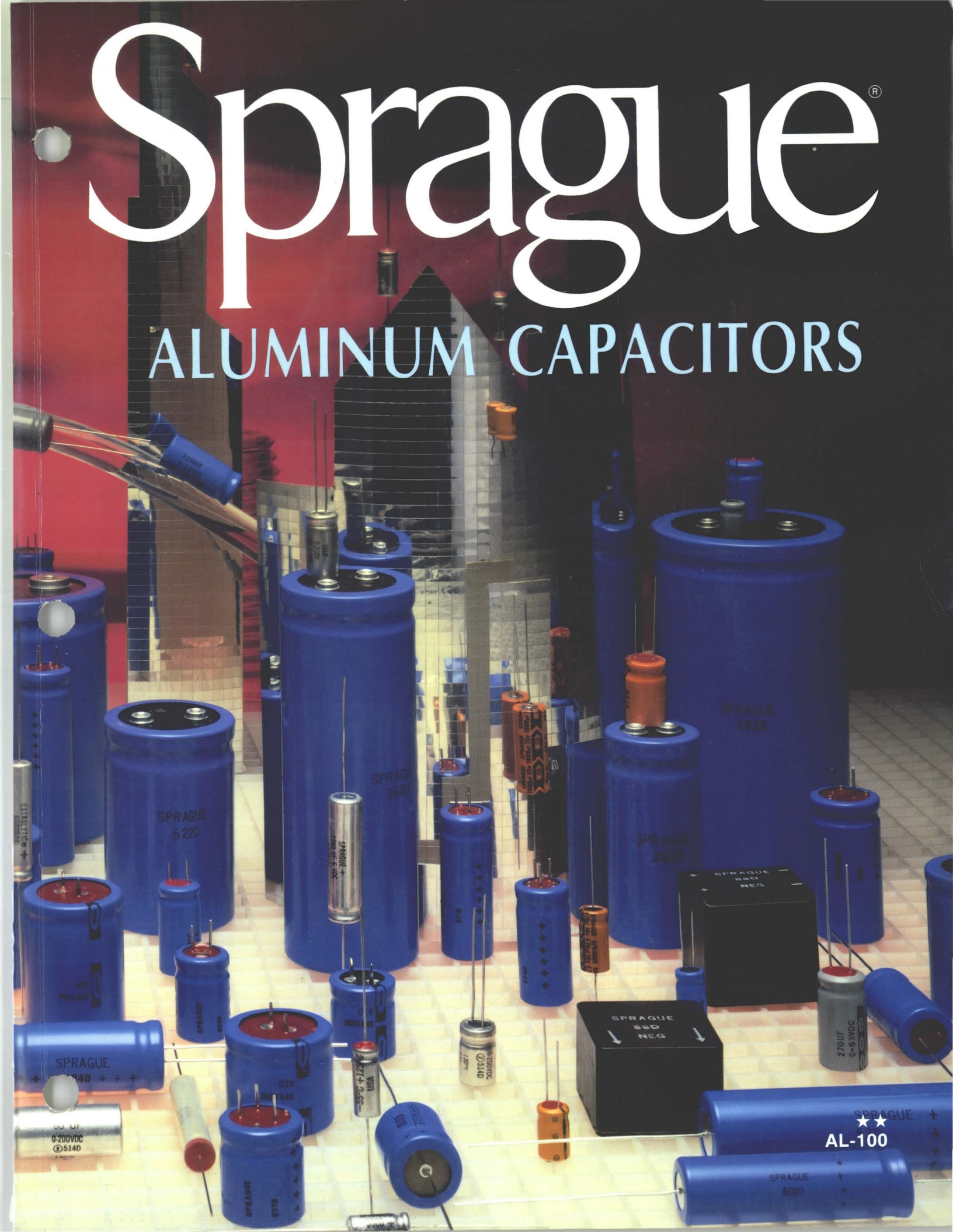
Sprague®

ALUMINUM CAPACITORS



★★

AL-100

SPRAGUE . . . A FULL LINE OF ALUMINUM CAPS FROM A U.S. SOURCE.

You can get any type of aluminum electrolytic capacitor that you need for *all* your applications from Sprague, the only U.S. based manufacturer of a complete line of high-performance aluminums. Whether it's axial-lead or single-ended miniature tubulars or large cans packed with capacitance, Sprague has the aluminum cap that'll meet your requirements. If you need radial or axial-lead miniatures for general purpose, power supply, special applications, or high-reliability military applications, we've got the capacitor you need. We offer all types of large cans for high-voltage SMPS input applications and low-voltage SMPS output use. And the best news of all . . . we can deliver fast because our aluminum cap line is available from Sprague plants in Lansing, NC and Hillsville, VA, or off-the-shelf from your Sprague distributor.

Aluminum Capacitors

Huntersville Business Park
9800 Kincey Avenue
Suite 100
Huntersville, NC 28078
704/875-8070
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In the construction of the components described, the full intent of the specification will be met. The Sprague Electric Company, however, reserves the right to make, from time to time, such departures from the detail specifications as may be required to permit improvements in the design of its products. Components made under military approvals will be in accordance with the approval requirements.

The information included herein is believed to be accurate and reliable. However, the Sprague Electric Company assumes no responsibility for its use; nor for any infringements of patents or other rights of third parties which may result from its use.

Contents

PARAMETER COMPARISON CHARTS

(Index of Sprague Type Aluminum Capacitors)

Type No.	Principal Features	Capacitance Range (µF)	Voltage Range (VDC)	Temperature Range (°C)	Termination	Nominal Case Sizes	Life Test Hrs. @ °C	Military Qualification	Page
MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS									
30D	Computer Grade Long Life	1-10,000	3-250	−40 to +105	Axial	6.3mm x 13mm to 18mm x 40mm	2000 @ +85 or 1000 @ +105	NA	75
500D	High CV General Purpose	0.22-10,000	6.3-400	−40 to +85	Axial	6.3mm x 13mm to 18mm x 40mm	2000 @ +85	NA	82
510DX	Low Leakage Premium Grade High Performance	1-3900	6.3-63	−40 to +125	Radial	6.0mm x 11mm to 18mm x 40mm	2000 @ +125 or 5000 @ +105	NA	27
511D	High CV Computer Grade Long Life	1-33,000	6.3-250	−40 to +105	Radial	6.0mm x 11mm to 18mm x 40mm	1000 @ +105 to 2000 @ +105	NA	35
515D	High CV General Purpose	0.2-18,000	6.3-450	−40 to +85 6.3~250V; −25 to +85 315~450V	Radial	4mm x 7mm to 18mm x 40mm	2000 @ +85	NA	44
516D	High CV General Purpose	0.47-10,000	6.3-450	−40 to +85	Axial	4.0mm x 7.0mm to 18mm x 14mm	2000 @ +85	NA	92
517D	High CV General Purpose High Temperature	0.47-15,000	6.3-250	−55 to +105 6.3~100V; −40 to +105 160~250V	Radial	5mm x 11mm to 18mm x 40mm	2000 @ +105	NA	51
600D	High Temperature Premium Grade	1-2700	5-250	−55 to +125	Axial	8mm x 20mm to 9mm x 68mm	2000 @ +125	MIL-C-39018/01 CUR13	98
610D	High Temperature Non Polar Premium Grade	1-2700	5-250	−55 to +125	Axial	8mm x 20mm to 9mm x 68mm	2000 @ +125	MIL-C-39018/02	106
630D	Low Leakage ±10% Cap. Tol. High Temperature Premium Grade	6.8-1500	3-63	−55 to +105	Axial	6mm x 12mm to 12mm x 45mm	2000 @ +85 or 500 @ +125	NA	112
672D	Low ESR Low Impedance High Ripple Current Premium Grade	4.7-3300	6.3-250	−55 to +105	Radial 2 or 3 Leads	10mm x 12mm to 18mm x 40mm	3000 @ +105 to 4000 @ +105	MIL-C-39018/08 CUR01	57
678D	Low ESR Low Impedance High Ripple Current High Performance	33-6800	6.3-63	−55 to +105	Radial 2 or 3 Leads	10mm x 12mm to 18mm x 40mm	3000 @ +105 to 4000 @ +105	NA	64

PARAMETER COMPARISON CHART

(Index of Sprague Type Aluminum Capacitors)

Type No.	Principal Features	Capacitance Range (μF)	Voltage Range (V)	Temperature Range (°C)	Termination	Nominal Case Sizes	Life Test Hrs. @ °C	Military Qualification	Page
SNAP MOUNT ALUMINUM ELECTROLYTIC CAPACITORS									
80D	High CV— High Ripple Current	82-56,000	6.3-250	−40 to +85	Radial Snap-Lock	22mm x 25mm to 35mm x 80mm	2000 @ +85	NA	174
81D	High Temperature High Ripple Current	47-180,000	6.3-400	−40 to +105	Radial Snap-Lock	22mm x 25mm to 35mm x 80mm	2000 @ +105	NA	181
82D	High CV	39-180,000	6.3-450	−40 to +85	Radial Snap Lock	22mm x 25mm to 35mm x 80mm	2000 @ +85	NA	195
RECTANGULAR PLASTIC CASE CAPACITORS									
88D	Low ESR— Low Inductance 4-Terminal— Rectangular Package	56-47,000	3-450	−40 to +85	4 Plug-in Leads	1.625″ x 0.690″ to 1.625″ x 1.576″	2000 @ +85	NA	212
	"Dual Pack" Rectangular Package	2 x 330- 2 x 680	200-250	−40 to +85	4 Plug-in Leads	1.625″ x 1.576″	2000 @ +85	NA	212
TUBULAR ALUMINUM ELECTROLYTIC CAPACITORS									
53D	High CV	15-220,000	6.3-450	−40 to +85	Axial	0.750″ x 1.125″ to 1.375″ x 4.125″	1000 @ +85	NA	139
601D	Wide Temperature Range	11-38,000	5-300	−55 to +105	Axial	0.625″ x 1.125″ to 1.000″ x 3.625″	2000 @ +105	MIL-C-39018/03 CUR17	153
604D	4-Terminal Low Inductance	47-22,000	5-200	−55 to +105	Axial	0.750″ x 1.675″ to 1.000″ x 3.625″	2000 @ +105	MIL-C-39018/07 CUR19	166
673D/ 674D	Low ESR— High Ripple Current	22-27,000	6.3-250	−55 to +105	Radial 2 or 3 Leads	0.750″ x 1.125″ to 1.000″ x 3.625″	2000 @ +105	MIL-C-39018/09 CUR02	119
676D/ 677D	Low ESR—High Ripple (±30% ESR—±20% Cap.)	140-15,000	6.3-63	−55 to +105	Radial 2 or 3 Leads	0.750″ x 1.125″ to 1.000″ x 3.625″	2000 @ +105	NA	131
LARGE CAN ALUMINUM ELECTROLYTIC CAPACITORS									
36DY/ DM	High CV Computer Grade	1000- 2,300,000	6.3-450	−40 to +85	Screw Terminals or PWB Mount*	1.375″ x 1.625″ to 3.000″ x 8.625″	2000 @ +85	NA	224
602D/ DM	High Reliability High Ripple Current	130-1,000,000	5-300	−55 to +85	Screw Terminals or 2.0 PWB Mount*	1.375″ x 1.625″ to 3.000″ x 8.625″	2000 @ +85	MIL-C-39018/04 CUR71	241
622D/ DM	Low Impedance ±30% ESR	2300-180,000	5-60	−55 to +95	Screw Terminals or PWB Mount*	1.375″ x 2.125″ to 2.000″ x 5.625″	2000 @ +85 or 1000 @ +95	NA	257

*PWB Mount: 2 or 3 solderable terminals.

INDEX OF SPRAGUE TYPE ALUMINUM CAPACITORS by TEMPERATURE RANGE

Type No.	Principal Features	Capacitance Range (μF)	Voltage Range (VDC)	Nominal Case Sizes	Page
		−40°C to +85°C			
515D	High CV General Purpose	0.2-18,000	6.3-450	4mm x 7mm to 18mm x 40mm	44
516D	High CV General Purpose	0.47-10,000	6.3-450	4mm x 7mm to 18mm x 40mm	92
500D	High CV General Purpose	0.22-10,000	6.3-450	0.250″ x 0.500″ to .709″ to 1.575″	82
53D	High CV	15-220,000	6.3-450	0.750″ x 1.125″ to 1.375″ to 4.125″	139
80D	High CV High Ripple	82-56,000	6.3-250	22mm x 25mm to 35mm x 80mm	174
82D	High CV	39-180,000	6.3-450	22mm x 25mm to 35mm x 80mm	195
88D	Low ESR Low Inductance 4-Terminal Rectangular Package	56-47,000	3-450	1.625″ x 0.690″ to 1.625″ x 1.576″	212
	''Dual Pack'' Rectangular Package	2 x 330 2 x 680	200-250	1.625″ x 1.576″	212
36DY/DM	High CV Computer Grade	100-2,300,000	6.3-450	1.375″ x 1.625″ to 3.000″ to 8.625″	224
		−55°C to +85°C			
602D/DM	High Ripple	130-1,000,000	5-300	1.375″ x 2.125″ to 3.000″ x 8.625″	241
		−55°C to +95°C			
622D/DM	Low Impedance ± 30% ESR	2,300-180,000	5-60	1.375″ x 2.125″ to 2.000″ x 5.625″	257
		−40°C to +105°C			
30D	Computer Grade Long Life	1-10,000	3-250	6.3mm x 13mm to 18mm x 40mm	75
511D	High CV Wide Temperature Computer Grade	1-33,000	6.3-250	6mm x 11mm to 18mm x 40mm	35

INDEX OF SPRAGUE TYPE ALUMINUM CAPACITORS by TEMPERATURE RANGE (Cont.)

Type No.	Principal Features	Capacitance Range (μF)	Voltage Range (VDC)	Nominal Case Sizes	Page
		−40°C to +105°C			
81D	High Temperature High Ripple	47-180,000	6.3-400	22mm x 25mm to 35mm x 80mm	181
		−55°C to +105°C			
678D	Low ESR Low Impedance High Ripple High Performance	33-6,800	6.3-63	10mm x 12mm to 18mm x 40mm	64
672D	Low ESR Low Impedance High Ripple Premium Grade	4.7-3,300	6.3-250	10mm x 12mm to 18mm x 40mm	57
601D	Wide Temperature	11-38,000	5-300	0.625″ x 1.125″ to 1.000″ x 3.625″	153
630D	Low Leakage ±10% Cap. Tol. Wide Temperature Premium Grade	68-1,500	3-63	6mm x 12mm to 12mm x 45mm	112
673D/ 674D	Low ESR High Ripple	27-27,000	6.3-250	0.750″ x 1.125″ to 1.000″ x 3.625″	119
676D/ 677D	Low ESR-High Ripple (±30% ESR-±20% Cap.)	140-15,000	6.3-63	0.750″ x 1.125″ to 1.000″ x 3.625″	131
517D	High CV General Purpose	0.47-15,000	6.3-250	5mm x 11mm to 18mm x 40mm	51
604D	4-Terminal Low Inductance	47-22,000	5-200	0.750″ x 1.625″ to 1.000″ x 3.625″	166
		−40°C to +125°C			
510D/DX	Low Leakage Premium Grade High Performance	1-3,900	6.3-63	6mm x 11mm to 20mm x 40mm	27
		−55°C to +125°C			
600D	Wide Temperature Premium Grade	1-2,700	7-250	8mm x 20mm to 9mm x 68mm	98
610D	High Temperature Non-Polar Premium Grade	1-2,700	5-250	8mm x 20mm to 9mm x 68mm	106

MILITARY SPECIFICATION QUALIFICATION APPROVALS*

Mil Type	Mil P/N	Sprague Type No.	Range	Certificate Number Reference
CU12, 13	M39018/01	600D	All Cap., 7-300V	39018-673-72
CU14, 15	M39018/02	610D	All Cap., All Volts	39018-841-65
CU16, 17	M39018/03	601D	All Cap., All Volts	39018-674-72
CU17H	0039018/03 USAF	601D	All Cap., All Tol., 7-200 Volts	39018-318-73
CUR17	M39018/03	601D	All Cap., All Tol., 6.3-300 Volts, Level M, P	39018-666-78
CU71	0039018/04 USAF	602D	All Cap., All Tol., All Volts	39018-959-73
CUR71	M39018/04	602D	All Cap. All Tol., 5-250 Volts, Level M	39018-667-78
CUR01	M39018/08	672D	All Cap., All Volts, Level M	39108-1278-83
CUR02	M39018/09	674D	All Cap., All Tol., 7-250 Volts, Level M	EQP-83-2306 39018-1288-82
CUR13	M39018/01	600D	All Cap./All Tol., 7-250 Volts, Level M, P, R	39018-665-78
CUR19	M39018/07	604D	All Cap., All Tol., All Volts, Level M	39018-668-78
CE10, 11	Mil-C-62/01	CE10	All Cap., All Volts	62-167-72/Mil-C-62
CE12, 13	Mil-C-62/02	CE12, 13	Char. C., All Cap., 5-450 Volts	62-1291-69 to Mil-C-62
CE31/34	Mil-C-62/03	CE31	All Cap., All Volts	62-755-65 to Mil-C-62
CE32/35	Mil-C-62/04	CE32	All Cap., All Volts	62-755-65 to Mil-C-62
CE33/36	Mil-C-62/05	CE33	All Cap., All Volts	62-755-65 to Mil-C-62
CE41/44	Mil-C-62/06	CE41	All Cap., All Volts	62-755-65 to Mil-C-62
CE42/45	Mil-C-62/07	CE42	All Cap., All Volts	62-755-65 to Mil-C-62
CE51/56	Mil-C-62/08	CE51	All Cap., All Volts	62-755-65 to Mil-C-62
CE52/57	Mil-C-62/09	CE52	All Cap., All Volts	62-755-65 to Mil-C-62
CE53/58	Mil-C-62/10	CE53	All Cap., All Volts	62-755-65 to Mil-C-62
CE70, 71	Mil-C-62/12	CE70, 71	Char. C, All Cap., 5-450 Volts	62-1288-69 to Mil-C-62

*As of January 1, 1990.
Note: For additional information on MIL Spec. parts, contact your Sprague representative or Aluminum Capacitor Marketing at Huntersville, N.C.

APPLICATION MATRIX FOR SMPS POWER SUPPLIES

Sprague Type No.	Primary Application							Classification			Voltage Range (WVDC)
	Input	Output	High C.V.	Low ESR	Low Z	High Ripple	Temp. Range	Computer Grade	Premium	Mil	
MINIATURE TYPES											
511D		X	X				−40 to +105C	X			6.3-250
515D	X	X	X				−40 to +85C				6.3-450
516D	X	X	X	X		X	−40 to +105C				6.3-450
517D	X	X	X	X		X	−40 to +105C				6.3-250
600D	X	X		X		X	−55 to +125C		X	X	7-250
672D	X	X	X	X		X	−55 to +105C		X	X	6.3-250
678D		X		X	X	X	−55 to +105C		X		6.3-63
LARGE CAN TYPES											
36DY	X		X	X		X	−40 to +85C	X			6.3-450
602D/DM	X	X		X		X	−55 to +85C		X	X	5-300
622DY		X		X	X		−55 to +95C	X			5-60
TUBULAR TYPES											
53D	X	X	X				−40 to +85C	X			3-450
80D	X	X	X	X		X	−40 to +85C	X			6.3-250
81D	X	X	X	X		X	−40 to +105C	X			6.3-400
82D	X	X	X				−40 to +85C	X			16-400
601D	X	X				X	−55 to +105C		X	X	5-250
604D		X		X	X		−55 to +105C		X	X	5-200
673D/674D	X	X		X		X	−55 to +105C		X	X	6.3-250
676D/677D		X		X		X	−55 to +105C		X		6.3-63
RECTANGULAR PLASTIC CASE											
88D	X	X		X	X		−40 to +85C	X			3-450

SPECIAL DESIGNS

Sprague will, upon request, design special capacitors to meet specific needs. Typical custom designs include:

- HIGH VIBRATION CAPABILITY including random vibration capability on some product types and sizes.
- CHARGE-DISCHARGE designs on most product types for photoflash, strobe and welding applications.
- NON POLAR designs.

INTRODUCTION TO ALUMINUM ELECTROLYTIC CAPACITORS

Requirements for capacitors have become very stringent in recent years. They are used to filter, tune, couple, block d-c, pass ac, shift phase, bypass, feedthru, compensate, store energy, isolate, suppress noise, start motors, etc. . . . and while doing so, they must operate reliably in such adverse conditions as shock, vibration, salt spray, extremes of temperatures and altitude, humidity and radiation. They must also be small, lightweight, reliable and, cost-effective.

Much research work has been carried out during the past decade to develop better manufacturing processes, uncover new and improved dielectric materials, enhance capacitor characteristics and improve reliability. Consequently, many new capacitor designs have reached the market. Such a wide choice, however, may make it difficult for circuit engineers to select the correct capacitor for their applications. Electrolytic capacitors have some common characteristics, yet each family is designed for a specific application where it will provide improved performance.

ALUMINUM ELECTROLYTIC CAPACITORS

Electrolytic capacitors provide high capacitance in small volume at a relatively low cost per microfarad-volt. They account for about a third of the total dollars spent on capacitors.

Background

The first electrolytic capacitor was made in Germany about 100 years ago. It was first used as a filter element in the 90V battery eliminators of the early 1920's. The earliest commercially available electrolytics were "wet" polarized types for vertical mounting. The "dry" electrolytic made its appearance about 1928. Performance was improved with better materials and processing techniques.

During the past ten years many new and important developments have occurred. Process controls have improved performance. Better seals have assured longer life. Improved etching has given a ten-fold increase in volume efficiencies, or improved performance. Leakage characteristics have improved a hundred-fold.

How They're Made

Basic to the construction of electrolytic capacitors (Figure 1) is the electrochemical formation of an oxide film on a metal surface. Intimate contact is made with this oxide film by means of another electrically conductive material. The metal on which the oxide film is formed serves as the anode or positive terminal of the capacitor; the oxide film is the dielectric, and the cathode or negative terminal is either a conducting liquid or a gel. All present-day electrolytic capacitors are essentially made this way, and the most commonly used basic materials are aluminum and tantalum.

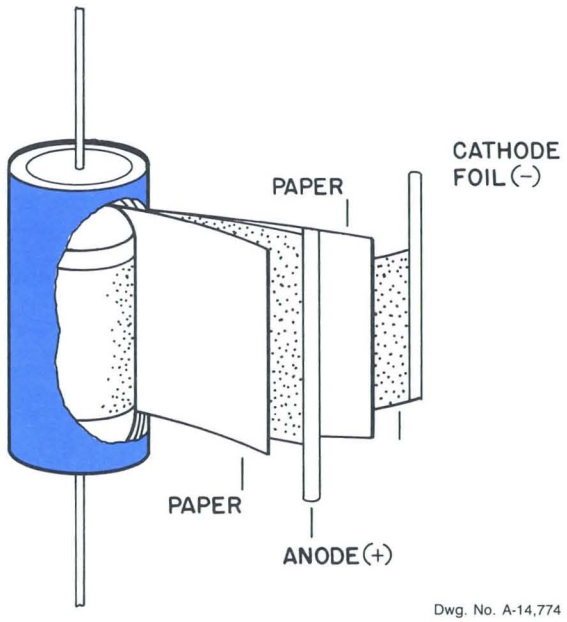
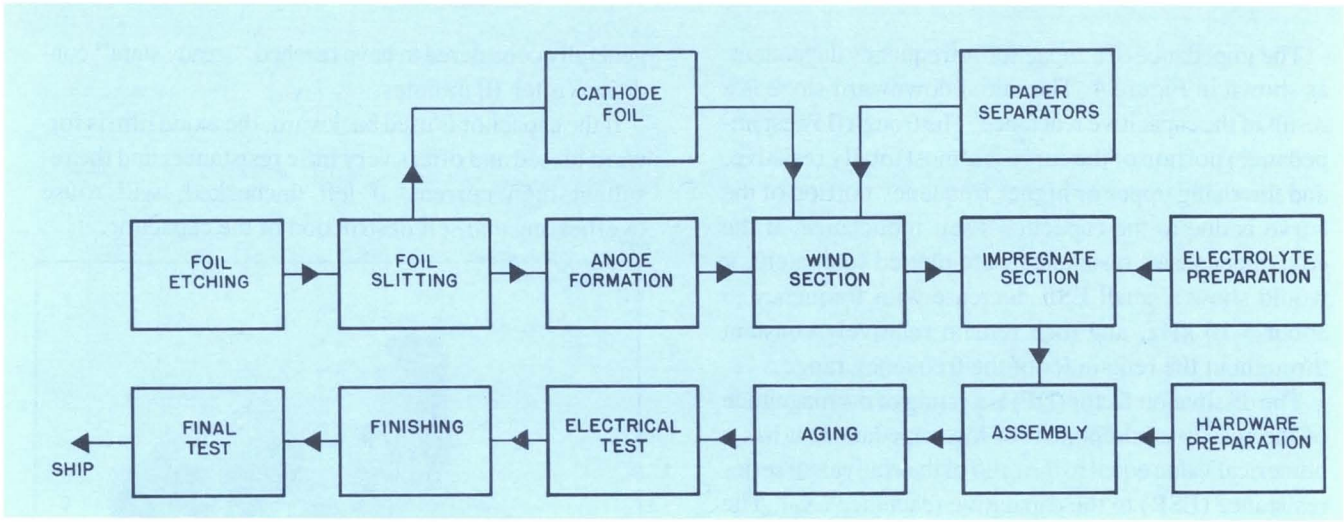


Figure 1.
Basic construction of an electrolytic capacitor.

The capacitors in this catalog use aluminum foil which has an etched surface. Etching increases surface area as much as 100 times that of unetched foil, resulting in higher capacitance in the same volume. During foil etching by an electrochemical process, the surface area of the foil is increased by etching and dissolving part of the base metal into the etching solution.

The type of etch pattern and the degree to which the surface area is increased involves many carefully controlled



Dwg. No. A-14,775

Figure 2.
Manufacturing steps in the production of aluminum electrolytic capacitors.

variables. If a fine-etch pattern is desired to achieve high capacitance per unit area of foil for low-voltage devices, the level of current density and time the foil is exposed to the etching solution will be far different than that required for a coarse etch pattern. The foil is then electrochemically treated to form a layer of aluminum oxide on its surface. Time and current density determine the amount of power consumed in the process. The oxide film — the dielectric — is extremely thin, usually about 15 Angstroms/V. When formed on a high purity aluminum foil, it has a dielectric constant between 7 and 10 and an equivalent dielectric strength of 25 million volts per inch.

The thickness of this oxide coating dielectric is determined by the voltage used to form it. The working voltage of the capacitor is somewhat less than this formation voltage. Thin films result in low voltage, high capacitance units; and thicker films produce higher voltage, lower capacitance units for a given case size.

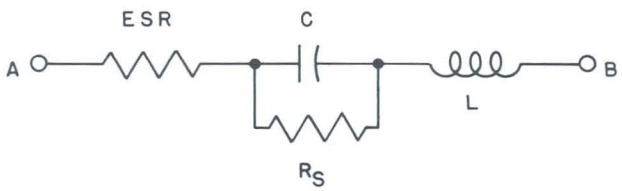
As a capacitor section is wound, a system of paper spacers is put in place to separate the foils. This prevents the possibility of direct shorts between anode and cathode foils that might result because of rough surfaces or jagged edges on either foil. The spacer material also absorbs the electrolyte with which the capacitor is impregnated, and thus assures uniform and intimate contact with all of the surface eccentricities of the etched anode foil throughout the life of the capacitor. The cathode foil serves only as an electrical connection to the electrolyte which is in fact the true cathode of the electrolytic capacitor.

The electrolyte commonly used in aluminum electrolytic capacitors is an ionogen which is dissolved in and reacts with glycol to form a paste-like mass of medium resistivity. This is normally supported in a carrier of high purity craft or hemp paper. In addition to the glycol electrolyte, low resistivity non-aqueous electrolytes are used to obtain a lower ESR and wider operating temperatures.

The foil-spacer-foil is wound into a cylinder, inserted into a suitable container, impregnated and sealed.

Electrical Characteristics

The equivalent circuit of an electrolytic capacitor is shown in Figure 3. The shunt resistance, R_S, in parallel with the effective capacitance, C, accounts for the d-c leakage current through the capacitor. Heat is generated in the ESR if there is ripple current and heat is generated in the shunt resistance by the voltage. In an aluminum electrolytic capacitor, the ESR resistance is due mainly to the spacer-electrolyte-oxide system. Generally it varies only slightly except at low temperature where it increases greatly.



Dwg. No. A-14,776

Figure 3.

Simplified equivalent circuit of an electrolytic capacitor.

A, B = capacitor terminals
C = effective capacitance
R_S = shunt resistance (insulation resistance) through which d-c leakage current flows
ESR = equivalent series resistance
L = self inductance of capacitor caused by terminals, electrodes and geometry.

The impedance of a capacitor is frequency dependent, as shown in Figure 4. The initial downward slope is a result of the capacitive reactance. The trough (lowest impedance) portion of the curve is almost totally resistive, and the rising upper or higher frequency portion of the curve is due to the capacitor's self-inductance. If the equivalent series resistance were plotted separately, it would show a small ESR decrease with frequency to about 5-10 kHz, and then remain relatively constant throughout the remainder of the frequency range.

The dissipation factor (DF) is a rating of the magnitude of the resistive component of the impedance. It has a numerical value equal to the ratio of the equivalent series resistance (ESR) to the capacitive reactance (X_C). The design objective is to make this value as close to zero as possible over the operating frequency and temperature range of the capacitor. (ESR measurements are more practical because most precision capacitance bridges balance both the ESR and capacitance of the unit under test at the same time. This normally results in a direct measurement of ESR.)

Equivalent circuit of capacitor
ESR = equivalent series resistance
X_C = capacitive reactance
X_L = inductive resistance

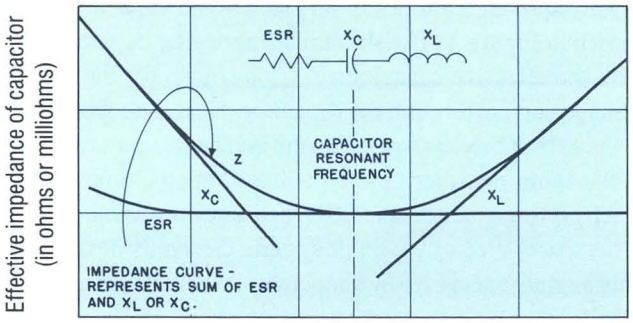


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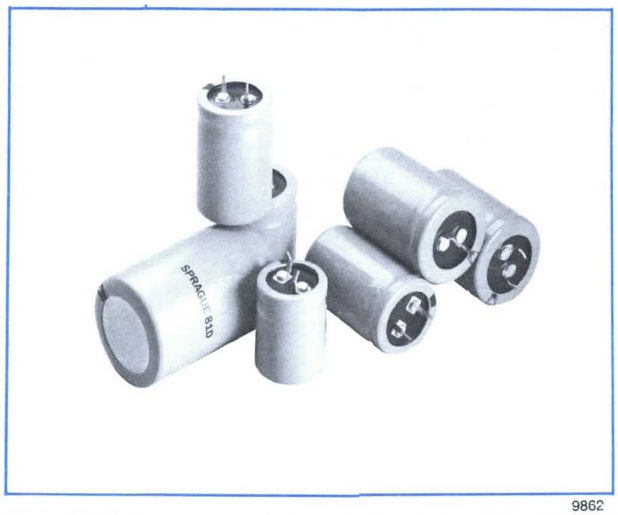
Figure 4.
RESONANT FREQUENCY
Frequency over which capacitor is used.

Note: Capacitors behave like capacitors up to their resonant frequency, then they behave like inductors.

Leakage current is the direct current which passes through a capacitor when a correctly polarized d-c voltage is applied to its terminals. This current is proportional to temperature and becomes increasingly important when capacitors are used at elevated ambients. Imperfections in the oxide dielectric film cause high leakage currents. High leakage currents can also be due to the use of relatively low purity material or to contaminants introduced during the manufacturing process. Leakage current decreases slowly after voltage is applied. It is generally considered to have reached "steady state" conditions after 10 minutes.

If the capacitor is used backward, the oxide film is forward biased and offers very little resistance; and the resultant high current, if left unchecked, will cause overheating and self destruction of the capacitor.



9862

9588

9912

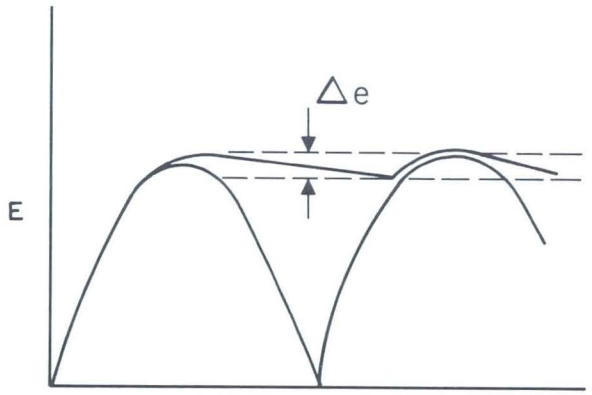
The total amount of heat generated within a capacitor is the sum of that caused by the I^2R losses in the equivalent series resistance, and that caused by the leakage current times the applied voltage.

Application Considerations

The a-c ripple current rating of an electrolytic capacitor is one of the most important factors in filter applications, because excessive current produces a greater than permissible temperature rise and shortens capacitor life. The maximum permissible RMS ripple current for any capacitor is limited by the temperature within the capacitor and the rate of heat dissipation from the capacitor. Lower ESR and longer cans increase the ripple current rating.

Aluminum electrolytic capacitors can withstand a reverse voltage of up to 1 ½ volts without noticeable effect on the operating characteristics. Higher reverse voltages, when applied over extended periods, will lead to some loss of capacity; excess voltages applied for short periods in the reverse direction will cause some change in capacitance but will not lead to capacitor failure during the reverse voltage application or during subsequent operation in the normal polarity direction.

A major use of large capacitors is the d-c power supply (See Figure 5). After a capacitor is fully charged, the rectifier stops conducting, and the capacitor will discharge into the load as shown in Figure 5 until the next cycle.



Dwg. No. A-14,782

Figure 5.
FULL WAVE RECTIFIER CAPACITOR CHARGE AND DISCHARGE

Then the capacitor is recharged again to the peak voltage. The Δe shown in the illustration is equal to the total peak-to-peak ripple voltage. Inspection shows that this is a complex wave which contains many harmonics of the fundamental ripple frequency. It is this ripple that causes the noticeable heating of the capacitor, and it can be mathematically determined. On the other hand, the ripple current through the capacitor can be measured to see if it is within the rating of the specifications. One way to make this measurement is to insert a low impedance true RMS ammeter in series with the capacitor. It is very important that the impedance of the meter be small compared with that of the capacitor; otherwise, a great measurement error will result.

A quick method for approximating ripple current is to measure the ripple voltage across the capacitor terminals and divide this measurement by the capacitor impedance. But misinterpretation of the waveform can lead to large errors. A current probe with suitable frequency characteristics can also be used to measure ripple current. The internal temperature of the capacitor can be measured by inserting of a thermocouple into the core of the capacitor (about half way between the top and the bottom).

Storage at elevated temperatures without voltage applied gives a good indication of stability of the oxide film and the compatibility of all the materials used in the manufacture of the capacitor. Following a period of at least 24 hours, with no voltage applied and at maximum operating temperature, the leakage current should be within initially specified limits after a brief period of electrification.

It used to be that electrolytic capacitors would deform their oxide film when used below their rated voltage. This is definitely not the case with properly manufactured electrolytic capacitors today. In fact, a lower operating voltage will only result in increased reliability; and, the capacitor can still be used at its full rated voltage if desired.

Standard life tests at rated voltage and maximum rated temperatures are usually the criteria for determining the quality of an electrolytic capacitor. These two conditions rarely occur simultaneously in practice. Capacitor life expectancy is doubled for each decrease of about 10 degrees in operating temperature. Thus, a capacitor operated at room temperature will have a life expectancy 64 times that of the same capacitor operated at 85°C.

Voltage derating will improve reliability by increasing the MTBF. For detailed information on the effects of voltage derating, see page 274.

The surge voltage specification of a capacitor determines its ability to withstand high transient voltages which generally occur during the starting up period of equipment. Standard tests generally specify a short on and long off period for an interval of 24 hours or more; and the allowable surge voltage levels are generally 10% above the rated voltage of the capacitor. Electrolytic capacitors have a limited over-voltage capability; tests of several times the rated voltage that sometimes are ap-

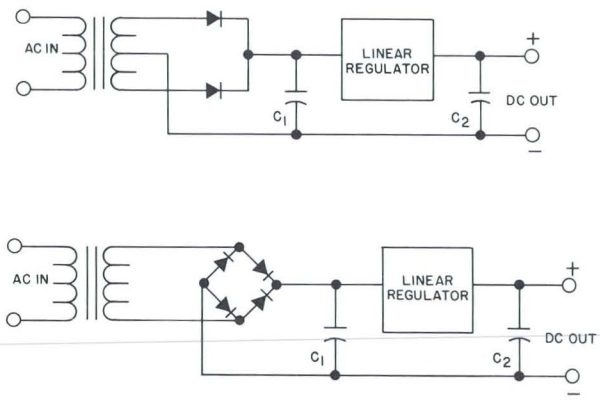
plied to electrostatic capacitors cannot be applied to electrolytic capacitors of any kind.

All polarized electrolytic capacitors, other than those that have one side grounded, characteristically exhibit an indeterminate resistance between the cathode terminal and the metal container. Therefore, the container must be considered at the same potential as the cathode terminal; and there should not be any potential difference between the case and this terminal. If this is not done, the capacitor may be damaged as the result of the current between the cathode terminals and the case.

Aluminum electrolytic capacitors are manufactured with a built-in pressure relief mechanism designed to open and slowly release internal gas pressures that may build up in the capacitor if it overheats. Such overheating is usually the result of accidentally connecting the capacitor to reverse polarity or, as sometimes happens, of a circuit malfunction such as a rectifier shorting. This relief mechanism may be in the form of a pressure-sensitive controlled-thickness vent in the aluminum can, or a small, calibrated pressure-relief diaphragm built into the cover of large-can electrolytics, or in the case of a miniature capacitor, the rubber cover itself. In any case, it is important to maintain adequate clearance near the vent. Without a vent, or if the vent is inoperative, high internal pressures will rupture the case in an explosive fashion.

Power Supply Application

Linear Supplies — Capacitors are used for energy storage and as output capacitors. Energy storage capacitors (C1 in Figure 6) supply all the power supply's output when the line voltage is less than the output, which is the majority of the time. Therefore they are large. Small power supplies use one capacitor; larger power supplies use more than one. The capacitor should have low ESR so that it has adequate ripple current capability at the ripple frequency (which is generally 120 Hz in US, 100 Hz in Europe). Its ESR and ripple current capability are significant at the ripple frequency. Its capacitance value will determine the ripple voltage and also the ripple current.

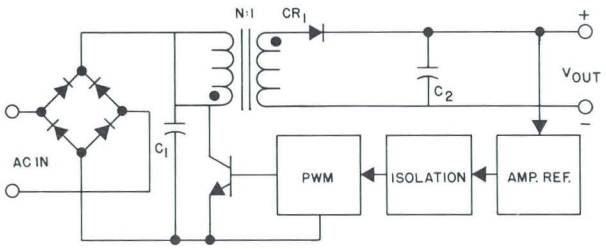


Dwg. No. A-14,784

Figure 6.
Linear Power Supply Circuits

$$\text{approx.}\frac{(.83)\,I_{out}}{2cf} = \Delta V$$

The latter is very sensitive to the transformer impedance. On the other hand the output capacitor (C2) must have a low impedance over a wide frequency range. There may be no need to have high ripple current capabilities because a good power supply should have low ripple voltage. The ESR should be low, to keep the output ripple voltage low for transient load currents at frequencies above the operating frequency of the regulator; i.e., 50 kHz. Large values of capacitors are undesirable due to the surge of the supply into a short and due to the slow voltage adjustment, both up and down.



Dwg. No. A-14,898

Figure 7.
Flyback Switching Supply

Switched-Mode Supplies — The increased utilization of more efficient and cooler-running switching power supplies has become more popular. The input capacitor (C1 in Figure 7) of a typical "off line" switcher has a voltage rating of 200 to 450V. The capacitor's ripple current capabilities are important at 100-120 Hz and at the superimposed switching frequency.

The switching circuit ripple current (I^2R) may account for about 15% of the capacitor's internal heat. Low ESR is important to reduce the switching ripple current from traveling out the power cord and producing RFI. The voltage rating of the output capacitor C2 is tied to the output voltage of the supply. This capacitor serves basically as a noise and high-frequency ripple filter. Unlike the linear supply, it may have significant ripple current.

Low ESR helps reduce output noise but too low an ESR may cause the control loop to oscillate or "ring" during transient loads.

In addition to cylindrically configured capacitors, the Sprague Electric Company offers a family of rectangular-shaped, plastic-encased, four-terminal SMPS capacitors

whose performance characteristics equal or exceed those of metal-cased capacitors. The flat profile and asymmetrical terminal arrangement offer distinct mechanical advantages, including polarity proof installation and built-in standoffs that allow proper cleaning of the circuit boards beneath the capacitors.

Failure Modes

Electrolytic capacitors may fail for a number of reasons. One of the main causes of failure is the eventual drying out of the electrolyte. This results in a decrease in capacitance, an increase in dissipation factor or, at worst, an open circuit. Short circuits in electrolytic capacitors have become of minor importance, since potential shorts are generally weeded out during the manufacturing process.

While parametric out-of-spec changes do not necessarily result in actual circuit malfunction, catastrophic failures like open or short circuits generally will render equipment totally inoperable or ineffective. The true end of life for an electrolytic capacitor depends on its use. In one application a change of 10% in capacitance may be unacceptable, whereas in another circuit even a change of 25% may be tolerated.

Quality and Reliability

Increasingly, more stringent quality measurement systems are being used in the electronics industry. AQL sample plans are being replaced by programs measuring component quality in PPM (Parts Per Million). Product quality specifications now approach perfection. Procedures used to calculate PPM quality levels are based on manufacturers' in-process controls and final inspection results, and users' data at incoming inspection and equipment assembly.

Initial quality requirements are only part of a good product specification. Reliability and useful life should be considered as well — to fit the reliability and useful life requirements of the end equipment.

Reliability is a measure of the expected failure rate during the useful life of the capacitor, and is dependent on the operating temperature and voltage. The MTBF (Mean Time Between Failures) is a simple mathematical manipulation of failure rate numbers, and provides information about the expected total unit hours between failures for a large group of capacitors. Neither reliability nor MTBF provide information about the useful life expectancy for individual capacitors.

Useful life expectancy is a function of the rate of electrolyte loss by means of vapor transmission through the end-seal, which is a function of the operating or storage temperature. The rate of electrolyte loss is relatively insensitive to operating voltage, provided the operating voltage does not exceed the rated voltage. Electrolyte loss is not related to the failure rate during the useful life period.

Quality levels expressed in parts per million (PPM) are becoming a part of every major capacitor supplier's quality-assurance program. Manufacturers rely on statistical process controls and modern manufacturing methods to achieve a continuing reduction in PPM levels. Like almost every other aspect of aluminum-electrolytic manufacturing, reliability is also undergoing change.

The cost of a capacitor with an extremely long useful life may not be justified if the end product has a short useful life. The degree of reliability, therefore, is predicated on the "planned life" of the end equipment.

Generally speaking, the Sprague Electric Company offers four identifiable levels of reliability, expressed in terms of required years of operating life:

1. *Commercial* — Consumer/industrial applications with 3-5 years life;

	COMMERCIAL	COMPUTER	LONG LIFE	PREMIUM
VOLTAGE	500	450	450	300
CV PRODUCT	3	1 (HI)	2	1
TEMP HI	65/85°C	85°C	85/105°C	85/125°C
TEMP LO	– 20	– 40	– 40	– 55
I_{DC}	4	3	2	1 (LO)
ESR	4	3	2	1 (LO)
ΔVS°C	4	3	2	1 (LO)
ΔVS TIME	4	3	2	1 (LO)
RIPPLE	3	3	2	1 (HI)
SURGE VOLT	3	2	1	1 (HI)
RELIABILITY	4	3	2	1 (HI)
NORM LIFE	3-5 yr.	5-10 yr.	10-20 yr.	10-20 yr.
COST	4	3	2	1 (HI)

2. *General Purpose* — Industrial/data-processing applications with 5-10 years life;
3. *Long Life* — Established-reliability applications requiring 10-20 years of life (– 40°C to + 85°C); and
4. *High Reliability* — Established-reliability applications requiring 10-20 years life (– 55°C to + 125°C).

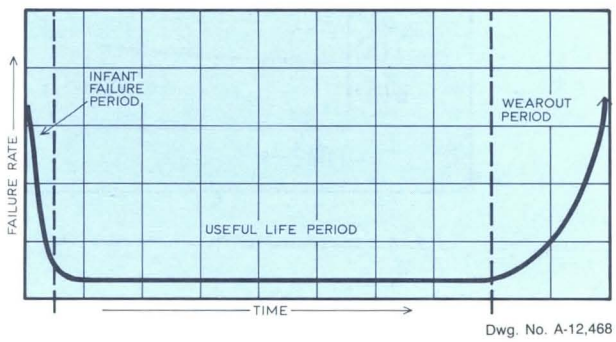
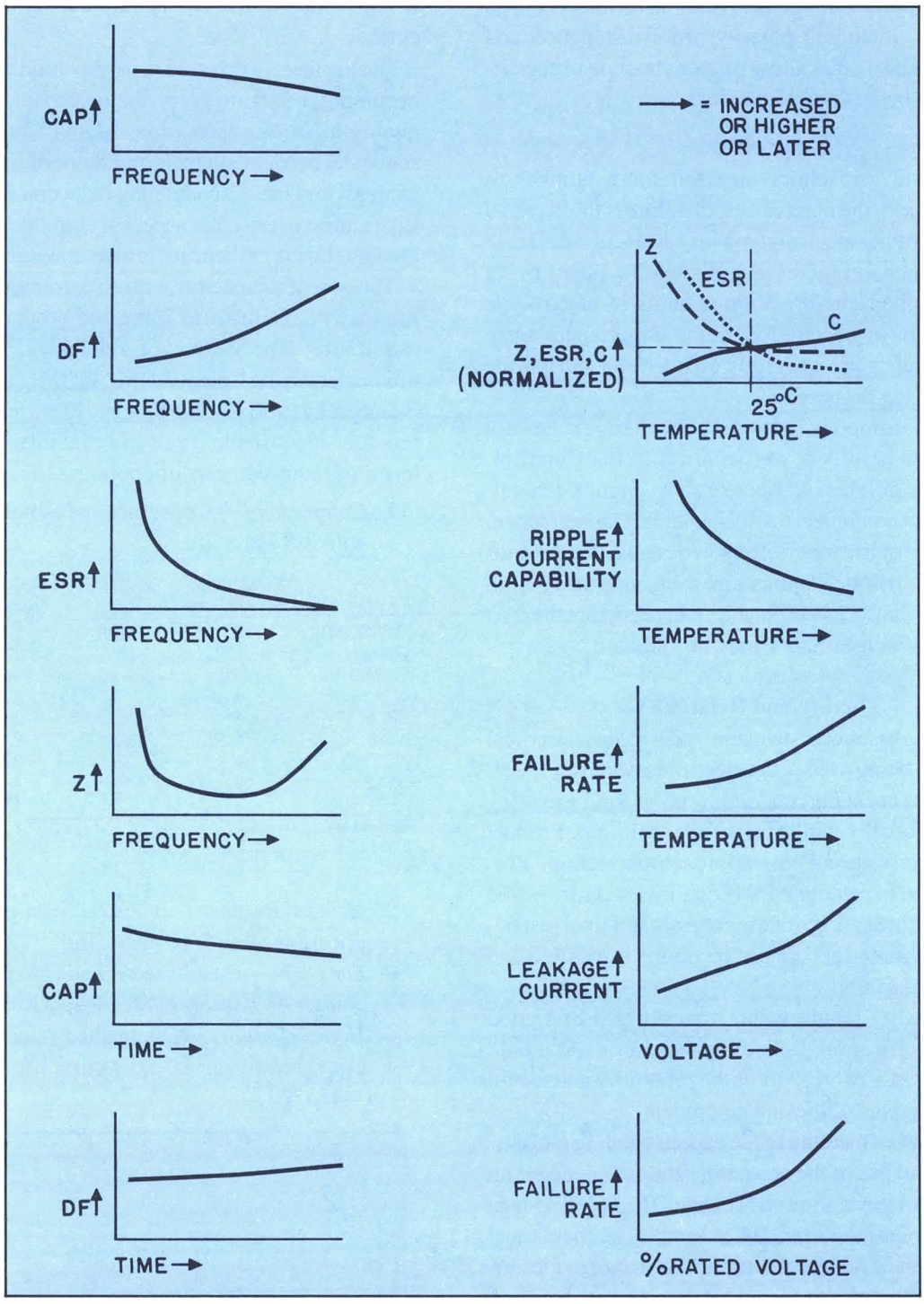


Figure 8.
RELIABILITY LIFE CYCLE — TYPICAL "BATHTUB" CURVE



Dwg. No. A-14,897

Figure 9.
ALUMINUM ELECTROLYTIC CHARACTERISTICS VARY WITH TEMPERATURE, FREQUENCY, TIME AND APPLIED VOLTAGE.

The typical failure rate vs time for aluminum electrolytic capacitors is shown in Figure 8. The plot of failure rate follows a characteristic "bathtub" curve, covering three periods in the typical capacitor life cycle.

The first period is the "Infant Failure" period, showing a decreasing failure rate. Sprague Electric conditions and screens all capacitors to prevent or remove failures during this period. For all practical purposes infant mortality is not a factor in shipped units.

Rudolf F. Graf

WARNING!

To avoid injury to personnel or damage to equipment or property, caution must be exercised in testing or use of capacitors covered by this catalog. The watt-second ratings of the capacitors listed in this catalog are relatively high and if they are improperly tested or used an *EXPLOSION* could occur or a *SHOCK HAZARD* could result. If the capacitors are to be used *IN LARGE BANKS* it is extremely important that suitable precautions be observed in the testing and use of these capacitors. For example, adequate bleeder resistors should be provided and the mechanical structure of capacitor banks should be such as to withstand any large fault currents which may occur in the event of a short circuit.

Capacitor Bank Design Should Be Such As To Eliminate So Far As Reasonably Possible Any Exposure To A Shock Hazard.

GLOSSARY OF TERMS RELATED TO ALUMINUM ELECTROLYTIC CAPACITORS

Aging — Operating a component at controlled conditions of time and temperature to screen out weak or defective devices and at the same time stabilize the good units.

Aluminum Electrolytic Capacitor — A capacitor with two aluminum electrodes (the anode has the dielectric film) separated by layers of absorbent paper saturated with the operating electrolyte. The aluminum-oxide film or dielectric is reparable in the presence of an operating electrolyte.

Ambient Temperature — The temperature of the air or liquid surrounding any electrical part or device. Usually refers to the effect of such temperature in aiding or retarding removal of heat by radiation and convection from the part or device in question.

Anode — Positive electrode of capacitor.

Capacitance — Property of a capacitor which determines its ability to store electrical energy when a given voltage is applied, measured in farads, microfarads, or picofarads.

Capacitive Reactance — Opposition offered to the flow of an alternating or pulsating current by capacitance measured in ohms.

Capacitor — An electrical device capable of storing electrical energy and releasing it at some predetermined rate at some predetermined time. It consists essentially of two conducting surfaces (electrodes) separated by an insulating material or dielectric. A capacitor stores electrical energy, blocks the flow of direct current, and permits the flow of alternating current to a degree dependent essentially upon capacitance and frequency. The amount of energy stored $E = \frac{1}{2} CV^2$.

Capacitor Bank — A number of capacitors connected together in series, in parallel or in series-parallel.

Capacitor-Input Filter — A power-supply filter in which a capacitor is connected directly across, or in parallel with, the rectifier output.

Cathode — The capacitor's negative electrode.

Charge — The quantity of electrical charge stored in a capacitor.

CV Product — The capacitance of a capacitor multiplied by its rated voltage. A useful rating to compare capacitor technologies.

Cycle — The change of an alternating wave from zero to a negative peak to zero to a positive peak and back to zero. The number of cycles per second (hertz) is called the frequency.

Dielectric — The insulating (non-conducting) medium between the two electrodes (plates) of a capacitor.

Dielectric Absorption — A measure of the reluctance of a capacitor dielectric to discharge completely. The charge remaining after a fully charged capacitor is momentarily discharged is expressed as a percentage of the original charge. Dielectric absorption is affected by charge/discharge time, voltage and temperature.

Dielectric Breakdown Voltage — The voltage between the electrodes (plates) of a capacitor at which electric breakdown occurs under prescribed test conditions. Also called breakdown voltage.

Dielectric Constant — The ratio of the capacitance of a capacitor with a given dielectric to that of the same capacitor having a vacuum dielectric.

Dissipation Factor (DF) — The ratio of the effective series resistance of a capacitor to its reactance at a specified frequency measured in percent.

Electrolyte — Current-conducting solution between two electrodes or plates of a capacitor at least one of which is covered by a dielectric.

Electrolytic Capacitor — A capacitor consisting of two conducting electrodes whose anode has a metal oxide film on it. The film acts as the dielectric or insulating medium.

Equivalent Series Resistance (ESR) — For purposes of calculation, all internal series resistance of a capacitor concentrated or "lumped" at one point and treated as one resistance of a capacitor regardless of source, i.e., lead resistance, termination losses or dissipation in the dielectric material.

Etching — An electro-chemical process that increases the surface area of aluminum foil.

Farad — The basic unit of measure in capacitors. A capacitor charged to one volt with a charge of one coulomb (one ampere flowing for one second) has a capacitance of one farad. Capacitors are generally rated at portions of a farad (microfarads or picofarads).
1 farad (F) = 1,000,000 microfarads (μF).

Impedance (Z) — Total opposition offered to the flow of an alternating or pulsating current measured in ohms. (Impedance is the vector sum of the resistance and the capacitive and inductive reactance, i.e., the ratio of voltage to current.)

Insulating Sleeve — Tube or tape of insulating material placed around metal-enclosed capacitors to electrically insulate the case from other components, wiring mounting rings and the chassis of the end equipment.

Insulation Resistance (R) — The ratio of the d-c voltage applied to the terminals of a capacitor and the resulting leakage current through the dielectric and over its surface after the initial charging current has ceased. Specifications usually call for a certain minimum value (several thousand megohms) determined by the application of a specific voltage.

Joule — A unit of energy or work. One joule is equal to one watt-second. Energy stored in a capacitor is equal to $CV^2/2$ joules or watt-seconds, where C is capacitance in farads and V is voltage at the terminals in volts.

Leakage Current — Stray direct current of relatively small value which flows through capacitor when voltage is impressed across it.

Phase — The angular relationship between current and voltage in AC circuits. The fraction of the period which has elapsed in a periodic function or wave measured from some fixed origin. If the time for one period is represented as 360° along a time axis, the phase position is called phase angle.

Polarized Capacitor — An electrolytic capacitor in which the dielectric film is formed on only one metal electrode. The impedance to the flow of current is then greater in one direction than in the other. Reversed polarity can damage the part if excessive current flow occurs.

Quality Factor (Q) — The ratio of the reactance to its equivalent series resistance i.e., $Q = \frac{1}{DF}$ *or* $\frac{X_C}{R}$

Rated Capacitance — The value which is indicated upon the capacitor. The actual capacitance value may deviate from this value within the tolerance limits for that capacitor.

Rated Voltage — The voltage which is indicated on the capacitor and which may be applied continuously to the terminals of the capacitor at temperatures within the applicable temperature category. Operation below the rated voltage (voltage derating) has a positive effect on the operational life.

Reactance (X) — Opposition to the flow of alternating current. Capacitive reactance (X_C) is the opposition offered by capacitors at a specified frequency and is measured in ohms.

Reliability — The probability that a device will perform adequately for the length of time intended and in the operating environment encountered.

Reverse Leakage Current — A non-destructive current flowing through a capacitor subjected to a voltage of polarity opposite to that normally specified.

Ripple Current — The total amount of alternating and direct current that may be applied to an electrolytic capacitor under stated conditions. In general, the higher the ripple current, the shorter the operating life of the capacitor. Application of significantly higher than rated ripple currents can shorten capacitor life dramatically and may even cause catastrophic failure, i.e., venting.

Stability — The ability of a component or device to maintain its initial operating characteristics after being subjected to changes in temperature, environment, current and time. It is usually expressed in either percent or parts per million for a given period of time.

Surge Voltage — The maximum safe voltage to which a capacitor should be subjected under any combination of circumstances of a short period of time.

Time Constant — In a capacitor-resistor circuit, the number of seconds required for the capacitor to reach 63.2% of its full charge after a voltage is applied. The time constant of a capacitor with a capacitance (C) in farads in series with a resistance (R) in ohms is equal to RxC seconds.

