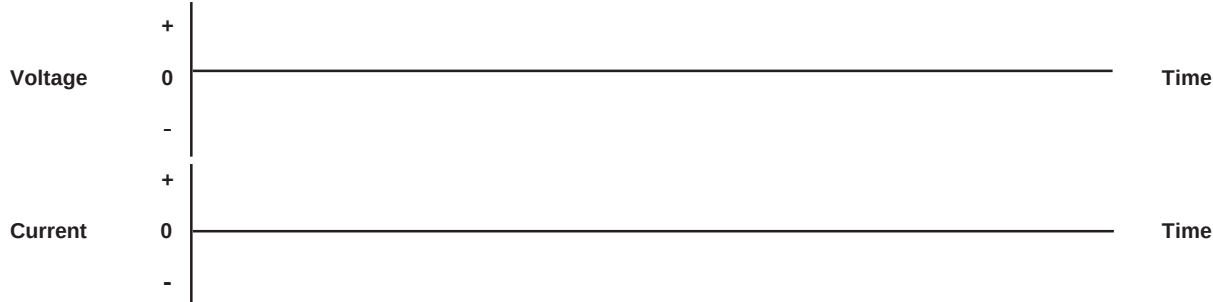
6. Frequency or Repetition Rate (Hz): _____ Duty Cycle: _____

7. Ambient Temperature: _____ Max.: _____ Min.: _____

8. Capacitor Charge Time: _____ Discharge Time: _____

9. Required Operating Life (Hours): _____

10. Waveforms:



SECONDARY INFORMATION (Provide as Appropriate)