Tolerance — The percentage of maximum deviation from the nominal capacitance value at a standard temperature, voltage and frequency.

Voltage — Electrical pressure, i.e., the force which causes current to flow through an electrical conductor. The difference of potential between any two conductors.

Watt-Second — A unit of measure of electrical energy; the work done by one watt acting for one second. One watt-second is equal to one joule.

Working Voltage — The maximum d-c voltage to be applied to a capacitor for continuous duty operation at maximum rated temperature.

CAPACITOR SPECIFICATION CHECK LIST

Items to consider when specifying aluminum capacitors:

Electrical
- capacitance
- tolerance
- rated voltage
- dissipation factor
- d-c leakage current
- maximum surge voltage
- duty cycle
- frequency effects
- reverse voltage
- polar or non-polar
- ripple voltage
- ripple current
- impedance
- shelf life
- equivalent series resistance
- load impedance
- test or measurement frequency

Mechanical
- dimensions
- shape
- weight
- radial/axial
- type of leads or terminals
- lead or terminal strength
- method of mounting

Environmental
- temperature range
- variation of parameters with temperature
- capacitance at temperature extremes
- MIL SPEC requirements
- shock
- vibration
- humidity
- pressure
- radiation
- cleaning solvent exposure

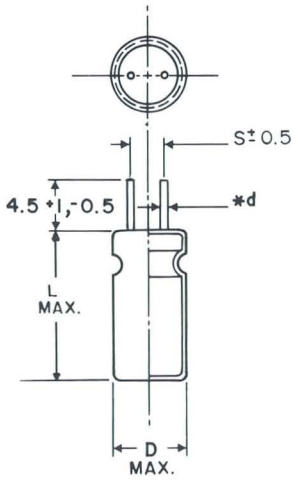
Miscellaneous
- marking
- packaging
- preconditioning
- life expectancy
- life test conditions
- reliability
- quality control level
- MIL SPECs

Miniature Radial Lead Capacitors

SPRAGUE®

OUTLINE DRAWINGS
TYPES 510DX, 511D, 672D, 678D
DIMENSIONS IN MILLIMETERS

TERMINAL CODE C



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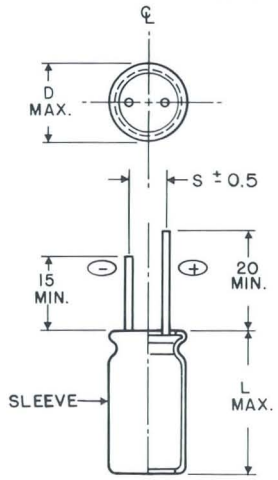

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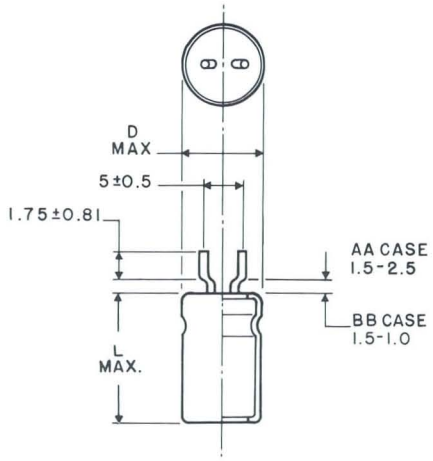

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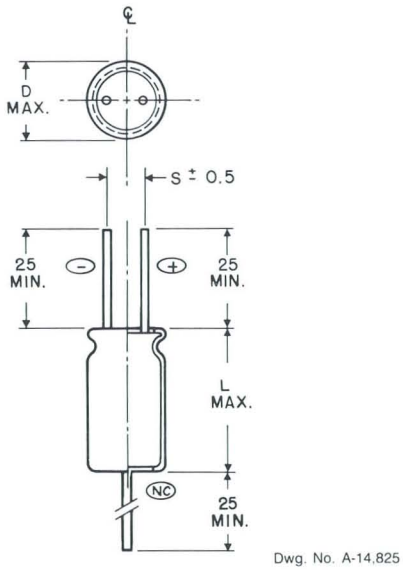

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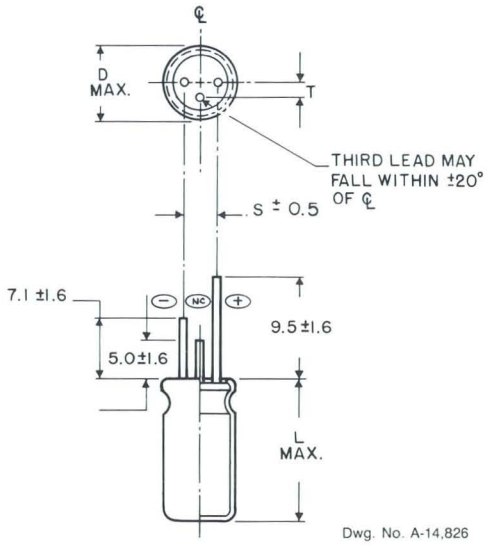

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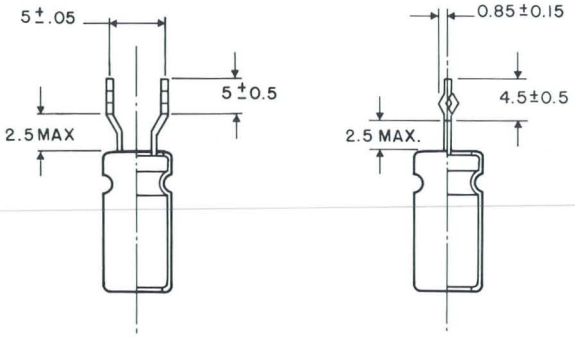
TERMINAL CODE V 5-8mm



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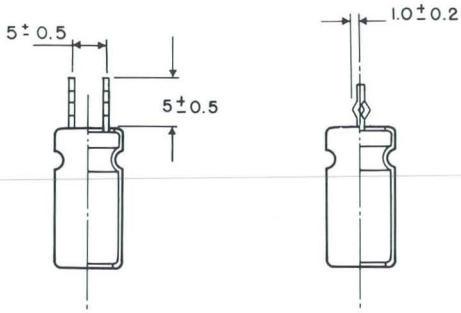
TERMINAL CODE V 10-18mm



Dwg. No. A-14,827

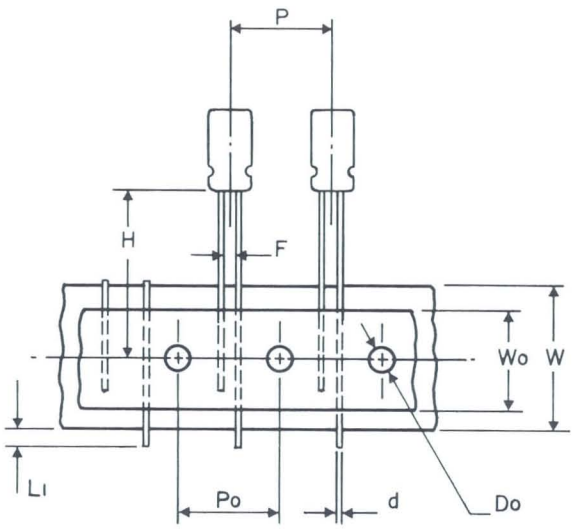
TAPE AND REEL PACKAGING SPECIFICATIONS
TO EIA STANDARD EIA-296D FOR TYPES 510DX, 511D, 672D, 678D

TERMINAL CODE "I"

SIZES 6 x 11
8 x 12

SIZES 10 x 13
10 x 16
10 x 20

STRAIGHT LEADS



Dwg. No. A-14,896

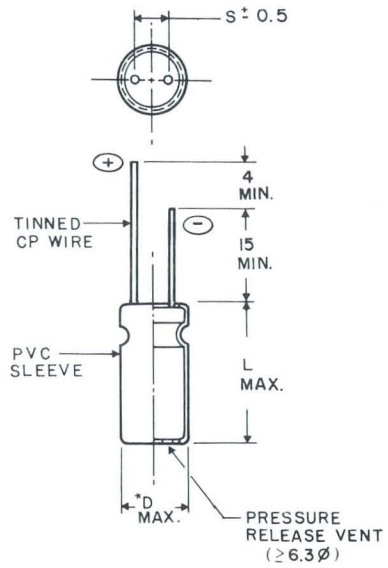
NOTE
1. POSITIVE LEADER IS STANDARD. NEGATIVE LEADER IS AVAILABLE BY SPECIAL ORDER.

DIMENSIONS IN MILLIMETERS

Item (Dia. x Length)	Case Size 6 x 11	8 x 12	10 x 13 10 x 16 10 x 20
d Lead-wire diameter	0.63	0.63	0.63
P Pitch of component	12.7	12.7	12.7
P_0 Feed hole pitch	12.7	12.7	12.7
F Lead-to-lead distance	5.0	5.0	5.0
K Clinch height	2.5	4.0	N/A
H Height of component from tape center	18.5	20.0	23.0
H_0 Lead-wire clinch height	16.0	16.0	N/A
W Tape width	18.0	18.0	18.0
W_0 Hold down tape width	15.0	15.0	15.0
D_0 Feed hole diameter	4.0	4.0	4.0
t Total tape thickness	0.7	0.7	0.7
L_1 Max. lead protrusion	3.0	3.0	3.0

OUTLINE DRAWINGS
TYPES 515D, 517D
DIMENSIONS IN MILLIMETERS

TERMINAL CODE A



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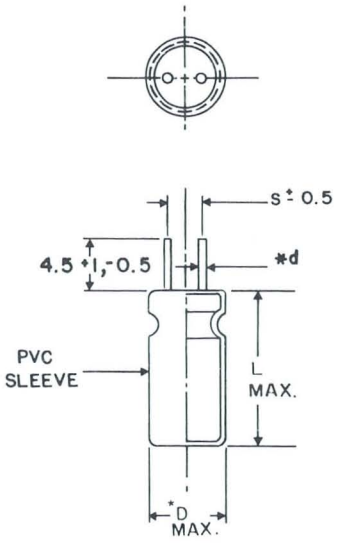

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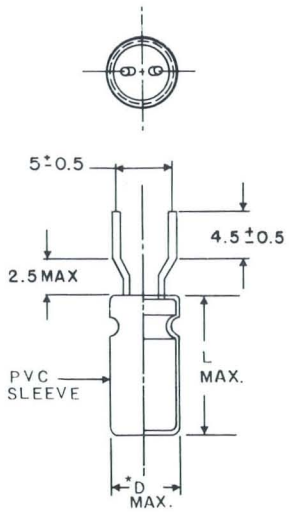
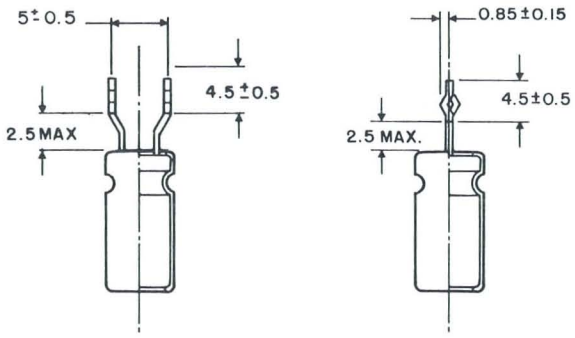


Dwg. No. A-14,879

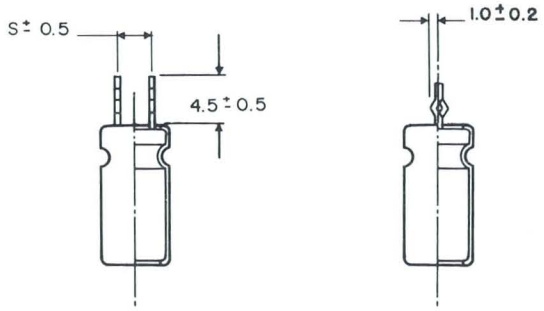
*D Max. = D Nom. +.5

TERMINAL CODE S 5-8mm



Dwg. No. A-14,830

TERMINAL CODE S 10-18mm



Dwg. No. A-14,850

TYPE 515D and 517D

LEAD DIMENSIONS

Forming Method	Formed lead code	Dimensions (mm)				
		D	S	P	ϱ	X
Formed and cut	F	4	5	1.5	—	1.5
		5	5	2.0	—	1.5
		6.3	5	2.5	—	2.5
		8	5	3.5	—	2.5
Cut	C	10	5	—	—	—
		12.5	5	—	—	—
		16	7.5	—	—	—
		18	7.5	—	—	—
Snap-in	S	4	5	1.5	1.1	1.5
		5	5	2.0	1.1	1.5
		6.3	5	2.5	1.1	1.5
		8	5	3.5	1.3	1.5
		10	5	—	1.3	—
		12.5	5	—	1.3	—
		16	7.5	—	1.3	—
		18	7.5	—	1.3	—

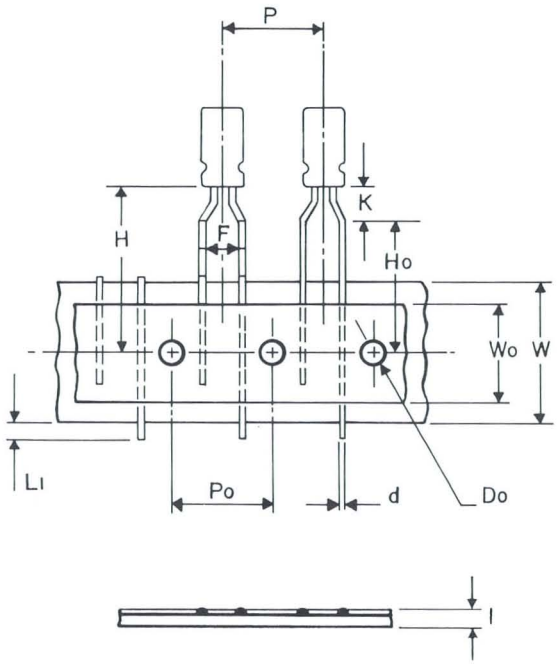
Note: Dimension "X" is max.

TAPE AND REEL SPECIFICATIONS

Packaging	Lead Code	Specification		Lead Space	Capacitor Sizes Available
		Lead Style	+ − Leader		
Reel Pack	J	Formed Lead*	Cathode	5.0	5x11 ~ 12.5x20
	K	Formed Lead*	Anode	5.0	5x11 ~ 12.5x20
	L	Formed Lead	Cathode	5.0	4,5 and 6.3x7
	M	Formed Lead	Anode	5.0	4,5 and 6.3x7
Ammo Pack	P	Formed Lead*	—	5.0	4x7 ~ 12.5x20

*Except 10 & 12.5mm Dia. Have Straight Uniformed Leads.

TYPE 515D and 517D



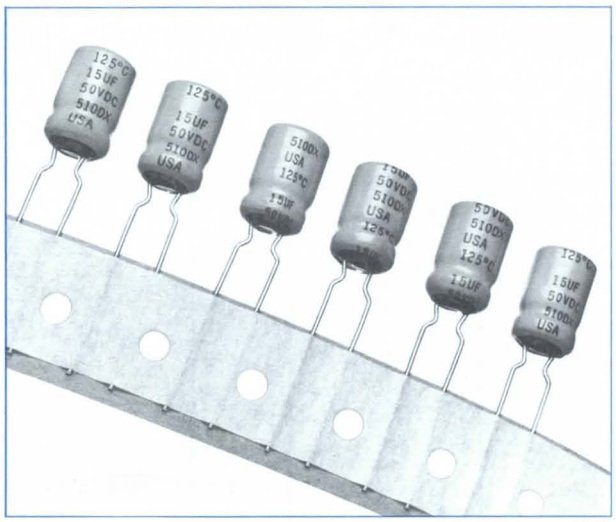
Dwg. No. A-14,895

TAPE AND REEL SPECIFICATIONS

Item	Type Size	Formed Lead Type						Straight Lead Type	
		4x7	5x7	5x11	6.3x7	6.3x11	8x11.5	10mm Dia.	12.5mm Dia.
d	Lead-wire diameter	0.45	0.45	0.5	0.45	0.5	0.6	0.6	0.6
P	Pitch of component	12.7	12.7	12.7	12.7	12.7	12.7	12.7	15.0
P_0	Feed hole pitch	12.7	12.7	12.7	12.7	12.7	12.7	12.7	15.0
F	Lead-to-lead distance	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
K	Clinch height	1.5	1.5	2.5	1.5	2.5	4.0	—	—
H	Height of component from tape center	17.5	17.5	18.5	17.5	18.5	20.0	18.5	16.0
H_0	Lead-wire clinch height	16.0	16.0	16.0	16.0	16.0	16.0	—	—
W	Tape width	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
W_0	Hold down tape width	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
D_0	Feed hole diameter	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
t	Total tape thickness	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7

Type 510DX

+125°C Miniature, Radial Lead, Aluminum Capacitors



9898

Features —

- 125°C Performance
- Suitable for Tantalum Foil Replacement Applications
- Low DC Leakage Currents
- Very Stable, Long Life
- Case Sizes through 18 x 36mm
- Optional 3rd Lead on Diameters ≥ 12.5mm

General Specifications —

Operating Temperature:
−40°C +125°C.

Voltage Range: 6.3 - 63 VDC.

Capacitance Range: 1.0 - 6800μF.

Capacitance Tolerance: ±20%.

Case Size Range: 8 x 12mm - 18 x 36mm.

Termination: 2 or 3 radial leads.

Life Validation Test: 2000 hrs @ +125°C:
Δ CAP ≤ 15% (6.3 - 10 VDC), ≤ 10% (16 - 63 VDC) from initial measurement.
Δ ESR ≤ 1.25x initial specified limit.
Δ DCL ≤ initial specified limit.

Shelf Test: 500 hrs. @ +105°C:
Δ CAP ≤ 12% from initial measurement.
Δ ESR ≤ 1.25x initial specified limit.
Δ DCL ≤ 2x initial specified limit.

DC Leakage Current: I = 0.01 CV
I in μA, C in μF, V in Volts

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	Multipliers
+125°C	0.4
+105°C	1.0
+85°C	1.41
+75°C	1.58
≤+65°C	1.73

FREQUENCY Hz.

Frequency (Hz)	50-60	100-120	300-400	1K-up
Multipliers	0.85 0.80	1.0 1.0	1.05 1.30	1.1 1.4

Low Temperature Performance:

Capacitance Ratio $C^{-55°C}/C^{+25°C}$ min. @ 120Hz

Rated Voltage (VDC)	Capacitance Remaining
6.3-10	75%
16-25	80%
35-63	85%

ESR Ratio $ESR^{-55°C}/ESR^{+25°C}$ max. @ 120Hz

Rated Voltage (VDC)	Multiplier
6.3-10	35
16-25	30
35-63	25

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

510DX 187 M 6R3 BB 2 D

TERMINAL CODE. D = STRAIGHT LEADS (Standard).
E = LEAD FORM TO 5mm CENTERS.
J = 3 LEAD AXIAL MOUNT.
O = KEYED POLARITY 3 LEAD RADIAL MOUNT.
C = CUT LEADS.
V = SNAP IN FORMED LEADS.
I = TAPE AND REEL PACKAGING.

CASE STYLE. 2 = POLYESTER INSULATING SLEEVE (Standard).
3 = PVC SLEEVE WITH RESIN END SEAL.*
(Required for exposure to halogenated cleaning solvents).
4 = PVC SLEEVE.*
5 = POLYESTER SLEEVE WITH RESIN END SEAL.
(Required for exposure to halogenated cleaning solvents).

CASE CODE. SEE DIMENSIONS.

DC VOLTAGE RATING. IN VOLTS. AN 'R' IS USED TO SIGNIFY A DECIMAL POINT.

CAPACITANCE TOLERANCE. M = ±20%.

CAPACITANCE. EXPRESSED IN PICOFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

*Sleeving rated to +105°C.

DIMENSIONS IN MILLIMETERS

CASE CODE	NOMINAL DIAMETER	NOMINAL LENGTH	STYLES 2 and 4 D Max.	STYLES 2 and 4 L Max.	STYLES 3 and 5 D Max.	STYLES 3 and 5 L Max.	LEAD SPACING S, ±.6	LEAD SPACING T, ±.5	LEAD DIAMETER NOM.	LEAD DIAMETER AWG NO.
BB	8	12	8.5	13.0	8.5	14.0	3.5	N/A	0.63	22
BD	8	16	8.5	17.0	8.5	18.8	3.5	N/A	0.63	22
CC	10	13	10.5	14.3	10.5	16.0	5.0	N/A	0.63	22
CD	10	16	10.5	17.0	10.5	18.8	5.0	N/A	0.63	22
CG	10	20	10.5	21.5	10.5	23.0	5.0	N/A	0.63	22
DG	12.5	20	13.0	21.5	13.0	23.0	5.0	2.5	0.81	20
DK	12.5	25	13.0	26.5	13.0	29.0	5.0	2.5	0.81	20
DM	12.5	26.5	13.0	28.0	13.0	29.5	5.0	2.5	0.81	20
DT	12.5	33.5	13.0	34.2	13.0	36.0	5.0	2.5	0.81	20
DS	12.5	42.5	13.0	43.7	13.0	45.5	5.0	2.5	0.81	20
EK	16	25	16.5	26.2	16.5	27.9	7.5	3.8	0.81	20
EN	16	32	16.5	33.5	16.5	36.0	7.5	3.8	0.81	20
ER	16	36	16.5	37.5	16.5	40.0	7.5	3.8	0.81	20
EU	16	40	16.5	41.7	16.5	42.4	7.5	3.8	0.81	20
FR	18	36	18.5	37.5	18.5	40.0	7.5	3.8	0.81	20

STANDARD RATINGS

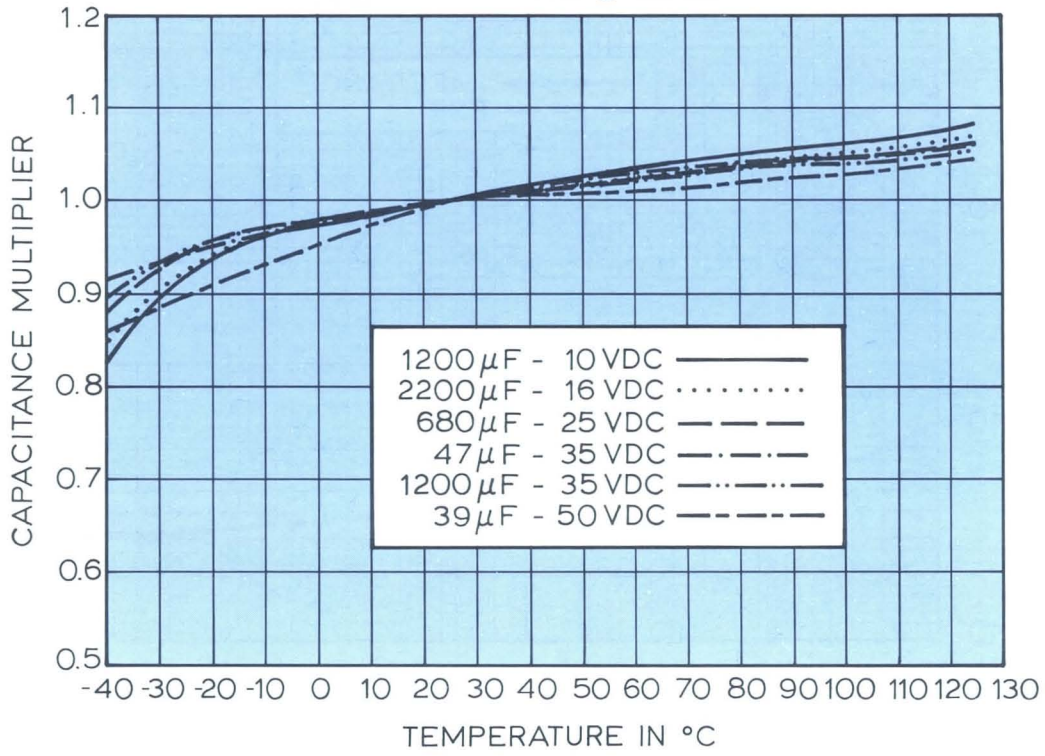
μF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20-40kHz	Max. Ripple Current @ +105°C (A) 120Hz	Max. Ripple Current @ +105°C (A) 20k-40kHz	Max. Z @ +25°C (mΩ) 100kHz
6.3 VOLTS DC WORKING; 8 VOLTS DC SURGE							
180	510DX187M6R3BB2D	8 x 12	2210	912	0.182	0.283	821
330	510DX337M6R3BD2D	8 x 16	1206	507	0.276	0.425	457
330	510DX337M6R3CC2D	10 x 13	1206	507	0.294	0.454	457
560	510DX567M6R3CD2D	10 x 16	710	317	0.412	0.616	286
820	510DX827M6R3CG2D	10 x 20	485	212	0.553	0.837	191
1000	510DX108M6R3DG2D	12.5 x 20	398	201	0.697	0.984	181
1500	510DX158M6R3DK2D	12.5 x 25	265	133	0.931	1.313	121
1800	510DX188M6R3DM2D	12.5 x 26.5	221	120	1.039	1.412	108
2200	510DX228M6R3DT2D	12.5 x 33.5	181	89	1.243	1.769	80
2700	510DX278M6R3EK2D	16 x 25	147	71	1.438	2.068	64
3900	510DX398M6R3EN2D	16 x 32	102	49	1.905	2.749	44
4700	510DX478M6R3ER2D	16 x 36	85	40	2.193	3.193	36
6800	510DX688M6R3FR2D	18 x 36	59	36	2.844	3.641	32
10 VOLTS DC WORKING; 13 VOLTS DC SURGE							
150	510DX157M010BB2D	8 x 12	2210	948	0.182	0.278	854
220	510DX227M010BD2D	8 x 16	1507	528	0.247	0.417	475
270	510DX277M010CC2D	10 x 13	1228	528	0.292	0.445	475
390	510DX397M010CD2D	10 x 16	850	330	0.377	0.604	297
560	510DX567M010CG2D	10 x 20	592	220	0.501	0.821	198
680	510DX687M010DG2D	12.5 x 20	488	207	0.629	0.965	187
1200	510DX128M010DK2D	12.5 x 25	276	138	0.911	1.287	124
1800	510DX188M010DT2D	12.5 x 33.5	184	93	1.232	1.734	84
1800	510DX188M010EK2D	16 x 25	184	74	1.285	2.027	67
2700	510DX278M010EN2D	16 x 32	123	51	1.737	2.695	46
3300	510DX338M010ER2D	16 x 36	100	42	2.018	3.114	37
4700	510DX478M010FR2D	18 x 36	71	37	2.582	3.576	33
16 VOLTS DC WORKING; 20 VOLTS DC SURGE							
82	510DX826M016BB2D	8 x 12	2588	986	0.168	0.272	888
150	510DX157M016BD2D	8 x 16	1415	549	0.255	0.409	494
150	510DX157M016CC2D	10 x 13	1415	549	0.272	0.436	494
270	510DX277M016CD2D	10 x 16	786	343	0.392	0.593	309
390	510DX397M016CG2D	10 x 20	544	229	0.522	0.805	206
470	510DX477M016DG2D	12.5 x 20	451	216	0.654	0.946	194
820	510DX827M016DK2D	12.5 x 25	259	144	0.941	1.262	129
1200	510DX128M016DT2D	12.5 x 33.5	177	97	1.257	1.701	87
1200	510DX128M016EK2D	16 x 25	177	77	1.311	1.987	70
1800	510DX188M016EN2D	16 x 32	118	53	1.772	2.643	48
2200	510DX228M016ER2D	16 x 36	96	43	2.060	3.078	39
3300	510DX338M016FR2D	18 x 36	64	39	2.719	3.501	35
25 VOLTS DC WORKING; 32 VOLTS DC SURGE							
56	510DX566M025BB2D	8 x 12	2605	1026	0.168	0.267	923
100	510DX107M025BD2D	8 x 16	1459	571	0.251	0.401	514
100	510DX107M025CC2D	10 x 13	1459	571	0.268	0.428	514
180	510DX187M025CD2D	10 x 16	810	357	0.386	0.581	321
270	510DX277M025CG2D	10 x 20	540	238	0.524	0.789	214
330	510DX337M025DG2D	12.5 x 20	442	224	0.661	0.927	202
470	510DX477M025DK2D	12.5 x 25	310	150	0.859	1.238	135
560	510DX567M025DM2D	12.5 x 26.5	261	135	0.957	1.331	121
680	510DX687M025DT2D	12.5 x 33.5	215	100	1.141	1.667	90
820	510DX827M025EK2D	16 x 25	178	80	1.307	1.949	72
1200	510DX128M025EN2D	16 x 32	122	55	1.742	2.595	50
1500	510DX158M025ER2D	16 x 36	97	45	2.049	3.009	40
1800	510DX188M025FR2D	18 x 36	81	40	2.417	3.439	36

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20-40kHz	Max. Ripple Current @ +105°C (A) 120Hz	Max. Ripple Current @ +105°C (A) 20k-40kHz	Max. Z @ +25°C (mΩ) 100kHz
35 VOLTS DC WORKING; 44 VOLTS DC SURGE							
47	510DX476M035BB2D	8 x 12	2822	1067	0.161	0.262	960
82	510DX826M035BD2D	8 x 16	1617	593	0.238	0.393	534
100	510DX107M035CC2D	10 x 13	1326	593	0.281	0.421	534
150	510DX157M035CD2D	10 x 16	884	371	0.369	0.571	334
220	510DX227M035CG2D	10 x 20	603	248	0.496	0.774	223
270	510DX277M035DG2D	12.5 x 20	491	233	0.627	0.911	210
470	510DX477M035DK2D	12.5 x 25	282	156	0.901	1.214	140
680	510DX687M035DT2D	12.5 x 33.5	195	104	1.197	1.615	94
820	510DX827M035EK2D	16 x 25	162	84	1.371	1.902	75
1200	510DX128M035EN2D	16 x 32	111	58	1.826	2.527	52
1500	510DX158M035ER2D	16 x 36	88	47	2.151	2.944	42
1800	510DX188M035FR2D	18 x 36	74	42	2.534	3.366	38
50 VOLTS DC WORKING; 63 VOLTS DC SURGE							
39	510DX396M050BB2D	8 x 12	3061	1110	0.155	0.257	999
68	510DX686M050BD2D	8 x 16	1755	617	0.229	0.385	555
82	510DX826M050CC2D	10 x 13	1456	617	0.268	0.412	555
120	510DX127M050CD2D	10 x 16	995	386	0.348	0.559	347
180	510DX187M050CG2D	10 x 20	663	258	0.473	0.759	232
220	510DX227M050DG2D	12.5 x 20	543	243	0.597	0.892	218
330	510DX337M050DK2D	12.5 x 25	362	162	0.796	1.191	146
390	510DX397M050DM2D	12.5 x 26.5	306	146	0.883	1.281	131
560	510DX567M050DT2D	12.5 x 33.5	213	109	1.145	1.604	98
560	510DX567M050EK2D	16 x 25	213	87	1.194	1.87	78
820	510DX827M050EN2D	16 x 32	146	60	1.595	2.485	54
1000	510DX108M050ER2D	16 x 36	119	49	1.847	2.883	44
1500	510DX158M050FR2D	18 x 36	80	43	2.432	3.317	39
63 VOLTS DC WORKING; 79 VOLTS DC SURGE							
27	510DX276M063BB2D	8 x 12	3438	1154	0.146	0.252	1039
47	510DX476M063BD2D	8 x 16	1975	642	0.215	0.378	578
47	510DX476M063CC2D	10 x 13	1975	642	0.231	0.404	578
82	510DX826M063CD2D	10 x 16	1132	401	0.326	0.548	361
120	510DX127M063CG2D	10 x 20	774	268	0.438	0.744	241
150	510DX157M063DG2D	12.5 x 20	619	252	0.559	0.875	227
220	510DX227M063DK2D	12.5 x 25	422	168	0.737	1.167	151
270	510DX277M063DM2D	12.5 x 26.5	344	151	0.833	1.255	136
390	510DX397M063DT2D	12.5 x 33.5	238	113	1.083	1.572	102
390	510DX397M063EK2D	16 x 25	238	90	1.131	1.834	81
560	510DX567M063EN2D	16 x 32	166	62	1.494	2.444	56
680	510DX687M063ER2D	16 x 36	137	51	1.724	2.826	45
1000	510DX108M063FR2D	18 x 36	93	45	2.256	3.243	41

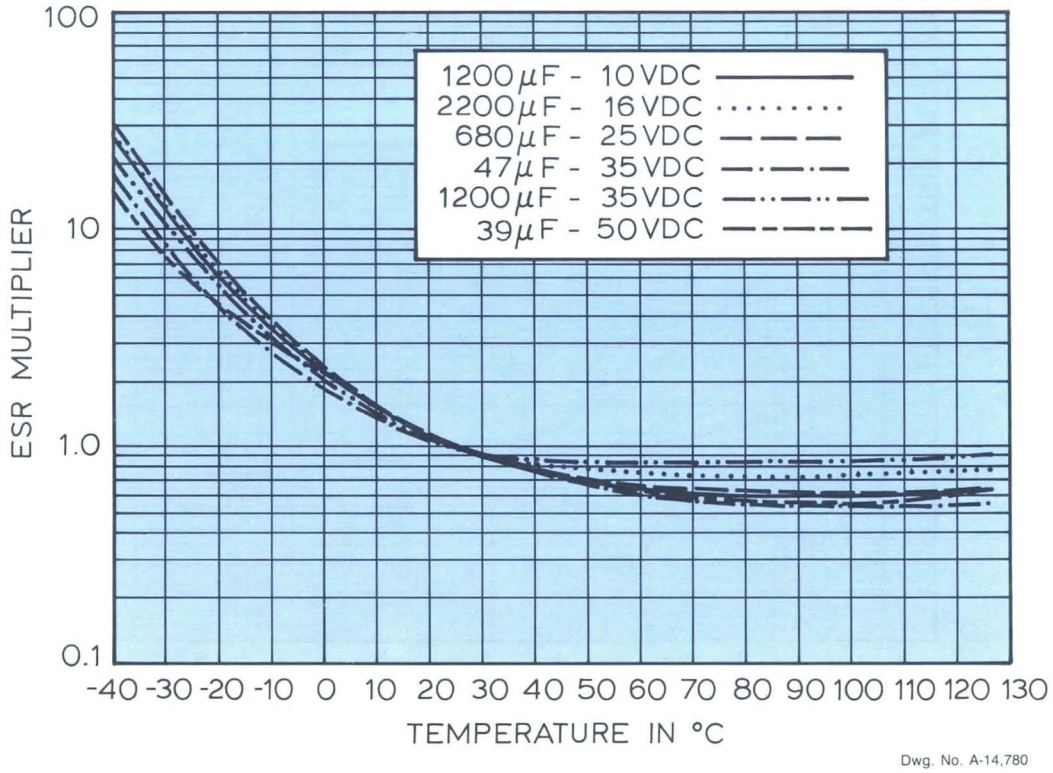
TYPICAL CURVES

TYPE 510DX — TYPICAL CAPACITANCE MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,781

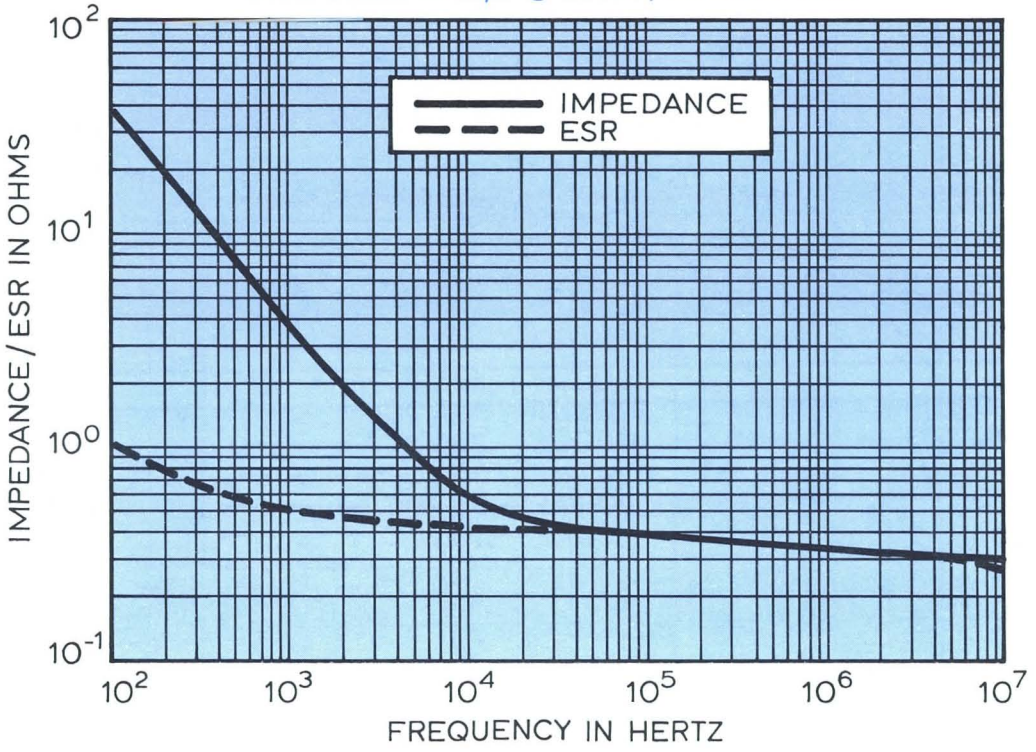
TYPE 510DX — TYPICAL ESR MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,780

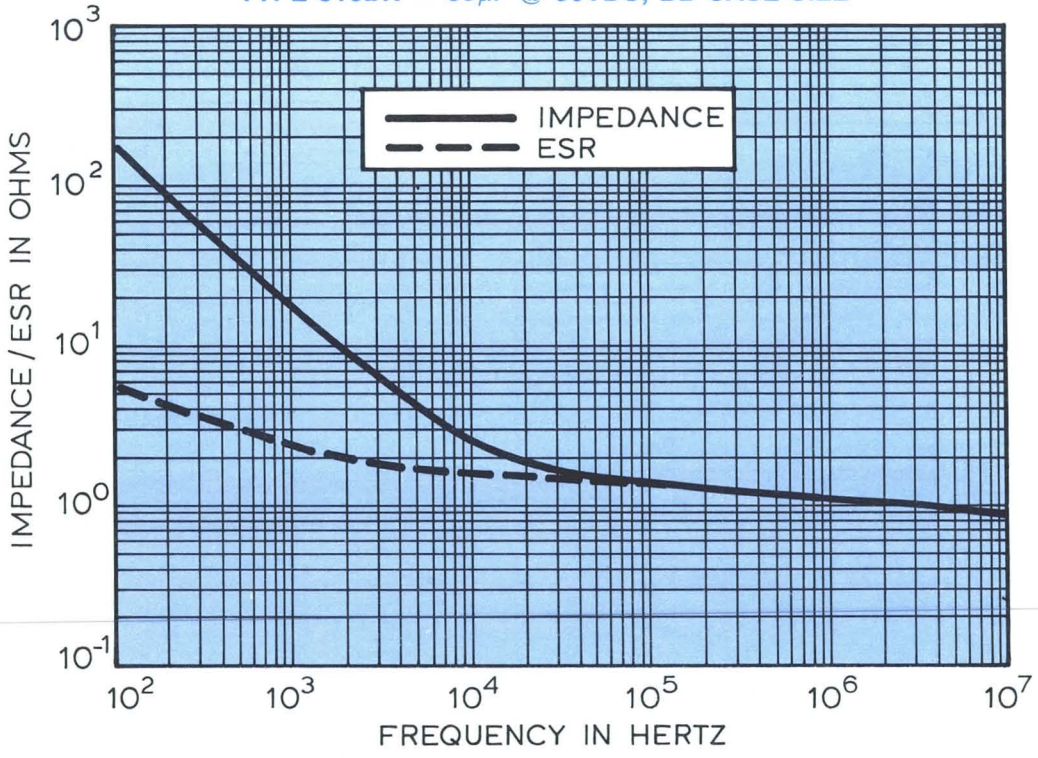
TYPICAL CURVES @ +25°C

TYPE 510DX — 47μF @ 35VDC, BB CASE SIZE



Dwg. No. A-14,744

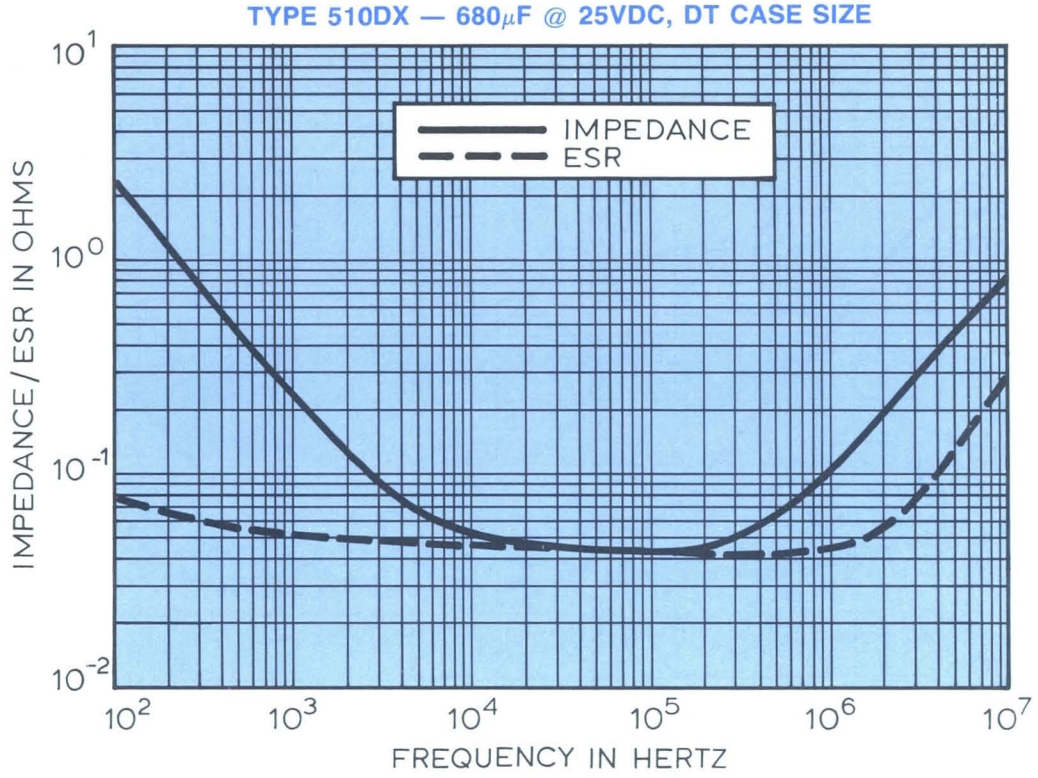
TYPE 510DX — 39μF @ 50VDC, BB CASE SIZE



Dwg. No. A-14,745

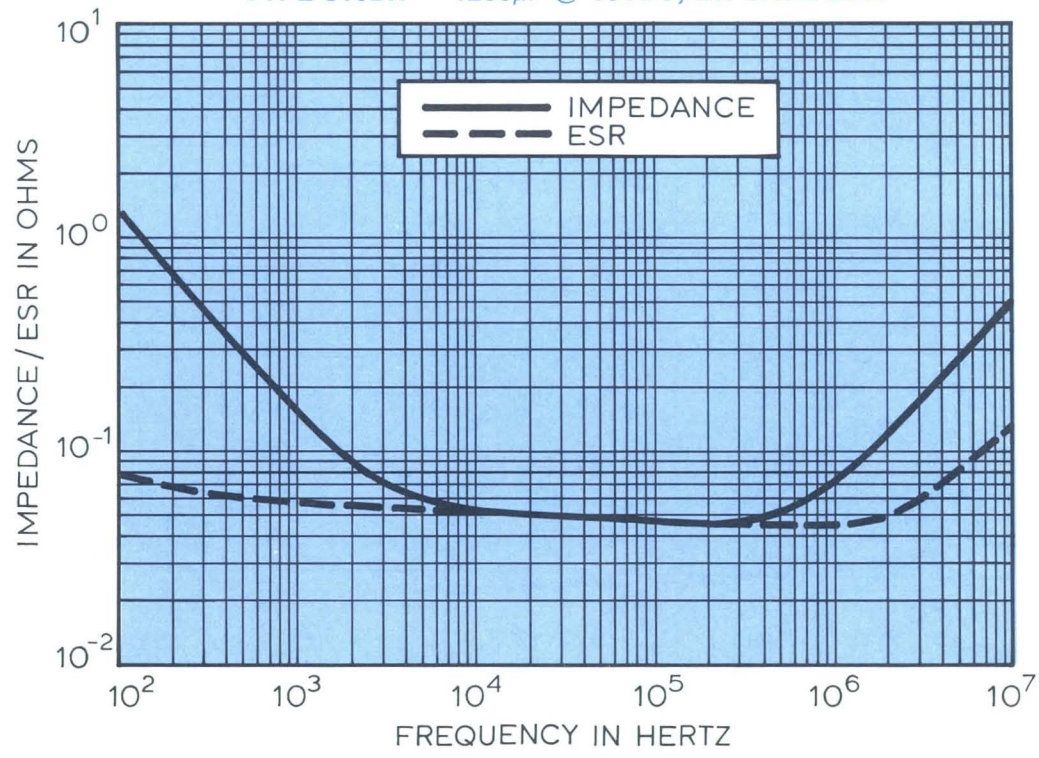
TYPICAL CURVES @ +25°C

TYPE 510DX — 680μF @ 25VDC, DT CASE SIZE



Dwg. No. A-14,742

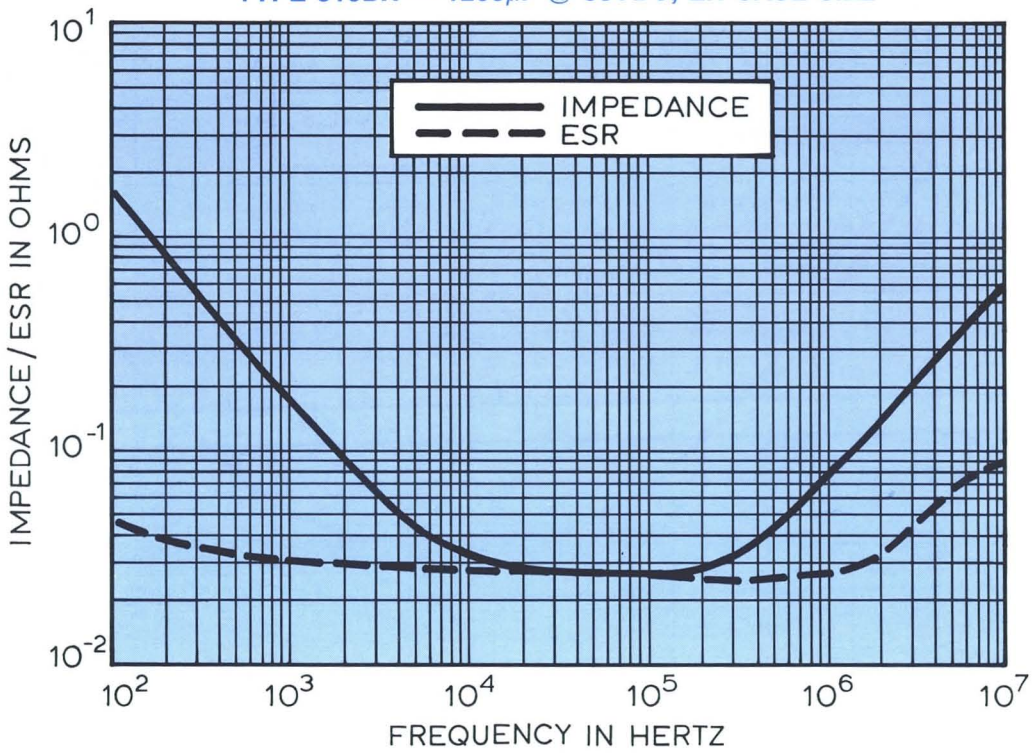
TYPE 510DX — 1200μF @ 10VDC, DK CASE SIZE



Dwg. No. A-14,740

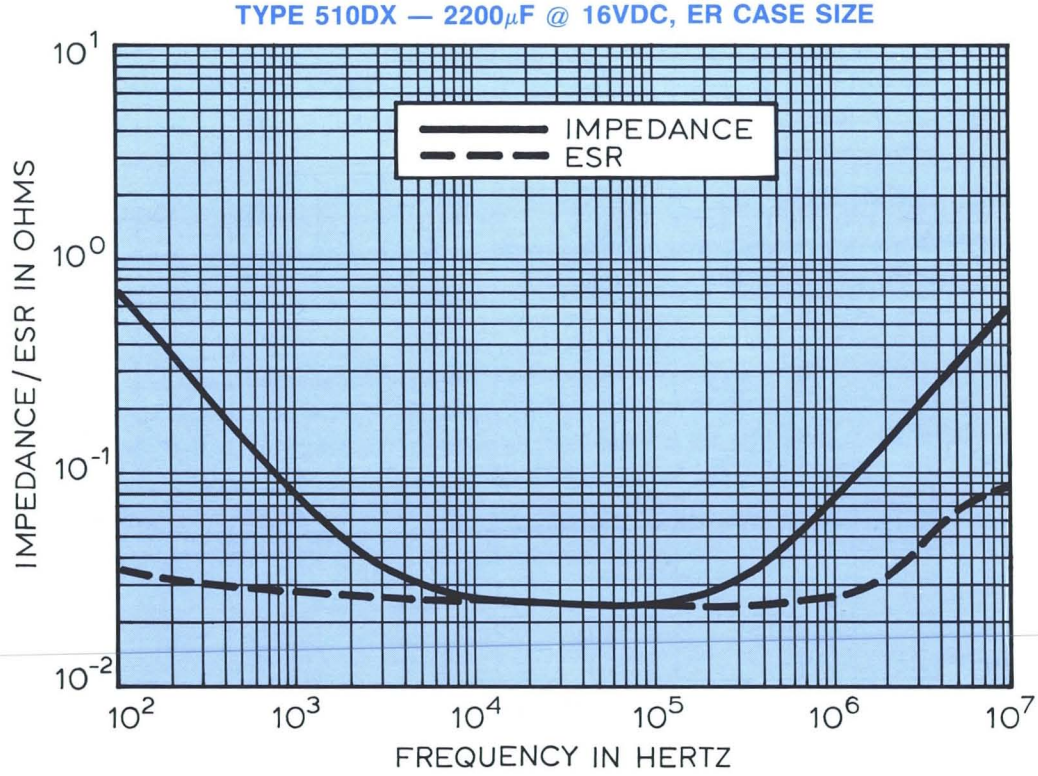
TYPICAL CURVES @ +25°C

TYPE 510DX — 1200μF @ 35VDC, EN CASE SIZE



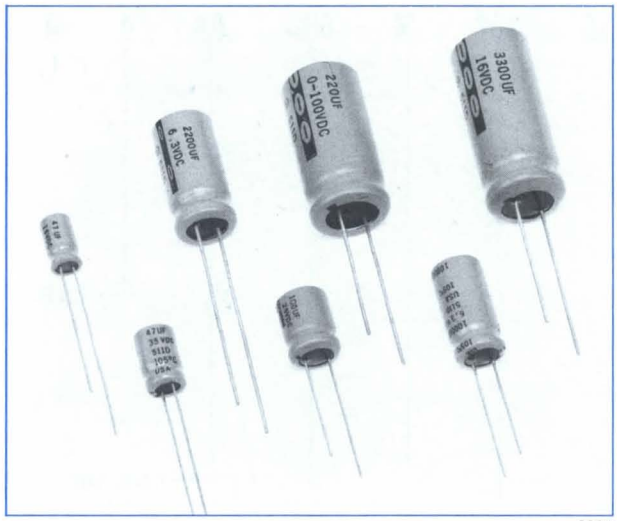
Dwg. No. A-14,743

TYPE 510DX — 2200μF @ 16VDC, ER CASE SIZE



Dwg. No. A-14,741

+105°C General Purpose Miniature Radial Lead, Aluminum Capacitors



9899

Features —

- +105°C Operation
- Suitable for Long Life Applications
- Improved CV
- New 18mm Diameter Case Size
- 3rd Lead Optional on Diameters ≥ 12.5mm

General Specifications —

Operating Temperature:
−40°C - +105°C.

Voltage Range: 6.3 - 250 VDC.

Capacitance Range: 1μF - 10,000μF.

Capacitance Tolerance: ±20%.

Case Size Range: 6 x 11mm - 18 x 36mm.

Termination: 2 or 3 radial leads.

Life Validation Test:
1000 hrs @ +105°C (dia. ≤ 8mm):
2000 hrs @ +105°C (dia. > 8mm):
Δ CAP ≤ 15% (6.3 - 16 VDC),
≤ 10% (25 - 250 VDC)
from initial measurement.
Δ ESR ≤ 1.2x initial specified limit.
Δ DCL ≤ initial specified limit.

Shelf Test: 500 hrs @ +105°C:
Δ CAP ≤ 10% initial measurement.
Δ ESR ≤ 1.2x initial specified limit.
Δ DCL ≤ 2x initial specified limit.

DC Leakage Current:

6.3 - 63 VDC	100-250 VDC
I = 0.005CV	I = 0.01 CV

I in μA, C in μF, V in Volts

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	Multipliers
+105°C	0.4
+95°C	0.7
+85°C	1.0
+75°C	1.2
≤+65°C	1.4

FREQUENCY Hz.

VDC	50-60	100-120	300-400	1K-100K
6.3-25	0.85	1.0	1.05	1.1
26-250	0.80	1.0	1.30	1.4

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

511D 157 M 6R3 AA 4 D

TERMINAL CODE. D = STRAIGHT LEADS (Standard).
E = LEAD FORM TO 5mm CENTERS.
J = 3 LEAD AXIAL MOUNT.
O = KEYED POLARITY 3 LEAD RADIAL MOUNT.
C = CUT LEADS.
V = SNAP IN FORMED LEADS.
I = TAPE AND REEL PACKAGING.

CASE STYLE. 2 = POLYESTER SLEEVE.
3 = PVC SLEEVE WITH RESIN SEAL.
(Required for exposure to halogenated cleaning solvents).
4 = PVC INSULATING SLEEVE (Standard).
5 = POLYESTER SLEEVE WITH RESIN END SEAL.
(Required for exposure to halogenated cleaning solvents).

CASE CODE. SEE DIMENSIONS.

DC VOLTAGE RATING. IN VOLTS. AN 'R' IS USED AS A DECIMAL POINT. FOR EXAMPLE: 6R3 = 6.3 VOLTS.

CAPACITANCE TOLERANCE. M = ±20%.

CAPACITANCE. EXPRESSED IN PICOFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

DIMENSIONS IN MILLIMETERS

CASE CODE	NOMINAL DIAMETER	NOMINAL LENGTH	STYLES 2 and 4 D Max.	STYLES 2 and 4 L Max.	STYLES 3 and 5 D Max.	STYLES 3 and 5 L Max.	LEAD SPACING S, ±.6	LEAD SPACING T, ±.5	LEAD DIAMETER NOM.	LEAD DIAMETER AWG NO.
AA	6	11	6.5	12.0	6.5	13.0	2.5	N/A	0.63	22
BB	8	12	8.5	13.0	8.5	14.0	3.5	N/A	0.63	22
CC	10	13	10.5	14.3	10.5	16.0	5.0	N/A	0.63	22
CD	10	16	10.5	17.0	10.5	18.8	5.0	N/A	0.63	22
CG	10	20	10.5	21.5	10.5	23.0	5.0	N/A	0.63	22
DG	12.5	20	13.0	21.5	13.0	23.0	5.0	2.5	0.81	20
DK	12.5	25	13.0	26.5	13.0	29.0	5.0	2.5	0.81	20
DM	12.5	26.5	13.0	28.0	13.0	29.5	5.0	2.5	0.81	20
DT	12.5	33.5	13.0	34.2	13.0	36.0	5.0	2.5	0.81	20
DS	12.5	42.5	13.0	43.7	13.0	45.5	5.0	2.5	0.81	20
EK	16	25	16.5	26.2	16.5	27.9	7.5	3.8	0.81	20
EN	16	32	16.5	33.5	16.5	36.0	7.5	3.8	0.81	20
ER	16	36	16.5	37.5	16.5	40.0	7.5	3.8	0.81	20
EU	16	40	16.5	41.7	16.5	42.4	7.5	3.8	0.81	20
FR	18	36	18.5	37.5	18.5	40.0	7.5	3.8	0.81	20

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C (Ω) 120Hz	Max. ESR @ +25°C (Ω) 20k-40kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40kHz	Max. Impedance @ +25°C (Ω) 100kHz
6.3 VOLTS DC WORKING; 8 VOLTS DC SURGE							
150	511D157M6R3AA4D	6 x 11	3.130	2.720	0.123	0.132	2.800
270	511D277M6R3BB4D	8 x 12	1.518	1.100	0.219	0.257	1.270
560	511D567M6R3CC4D	10 x 13	0.710	0.650	0.383	0.400	0.670
820	511D827M6R3CD4D	10 x 16	0.520	0.400	0.481	0.548	0.400
1200	511D128M6R3CG4D	10 x 20	0.420	0.270	0.590	0.741	0.286
1800	511D188M6R3DG4D	12.5 x 20	0.300	0.190	0.802	1.010	0.200
2700	511D278M6R3DK4D	12.5 x 25	0.204	0.128	1.020	1.280	0.136
4700	511D478M6R3EK4D	16 x 25	0.121	0.075	1.580	2.010	0.090
6800	511D688M6R3EN4D	16 x 32	0.089	0.060	2.040	2.480	0.066
8200	511D828M6R3ER4D	16 x 36	0.078	0.055	2.280	2.720	0.062
10000	511D109M6R3FR4D	18 x 36	0.068	0.050	2.640	3.070	0.061
10 VOLTS DC WORKING; 13 VOLTS DC SURGE							
100	511D107M010AA4D	6 x 11	4.073	2.800	0.108	0.131	2.900
220	511D227M010BB4D	8 x 12	1.855	1.150	0.198	0.252	1.300
390	511D397M010CC4D	10 x 13	1.012	0.625	0.321	0.408	0.650
680	511D687M010CD4D	10 x 16	0.596	0.430	0.449	0.529	0.435
1000	511D108M010CG4D	10 x 20	0.407	0.290	0.603	0.715	0.290
1200	511D128M010DG4D	12.5 x 20	0.371	0.206	0.721	0.968	0.206
1800	511D188M010DK4D	12.5 x 25	0.265	0.138	0.930	1.280	0.138
3300	511D338M010EK4D	16 x 25	0.166	0.086	1.350	1.880	0.094
4700	511D478M010EN4D	16 x 32	0.122	0.060	1.740	2.480	0.067
5600	511D568M010ER4D	16 x 36	0.104	0.056	1.970	2.690	0.063
8200	511D828M010FR4D	18 x 36	0.094	0.056	2.240	2.910	0.063
16 VOLTS DC WORKING; 20 VOLTS DC SURGE							
82	511D826M016AA4D	6 x 11	4.294	2.940	0.106	0.127	2.950
150	511D157M016BB4D	8 x 12	2.433	1.250	0.173	0.241	1.250
270	511D277M016CC4D	10 x 13	1.081	0.685	0.310	0.390	0.680
470	511D477M016CD4D	10 x 16	0.748	0.442	0.419	0.522	0.442
680	511D687M016CG4D	10 x 20	0.521	0.295	0.533	0.709	0.295
820	511D827M016DG4D	12.5 x 20	0.429	0.208	0.671	0.963	0.208
1500	511D158M016DK4D	12.5 x 25	0.243	0.140	0.971	1.270	0.140
2200	511D228M016EK4D	16 x 25	0.176	0.090	1.310	1.840	0.098
3300	511D338M016EN4D	16 x 32	0.147	0.062	1.580	2.440	0.067
3900	511D398M016ER4D	16 x 36	0.125	0.058	1.800	2.650	0.063
5600	511D568M016FR4D	18 x 36	0.100	0.055	2.170	2.930	0.059
20 VOLTS DC WORKING; 25 VOLTS DC SURGE							
56	511D566M020AA4D	6 x 11	5.630	2.800	0.092	0.13	2.900
120	511D127M020BB4D	8 x 12	2.650	1.350	0.166	0.232	1.350
220	511D227M020CC4D	10 x 13	1.472	0.950	0.266	0.331	0.900
330	511D337M020CD4D	10 x 16	0.981	0.550	0.350	0.468	0.500
470	511D477M020CG4D	10 x 20	0.679	0.300	0.467	0.703	0.305
680	511D687M020DG4D	12.5 x 20	0.473	0.200	0.639	0.982	0.200
820	511D827M020DK4D	12.5 x 25	0.389	0.140	0.767	1.27	0.140
1500	511D158M020EK4D	16 x 25	0.243	0.110	1.120	1.66	0.100
2200	511D228M020EN4D	16 x 32	0.163	0.080	1.510	2.15	0.080
2700	511D278M020ER4D	16 x 36	0.132	0.064	1.750	2.52	0.074
3300	511D338M020FR4D	18 x 36	0.128	0.060	1.920	2.81	0.064

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C (Ω) 120Hz	Max. ESR @ +25°C (Ω) 20k-40kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40kHz	Max. Impedance @ +25°C (Ω) 100kHz
25 VOLTS DC WORKING; 32 VOLTS DC SURGE							
47	511D476M025AA4D	6 x 11	6.120	2.940	0.089	0.127	2.950
100	511D107M025BB4D	8 x 12	2.914	1.350	0.158	0.232	1.350
180	511D187M025CC4D	10 x 13	1.590	0.950	0.256	0.331	0.900
270	511D277M025CD4D	10 x 16	1.086	0.550	0.333	0.468	0.500
390	511D397M025CG4D	10 x 20	0.724	0.300	0.452	0.703	0.305
560	511D567M025DG4D	12.5 x 20	0.508	0.208	0.616	0.963	0.205
820	511D827M025DK4D	12.5 x 25	0.351	0.140	0.808	1.270	0.140
1200	511D128M025EK4D	16 x 25	0.239	0.110	1.127	1.660	0.105
1800	511D188M025EN4D	16 x 32	0.194	0.080	1.380	2.150	0.080
2200	511D228M025ER4D	16 x 36	0.162	0.064	1.580	2.520	0.074
3300	511D338M025FR4D	18 x 36	0.150	0.060	1.770	2.810	0.064
35 VOLTS DC WORKING; 44 VOLTS DC SURGE							
33	511D336M035AA4D	6 x 11	6.777	3.600	0.084	0.115	3.500
68	511D686M035BB4D	8 x 12	3.260	1.400	0.149	0.228	1.400
120	511D127M035CC4D	10 x 13	1.830	1.010	0.239	0.323	0.980
220	511D227M035CD4D	10 x 16	1.016	0.460	0.344	0.512	0.470
330	511D337M035CG4D	10 x 20	0.677	0.305	0.468	0.697	0.310
390	511D397M035DG4D	12.5 x 20	0.554	0.210	0.590	0.959	0.220
680	511D687M035DK4D	12.5 x 25	0.326	0.150	0.838	1.236	0.157
1000	511D108M035EK4D	16 x 25	0.223	0.110	1.170	1.660	0.112
1500	511D158M035EN4D	16 x 32	0.165	0.078	1.490	2.180	0.078
1800	511D188M035ER4D	16 x 36	0.132	0.060	1.760	2.610	0.062
2200	511D228M035FR4D	18 x 36	0.121	0.060	1.980	2.810	0.062
40 VOLTS DC WORKING; 50 VOLTS DC SURGE							
27	511D276M040AA4D	6 x 11	7.227	3.610	0.082	0.115	3.501
56	511D566M040BB4D	8 x 12	3.382	1.401	0.147	0.228	1.401
100	511D107M040CC4D	10 x 13	1.939	1.010	0.232	0.323	0.981
180	511D187M040CD4D	10 x 16	1.060	0.461	0.337	0.512	0.471
220	511D227M040CG4D	10 x 20	0.883	0.305	0.411	0.698	0.311
330	511D337M040DG4D	12.5 x 20	0.588	0.210	0.573	0.959	0.221
470	511D477M040DK4D	12.5 x 25	0.407	0.151	0.719	1.190	0.157
680	511D687M040EK4D	16 x 25	0.283	0.111	1.040	1.660	0.112
1000	511D108M040EN4D	16 x 32	0.193	0.078	1.390	2.180	0.078
1200	511D128M040ER4D	16 x 36	0.159	0.061	1.610	2.610	0.062
1800	511D188M040FR4D	18 x 36	0.136	0.061	1.860	2.810	0.062
50 VOLTS DC WORKING; 63 VOLTS DC SURGE							
22	511D226M050AA4D	6 x 11	7.330	3.750	0.081	0.113	3.410
47	511D476M050BB4D	8 x 12	3.884	1.510	0.137	0.221	1.450
82	511D826M050CC4D	10 x 13	1.940	1.050	0.232	0.315	1.010
120	511D127M050CD4D	10 x 16	1.320	0.466	0.302	0.509	0.488
180	511D187M050CG4D	10 x 20	0.881	0.311	0.411	0.691	0.321
270	511D277M050DG4D	12.5 x 20	0.601	0.221	0.567	0.937	0.231
390	511D397M050DK4D	12.5 x 25	0.401	0.181	0.756	1.130	0.175
560	511D567M050EK4D	16 x 25	0.281	0.121	1.040	1.590	0.121
820	511D827M050EN4D	16 x 32	0.194	0.083	1.380	2.110	0.083
1000	511D108M050ER4D	16 x 36	0.161	0.065	1.590	2.510	0.068
1500	511D158M050FR4D	18 x 36	0.153	0.065	1.760	2.710	0.068

STANDARD RATINGS

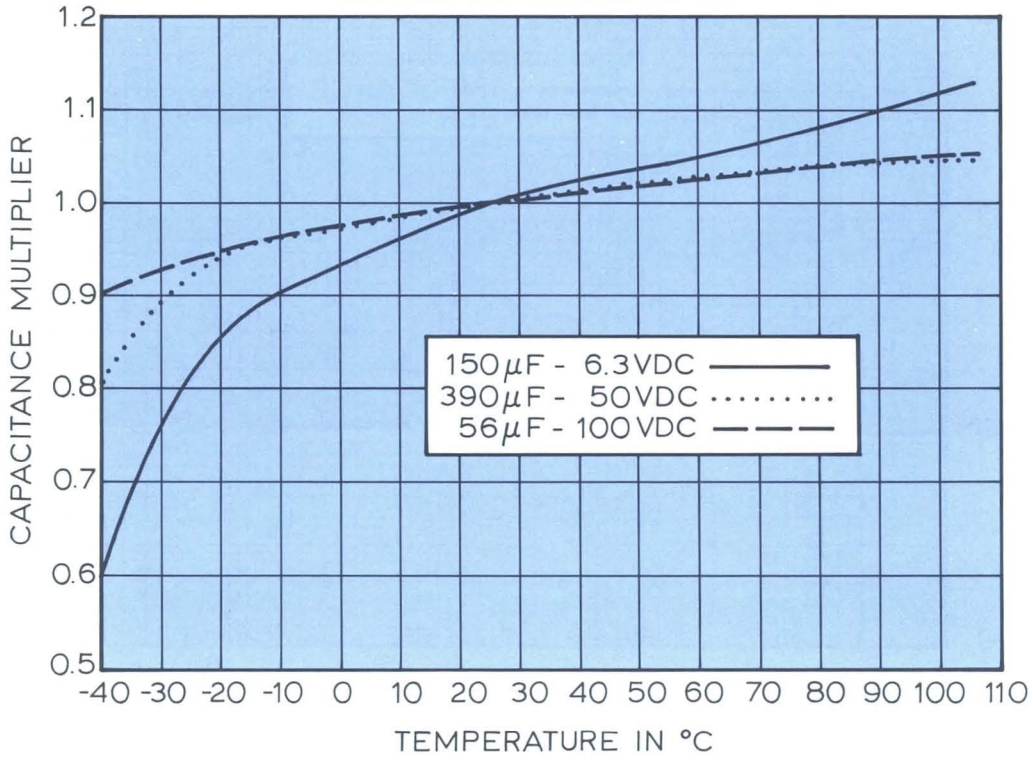
μF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C (Ω) 120Hz	Max. ESR @ +25°C (Ω) 20k-40kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40kHz	Max. Impedance @ +25°C (Ω) 100kHz
63 VOLTS DC WORKING; 79 VOLTS DC SURGE							
12	511D126M063AA4D	6 x 11	12.010	4.010	0.064	0.109	3.810
27	511D276M063BB4D	8 x 12	5.450	1.610	0.116	0.214	1.510
47	511D476M063CC4D	10 x 13	3.076	1.170	0.184	0.299	1.110
82	511D826M063CD4D	10 x 16	1.760	0.501	0.262	0.491	0.511
150	511D157M063CG4D	10 x 20	1.010	0.331	0.385	0.671	0.341
150	511D157M063DG4D	12.5 x 20	1.010	0.250	0.439	0.879	0.255
270	511D277M063DK4D	12.5 x 25	0.345	0.201	0.815	1.070	0.211
470	511D477M063EK4D	16 x 25	0.307	0.125	0.995	1.560	0.125
680	511D687M063EN4D	16 x 32	0.214	0.101	1.320	1.930	0.101
820	511D827M063ER4D	16 x 36	0.176	0.710	1.520	2.410	0.072
1200	511D128M063FR4D	18 x 36	0.165	0.065	1.690	2.710	0.068
75 VOLTS DC WORKING; 90 VOLTS DC SURGE							
8.2	511D825M075AA4D	6 x 11	12.640	4.210	0.053	0.107	4.110
18	511D186M075BB4D	8 x 12	6.010	1.710	0.096	0.208	1.650
33	511D336M075CC4D	10 x 13	4.440	1.210	0.153	0.295	1.210
56	511D566M075CD4D	10 x 16	2.550	0.521	0.217	0.481	0.521
100	511D107M075CG4D	10 x 20	1.460	0.341	0.318	0.661	0.341
150	511D157M075DG4D	12.5 x 20	1.010	0.261	0.439	0.862	0.261
220	511D227M075DK4D	12.5 x 25	0.666	0.211	0.589	1.050	0.211
270	511D277M075EK4D	16 x 25	0.545	0.131	0.747	1.530	0.131
470	511D477M075EN4D	16 x 32	0.307	0.105	1.110	1.880	0.105
560	511D567M075ER4D	16 x 36	0.255	0.075	1.260	2.330	0.078
820	511D827M075FR4D	18 x 36	0.241	0.068	1.410	2.640	0.072
100 VOLTS DC WORKING; 125 VOLTS DC SURGE							
4.7	511D475M100AA4D	6 x 11	30.79	4.310	0.041	0.106	4.21
10	511D106M100BB4D	8 x 12	14.63	1.810	0.071	0.202	1.71
18	511D186M100CC4D	10 x 13	8.01	1.250	0.114	0.289	1.25
33	511D336M100CD4D	10 x 16	4.44	0.531	0.165	0.477	0.531
56	511D566M100CG4D	10 x 20	2.55	0.351	0.241	0.651	0.351
56	511D566M100DG4D	12.5 x 20	2.55	0.265	0.276	0.854	0.265
120	511D127M100DK4D	12.5 x 25	1.21	0.215	0.437	1.03	0.215
180	511D187M100EK4D	16 x 25	0.801	0.134	0.616	1.51	0.134
270	511D277M100EN4D	16 x 32	0.545	0.108	0.824	1.85	0.108
330	511D337M100ER4D	16 x 36	0.444	0.076	0.958	2.32	0.078
470	511D477M100FR4D	18 x 36	0.361	0.071	1.15	2.61	0.074
160 VOLTS DC WORKING; 185 VOLTS DC SURGE							
1.8	511D185M160AA4D	6 x 11	88.01	27.010	0.023	0.042	26.010
3.9	511D395M160BB4D	8 x 12	40.01	12.250	0.043	0.077	12.010
6.8	511D685M160CC4D	10 x 13	23.57	7.310	0.067	0.119	7.310
10	511D106M160CD4D	10 x 16	16.09	4.910	0.086	0.157	4.910
15	511D156M160CG4D	10 x 20	11.01	3.610	0.116	0.203	3.610
22	511D226M160DG4D	12.5 x 20	7.33	3.210	0.162	0.245	3.210
33	511D336M160DK4D	12.5 x 25	4.88	2.250	0.216	0.319	2.250
56	511D566M160EK4D	16 x 25	2.81	1.210	0.329	0.501	1.210
68	511D686M160EN4D	16 x 32	2.35	0.721	0.396	0.717	0.721
100	511D107M160ER4D	16 x 36	1.61	0.531	0.504	0.876	0.531
120	511D127M160FR4D	18 x 36	1.32	0.471	0.598	1.01	0.481

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C (Ω) 120Hz	Max. ESR @ +25°C (Ω) 20k-40kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40kHz	Max. Impedance @ +25°C (Ω) 100kHz
200 VOLTS DC WORKING; 225 VOLTS DC SURGE							
1.5	511D155M200AA4D	6 x 11	110.010	33.110	0.021	0.038	33.010
3.3	511D335M200BB4D	8 x 12	48.810	14.010	0.039	0.072	13.900
5.6	511D565M200CC4D	10 x 13	28.080	8.410	0.061	0.111	8.410
8.2	511D825M200CD4D	10 x 16	19.410	4.910	0.078	0.156	4.910
12	511D126M200CG4D	10 x 20	13.210	3.610	0.106	0.203	3.610
22	511D226M200DG4D	12.5 x 20	7.330	3.210	0.162	0.245	3.210
33	511D336M200DK4D	12.5 x 25	4.880	2.250	0.216	0.319	2.250
47	511D476M200EK4D	16 x 25	3.384	1.210	0.299	0.501	1.210
68	511D686M200EN4D	16 x 32	2.350	0.721	0.396	0.717	0.721
82	511D826M200ER4D	16 x 36	1.940	0.531	0.458	0.876	0.531
120	511D127M200FR4D	18 x 36	1.420	0.481	0.577	0.991	0.491
250 VOLTS DC WORKING; 275 VOLTS DC SURGE							
1.2	511D125M250AA4D	6 x 11	132.010	34.910	0.019	0.037	34.010
2.7	511D275M250BB4D	8 x 12	60.010	15.910	0.035	0.067	15.010
3.9	511D395M250CC4D	10 x 13	40.010	10.610	0.051	0.099	10.010
6.8	511D685M250CD4D	10 x 16	23.570	5.010	0.071	0.155	5.010
10	511D106M250CG4D	10 x 20	16.090	3.760	0.096	0.198	3.760
12	511D126M250DG4D	12.5 x 20	13.200	3.220	0.121	0.245	3.220
18	511D186M250DK4D	12.5 x 25	8.810	2.250	0.161	0.319	2.250
33	511D336M250EK4D	16 x 25	4.880	1.270	0.249	0.489	1.270
47	511D476M250EN4D	16 x 32	3.380	0.721	0.331	0.717	0.721
56	511D566M250ER4D	16 x 36	2.080	0.531	0.381	0.867	0.531
82	511D826M250FR4D	18 x 36	1.940	0.491	0.493	0.983	0.501

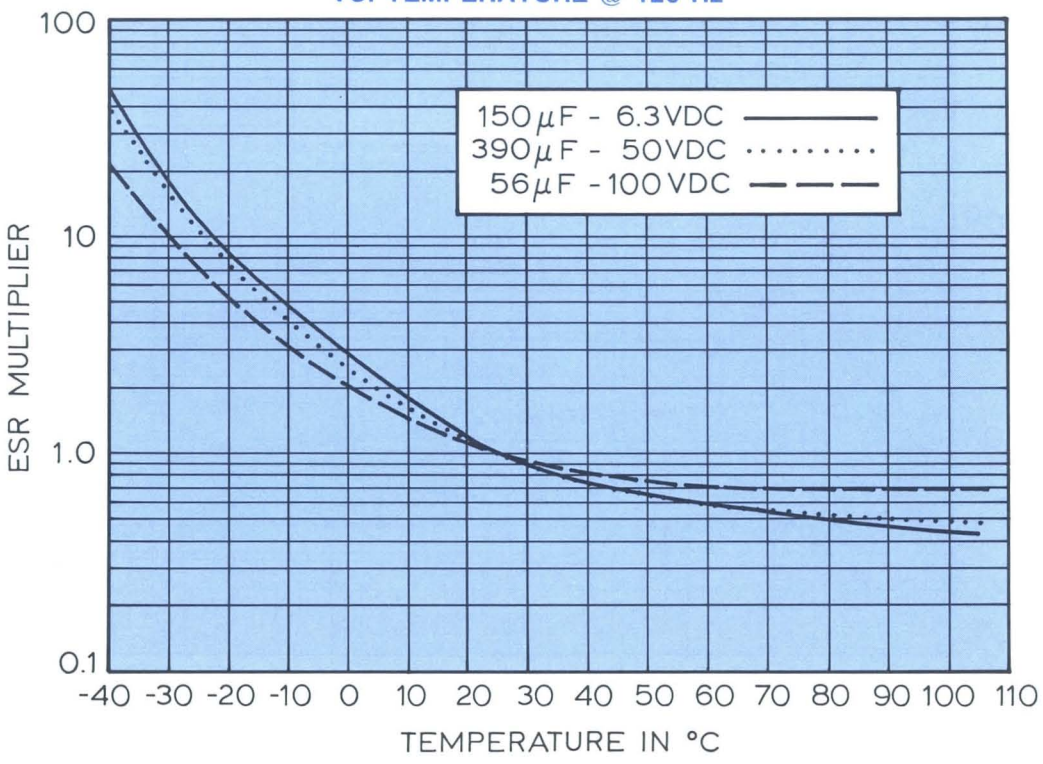
TYPICAL CURVES

TYPE 511D — TYPICAL CAPACITANCE MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,779

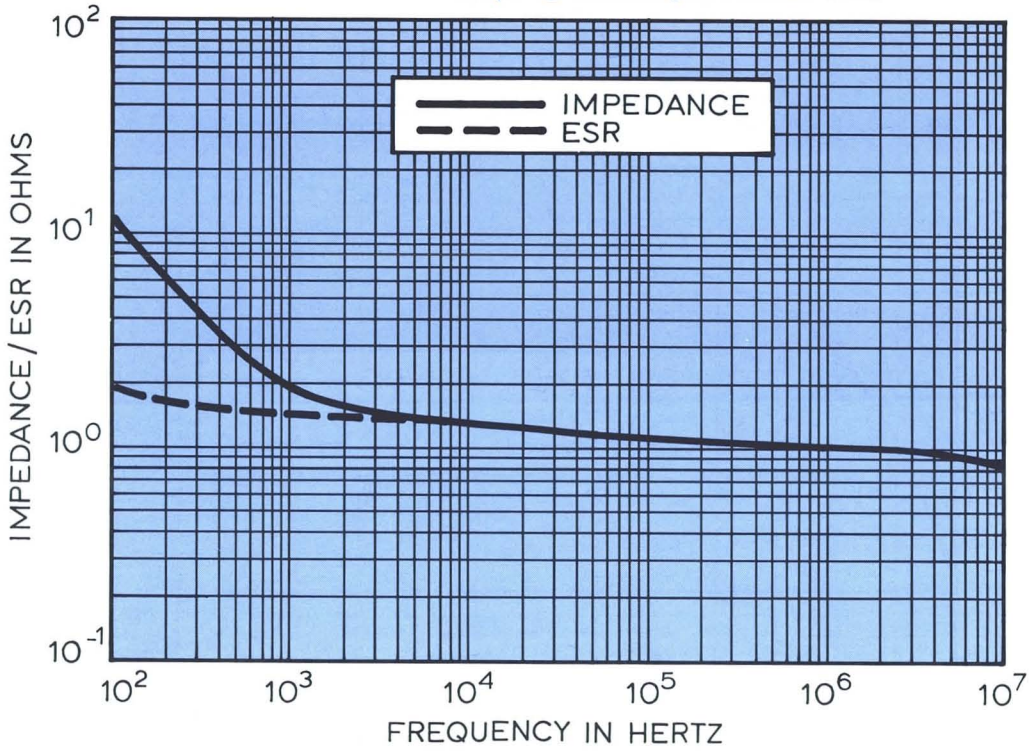
TYPE 511D — TYPICAL ESR MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,778

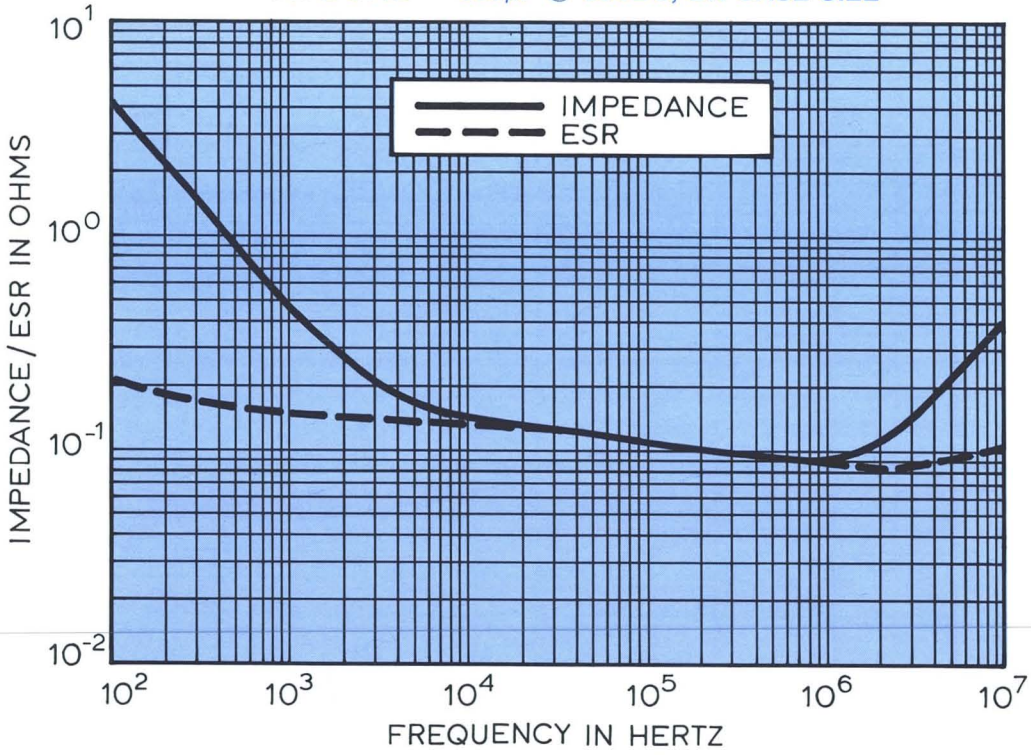
TYPICAL CURVES @ +25°C

TYPE 511D — 150μF @ 6.3VDC, AA CASE SIZE



Dwg. No. A-14,739

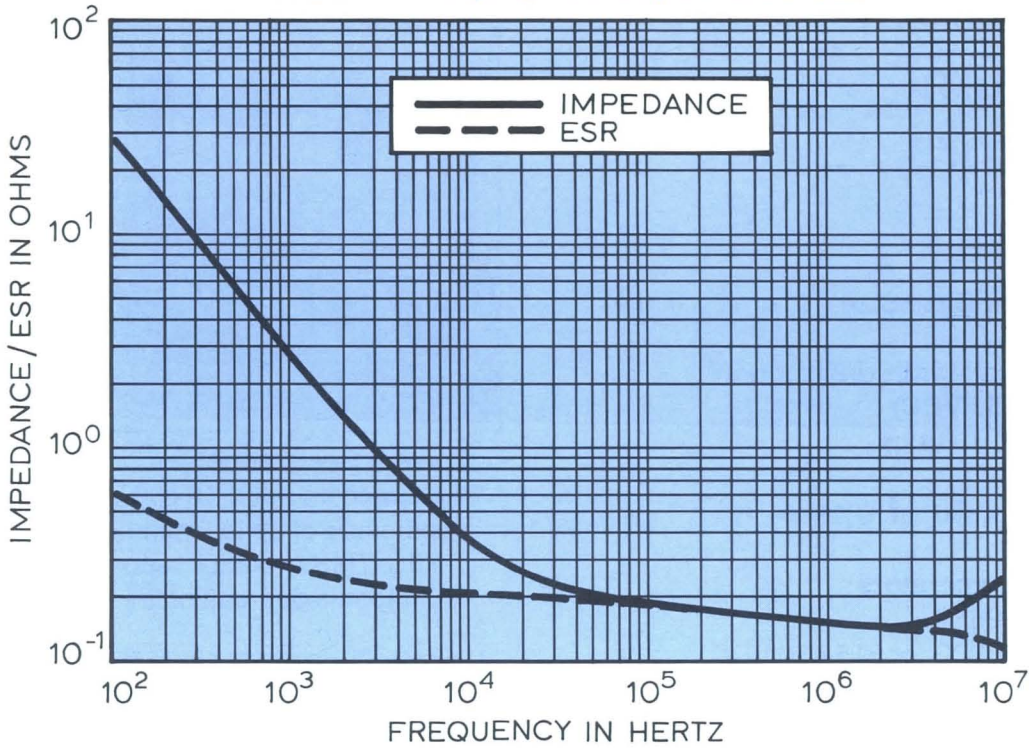
TYPE 511D — 390μF @ 50VDC, DK CASE SIZE



Dwg. No. A-14,737

TYPICAL CURVES @ +25°C

TYPE 511D — 56μF @ 100VDC, CG CASE SIZE



Dwg. No. A-14,738

Miniature Radial-Lead Aluminum Capacitors

Features —

- **High CV per Case Size**
- **Low Cost**
- **Solvent Resistant Construction (through 100 VDC)**
- **Low Profile Ratings**

General Specifications —

Operating Temperature:
– 40°C - + 85°C.
– 25°C - + 85°C for 315-450 VDC.

Voltage Range: 6.3 VDC - 450 VDC.

Capacitance Range: 0.1μF - 18,000μF.

Capacitance Tolerance: ± 20%.

Case Size Range: 4 x 7mm - 18 x 40mm.

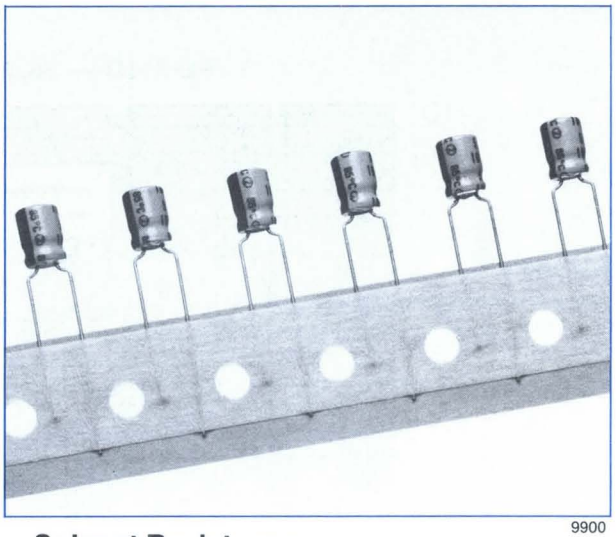
Termination: 2 radial leads.

Life Validation Test: 2000 hrs. @ +85°C:
Δ CAP ± 20% from initial measurement.
Δ DF 2x initial specified limit.
Δ DCL ≤ initial specified limit.

Shelf Test: 1000 hrs. @ +85°C:
Δ CAP ± 20% from initial measurement.
Δ DF 2x initial specified limit.
Δ DCL ≤ initial specified limit.

DC Leakage Current:

Rated voltage for 1 and 2 minutes for 6.3-100 VDC units
I < 0.03CV or 4μA (whichever is greater)
I < 0.01CV or 3μA (whichever is greater)
Rated voltage for 1 minute for 160-450 VDC units
I < 0.1CV +40μA and CV ≤1000
I < 0.04CV +100μA and CV >1000



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Solvent Resistance:
Capacitors rated 6.3-100 VDC will withstand exposure of up to 5 minutes in Freon TE, TES, TMS by either vapor immersion or ultrasonic degreasing.

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	Multipliers
≤+70°C	1.27
+85°C	1.0

FREQUENCY Hz

VDC	μF	50-60	100-120	300-400	1kHz	≥ 10kHz
6.3-100	0-47	0.75	1	1.35	1.57	2.00
	100-470	0.80	1	1.23	1.34	1.50
	1000-18,000	0.85	1	1.10	1.13	1.15
160-450	0.47-220	0.80	1	1.25	1.40	1.60

Low Temperature Performance:

Maximum Impedance Ratio
$Z^{(T)}/Z^{(+20°C)}$ max. @ 120Hz

Rated Voltage	Z–25°C/Z+20°C	Z–40°C/Z+20°C
6.3	4	10
10	3	8
16	2	6
25	2	4
35-100	2	3
160-200	3	4
250	3	6
315-400	6	—
450	15	—

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

515D 107 M 6R3 JA 6 A

- **SPRAGUE TYPE NUMBER.** THIS IDENTIFIES THE BASIC CAPACITOR DESIGN.
- **CAPACITANCE.** THIS IS EXPRESSED IN PICOFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES. THE THIRD IS THE NUMBER OF ZEROS.
- **CAPACITANCE TOLERANCE.** M ±20%
- **DC VOLTAGE RATING.** THIS IS EXPRESSED IN VOLTS. WHERE NECESSARY TO COMPLETE THE THREE DIGIT BLOCK, ZEROS PRECEDE THE VOLTAGE RATING THE LETTER "R" IS USED AS A DECIMAL POINT.
- **CASE CODE.** SEE DIMENSIONS.
- **PACKAGING CODE.** 6 = BULK PACKED
  7 = TAPE AND REEL
  8 = TAPE AND AMMO
- **LEAD CONFIGURATION.** A = UNCUT LEADS. FOR OTHER LEAD VARIATIONS SEE PAGE 25 FOR DETAILS AND CODING

DIMENSIONS IN MILLIMETERS

Case Code	Nominal Case Size (D x L)	Lead Spacing (S)	Nominal Lead Diameter (D)	Typical Weight (gm)
HW	4 x 7	1.5	0.45	0.20
JW	5 x 7	2.0	0.45	0.30
AW	6.3 x 7	2.5	0.45	0.40
JA	5 x 11	2.0	0.50	0.44
AA	6.3 x 11	2.5	0.50	0.60
BB	8 x 11.5	3.5	0.60	0.95
CC	10 x 12.5	5.0	0.60	1.48
CD	10 x 16	5.0	0.60	1.75
CG	10 x 20	5.0	0.60	2.37
DG	12.5 x 20	5.0	0.60	3.73
DK	12.5 x 25	5.0	0.60	4.85
EK	16 x 25	7.5	0.80	7.08
EN	16 x 31.5	7.5	0.80	8.94
ER	16 x 35.5	7.5	0.80	10.50
FR	18 x 35.5	7.5	0.80	12.53
FV	18 x 40	7.5	0.80	15.71

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. Ripple Current 120Hz, +85°C (mA)	Max. D.F. 120Hz, +20°C
6.3 VOLTS DC WORKING; 8 VOLTS DC SURGE				
22	515D226M6R3JA6A	5 x 11	34	0.24
33	515D336M6R3JA6A	5 x 11	42	0.24
47	515D476M6R3JA6A	5 x 11	50	0.24
100	515D107M6R3JA6A	5 x 11	77	0.24
220	515D227M6R3AA6A	6.3 x 11	215	0.24
330	515D337M6R3AA6A	6.3 x 11	265	0.24
470	515D477M6R3BB6A	8 x 11.5	360	0.24
1000	515D108M6R3CC6A	10 x 12.5	570	0.24
2200	515D228M6R3DG6A	12.5 x 20	1050	0.24
3300	515D338M6R3DG6A	12.5 x 20	1250	0.24
4700	515D478M6R3EK6A	16 x 25	1700	0.24
6800	515D688M6R3EK6A	16 x 25	1900	0.24
10000	515D109M6R3EN6A	16 x 31.5	2250	0.24
15000	515D159M6R3FR6A	18 x 35.5	2680	0.24
18000	515D189M6R3FV6A	18 x 40	2750	0.24
10 VOLTS DC WORKING; 13 VOLTS DC SURGE				
22	515D226M010JA6A	5 x 11	38	0.20
33	515D336M010JA6A	5 x 11	47	0.20
47	515D476M010JA6A	5 x 11	59	0.20
100	515D107M010JA6A	5 x 11	145	0.20
220	515D227M010AA6A	6.3 x 11	230	0.20
330	515D337M010BB6A	8 x 11.5	330	0.20
470	515D477M010BB6A	8 x 11.5	390	0.20
1000	515D108M010CD6A	10 x 16	630	0.20
2200	515D228M010DG6A	12.5 x 20	1100	0.20
3300	515D338M010DK6A	12.5 x 25	1400	0.20
4700	515D478M010EK6A	16 x 25	1800	0.20
6800	515D688M010EN6A	16 x 31.5	2150	0.20
10000	515D109M010FR6A	18 x 35.5	2500	0.20
15000	515D159M010FV6A	18 x 40	2720	0.20
16 VOLTS DC WORKING; 20 VOLTS DC SURGE				
10	515D106M016JA6A	5 x 11	28	0.16
22	515D226M016JA6A	5 x 11	44	0.16
33	515D336M016JA6A	5 x 11	57	0.16
47	515D476M016JA6A	5 x 11	168	0.16
100	515D107M016AA6A	6.3 x 11	175	0.16
220	515D227M016BB6A	8 x 11.5	300	0.16
330	515D337M016BB6A	8 x 11.5	360	0.16
470	515D477M016CC6A	10 x 12.5	470	0.16
1000	515D108M016CG6A	10 x 20	790	0.16
2200	515D228M016DK6A	12.5 x 25	1350	0.16
3300	515D338M016EK6A	16 x 25	1700	0.16
4700	515D478M016EN6A	16 x 31.5	2100	0.16
6800	515D688M016FR6A	18 x 35.5	2500	0.16
10000	515D109M016FV6A	18 x 40	2640	0.16

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size (mm) D x L	Max. Ripple Current 120Hz, +85°C (mA)	Max. D.F. 120Hz, +20°C
25 VOLTS DC WORKING; 32 VOLTS DC SURGE				
4.7	515D475M025JA6A	5 x 11	30	0.14
10	515D106M025JA6A	5 x 11	33	0.14
22	515D226M025JA6A	5 x 11	51	0.14
33	515D336M025JA6A	5 x 11	63	0.14
47	515D476M025JA6A	5 x 11	115	0.14
100	515D107M025AA6A	6.3 x 11	185	0.14
220	515D227M025BB6A	8 x 11.5	320	0.14
330	515D337M025CC6A	10 x 12.5	420	0.14
470	515D477M025CD6A	10 x 16	540	0.14
1000	515D108M025DG6A	12.5 x 20	950	0.14
2200	515D228M025EK6A	16 x 25	1550	0.14
3300	515D338M025EN6A	16 x 31.5	1950	0.14
4700	515D478M025FR6A	18 x 35.5	2360	0.14
35 VOLTS DC WORKING; 44 VOLTS DC SURGE				
4.7	515D475M035JA6A	5 x 11	24	0.12
10	515D106M035JA6A	5 x 11	36	0.12
22	515D226M035JA6A	5 x 11	57	0.12
33	515D336M035JA6A	5 x 11	105	0.12
47	515D476M035AA6A	6.3 x 11	140	0.12
100	515D107M035BB6A	8 x 11.5	230	0.12
220	515D227M035CC6A	10 x 12.5	370	0.12
330	515D337M035CD6A	10 x 16	490	0.12
470	515D477M035CG6A	10 x 20	640	0.12
1000	515D108M035DK6A	12.5 x 25	1100	0.12
2200	515D228M035EN6A	16 x 31.5	1850	0.12
3300	515D338M035FR6A	18 x 35.5	2220	0.12
4700	515D478M035FV6A	18 x 40	2490	0.12
50 VOLTS DC WORKING; 63 VOLTS DC SURGE				
0.1	515D104M050JA6A	5 x 11	1	0.10
0.22	515D224M050JA6A	5 x 11	2.3	0.10
0.33	515D334M050JA6A	5 x 11	3.5	0.10
0.47	515D474M050JA6A	5 x 11	5	0.10
1	515D105M050JA6A	5 x 11	10	0.10
2.2	515D225M050JA6A	5 x 11	19	0.10
3.3	515D335M050JA6A	5 x 11	24	0.10
4.7	515D475M050JA6A	5 x 11	29	0.10
10	515D106M050JA6A	5 x 11	44	0.10
22	515D226M050JA6A	5 x 11	95	0.10
33	515D336M050AA6A	6.3 x 11	125	0.10
47	515D476M050AA6A	6.3 x 11	150	0.10
100	515D107M050BB6A	8 x 11.5	250	0.10
220	515D227M050CD6A	10 x 16	440	0.10
330	515D337M050CG6A	10 x 20	580	0.10
470	515D477M050DG6A	12.5 x 20	760	0.10
1000	515D108M050EK6A	16 x 25	1350	0.10
2200	515D228M050FR6A	18 x 35.5	2090	0.10

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. Ripple Current 120Hz, +85°C (mA)	Max. D.F. 120Hz, +20°C
63 VOLTS DC WORKING; 79 VOLTS DC SURGE				
4.7	515D475M063JA6A	5 x 11	45	0.08
10	515D106M063JA6A	5 x 11	70	0.08
22	515D226M063AA6A	6.3 x 11	115	0.08
33	515D336M063AA6A	6.3 x 11	140	0.08
47	515D476M063BB6A	8 x 11.5	190	0.08
100	515D107M063CC6A	10 x 12.5	300	0.08
220	515D227M063CG6A	10 x 20	490	0.08
330	515D337M063DG6A	12.5 x 20	680	0.08
4700	515D477M063DK6A	12.5 x 25	880	0.08
1000	515D108M063EN6A	16 x 31.5	1550	0.08
2200	515D228M063FV6A	18 x 40	2200	0.08
100 VOLTS DC WORKING; 125 VOLTS DC SURGE				
0.1	515D104M100JA6A	5 x 11	2.1	0.08
0.22	515D224M100JA6A	5 x 11	4.7	0.08
0.33	515D334M100JA6A	5 x 11	7	0.08
0.47	515D474M100JA6A	5 x 11	10	0.08
1	515D105M100JA6A	5 x 11	21	0.08
2.2	515D225M100JA6A	5 x 11	30	0.08
3.3	515D335M100JA6A	5 x 11	40	0.08
4.7	515D475M100JA6A	5 x 11	45	0.08
10	515D106M100AA6A	6.3 x 11	75	0.08
22	515D226M100BB6A	8 x 11.5	130	0.08
33	515D336M100CC6A	10 x 12.5	170	0.08
47	515D476M100CD6A	10 x 16	230	0.08
100	515D107M100DG6A	12.5 x 20	400	0.08
220	515D227M100EK6A	16 x 25	710	0.08
330	515D337M100EK6A	16 x 25	860	0.08
470	515D477M100EN6A	16 x 31.5	1100	0.08
1000	515D108M100FV6A	18 x 40	1690	0.08
160 VOLTS DC WORKING; 200 VOLTS DC SURGE				
.47	515D474M160AA6A	6.3 x 11	12	0.20
1	515D105M160AA6A	6.3 x 11	17	0.20
2.2	515D225M160AA6A	6.3 x 11	26	0.20
3.3	515D335M160BB6A	8 x 11.5	35	0.20
4.7	515D475M160BB6A	8 x 11.5	40	0.20
10	515D106M160CC6A	10 x 12.5	65	0.20
22	515D226M160CG6A	10 x 20	110	0.20
33	515D336M160DG6A	12.5 x 20	150	0.20
47	515D476M160DK6A	12.5 x 25	180	0.20
100	515D107M160EK6A	16 x 25	300	0.20
220	515D227M160FR6A	18 x 35.5	510	0.20
200 VOLTS DC WORKING; 250 VOLTS DC SURGE				
.47	515D474M200AA6A	6.3 x 11	12	0.20
1	515D105M200AA6A	6.3 x 11	17	0.20
2.2	515D225M200AA6A	6.3 x 11	26	0.20
3.3	515D335M200BB6A	8 x 11.5	35	0.20
4.7	515D475M200CC6A	10 x 12.5	45	0.20
10	515D106M200CD6A	10 x 16	70	0.20
22	515D226M200CG6A	10 x 20	110	0.20
33	515D336M200DK6A	12.5 x 25	160	0.20

STANDARD RATINGS

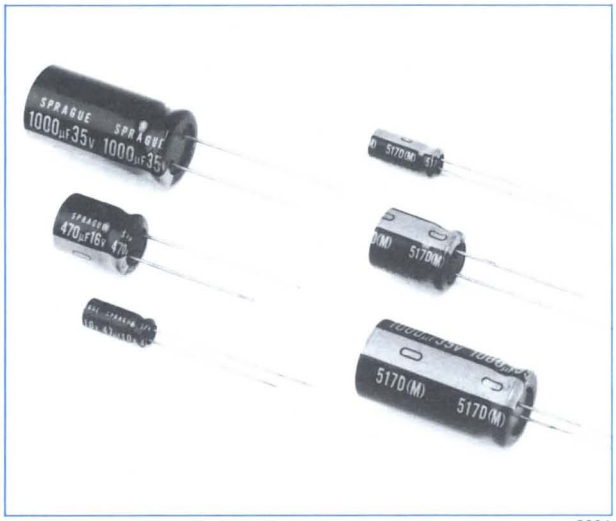
μF	Catalog Number	Nominal Case Size (mm) D x L	Max. Ripple Current 120Hz, +85°C (mA)	Max. D.F. 120Hz, +20°C
200 VOLTS DC WORKING; 250 VOLTS DC SURGE (Cont.)				
47	515D476M200DK6A	12.5 x 25	180	0.20
100	515D107M200EN6A	16 x 31.5	330	0.20
220	515D227M200FV6A	18 x 40	520	0.20
250 VOLTS DC WORKING; 300 VOLTS DC SURGE				
.47	515D474M250AA6A	6.3 x 11	12	0.20
1	515D105M250AA6A	6.3 x 11	17	0.20
2.2	515D225M250BB6A	8 x 11.5	30	0.20
3.3	515D335M250CC6A	10 x 12.5	35	0.20
4.7	515D475M250CC6A	10 x 12.5	45	0.20
10	515D106M250CG6A	10 x 20	70	0.20
22	515D226M250DK6A	12.5 x 25	130	0.20
33	515D336M250DK6A	12.5 x 25	160	0.20
47	515D476M250EK6A	16 x 31.5	210	0.20
100	515D107M250FR6A	18 x 40	340	0.20
315 VOLTS DC WORKING; 365 VOLTS DC SURGE				
1	515D105M315AA6A	6.3 x 11	17	0.20
2.2	515D225M315BB6A	8 x 11.5	30	0.20
3.3	515D335M315CC6A	10 x 12.5	35	0.20
4.7	515D475M315CD6A	10 x 16	45	0.20
10	515D106M315CG6A	10 x 20	70	0.20
22	515D226M315DK6A	12.5 x 25	120	0.20
33	515D336M315EK6A	16 x 31.5	150	0.20
47	515D476M315EN6A	16 x 31.5	190	0.20
100	515D107M315FV6A	18 x 40	340	0.20
350 VOLTS DC WORKING; 400 VOLTS DC SURGE				
1	515D105M350BB6A	8 x 11.5	18	0.25
2.2	515D225M350CC6A	10 x 12.5	28	0.25
3.3	515D335M350CD6A	10 x 16	35	0.25
4.7	515D475M350CD6A	10 x 16	40	0.25
10	515D106M350DG6A	12.5 x 20	70	0.25
22	515D226M350DK6A	12.5 x 25	110	0.25
33	515D336M350EN6A	16 x 31.5	140	0.25
47	515D476M350FR6A	18 x 35.5	220	0.25
400 VOLTS DC WORKING; 450 VOLTS DC SURGE				
1	515D105M400BB6A	8 x 11.5	18	0.25
2.2	515D225M400CC6A	10 x 12.5	28	0.25
3.3	515D335M400CD6A	10 x 16	35	0.25
4.7	515D475M400CD6A	10 x 20	45	0.25
10	515D106M400DG6A	12.5 x 20	70	0.25
22	515D226M400DK6A	16 x 25	110	0.25
33	515D336M400EN6A	16 x 31.5	140	0.25
47	515D476M400FR6A	18 x 35.5	220	0.25
450 VOLTS DC WORKING; 500 VOLTS DC SURGE				
1	515D105M400CC6A	10 x 12.5	19	0.25
2.2	515D225M400CD6A	10 x 16	29	0.25
3.3	515D335M400CG6A	10 x 20	35	0.25
4.7	515D475M400DG6A	12.5 x 20	50	0.25
10	515D106M400EK6A	12.5 x 25	75	0.25
22	515D226M400EN6A	16 x 31.5	110	0.25
33	515D336M400FR6A	18 x 35.5	170	0.25

LOW PROFILE RATINGS

µF	Catalog Number	Nominal Case Size (mm) D x L	Max. Ripple Current 120Hz, +85°C (mA)	Max. D.F. 120Hz, +20°C
6.3 VOLTS DC WORKING; 8 VOLTS DC SURGE				
22	515D226M6R3HW6A	4 x 7	34	0.24
33	515D336M6R3JW6A	5 x 7	42	0.24
47	515D476M6R3JW6A	5 x 7	50	0.24
100	515D107M6R3AW6A	6.3 x 7	77	0.24
10 VOLTS DC WORKING; 13 VOLTS DC SURGE				
22	515D226M010JW6A	5 x 7	38	0.20
33	515D336M010JW6A	5 x 7	47	0.20
47	515D476M010AW6A	6.3 x 7	59	0.20
16 VOLTS DC WORKING; 20 VOLTS DC SURGE				
10	515D106M016HW6A	4 x 7	28	0.16
22	515D226M016JW6A	5 x 7	44	0.16
33	515D336M016AW6A	6.3 x 7	57	0.16
47	515D476M016AW6A	6.3 x 7	68	0.16
25 VOLTS DC WORKING; 32 VOLTS DC SURGE				
10	515D106M025JW6A	5 x 7	33	0.14
22	515D226M025AW6A	6.3 x 7	51	0.14
33	515D336M025AW6A	6.3 x 7	63	0.14
35 VOLTS DC WORKING; 44 VOLTS DC SURGE				
4.7	515D475M035HW6A	4 x 7	24	0.12
10	515D106M035JW6A	5 x 7	36	0.12
22	515D226M035AW6A	6.3 x 7	57	0.12
50 VOLTS DC WORKING; 63 VOLTS DC SURGE				
0.1	515D104M050HW6A	4 x 7	1	0.10
0.22	515D224M050HW6A	4 x 7	2.3	0.10
0.33	515D334M050HW6A	4 x 7	3.5	0.10
0.47	515D474M050HW6A	4 x 7	5	0.10
1	515D105M050HW6A	4 x 7	10	0.10
2.2	515D225M050HW6A	4 x 7	19	0.10
3.3	515D335M050HW6A	4 x 7	24	0.10
4.7	515D475M050JW6A	5 x 7	29	0.10
10	515D106M050AW6A	6.3 x 7	44	0.10

Type 517D

+105°C, General Purpose Miniature Radial-Lead Aluminum Capacitors



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Features —

- **High CV per Case Size**
- **Low Cost**
- **Solvent Resistant Construction (through 100 VDC)**
- **High Temperature Operation**
- **Life Test to 2000 Hours @ +105°C**

General Specifications —

Operating Temperature:
– 55°C - +105°C (6.3 - 100 VDC);
– 40°C to +105°C (160-250 VDC).

Voltage Range: 6.3 VDC - 250 VDC.

Capacitance Range: 0.47µF - 15,000µF.

Capacitance Tolerance: ±20%.

Case Size Range: 5 x 11mm - 18 x 40mm.

Life Validation Test: 2000 hrs. @ +85°C:
Δ CAP ±20% from initial measurement.
Δ DF 2x initial specified limit.
Δ DCL ≤ initial specified limit.

Shelf Test: 1000 hrs. @ +105°C:
Δ CAP ±20% from initial measurement.
Δ DF 2x initial specified limit.
Δ DCL ≤ initial specified limit.

Performance Characteristics:
SEE PAGE 266.

DC Leakage Current:

Rated voltage for 1 minute for 6.3-100 VDC units
I < 0.03CV or 4µA (whichever is greater)
Rated voltage for 2 minutes for 6.3-100 VDC units
I < 0.01CV or 3µA (whichever is greater)
Rated voltage for 1 minute for 160-250 VDC units
I < 0.1CV +40µA and CV > 1000
I < 0.04CV +100µA and CV > 1000

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	Multipliers
+ 70°C	1.78
+ 85°C	1.4
+105°C	1.0

FREQUENCY Hz

VDC	CAP	50-60	100-120	300-400	1kHz	≥10kHz
6.3-100	0-47	0.75	1	1.35	1.57	2.0
	100-470	0.80	1	1.23	1.34	1.5
	1000-22,000	0.85	1	1.10	1.13	1.15
160-250	0.47-100	0.80	1	1.25	1.40	1.60

Low Temperature Performance:

Maximum Impedance Ratio ($Z^{(T)}/Z^{(+20°C)}$) Max. @ 120 Hz

Rated Voltage	Z–25°C/Z+20°C	Z–40°C/Z+20°C
6.3	4	8
10	3	6
16	2	4
25-100	2	3
160-200	2	4
250	4	6

Catalog Numbering System

517D 107 M 6R3 JA 6 A

LEAD CONFIGURATION. A = UNCUT LEADS. FOR OTHER LEAD VARIATIONS SEE PAGE 25 FOR DETAILS AND CODING

PACKAGING CODE. 6 = BULK PACKED
7 = TAPE AND REEL
8 = TAPE AND AMMO

CASE CODE. SEE DIMENSIONS.

DC VOLTAGE RATING. EXPRESSED IN VOLTS. THE LETTER "R" IS USED AS A DECIMAL POINT.