11. Physical Size Limitations: _____

12. Mounting Requirements: _____

13. Applicable Specifications: _____

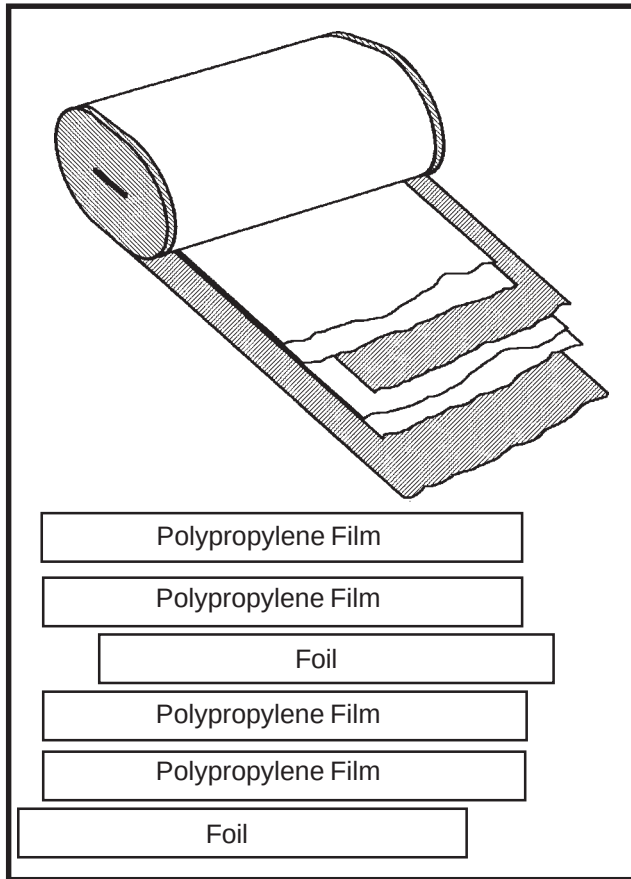
14. Type of Cooling Available: _____

15. Unusual Atmospheric Conditions: _____

16. Other Special Requirements: _____

17. Potential Usage: _____

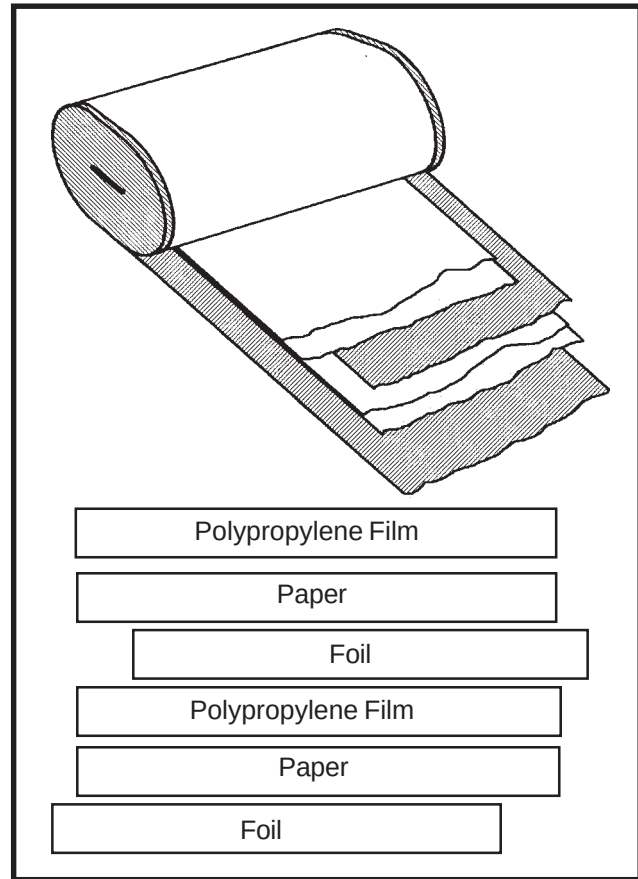
Film/Foil Electrode Construction



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.

Film/Paper Foil Construction



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 unnecessary, 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 μ F	
Capacitance Tolerance:	$\pm 10\%$	
Capacitance Variation with Temperature:	$\pm 3\%$ 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.	

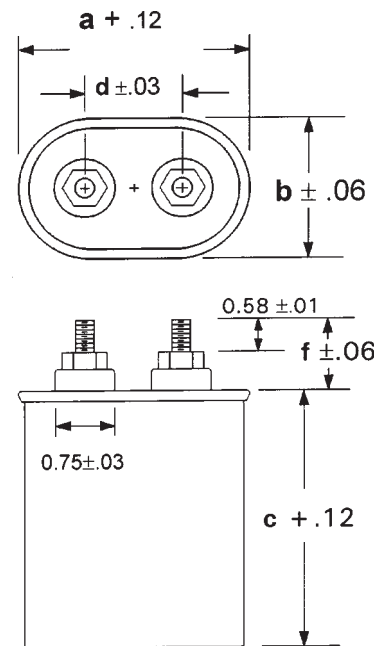
SCR Commutation Capacitors
(All Dimensions in Inches)

STANDARD RATINGS *

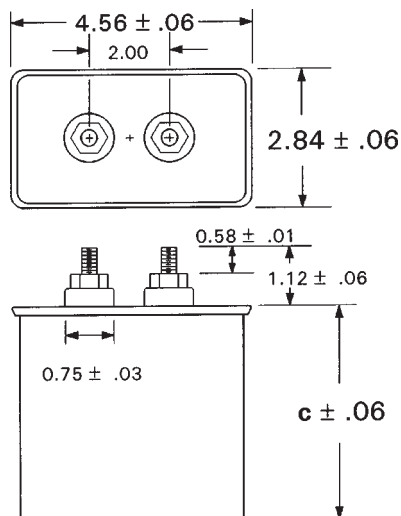
Capacitance (μ F)	Catalog #	Case Style	Height c (in)	Current (A)
600 Volts Peak				
2	A97F8670	A	2.38	38
5	A97F8671	A	4.50	86
10	A97F8672	C	4.25	136
20	A97F8673	D	5.25	235
30	A97F8674	D	7.25	339
40	A97F8675	G	5.18	414
50	A97F8676	G	6.25	610
800 Volts Peak				
1	A97F8677	A	2.62	28
2	A97F8678	A	3.50	47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