CAPACITANCE TOLERANCE. M ± 20%

CAPACITANCE. EXPRESSED IN PICOFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES. THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

DIMENSIONS IN MILLIMETERS

Case Code	Nominal Case Size (D x L)	Lead Spacing (S)	Nominal Lead Diameter (D)	Typical Weight (gm)
JA	5 x 11	2.0	0.50	0.44
AA	6.3 x 11	2.5	0.50	0.63
BB	8 x 11.5	3.5	0.60	1.03
CC	10 x 12.5	5.0	0.60	1.53
CD	10 x 16	5.0	0.60	1.86
CG	10 x 20	5.0	0.60	2.48
DG	12.5 x 20	5.0	0.60	3.98
DK	12.5 x 25	5.0	0.60	5.27
EK	16 x 25	7.5	0.80	7.72
EN	16 x 31.5	7.5	0.80	9.90
ER	16 x 35.5	7.5	0.80	11.10
FR	18 x 35.5	7.5	0.80	13.04
FV	18 x 40	7.5	0.80	15.74

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. Ripple Current 120Hz, +105°C (μA)	Max. D.F. 120Hz, +20°C
6.3 VOLTS DC WORKING; 8 VOLTS DC SURGE				
22	517D226M6R3JA6A	5 x 11	34	0.26
33	517D336M6R3JA6A	5 x 11	50	0.26
47	517D476M6R3JA6A	5 x 11	65	0.26
100	517D107M6R3JA6A	5 x 11	100	0.26
220	517D227M6R3AA6A	6.3 x 11	165	0.26
330	517D337M6R3AA6A	6.3 x 11	200	0.26
470	517D477M6R3BB6A	8 x 11.5	280	0.26
1000	517D108M6R3CC6A	10 x 12.5	470	0.26
2200	517D228M6R3DG6A	12.5 x 20	930	0.26
3300	517D338M6R3DG6A	12.5 x 20	1100	0.26
4700	517D478M6R3EK6A	16 x 25	1320	0.26
6800	517D688M6R3EK6A	16 x 25	1490	0.26
10000	517D109M6R3EN6A	16 x 31.5	1830	0.26
15000	517D159M6R3FR6A	18 x 35.5	2280	0.26
10 VOLTS DC WORKING; 13 VOLTS DC SURGE				
22	517D226M010JA6A	5 x 11	45	0.22
33	517D336M010JA6A	5 x 11	60	0.22
47	517D476M010JA6A	5 x 11	75	0.22
100	517D107M010JA6A	5 x 11	110	0.22
220	517D227M010AA6A	6.3 x 11	180	0.22
330	517D337M010BB6A	8 x 11.5	255	0.22
470	517D477M010BB6A	8 x 11.5	305	0.22
1000	517D108M010CD6A	10 x 16	570	0.22
2200	517D228M010DG6A	12.5 x 20	1010	0.22
3300	517D338M010DK6A	12.5 x 25	1220	0.22
4700	517D478M010EK6A	16 x 25	1410	0.22
6800	517D688M010EN6A	16 x 31.5	1610	0.22
10000	517D109M010FR6A	18 x 35.5	1980	0.22
15000	517D159M010FV6A	18 x 40	2470	0.22
16 VOLTS DC WORKING; 20 VOLTS DC SURGE				
10	517D106M016JA6A	5 x 11	35	0.18
22	517D226M016JA6A	5 x 11	55	0.18
33	517D336M016JA6A	5 x 11	70	0.18
47	517D476M016JA6A	5 x 11	85	0.18
100	517D107M016AA6A	6.3 x 11	135	0.18
220	517D227M016BB6A	8 x 11.5	235	0.18
330	517D337M016BB6A	8 x 11.5	285	0.18
470	517D477M016CC6A	10 x 12.5	395	0.18
1000	517D108M016CG6A	10 x 20	700	0.18
2200	517D228M016DK6A	12.5 x 25	1150	0.18
3300	517D338M016EK6A	16 x 25	1350	0.18
4700	517D478M016EN6A	16 x 31.5	1560	0.18
6800	517D688M016FR6A	18 x 35.5	1750	0.18
10000	517D109M016FV6A	18 x 40	2170	0.18

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. Ripple Current 120Hz, +105°C (μA)	Max. D.F. 120Hz, +20°C
25 VOLTS DC WORKING; 32 VOLTS DC SURGE				
4.7	517D475M025JA6A	5 x 11	24	0.16
10	517D106M025JA6A	5 x 11	39	0.16
22	517D226M025JA6A	5 x 11	60	0.16
33	517D336M025JA6A	5 x 11	75	0.16
47	517D476M025JA6A	5 x 11	90	0.16
100	517D107M025AA6A	6.3 x 11	145	0.16
220	517D227M025BB6A	8 x 11.5	250	0.16
330	517D337M025CC6A	10 x 12.5	355	0.16
470	517D477M025CD6A	10 x 16	470	0.16
1000	517D108M025DG6A	12.5 x 20	855	0.16
2200	517D228M025EK6A	16 x 25	1230	0.16
3300	517D338M025EN6A	16 x 31.5	1450	0.16
4700	517D478M025FR6A	18 x 35.5	1660	0.16
35 VOLTS DC WORKING; 44 VOLTS DC SURGE				
4.7	517D475M035JA6A	5 x 11	27	0.13
10	517D106M035JA6A	5 x 11	44	0.13
22	517D226M035JA6A	5 x 11	65	0.13
33	517D336M035JA6A	5 x 11	85	0.13
47	517D476M035AA6A	6.3 x 11	115	0.13
100	517D107M035BB6A	8 x 11.5	190	0.13
220	517D227M035CC6A	10 x 12.5	325	0.13
330	517D337M035CD6A	10 x 16	440	0.13
470	517D477M035CG6A	10 x 20	580	0.13
1000	517D108M035DK6A	12.5 x 25	995	0.13
2200	517D228M035EN6A	16 x 31.5	1450	0.13
3300	517D338M035FR6A	18 x 35.5	1660	0.13
4700	517D478M035FV6A	18 x 40	2030	0.13
50 VOLTS DC WORKING; 63 VOLTS DC SURGE				
0.47	517D474M050JA6A	5 x 11	7	0.10
1	517D105M050JA6A	5 x 11	12	0.10
2.2	517D225M050JA6A	5 x 11	18	0.10
3.3	517D335M050JA6A	5 x 11	25	0.10
4.7	517D475M050JA6A	5 x 11	30	0.10
10	517D106M050JA6A	5 x 11	50	0.10
22	517D226M050JA6A	5 x 11	75	0.10
33	517D336M050AA6A	6.3 x 11	105	0.10
47	517D476M050AA6A	6.3 x 11	125	0.10
100	517D107M050BB6A	8 x 11.5	210	0.10
220	517D227M050CD6A	10 x 16	400	0.10
330	517D337M050CG6A	10 x 20	535	0.10
470	517D477M050DG6A	12.5 x 20	730	0.10
1000	517D108M050EK6A	16 x 25	1110	0.10
2200	517D228M050FR6A	18 x 35.5	1530	0.10

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. Ripple Current 120Hz, +105°C (μA)	Max. D.F. 120Hz, +20°C
63 VOLTS DC WORKING; 79 VOLTS DC SURGE				
4.7	517D475M063JA6A	5 x 11	34	0.09
10	517D106M063JA6A	5 x 11	55	0.09
22	517D226M063AA6A	6.3 x 11	90	0.09
33	517D336M063AA6A	6.3 x 11	110	0.09
47	517D476M063BB6A	8 x 11.5	155	0.09
100	517D107M063CC6A	10 x 12.5	260	0.09
220	517D227M063CG6A	10 x 20	465	0.09
330	517D337M063DG6A	12.5 x 20	650	0.09
4700	517D477M063DK6A	12.5 x 25	800	0.09
1000	517D108M063EN6A	16 x 31.5	1200	0.09
2200	517D228M063FV6A	18 x 40	1840	0.09
100 VOLTS DC WORKING; 125 VOLTS DC SURGE				
0.47	517D474M100JA6A	5 x 11	10	0.08
1	517D105M100JA6A	5 x 11	15	0.08
2.2	517D225M100JA6A	5 x 11	22	0.08
3.3	517D335M100JA6A	5 x 11	29	0.08
4.7	517D475M100JA6A	5 x 11	37	0.08
10	517D106M100AA6A	6.3 x 11	65	0.08
22	517D226M100BB6A	8 x 11.5	115	0.08
33	517D336M100CC6A	10 x 12.5	160	0.08
47	517D476M100CD6A	10 x 16	220	0.08
100	517D107M100DG6A	12.5 x 20	385	0.08
220	517D227M100EK6A	16 x 25	590	0.08
330	517D337M100EK6A	16 x 25	720	0.08
470	517D477M100EN6A	16 x 31.5	875	0.08
1000	517D108M100FV6A	18 x 40	1320	0.08
160 VOLTS DC WORKING; 200 VOLTS DC SURGE				
0.47	517D474M160AA6A	6.3 x 11	12	0.15
1	517D105M160AA6A	6.3 x 11	17	0.15
2.2	517D225M160AA6A	6.3 x 11	25	0.15
3.3	517D335M160BB6A	8 x 11.5	36	0.15
4.7	517D475M160BB6A	8 x 11.5	43	0.15
10	517D106M160CC6A	10 x 12.5	70	0.15
22	517D226M160CG6A	10 x 20	130	0.15
33	517D336M160DG6A	12.5 x 20	180	0.15
47	517D476M160DK6A	12.5 x 25	220	0.15
100	517D107M160EK6A	16 x 25	330	0.15
220	517D227M160FR6A	18 x 35.5	500	0.15

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. Ripple Current 120Hz, +105°C (μA)	Max. D.F. 120Hz, +20°C
200 VOLTS DC WORKING; 250 VOLTS DC SURGE				
0.47	517D474M200AA6A	6.3 x 11	12	0.15
1	517D105M200AA6A	6.3 x 11	17	0.15
2.2	517D225M200AA6A	6.3 x 11	25	0.15
3.3	517D335M200BB6A	8 x 11.5	36	0.15
4.7	517D475M200CC6A	10 x 12.5	50	0.15
10	517D106M200CD6A	10 x 16	80	0.15
22	517D226M200CG6A	10 x 20	140	0.15
33	517D336M200DK6A	12.5 x 25	198	0.15
47	517D476M200DK6A	12.5 x 25	220	0.15
100	517D107M200EN6A	16 x 31.5	335	0.15
220	517D227M200FV6A	18 x 40	515	0.15
250 VOLTS DC WORKING; 300 VOLTS DC SURGE				
0.47	517D474M250AA6A	6.3 x 11	12	0.15
1	517D105M250AA6A	6.3 x 11	17	0.15
2.2	517D225M250BB6A	8 x 11.5	29	0.15
3.3	517D335M250CC6A	10 x 12.5	42	0.15
4.7	517D475M250CC6A	10 x 12.5	50	0.15
10	517D106M250CG6A	10 x 20	88	0.15
22	517D226M250DK6A	12.5 x 25	155	0.15
33	517D336M250DK6A	12.5 x 25	190	0.15
47	517D476M250EK6A	16 x 25	230	0.15
100	517D107M250FR6A	18 x 35.5	340	0.15

+105°C Miniature, Radial Lead, Aluminum Capacitors

9902

Features —

- **Original SMPS Output Capacitors**
- **Minimal ESR Change**
- **High Ripple Current Capability**
- **Optional 3rd Lead on Diameters ≥12.5mm**
- **Optional 3rd Lead for Axial Style Mounting**

General Specifications —

Operating Temperature:
−55°C - +105°C.

Voltage Range: 6.3 - 250 VDC.

Capacitance Range: 4.7μF - 3300μF.

Capacitance Tolerance: −10%, +50%.

Case Size Range: 10 x 12mm - 18 x 40mm.

Termination: 2 and 3 lead radial and axial mount.

Life Validation Test:
4000 hrs @ +105°C (>10mm dia.):
3000 hrs @ +105°C (10mm dia.)
Δ CAP ≤ 20% from individual measurements.
Δ ESR ≤ 1.15x initial specified limit.
Δ DCL ≤ initial specified limit.

Shelf Test: 500 hrs. @ +105°C:
Δ CAP ≤ 10% from initial measurement.
Δ ESR ≤ 1.15x initial specified limit.
Δ DCL ≤ 2x initial specified limit, (6.3-100 VDC);
≤ 3x initial specified limit (150-250 VDC).

DC Leakage Current:

6.3 - 100 VDC	150-250 VDC
$I = 0.03\sqrt{CV}$	$I = 0.01\ CV$

I in μA, C in μF, V in Volts

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	Multipliers
+105°C	0.5
+85°C	1.0
≤+75°C	1.25

FREQUENCY Hz.

VDC	50-60	100-120	300-400	1K-19K
0-75	0.60	0.70	0.75	0.80
76-100	0.45	0.55	0.70	0.80
101-250	0.25	0.35	0.45	0.65

Low Temperature Performance:
Capacitance Ratio $C_{-55°C}/C_{+25°C}$ min. @ 120Hz.

Max Capacitance Change	VOLTAGE	MULTIPLIER
	63-100V	0.75
	150-250V	0.70

Max Impedance Change	VOLTAGE	MULTIPLIER
	6.3-100V	2.5
	150-250V	2.0

ESL (Typical values @ 1MHz-10MHz):

Nominal Diameter (mm)	Typical ESL (nH)
10	4
13	7
16	10
18	12

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

672D 157 F 6R3 CD 4 D

LEAD CODE. D = STRAIGHT LEADS (Standard).
E = LEAD FORM TO 5mm CENTERS.
J = 3 LEAD AXIAL MOUNT.
O = KEYED POLARITY 3 LEAD RADIAL MOUNT.
Y = SNAP IN FORMED LEADS.
I = TAPE AND REEL PACKAGING.

CASE STYLE. 2 = POLYESTER SLEEVE.
3 = PVC SLEEVE WITH RESIN SEAL.
(Required for exposure to halogenated cleaning solvents).
4 = PVC INSULATING SLEEVE (Standard).
5 = POLYESTER SLEEVE WITH RESIN END SEAL.
(Required for exposure to halogenated cleaning solvents).

CASE CODE. SEE DIMENSIONS.

DC VOLTAGE RATING. EXPRESSED IN VOLTS. FOR RATINGS BELOW 10 VOLTS, THE LETTER "R" IS USED AS THE DECIMAL POINT, E.G. 6R3 = 6.3 VOLTS.

CAPACITANCE TOLERANCE. F = −10, +50%.

CAPACITANCE. EXPRESSED IN PICOFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

DIMENSIONS IN MILLIMETERS

CASE CODE	NOMINAL DIAMETER	NOMINAL LENGTH	STYLES 2 and 4 D Max.	STYLES 2 and 4 L Max.	STYLES 3 and 5 D Max.	STYLES 3 and 5 L Max.	LEAD SPACING S, ±.6	LEAD SPACING T, ±.5	LEAD DIAMETER NOM.	LEAD DIAMETER AWG NO.
CC	10	13	10.5	14.3	10.5	16.0	5.0	N/A	0.63	22
CD	10	16	10.5	17.0	10.5	18.8	5.0	N/A	0.63	22
CG	10	20	10.5	21.5	10.5	23.0	5.0	N/A	0.63	22
DG	12.5	20	13.0	21.5	13.0	23.0	5.0	2.5	0.81	20
DK	12.5	25	13.0	26.5	13.0	29.0	5.0	2.5	0.81	20
DM	12.5	26.5	13.0	28.0	13.0	29.5	5.0	2.5	0.81	20
DT	12.5	33.5	13.0	34.2	13.0	36.0	5.0	2.5	0.81	20
DS	12.5	42.5	13.0	43.7	13.0	45.5	5.0	2.5	0.81	20
EK	16	25	16.5	26.2	16.5	27.9	7.5	3.8	0.81	20
EN	16	32	16.5	33.5	16.5	36.0	7.5	3.8	0.81	20
ER	16	36	16.5	37.5	16.5	40.0	7.5	3.8	0.81	20
EU	16	40	16.5	41.7	16.5	42.4	7.5	3.8	0.81	20
FR	18	36	18.5	37.5	18.5	40.0	7.5	3.8	0.81	20
FV	18	40	18.5	42.0	18.5	43.0	7.5	3.8	0.81	20

STANDARD RATINGS

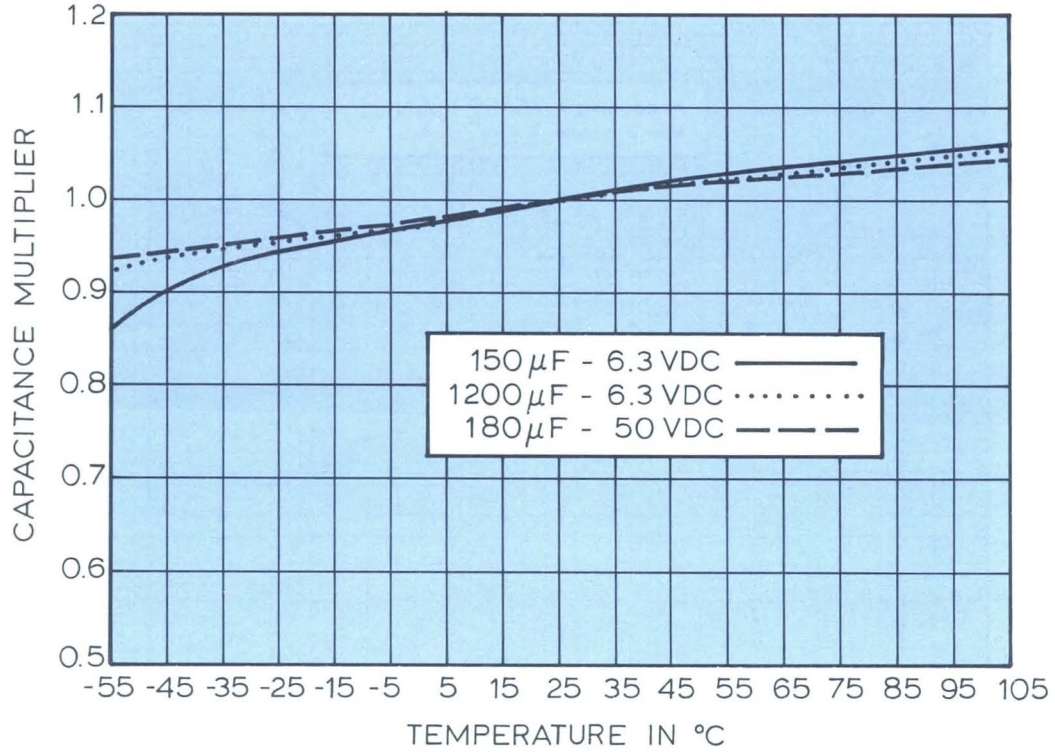
μF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C (Ω) 120Hz	20kHz	Max. Ripple Current @ 20kHz-100kHz and +85°C (A)	Max. Impedance @ 100kHz and +25°C (Ω)
6.3 VOLTS DC WORKING; 9 VOLTS DC SURGE						
150	672D157F6R3CD4D	10 x 16	1.10	0.70	0.50	0.60
220	672D227F6R3CG4D	10 x 20	0.75	0.40	0.70	0.33
680	672D687F6R3DM4D	12.5 x 26.5	0.23	0.15	1.45	0.12
1000	672D108F6R3EK4D	16 x 25	0.16	0.09	2.05	0.085
1200	672D128F6R3DS4D	12.5 x 42.5	0.135	0.07	2.45	0.06
1500	672D158F6R3ET4D	16 x 33.5	0.105	0.06	2.90	0.055
3300	672D338F6R3FV4D	18 x 40	0.075	0.045	3.40	0.045
7.5 VOLTS DC WORKING; 10 VOLTS DC SURGE						
100	672D107F7R5CC4D	10 x 13	1.65	0.85	0.40	0.70
150	672D157F7R5CD4D	10 x 16	1.10	0.70	0.50	0.60
680	672D687F7R5DT4D	12.5 x 33.5	0.23	0.12	1.75	0.10
1000	672D108F7R5ET4D	16 x 33.5	0.15	0.06	2.90	0.055
2700	672D278F7R5FV4D	18 x 40	0.075	0.045	3.35	0.05
12 VOLTS DC WORKING; 16 VOLTS DC SURGE						
100	672D107F012CC4D	10 x 13	1.60	0.90	0.40	0.70
150	672D157F012CG4D	10 x 20	1.10	0.40	0.70	0.33
470	672D477F012DM4D	12.5 x 26.5	0.31	0.16	1.35	0.12
680	672D687F012DT4D	12.5 x 33.5	0.22	0.12	1.75	0.10
1000	672D108F012DS4D	12.5 x 42.5	0.15	0.08	2.35	0.06
2200	672D228F012FV4D	18 x 40	0.08	0.05	3.30	0.05
15 VOLTS DC WORKING; 20 VOLTS DC SURGE						
100	672D107F015CD4D	10 x 16	1.35	0.70	0.50	0.50
150	672D157F015CG4D	10 x 20	0.90	0.40	0.70	0.35
470	672D477F015DT4D	12.5 x 33.5	0.25	0.12	1.75	0.11
680	672D687F015EK4D	16 x 25	0.18	0.09	2.00	0.09
820	672D827F015DS4D	12.5 x 42.5	0.15	0.08	2.30	0.06
1000	672D108F015ET4D	16 x 33.5	0.12	0.06	2.90	0.055
1800	672D188F015FV4D	18 x 40	0.08	0.05	3.30	0.05
20 VOLTS DC WORKING; 30 VOLTS DC SURGE						
68	672D686F020CD4D	10 x 16	1.85	0.70	0.50	0.60
100	672D107F020CG4D	10 x 20	1.25	0.40	0.70	0.35
330	672D337F020DM4D	12.5 x 26.5	0.35	0.16	1.35	0.14
470	672D477F020EK4D	16 x 25	0.24	0.09	2.00	0.085
560	672D567F020DS4D	12.5 x 42.5	0.21	0.08	2.35	0.06
680	672D687F020ET4D	16 x 33.5	0.17	0.06	2.90	0.055
1500	672D158F020FV4D	18 x 40	0.09	0.05	3.25	0.05
25 VOLTS DC WORKING; 35 VOLTS DC SURGE						
47	672D476F025CC4D	10 x 13	2.35	0.90	0.40	0.85
68	672D686F025CD4D	10 x 16	1.65	0.70	0.50	0.60
330	672D337F025DT4D	12.5 x 33.5	0.29	0.12	1.75	0.10
470	672D477F025DS4D	12.5 x 42.5	0.22	0.08	2.35	0.07
680	672D687F025EU4D	16 x 40	0.18	0.075	2.45	0.075
1200	672D128F025FV4D	18 x 40	0.10	0.05	3.20	0.055
40 VOLTS DC WORKING; 55 VOLTS DC SURGE						
47	672D476F040CD4D	10 x 13	2.30	1.10	0.35	0.85
220	672D227F040EK4D	16 x 25	0.48	0.14	1.65	0.12
330	672D337F040ET4D	16 x 33.5	0.32	0.12	2.25	0.08
390	672D397F040DS4D	12.5 x 42.5	0.27	0.15	1.90	0.10
820	672D827F040FV4D	18 x 40	0.16	0.075	2.60	0.08

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C (Ω) 120Hz	Max. ESR @ +25°C (Ω) 20kHz	Max. Ripple Current @ 20kHz-100kHz and +85°C (A)	Max. Impedance @ 100kHz and +25°C (Ω)
50 VOLTS DC WORKING; 75 VOLTS DC SURGE						
22	672D226F050CD4D	10 x 13	4.80	1.60	0.32	1.35
100	672D107F050DT4D	12.5 x 33.5	0.80	0.26	1.15	0.22
150	672D157F050EK4D	16 x 25	0.55	0.22	1.30	0.18
180	672D187F050DS4D	12.5 x 42.5	0.50	0.18	1.55	0.15
220	672D227F050ET4D	16 x 33.5	0.40	0.15	1.85	0.12
470	672D477F050FV4D	18 x 40	0.25	0.09	2.40	0.095
60 VOLTS DC WORKING; 85 VOLTS DC SURGE						
15	672D156F060CD4D	10 x 13	7.00	2.00	0.28	1.70
22	672D226F060CG4D	10 x 20	4.60	1.20	0.40	1.00
68	672D686F060DM4D	12.5 x 26.5	1.25	0.45	0.80	0.38
100	672D107F060EK4D	16 x 25	0.90	0.28	1.20	0.24
120	672D127F060DS4D	12.5 x 42.5	0.80	0.24	1.35	0.20
150	672D157F060ET4D	16 x 33.5	0.60	0.18	1.65	0.15
390	672D397F060FV4D	18 x 40	0.30	0.11	2.20	0.11
75 VOLTS DC WORKING; 100 VOLTS DC SURGE						
12	672D126F075CD4D	10 x 13	8.50	2.20	0.26	1.75
18	672D186F075CG4D	10 x 20	5.60	1.25	0.35	1.05
82	672D826F075EK4D	16 x 25	1.00	0.30	1.10	0.24
120	672D127F075ET4D	16 x 33.5	0.68	0.18	1.50	0.16
270	672D277F075FV4D	18 x 40	0.36	0.11	2.10	0.12
100 VOLTS DC WORKING; 125 VOLTS DC SURGE						
8.2	672D825F100CC4D	10 x 13	12.30	3.10	0.20	2.60
10	672D106F100CD4D	10 x 16	10.00	2.30	0.26	1.80
33	672D336F100DM4D	12.5 x 26.5	2.55	0.55	0.72	0.39
68	672D686F100EK4D	16 x 25	1.20	0.31	1.05	0.26
120	672D127F100ET4D	16 x 33.5	0.68	0.19	1.50	0.17
180	672D187F100FV4D	18 x 40	0.52	0.12	2.10	0.12
150 VOLTS DC WORKING; 200 VOLTS DC SURGE						
6.8	672D685F150CG4D	10 x 20	20.00	2.00	0.31	1.75
22	672D226F150DT4D	12.5 x 33.5	6.20	0.60	0.75	0.52
39	672D396F150ET4D	16 x 33.5	3.50	0.35	1.15	0.28
68	672D686F150FV4D	18 x 40	2.00	0.19	1.80	0.16
200 VOLTS DC WORKING; 250 VOLTS DC SURGE						
4.7	672D475F200CG4D	10 x 20	22.50	1.95	0.31	1.75
15	672D156F200DT4D	12.5 x 33.5	7.00	0.58	0.76	0.55
27	672D276F200ET4D	16 x 33.5	3.90	0.34	1.16	0.30
47	672D476F200FV4D	18 x 40	2.30	0.18	1.90	0.165
250 VOLTS DC WORKING; 300 VOLTS DC SURGE						
8.2	672D825F250DM4D	12.5 x 26.5	15.00	1.90	0.38	2.00
10	672D106F250DT4D	12.5 x 33.5	12.00	1.50	0.48	1.60
22	672D226F250ET4D	16 x 33.5	5.50	0.72	0.80	0.73
39	672D396F250FV4D	18 x 40	3.10	0.36	1.30	0.36

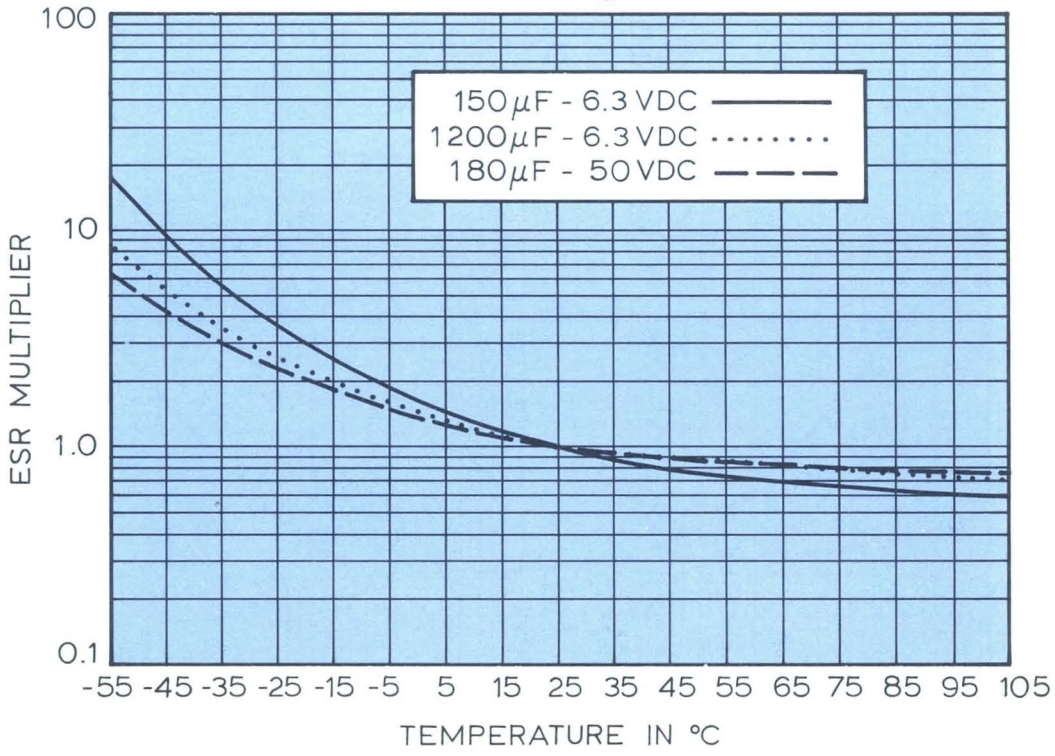
TYPICAL CURVES

TYPE 672D — TYPICAL CAPACITANCE MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,772

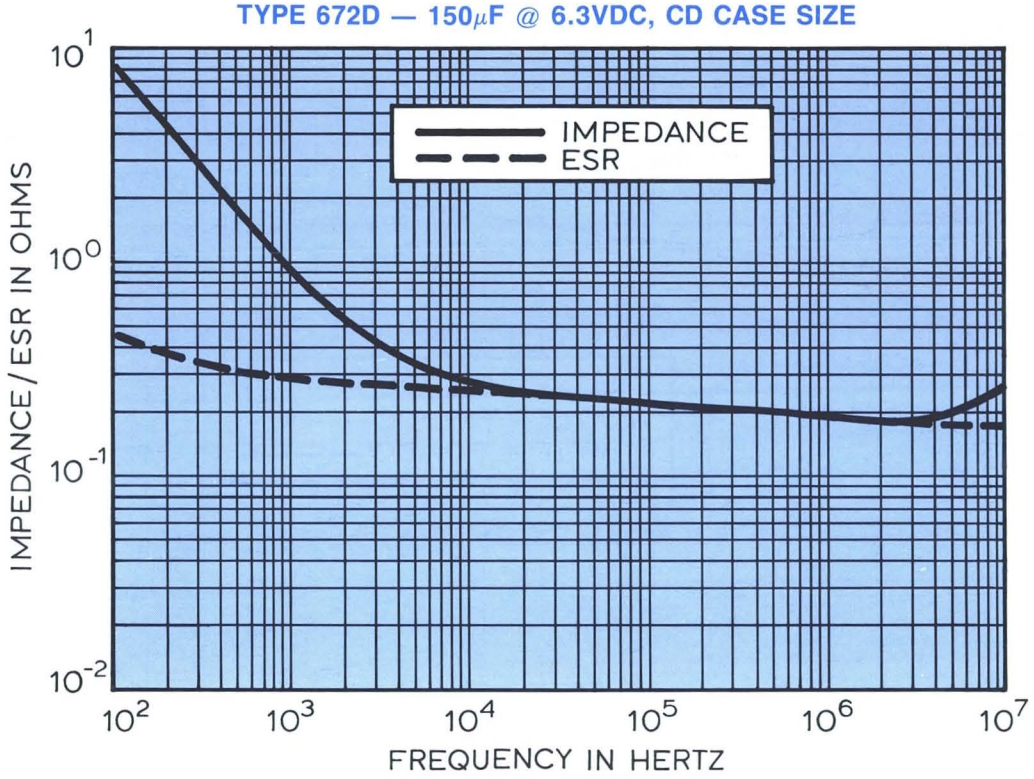
TYPE 672D — TYPICAL ESR MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,771

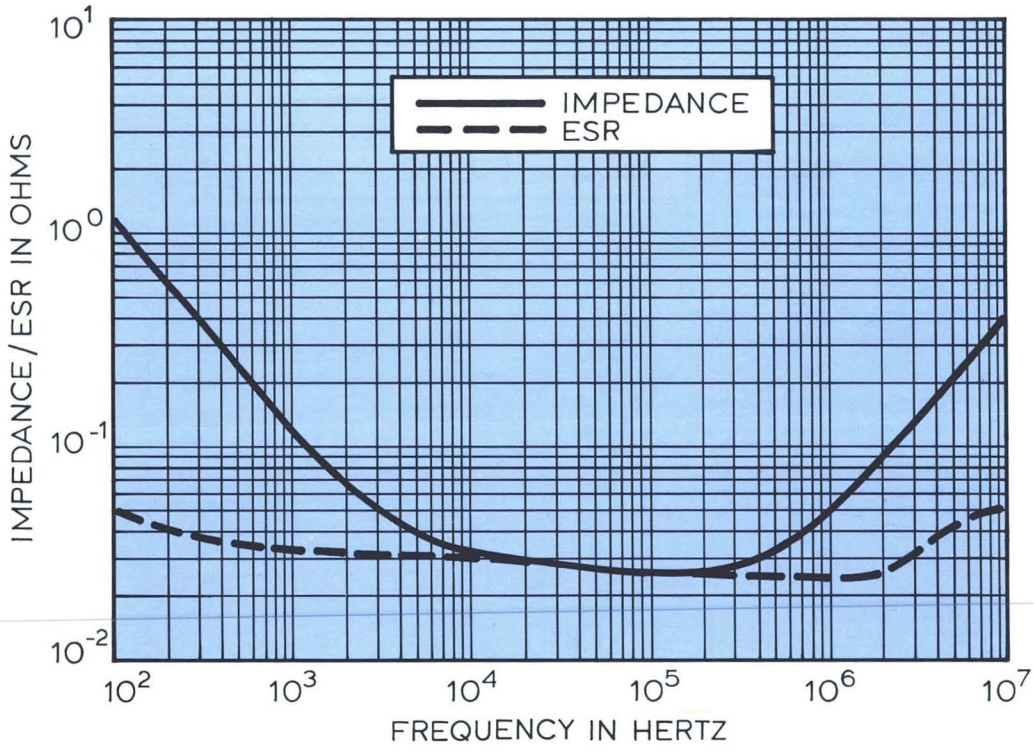
TYPICAL CURVES @ +25°C

TYPE 672D — 150μF @ 6.3VDC, CD CASE SIZE



Dwg. No. A-14,736

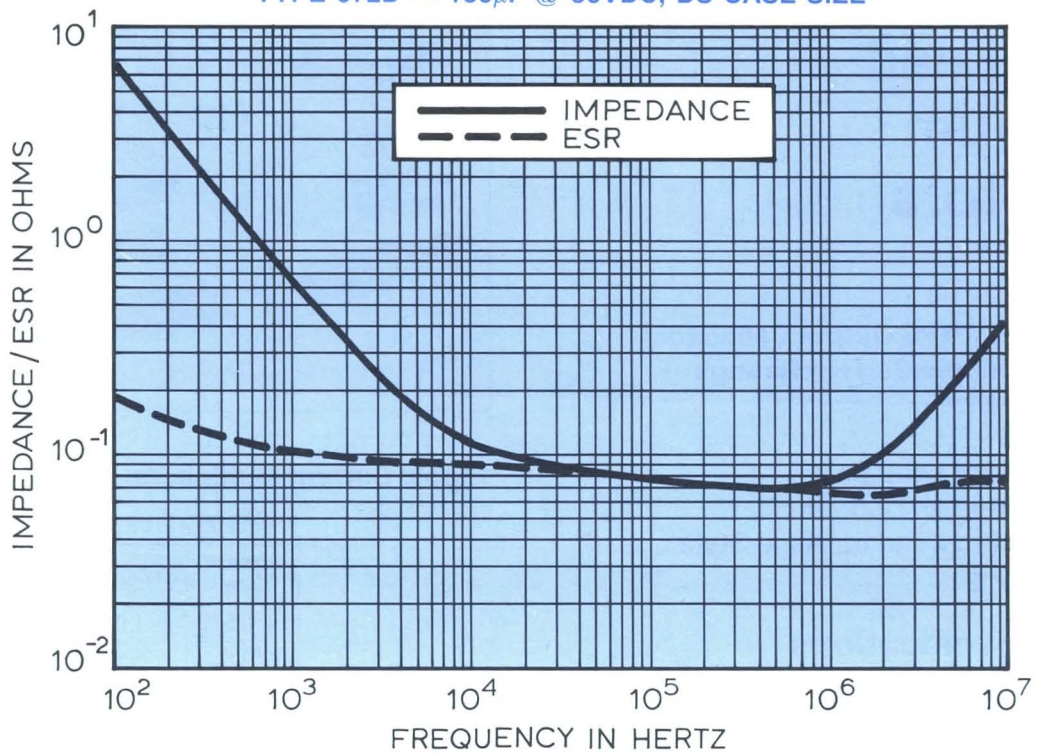
TYPE 672D — 1200μF @ 6.3VDC, DS CASE SIZE



Dwg. No. A-14,734

TYPICAL CURVES @ +25°C

TYPE 672D — 180μF @ 50VDC, DS CASE SIZE



Dwg. No. A-14,735

+105°C Miniature, Radial Lead Aluminum Capacitors

Features —

- Improved SMPS Output Capacitors
- Highest Ripple Current Ratings per Case Size
- High CV
- Optional 3rd Lead on Diameters ≥ 12.5mm
- Optional 3rd Lead for Axial Style Mounting

General Specifications —

Operating Temperature:
−55°C - +105°C.

Voltage Range: 6.3 - 63 VDC.

Capacitance Range: 33μF - 6800μF.

Capacitance Tolerance: ±20%.

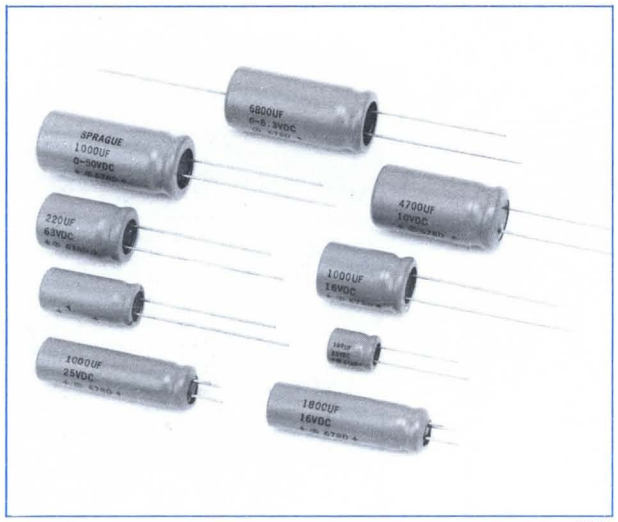
Case Size Range: 10 x 12mm - 18 x 40mm.

Termination: 2 and 3 lead radial and axial mount.

Life Validation Test:
4000 hrs @ +105°C (≥13mm dia.):
3000 hrs @ +105°C (10mm dia.):
- Δ CAP ≤ 20% (6.3-25 VDC), ≤15% (40-63 VDC) from initial measurement.
- Δ ESR ≤ 1.3x initial specified limit.
- Δ DCL ≤ 2x initial specified limit.

Shelf Test: 1000 hrs. @ +105°C:
- Δ CAP ≤ 20% (6.3-25 VDC), ≤15% (40-63 VDC) from initial measurement.
- Δ ESR ≤ 1.3x initial specified limit.
- Δ DCL ≤ 2x initial specified limit.

DC Leakage Current:
I = 0.01 CV, 2 minutes charge time.
I = 0.03 CV, 1 minute charge time.
I in μA, C in μF, V in Volts



9903

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	Multipliers
+105°C	1.0
+85°C	2.2
+75°C	2.7
≤+65°C	3.0

FREQUENCY Hz.

VDC	50-60	100-120	300-400	1K-19K	20K-200K
6.3-63	0.6	0.70	0.75	0.82	1.0

Low Temperature Performance:
Capacitance Ratio $C^{-55°C}/C^{+25°C}$ min. @ 120Hz.

	VOLTAGE	MULTIPLIER
Max Capacitance Change	63-16V	0.75
	25-63V	0.85

	VOLTAGE	MULTIPLIER
Max Impedance Change	6.3-16V	2.0
	25-63V	1.5

ESL (Typical values @ 1MHz-10MHz):

Nominal Diameter (mm)	Typical ESL (nH)
10	4
13	7
16	10
18	12

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

678D 108 M 010 DM 4 D

TERMINAL CODE. D = STRAIGHT LEADS (Standard).
E = LEAD FORM TO 5mm CENTERS.
J = 3 LEAD AXIAL MOUNT.
O = KEYED POLARITY 3 LEAD RADIAL MOUNT.
V = SNAP IN FORMED LEADS.
I = TAPE AND REEL PACKAGING.

CASE STYLE. 2 = POLYESTER SLEEVE.
3 = PVC SLEEVE WITH RESIN SEAL.
(Required for exposure to halogenated cleaning solvents).
4 = PVC INSULATING SLEEVE (Standard).
5 = POLYESTER SLEEVE WITH RESIN END SEAL.
(Required for exposure to halogenated cleaning solvents).

CASE CODE. SEE DIMENSIONS.

DC VOLTAGE RATING. IN VOLTS. 'R' INDICATES A DECIMAL POINT. FOR EXAMPLE, 6R3 = 6.3 VOLTS.

CAPACITANCE TOLERANCE. M = ±20% (Standard)
F = −10%, +50% (Special Order)

CAPACITANCE. EXPRESSED IN PICOFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

DIMENSIONS IN MILLIMETERS

CASE CODE	NOMINAL DIAMETER	NOMINAL LENGTH	STYLES 2 and 4 D Max.	STYLES 2 and 4 L Max.	STYLES 3 and 5 D Max.	STYLES 3 and 5 L Max.	LEAD SPACING S, ±.6	LEAD SPACING T, ±.5	LEAD DIAMETER NOM.	LEAD DIAMETER AWG NO.
CC	10	13	10.5	14.3	10.5	16.0	5.0	N/A	0.63	22
CD	10	16	10.5	17.0	10.5	18.8	5.0	N/A	0.63	22
CG	10	20	10.5	21.5	10.5	23.0	5.0	N/A	0.63	22
DG	12.5	20	13.0	21.5	13.0	23.0	5.0	2.5	0.81	20
DK	12.5	25	13.0	26.5	13.0	29.0	5.0	2.5	0.81	20
DM	12.5	26.5	13.0	28.0	13.0	29.5	5.0	2.5	0.81	20
DT	12.5	33.5	13.0	34.2	13.0	36.0	5.0	2.5	0.81	20
DS	12.5	42.5	13.0	43.7	13.0	45.5	5.0	2.5	0.81	20
EK	16	25	16.5	26.2	16.5	27.9	7.5	3.8	0.81	20
EN	16	32	16.5	33.5	16.5	36.0	7.5	3.8	0.81	20
ER	16	36	16.5	37.5	16.5	40.0	7.5	3.8	0.81	20
EU	16	40	16.5	41.7	16.5	42.4	7.5	3.8	0.81	20
FR	18	36	18.5	37.5	18.5	40.0	7.5	3.8	0.81	20
FV	18	40	18.5	42.0	18.5	43.0	7.5	3.8	0.81	20

STANDARD RATINGS

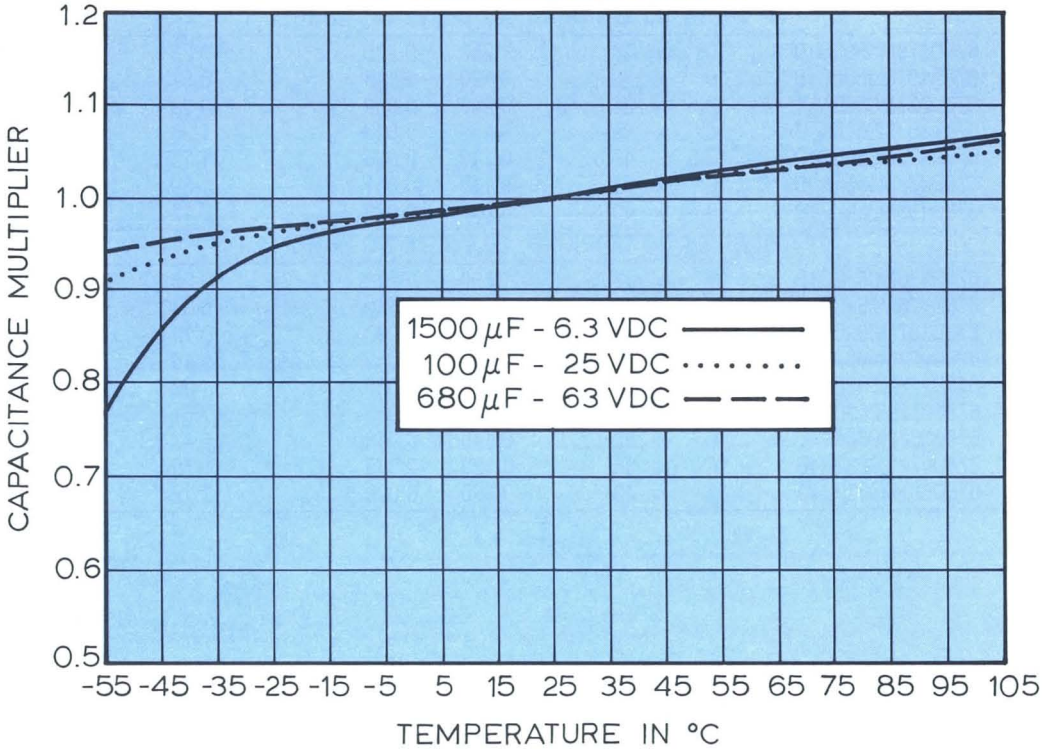
μF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR (Ω) @ +25°C 120Hz	Max. ESR (Ω) @ +25°C 20kHz	Max. Ripple Current 20-100kHz +105°C (A)	Max. Impedance 100kHz +25°C (Ω)
6.3 VOLTS DC WORKING; 9 VDC SURGE						
330	678D337M6R3CC4D	10 x 13	0.540	0.213	0.36	0.213
470	678D477M6R3CD4D	10 x 16	0.340	0.133	0.49	0.132
1000	678D108M6R3DG4D	12.5 x 20	0.200	0.071	0.83	0.070
1500	678D158M6R3DM4D	12.5 x 26.5	0.110	0.060	0.73	0.059
2200	678D228M6R3EK4D	16 x 25	0.110	0.041	1.36	0.045
3300	678D338M6R3DS4D	12.5 x 42.5	0.067	0.031	1.67	0.032
3300	678D338M6R3EN4D	16 x 32	0.078	0.037	1.58	0.040
4700	678D478M6R3FR4D	18 x 36	0.066	0.029	2.02	0.031
6800	678D688M6R3FV4D	18 x 40	0.054	0.024	2.33	0.026
10 VOLTS DC WORKING; 13 VOLTS DC SURGE						
220	678D227M010CC4D	10 x 13	0.550	0.215	0.36	0.215
330	678D337M010CD4D	10 x 16	0.350	0.135	0.46	0.134
470	678D477M010CG4D	10 x 20	0.235	0.092	0.63	0.090
1000	678D108M010DM4D	12.5 x 26.5	0.120	0.062	0.98	0.061
2200	678D228M010EK4D	16 x 25	0.115	0.042	1.52	0.046
2700	678D278M010DS4D	12.5 x 42.5	0.075	0.032	1.65	0.033
3300	678D338M010EN4D	16 x 32	0.085	0.038	1.56	0.041
4700	678D478M010FR4D	18 x 36	0.070	0.031	1.97	0.033
5600	678D568M010FV4D	18 x 40	0.060	0.026	2.24	0.028
16 VOLTS DC WORKING; 20 VOLTS DC SURGE						
220	678D227M016CC4D	10 x 13	0.585	0.217	0.40	0.217
330	678D337M016CD4D	10 x 16	0.370	0.137	0.52	0.136
470	678D477M016CG4D	10 x 20	0.250	0.098	0.70	0.094
1000	678D108M016DM4D	12.5 x 26.5	0.130	0.066	1.00	0.065
1000	678D108M016EK4D	16 x 25	0.120	0.042	1.35	0.046
1800	678D188M016DS4D	12.5 x 42.5	0.080	0.032	1.64	0.034
2200	678D228M016ER4D	16 x 36	0.074	0.032	1.78	0.034
3300	678D338M016FR4D	18 x 36	0.074	0.032	1.94	0.034
3900	678D398M016FV4D	18 x 40	0.061	0.026	2.23	0.028
20 VOLTS DC WORKING; 30 VOLTS DC SURGE						
220	678D227M020CD4D	10 x 16	0.380	0.150	0.41	0.148
330	678D337M020CG4D	10 x 20	0.270	0.100	0.61	0.098
470	678D477M020DG4D	12.5 x 20	0.250	0.077	0.45	0.075
680	678D687M020DM4D	12.5 x 26.5	0.140	0.067	0.96	0.067
1000	678D108M020DT4D	12.5 x 32.5	0.115	0.048	0.78	0.045
1500	678D158M020DS4D	12.5 x 42.5	0.085	0.033	1.63	0.035
2200	678D228M020ER4D	16 x 36	0.077	0.032	1.80	0.034
3300	678D338M020FV4D	18 x 40	0.061	0.026	2.25	0.028
25 VOLTS DC WORKING; 35 VOLTS DC SURGE						
100	678D107M025CC4D	10 x 13	0.700	0.250	0.32	0.250
220	678D227M025CG4D	10 x 20	0.300	0.105	0.59	0.100
330	678D337M025DG4D	12.5 x 20	0.270	0.078	0.79	0.076
470	678D477M025DM4D	12.5 x 26.5	0.160	0.067	0.97	0.068
1000	678D108M025DS4D	12.5 x 42.5	0.090	0.034	1.60	0.036
1000	678D108M025EN4D	16 x 32	0.095	0.039	1.54	0.041
2200	678D228M025FV4D	18 x 40	0.062	0.026	2.22	0.028
40 VOLTS DC WORKING; 55 VOLTS DC SURGE						
47	678D476M040CC4D	10 x 13	0.950	0.265	0.28	0.265
100	678D107M040CD4D	10 x 16	0.580	0.165	0.38	0.165
330	678D337M040DM4D	12.5 x 26.5	0.200	0.068	0.93	0.070
470	678D477M040EK4D	16 x 25	0.133	0.046	1.28	0.050
680	678D687M040DS4D	12.5 x 42.5	0.093	0.035	1.57	0.037
1000	678D108M040ER4D	16 x 36	0.080	0.033	1.76	0.035
1500	678D158M040FV4D	18 x 40	0.063	0.027	2.19	0.030

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR (Ω) @ +25°C 120Hz	Max. ESR (Ω) @ +25°C 20kHz	Max. Ripple Current 20-100kHz +105°C (A)	Max. Impedance 100kHz +25°C (Ω)
50 VOLTS DC WORKING; 75 VOLTS DC SURGE						
47	678D476M050CC4D	10 x 13	1.250	0.275	0.28	0.275
100	678D107M050CG4D	10 x 20	0.520	0.115	0.57	0.112
220	678D227M050DM4D	12.5 x 26.5	0.240	0.069	0.93	0.071
330	678D337M050EK4D	16 x 25	0.150	0.048	1.26	0.052
470	678D477M050DS4D	12.5 x 42.5	0.110	0.036	1.55	0.039
470	678D477M050EN4D	16 x 32	0.118	0.041	1.50	0.043
1000	678D108M050FV4D	18 x 40	0.077	0.028	2.15	0.032
63 VOLTS DC WORKING; 80 VOLTS DC SURGE						
33	678D336M063CC4D	10 x 13	1.600	0.288	0.27	0.288
47	678D476M063CD4D	10 x 16	1.000	0.180	0.37	0.180
100	678D107M063DG4D	12.5 x 20	0.450	0.093	0.72	0.090
220	678D227M063DT4D	12.5 x 32.5	0.160	0.055	1.10	0.054
220	678D227M063EK4D	16 x 25	0.170	0.050	1.23	0.054
330	678D337M063DS4D	12.5 x 42.5	0.130	0.038	1.51	0.040
330	678D337M063EN4D	16 x 32	0.140	0.043	1.47	0.045
470	678D477M063ER4D	16 x 36	0.120	0.035	1.70	0.038
680	678D687M063FV4D	18 x 40	0.090	0.029	2.12	0.033

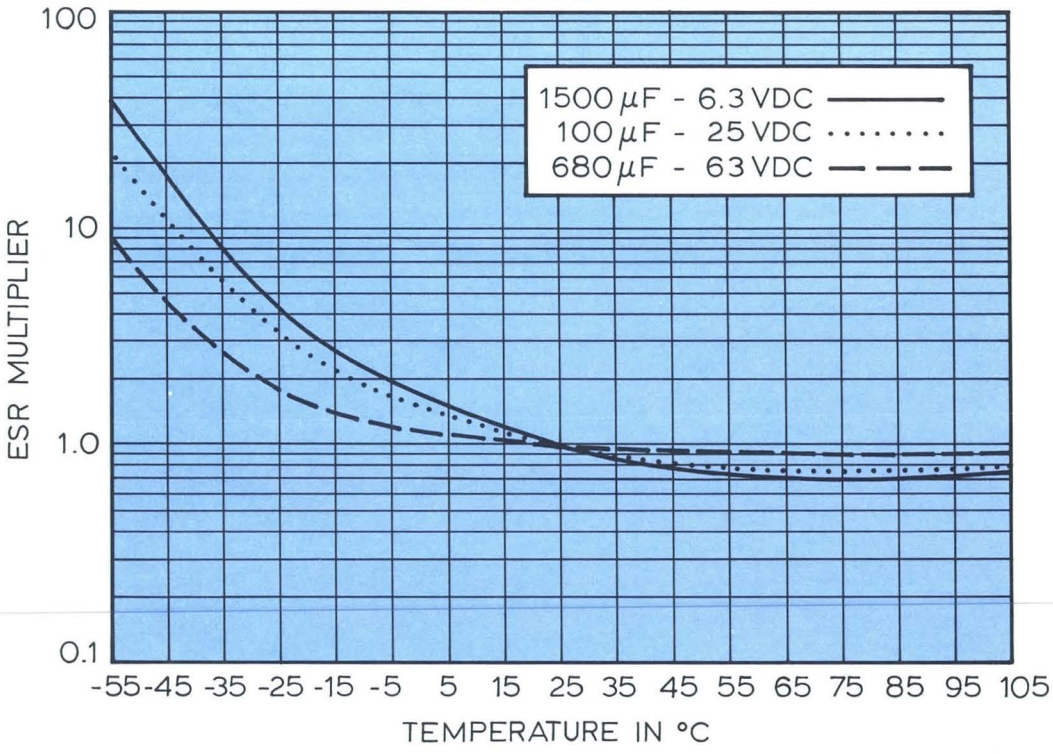
TYPICAL CURVES

TYPE 678D — TYPICAL CAPACITANCE MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,770

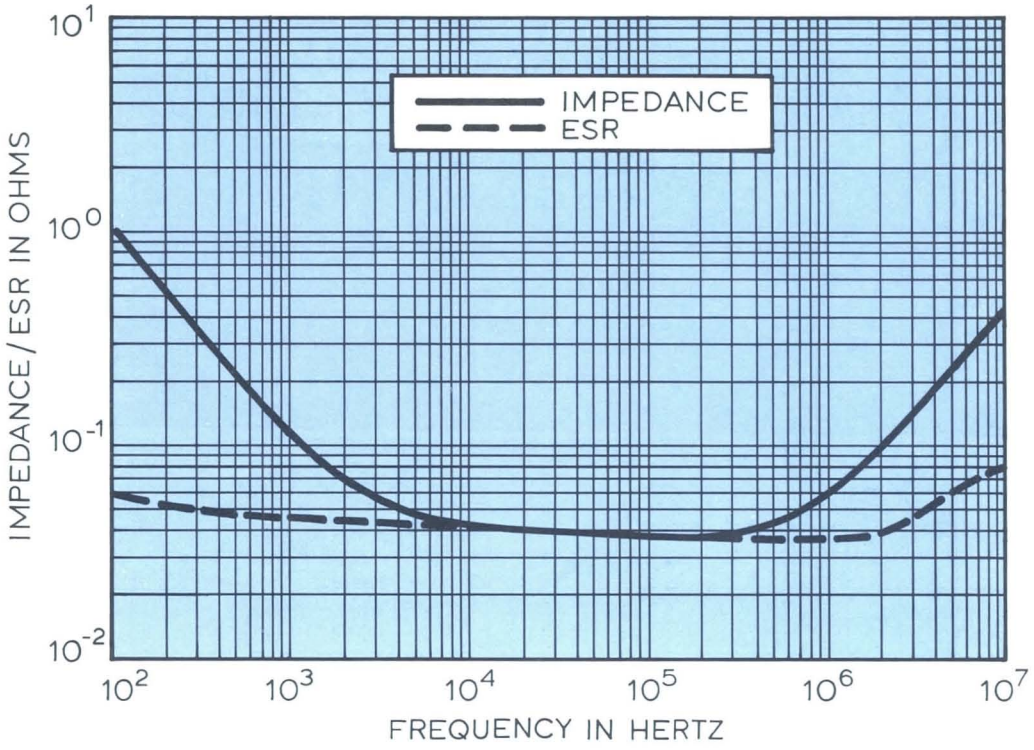
TYPE 678D — TYPICAL ESR MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,769