*** ALL UNITS ARE UNPAINTED CASE & COVER**

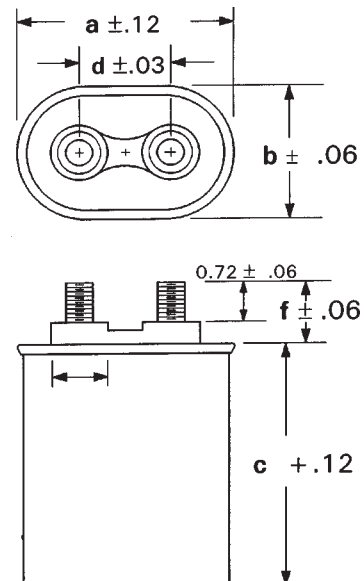
Case Styles A, C and D



**Case
Style G**



Case Styles C* and D*



Case Style	a	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

SCR Commutation Capacitors

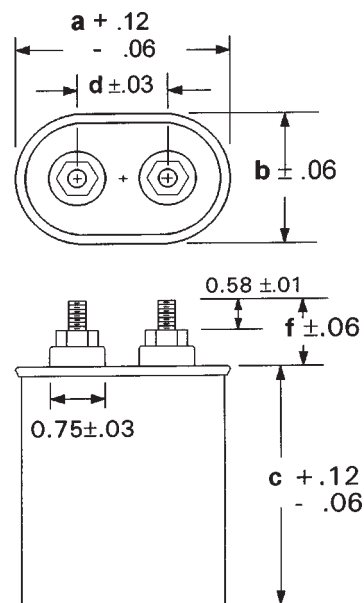
(All Dimensions in Inches)

STANDARD RATINGS *

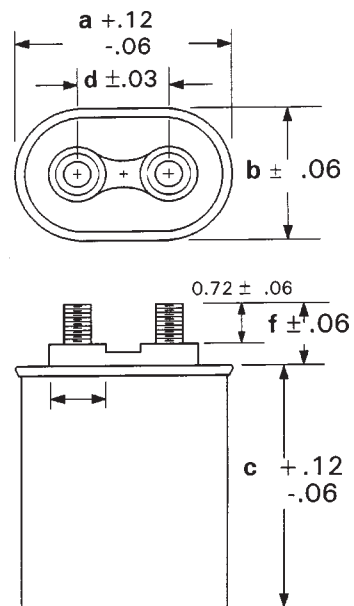
Capacitance (μ F)	Catalog #	Case Style	Height c (in)	Current (A)
1000 Volts Peak				
2	A97F8614	A	4.75	55
3	A97F8615	C	3.88	71
5	A97F8616	C	4.75	102
5	A97F8617	C*	5.25	107
10	A97F8618	D	6.25	182
10	A97F8619	D*	6.75	189
1500 Volts Peak				
1	A97F8620	A	3.88	35
2	A97F8621	C	3.88	58
3	A97F8622	C	4.50	76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

* ALL UNITS ARE UNPAINTED CASE & COVER

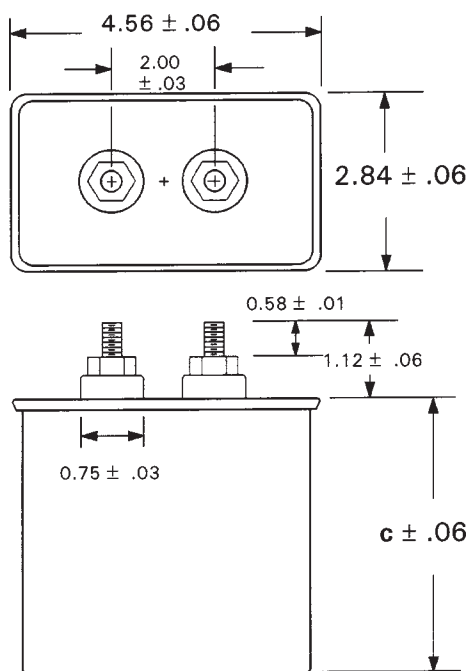
Case Styles A, C and D



Case Styles C* and D*



Case Style G



Case Style	a	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

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 commitment to environmental programs. Please note the change in RMS current ratings from previous catalogs.



SPECIFICATIONS

Available Capacitance Range:	25 to 200 μ F
Capacitance Tolerance:	$\pm 10\%$
Capacitance Variation with Temperature:	$\pm 3\%$ from $-20\text{ }^{\circ}\text{C}$ to $+80\text{ }^{\circ}\text{C}$
Rated Voltage:	250 V Peak. 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 RMS current rating of the terminals be exceeded.
Operating Temperature:	$-40\text{ }^{\circ}\text{C}$ to $+70\text{ }^{\circ}\text{C}$
Storage Temperature:	$-55\text{ }^{\circ}\text{C}$ to $+90\text{ }^{\circ}\text{C}$
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