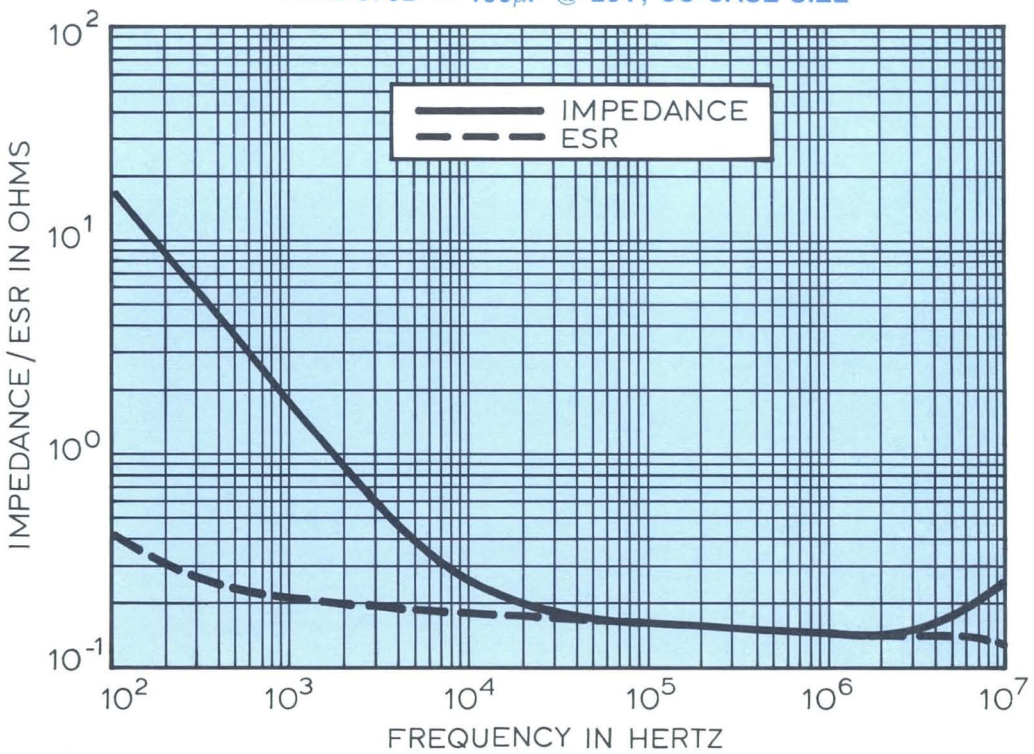
TYPICAL CURVES @ +25°C

TYPE 678D — 1500μF @ 6.3VDC, DM CASE SIZE



Dwg. No. A-14,712

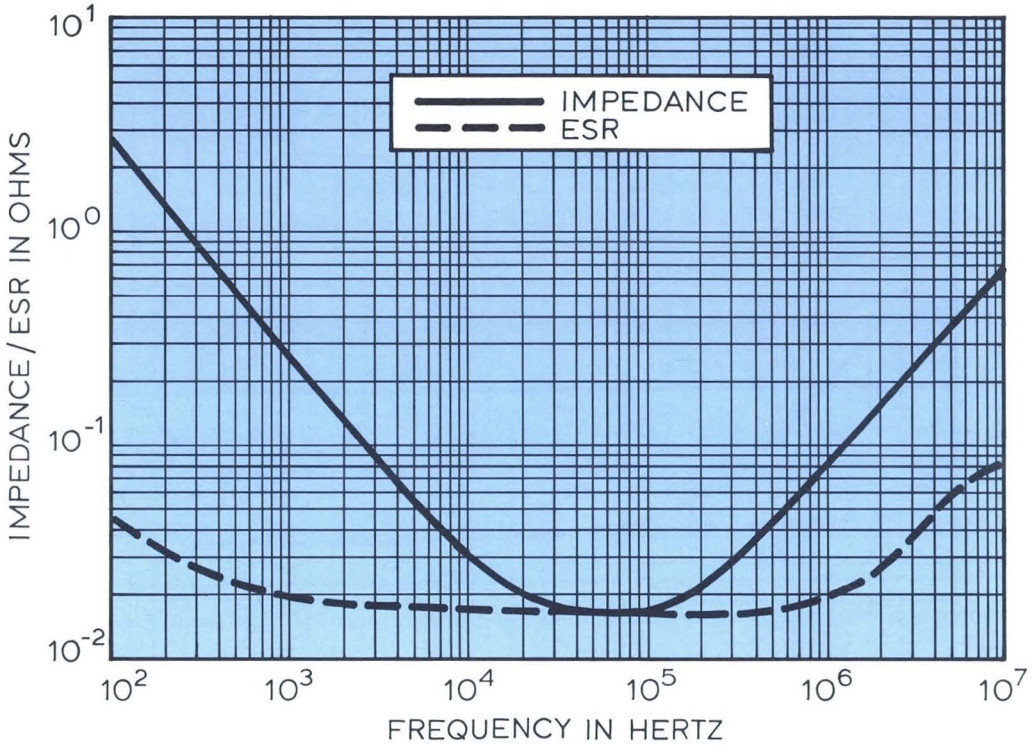
TYPE 678D — 100μF @ 25V, CC CASE SIZE



Dwg. No. A-14,711

TYPICAL CURVES @ +25°C

TYPE 678D — 680μF @ 63VDC, FV CASE SIZE



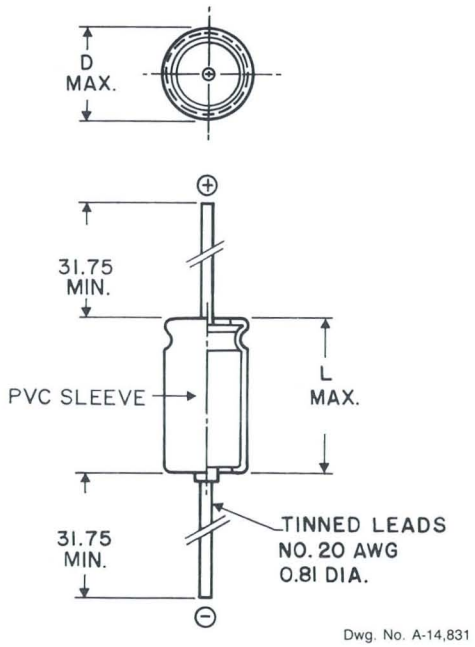
Dwg. No. A-14,713

Miniature Axial Lead Capacitors

SPRAGUE®

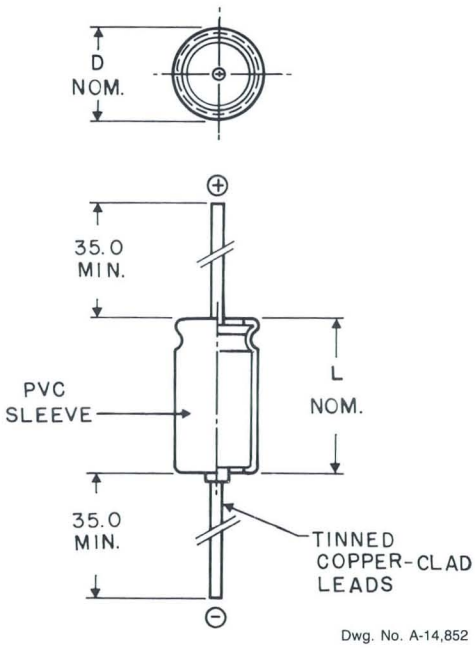
OUTLINE DRAWINGS
DIMENSIONS IN MILLIMETERS

TYPES 500D, 30D, 630D



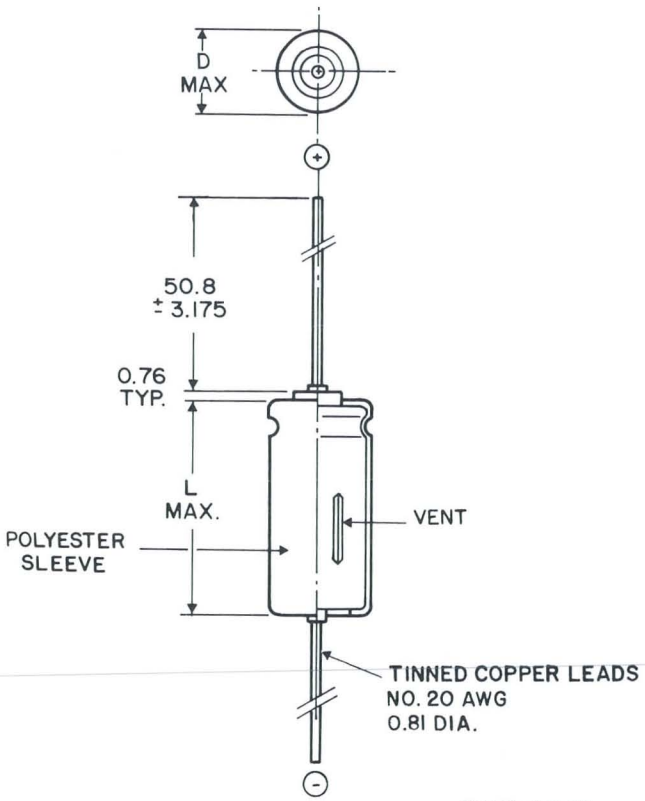
Dwg. No. A-14,831

TYPE 516D



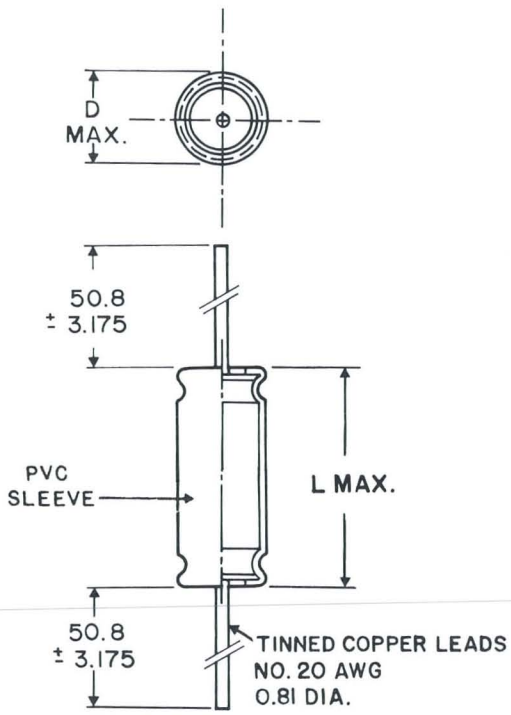
Dwg. No. A-14,852

TYPE 600D



Dwg. No. A-14,832

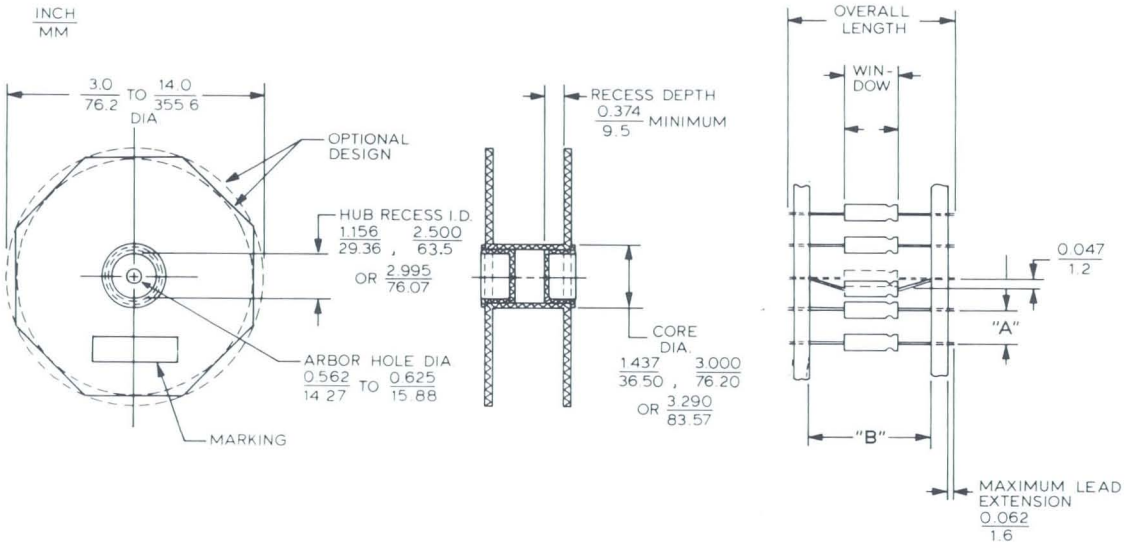
TYPE 610D



Dwg. No. A-14,851

TAPE AND REEL PACKAGING SPECIFICATIONS TO EIA STANDARD EIA-296D FOR TYPES 30D, 500D, 630D

LEAD CODE "T"



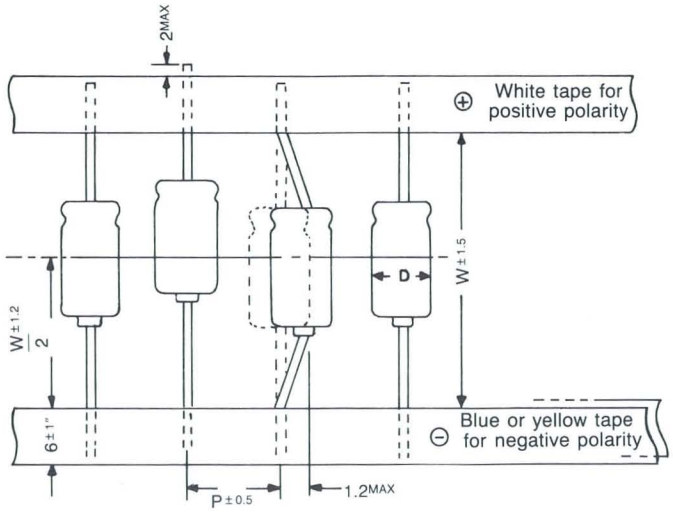
Dwg. No. A-14,875

Case Size	Dimensions With Insulating Sleeve D MM ±0.41	D Inch ±0.016	L MM ±0.79	L Inch ±0.031	With Epoxy End Seal L Max. MM	L Max. Inch	A Component Spacing ±0.508 MM	A Component Spacing ±0.020 Inch	B* Tape Spacing MM	B* Tape Spacing ±0.062 Inch	Approximate † Units Per Reel Min.	Approximate † Units Per Reel Max.
BA	6.60	0.260	13.61	0.536	15.88	0.625	10	0.400	52.4	2.062	500	1000
BB	6.60	0.260	18.36	0.732	20.63	0.812	10	0.400	52.4	2.062	500	1000
CB	8.18	0.322	18.36	0.732	20.63	0.812	10	0.400	52.4	2.062	400	800
CC	8.18	0.322	21.43	0.844	23.80	0.937	10	0.400	63.5	2.500	400	800
DB	9.78	0.385	18.36	0.723	20.63	0.812	15	0.600	52.4	2.062	300	450
DC	9.78	0.385	21.43	0.844	23.80	0.937	15	0.600	63.5	2.500	300	450
DD	9.78	0.385	24.71	0.973	26.97	1.062	15	0.600	63.5	2.500	250	450
DF	9.78	0.385	32.66	1.286	34.93	1.375	15	0.600	73.0	2.875	250	450
DH	9.78	0.385	39.01	1.536	41.28	1.625	15	0.600	73.0	2.875	250	450
EF	11.38	0.448	32.66	1.286	34.93	1.375	15	0.600	73.0	2.875	250	400
EH	11.38	0.448	39.01	1.536	41.28	1.625	15	0.600	73.0	2.875	250	400
FF	12.70	0.500	32.94	1.297	34.93	1.375	15	0.600	73.0	2.875	200	350
FH	12.70	0.500	39.01	1.536	41.28	1.625	15	0.600	73.0	2.875	200	350
FK	12.70	0.500	45.64	1.797	47.62	1.875	15	0.600	77.8	3.062	200	350

*Recommended spacing for capacitors listed. Other spacings available on special order.

†For quantities greater than the maximum shown for each case size, the maximum quantity will be wound on reels with the last quantity being variable. For example, an order for 1500 pieces of case size BA, will consist of 1 reel with 1000 units and 1 reel with 500 units.

TAPE AND REEL SPECIFICATIONS
TYPE 516D

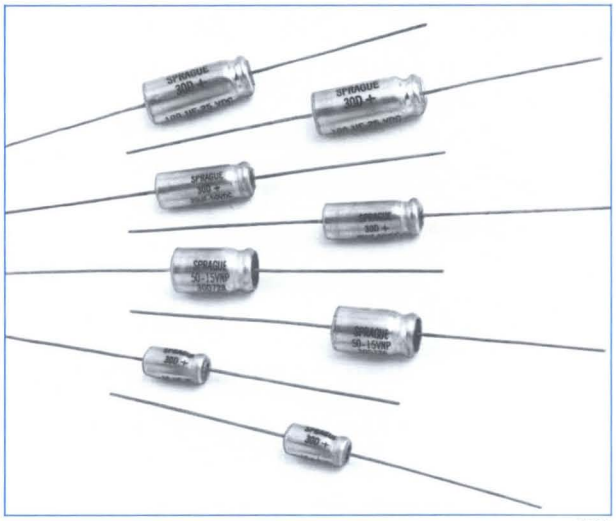


Dwg. No. A-14,881

SPECIFICATIONS

CASE CODE	TAPING CODE	W TAPE WIDTH	P PITCH OF COMPONENT	QUANTITY/REEL
JL	B	52.4mm	10mm	1500
LL	B	52.4	10	1300
LM	B	52.4	10	1300
MM	B	52.4	10	1000
MN	B	63.5	10	1000
NP	B	63.5	15	500
NP	C	73.0	15	500
NR	B	63.5	15	500
NR	C	73.0	15	500
PR	B	63.5	15	350
PR	C	73.0	15	350
PS	B	73.0	15	350

+105°C General Purpose Miniature Axial Lead, Aluminum Capacitors


9904

Features —

- +105°C, Long Life, High Performance
- High CV Per Case Size
- Case Sizes to 18mm Diameters

General Specifications —

Operating Temperature:
−40°C - +105°C.

Voltage Range: 3 - 250 VDC.

Capacitance Range: 1μF - 3,900μF.

Capacitance Tolerance: ±20%.

Case Size Range: 6.3 x 13mm - 18 x 40mm.

Termination: Axial leads.

Life Validation Test: 2000 hrs @ +105°C:
Δ CAP ≤ 20% from initial measurement.
Δ ESR ≤ 1.5x initial specified limit.
Δ DCL ≤ initial specified limit.

Shelf Test: 500 hrs @ +85°C:
Δ CAP ≤ 20% from initial measurement.
Δ ESR ≤ 1.5x initial specified limit.
Δ DCL ≤ 2x initial specified limit.

DC Leakage Current:

3 - 16 VDC	25-250 VDC
$I = 0.1\sqrt{CV} + 2$	$I = 0.2\sqrt{CV} + 2$

I in μA, C in μF, V in Volts

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	Multipliers
+105°C	0.5
+85°C	1.0
≤+65°C	2.0

FREQUENCY Hz

VDC	50-60	100-120	300-400	1K-100K
3-50	0.9	1.0	1.1	1.4
51-250	0.8	1.0	1.3	1.6

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

30D 826 M 003 BA 2 A

PACKAGING. A = BULK PACK (Standard).
T = TAPE AND REEL.

CASE STYLE. 2 = POLYESTER INSULATING SLEEVE (Standard).
5 = POLYESTER SLEEVE WITH RESIN END SEAL.
(Required for exposure to halogenated cleaning solvents).

CASE CODE. SEE DIMENSIONS, BELOW.

DC VOLTAGE RATING. EXPRESSED IN VOLTS. THE LETTER 'R' SIGNIFIES A DECIMAL POINT.

CAPACITANCE TOLERANCE. M = ±20%.

CAPACITANCE. EXPRESSED IN PICOFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

DIMENSIONS IN MILLIMETERS

Case Code	Nominal		Style 2		Style 5	
	Diameter	Length	D Max.	L Max.	D Max.	L Max.
BA	6.3	13	7.0	14.4	7.0	15.9
BB	6.3	17.5	7.0	19.2	7.0	20.7
CB	8	17.5	8.6	19.2	8.6	20.7
CC	8	20.5	8.6	22.3	8.6	23.8
DC	9.5	20.5	10.2	22.3	10.2	23.8
DD	9.5	24	10.2	25.5	10.2	27.0
DF	9.5	32	10.2	33.5	10.2	35.0
DH	9.5	38	10.2	39.8	10.2	41.3
EF	11	32	11.8	33.5	11.8	35.0
EH	11	38	11.8	39.8	11.8	41.3
FH	12.5	38	13.1	39.8	13.1	41.3
FK	12.5	44.5	13.1	46.5	13.1	48.0
GH	16	38	16.6	39.8	16.6	41.3
GK	16	44.5	16.6	46.5	16.6	48.0
LS	18	40	18.7	42.5	18.7	43.0

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR +25°C, 120Hz (Ω)	Max. Ripple Current +85°C, 120Hz (A)
3 VOLTS DC WORKING; 4 VOLTS DC SURGE				
82	30D826M003BA2A	6.3 x 13	6.647	0.094
220	30D227M003BB2A	6.3 x 17.5	2.511	0.175
330	30D337M003CB2A	8 x 17.5	1.674	0.243
390	30D397M003CC2A	8 x 20.5	1.369	0.288
820	30D827M003DC2A	9.5 x 20.5	0.664	0.461
1000	30D108M003DD2A	9.5 x 24	0.551	0.537
1500	30D158M003DF2A	9.5 x 32	0.386	0.725
2700	30D278M003DH2A	9.5 x 38	0.223	1.04
3300	30D338M003EH2A	11 x 38	0.192	1.21
3900	30D398M003FH2A	12.5 x 38	0.156	1.45
4700	30D478M003FK2A	12.5 x 44.5	0.143	1.62
5600	30D568M003GH2A	16 x 38	0.126	1.84
8200	30D828M003GK2A	16 x 44.5	0.094	2.28
10000	30D109M003LS2A	18 x 40	0.084	2.49
6.3 VOLTS DC WORKING; 8 VOLTS DC SURGE				
68	30D686M6R3BA2A	6.3 x 13	6.16	0.098
150	30D157M6R3BB2A	6.3 x 17.5	2.875	0.163
220	30D227M6R3CB2A	8 x 17.5	1.916	0.227
330	30D337M6R3CC2A	8 x 20.5	1.277	0.299
680	30D687M6R3DC2A	9.5 x 20.5	0.616	0.479
820	30D827M6R3DD2A	9.5 x 24	0.507	0.559
1200	30D128M6R3DF2A	9.5 x 32	0.345	0.767
1800	30D188M6R3DH2A	6.5 x 38	0.248	1.981
2200	30D228M6R3EF2A	11 x 32	0.206	1.08
2700	30D278M6R3EH2A	11 x 38	0.181	1.25
3900	30D398M6R3FK2A	12.5 x 44.5	0.132	1.69
4700	30D478M6R3GH2A	16 x 38	0.118	1.91
6800	30D688M6R3GK2A	16 x 44.5	0.095	2.27
8200	30D828M6R3LS2A	18 x 40	0.086	2.46
10 VOLTS DC WORKING; 12 VOLTS DC SURGE				
47	30D476M010BA2A	6.3 x 13	7.487	0.089
100	30D107M010BB2A	6.3 x 17.5	3.561	0.147
220	30D227M010CB2A	8 x 17.5	1.612	0.247
330	30D337M010CC2A	8 x 20.5	1.081	0.325
470	30D477M010DC2A	9.5 x 20.5	0.748	0.434
680	30D687M010DD2A	9.5 x 24	0.521	0.552
1000	30D108M010DF2A	9.5 x 32	0.356	0.755
1500	30D158M010DH2A	6.5 x 38	0.254	0.968
1500	30D158M010EF2A	11 x 32	0.254	0.976
2200	30D228M010EH2A	11 x 38	0.184	1.24
3900	30D398M010FK2A	12.5 x 44.5	0.108	1.87
3900	30D398M010GH2A	16 x 38	0.108	1.99
5600	30D568M010GK2A	16 x 44.5	0.091	2.32
6800	30D688M010LS2A	18 x 40	0.085	2.48
12 VOLTS DC WORKING; 15 VOLTS DC SURGE				
39	30D396M012BA2A	6.3 x 13	8.454	0.084
68	30D686M012BB2A	6.3 x 17.5	4.982	0.124
150	30D157M012CB2A	8 x 17.5	2.325	0.207
220	30D227M012CC2A	8 x 20.5	1.55	0.271
330	30D337M012DC2A	9.5 x 20.5	1.03	0.371
560	30D567M012DD2A	9.5 x 24	0.593	0.518
820	30D827M012DF2A	9.5 x 32	0.411	0.704
1200	30D128M012DH2A	6.5 x 38	0.279	0.924

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR +25°C, 120Hz (Ω)	Max. Ripple Current +85°C, 120Hz (A)
12 VOLTS DC WORKING; 15 VOLTS DC SURGE (Cont.)				
1200	30D128M012EF2A	11 x 32	0.292	0.908
1800	30D188M012EH2A	11 x 38	0.203	1.18
2700	30D278M012FK2A	12.5 x 44.5	0.145	1.61
3300	30D338M012GH2A	16 x 38	0.127	1.83
4700	30D478M012GK2A	16 x 44.5	0.102	2.91
5600	30D568M012LS2A	18 x 40	0.101	2.27
16 VOLTS DC WORKING; 20 VOLTS DC SURGE				
33	30D336M016BA2A	6.3 x 13	9.814	0.078
68	30D686M016BB2A	6.3 x 17.5	4.732	0.127
150	30D157M016CB2A	8 x 17.5	2.208	0.212
220	30D227M016CC2A	8 x 20.5	1.471	0.278
330	30D337M016DC2A	9.5 x 20.5	1.981	0.379
470	30D477M016DD2A	9.5 x 24	0.679	0.483
680	30D687M016DF2A	9.5 x 32	0.473	0.655
1200	30D128M016DH2A	6.5 x 38	0.265	0.947
1200	30D128M016EF2A	11 x 32	0.265	0.953
1800	30D188M016EH2A	11 x 38	0.186	1.23
2700	30D278M016FK2A	12.5 x 44.5	0.138	1.65
2700	30D278M016GH2A	16 x 38	0.138	1.75
4700	30D478M016GK2A	16 x 44.5	0.093	2.29
5600	30D568M016LS2A	18 x 40	0.082	2.52
20 VOLTS DC WORKING; 25 VOLTS DC SURGE				
27	30D276M020BA2A	6.3 x 13	11.45	0.072
56	30D566M020BB2A	6.3 x 17.5	5.36	0.119
82	30D826M020CB2A	8 x 17.5	3.705	0.164
150	30D157M020CC2A	8 x 20.5	2.11	0.233
220	30D227M020DC2A	9.5 x 20.5	1.41	0.318
390	30D397M020DD2A	9.5 x 24	0.763	0.456
680	30D687M020DF2A	9.5 x 32	0.451	0.671
820	30D827M020DH2A	6.5 x 38	0.371	0.802
1000	30D108M020EF2A	11 x 32	0.323	0.863
1500	30D158M020EH2A	11 x 38	0.221	1.14
1800	30D188M020FK2A	12.5 x 44.5	0.195	1.39
2700	30D278M020GH2A	16 x 38	0.132	1.81
3300	30D338M020GK2A	16 x 44.5	0.118	2.04
3900	30D398M020LS2A	18 x 40	0.104	2.24
25 VOLTS DC WORKING; 35 VOLTS DC SURGE				
22	30D226M025BA2A	6.3 x 13	13.27	0.067
47	30D476M025BB2A	6.3 x 17.5	6.128	0.112
68	30D686M025CB2A	8 x 17.5	4.267	0.152
100	30D107M025CC2A	8 x 20.5	2.914	0.197
220	30D227M025DC2A	9.5 x 20.5	1.327	0.326
330	30D337M025DD2A	9.5 x 24	0.885	0.423
470	30D477M025DF2A	9.5 x 32	0.612	0.575
820	30D827M025DH2A	6.5 x 38	0.351	0.823
680	30D687M025EF2A	11 x 32	0.426	0.752
1000	30D128M025EH2A	11 x 38	0.239	1.09
1500	30D158M025FK2A	12.5 x 44.5	0.21	1.34
1800	30D188M025GH2A	16 x 38	0.168	1.59
2700	30D278M025GK2A	16 x 44.5	0.127	1.96
3300	30D338M025LS2A	18 x 40	0.108	2.19

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR +25°C, 120Hz (Ω)	Max. Ripple Current +85°C, 120Hz (A)
35 VOLTS DC WORKING; 45 VOLTS DC SURGE				
18	30D186M035BA2A	6.3 x 13	15	0.063
33	30D336M035BB2A	6.3 x 17.5	8.33	0.096
56	30D566M035CB2A	8 x 17.5	4.78	0.144
82	30D826M035CC2A	8 x 20.5	3.308	0.185
100	30D107M035DC2A	9.5 x 20.5	2.74	0.212
220	30D227M035DD2A	9.5 x 24	1.25	0.356
330	30D337M035DF2A	9.5 x 32	0.83	0.495
560	30D567M035DH2A	6.5 x 38	0.478	0.706
560	30D567M035EF2A	11 x 32	0.478	0.711
1000	30D108M035EH2A	11 x 38	0.274	1.02
1200	30D128M035FK2A	12.5 x 44.5	0.225	1.29
1200	30D128M035GH2A	16 x 38	0.225	1.38
2200	30D228M035GK2A	16 x 44.5	0.125	1.98
2700	30D278M035LS2A	18 x 40	0.114	2.14
40 VOLTS DC WORKING; 50 VOLTS DC SURGE				
15	30D156M040BA2A	6.3 x 13	17.6	0.058
22	30D226M040BB2A	6.3 x 17.5	11.7	0.081
47	30D476M040CB2A	8 x 17.5	5.435	0.134
68	30D686M040CC2A	8 x 20.5	3.785	0.173
100	30D107M040DC2A	9.5 x 20.5	2.585	0.234
180	30D187M040DD2A	9.5 x 24	1.413	0.335
270	30D277M040DF2A	9.5 x 32	0.963	0.459
470	30D477M040DH2A	6.5 x 38	0.543	0.663
470	30D477M040EF2A	11 x 32	0.543	0.667
680	30D687M040EH2A	11 x 38	0.378	0.865
1000	30D108M040FK2A	12.5 x 44.5	0.258	1.21
1200	30D128M040GH2A	16 x 38	0.212	1.42
1800	30D188M040GK2A	16 x 44.5	0.15	1.81
2200	30D228M040LS2A	18 x 40	0.125	2.04
50 VOLTS DC WORKING; 65 VOLTS DC SURGE				
10	30D106M050BA2A	6.3 x 13	25.85	0.048
22	30D226M050BB2A	6.3 x 17.5	11.7	0.081
33	30D336M050CB2A	8 x 17.5	7.85	0.112
68	30D686M050CC2A	8 x 20.5	3.785	0.173
100	30D107M050DC2A	9.5 x 20.5	2.585	0.233
150	30D157M050DD2A	9.5 x 24	1.76	0.301
220	30D227M050DF2A	9.5 x 32	1.177	0.417
330	30D337M050DH2A	6.5 x 38	0.785	0.551
330	30D337M050EF2A	11 x 32	0.785	0.554
560	30D567M050EH2A	11 x 38	0.451	0.792
820	30D827M050FK2A	12.5 x 44.5	0.311	1.11
820	30D827M050GH2A	16 x 38	0.311	1.17
1500	30D158M050GK2A	16 x 44.5	0.176	1.67
1800	30D188M050LS2A	18 x 40	0.141	1.92
63 VOLTS DC WORKING; 75 VOLTS DC SURGE				
6.8	30D685M063BA2A	6.3 x 13	35.53	0.041
15	30D156M063BB2A	6.3 x 17.5	16.58	0.068
33	30D336M063CB2A	8 x 17.5	7.37	0.116
47	30D476M063CC2A	8 x 20.5	5.1	0.149
68	30D686M063DC2A	9.5 x 20.5	3.55	0.187
100	30D107M063DD2A	9.5 x 24	2.426	0.256
150	30D157M063DF2A	9.5 x 32	1.658	0.349
270	30D277M063DH2A	6.5 x 38	0.904	0.513

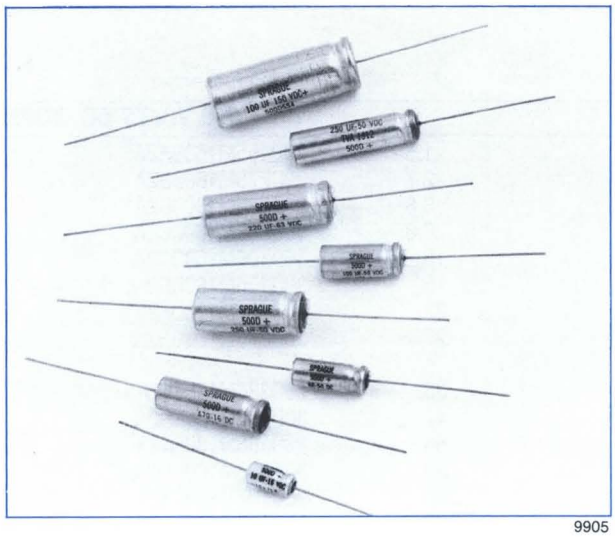
STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR +25°C, 120Hz (Ω)	Max. Ripple Current +85°C, 120Hz (A)
63 VOLTS DC WORKING; 75 VOLTS DC SURGE (Cont.)				
220	30D227M063EF2A	11 x 32	1.105	0.467
470	30D477M063EH2A	11 x 38	0.51	0.745
560	30D567M063FK2A	12.5 x 44.5	0.423	0.944
560	30D567M063GH2A	16 x 38	0.423	1.01
1000	30D108M063GK2A	16 x 44.5	0.242	1.42
1200	30D128M063LS2A	18 x 40	0.199	1.62
75 VOLTS DC WORKING; 85 VOLTS DC SURGE				
5.6	30D565M075BA2A	6.3 x 13	28.08	0.046
12	30D126M075BB2A	6.3 x 17.5	13.2	0.076
18	30D186M075CB2A	8 x 17.5	8.8	0.106
27	30D276M075CC2A	8 x 20.5	6	0.138
47	30D476M075DC2A	9.5 x 20.5	3.384	0.204
82	30D826M075DD2A	9.5 x 24	1.941	0.286
120	30D127M075DF2A	9.5 x 32	1.32	0.392
180	30D187M075DH2A	6.5 x 38	0.88	0.521
150	30D157M075EF2A	11 x 32	1.1	0.468
270	30D277M075EH2A	11 x 38	0.6	0.687
390	30D397M075FK2A	12.5 x 44.5	0.4	0.971
390	30D397M075GH2A	16 x 38	0.4	1.03
680	30D687M075GK2A	16 x 44.5	0.235	1.44
1000	30D108M075LS2A	18 x 40	0.16	1.81
80 VOLTS DC WORKING; 100 VOLTS DC SURGE				
4.7	30D475M080BA2A	6.3 x 13	33.84	0.042
10	30D106M080BB2A	6.3 x 17.5	16.09	0.069
15	30D156M080CB2A	8 x 17.5	11	0.095
22	30D226M080CC2A	8 x 20.5	7.33	0.125
33	30D336M080DC2A	9.5 x 20.5	4.88	0.171
68	30D686M080DD2A	9.5 x 24	2.357	0.261
100	30D107M080DF2A	9.5 x 32	1.609	0.356
150	30D157M080DH2A	6.5 x 38	1.1	0.466
120	30D127M080EF2A	11 x 32	1.32	0.427
220	30D227M080EH2A	11 x 38	0.733	0.621
270	30D277M080FK2A	12.5 x 44.5	0.6	0.793
330	30D337M080GH2A	16 x 38	0.488	0.935
470	30D477M080GK2A	16 x 44.5	0.338	1.21
680	30D687M080LS2A	18 x 40	0.235	1.49
100 VOLTS DC WORKING; 125 VOLTS DC SURGE				
3.3	30D335M100BA2A	6.3 x 13	48.88	0.035
4.7	30D475M100BB2A	6.3 x 17.5	33.84	0.048
10	30D106M100CB2A	8 x 17.5	16.097	0.079
15	30D156M100CC2A	8 x 20.5	11	0.102
22	30D226M100DC2A	9.5 x 20.5	7.333	0.138
39	30D396M100DD2A	9.5 x 24	4	0.199
56	30D566M100DF2A	9.5 x 32	2.808	0.269
100	30D107M100DH2A	6.5 x 38	1.609	0.386
100	30D107M100EF2A	11 x 32	1.609	0.388
150	30D157M100EH2A	11 x 38	1.1	0.507
220	30D227M100FK2A	12.5 x 44.5	0.733	0.717
220	30D227M100GH2A	16 x 38	0.733	0.763
390	30D397M100GK2A	16 x 44.5	0.4	1.11
470	30D477M100LS2A	18 x 40	0.338	1.24

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR +25°C, 120Hz (Ω)	Max. Ripple Current +85°C, 120Hz (A)
160 VOLTS DC WORKING; 180 VOLTS DC SURGE				
1.5	30D155M160BA2A	6.3 x 13	110.1	0.023
2.7	30D275M160BB2A	6.3 x 17.5	60.01	0.036
3.3	30D335M160CB2A	8 x 17.5	48.88	0.045
6.8	30D685M160CC2A	8 x 20.5	23.57	0.071
10	30D106M160DC2A	9.5 x 20.5	16.097	0.093
15	30D156M160DD2A	9.5 x 24	11.01	0.121
22	30D226M160DF2A	9.5 x 32	7.333	0.166
27	30D276M160DH2A	6.5 x 38	6.01	0.199
33	30D336M160EF2A	11 x 32	4.888	0.222
47	30D476M160EH2A	11 x 38	3.384	0.289
56	30D566M160FK2A	12.5 x 44.5	2.808	0.366
82	30D826M160GH2A	16 x 38	1.941	0.469
100	30D107M160GK2A	16 x 44.5	1.609	0.552
120	30D107M160LS2A	18 x 40	1.321	0.628
200 VOLTS DC WORKING; 250 VOLTS DC SURGE				
1.2	30D125M200BA2A	6.3 x 13	132.01	0.022
2.2	30D225M200BB2A	6.3 x 17.5	73.31	0.033
2.7	30D275M200CB2A	8 x 17.5	60.01	0.041
4.7	30D475M200CC2A	8 x 20.5	33.85	0.058
8.2	30D825M200DC2A	9.5 x 20.5	19.41	0.085
10	30D106M200DD2A	9.5 x 24	16.09	0.101
15	30D156M200DF2A	9.5 x 32	11.023	0.135
22	30D226M200DH2A	6.5 x 38	7.331	0.181
27	30D276M200EF2A	11 x 32	6.01	0.201
33	30D336M200EH2A	11 x 38	4.88	0.241
39	30D396M200FH2A	12.5 x 38	4.01	0.287
47	30D476M200FK2A	12.5 x 44.5	3.384	0.334
68	30D686M200GH2A	16 x 38	2.357	0.426
82	30D826M200GK2A	16 x 44.5	1.94	0.501
100	30D107M200LS2A	18 x 40	1.609	0.571
250 VOLTS DC WORKING; 300 VOLTS DC SURGE				
1.0	30D155M250BA2A	6.3 x 13	160.97	0.021
1.8	30D185M250BB2A	6.3 x 17.5	88.01	0.031
2.2	30D225M250CB2A	8 x 17.5	73.31	0.037
3.3	30D335M250CC2A	8 x 20.5	48.01	0.049
6.8	30D685M250DC2A	9.5 x 20.5	23.57	0.078
8.2	30D825M250DD2A	9.5 x 24	19.41	0.191
12	30D126M250DF2A	9.5 x 32	13.21	0.124
18	30D186M250DH2A	6.5 x 38	8.81	0.165
18	30D186M250EF2A	11 x 32	8.81	0.166
27	30D276M250EH2A	11 x 38	6.0	0.217
39	30D396M250FK2A	12.5 x 44.5	4.0	0.307
47	30D476M250GH2A	16 x 38	3.384	0.355
56	30D566M250GK2A	16 x 44.5	2.808	0.417
82	30D826M250LS2A	18 x 40	1.94	0.518

+85°C General Purpose Miniature Aluminum Capacitors



9905

Features —

- **Increased CV Efficiency**
- **New 18mm Diameter Case Size**
- **Non Polar Designs Available (Special Order)**

General Specifications —

Operating Temperature:
– 40°C to +85°C (3-250 VDC),
– 20°C to +85°C (251-400 VDC).

Voltage Range: 3 - 400 VDC.

Capacitance Range: 0.22μF - 10,000μF.

Capacitance Tolerance: ±20%.

Case Size Range: 6.3 x 13mm - 18 x 40mm.

Termination: Axial leads.

Life Validation Test: 2000 hrs @ +85°C:
Δ CAP ≤ 20% from initial measurement.
Δ ESR ≤ 1.5x initial specified limit.
Δ DCL ≤ the initial specified limit.

Shelf Test: 500 hrs @ +85°C:
Δ CAP ≤ 20% from initial measurement.
Δ ESR ≤ 1.5x initial specified limit.
Δ DCL ≤ 2x initial specified limit.

DC Leakage Current:

3 - 100 VDC	101-400 VDC
I = 0.01 CV + 10	I = 0.03 CV + 20

I in μA, C in μF, V in Volts

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	Multipliers
+85°C	1.0
+75°C	1.25
≤+65°C	1.5

FREQUENCY Hz

VDC	50-60	100-120	300-400	1K-100K
0-50	0.85	1.0	1.05	1.1
51-450	0.8	1.0	1.3	1.5

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

500D 686 M 6R3 BA 2 A

PACKAGING. A = BULK PACK (Standard).
T = TAPE AND REEL.

CASE STYLE. 2 = POLYESTER INSULATING SLEEVE (Standard).
5 = POLYESTER SLEEVE WITH RESIN END SEAL.
(Recommended for exposure to halogenated cleaning solvents).

CASE CODE. SEE DIMENSIONS, BELOW.

DC VOLTAGE RATING. EXPRESSED IN VOLTS. 'R' SIGNIFIES A DECIMAL POINT. FOR EXAMPLE, 6R3 = 6.3 VOLTS.

CAPACITANCE TOLERANCE. M = ±20%.

CAPACITANCE. EXPRESSED IN PICOFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

DIMENSIONS IN MILLIMETERS

Case Code	Nominal		Style 2		Style 5	
	Diameter	Length	D Max.	L Max.	D Max.	L Max.
BA	6.3	13	7.0	14.4	7.0	15.9
BB	6.3	17.5	7.0	19.2	7.0	20.7
CB	8	17.5	8.6	19.2	8.6	20.7
CC	8	20.5	8.6	22.3	8.6	23.8
DC	9.5	20.5	10.2	22.3	10.2	23.8
DD	9.5	24	10.2	25.5	10.2	27.0
DF	9.5	32	10.2	33.5	10.2	35.0
DH	9.5	38	10.2	39.8	10.2	41.3
EF	11	32	11.8	33.5	11.8	35.0
EH	11	38	11.8	39.8	11.8	41.3
FH	12.5	38	13.1	39.8	13.1	41.3
FK	12.5	44.5	13.1	46.5	13.1	48.0
GH	16	38	16.6	39.8	16.6	41.3
GK	16	44.5	16.6	46.5	16.6	48.0
LS	18	40	18.7	42.5	18.7	43.0

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C, 120Hz (Ω)	Max. Ripple Current @ +85°C, 120Hz (A)
6.3 VOLTS DC WORKING; 8 VOLTS DC SURGE				
68	500D686M6R3BA2A	6.3 x 13	5.670	0.088
150	500D157M6R3BB2A	6.3 x 17.5	2.650	0.147
220	500D227M6R3CB2A	8 x 17.5	1.760	0.205
330	500D337M6R3CC2A	8 x 20.5	1.170	0.271
680	500D687M6R3DC2A	9.5 x 20.5	0.567	0.432
820	500D827M6R3DD2A	9.5 x 24	0.467	0.505
1200	500D128M6R3DF2A	9.5 x 32	0.331	0.677
2200	500D228M6R3DH2A	9.5 x 38	0.198	0.951
2200	500D228M6R3EF2A	11 x 32	0.198	0.957
3300	500D338M6R3EH2A	11 x 38	0.142	1.220
3300	500D338M6R3FH2A	12.5 x 38	0.142	1.320
4700	500D478M6R3FK2A	12.5 x 44.5	0.105	1.640
5600	500D568M6R3GH2A	16 x 38	0.093	1.850
8200	500D828M6R3GK2A	16 x 44.5	0.074	2.230
10000	500D109M6R3LS2A	18 x 40	0.067	2.410
10 VOLTS DC WORKING; 12 VOLTS DC SURGE				
47	500D476M010BA2A	6.3 x 13	6.790	0.081
100	500D107M010BB2A	6.3 x 17.5	3.230	0.133
220	500D227M010CB2A	8 x 17.5	1.470	0.225
330	500D337M010CC2A	8 x 20.5	0.981	0.295
470	500D477M010DC2A	9.5 x 20.5	0.679	0.394
680	500D687M010DD2A	9.5 x 24	0.473	0.502
1000	500D108M010DF2A	9.5 x 32	0.323	0.687
1500	500D158M010DH2A	9.5 x 38	0.231	0.879
1800	500D188M010EF2A	11 x 32	0.185	0.991
2700	500D278M010EH2A	11 x 38	0.144	1.210
2700	500D278M010FH2A	12.5 x 38	0.144	1.310
3900	500D398M010FK2A	12.5 x 44.5	0.101	1.680
4700	500D478M010GH2A	16 x 38	0.091	1.870
6800	500D688M010GK2A	16 x 44.5	0.073	2.240
8200	500D828M010LS2A	18 x 40	0.066	2.430
12 VOLTS DC WORKING; 15 VOLTS DC SURGE				
39	500D396M012BA2A	6.3 x 13	7.240	0.078
68	500D686M012BB2A	6.3 x 17.5	4.260	0.116
150	500D157M012CB2A	8 x 17.5	1.990	0.193
220	500D227M012CC2A	8 x 20.5	1.320	0.254
330	500D337M012DC2A	9.5 x 20.5	0.885	0.346
560	500D567M012DD2A	9.5 x 20.5	0.508	0.484
820	500D827M012DF2A	9.5 x 32	0.351	0.658
1200	500D128M012DH2A	9.5 x 38	0.239	0.865
1500	500D158M012EF2A	11 x 32	0.211	0.929
2200	500D228M012EH2A	11 x 38	0.147	1.210
2200	500D228M012FH2A	12.5 x 38	0.147	1.290
2700	500D278M012FK2A	12.5 x 44.5	0.126	1.490
3900	500D398M012GH2A	16 x 38	0.093	1.850
5600	500D568M012GK2A	16 x 44.5	0.076	2.190
6800	500D688M012LS2A	18 x 40	0.068	2.390
16 VOLTS DC WORKING; 20 VOLTS DC SURGE				
33	500D336M016BA2A	6.3 x 13	7.850	0.075
68	500D686M016BB2A	6.3 x 17.5	3.750	0.123
150	500D157M016CB2A	8 x 17.5	1.770	0.205
220	500D227M016CC2A	8 x 20.5	1.170	0.269
330	500D337M016DC2A	9.5 x 20.5	0.785	0.367
470	500D477M016DD2A	9.5 x 24	0.543	0.468
680	500D687M016DF2A	9.5 x 32	0.378	0.634
1200	500D128M016DH2A	9.5 x 38	0.225	0.891

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C, 120Hz (Ω)	Max. Ripple Current @ +85°C, 120Hz (A)
16 VOLTS DC WORKING; 20 VOLTS DC SURGE (Cont.)				
1200	500D128M016EF2A	11 x 32	0.225	0.898
1800	500D188M016EH2A	11 x 38	0.151	1.190
1800	500D188M016FH2A	12.5 x 38	0.151	1.280
2700	500D278M016FK2A	12.5 x 44.5	0.114	1.570
3300	500D338M016GH2A	16 x 38	0.098	1.810
4700	500D478M016GK2A	16 x 44.5	0.078	2.170
5600	500D568M016LS2A	18 x 40	0.071	2.360
25 VOLTS DC WORKING; 35 VOLTS DC SURGE				
22	500D226M025BA2A	6.3 x 13	10.330	0.065
47	500D476M025BB2A	6.3 x 17.5	4.760	0.109
68	500D686M025CB2A	8 x 17.5	3.320	0.149
100	500D107M025CC2A	8 x 20.5	2.270	0.194
220	500D227M025DC2A	9.5 x 20.5	1.030	0.321
330	500D337M025DD2A	9.5 x 24	0.688	0.416
470	500D477M025DF2A	9.5 x 32	0.476	0.566
820	500D827M025DH2A	9.5 x 38	0.273	0.809
680	500D687M025EF2A	11 x 32	0.332	0.739
1200	500D128M025EH2A	11 x 38	0.186	1.070
1200	500D128M025FH2A	12.5 x 38	0.186	1.150
1800	500D188M025FK2A	12.5 x 44.5	0.132	1.460
1800	500D188M025GH2A	16 x 38	0.132	1.560
2700	500D278M025GK2A	16 x 44.5	0.102	1.890
3300	500D338M025LS2A	18 x 40	0.089	2.090
40 VOLTS DC WORKING; 50 VOLTS DC SURGE				
15	500D156M040BA2A	6.3 x 13	13.25	0.058
22	500D226M040BB2A	6.3 x 17.5	10.51	0.074
47	500D476M040CB2A	8 x 17.5	4.07	0.135
68	500D686M040CC2A	8 x 20.5	2.69	0.178
100	500D107M040DC2A	9.5 x 20.5	1.94	0.233
180	500D187M040DD2A	9.5 x 24	1.06	0.335
270	500D277M040DF2A	9.5 x 32	0.722	0.459
470	500D477M040DH2A	9.5 x 38	0.407	0.663
470	500D477M040EF2A	11 x 32	0.407	0.668
680	500D687M040EH2A	11 x 38	0.283	0.866
680	500D687M040FH2A	12.5 x 38	0.283	0.935
1000	500D108M040FK2A	12.5 x 44.5	0.193	1.21
1200	500D128M040GH2A	16 x 38	0.159	1.42
1800	500D182M040GK2A	16 x 44.5	0.115	1.79
2200	500D228M040LS2A	18 x 40	0.103	1.95
50 VOLTS DC WORKING; 65 VOLTS DC SURGE				
10	500D106M050BA2A	6.3 x 13	16.09	0.052
22	500D226M050BB2A	6.3 x 17.5	7.33	0.088
33	500D336M050CB2A	8 x 17.5	4.88	0.123
68	500D686M050CC2A	8 x 20.5	2.35	0.191
100	500D107M050DC2A	9.5 x 20.5	1.61	0.257
150	500D157M050DD2A	9.5 x 24	1.11	0.329
220	500D227M050DF2A	9.5 x 32	0.733	0.455
330	500D337M050DH2A	9.5 x 38	0.488	0.605
330	500D337M050EF2A	11 x 32	0.488	0.609
560	500D567M050EH2A	11 x 38	0.281	0.871
470	500D477M050FH2A	12.5 x 38	0.338	0.855
820	500D827M050FK2A	12.5 x 44.5	0.194	1.21
820	500D827M050GH2A	16 x 38	0.194	1.28
1500	500D158M050GK2A	16 x 44.5	0.121	1.74
1800	500D188M050LS2A	18 x 40	0.098	1.99

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C, 120Hz (Ω)	Max. Ripple Current @ +85°C, 120Hz (A)
63 VOLTS DC WORKING; 75 VOLTS DC SURGE				
6.8	500D685M063BA2A	6.3 x 13	23.57	0.043
15	500D156M063BB2A	6.3 x 17.5	11.01	0.082
33	500D336M063CB2A	8 x 17.5	4.88	0.123
47	500D476M063CC2A	8 x 20.5	3.38	0.158
68	500D686M063DC2A	9.5 x 20.5	2.35	0.211
100	500D107M063DD2A	9.5 x 24	1.61	0.272
150	500D157M063DF2A	9.5 x 32	1.11	0.372
270	500D277M063DH2A	9.5 x 38	0.601	0.546
220	500D227M063EF2A	11 x 32	0.733	0.497
470	500D477M063EH2A	11 x 38	0.338	0.792
390	500D397M063FH2A	12.5 x 38	0.401	0.786
560	500D567M063FK2A	12.5 x 44.5	0.281	1.01
560	500D567M063GH2A	16 x 38	0.281	1.07
1000	500D108M063GK2A	16 x 44.5	0.161	1.51
1200	500D128M063LS2A	18 x 40	0.132	1.72
100 VOLTS DC WORKING; 125 VOLTS DC SURGE				
3.3	500D335M100BA2A	6.3 x 13	48.888	0.03
4.7	500D475M100BB2A	6.3 x 17.5	33.846	0.041
10	500D106M100CB2A	8 x 17.5	16.097	0.068
15	500D156M100CC2A	8 x 20.5	11	0.088
22	500D226M100DC2A	9.5 x 20.5	7.333	0.121
39	500D396M100DD2A	9.5 x 24	4	0.173
56	500D566M100DF2A	9.5 x 32	2.808	0.233
100	500D107M100DH2A	9.5 x 38	1.609	0.334
100	500D107M100EF2A	11 x 32	1.609	0.337
150	500D157M100EH2A	11 x 38	1.1	0.439
150	500D157M100FH2A	12.5 x 38	1.1	0.474
220	500D227M100FK2A	12.5 x 44.5	0.733	0.621
220	500D227M100GH2A	16 x 38	0.733	0.661
390	500D397M100GK2A	16 x 44.5	0.4	0.958
470	500D477M100LS2A	18 x 40	0.338	1.07
160 VOLTS DC WORKING; 180 VOLTS DC SURGE				
1.5	500D155M160BA2A	6.3 x 13	110	0.02
2.7	500D275M160BB2A	6.3 x 17.5	60	0.031
3.3	500D335M160CB2A	8 x 17.5	48.88	0.039
6.8	500D685M160CC2A	8 x 20.5	23.57	0.06
10	500D106M160DC2A	9.5 x 20.5	16.097	0.081
15	500D156M160DD2A	9.5 x 24	11	0.104
22	500D226M160DF2A	9.5 x 32	7.333	0.144
27	500D276M160DH2A	9.5 x 38	6	0.172
33	500D336M160EF2A	11 x 32	4.888	0.192
47	500D476M160EH2A	11 x 38	3.384	0.25
47	500D476M160FH2A	12.5 x 38	3.384	0.271
56	500D566M160FK2A	12.5 x 44.5	2.808	0.317
82	500D826M160GH2A	16 x 38	1.941	0.406
100	500D107M160GK2A	16 x 44.5	1.609	0.478
120	500D127M160LS2A	18 x 40	1.32	0.543
200 VOLTS DC WORKING; 250 VOLTS DC SURGE				
1.2	500D125M200BA2A	6.3 x 13	132	0.018
2.2	500D225M200BB2A	6.3 x 17.5	73.3	0.028
2.7	500D275M200CB2A	8 x 17.5	60	0.035
4.7	500D475M200CC2A	8 x 20.5	33.84	0.05
8.2	500D825M200DC2A	9.5 x 20.5	19.4	0.074
10	500D106M200DD2A	9.5 x 24	16.09	0.086
15	500D156M200DF2A	9.5 x 32	11	0.118

STANDARD RATINGS

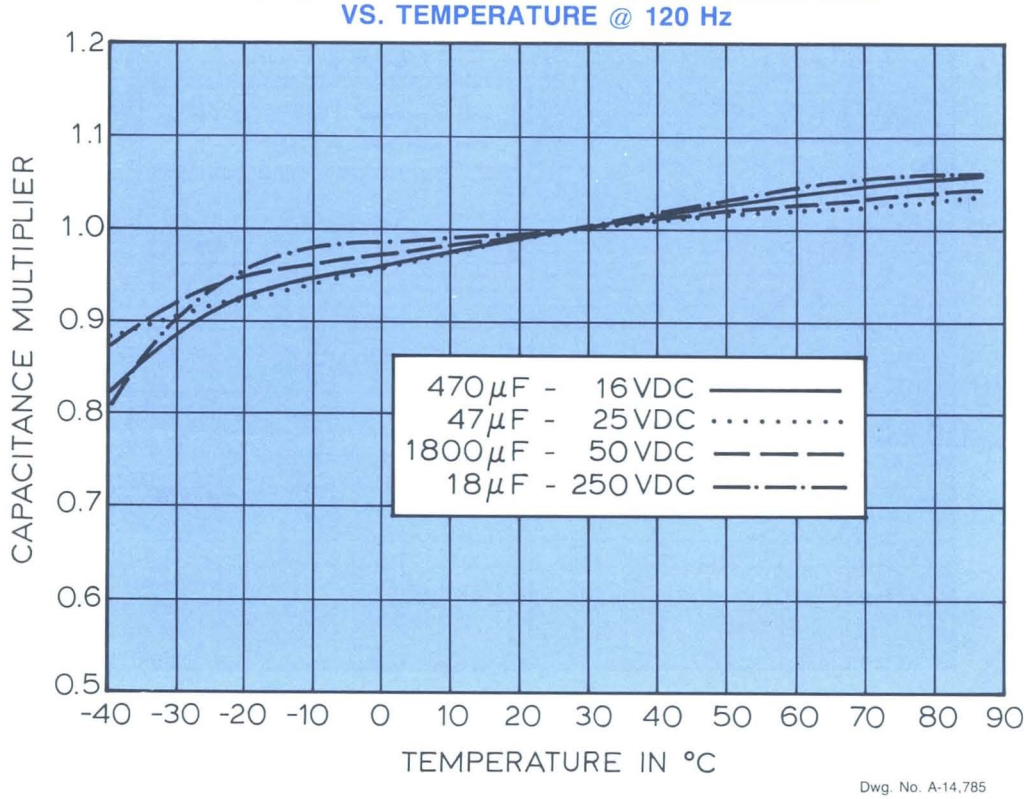
µF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C, 120Hz (Ω)	Max. Ripple Current @ +85°C, 120Hz (A)
200 VOLTS DC WORKING; 250 VOLTS DC SURGE (Cont.)				
22	500D226M200DH2A	9.5 x 38	7.33	0.156
27	500D276M200EF2A	11 x 32	6	0.173
33	500D336M200EH2A	11 x 38	4.888	0.208
39	500D396M200FH2A	12.5 x 38	4	0.248
47	500D476M200FK2A	12.5 x 44.5	3.384	0.289
68	500D686M200GH2A	16 x 38	2.357	0.368
82	500D826M200GK2A	16 x 44.5	1.94	0.435
100	500D107M200LS2A	18 x 40	1.609	0.494
250 VOLTS DC WORKING; 300 VOLTS DC SURGE				
1.0	500D105M250BA2A	6.3 x 13	160.97	0.017
1.8	500D185M250BB2A	6.3 x 17.5	88	0.026
2.2	500D225M250CB2A	8 x 17.5	73.3	0.032
3.3	500D335M250CC2A	8 x 20.5	48	0.042
6.8	500D685M250DC2A	9.5 x 20.5	23.57	0.067
8.2	500D825M250DD2A	9.5 x 24	19.4	0.078
12	500D126M250DF2A	9.5 x 32	13.2	0.107
18	500D186M250DH2A	9.5 x 38	8.8	0.143
18	500D186M250EF2A	11 x 32	8.8	0.144
27	500D276M250EH2A	11 x 38	6	0.188
27	500D276M250FH2A	12.5 x 38	6	0.203
39	500D396M250FK2A	12.5 x 44.5	4	0.266
47	500D476M250GH2A	16 x 38	3.384	0.307
56	500D566M250GK2A	16 x 44.5	2.808	0.362
82	500D826M250LS2A	18 x 40	1.94	0.448
350 VOLTS DC WORKING; 400 VOLTS DC SURGE				
0.47	500D474M350BA2A	6.3 x 13	338	0.012
0.82	500D824M350BB2A	6.3 x 17.5	1.94	0.017
1.2	500D125M350CB2A	8 x 17.5	132	0.024
1.8	500D185M350CC2A	8 x 20.5	88	0.031
3.3	500D335M350DC2A	9.5 x 20.5	48.8	0.047
3.9	500D395M350DD2A	9.5 x 24	40	0.055
5.6	500D565M350DF2A	9.5 x 32	28	0.074
8.2	500D825M350DH2A	9.5 x 38	19.4	0.096
10	500D106M350EF2A	11 x 32	16.09	0.106
12	500D126M350EH2A	11 x 38	13.2	0.127
15	500D156M350FH2A	12.5 x 38	11	0.151
18	500D186M350FK2A	12.5 x 44.5	8.8	0.179
22	500D226M350GH2A	16 x 38	7.33	0.209
33	500D336M350GK2A	16 x 44.5	4.88	0.274
39	500D396M350LS2A	18 x 40	4	0.312
400 VOLTS DC WORKING; 450 VOLTS DC SURGE				
0.27	500D274M400BA2A	6.3 x 13	600	0.009
0.56	500D564M400BB2A	6.3 x 17.5	280	0.015
0.68	500D684M400CB2A	8 x 17.5	235	0.018
1.0	500D105M400CC2A	8 x 20.5	160.97	0.023
2.2	500D225M400DC2A	9.5 x 20.5	73.3	0.038
2.7	500D275M400DD2A	9.5 x 24	60	0.045
3.9	500D395M400DF2A	9.5 x 32	40	0.063
5.6	500D565M400DH2A	9.5 x 38	28	0.08
6.8	500D685M400EF2A	11 x 32	23.57	0.088
10	500D106M400EH2A	11 x 38	16.09	0.115
12	500D126M400FH2A	12.5 x 38	13.2	0.137
15	500D156M400FK2A	12.5 x 44.5	11	0.161
18	500D186M400GH2A	16 x 38	8.8	0.191
22	500D226M400GK2A	16 x 44.5	7.33	0.224
39	500D396M400LS2A	18 x 40	4	0.312

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C, 120Hz (Ω)	Max. Ripple Current @ +85°C, 120Hz (A)
450 VOLTS DC WORKING; 500 VOLTS DC SURGE				
0.22	500D224M450BA2A	6.3 x 13	733	0.008
0.47	500D474M450BB2A	6.3 x 17.5	338.4	0.013
0.56	500D564M450CB2A	8 x 17.5	280	0.016
0.82	500D824M450CC2A	8 x 20.5	194.1	0.021
1.8	500D185M450DC2A	9.5 x 20.5	88	0.035
2.2	500D225M450DD2A	9.5 x 24	73.3	0.04
3.3	500D335M450DF2A	9.5 x 32	48.88	0.056
4.7	500D475M450DH2A	9.5 x 38	33.84	0.073
5.6	500D565M450EF2A	11 x 32	28	0.08
8.2	500D825M450EH2A	11 x 38	19.41	0.105
10	500D106M450FH2A	12.5 x 38	16.09	0.124
12	500D126M450FK2A	12.5 x 44.5	13.2	0.146
15	500D156M450GH2A	16 x 38	11	0.171
18	500D186M450GK2A	16 x 44.5	8.8	0.204
33	500D336M450LS2A	18 x 40	4.88	0.283

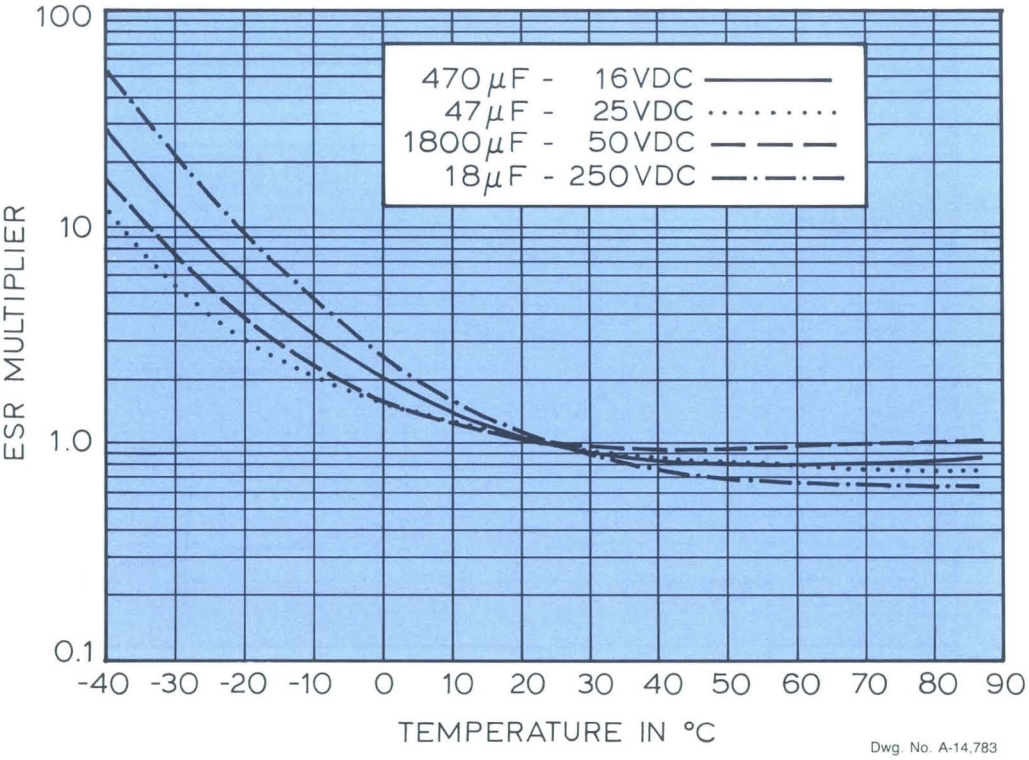
TYPICAL CURVES

TYPE 500D — TYPICAL CAPACITANCE MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,785

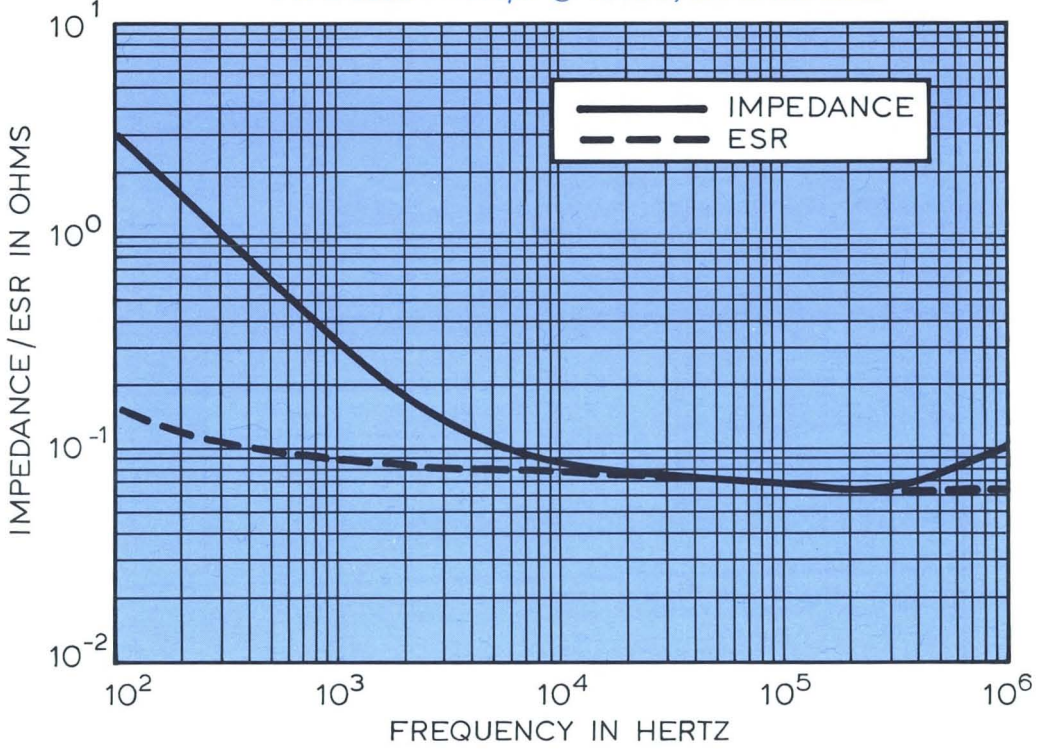
TYPE 500D — TYPICAL ESR MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,783

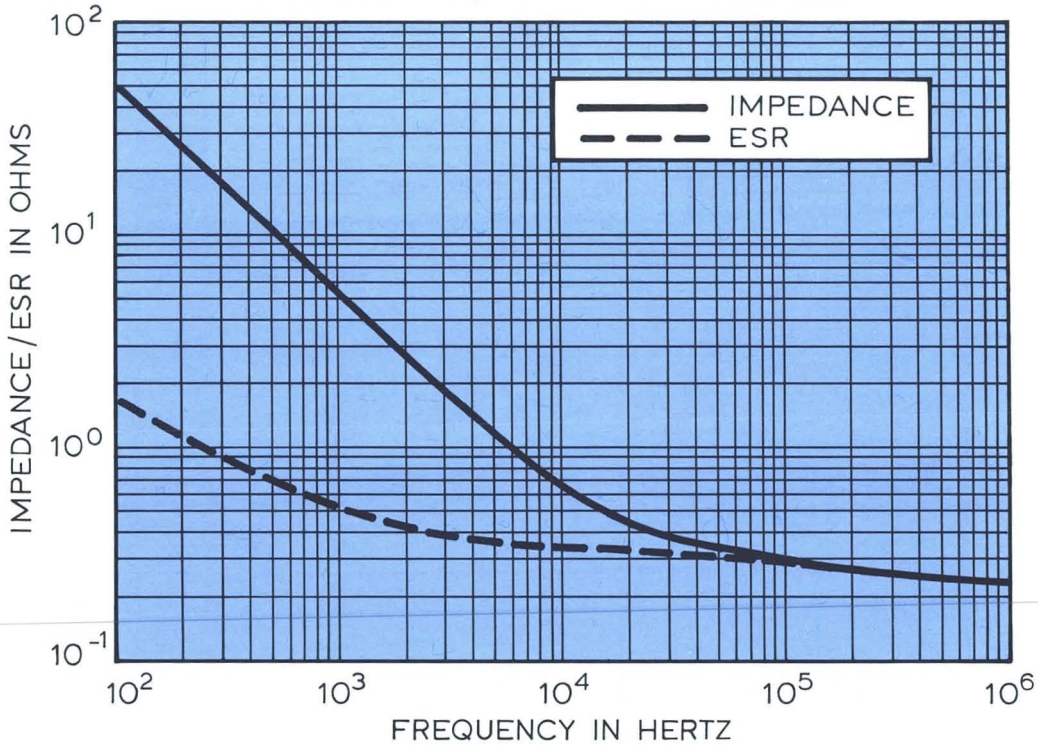
TYPICAL CURVES @ +25°C

TYPE 500D — 470μF @ 16VDC, DD CASE SIZE



Dwg. No. A-14,753

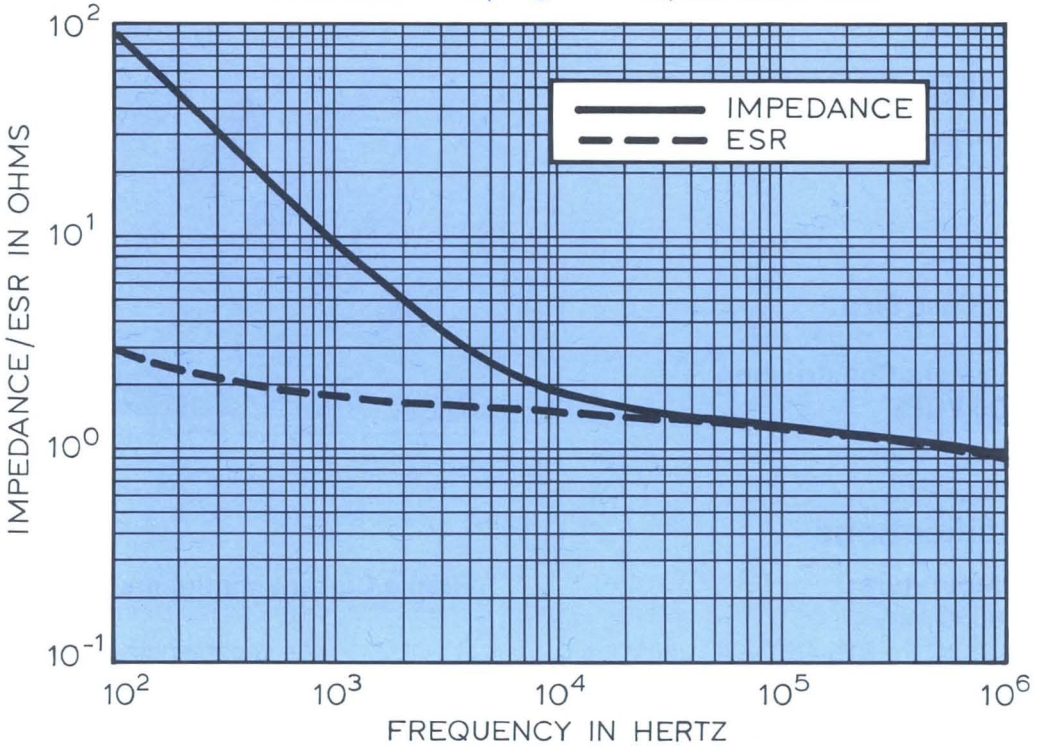
TYPE 500D — 47μF @ 25VDC, BB CASE SIZE



Dwg. No. A-14,751

TYPICAL CURVES @ +25°C

TYPE 500D — 18μF @ 250VDC, DH CASE SIZE

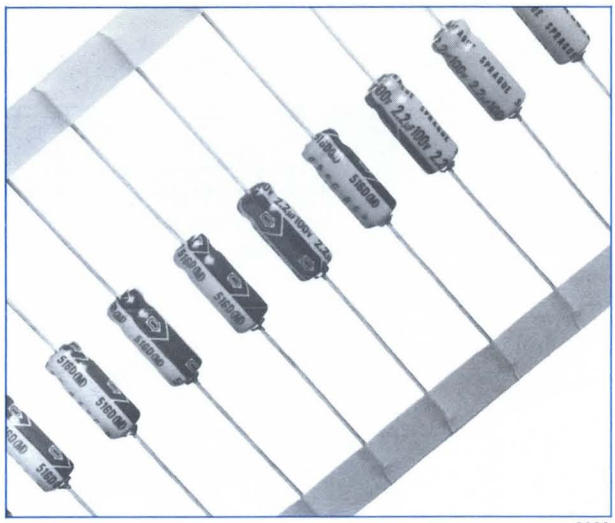


Dwg. No. A-14,752

Miniature Axial Lead Aluminum Capacitors

Features —

- High CV per Case Size
- Low Cost
- Solvent Resistant Construction (through 100 VDC)



General Specifications —

Operating Temperature:
– 40°C - + 85°C;
(– 25°C - + 85°C for 315-450 VDC units).

Voltage Range: 6.3 VDC - 450 VDC.

Capacitance Range: 0.47μF - 10,000μF.

Capacitance Tolerance: ± 20%.

Case Size Range: 5 x 12mm - 18 x 41mm.

Termination: 2 axial leads.

Life Validation Test: 2000 hrs. @ +85°C:
Δ CAP ± 20% from initial measurement.
Δ DF 2x initial specified limit.
Δ DCL ≤ initial specified limit.

Shelf Test: 1000 hrs. @ +85°C:
Δ CAP ± 20% from initial measurement.
Δ DF 2x initial specified limit.
Δ DCL ≤ initial specified limit.

DC Leakage Current:
Rated voltage for 1 minute for 6.3-100 VDC units
I < 0.03CV or 4μA (whichever is greater)
Rated voltage for 2 minutes for 6.3-100 VDC units
I < 0.01CV or 3μA (whichever is greater)
Rated voltage for 1 minute for 160-450 VDC units
I < 0.1CV +40μA and CV ≤1000
I < 0.04CV +100μA and CV >1000

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	Multipliers
≤+70°C	1.27
+85°C	1.0

Frequency Hz/Capacitance (μF)

VDC	CAP	50-60	100-120	300-400	1kHz	≤ 10kHz
6.3-100	0-47	0.75	1	1.35	1.57	2.00
	100-470	0.80	1	1.23	1.34	1.50
	1000-10,000	0.85	1	1.10	1.13	1.15
160-450	1-100	0.80	1	1.25	1.40	1.60

Low Temperature Performance:

Maximum Impedance Ratio
$Z^{(T)}/Z^{(+20°C)}$ max. @ 120Hz

Rated Voltage (VDC)	Z–25°C/Z+20°C	Z–40°C/Z+20°C
6.3	4	10
10	3	8
16	2	6
25	2	4
35-100	2	3
160-250	4	12
315-350	6	—
400-450	15	—

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

516D 107 M 6R3 JL 6 A

- **LEAD CONFIGURATION.** A = STANDARD LEADS. B OR C = TAPING CODES (SEE TAPE SPECIFICATION ON PAGE 74)
- **PACKAGING CODE.** 6 = BULK PACKED, 7 = TAPE AND REEL
- **CASE CODE.** SEE DIMENSIONS.
- **DC VOLTAGE RATING.** THIS IS EXPRESSED IN VOLTS. THE LETTER "R" IS USED AS A DECIMAL POINT.
- **CAPACITANCE TOLERANCE.** M ±20%
- **CAPACITANCE.** THIS IS EXPRESSED IN PICOFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES. THE THIRD IS THE NUMBER OF ZEROS.
- **SPRAGUE TYPE NUMBER.** THIS IDENTIFIES THE BASIC CAPACITOR DESIGN.

DIMENSIONS IN MILLIMETERS

Case Code	Nominal Case Size D x L	Lead Diameter	Typical Weight (gm)
JL	5 x 12	0.6	0.56
LL	6.3 x 12	0.6	0.74
LM	6.3 x 12	0.6	0.91
MM	8 x 16	0.6	1.00
MN	8 x 20	0.6	1.70
NP	10 x 21	0.6	2.32
NR	10 x 25	0.6	3.10
PR	13 x 26	0.6	4.63
PS	13 x 31.5	0.6	5.47
QS	16 x 31.5	0.8	8.26
QT	16 x 41.5	0.8	10.42
RT	18 x 41.0	0.8	12.42

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Lead Diameter	Max. Ripple Current 120Hz, +85°C (mA)	Max. D.F. 120Hz, +20°C
6.3 VOLTS DC WORKING; 8 VDC SURGE					
100	516D107M6R3JL6A	5 x 12	0.6	110	0.24
220	516D227M6R3LM6A	6.3 x 16	0.6	200	0.24
330	516D337M6R3LM6A	6.3 x 16	0.6	250	0.24
470	516D477M6R3MM6A	8 x 16	0.6	330	0.24
1000	516D108M6R3NP6A	10 x 21	0.6	600	0.24
2200	516D228M6R3PR6A	13 x 26	0.6	1020	0.24
3300	516D338M6R3PR6A	13 x 26	0.6	1200	0.24
4700	516D478M6R3QS6A	16 x 31.5	0.6	1500	0.24
6800	516D688M6R3QS6A	16 x 31.5	0.8	1840	0.24
10000	516D109M6R3QT6A	16 x 41.5	0.8	2260	0.24
10 VOLTS DC WORKING; 13 VDC SURGE					
33	516D336M010JL6A	5 x 12	0.6	65	0.20
47	516D476M010JL6A	5 x 12	0.6	80	0.20
100	516D107M010LL6A	6.3 x 12	0.6	130	0.20
220	516D227M010LM6A	6.3 x 16	0.6	210	0.20
330	516D337M010MM6A	8 x 16	0.6	300	0.20
470	516D477M010MM6A	8 x 16	0.6	350	0.20
1000	516D108M010NP6A	10 x 21	0.6	640	0.20
2200	516D228M010PR6A	13 x 26	0.6	1090	0.20
3300	516D338M010PS6A	13 x 31.5	0.6	1390	0.20
4700	516D478M010QS6A	16 x 31.5	0.8	1730	0.20
6800	516D688M010QT6A	16 x 41.5	0.8	1930	0.20
10000	516D109M010RT6A	18 x 41	0.8	2350	0.20
16 VOLTS DC WORKING; 20 VDC SURGE					
22	516D226M016JL6A	5 x 12	0.6	60	0.16
33	516D336M016JL6A	5 x 12	0.6	70	0.16
47	516D476M016JL6A	5 x 12	0.6	85	0.16
100	516D107M016LM6A	6.3 x 16	0.6	160	0.16
220	516D227M016MM6A	8 x 16	0.6	260	0.16
330	516D337M016MM6A	8 x 16	0.6	320	0.16
470	516D477M016MN6A	8 x 20	0.6	430	0.16
1000	516D108M016NR6A	10 x 26	0.6	770	0.16
2200	516D228M016PS6A	13 x 31.5	0.6	1180	0.16
3300	516D338M016QS6A	16 x 31.5	0.8	1620	0.16
4700	516D478M016QT6A	16 x 41.5	0.8	1840	0.16
6800	516D688M016RT6A	18 x 41	0.8	2310	0.16
25 VOLTS DC WORKING; 32 VDC SURGE					
10	516D106M025JL6A	5 x 12	0.6	40	0.14
22	516D226M025JL6A	5 x 12	0.6	65	0.14
33	516D336M025JL6A	5 x 12	0.6	80	0.14
47	516D476M025LL6A	6.3 x 12	0.6	100	0.14
100	516D107M025LM6A	6.3 x 16	0.6	170	0.14
220	516D227M025MM6A	8 x 16	0.6	280	0.14
330	516D337M025MN6A	8 x 20	0.6	380	0.14
470	516D477M025NR6A	10 x 26	0.6	510	0.14
1000	516D108M025PR6A	13 x 26	0.6	900	0.14
2200	516D228M025QS6A	16 x 31.5	0.8	1480	0.14
3300	516D338M025QT6A	16 x 41.5	0.8	1710	0.14
4700	516D478M025RT6A	18 x 41	0.8	2170	0.14

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Lead Diameter	Max. Ripple Current 120Hz, +85°C (mA)	Max. D.F. 120Hz, +20°C
35 VOLTS DC WORKING; 44 VDC SURGE					
10	516D106M035JL6A	5 x 12	0.6	45	0.12
22	516D226M035JL6A	5 x 12	0.6	70	0.12
33	516D336M035LL6A	6.3 x 12	0.6	90	0.12
47	516D476M035LM6A	6.3 x 16	0.6	120	0.12
100	516D107M035MM6A	8 x 16	0.6	210	0.12
220	516D227M035MN6A	8 x 20	0.6	340	0.12
330	516D337M035NP6A	10 x 21	0.6	460	0.12
470	516D477M035NR6A	10 x 26	0.6	610	0.12
1000	516D108M035PS6A	13 x 31.5	0.6	1060	0.12
2200	516D228M035QS6A	16 x 31.5	0.8	1580	0.12
3300	516D338M035QT6A	16 x 41.5	0.8	2050	0.12
50 VOLTS DC WORKING; 63 VDC SURGE					
.47	516D474M050JL6A	5 x 12	0.6	5	0.10
1	516D105M050JL6A	5 x 12	0.6	10	0.10
2.2	516D225M050JL6A	5 x 12	0.6	23	0.10
3.3	516D335M050JL6A	5 x 12	0.6	28	0.10
4.7	516D475M050JL6A	5 x 12	0.6	34	0.10
10	516D106M050JL6A	5 x 12	0.6	50	0.10
22	516D226M050LL6A	6.3 x 12	0.6	85	0.10
33	516D336M050LM6A	6.3 x 16	0.6	110	0.10
47	516D476M050LM6A	6.3 x 16	0.6	130	0.10
100	516D107M050MM6A	8 x 16	0.6	220	0.10
220	516D227M050NP6A	10 x 21	0.6	410	0.10
330	516D337M050NR6A	10 x 26	0.6	560	0.10
470	516D477M050PR6A	13 x 26	0.6	730	0.10
1000	516D108M050QS6A	16 x 31.5	0.8	1260	0.10
2200	516D228M050RT6A	18 x 41	0.8	1920	0.10
63 VOLTS DC WORKING; 79 VDC SURGE					
3.3	516D335M063JL6A	5 x 12	0.6	31	0.08
4.7	516D475M063JL6A	5 x 12	0.6	37	0.08
10	516D106M063JL6A	5 x 12	0.6	55	0.08
22	516D226M063LL6A	6.3 x 12	0.6	90	0.08
33	516D336M063LM6A	6.3 x 16	0.6	120	0.08
47	516D476M063MM6A	8 x 16	0.6	160	0.08
100	516D107M063MN6A	8 x 20	0.6	260	0.08
220	516D227M063NR6A	10 x 26	0.6	480	0.08
330	516D337M063PR6A	13 x 26	0.6	650	0.08
470	516D477M063PS6A	13 x 31.5	0.6	840	0.08
1000	516D108M063QS6A	16 x 31.5	0.8	1330	0.08
100 VOLTS DC WORKING; 125 VDC SURGE					
.47	516D474M100JL6A	5 x 12	0.6	10	0.08
1	516D105M100JL6A	5 x 12	0.6	18	0.08
2.2	516D225M100JL6A	5 x 12	0.6	28	0.08
3.3	516D335M100JL6A	5 x 12	0.6	34	0.08
4.7	516D475M100JL6A	5 x 12	0.6	40	0.08
10	516D106M100LL6A	6.3 x 12	0.6	60	0.08
22	516D226M100MM6A	8 x 16	0.6	120	0.08
33	516D336M100MM6A	8 x 16	0.6	150	0.08

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Lead Diameter	Max. Ripple Current 120Hz, +85°C (mA)	Max. D.F. 120Hz, +20°C
100 VOLTS DC WORKING; 125 VDC SURGE (Cont.)					
47	516D476M100MN6A	8 x 20	0.6	190	0.08
100	516D107M100NR6A	10 x 26	0.6	340	0.08
220	516D227M100PR6A	13 x 26	0.6	560	0.08
330	516D337M100PS6A	13 x 31.5	0.6	750	0.08
470	516D477M100QS6A	16 x 31.5	0.8	970	0.08
160 VOLTS DC WORKING; 200 VDC SURGE					
1	516D105M160LL6A	6.3 x 12	0.6	13	0.20
2.2	516D225M160LM6A	6.3 x 16	0.6	23	0.20
3.3	516D335M160MM6A	8 x 16	0.6	33	0.20
4.7	516D475M160MM6A	8 x 16	0.6	39	0.20
10	516D106M160MN6A	8 x 20	0.6	60	0.20
22	516D226M160NR6A	10 x 26	0.6	120	0.20
33	516D336M160PR6A	13 x 26	0.6	170	0.20
47	516D476M160PS6A	13 x 31.5	0.6	230	0.20
100	516D107M160QT6A	16 x 41.5	0.8	430	0.20
200 VOLTS DC WORKING; 250 VDC SURGE					
1	516D105M200LL6A	6.3 x 12	0.6	13	0.20
2.2	516D225M200LM6A	6.3 x 16	0.6	23	0.20
3.3	516D335M200MM6A	8 x 16	0.6	33	0.20
4.7	516D475M200MM6A	8 x 16	0.6	39	0.20
10	516D106M200NP6A	10 x 21	0.6	70	0.20
22	516D226M200PR6A	13 x 26	0.6	140	0.20
33	516D336M200PR6A	13 x 26	0.6	170	0.20
47	516D476M200PS6A	13 x 31.5	0.6	230	0.20
100	516D107M200QT6A	16 x 41.5	0.8	430	0.20
250 VOLTS DC WORKING; 300 VDC SURGE					
1	516D105M250LM6A	6.3 x 16	0.6	14	0.20
2.2	516D225M250MM6A	8 x 16	0.6	27	0.20
3.3	516D335M250MM6A	8 x 16	0.6	33	0.20
4.7	516D475M250MN6A	8 x 20	0.6	45	0.20
10	516D106M250NP6A	10 x 21	0.6	70	0.20
22	516D226M250PR6A	13 x 26	0.6	140	0.20
33	516D336M250PS6A	13 x 31.5	0.6	190	0.20
47	516D476M250QS6A	16 x 31.5	0.8	260	0.20
100	516D107M250QT6A	16 x 41.5	0.8	430	0.20
315 VOLTS DC WORKING; 365 VDC SURGE					
1	516D105M315LM6A	6.3 x 16	0.6	14	0.20
2.2	516D225M315MM6A	8 x 16	0.6	27	0.20
3.3	516D335M315MN6A	8 x 20	0.6	36	0.20
4.7	516D475M315MN6A	8 x 20	0.6	45	0.20
10	516D106M315NR6A	10 x 26	0.6	80	0.20
22	516D226M315PS6A	13 x 31.5	0.6	150	0.20
33	516D336M315QS6A	16 x 31.5	0.8	210	0.20
47	516D476M315QS6A	16 x 31.5	0.8	260	0.20
350 VOLTS DC WORKING; 400 VDC SURGE					
1	516D105M350LM6A	6.3 x 16	0.6	12	0.25
2.2	516D225M350MM6A	8 x 16	0.6	24	0.25
3.3	516D335M350MN6A	8 x 20	0.6	32	0.25
4.7	516D475M350NP6A	10 x 21	0.6	46	0.25

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (mm) D x L	Lead Diameter	Max. Ripple Current 120Hz, +85°C (mA)	Max. D.F. 120Hz, +20°C
350 VOLTS DC WORKING; 400 VDC SURGE (Cont.)					
10	516D106M350PR6A	13 x 26	0.6	85	0.25
22	516D226M350PS6A	13 x 31.5	0.6	140	0.25
33	516D336M350QS6A	16 x 31.5	0.8	190	0.25
47	516D476M350QT6A	16 x 41.5	0.8	260	0.25
400 VOLTS DC WORKING; 450 VDC SURGE					
1	516D105M400MM6A	8 x 16	0.6	14	0.25
2.2	516D225M400MN6A	8 x 20	0.6	28	0.25
3.3	516D335M400NP6A	10 x 21	0.6	38	0.25
4.7	516D475M400NP6A	10 x 21	0.6	46	0.25
10	516D106M400PR6A	13 x 26	0.6	85	0.25
22	516D226M400QS6A	16 x 31.5	0.8	150	0.25
33	516D336M400QT6A	16 x 41.5	0.8	210	0.25
47	516D476M400RT6A	18 x 41	0.8	290	0.25
450 VOLTS DC WORKING; 500 VDC SURGE					
1	516D105M450MM6A	8 x 16	0.6	14	0.25
2.2	516D225M450NP6A	10 x 21	0.6	31	0.25
3.3	516D335M450NP6A	10 x 21	0.6	38	0.25
4.7	516D475M450NR6A	10 x 26	0.6	50	0.25
10	516D106M450PR6A	13 x 26	0.6	85	0.25
22	516D226M450QS6A	16 x 31.5	0.8	150	0.25
33	516D336M450RT6A	18 x 41	0.8	230	0.25

+125°C High Reliability Miniature Axial Lead Aluminum Capacitors

9907

Features —

- **Wide Temperature Range**
- **Military Version — MIL-C-39018/01**
- **Foil Tantalum Replacement**
- **Unique Teflon End Seal for Long Life**
- **High Vibration Capability**
- **Life Test 2000 Hours @ +125°C**

General Specifications —

Operating Temperature:
−55°C - +125°C.

Voltage Range: 5 - 250 VDC.

Capacitance Range: 2.2μF - 2,700μF.

Capacitance Tolerance: −10%, +50%.

Case Size Range: 7 x 24mm - 9.5 x 68mm.

Termination: Axial leaded.

Life Validation Test: 2000 hrs @ +125°C:
Δ CAP ≤ 15% from initial measurement.
Δ ESR ≤ 1.3x initial specified limit.
Δ DCL ≤ initial specified limit.

Shelf Test: 500 hrs @ +125°C:
Δ CAP ≤ 10% from initial measurement.
Δ ESR ≤ 1.15x initial specified limit.
Δ DCL ≤ 2x initial specified limit.

DC Leakage Current:

0 - 75 VDC	100-250 VDC
$I = .15\sqrt{CV}$	$I = .15\sqrt{CV} + 5$

I in μA, C in μF, V in Volts

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	Multipliers
+125°C	1.0
+85°C	2.0
+75°C or less	2.4

FREQUENCY Hz

VDC	50-60	100-120	300-400	>1000
0-30	0.85	1.00	1.04	1.08
31-250	0.80	1.00	1.30	1.40

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

600D 227 F 005 KD 4

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

CAPACITANCE. EXPRESSED IN PICOFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

CAPACITANCE TOLERANCE. F = −10, +50%.

DC VOLTAGE RATING. EXPRESSED IN VOLTS.

CASE CODE. SEE DIMENSIONS, BELOW.

CASE STYLE. 0 = BARE CASE.
4 = POLYESTER INSULATING SLEEVE (Standard).
5 = POLYESTER SLEEVE WITH RESIN END SEAL.
(Required for exposure to halogenated cleaning solvents).

DIMENSIONS IN MILLIMETERS

Case Code	Bare Case		With Outer Insulation	
	Diameter ± 0.40	Length ± 0.79	Diameter ± 0.79	Length Max.
KD	7.14	23.81	7.54	25.40
DD	9.53	23.81	9.92	25.40
DE	9.53	28.58	9.92	30.16
DG	9.53	34.93	9.92	36.51
DJ	9.53	41.28	9.92	42.86
DL	9.53	55.56	9.92	57.12
DX	9.53	68.26	9.92	69.82

STANDARD RATINGS

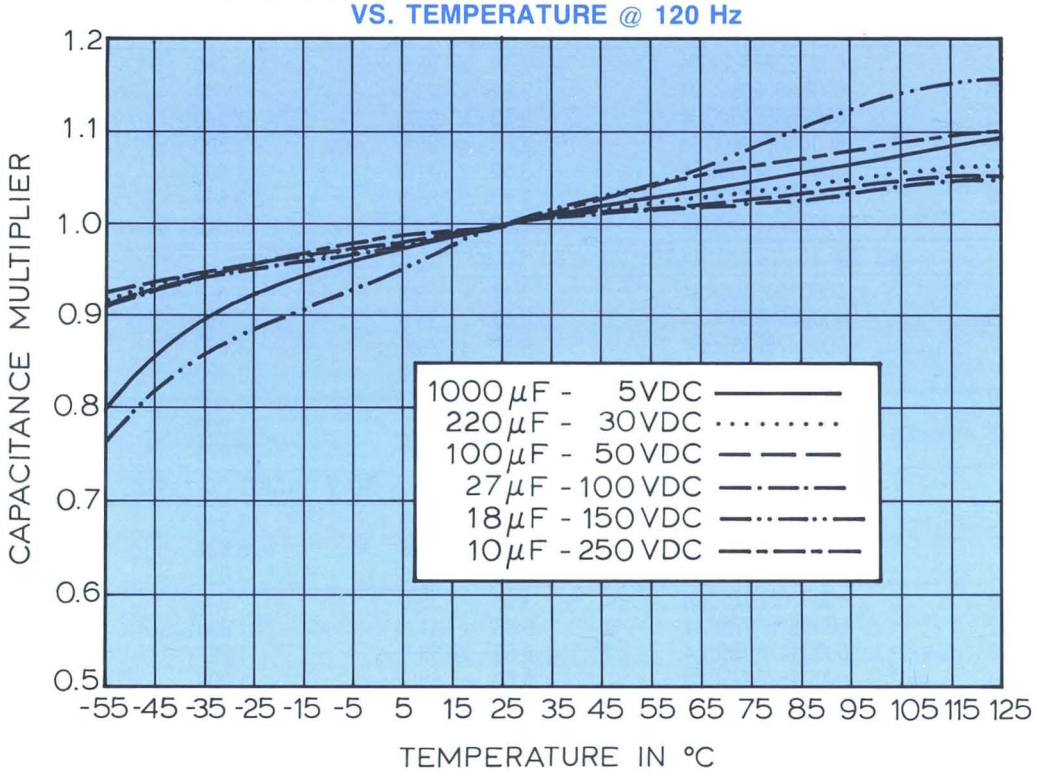
µF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C, 120Hz (Ω)	Max. Ripple Current @ +125°C, 120Hz (A)
5 VOLTS DC WORKING @ +85°C; 3 VOLTS DC WORKING @ +125°C				
220	600D227F005KD4	7.14 x 23.8	1.750	0.127
470	600D477F005DD4	9.53 x 23.8	0.813	0.221
680	600D687F005DE4	9.53 x 28.6	0.564	0.286
1000	600D108F005DG4	9.53 x 35.0	0.388	0.377
1200	600D128F005DJ4	9.53 x 41.3	0.320	0.477
1800	600D188F005DL4	9.53 x 55.5	0.210	0.631
2700	600D278F005DX4	9.53 x 68.2	0.140	0.851
7 VOLTS DC WORKING @ +85°C; 5 VOLTS DC WORKING @ +125°C				
180	600D187F007KD4	7.14 x 23.8	2.121	0.115
390	600D397F007DD4	9.53 x 23.8	0.972	0.202
470	600D477F007DE4	9.53 x 28.6	0.813	0.238
680	600D687F007DG4	9.53 x 35.0	0.564	0.312
1000	600D108F007DJ4	9.53 x 41.3	0.388	0.406
1500	600D158F007DL4	9.53 x 55.5	0.260	0.567
2200	600D228F007DX4	9.35 x 68.2	0.175	0.761
10 VOLTS DC WORKING @ +85°C; 7 VOLTS DC WORKING @ +125°C				
120	600D127F010KD4	7.14 x 23.8	3.180	0.094
330	600D337F010DD4	9.53 x 23.8	1.160	0.185
390	600D397F010DE4	9.53 x 28.6	0.972	0.218
560	600D567F010DG4	9.53 x 35.0	0.673	0.286
820	600D827F010DJ4	9.53 x 41.3	0.460	0.373
1200	600D128F010DL4	9.53 x 55.5	0.318	0.513
1500	600D158F010DX4	9.53 x 68.2	0.230	0.664
15 VOLTS DC WORKING @ +85°C; 10 VOLTS DC WORKING @ +125°C				
100	600D107F015KD4	7.14 x 23.8	3.880	0.085
220	600D227F015DD4	9.53 x 23.8	1.750	0.150
330	600D337F015DE4	9.53 x 28.6	1.160	0.199
470	600D477F015DG4	9.53 x 35.0	0.813	0.260
560	600D567F015DJ4	9.53 x 41.3	0.686	0.305
820	600D827F015DL4	9.53 x 55.5	0.460	0.426
1200	600D128F015DX4	9.53 x 68.2	0.320	0.563
20 VOLTS DC WORKING @ +85°C; 15 VOLTS DC WORKING @ +125°C				
68	600D686F020KD4	7.14 x 23.8	4.274	0.081
150	600D157F020DD4	9.53 x 23.8	1.962	0.142
220	600D226F020DE4	9.53 x 28.6	1.325	0.186
330	600D337F020DG4	9.53 x 35.0	0.883	0.250
390	600D397F020DJ4	9.53 x 41.3	0.257	0.299
680	600D687F020DL4	9.53 x 55.5	0.564	0.385
820	600D827F020DX4	9.53 x 68.2	0.360	0.530
30 VOLTS DC WORKING @ +85°C; 20 VOLTS DC WORKING @ +125°C				
47	600D476F030KD4	7.14 x 23.8	3.060	0.096
100	600D107F030DD4	9.53 x 23.8	1.500	0.162
150	600D157F030DE4	9.53 x 28.6	1.000	0.215
220	600D227F030DG4	9.53 x 35.0	0.675	0.285
270	600D277F030DJ4	9.53 x 41.3	0.560	0.338
390	600D397F030DL4	9.53 x 55.5	0.375	0.472
560	600D567F030DX4	9.53 x 68.2	0.264	0.620
40 VOLTS DC WORKING @ +85°C; 30 VOLTS DC WORKING @ +125°C				
33	600D336F040KD4	7.14 x 23.8	4.500	0.079
82	600D826F040DD4	9.53 x 23.8	1.824	0.147
100	600D107F040DE4	9.53 x 28.6	1.500	0.175
150	600D157F040DG4	9.53 x 35.0	1.000	0.234
180	600D187F040DJ4	9.53 x 41.3	0.844	0.275
270	600D277F040DL4	9.53 x 55.5	0.540	0.394
390	600D397F040DX4	9.53 x 68.2	0.397	0.505

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C, 120Hz (Ω)	Max. Ripple Current @ +125°C, 120Hz (A)
50 VOLTS DC WORKING @ +85°C; 40 VOLTS DC WORKING @ +125°C				
22	600D226F050KD4	7.14 x 23.8	6.750	0.065
56	600D566F050DD4	9.53 x 23.8	2.650	0.122
68	600D686F050DE4	9.53 x 28.6	2.170	0.146
100	600D107F050DG4	9.53 x 35.0	1.500	0.192
150	600D157F050DJ4	9.53 x 41.3	1.000	0.253
180	600D187F050DL4	9.53 x 55.5	0.844	0.315
270	600D277F050DX4	9.53 x 68.2	0.540	0.433
60 VOLTS DC WORKING @ +85°C; 50 VOLTS DC WORKING @ +125°C				
15	600D156F060KD4	7.14 x 23.8	9.650	0.055
39	600D396F060DD4	9.53 x 23.8	3.850	0.102
47	600D476F060DE4	9.53 x 28.6	3.060	0.123
82	600D826F060DG4	9.53 x 35.0	1.820	0.174
100	600D107F060DJ4	9.53 x 41.3	1.500	0.207
150	600D157F060DL4	9.53 x 55.5	1.000	0.290
220	600D227F060DX4	9.53 x 68.2	0.675	0.388
75 VOLTS DC WORKING @ +85°C; 60 VOLTS DC WORKING @ +125°C				
12	600D126F075KD4	7.14 x 23.8	12.300	0.048
27	600D276F075DD4	9.53 x 23.8	5.625	0.084
39	600D396F075DE4	9.53 x 28.6	3.857	0.110
56	600D566F075DG4	9.53 x 35.0	2.640	0.144
82	600D826F075DJ4	9.53 x 41.3	1.820	0.187
120	600D127F075DL4	9.53 x 55.5	1.227	0.261
150	600D157F075DX4	9.53 x 68.2	1.000	0.399
100 VOLTS DC WORKING @ +85°C; 75 VOLTS DC WORKING @ +125°C				
6.8	600D685F100KD4	7.14 x 23.8	22.500	0.036
22	600D226F100DD4	9.53 x 23.8	6.750	0.077
27	600D276F100DE4	9.53 x 28.6	5.625	0.091
39	600D396F100DG4	9.53 x 43.0	3.857	0.120
56	600D566F100DJ4	9.53 x 55.3	2.640	0.156
82	600D826F100DL4	9.53 x 68.5	1.824	0.215
120	600D127F100DX4	9.53 x 68.2	1.270	0.910
150 VOLTS DC WORKING @ +85°C; 100 VOLTS DC WORKING @ +125°C				
3.3	600D335F150KD4	7.14 x 23.8	38.300	0.028
6.8	600D685F150DD4	9.53 x 23.8	19.160	0.046
12	600D126F150DE4	9.53 x 28.6	10.500	0.066
18	600D186F150DG4	9.53 x 35.0	6.850	0.090
22	600D226F150DJ4	9.53 x 41.3	5.750	0.106
33	600D336F150DL4	9.53 x 55.5	3.830	0.148
47	600D476F150DX4	9.53 x 68.2	2.610	0.197
200 VOLTS DC WORKING @ +85°C; 150 VOLTS DC WORKING @ +125°C				
3.3	600D335F200KD40	7.14 x 23.8	38.300	0.028
6.8	600D685F200DD40	9.53 x 23.8	19.160	0.046
8.2	600D825F200DE40	9.53 x 28.6	15.500	0.055
12	600D126F200DG40	9.53 x 35.0	10.500	0.073
18	600D186F200DJ40	9.53 x 41.3	6.780	0.098
27	600D276F200DL40	9.53 x 55.5	4.790	0.132
33	600D336F200DX40	9.53 x 68.2	3.830	0.162
250 VOLTS DC WORKING @ +85°C; 200 VOLTS DC WORKING @ +125°C				
2.2	600D225F250KD4	7.14 x 23.8	57.500	0.023
5.6	600D565F250DD4	9.53 x 23.8	23.100	0.042
6.8	600D685F250DE4	9.53 x 28.6	19.160	0.050
10	600D106F250DG4	9.53 x 35.0	12.700	0.066
15	600D156F250DJ4	9.53 x 41.3	8.230	0.088
22	600D226F250DL4	9.53 x 55.5	5.750	0.121
27	600D276F250DX4	9.53 x 68.2	4.790	0.146

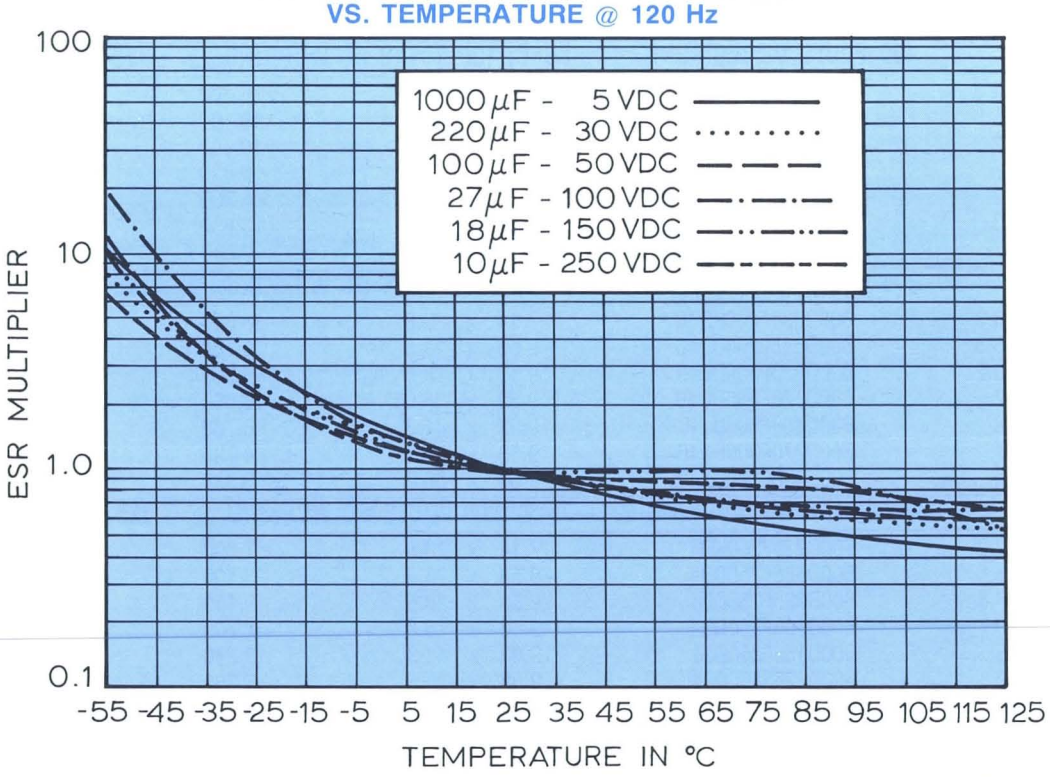
TYPICAL CURVES

TYPE 600D — TYPICAL CAPACITANCE MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,786

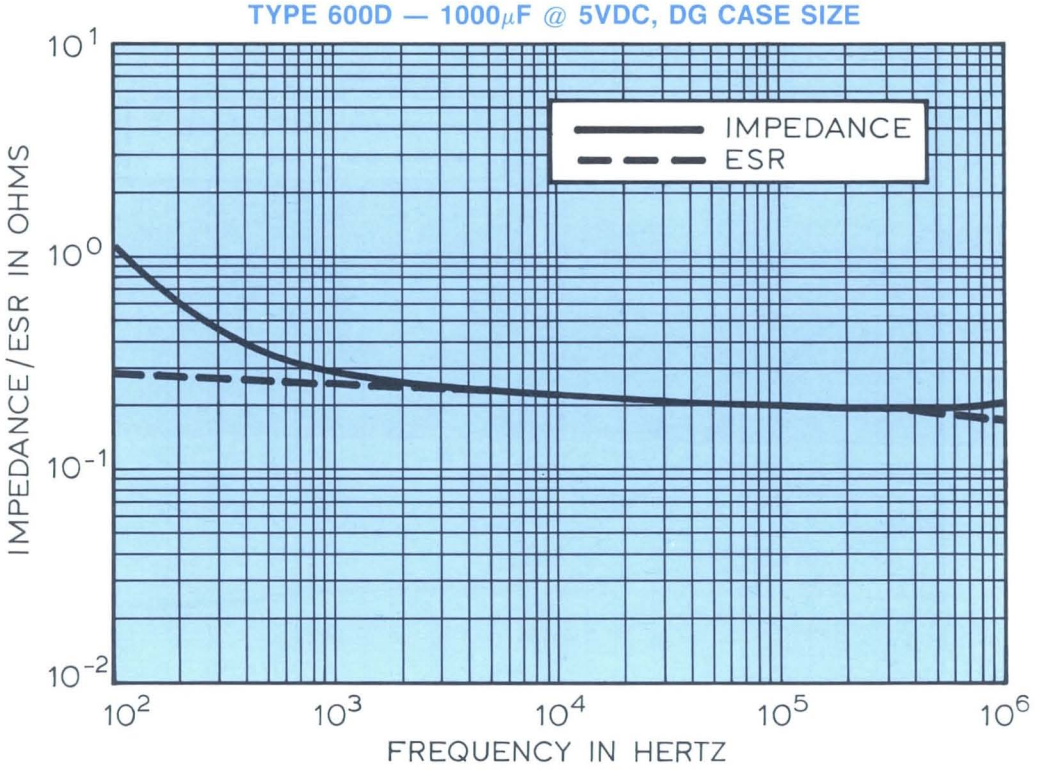
TYPE 600D — TYPICAL ESR MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,773

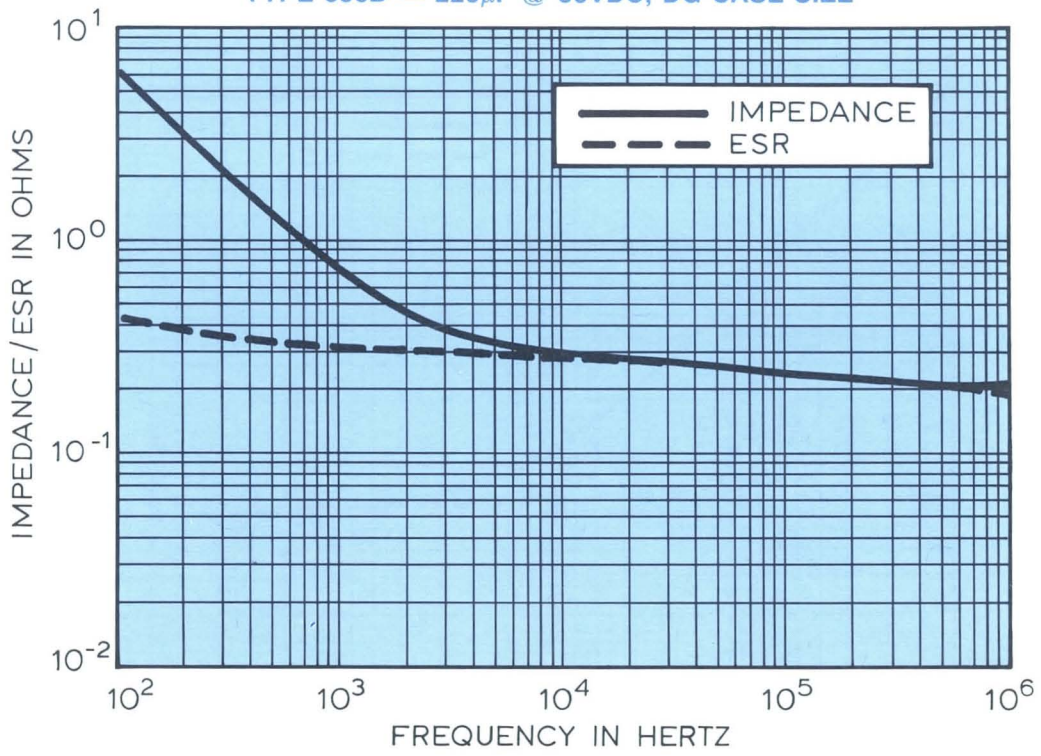
TYPICAL CURVES @ +25°C

TYPE 600D — 1000μF @ 5VDC, DG CASE SIZE



Dwg. No. A-14,766

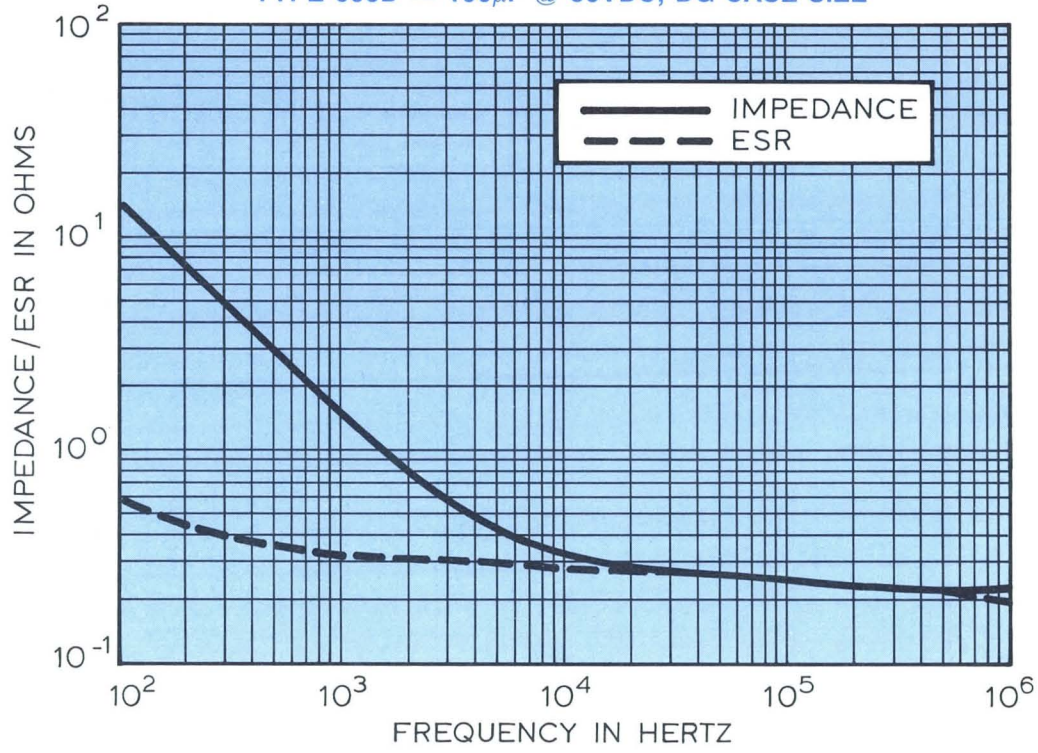
TYPE 600D — 220μF @ 30VDC, DG CASE SIZE



Dwg. No. A-14,767

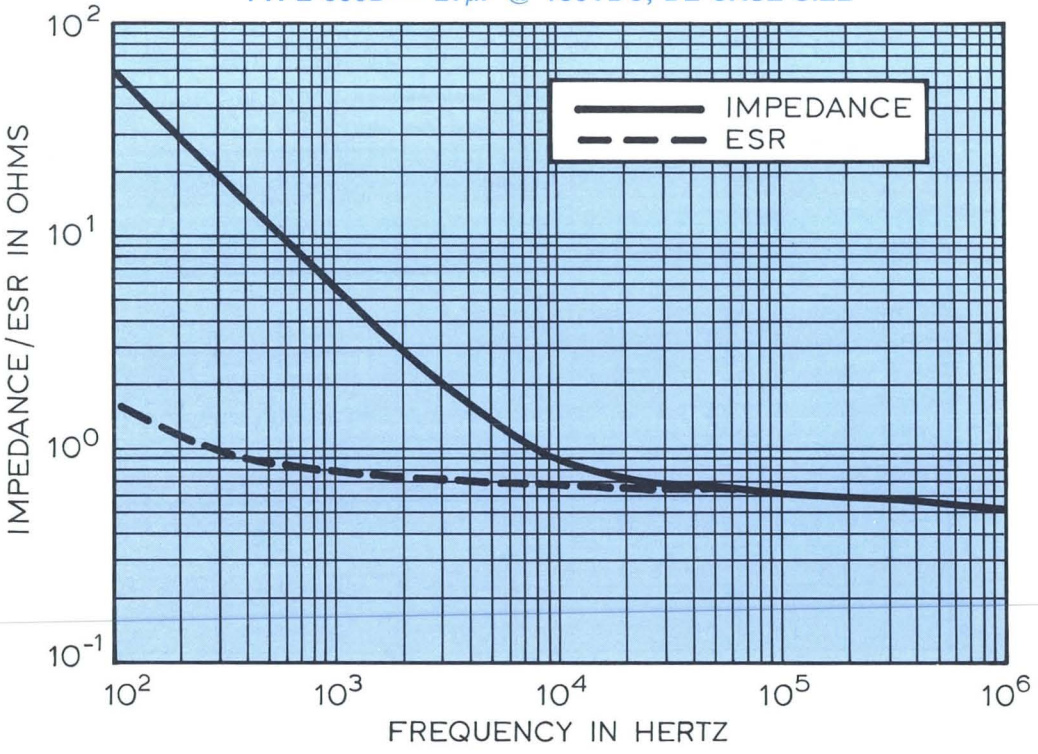
TYPICAL CURVES @ +25°C

TYPE 600D — 100μF @ 50VDC, DG CASE SIZE



Dwg. No. A-14,765

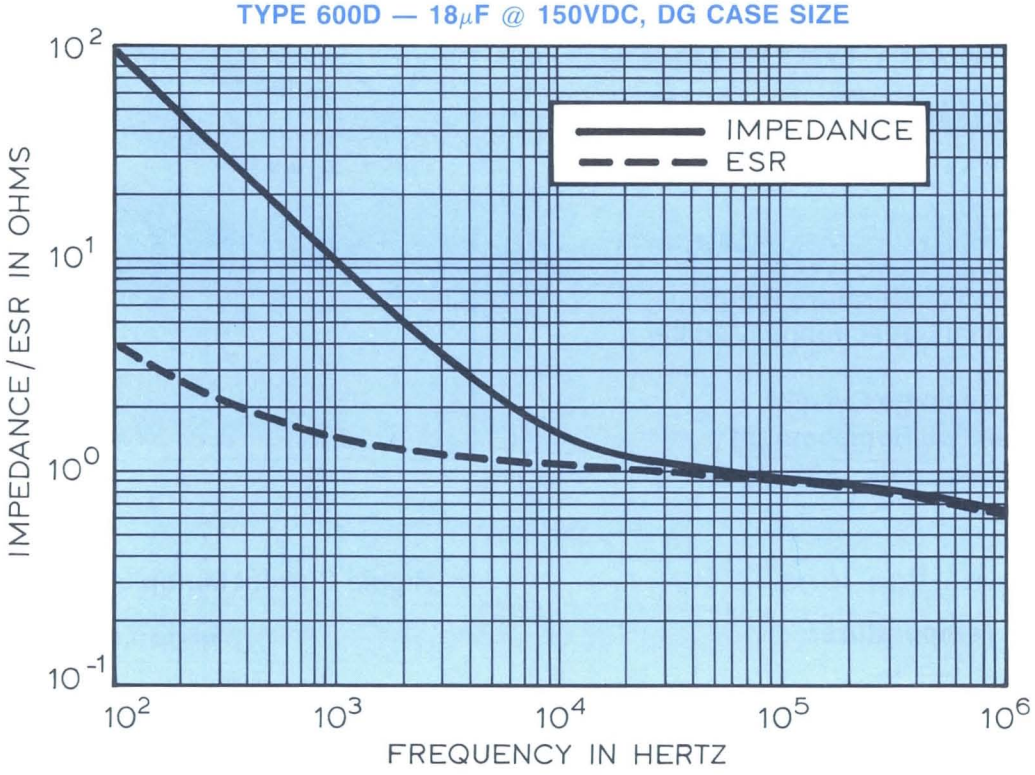
TYPE 600D — 27μF @ 100VDC, DE CASE SIZE



Dwg. No. A-14,764

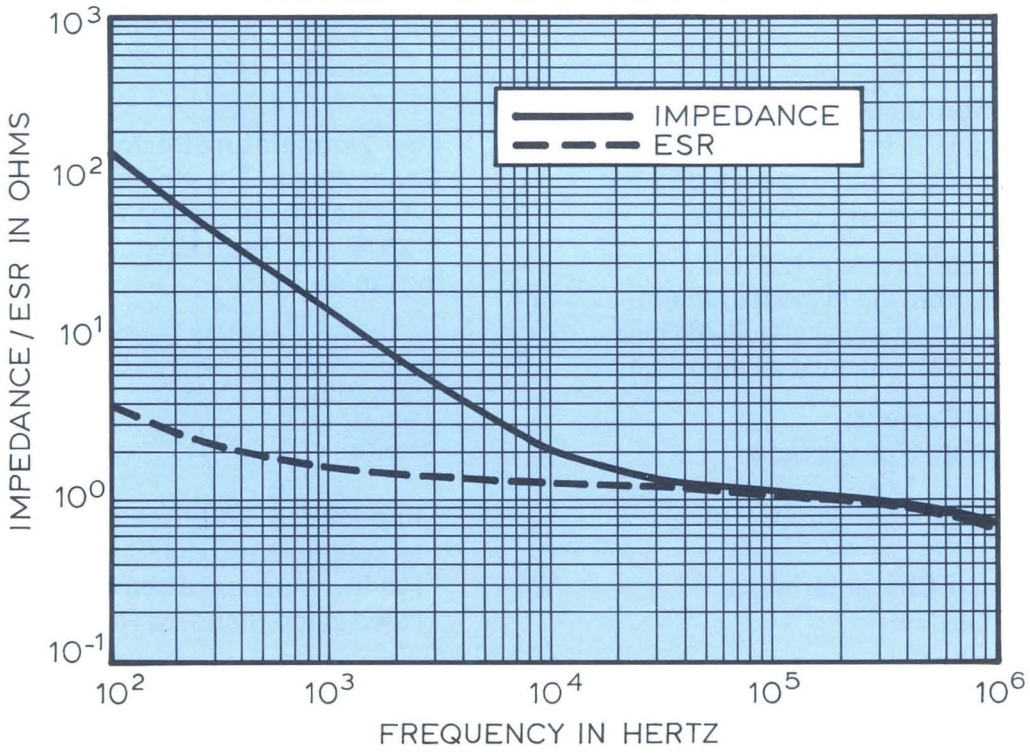
TYPICAL CURVES @ +25°C

TYPE 600D — 18μF @ 150VDC, DG CASE SIZE



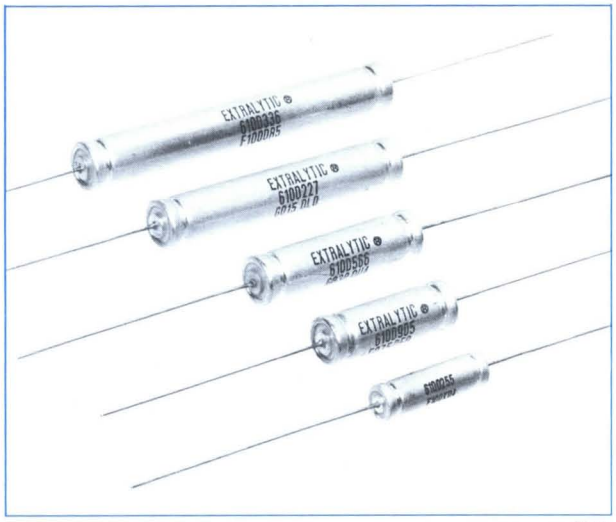
Dwg. No. A-14,763

TYPE 600D — 10μF @ 250VDC, DG CASE SIZE



Dwg. No. A-14,768

+125°C Non-Polar, Miniature Aluminum Capacitors



9908

Features —

- Extended Temperature Range
- Exceptional Capacitance Stability
- Low DF
- Low DC Leakage Current
- Tantalum Foil Replacement
- Mil Version — MIL-C-39018/02

General Specifications —

Operating Temperature:
−55°C - +125°C.