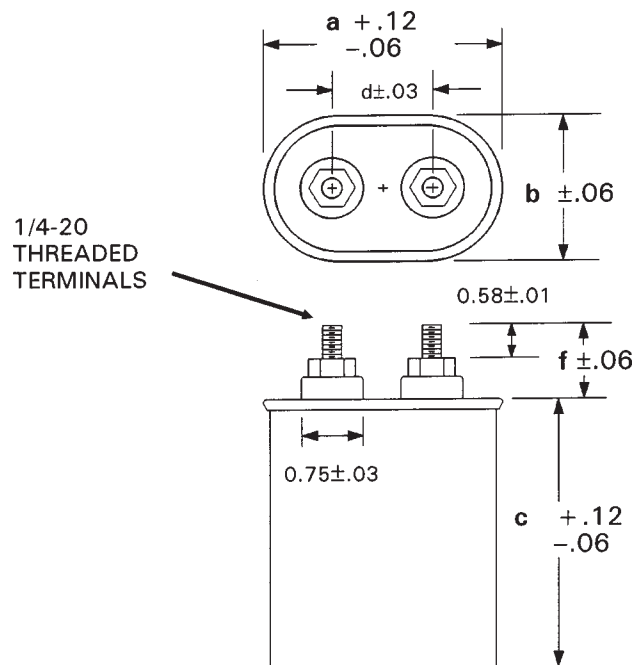
(All Dimensions in Inches)

STANDARD RATINGS

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

** NOTE ALL RMS CURRENT RATINGS ARE FOR UNPAINTED UNITS.

Case Styles A, C and D



Case Style	a	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

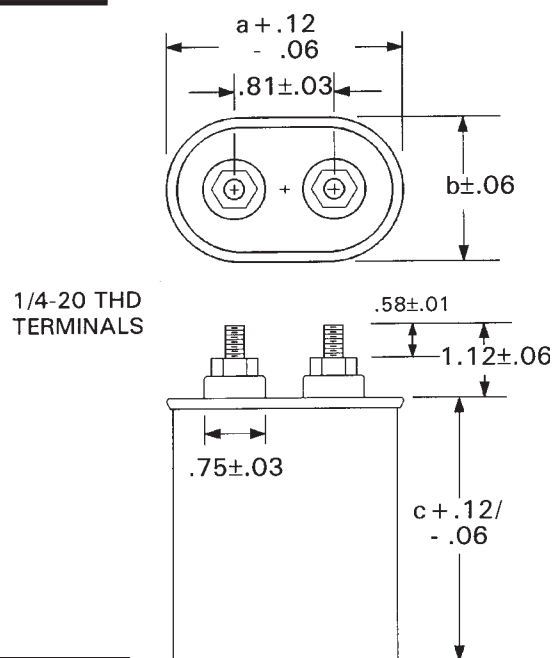
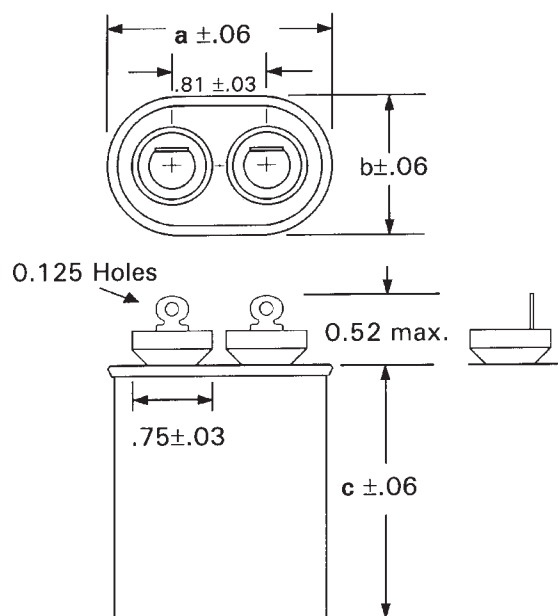
Available Capacitance Range:	0.05 to 2 μ F
Capacitance Tolerance:	$\pm 10\%$
Capacitance Variation with Temperature:	$\pm 3\%$ from -30 °C to +80 °C
Rated Voltage:	See Ratings Table. The rating is the Maximum Peak voltage permissible in either polarity.
Rated Current:	See Ratings Tables. The value given 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 (μ F)	Catalog #	Case Style	Height c (in)	Current (A)
1000 Volts Peak / Max DC				
.5	A28F5502	A	2.12	6
1.0	A28F5503	A	2.12	7
2.0	A28F5504	A	2.88	11
2000 Volts Peak / Max DC				
.05	A28F5600	A	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
* Denotes 1/4-20 threaded terminal styles				