Voltage Range: 7 - 250 VDC.

Capacitance Range: 0.68μF - 680μF.

Capacitance Tolerance: −10%, +50%.

Case Size Range: 0.296″ x 1.000″ - 0.390″ x 2.812″

Termination: Axial.

Life Validation Test: 2000 hours @ +125°C:
Δ CAP ±15% from initial measurement.
Δ ESR < 1.3x initial specified limit.
Δ DCL < initial specified limit.

Shelf Test: 500 hrs @ +125°C:
C < 10% from initial measurement.
Δ ESR < 1.2x initial specified limit.
Δ DCL < 2.0x initial specified limit.

DC Leakage Current:
See Standard Ratings table.

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	Multipliers
+100°C	1.5
+85°C	2.0
+65°C	2.5

FREQUENCY Hz

VDC	50-60	100-120	300-400	>100K
6-60	0.85	1.0	1.10	1.15
61-250	0.83	1.0	1.15	1.20

Low Temperature Performance:
Capacitance. The maximum allowable capacitance change with temperature from +25°C shall be in accordance with the following table:

Rated Voltage at 125°C	Per Cent Capacitance Change at −55°C	+85°C	+125°C
5 thru 15	−30	+15	+20
20 and up	−25	+15	+20

Impedance. When measured at a temperature of −55°C and a frequency of 120 Hz, the impedance shall not exceed the values listed in the Standard Ratings Table.

Catalog Numbering System

610D 476 G 007 KD 2

STYLE NUMBER. 2 = OUTER INSULATION
5 = OUTER INSULATION WITH POLYMER COATED END-SEALS

CASE CODE. SEE TABLE OF DIMENSIONS.

DC VOLTAGE RATING TO 85°C. EXPRESSED IN VOLTS. ZEROS ARE USED TO PRECEDE THE VOLTAGE RATING.

CAPACITANCE TOLERANCE. F = −10, +50%
G = −10, +75%

CAPACITANCE. EXPRESSED IN PICOFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

DIMENSIONS IN INCHES

	With Outer Insulation		
Case Code	Diam. (±0.031)	Length* (Max.)	Typical Weight (Grams)
KD	0.296	1.000	1.9
DE	0.390	1.187	3.9
DU	0.390	1.500	4.9
DL	0.390	2.187	7.0
DR	0.390	2.812	8.6

*Style 2. For Style 5 increase the maximum length by 0.125″

DIMENSIONS IN MILLIMETERS

	With Outer Insulation		
Case Code	Diam. (±0.79)	Length* (Max.)	Typical Weight (Grams)
KD	7.54	25.40	1.9
DE	9.92	30.16	3.9
DU	9.92	38.10	4.9
DL	9.92	55.56	7.0
DR	9.92	71.42	8.6

*Style 2. For Style 5 increase the maximum length by 3.18 mm.

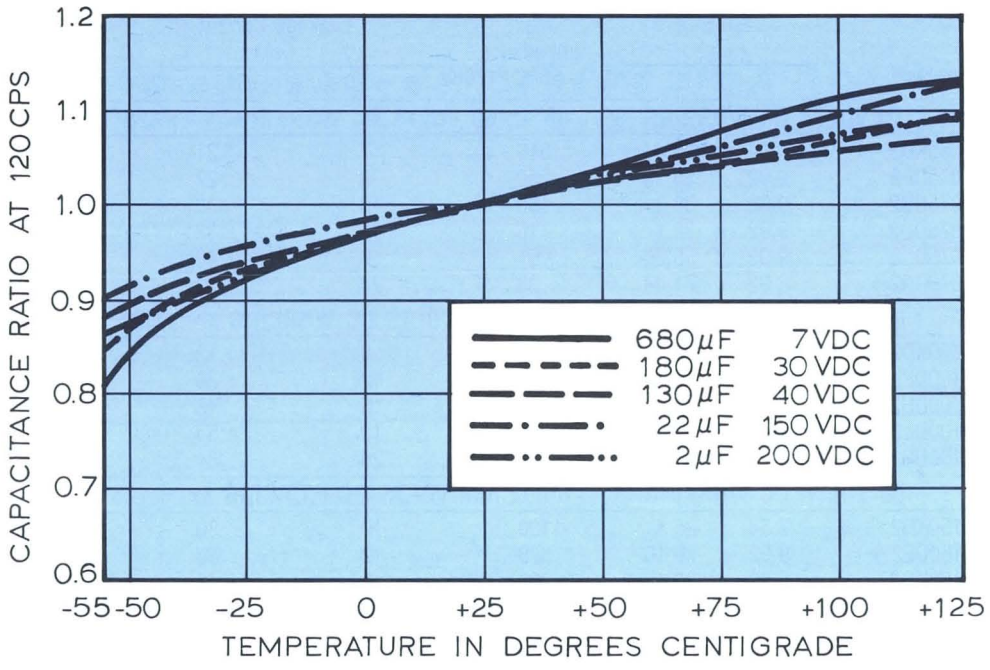
STANDARD RATINGS

μF	Catalog Number*	Case Size (mm) D x L	Max. Impedance @ −55°C, 120Hz	Max. DC Leakage Current (μA) @ +25°C	Max. DC Leakage Current (μA) @ +85°C & +125°C	Max. ESR @ +25°C 120Hz (Ω)	Max. Ripple Current @ +125°C 120HZ (mA)
7 VOLTS DC WORKING @ +85°C; 5 VOLTS DC WORKING @ +125°C							
47	610D476G007KD2	7.54 x 25.4	64	4	12	5.8	100
90	610D906G007DE2	9.92 x 30.16	33	7	21	3.0	180
220	610D227G007DU2	9.92 x 38.1	14	10	30	1.2	300
470	610D477G007DL2	9.92 x 55.56	6.4	16	48	0.58	500
680	610D687G007DR2	9.92 x 71.44	4.4	24	72	0.40	700
10 VOLTS DC WORKING @ +85°C; 7 VOLTS DC WORKING @ +125°C							
39	610D396G010KD2	7.54 x 25.4	77	4	12	7.1	90
70	610D706G010DE2	9.92 x 30.16	43	7	21	3.9	160
180	610D187G010DU2	9.92 x 38.1	17	10	30	1.5	270
330	610D337G010DL2	9.92 x 55.56	9.1	16	48	0.82	440
470	610D477G010DR2	9.92 x 71.44	6.4	24	72	0.58	600
15 VOLTS DC WORKING @ +85°C; 10 VOLTS DC WORKING @ +125°C							
33	610D336G015KD2	7.54 x 25.4	91	4	12	8.3	80
55	610D556G015DE2	9.92 x 30.16	55	7	21	5.0	140
120	610D127G015DU2	9.92 x 38.1	25	9	27	2.3	220
150	610D157G015DU2	9.92 x 38.1	20	10	30	1.8	250
270	610D277G015DL2	9.92 x 55.56	11	16	48	1.0	400
390	610D397G015DR2	9.92 x 71.44	7.7	24	72	0.70	550
20 VOLTS DC WORKING @ +85°C; 15 VOLTS DC WORKING @ +125°C							
22	610D226G020KD2	7.54 x 25.4	136	54	15	12	65
40	610D406G020DE2	9.92 x 30.16	75	7	21	6.9	120
100	610D107G020DU2	9.92 x 38.1	30	10	30	2.8	260
200	610D207G020DL2	9.92 x 55.56	15	16	48	1.42	340
300	610D307G020DR2	9.92 x 71.44	10	24	72	0.92	480
30 VOLTS DC WORKING @ +85°C; 20 VOLTS DC WORKING @ +125°C							
15	610D156G030KD2	7.54 x 25.4	130	5	15	13	65
27	610D276G030DE2	9.92 x 30.16	75	7	21	7.4	120
56	610D566G030DU2	9.92 x 38.1	36	9	27	3.6	180
68	610D686G030DU2	9.92 x 38.1	30	10	30	2.9	190
120	610D127G030DL2	9.92 x 55.56	17	15	45	1.7	310
150	610D157G030DL2	9.92 x 55.56	13	16	48	1.3	340
180	610D187G030DR2	9.92 x 71.44	11	24	72	1.1	440
40 VOLTS DC WORKING @ +85°C; 30 VOLTS DC WORKING @ +125°C							
9	610D905G040KD2	7.54 x 25.4	220	6	18	22	50
17	610D176G040DE2	9.92 x 30.16	120	8	24	12	90
40	610D406G040DU2	9.92 x 38.1	50	10	30	5.0	150
85	610D856G040DL2	9.92 x 55.56	24	16	48	2.4	260
130	610D137G040DR2	9.92 x 71.44	15	24	72	1.5	370
50 VOLTS DC WORKING @ +85°C; 40 VOLTS DC WORKING @ +125°C							
6.8	610D685G050KD2	7.54 x 25.4	300	6	18	29	40
12	610D126G050DE2	9.92 x 30.16	170	8	24	17	80
27	610D276G050DU2	9.92 x 38.1	74	10	30	7.4	120
56	610D566G050DL2	9.92 x 55.56	36	16	48	3.6	210
82	610D826G050DR2	9.92 x 71.44	23	24	72	2.4	290
60 VOLTS DC WORKING @ +85°C; 50 VOLTS DC WORKING @ +125°C							
5.0	610D505G060KD2	7.54 x 25.4	400	7	21	40	35
9.0	610D905G060DE2	9.92 x 30.16	220	9	27	22	65
24	610D246G060DU2	9.92 x 38.1	83	11	33	8.3	110
47	610D476G060DL2	9.92 x 55.56	43	16	48	4.3	200
70	610D706G060DR2	9.92 x 71.44	29	24	72	2.9	270

STANDARD RATINGS

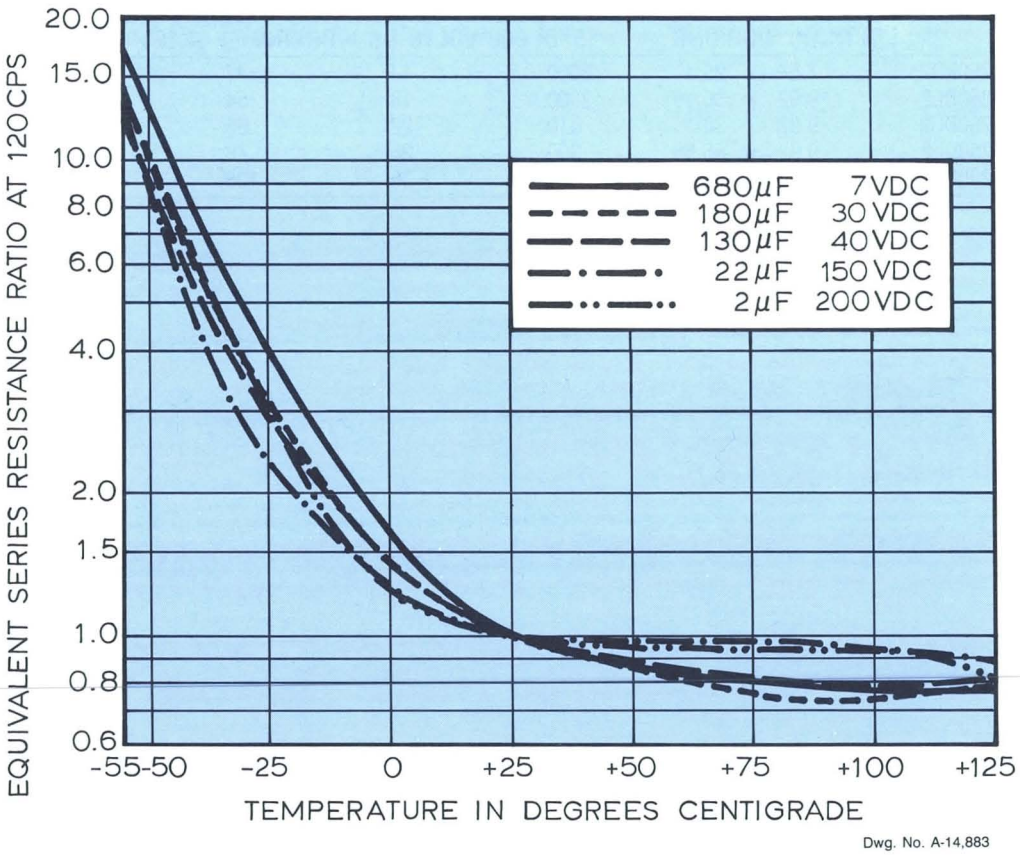
µF	Catalog Number*	Case Size (mm) D x L	Max. Impedance @ −55°C, 120Hz	Max. DC Leakage Current (µA) @ +25°C	Max. DC Leakage Current (µA) @ +85°C & +125°C	Max. ESR @ +25°C 120Hz (Ω)	Max. Ripple Current @ +125°C 120Hz (mA)
75 VOLTS DC WORKING @ +85°C; 60 VOLTS DC WORKING @ +125°C							
3.9	610D395F075KD2	7.54 x 25.4	510	7	21	51	30
8.0	610D805F075DE2	9.92 x 30.16	250	9	27	25	60
15	610D156F075DU2	9.92 x 38.1	130	10	30	133	90
18	610D186F075DU2	9.92 x 38.1	110	11	33	11	100
39	610D396F075DL2	9.92 x 55.56	51	16	48	5.1	170
56	610D566F075DR2	9.92 x 71.44	36	24	72	3.6	240
100 VOLTS DC WORKING @ +85°C; 75 VOLTS DC WORKING @ +125°C							
2.2	610D225F100KD2	7.54 x 25.4	910	8	12	91	25
4.0	610D405F100DE2	9.92 x 30.16	500	12	36	50	45
12	610D126F100DU2	9.92 x 38.1	170	16	48	17	80
22	610D226F100DL2	9.92 x 55.56	91	18	54	9.1	130
33	610D336F100DR2	9.92 x 71.44	61	28	84	6.0	180
150 VOLTS DC WORKING @ +85°C; 100 VOLTS DC WORKING @ +125°C							
1.8	610D185F150KD2	7.54 x 25.4	1100	10	30	110	20
3.0	610D305F150DE2	9.92 x 30.16	670	12	36	67	40
5.6	610D565F150DU2	9.92 x 38.1	360	14	42	36	55
8.2	610D825F150DU2	9.92 x 38.1	230	16	48	24	70
12	610D126F150DL2	9.92 x 55.56	170	18	54	17	100
15	610D156F150DL2	9.92 x 55.56	130	20	60	13	110
22	610D226F150DR2	9.92 x 71.44	91	28	84	9.1	150
200 VOLTS DC WORKING @ +85°C; 150 VOLTS DC WORKING @ +125°C							
1.0	610D105F200KD2	7.54 x 25.4	2000	12	36	200	15
2.0	610D205F200DE2	9.92 x 30.16	1000	16	48	100	30
5.0	610D505F200DU2	9.92 x 38.1	400	20	60	40	50
10	610D106F200DL2	9.92 x 55.56	200	24	72	20	90
15	610D156F200DR2	9.92 x 71.44	130	32	96	13	120
250 VOLTS DC WORKING @ +85°C; 200 VOLTS DC WORKING @ +125°C							
0.68	610D684F250KD2	7.54 x 25.4	3000	14	42	290	15
1.0	610D105F250DE2	9.92 x 30.16	2000	18	54	200	20
3.3	610D335F250DU2	9.92 x 38.1	610	22	66	60	40
6.8	610D685F250DL2	9.92 x 55.56	300	26	78	29	70
10	610D106F250DR2	9.92 x 71.44	200	36	108	20	100

TYPICAL CURVES OF CAPACITANCE VS. TEMPERATURE



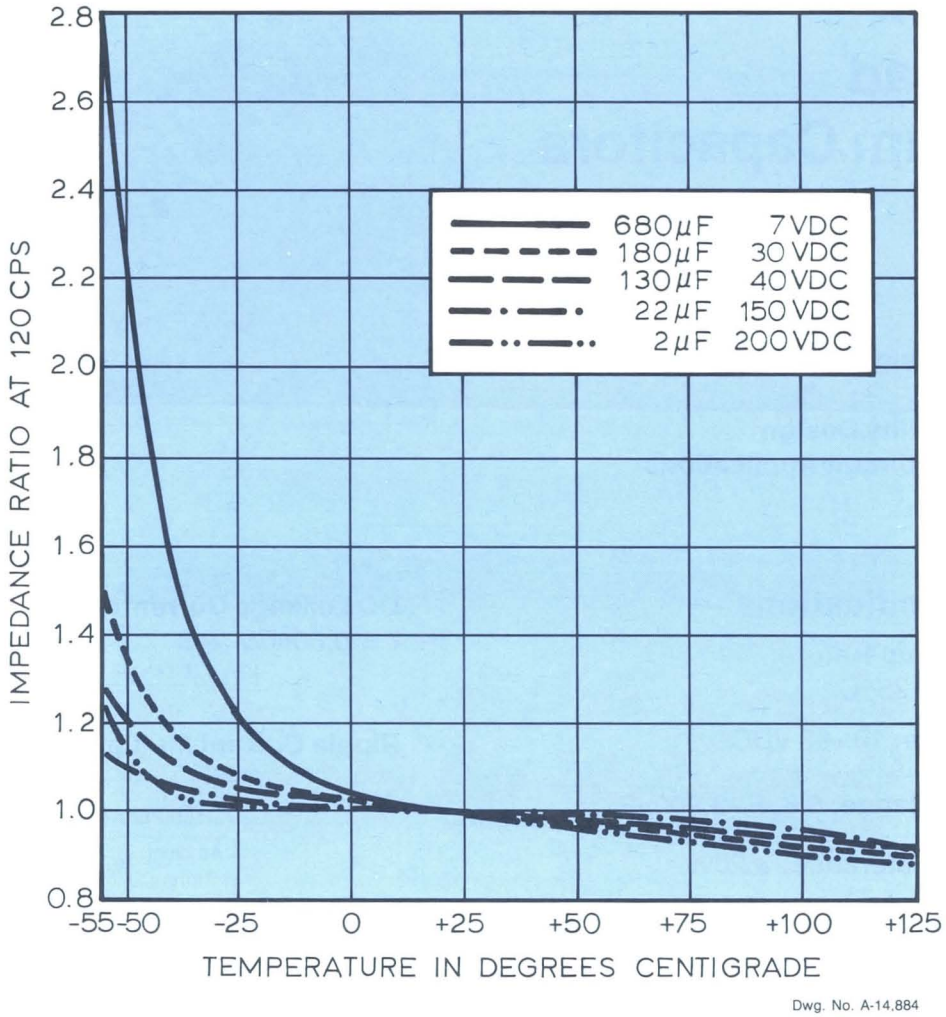
Dwg. No. A-14,882

TYPICAL CURVES OF EQUIVALENT SERIES RESISTANCE VS. TEMPERATURE



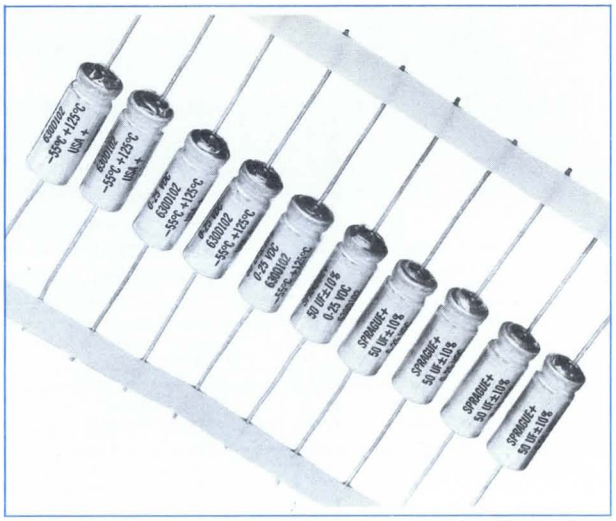
Dwg. No. A-14,883

TYPICAL CURVES OF IMPEDANCE VS. TEMPERATURE



Dwg. No. A-14,884

+125°C Miniature Axial Lead Aluminum Capacitors



9909

Features —

- Extended Temperature Range
- Economical
- High Reliability Design
- For Timing Circuit Applications

General Specifications —

Operating Temperature:
– 55°C - +125°C.

Voltage Range: 10 - 63 VDC.

Capacitance Range: 6.8μF - 3,900μF.

Capacitance Tolerance: ±20%.

Case Size Range: 6 x 12mm - 12 x 45mm.

Termination: Axial leaded.

Life Validation Test: 1000 hrs @ +105°C:
Δ CAP ≤ 20% from initial measurement.
Δ ESR ≤ 1.5x initial specified limit.
Δ DCL ≤ initial specified limit.

Shelf Test: 500 hrs @ +85°C:
Δ CAP ≤ 20% from initial measurement.
Δ ESR ≤ 1.5x initial specified limit.
Δ DCL ≤ 3x initial specified limit.

DC Leakage Current:
I = 0.004CV + 3
I in μA, C in μF, V in Volts

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	Multipliers
+125°C	0.5
+85°C	1.0
+65°C	2.0
+55°C or less	2.5

FREQUENCY Hz

VDC	50-60	100-120	300-400	>1000
3-63	0.90	1.00	1.10	1.35

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

630D 826 M 003 BB 2 A

PACKAGING. A = BULK PACK (Standard).
T = TAPE AND REEL.

CASE STYLE. 2 = POLYESTER INSULATING SLEEVE (Standard).
5 = POLYESTER SLEEVE WITH RESIN END SEAL.
(Required for exposure to halogenated cleaning solvents).

CASE CODE. SEE DIMENSIONS, BELOW.

DC VOLTAGE RATING. EXPRESSED IN VOLTS. AN "R" IS USED TO INDICATE A DECIMAL POINT.

CAPACITANCE TOLERANCE. M = ±20%.

CAPACITANCE. EXPRESSED IN PICOFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

DIMENSIONS IN MILLIMETERS

Case Code	Nominal		Style 2		Style 5	
	Diameter	Length	D Max.	L Max.	D Max.	L Max.
BB	6.3	17.5	7.0	19.2	7.0	20.7
CB	8	17.5	8.6	19.2	8.6	20.7
CC	8	20.5	8.6	22.3	8.6	23.8
DC	9.5	20.5	10.2	22.3	10.2	23.8
DD	9.5	24	10.2	25.5	10.2	27.0
DF	9.5	32	10.2	33.5	10.2	35.0
DH	9.5	38	10.2	39.8	10.2	41.3
EF	11	32	11.8	33.5	11.8	35.0
EH	11	38	11.8	39.8	11.8	41.3
FH	12.5	38	13.1	39.8	13.1	41.3
FK	12.5	44.5	13.1	46.5	13.1	48.0

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C (Ω) 120Hz	Max. Ripple Current @ +85°C (A) 120Hz
3 VOLTS DC WORKING; 5 VOLTS DC SURGE				
82	630D826M003BB2A	6.3 x 17.5	5.070	0.173
120	630D127M003CB2A	8 x 17.5	3.450	0.240
180	630D187M003CC2A	8 x 20.5	2.310	0.314
270	630D277M003DC2A	9.5 x 20.5	1.570	0.424
820	630D827M003DD2A	9.5 x 24	0.507	0.790
1200	630D128M003DF2A	9.5 x 32	0.345	1.080
1500	630D158M003DH2A	9.5 x 38	0.310	1.260
2200	630D228M003EF2A	11 x 32	0.206	1.530
2700	630D278M003EH2A	11 x 38	0.175	1.790
2700	630D278M003FH2A	12.5 x 38	0.175	1.940
3900	630D398M003FK2A	12.5 x 44.5	0.124	2.460
6.3 VOLTS DC WORKING; 9 VOLTS DC SURGE				
82	630D826M6R3BB2A	6.3 x 17.5	4.867	0.176
100	630D227M6R3CB2A	8 x 17.5	4.036	0.222
150	630D157M6R3CC2A	8 x 20.5	2.758	0.286
270	630D277M6R3DC2A	9.5 x 20.5	1.504	0.433
680	630D687M6R3DD2A	9.5 x 24	0.591	0.732
1200	630D128M6R3DF2A	9.5 x 32	0.331	1.111
1500	630D158M6R3DH2A	9.5 x 38	0.287	1.290
1800	630D188M6R3EF2A	11 x 32	0.230	1.450
2200	630D228M6R3EH2A	11 x 38	0.199	1.690
2700	630D278M6R3FH2A	12.5 x 38	0.169	1.970
3300	630D338M6R3FK2A	12.5 x 44.5	0.142	2.310
7.5 VOLTS DC WORKING; 10 VOLTS DC SURGE				
68	630D686M7R5BB2A	6.3 x 17.5	5.910	0.160
82	630D826M7R5CB2A	8 x 17.5	4.860	0.202
150	630D157M7R5CC2A	8 x 20.5	2.750	0.287
220	630D227M7R5DC2A	9.5 x 20.5	1.838	0.391
680	630D687M7R5DD2A	9.5 x 24	0.591	0.732
1000	630D108M7R5DF2A	9.5 x 32	0.403	1.010
1200	630D128M7R5DH2A	9.5 x 38	0.331	1.210
1500	630D158M7R5EF2A	11 x 32	0.287	1.290
2200	630D228M7R5EH2A	11 x 38	0.199	1.690
2700	630D278M7R5FH2A	12.5 x 38	0.169	1.970
3300	630D338M7R5FK2A	12.5 x 44.5	0.142	2.310
10 VOLTS DC WORKING; 15 VOLTS DC SURGE				
56	630D566M010BB2A	6.3 x 17.5	6.120	0.156
68	630D686M010CB2A	8 x 17.5	5.214	0.195
100	630D107M010CC2A	8 x 20.5	3.560	0.252
180	630D187M010DC2A	9.5 x 20.5	1.946	0.381
560	630D567M010DD2A	9.5 x 24	0.621	0.714
820	630D827M010DF2A	9.5 x 32	0.429	0.972
1000	630D108M010DH2A	9.5 x 38	0.356	1.160
1200	630D128M010EF2A	11 x 32	0.292	1.290
1800	630D188M010EH2A	11 x 38	0.203	1.670
1800	630D188M010FH2A	12.5 x 38	0.203	1.810
2200	630D228M010FK2A	12.5 x 44.5	0.176	2.070
12 VOLTS DC WORKING; 16 VOLTS DC SURGE				
47	630D476M012BB2A	6.3 x 17.5	6.794	0.150
68	630D686M012CB2A	8 x 17.5	4.732	0.205
100	630D107M012CC2A	8 x 20.5	3.231	0.265
180	630D187M012DC2A	9.5 x 20.5	1.766	0.399
470	630D477M012DD2A	9.5 x 24	0.679	0.683
680	630D687M012DF2A	9.5 x 32	0.473	0.926
820	630D827M012DH2A	9.5 x 38	0.389	1.110

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C (Ω) 120Hz	Max. Ripple Current @ +85°C (A) 120Hz
		12 VOLTS DC WORKING; 16 VOLTS DC SURGE (Cont.)		
1200	630D128M012EF2A	11 x 32	0.265	1.350
1500	630D158M012EH2A	11 x 38	0.231	1.560
1800	630D188M012FH2A	12.5 x 38	0.185	1.890
2200	630D228M012FK2A	12.5 x 44.5	0.162	2.160
		16 VOLTS DC WORKING; 20 VOLTS DC SURGE		
47	630D476M016BB2A	6.3 x 17.5	5.460	0.153
56	630D566M016CB2A	8 x 17.5	5.360	0.192
82	630D826M016CC2A	8 x 20.5	3.705	0.248
150	630D157M016DC2A	9.5 x 20.5	2.110	0.366
390	630D397M016DD2A	9.5 x 24	0.763	0.644
560	630D567M016DF2A	9.5 x 32	0.536	0.871
820	630D827M016DH2A	9.5 x 38	0.371	1.140
1000	630D108M016EF2A	11 x 32	0.307	1.250
1200	630D128M016EH2A	11 x 38	0.252	1.510
1500	630D158M016FH2A	12.5 x 38	0.221	1.730
1800	630D188M016KF2A	12.5 x 44.5	0.176	2.070
		20 VOLTS DC WORKING; 25 VOLTS DC SURGE		
27	630D276M020BB2A	6.3 x 17.5	0.818	0.118
39	630D396M020CB2A	8 x 17.5	7.212	0.165
56	630D566M020CC2A	8 x 20.5	5.063	0.212
100	630D107M020DC2A	9.5 x 20.5	2.902	0.312
270	630D227M020DD2A	9.5 x 24	1.081	0.541
390	630D397M020DF2A	9.5 x 32	0.721	0.750
560	630D567M020DH2A	9.5 x 38	0.506	0.970
680	630D687M020EF2A	11 x 32	0.425	1.070
820	630D827M020EH2A	11 x 38	0.350	1.270
1000	630D108M020FH2A	12.5 x 38	0.290	1.510
1200	630D128M020FK2A	12.5 x 44.5	0.238	1.780
		25 VOLTS DC WORKING; 30 VOLTS DC SURGE		
22	630D226M025BB2A	6.3 x 17.5	12.500	0.110
33	630D336M025CB2A	8 x 17.5	8.333	0.154
47	630D476M025CC2A	8 x 20.5	5.769	0.198
82	630D826M025DC2A	9.5 x 20.5	3.308	0.292
220	630D227M025DD2A	9.5 x 24	1.250	0.504
330	630D337M025DF2A	9.5 x 32	0.833	0.698
390	630D397M025DH2A	9.5 x 38	0.681	0.837
560	630D567M025EF2A	11 x 32	0.478	1.010
680	630D687M025EH2A	11 x 38	0.401	1.190
820	630D827M025FH2A	12.5 x 38	0.330	1.410
1000	630D108M025FK2A	12.5 x 44.5	0.274	1.660
		30 VOLTS DC WORKING; 40 VOLTS DC SURGE		
18	630D186M030BB2A	6.3 x 17.5	14.133	0.104
27	630D276M030CB2A	8 x 17.5	9.636	0.143
39	630D396M030CC2A	8 x 20.5	6.424	0.187
68	630D686M030DC2A	9.5 x 20.5	3.785	0.269
180	630D187M030DD2A	9.5 x 24	1.413	0.474
270	630D277M030DF2A	9.5 x 32	0.963	0.649
330	630D337M030DH2A	9.5 x 38	0.785	0.780
470	630D477M030EF2A	11 x 32	0.543	0.943
560	630D567M030EH2A	11 x 38	0.451	1.120
680	630D687M030FH2A	12.5 x 38	0.378	1.320
820	630D827M030FK2A	12.5 x 44.5	0.311	1.560

STANDARD RATINGS

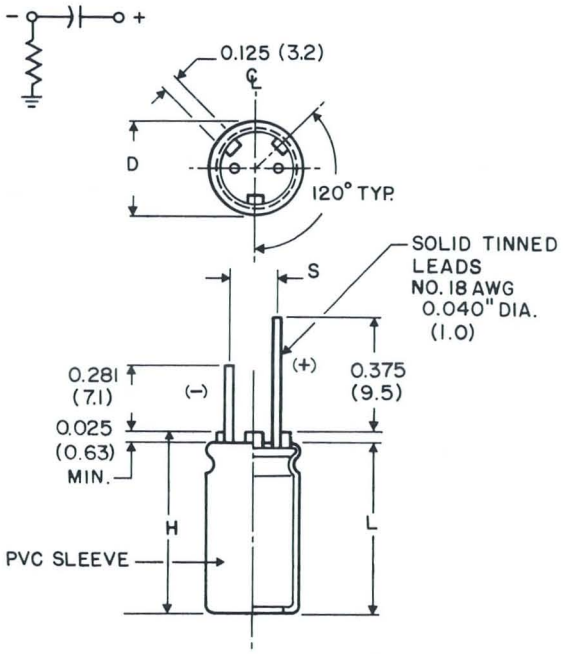
µF	Catalog Number	Nominal Case Size (mm) D x L	Max. ESR @ +25°C (Ω) 120Hz	Max. Ripple Current @ +85°C (A) 120Hz
35 VOLTS DC WORKING; 40 VOLTS DC SURGE				
18	630D186M035BB2A	6.3 x 17.5	14.133	0.104
22	630D226M035CB2A	8 x 17.5	11.777	0.129
27	630D276M035CC2A	8 x 20.5	9.636	0.153
56	630D566M035DC2A	9.5 x 20.5	4.510	0.250
150	630D157M035DD2A	9.5 x 24	1.766	0.424
220	630D227M035DF2A	9.5 x 32	1.177	0.587
270	630D277M035DH2A	9.5 x 38	0.966	0.702
390	630D397M035EF2A	11 x 32	0.642	0.867
470	630D477M035EH2A	11 x 38	0.543	1.020
560	630D567M035FH2A	12.5 x 38	0.451	1.210
680	630D687M035FK2A	12.5 x 44.5	0.378	1.410
40 VOLTS DC WORKING; 45 VOLTS DC SURGE				
12	630D126M040BB2A	6.3 x 17.5	21.200	0.085
18	630D186M040CB2A	8 x 17.5	14.133	0.118
27	630D276M040CC2A	8 x 20.5	9.636	0.153
47	630D476M040DC2A	9.5 x 20.5	5.435	0.228
120	630D127M040DD2A	9.5 x 24	2.120	0.387
180	630D187M040DF2A	9.5 x 32	1.413	0.536
270	630D277M040DH2A	9.5 x 38	0.963	0.703
330	630D337M040EF2A	11 x 32	0.785	0.776
390	630D397M040EH2A	11 x 38	0.642	0.939
470	630D477M040FH2A	12.5 x 38	0.543	1.100
560	630D567M040FK2A	12.5 x 44.5	0.451	1.290
50 VOLTS DC WORKING; 60 VOLTS DC SURGE				
10	630D106M050BB2A	6.3 x 17.5	24.260	0.079
12	630D126M050CB2A	8 x 17.5	19.900	0.101
22	630D226M050CC2A	8 x 20.5	11.050	0.143
33	630D336M050DC2A	9.5 x 20.5	7.370	0.196
82	630D826M050DD2A	9.5 x 24	2.926	0.329
120	630D127M050DF2A	9.5 x 32	1.990	0.451
180	630D187M050DH2A	9.5 x 38	1.326	0.601
220	630D227M050EF2A	11 x 32	1.105	0.661
270	630D277M050EH2A	11 x 38	0.904	0.791
330	630D337M050FH2A	12.5 x 38	0.737	0.946
390	630D397M050FK2A	12.5 x 44.5	0.603	1.120
63 VOLTS DC WORKING; 70 VOLTS DC SURGE				
6.8	630D685M063BB2A	6.3 x 17.5	35.530	0.066
8.2	630D825M063CB2A	8 x 17.5	29.260	0.082
12	630D126M063CC2A	8 x 20.5	19.910	0.107
22	630D226M063DC2A	9.5 x 20.5	11.050	0.161
56	630D566M063DD2A	9.5 x 24	4.234	0.273
82	630D826M063DF2A	9.5 x 32	2.926	0.372
120	630D127M063DH2A	9.5 x 38	1.990	0.491
150	630D157M063EF2A	11 x 32	1.658	0.541
180	630D187M063EH2A	11 x 38	1.326	0.653
180	630D187M063FH2A	12.5 x 38	1.326	0.704
220	630D227M063FK2A	12.5 x 44.5	1.105	0.825

Tubular Radial Lead Capacitors

SPRAGUE®

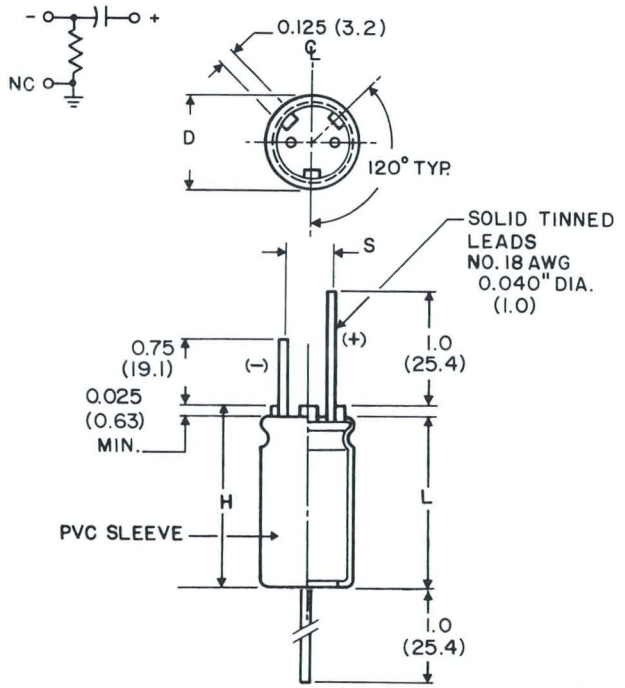
OUTLINE DRAWINGS FOR TYPES 673D/674D, 676D/677D

TERMINAL CODE C INCHES (MM)



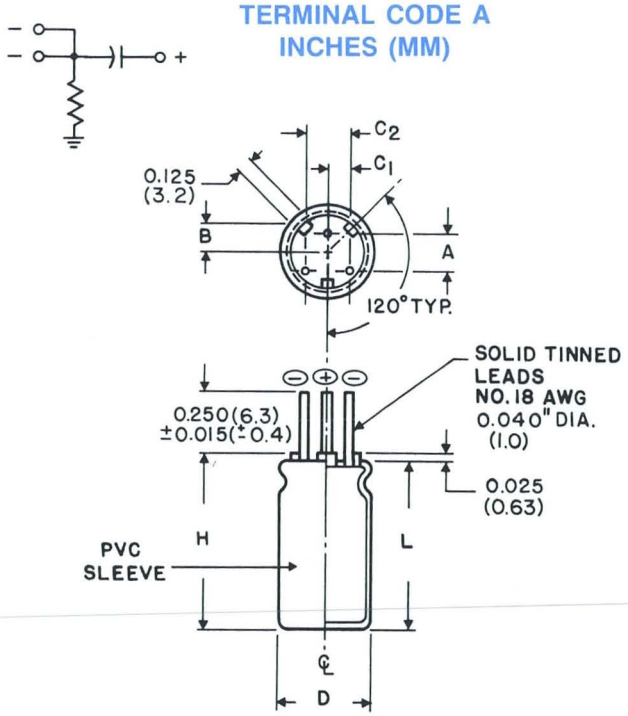
Dwg. No. A-14,853

TERMINAL CODE J INCHES (MM)



Dwg. No. A-14,833

TERMINAL CODE A INCHES (MM)



Dwg. No. A-14,834

LEAD SPACING — INCHES

Case Diameter	A ±0.015	C1 ±0.015	C2 ±0.015
0.750	0.300	0.100	0.200
0.875	0.400	0.150	0.300
1.000	0.400	0.150	0.300

LEAD SPACING — MM

Case Diameter	A ±0.381	C1 ±0.381	C2 ±0.381
19.1	7.6	2.5	5.1
22.2	10.2	3.8	7.6
25.4	10.2	3.8	7.6

+105°C Tubular Radial Lead Aluminum Capacitors


9915

Features —

- **Wide Temperature Range**
- **Radial Design in 2 & 3 Lead Configuration**
- **Ideal SMPS Output Filter**

General Specifications —

Operating Temperature: −55°C - +105°C.

Voltage Range: 6.3 - 250 VDC.

Capacitance Range: 27μF - 27,000μF.

Capacitance Tolerance: −10%, +50%.

Case Size Range: 0.75″ x 1.125″ - 1.0″ x 3.625″.

Termination: Radial leads.

Life Validation Test: 2000 hrs @ +105°C:
- Δ CAP ≤ 15% from initial measurement.
- Δ ESR ≤ 1.5x initial specified limit.
- Δ DCL ≤ initial specified limit.

Shelf Test: 500 hrs @ +105°C:
- Δ CAP ≤ 10% from initial measurement.
- Δ ESR ≤ 1.15x initial specified limit.
- Δ DCL ≤ 2x initial specified limit.

DC Leakage Current:
$I = K\sqrt{CV}$
K = 0.5 @ +25°C
I in μa, C in μF, V in Volts

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	+105°C	+85°C	+65°C	+45°C	+25°C
Multipliers	0.4	1.0	1.4	1.7	2.0

FREQUENCY Hz

Rated WVDC	50-60	100-120	300-400	1000	20,000
0-60	0.60	0.75	0.80	0.90	1.0
61-250	0.43	0.54	0.75	0.85	1.0

Low Temperature Performance:
Capacitance Ratio $C^{-55°C}/C^{+25°C}$ min. @ 120Hz

Rated Voltage (VDC)	Capacitance Remaining
6.3-25	75%
40-100	80%
150-250	65%

ESR Ratio $ESR^{-55°C}/ESR^{+25°C}$ max. @ 120Hz

Rated Voltage (VDC)	Multipliers
0-12	8
13-40	10
41-250	16

ESL (Typical values @ 1MHz-10MHz):

Nominal Diameter Inches	Nominal Diameter Millimeters	Typical ESL (nH)
0.75	19	10
0.875	22	11
1.00	25	13

Catalog Numbering System

673D 222 F 6R3 GE 1 C

LEAD CODE. C = 2 LEAD RADIAL MOUNT (Standard on 673D).
J = 3 LEAD AXIAL MOUNT (Optional on 673D).
A = KEYED POLARITY 3 LEAD RADIAL MOUNT (Standard on 674D).

CASE STYLE. 1 = PVC INSULATING SLEEVE (Standard for +105°C Operation).
7 = PVC SLEEVE WITH RESIN END SEAL. (Optional).
(Required for exposure to halogenated cleaning solvents).

CASE CODE. SEE DIMENSIONS.

DC VOLTAGE RATING. EXPRESSED IN VOLTS. THE LETTER 'R' IS USED AS THE DECIMAL POINT, E.G. 6R3 = 6.3 VOLTS.

CAPACITANCE TOLERANCE. F = −10, +50%.

CAPACITANCE. EXPRESSED IN PICOFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.
673D = LEAD CODES C AND J ONLY.
674D = LEAD CODE A ONLY.

DIMENSIONS IN INCHES

CASE CODE	STYLE 1 STYLE 7		OVERALL LENGTH	LEAD SPACING*	TYPICAL WEIGHT (oz)
	D ±0.015	L ±0.062	H MAX.	S ±0.015	
GE	0.770	1.150	1.246	0.250	0.46
GJ	0.770	1.650	1.746	0.250	0.67
GL	0.770	2.150	2.246	0.250	0.74
GP	0.770	2.650	2.746	0.250	0.88
GS	0.770	3.150	3.246	0.250	1.16
GT	0.770	3.650	3.746	0.250	1.34
HE	0.895	1.150	1.246	0.300	0.63
HJ	0.895	1.650	1.746	0.300	0.95
HL	0.895	2.150	2.246	0.300	1.02
HP	0.895	2.650	2.746	0.300	1.37
HS	0.895	3.150	3.246	0.300	1.73
HT	0.895	3.650	3.746	0.300	2.08
JE	1.020	1.150	1.246	0.400	0.81
JJ	1.020	1.650	1.746	0.400	1.02
JL	1.020	2.150	2.246	0.400	1.20
JP	1.020	2.650	2.746	0.400	1.87
JS	1.020	3.150	3.246	0.400	2.22
JT	1.020	3.650	3.746	0.400	2.54

*Type 673D Only.

DIMENSIONS IN MILLIMETERS

(Based on 1″ = 25.4 mm)

CASE CODE	STYLE 1 STYLE 7		OVERALL LENGTH	LEAD SPACING*	TYPICAL WEIGHT (grams)
	D ±0.4	L ±1.6	H MAX.	S ±0.4	
GE	19.6	29.2	31.6	6.4	13
GJ	19.6	41.9	44.3	6.4	19
GL	19.6	54.6	57.0	6.4	21
GP	19.6	67.3	69.7	6.4	25
GS	19.6	80.0	82.4	6.4	33
GT	19.6	92.7	95.1	6.4	38
HE	22.7	29.2	31.6	7.6	18
HJ	22.7	41.9	44.3	7.6	27
HL	22.7	54.6	57.0	7.6	29
HP	22.7	67.3	69.7	7.6	39
HS	22.7	80.0	82.4	7.6	49
HT	22.7	92.7	95.1	7.6	59
JE	25.9	29.2	31.6	10.2	23
JJ	25.9	41.9	44.3	10.2	29
JL	25.9	54.6	57.0	10.2	34
JP	25.9	67.3	69.7	10.2	53
JS	25.9	80.0	82.4	10.2	63
JT	25.9	92.7	95.1	10.2	72

*Type 673D Only.