Case Style	a	b
A	2.16	1.31
C	2.91	1.91

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.
2. Select a capacitor with the correct 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 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

$$\begin{aligned} \text{Peak Voltage} &= 200 \times \sqrt{2} = 283 \text{ Volts} \\ \text{RMS Current} &= 2p \times 3000 \times 10 \times 10^{-6} \times 200 \\ &= 37.7 \text{ A} \\ \text{Current Pulsewidth} &= 166 \mu\text{s} \end{aligned}$$

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

$$\begin{aligned} \text{RMS current rating} &= 136 \times 0.56 \times 0.75 \\ &= 57.1 \text{ A} \end{aligned}$$

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

Example No. 2

Capacitance: 5 μ F
 Voltage: 60 Vac RMS 16.6 kHz
 Sinewave
 Ambient Temperature: 65°C

$$\begin{aligned} \text{Peak Voltage} &= 60 \sqrt{2} = 85 \text{ V} \\ \text{RMS current} &= 2p \times 16,600 \times 5 \times 10^{-6} \times 60 \\ &= 31.3 \text{ A} \\ \text{Current Pulsewidth} &= 30 \mu\text{s} \end{aligned}$$

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 μ F
 Voltage: 600 Vpeak unidirectional squarewave
 Frequency: 200 Hz
 Rise Time: 60 μ s
 Fall Time: 60 μ s
 Ambient Temperature: 65°C

$$\text{Peak Voltage} = 600 \text{ V}$$

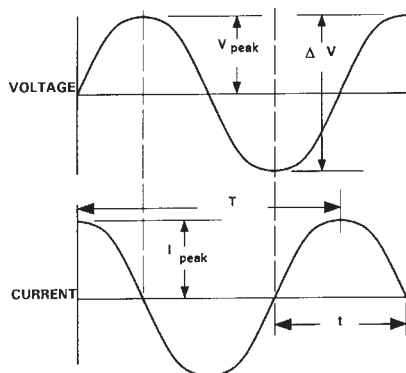
$$I_{\text{peak}} = \frac{\text{CDV}}{0.64t} = \frac{20 \times 10^{-6} \times 600}{0.64 \times 60 \times 10^{-6}} = 313 \text{ A}$$

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

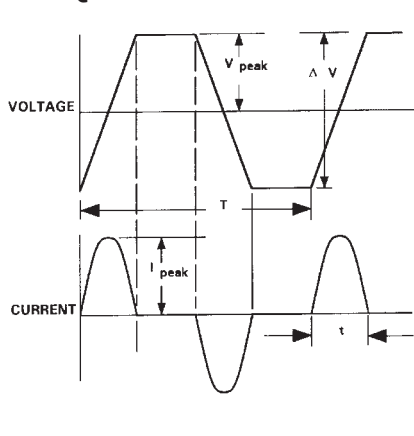
$$\text{Current Pulsewidth} = 60 \text{ ms}$$

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 μ s 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)

$$I_{rms} = 2p f C V_{rms} = \frac{pC}{t} v_{rms}$$

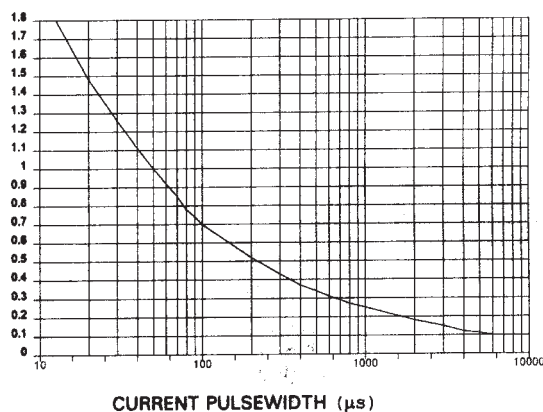
$$I_{peak} = \frac{pC}{2t} DV = \frac{CDV}{0.64t}$$

$$V_{peak} = \sqrt{2} V_{rms}$$

$$I_{rms} = \sqrt{2 \left[I_{peak} \sqrt{\frac{ft}{2}} \right]^2} = \sqrt{ft} I_{peak}$$

CORRECTION FACTOR FOR CURRENT PULSEWIDTH

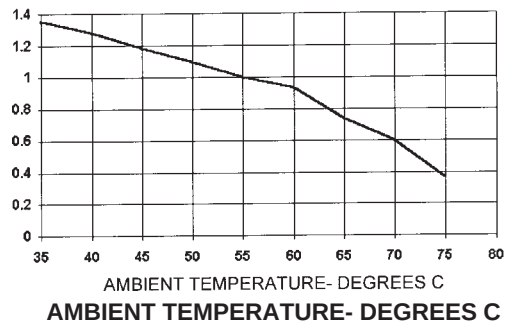
RMS CURRENT
CORRECTION
FACTOR



CURRENT PULSEWIDTH (μs)

CORRECTION FACTOR FOR AMBIENT TEMPERATURE

RMS CURRENT
CORRECTION
FACTOR

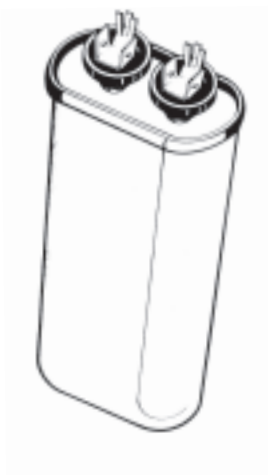


AMBIENT TEMPERATURE- DEGREES C
AMBIENT TEMPERATURE- DEGREES C

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 μ F
Capacitance Tolerance:	26F Series: $\pm 10\%$
Capacitance Variation with Temperature:	$\pm 5\%$ from $-40\text{ }^{\circ}\text{C}$ to $+70\text{ }^{\circ}\text{C}$
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:

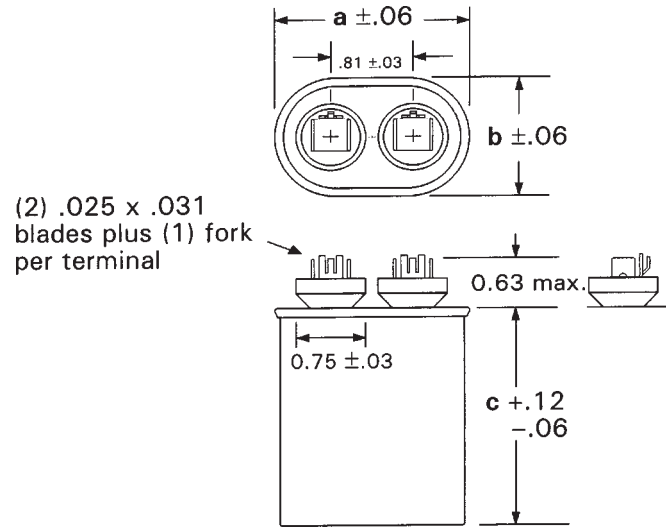
Frequency	% of Rated Voltage
60 Hz	30
120 Hz	20
400 Hz	14
1,000 Hz	8
10,000 Hz	1

Operating Temperature:	$-30\text{ }^{\circ}\text{C}$ to $+70\text{ }^{\circ}\text{C}$
Storage Temperature:	$-55\text{ }^{\circ}\text{C}$ to $+90\text{ }^{\circ}\text{C}$
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 (μ F)	Catalog #	Case Style	Height c (in)
1500 Volts Peak			
1	A26F7500	A	2.12
2	A26F7501	A	3.12
4	A26F7502	C	3.12
5	A26F7503	C	3.88
6	A26F7504	C	4.25
8	A26F7505	C	5.25
10	A26F7506	D	5.25
2500 Volts Peak			
0.1	A26F7515	A	2.12
0.25	A26F7516	A	2.12
0.5	A26F7517	A	2.12
1.0	A26F7576	A	3.12
2.0	A26F7519	A	4.25
4.0	A26F7520	C	4.25

General Purpose DC Capacitors (All Dimensions in Inches)



Case Style	a	b
A	2.16	1.31
B	2.69	1.56
C	2.91	1.91
D	3.66	1.97

Mounting Hardware

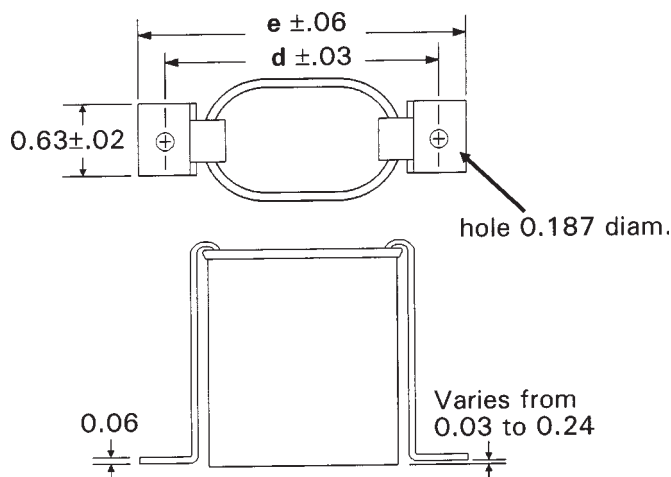
(All Dimensions in Inches)

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



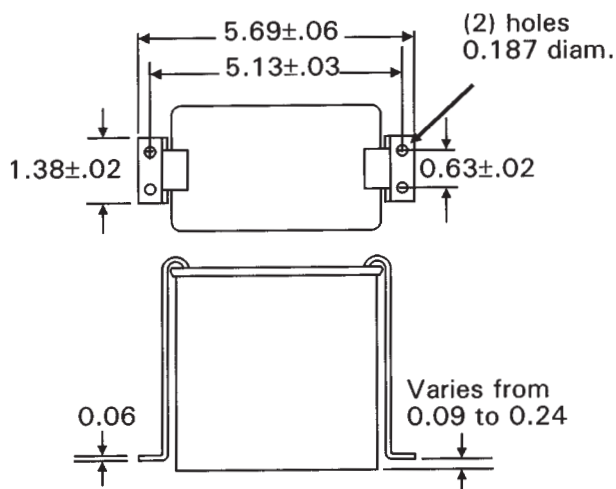
Case Style	d	e
**A	2.56	3.00
B	3.13	3.56
C	3.38	3.81
D	4.13	4.56

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

FOOTED BRACKETS FOR RECTANGULAR CASE STYLE G

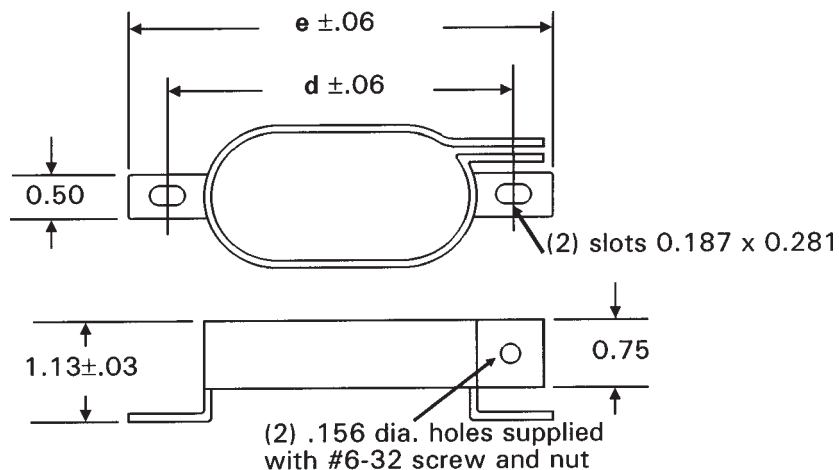
(2 per Capacitor)

Case Height	Bracket Part Number
5.18	302C920000189
6.25	302C920000190
7.25	302C920000207
8.00	302C920000194
9.00	302C920000196



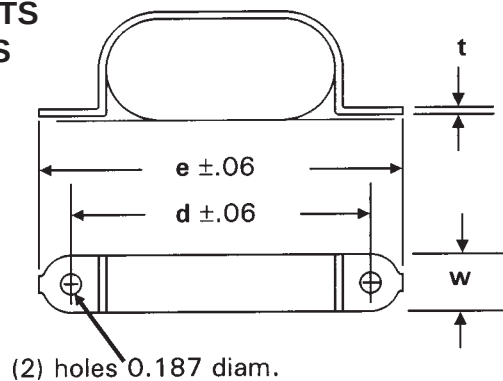
Mounting Hardware (All Dimensions in Inches)

UNIVERSAL WRAPAROUND BRACKETS FOR OVAL CASE STYLES



Case Style	Bracket Part number	d	e
A	128A2244AC021	2.69	3.13
B	128A2244AB025	3.27	3.70
C	128A2244AB022	3.44	3.88
D	128A2244AB023	4.19	4.63

WRAPAROUND BRACKETS FOR OVAL CASE STYLES



Case Style	Bracket Part Number	d	e	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

Please contact your GE Sales Representative for further information, or write to:

GE Industrial Systems
Transmission, Distribution & Industrial Systems
381 Broadway
Fort Edward, NY 12828-1000