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size (in) D x L	Max. ESR @ +25°C (mΩ) 120 Hz	Max. ESR @ +25°C (mΩ) 20k-40kHz	Max Ripple Current @ +85°C (A) 20k-40kHz	Max. Impedance @ 100 kHz (mΩ)
6.3 VOLTS DC WORKING; 9 VOLTS DC SURGE						
2200	673D228F6R3GE1C	0.770 x 1.150	105.0	81.0	2.30	83.0
4700	673D478F6R3GJ1C	0.770 x 1.650	53.0	41.0	3.70	43.0
6800	673D688F6R3GL1C	0.770 x 2.150	36.0	28.0	4.95	30.0
8200	673D828F6R3GP1C	0.770 x 2.650	28.0	22.7	6.11	25.0
10000	673D109F6R3GS1C	0.770 x 3.150	23.0	19.0	7.20	21.0
12000	673D129F6R3GT1C	0.770 x 3.650	21.0	17.0	8.14	19.0
3300	673D338F6R3HE1C	0.895 x 1.150	74.0	58.0	3.00	60.0
6800	673D688F6R3HJ1C	0.895 x 1.650	38.0	39.0	4.73	41.0
10000	673D109F6R3HL1C	0.895 x 2.150	27.0	22.0	6.20	24.0
15000	673D159F6R3HP1C	0.895 x 2.650	21.0	17.4	7.62	19.0
18000	673D189F6R3HS1C	0.895 x 3.150	18.0	15.0	8.83	17.0
22000	673D229F6R3HT1C	0.895 x 3.650	15.8	13.3	10.10	15.0
4700	673D478F6R3JE1C	1.020 x 1.150	60.0	48.0	3.60	50.0
10000	673D109F6R3JJ1C	1.020 x 1.650	32.0	26.0	5.54	28.0
15000	673D159F6R3JL1C	1.020 x 2.150	22.6	18.8	7.30	21.0
18000	673D189F6R3JP1C	1.020 x 2.650	18.0	15.2	8.81	17.0
22000	673D229F6R3JS1C	1.020 x 3.150	15.4	13.0	10.20	14.0
27000	673D279F6R3JT1C	1.020 x 3.650	13.4	11.5	11.60	13.0
7.5 VOLTS DC WORKING; 10 VOLTS DC SURGE						
1800	673D188F7R5GE1C	0.770 x 1.150	110.0	82.0	2.30	84.0
3900	673D398F7R5GJ1C	0.770 x 1.650	55.0	41.0	3.70	52.0
5600	673D568F7R5GL1C	0.770 x 2.150	38.0	29.0	4.93	31.0
8200	673D828F7R5GP1C	0.770 x 2.650	29.5	22.8	6.10	25.0
10000	673D109F7R5GS1C	0.770 x 3.150	25.8	20.0	7.04	22.0
12000	673D129F7R5GT1C	0.770 x 3.650	22.0	17.4	8.06	19.0
3300	673D338F7R5HE1C	0.895 x 1.150	76.0	58.4	2.97	61.0
5600	673D568F7R5HJ1C	0.895 x 1.650	39.5	30.6	4.72	33.0
8200	673D828F7R5HL1C	0.895 x 2.150	27.7	21.8	6.23	24.0
12000	673D129F7R5HP1C	0.895 x 2.650	22.0	17.6	7.58	20.0
15000	673D159F7R5HS1C	0.895 x 3.150	18.7	15.0	8.82	17.0
18000	673D189F7R5HT1C	0.895 x 3.650	16.4	13.5	9.97	15.0
3900	673D398F7R5JE1C	1.020 x 1.150	62.0	48.0	3.55	50.0
8200	673D828F7R5JJ1C	1.020 x 1.650	32.0	25.9	5.56	28.0
12000	673D129F7R5JL1C	1.020 x 2.150	23.5	19.0	7.22	21.0
18000	673D189F7R5JP1C	1.020 x 2.650	18.3	15.0	8.83	17.0
22000	673D229F7R5JS1C	1.020 x 3.150	15.8	13.0	10.20	15.0
27000	673D279F7R5JT1C	1.020 x 3.650	13.8	11.6	11.60	13.0
10 VOLTS DC WORKING; 12 VOLTS DC SURGE						
1800	673D188F010GE1C	0.770 x 1.150	123.0	89.0	2.20	91.0
3300	673D338F010GJ1C	0.770 x 1.650	60.0	44.0	3.56	46.0
5600	673D568F010GL1C	0.770 x 2.150	41.0	30.0	4.79	32.0
6800	673D688F010GP1C	0.770 x 2.650	31.0	24.0	5.93	26.0
8200	673D828F010GS1C	0.770 x 3.150	26.0	20.0	7.02	22.0
10000	673D109F010GT1C	0.770 x 3.650	23.0	17.8	7.97	20.0
2700	673D278F010HE1C	0.895 x 1.150	82.0	61.0	2.90	62.0
5600	673D568F010HJ1C	0.895 x 1.650	42.0	32.0	4.61	34.0
8200	673D828F010HL1C	0.895 x 2.150	29.6	22.0	6.11	24.0
10000	673D109F010HP1C	0.895 x 2.650	24.0	18.0	7.33	20.0
12000	673D129F010HS1C	0.895 x 3.150	19.9	15.8	8.63	17.0
15000	673D159F010HT1C	0.895 x 3.650	17.3	13.8	9.85	16.0

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (in) D x L	Max. ESR @ +25°C (mΩ) 120 Hz	Max. ESR @ +25°C (mΩ) 20k-40kHz	Max Ripple Current @ +85°C (A) 20k-40kHz	Max. Impedance @ 100 kHz (mΩ)
10 VOLTS DC WORKING; 12 VOLTS DC SURGE (Cont.)						
3900	673D398F010JE1C	1.020 x 1.150	66.6	50.0	3.47	52.0
6800	673D688F010JJ1C	1.020 x 1.650	34.0	26.7	5.48	29.0
12000	673D129F010JL1C	1.020 x 2.150	24.0	19.0	7.18	21.0
15000	673D159F010JP1C	1.020 x 2.650	19.2	15.0	8.72	17.0
18000	673D189F010JS1C	1.020 x 3.150	16.0	13.0	10.20	15.0
22000	673D229F010JT1C	1.020 x 3.650	14.3	11.8	11.50	14.0
12 VOLTS DC WORKING; 16 VOLTS DC SURGE						
1500	673D158F012GE1C	0.770 x 1.150	119.0	83.0	2.26	85.0
3300	673D338F012GJ1C	0.770 x 1.650	60.0	42.0	3.65	44.0
4700	673D478F012GL1C	0.770 x 2.150	41.0	29.0	4.88	31.0
6800	673D688F012GP1C	0.770 x 2.650	31.0	23.0	6.07	26.0
8200	673D828F012GS1C	0.770 x 3.150	26.0	19.4	7.14	22.0
10000	673D109F012GT1C	0.770 x 3.650	23.0	17.0	8.11	20.0
2200	673D228F012HE1C	0.895 x 1.150	83.0	60.0	2.93	62.0
4700	673D478F012HJ1C	0.895 x 1.650	42.0	31.0	4.69	33.0
6800	673D688F012HL1C	0.895 x 2.150	29.0	22.0	6.20	25.0
10000	673D109F012HP1C	0.895 x 2.650	24.0	18.3	7.43	21.0
12000	673D129F012HS1C	0.895 x 3.150	19.7	15.0	8.82	18.0
15000	673D159F012HT1C	0.895 x 3.650	17.0	13.3	10.10	16.0
3300	673D338F012JE1C	1.020 x 1.150	66.0	49.0	3.53	52.0
6800	673D688F012JJ1C	1.020 x 1.650	34.0	26.0	5.54	29.0
10000	673D109F012JL1C	1.020 x 2.150	25.5	19.0	7.12	22.0
12000	673D129F012JP1C	1.020 x 2.650	19.7	15.0	8.75	18.0
18000	673D189F012JS1C	1.020 x 3.150	16.4	13.0	10.20	16.0
22000	673D229F012JT1C	1.020 x 3.650	14.6	11.8	11.50	15.0
16 VOLTS DC WORKING; 20 VOLTS DC SURGE						
1200	673D128F016GE1C	0.770 x 1.150	129.0	83.0	2.24	85.0
2700	673D278F016GJ1C	0.770 x 1.650	65.0	43.0	3.62	45.0
3900	673D398F016GL1C	0.770 x 2.150	44.0	30.0	4.84	32.0
5600	673D568F016GP1C	0.770 x 2.650	34.0	23.5	6.01	26.0
6800	673D688F016GS1C	0.770 x 3.150	28.0	19.7	7.09	23.0
8200	673D828F016GT1C	0.770 x 3.650	24.0	17.0	8.16	21.0
2200	673D228F016HE1C	0.895 x 1.150	89.0	59.0	2.93	61.0
3900	673D398F016HJ1C	0.895 x 1.650	45.0	31.6	4.64	34.0
5600	673D568F016HL1C	0.895 x 2.150	31.6	22.4	6.14	25.0
8200	673D828F016HP1C	0.895 x 2.650	24.7	17.9	7.51	20.0
10000	673D109F016HS1C	0.895 x 3.150	20.7	15.2	8.79	18.0
12000	673D129F016HT1C	0.895 x 3.650	18.0	13.6	9.93	17.0
2700	673D278F016JE1C	1.020 x 1.150	71.0	50.0	3.49	52.0
5600	673D568F016JJ1C	1.020 x 1.650	36.7	26.7	5.48	29.0
8200	673D828F016JL1C	1.020 x 2.150	26.0	19.2	7.18	22.0
12000	673D129F016JP1C	1.020 x 2.650	20.5	15.4	8.75	19.0
15000	673D159F016JS1C	1.020 x 3.150	17.4	13.3	10.20	17.0
18000	673D189F016JT1C	1.020 x 3.650	15.3	11.8	11.50	17.0
20 VOLTS DC WORKING; 30 VOLTS DC SURGE						
1000	673D108F020GE1C	0.770 x 1.150	140.0	84.0	2.16	87.0
1800	673D188F020GJ1C	0.770 x 1.650	67.0	44.0	3.56	47.0
2700	673D278F020GL1C	0.770 x 2.150	45.0	30.0	4.81	33.0
3900	673D398F020GP1C	0.770 x 2.650	34.9	23.9	6.96	27.0
4700	673D478F020GS1C	0.770 x 3.150	28.7	19.9	7.05	24.0
5600	673D568F020GT1C	0.770 x 3.650	24.6	17.0	8.09	21.0

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size (in) D x L	Max. ESR @ +25°C (mΩ) 120 Hz	Max. ESR @ +25°C (mΩ) 20k-40kHz	Max Ripple Current @ +85°C (A) 20k-40kHz	Max. Impedance @ 100 kHz (mΩ)
20 VOLTS DC WORKING; 30 VOLTS DC SURGE (Cont.)						
1500	673D158F020HE1C	0.895 x 1.150	94.0	59.0	2.86	62.0
3300	673D338F020HJ1C	0.895 x 1.650	46.9	32.0	4.60	35.0
4700	673D478F020HL1C	0.895 x 2.150	32.0	22.7	6.10	26.0
6800	673D688F020HP1C	0.895 x 2.650	25.0	18.0	7.49	21.0
8200	673D828F020HS1C	0.895 x 3.150	21.0	15.3	8.77	19.0
10000	673D109F020HT1C	0.895 x 3.650	18.0	13.6	9.93	18.0
2200	673D228F020JE1C	1.020 x 1.150	72.0	49.0	3.48	52.0
4700	673D478F020JJ1C	1.020 x 1.650	37.0	26.0	5.47	29.0
6800	673D688F020JL1C	1.020 x 2.150	26.0	19.3	7.16	23.0
8200	673D828F020JP1C	1.020 x 2.650	20.7	15.5	8.72	19.0
10000	673D109F020JS1C	1.020 x 3.150	17.9	13.6	10.10	18.0
12000	673D129F020JT1C	1.020 x 3.650	15.8	12.0	11.40	16.0
25 VOLTS DC WORKING; 35 VOLTS DC SURGE						
820	673D827F025GE1C	0.770 x 1.150	143.0	85.0	2.23	88.0
1500	673D158F025GJ1C	0.770 x 1.650	73.0	44.0	3.56	47.0
2200	673D228F025GL1C	0.770 x 2.150	49.0	30.5	4.82	33.0
3300	673D338F025GP1C	0.770 x 2.650	37.0	23.9	5.96	27.0
3900	673D398F025GS1C	0.770 x 3.150	31.0	20.0	7.00	23.0
4700	673D478F025GT1C	0.770 x 3.650	26.7	17.5	8.04	21.0
1200	673D128F025HE1C	0.895 x 1.150	101.0	62.9	2.86	66.0
2700	673D278F025HJ1C	0.895 x 1.650	50.0	32.0	4.61	35.0
3900	673D398F025HL1C	0.895 x 2.150	35.0	22.9	6.08	26.0
4700	673D478F025HP1C	0.895 x 2.650	27.0	18.0	7.47	21.0
6800	673D688F025HS1C	0.895 x 3.150	22.7	15.4	8.74	19.0
8200	673D828F025HT1C	0.895 x 3.650	19.6	13.6	9.93	17.0
1800	673D188F025JE1C	1.020 x 1.150	79.0	51.0	3.45	53.0
3900	673D398F025JJ1C	1.020 x 1.650	40.0	26.9	5.46	30.0
5600	673D568F025JL1C	1.020 x 2.150	28.0	19.0	7.14	22.0
6800	673D688F025JP1C	1.020 x 2.650	22.0	15.7	8.66	19.0
8200	673D828F025JS1C	1.020 x 3.150	18.7	13.5	10.10	17.0
10000	673D109F025JT1C	1.020 x 3.650	16.4	12.0	11.40	15.0
30 VOLTS DC WORKING; 40 VOLTS DC SURGE						
820	673D827F030GE1C	0.770 x 1.150	156.0	86.0	2.16	89.0
1500	673D158F030GJ1C	0.770 x 1.650	80.0	47.0	3.45	50.0
2200	673D228F030GL1C	0.770 x 2.150	53.0	32.0	4.68	35.0
3300	673D338F030GP1C	0.770 x 2.650	40.0	25.0	5.81	28.0
3900	673D398F030GS1C	0.770 x 3.150	34.0	21.0	6.82	24.0
4700	673D478F030GT1C	0.770 x 3.650	28.8	18.4	7.84	22.0
1200	673D128F030HE1C	0.895 x 1.150	106.0	64.0	2.83	67.0
2700	673D278F030HJ1C	0.895 x 1.650	54.0	33.4	4.51	37.0
3900	673D398F030HL1C	0.895 x 2.150	37.0	23.7	5.97	27.0
4700	673D478F030HP1C	0.895 x 2.650	29.0	18.9	7.31	22.0
6800	673D688F030HS1C	0.895 x 3.150	24.0	16.0	8.57	19.0
8200	673D828F030HT1C	0.895 x 3.650	20.8	14.0	9.75	17.0
1800	673D188F030JE1C	1.020 x 1.150	85.0	53.0	3.39	56.0
3300	673D338F030JJ1C	1.020 x 1.650	43.7	28.0	5.33	31.0
4700	673D478F030JL1C	1.020 x 2.150	30.0	20.0	7.04	23.0
6800	673D688F030JP1C	1.020 x 2.650	23.7	16.2	8.53	20.0
8200	673D828F030JS1C	1.020 x 3.150	19.8	13.8	9.95	17.0
10000	673D109F030JT1C	1.020 x 3.650	17.3	12.2	11.30	15.0

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size (in) D x L	Max. ESR @ +25°C (mΩ) 120 Hz	Max. ESR @ +25°C (mΩ) 20k-40kHz	Max Ripple Current @ +85°C (A) 20k-40kHz	Max. Impedance @ 100 kHz (mΩ)
40 VOLTS DC WORKING; 55 VOLTS DC SURGE						
560	673D567F040GE1C	0.770 x 1.150	191.0	86.0	2.22	89.0
1000	673D108F040GJ1C	0.770 x 1.650	94.0	47.0	3.57	67.0
1500	673D158F040GL1C	0.770 x 2.150	64.0	32.0	4.80	30.0
1800	673D188F040GP1C	0.770 x 2.650	49.0	25.0	5.92	27.0
2200	673D228F040GS1C	0.770 x 3.150	40.0	21.0	7.00	30.0
2700	673D278F040GT1C	0.770 x 3.650	34.8	18.6	8.02	21.0
680	673D687F040HE1C	0.895 x 1.150	130.0	64.0	3.00	62.0
1500	673D158F040HJ1C	0.895 x 1.650	67.0	33.0	4.54	36.0
2200	673D228F040HL1C	0.895 x 2.150	45.0	23.0	6.05	26.0
3300	673D338F040HP1C	0.895 x 2.650	34.0	18.4	7.41	22.0
3900	673D398F040HS1C	0.895 x 3.150	29.0	16.8	8.63	19.0
4700	673D478F040HT1C	0.895 x 3.650	25.8	14.8	9.85	17.0
1000	673D108F040JE1C	1.020 x 1.150	105.0	53.0	3.41	55.0
2200	673D228F040JJ1C	1.020 x 1.650	51.7	28.0	5.42	30.0
2700	673D278F040JL1C	1.020 x 2.150	36.0	20.0	7.49	23.0
3900	673D398F040JP1C	1.020 x 2.650	28.7	16.0	8.90	19.0
4700	673D478F040JS1C	1.020 x 3.150	23.8	13.0	10.60	17.0
5600	673D568F040JT1C	1.020 x 3.650	20.3	12.0	11.40	16.0
50 VOLTS DC WORKING; 75 VOLTS DC SURGE						
390	673D397F050GE1C	0.770 x 1.150	212.0	86.0	2.21	89.0
820	673D828F050GJ1C	0.770 x 1.650	50.0	44.0	3.57	47.0
1200	673D128F050GL1C	0.770 x 2.150	74.0	32.0	4.70	35.0
1500	673D158F050GP1C	0.770 x 2.650	56.0	25.0	5.83	28.0
1800	673D188F050GS1C	0.770 x 3.150	44.0	20.0	7.00	23.0
2200	673D228F050GT1C	0.770 x 3.650	37.7	17.7	8.00	21.0
560	673D567F050HE1C	0.895 x 1.150	145.0	59.0	2.87	62.0
1200	673D128F050HJ1C	0.895 x 1.650	76.0	34.0	4.46	37.0
1800	673D188F050HL1C	0.895 x 2.150	50.0	23.3	6.02	26.0
2200	673D228F050HP1C	0.895 x 2.650	39.0	18.7	7.35	22.0
2700	673D278F050HS1C	0.895 x 3.150	31.4	15.7	8.65	19.0
3300	673D338F050HT1C	0.895 x 3.650	27.0	13.9	9.82	17.0
820	673D828F050JE1C	1.020 x 1.150	112.0	51.4	3.45	54.0
1500	673D158F050JJ1C	1.020 x 1.650	58.0	27.8	5.37	31.0
2200	673D228F050JL1C	1.020 x 2.150	39.0	19.7	7.09	23.0
3300	673D338F050JP1C	1.020 x 2.650	30.0	15.9	8.61	20.0
3900	673D398F050JS1C	1.020 x 3.150	25.0	13.6	10.10	18.0
4700	673D478F050JT1C	1.020 x 3.650	21.6	12.0	11.40	16.0
63 VOLTS DC WORKING; 85 VOLTS DC SURGE						
330	673D337F063GE1C	0.770 x 1.150	236.0	89.0	2.13	93.0
680	673D688F063GJ1C	0.770 x 1.650	117.0	47.0	3.44	50.0
1000	673D108F063GL1C	0.770 x 2.150	79.0	33.3	4.61	36.0
1200	673D128F063GP1C	0.770 x 2.650	63.0	27.0	5.61	30.0
1800	673D188F063GS1C	0.770 x 3.150	49.9	22.0	6.71	25.0
2200	673D228F063GT1C	0.770 x 3.650	41.7	18.9	7.74	22.0
560	673D567F063HE1C	0.895 x 1.150	159.0	66.0	2.79	69.0
1000	673D108F063HJ1C	0.895 x 1.650	82.0	35.4	4.38	38.0
1500	673D158F063HL1C	0.895 x 2.150	54.0	24.5	5.87	28.0
2200	673D228F063HP1C	0.895 x 2.650	41.0	19.3	7.24	22.0
2700	673D278F063HS1C	0.895 x 3.150	34.6	16.6	8.42	20.0
3300	673D338F063HT1C	0.895 x 3.650	29.0	14.5	9.61	18.0

STANDARD RATINGS

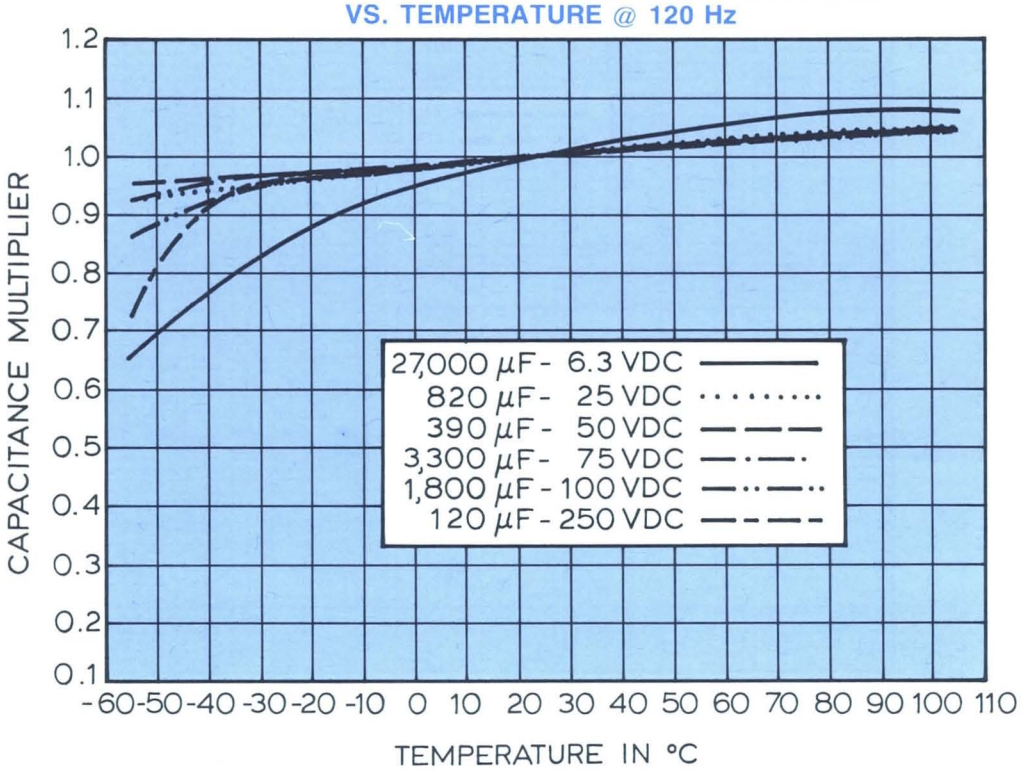
μF	Catalog Number	Nominal Case Size (in) D x L	Max. ESR @ +25°C (mΩ) 120 Hz	Max. ESR @ +25°C (mΩ) 20k-40kHz	Max Ripple Current @ +85°C (A) 20k-40kHz	Max. Impedance @ 100 kHz (mΩ)
63 VOLTS DC WORKING; 85 VOLTS DC SURGE (Cont.)						
680	673D687F063JE1C	1.020 x 1.150	122.0	51.0	3.70	54.0
1500	673D158F063JJ1C	1.020 x 1.650	63.0	28.0	5.54	31.0
2200	673D228F063JL1C	1.020 x 2.150	42.0	20.6	6.93	24.0
2700	673D278F063JP1C	1.020 x 2.650	32.9	16.5	8.45	20.0
3900	673D398F063JS1C	1.020 x 3.150	27.0	14.0	9.85	18.0
4700	673D478F063JT1C	1.020 x 3.650	23.3	12.4	11.20	16.0
75 VOLTS DC WORKING; 100 VOLTS DC SURGE						
270	673D277F075GE1C	0.770 x 1.150	311.0	141.0	1.73	145.0
560	673D567F075GJ1C	0.770 x 1.650	150.0	70.0	2.84	73.0
820	673D827F075GL1C	0.770 x 2.150	101.0	48.0	3.84	51.0
1200	673D128F075GP1C	0.770 x 2.650	77.0	37.3	4.77	40.0
1500	673D158F075GS1C	0.770 x 3.150	63.0	30.7	5.68	34.0
1800	673D188F075GT1C	0.770 x 3.650	53.0	26.4	6.55	30.0
390	673D397F075HE1C	0.895 x 1.150	214.0	100.0	2.27	104.0
820	673D827F075HJ1C	0.895 x 1.650	104.0	50.0	3.67	53.0
1200	673D128F075HL1C	0.895 x 2.150	73.0	36.0	4.83	39.0
1800	673D188F075HP1C	0.895 x 2.650	54.0	27.5	6.06	31.0
2200	673D228F075HS1C	0.895 x 3.150	45.0	23.0	7.12	26.0
2700	673D278F075HT1C	0.895 x 3.650	37.0	19.8	8.23	23.0
560	673D567F075JE1C	1.020 x 1.150	159.0	78.0	2.81	81.0
1200	673D128F075JJ1C	1.020 x 1.650	82.0	41.4	4.40	44.0
1800	673D188F075JL1C	1.020 x 2.150	53.9	28.0	5.95	30.0
2200	673D228F075JP1C	1.020 x 2.650	41.8	22.2	7.29	25.0
2700	673D278F075JS1C	1.020 x 3.150	33.7	18.5	8.60	22.0
3300	673D338F075JT1C	1.020 x 3.650	29.0	16.2	9.80	19.0
100 VOLTS DC WORKING; 125 VOLTS DC SURGE						
150	673D157F100GE1C	0.770 x 1.150	698.0	324.0	1.14	326.0
270	673D277F100GJ1C	0.770 x 1.650	329.0	154.0	1.92	156.0
390	673D397F100GL1C	0.770 x 2.150	221.0	104.0	2.60	106.0
560	673D567F100GP1C	0.770 x 2.650	164.0	78.0	3.39	80.0
680	673D687F100GS1C	0.770 x 3.150	131.0	63.0	3.96	65.0
820	673D827F100GT1C	0.770 x 3.650	110.0	53.0	4.60	54.0
220	673D227F100HE1C	0.895 x 1.150	452.0	212.0	1.55	215.0
390	673D397F100HJ1C	0.895 x 1.650	216.0	103.0	2.57	106.0
680	673D687F100HL1C	0.895 x 2.150	143.0	69.0	3.49	71.0
820	673D827F100HP1C	0.895 x 2.650	107.0	52.0	4.37	53.0
1000	673D108F100HS1C	0.895 x 3.150	89.0	44.0	5.15	45.0
1200	673D128F100HT1C	0.895 x 3.650	76.0	38.0	5.93	39.0
270	673D277F100JE1C	1.020 x 1.150	337.0	162.0	1.95	163.0
560	673D567F100JJ1C	1.020 x 1.650	163.0	79.0	3.17	81.0
820	673D827F100JL1C	1.020 x 2.150	109.0	54.0	4.27	55.0
1200	673D128F100JP1C	1.020 x 2.650	83.0	42.0	5.28	43.0
1500	673D158F100JS1C	1.020 x 3.150	67.0	34.0	6.29	35.0
1800	673D182F100JT1C	1.020 x 3.650	57.0	29.5	7.26	31.0
150 VOLTS DC WORKING; 200 VOLTS DC SURGE						
56	673D568F150GE1C	0.770 x 1.150	1733.0	881.0	.694	895.0
100	673D107F150GJ1C	0.770 x 1.650	886.0	450.0	1.12	460.0
150	673D157F150GL1C	0.770 x 2.150	569.0	290.0	1.56	297.0
82	673D828F150HE1C	0.895 x 1.150	1152.0	588.0	.936	592.0
220	673D227F150HL1C	0.895 x 2.150	376.0	193.0	2.09	198.0
470	673D477F150HT1C	0.895 x 3.650	185.0	96.0	3.74	100.0

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size (in) D x L	Max. ESR @ +25°C (mΩ) 120 Hz	Max. ESR @ +25°C (mΩ) 20k-40kHz	Max Ripple Current @ +85°C (A) 20k-40kHz	Max. Impedance @ 100 kHz (mΩ)
150 VOLTS DC WORKING; 200 VOLTS DC SURGE (Cont.)						
330	673D337F150JL1C	1.020 x 2.150	275.0	142.0	2.64	148.0
470	673D477F150JP1C	1.020 x 2.150	202.0	105.0	3.35	108.0
560	673D567F150JS1C	1.020 x 3.150	163.0	84.0	4.03	88.0
680	673D687F150JT1C	1.020 x 3.650	137.0	71.0	4.69	74.0
200 VOLTS DC WORKING; 250 VOLTS DC SURGE						
33	673D336F200GE1C	0.770 x 1.150	2290.0	1000.0	.651	1040.0
56	673D566F200HE1C	0.770 x 1.650	1510.0	670.0	.878	680.0
82	673D826F200GJ1C	0.770 x 2.650	1090.0	486.0	1.13	492.0
150	673D157F200GL1C	0.770 x 3.650	538.0	240.0	1.83	246.0
220	673D227F200HL1C	0.895 x 2.150	356.0	160.0	2.49	168.0
330	673D337F200HP1C	0.895 x 2.650	242.0	108.0	3.53	112.0
390	673D397F200HS1C	0.895 x 3.150	214.0	97.0	3.76	101.0
470	673D477F200HT1C	0.895 x 3.650	179.0	80.0	4.42	84.0
250 VOLTS DC WORKING; 300 VOLTS DC SURGE						
27	673D276F250GE1C	0.770 x 1.150	2400.0	700.0	0.771	710.0
56	673D566F250GJ1C	0.770 x 1.650	1147.0	338.0	1.29	348.0
82	673D826F250GL1C	0.770 x 2.150	754.0	232.0	1.77	240.0
100	673D107F250GP1C	0.770 x 2.650	587.0	178.0	2.19	186.0
150	673D157F250GS1C	0.770 x 3.150	461.0	137.0	2.67	143.0
180	673D187F250GT1C	0.770 x 3.650	379.0	117.0	3.13	122.0
39	673D398F250HE1C	0.895 x 1.150	1579.0	467.0	1.05	476.0
82	673D828F250HJ1C	0.895 x 1.650	766.0	237.0	1.72	246.0
120	673D127F250HL1C	0.895 x 2.150	503.0	158.0	2.35	166.0
180	673D187F250HP1C	0.895 x 2.650	383.0	119.0	2.94	125.0
220	673D227F250HS1C	0.895 x 3.150	310.0	92.0	3.51	97.0
270	673D277F250HT1C	0.895 x 3.650	251.0	78.0	4.15	83.0
56	673D566F250JE1C	1.020 x 1.150	1140.0	345.0	1.33	354.0
120	673D127F250JJ1C	1.020 x 1.650	554.0	243.0	2.17	252.0
180	673D187F250JL1C	1.020 x 2.150	367.0	116.0	2.95	122.0
220	673D227F250JP1C	1.020 x 2.650	257.0	87.0	3.71	91.0
270	673D277F250JS1C	1.020 x 3.150	220.0	69.0	4.44	74.0
330	673D331F250JT1C	1.020 x 3.650	184.0	58.0	5.16	63.0

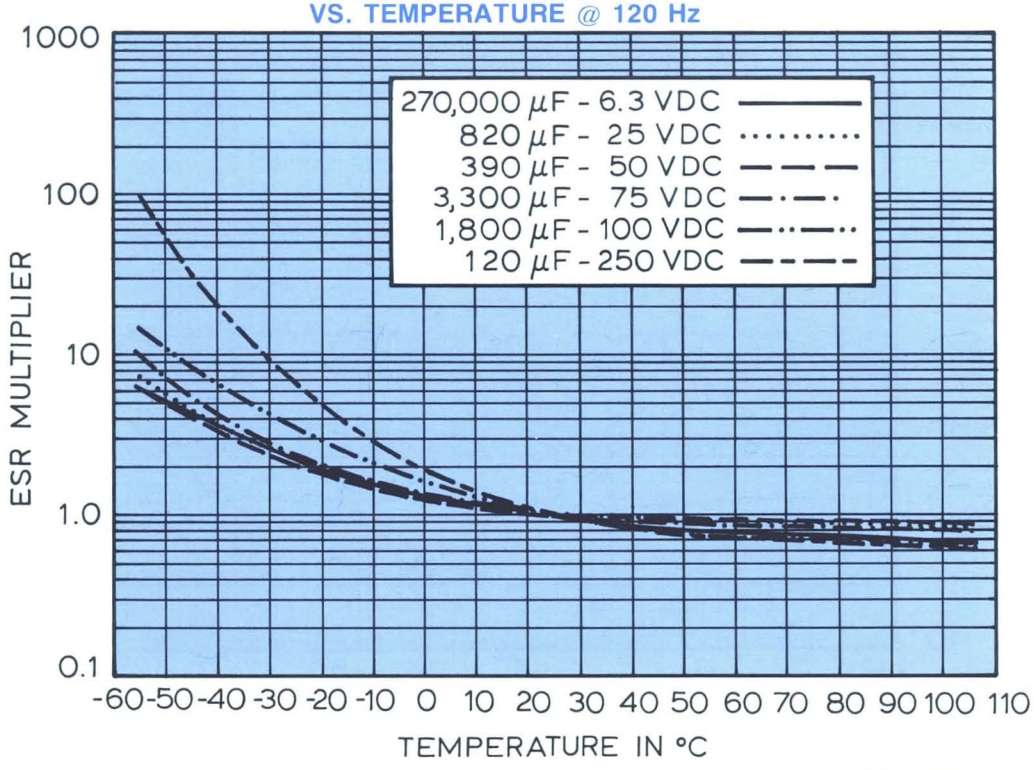
TYPICAL CURVES

TYPE 673D — TYPICAL CAPACITANCE MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,723

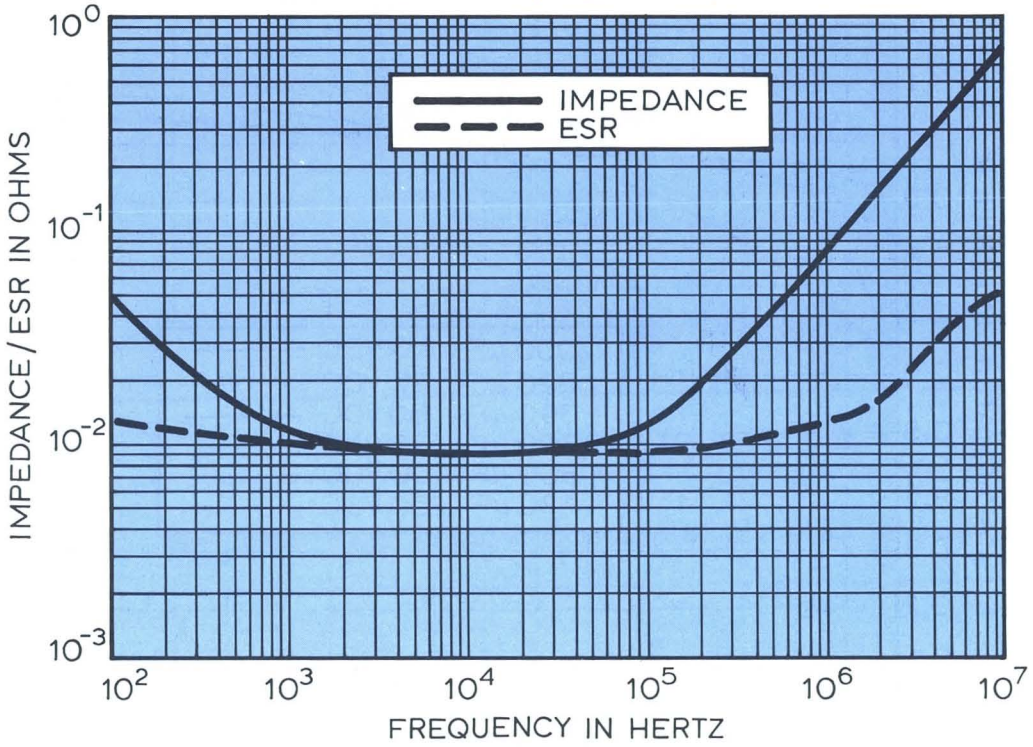
TYPE 673D — TYPICAL ESR MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,715

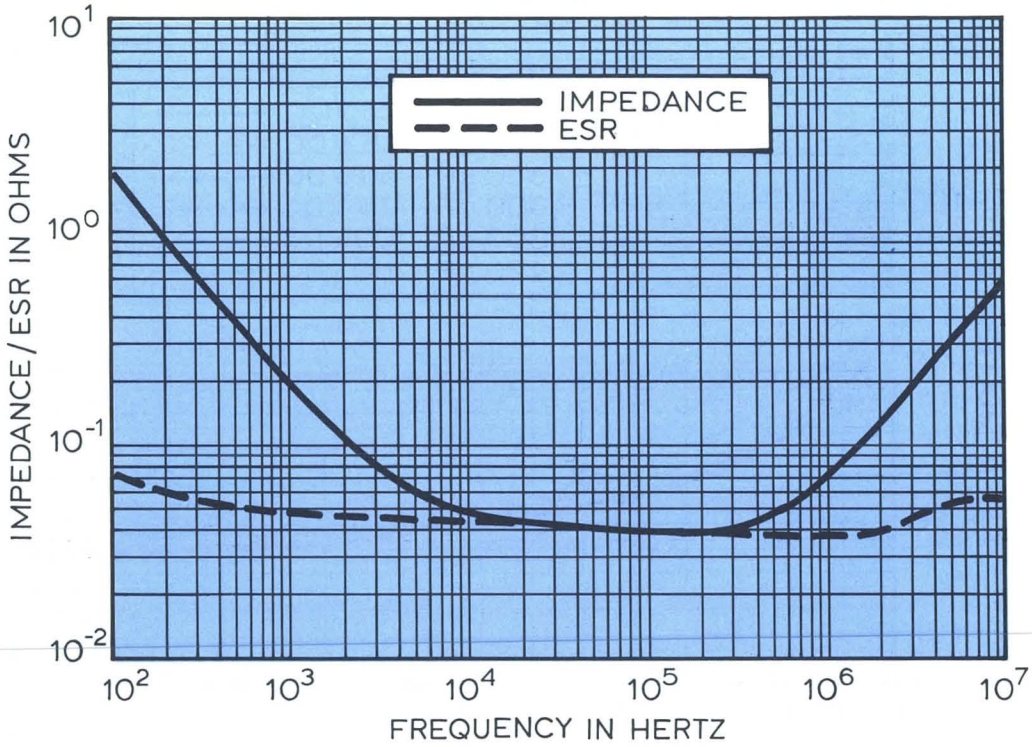
TYPICAL CURVES @ +25°C

TYPE 673D/674D — 27000μF @ 6.3VDC, JT CASE SIZE



Dwg. No. A-14,759

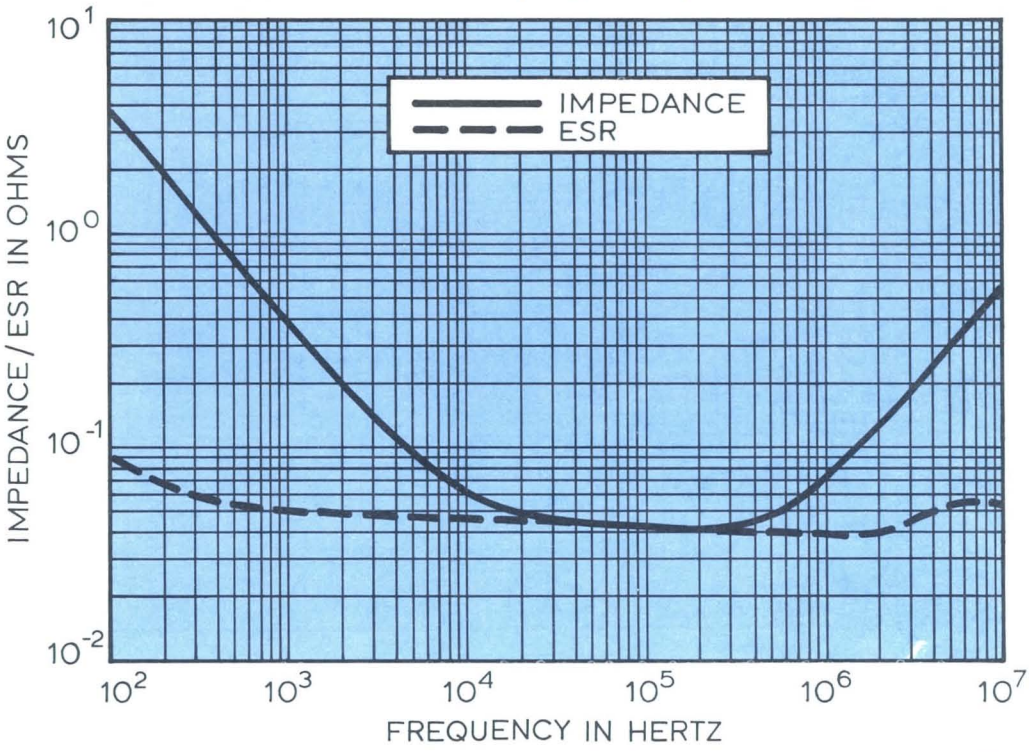
TYPE 673D/674D — 820μF @ 25VDC, GE CASE SIZE



Dwg. No. A-14,758

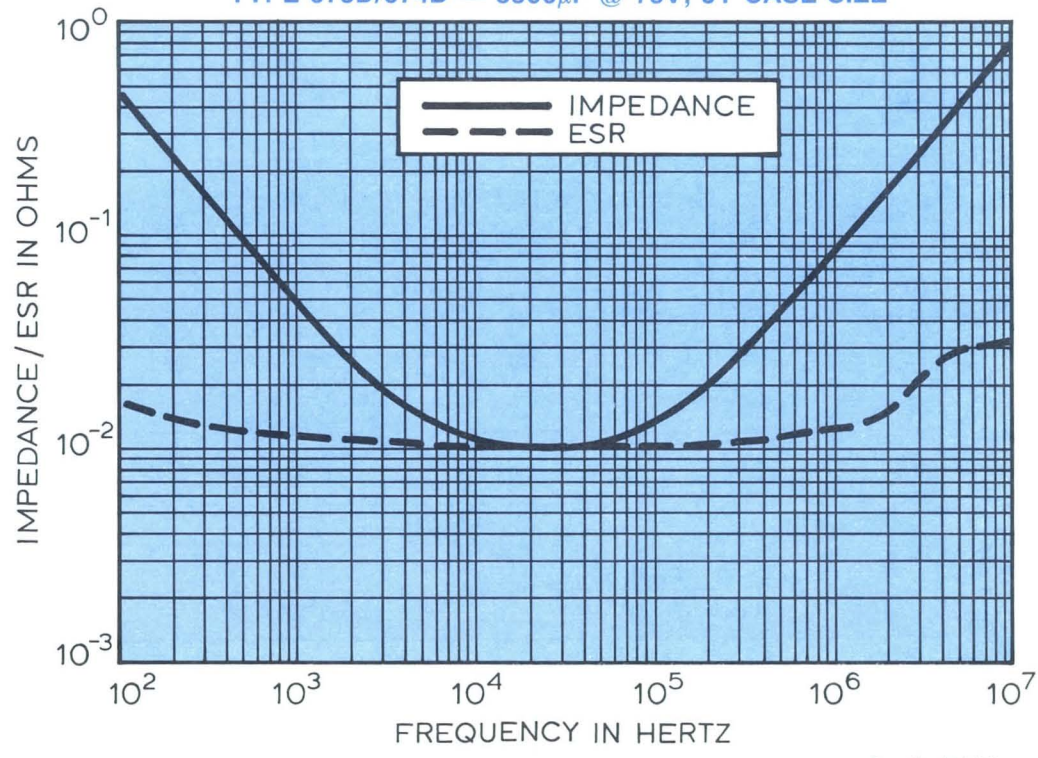
TYPICAL CURVES @ +25°C

TYPE 673D/674D — 390μF @ 50VDC, GE CASE SIZE



Dwg. No. A-14,756

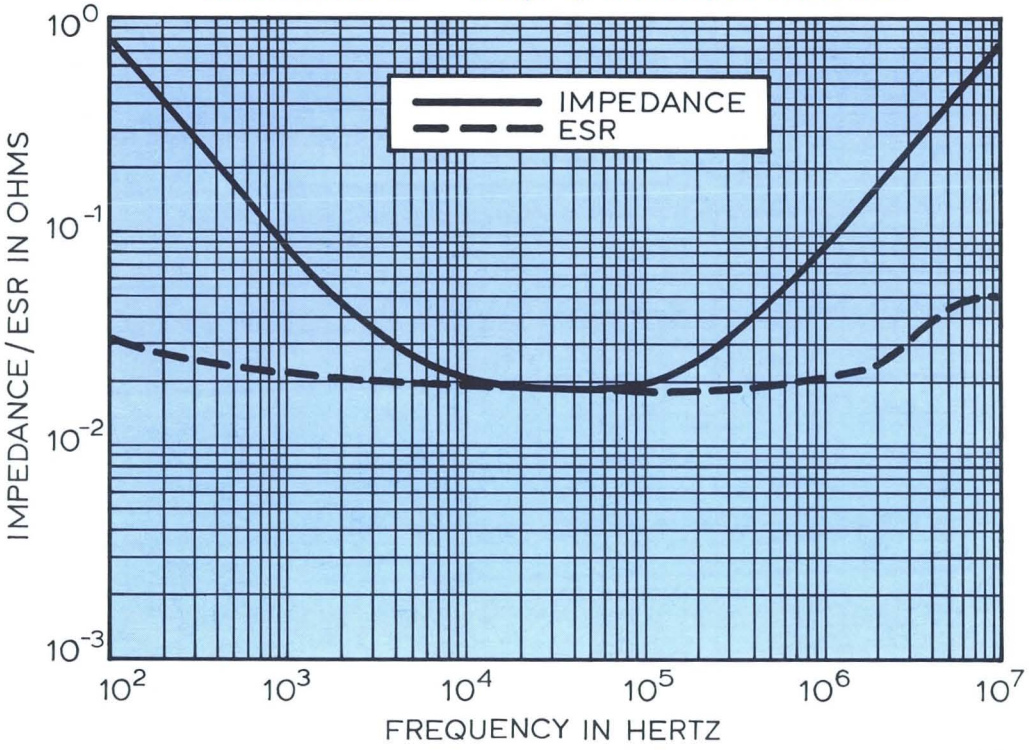
TYPE 673D/674D — 3300μF @ 75V, JT CASE SIZE



Dwg. No. A-14,757

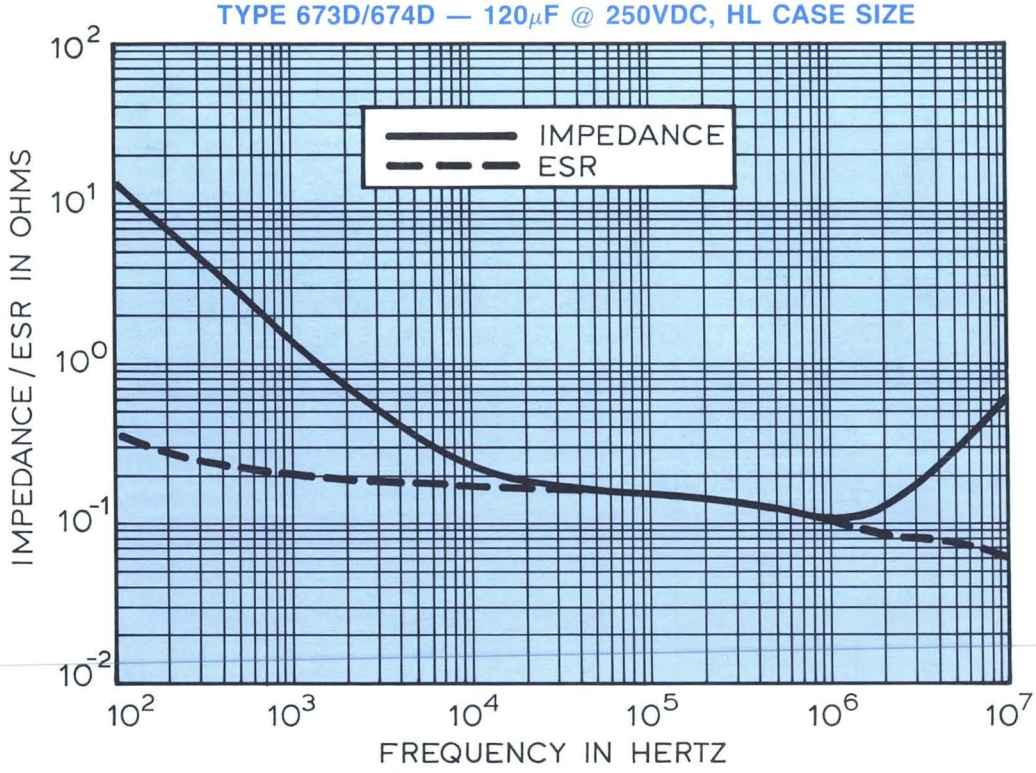
TYPICAL CURVES @ +25°C

TYPE 673D/674D — 1800μF @ 100VDC, JT CASE SIZE



Dwg. No. A-14,755

TYPE 673D/674D — 120μF @ 250VDC, HL CASE SIZE



Dwg. No. A-14,754

+105°C Tubular Radial Lead Aluminum Capacitors

9715

Features —

- Low Impedance
- Low ESR
- Symmetrical ESR (±30%), and Capacitance (±20%)
- Long Life

General Specifications —

Operating Temperature:
−55°C - +105°C.

Voltage Range: 6.3 - 63 VDC.

Capacitance Range: 140μF - 15,000μF.

Capacitance Tolerance: ±20%.

Case Size Range: 0.75″ x 1.125″ - 1.0″ x 3.625″.

Termination: Radial leads.

Life Validation Test: 2000 hrs @ +105°C:
Δ CAP ≤ 15% from initial measurement.
Δ ESR ≤ 1.5x initial specified limit.
Δ DCL ≤ initial specified limit.

Shelf Test: 500 hrs @ +105°C:
Δ CAP ≤ 10% from initial measurement.
Δ ESR ≤ 1.15x initial specified limit.
Δ DCL ≤ 2x initial specified limit.

DC Leakage Current:
$I = K\sqrt{CV}$
K = 0.5 @ +25°C
I in μa, C in μF, V in Volts

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	+105°C	+85°C	+65°C	+45°C	+25°C
Multiplier	0.4	1.0	1.4	1.7	2.0

FREQUENCY Hz

Rated WVDC	50-60	100-120	300-400	1000	20K-100K
6.3 to 63	0.60	0.75	0.80	0.90	1.0

Low Temperature Performance:
Capacitance Ratio $C^{-55°C}/C^{+25°C}$ min. @ 120Hz

Rated Voltage (VDC)	Ratio
6.3-25	0.75
40-63	0.8

ESR Ratio $ESR^{-55°C}/ESR^{+25°C}$ max. @ 120Hz

Rated Voltage (VDC)	Ratio
6.3-25	8
40-63	10

ESL (Typical values @ 1MHz-10MHz):

Nominal Diameter Inches	Nominal Diameter Millimeters	Typical ESL (nH)
0.75	19	10
0.875	22	11
1.00	25	13

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

676D 128 M 6R3 GE 1 C

LEAD CODE. C = 2 LEAD RADIAL MOUNT (Standard on 676D).
J = 3 LEAD AXIAL MOUNT (Optional on 676D).
A = KEYED POLARITY 3 LEAD RADIAL MOUNT (Standard on 677D).

CASE STYLE. 1 = PVC INSULATING SLEEVE (Standard for +105°C Operation).
7 = PVC SLEEVE WITH RESIN END SEAL (Optional).
(Required for exposure to halogenated cleaning solvents).

CASE CODE. SEE DIMENSIONS, BELOW.

DC VOLTAGE RATING. EXPRESSED IN VOLTS. AN 'R' IS USED AS A DECIMAL POINT. FOR EXAMPLE: 6R3 = 6.3 VOLTS.

CAPACITANCE TOLERANCE. M = ±20%.

CAPACITANCE. EXPRESSED IN PICOFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES. THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.
676D = LEAD CODES C AND J ONLY.
677D = LEAD CODE A ONLY.

DIMENSIONS IN INCHES

CASE CODE	STYLE 1 STYLE 7		OVERALL LENGTH	LEAD SPACING*	TYPICAL WEIGHT (oz)
	D ±0.015	L ±0.062	H MAX.	S ±0.015	
GE	0.770	1.150	1.246	0.250	0.46
GJ	0.770	1.650	1.746	0.250	0.67
GL	0.770	2.150	2.246	0.250	0.74
GP	0.770	2.650	2.746	0.250	0.88
GS	0.770	3.150	3.246	0.250	1.16
GT	0.770	3.650	3.746	0.250	1.34
HE	0.895	1.150	1.246	0.300	0.63
HJ	0.895	1.650	1.746	0.300	0.95
HL	0.895	2.150	2.246	0.300	1.02
HP	0.895	2.650	2.746	0.300	1.37
HS	0.895	3.150	3.246	0.300	1.73
HT	0.895	3.650	3.746	0.300	2.08
JE	1.020	1.150	1.246	0.400	0.81
JJ	1.020	1.650	1.746	0.400	1.02
JL	1.020	2.150	2.246	0.400	1.20
JP	1.020	2.650	2.746	0.400	1.87
JS	1.020	3.150	3.246	0.400	2.22
JT	1.020	3.650	3.746	0.400	2.54

*Type 676D Only.

DIMENSIONS IN MILLIMETERS

CASE CODE	STYLE 1 STYLE 7		OVERALL LENGTH	LEAD SPACING*	TYPICAL WEIGHT (grams)
	D ±0.4	L ±1.6	H MAX.	S ±0.4	
GE	19.6	29.2	31.6	6.4	13
GJ	19.6	41.9	44.3	6.4	19
GL	19.6	54.6	57.0	6.4	21
GP	19.6	67.3	69.7	6.4	25
GS	19.6	80.0	82.4	6.4	33
GT	19.6	92.7	95.1	6.4	38
HE	22.7	29.2	31.6	7.6	18
HJ	22.7	41.9	44.3	7.6	27
HL	22.7	54.6	57.0	7.6	29
HP	22.7	67.3	69.7	7.6	39
HS	22.7	80.0	82.4	7.6	49
HT	22.7	92.7	95.1	7.6	59
JE	25.9	29.2	31.6	10.2	23
JJ	25.9	41.9	44.3	10.2	29
JL	25.9	54.6	57.0	10.2	34
JP	25.9	67.3	69.7	10.2	53
JS	25.9	80.0	82.4	10.2	63
JT	25.9	92.7	95.1	10.2	72

*Type 676D Only.

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D ± 0.015	x	L ± 0.062	@ +25°C (mΩ) 120Hz Max.	20k-100kHz ±30%	Max. Ripple Current +85°C (A) 120Hz	20k-100kHz	Max. Impedance (mΩ) @ +25°C, 100kHz
6.3 VOLTS DC WORKING; 9 VDC SURGE									
1200	676D128M6R3GE1C	0.760	x	1.140	98.0	42.9	1.89	2.76	57.8
2700	676D278M6R3GJ1C	0.760	x	1.640	52.0	22.6	3.13	4.38	31.4
3900	676D398M6R3GL1C	0.760	x	2.140	37.0	16.2	4.24	5.79	23.1
5600	676D568M6R3GP1C	0.760	x	2.640	28.0	12.9	5.24	7.11	18.8
6800	676D688M6R3GS1C	0.760	x	3.140	23.0	11.1	6.24	8.27	16.4
8200	676D828M6R3GT1C	0.760	x	3.640	20.0	9.8	7.20	9.43	14.7
1800	676D188M6R3HE1C	0.885	x	1.140	69.1	25.9	2.62	3.91	36.7
3900	676D398M6R3HJ1C	0.885	x	1.640	35.0	13.5	4.30	6.22	20.6
5600	676D568M6R3HL1C	0.885	x	2.140	24.1	9.5	5.76	8.27	15.4
8200	676D828M6R3HP1C	0.885	x	2.640	18.7	7.6	7.19	10.11	12.9
10000	676D109M6R3HS1C	0.885	x	3.140	15.5	6.4	8.51	11.88	11.3
12000	676D129M6R3HT1C	0.885	x	3.640	13.4	5.6	9.64	13.58	10.3
2700	676D278M6R3JE1C	1.010	x	1.140	54.3	21.3	3.25	4.70	31.7
5600	676D568M6R3JJ1C	1.010	x	1.640	27.8	11.2	5.22	7.42	18.6
8200	676D828M6R3JL1C	1.010	x	2.140	19.3	8.0	7.01	9.75	14.4
10000	676D109M6R3JP1C	1.010	x	2.640	15.2	6.4	8.63	11.89	12.3
12000	676D129M6R3JS1C	1.010	x	3.140	12.7	5.5	9.98	13.83	11.2
15000	676D159M6R3JT1C	1.010	x	3.640	11.0	4.9	11.68	15.64	10.4
7.5 VOLTS DC WORKING; 10 VDC SURGE									
1200	676D128M7R5GE1C	0.760	x	1.140	98.0	42.9	1.90	2.76	57.8
2700	676D278M7R5GJ1C	0.760	x	1.640	52.0	22.6	3.14	4.38	31.4
3900	676D398M7R5GL1C	0.760	x	2.140	37.0	16.2	4.22	5.79	23.1
5600	676D568M7R5GP1C	0.760	x	2.640	28.0	12.9	5.27	7.11	18.8
6800	676D688M7R5GS1C	0.760	x	3.140	23.0	11.1	6.23	8.27	16.4
8200	676D828M7R5GT1C	0.760	x	3.640	20.0	9.8	7.18	9.43	14.7
1800	676D188M7R5HE1C	0.885	x	1.140	69.1	25.9	2.63	3.91	36.7
3900	676D398M7R5HJ1C	0.885	x	1.640	35.0	13.5	4.27	6.22	20.6
5600	676D568M7R5HL1C	0.885	x	2.140	24.1	9.5	5.80	8.27	15.4
8200	676D828M7R5HP1C	0.885	x	2.640	18.7	7.6	7.17	10.11	12.9
10000	676D109M7R5HS1C	0.885	x	3.140	15.5	6.4	8.51	11.88	11.3
12000	676D129M7R5HT1C	0.885	x	3.640	13.4	5.6	9.68	13.58	10.3
2700	676D278M7R5JE1C	1.010	x	1.140	54.3	21.3	3.27	4.70	31.7
5600	676D568M7R5JJ1C	1.010	x	1.640	27.8	11.2	5.24	7.42	18.6
8200	676D828M7R5JL1C	1.010	x	2.140	19.3	8.0	6.99	9.75	14.4
10000	676D109M7R5JP1C	1.010	x	2.640	15.2	6.4	8.63	11.89	12,3
12000	676D129M7R5JS1C	1.010	x	3.140	12.7	5.5	10.02	13.83	11.2
15000	676D159M7R5JT1C	1.010	x	3.640	11.0	4.9	11.43	15.64	10.4
10 VOLTS DC WORKING; 14 VDC SURGE									
1000	676D108M010GE1C	0.760	x	1.140	123.0	43.0	1.80	2.75	57.9
2200	676D228M010GJ1C	0.760	x	1.640	61.0	22.6	2.92	4.38	31.4
3300	676D338M010GL1C	0.760	x	2.140	40.0	16.2	3.95	5.79	23.1
3900	676D398M010GP1C	0.760	x	2.640	31.0	12.9	4.93	7.11	18.8
5600	676D568M010GS1C	0.760	x	3.140	26.0	11.1	5.87	8.27	16.4
6800	676D688M010GT1C	0.760	x	3.640	23.0	9.9	6.76	9.38	14.9
1500	676D158M010HE1C	0.885	x	1.140	80.5	25.9	2.41	3.91	36.7
3300	676D338M010HJ1C	0.885	x	1.640	40.5	13.5	3.98	6.22	20.6
4700	676D478M010HL1C	0.885	x	2.140	27.7	9.5	5.41	8.27	15.4
6800	676D688M010HP1C	0.885	x	2.640	21.4	7.6	6.70	10.11	12.9
8200	676D828M010HS1C	0.885	x	3.140	17.7	6.4	7.99	11.88	11.3
10000	676D109M010HT1C	0.885	x	3.640	15.2	5.6	9.23	13.58	10.3

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D ± 0.015 x L ± 0.062	@ +25°C (mΩ) 120Hz Max.	@ +25°C (mΩ) 20k-100kHz ±30%	Max. Ripple Current +85°C (A) 120Hz	Max. Ripple Current +85°C (A) 20k-100kHz	Max. Impedance (mΩ) @ +25°C, 100kHz
10 VOLTS DC WORKING; 14 VDC SURGE (Cont.)							
2200	676D228M010JE1C	1.010 x 1.140	62.8	21.3	3.03	4.70	31.7
4700	676D478M010JJ1C	1.010 x 1.640	31.9	11.2	4.89	7.42	18.6
6800	676D688M010JL1C	1.010 x 2.140	22.0	8.0	6.53	9.75	14.4
8200	676D828M010JP1C	1.010 x 2.640	17.2	6.5	8.13	11.80	12.5
10000	676D109M010JS1C	1.010 x 3.140	14.3	5.5	9.60	13.83	11.2
12000	676D129M010JT1C	1.010 x 3.640	12.4	4.9	10.69	15.64	10.4
12 VOLTS DC WORKING; 16 VDC SURGE							
1000	676D108M012GE1C	0.760 x 1.140	126.0	42.7	1.76	2.76	57.5
1800	676D188M012GJ1C	0.760 x 1.640	63.0	22.6	2.81	4.38	31.4
2700	676D278M012GL1C	0.760 x 2.140	41.0	16.1	3.87	5.79	22.9
3900	676D398M012GP1C	0.760 x 2.640	32.0	12.9	4.81	7.11	18.8
4700	676D478M012GS1C	0.760 x 3.140	26.0	11.1	5.26	8.27	16.3
5600	676D568M012GT1C	0.760 x 3.640	22.0	9.8	6.63	9.38	14.7
1500	676D158M012HE1C	0.885 x 1.140	84.7	26.0	2.35	3.91	36.8
2700	676D278M012HJ1C	0.885 x 1.640	42.5	13.5	3.90	6.22	20.6
4700	676D478M012HL1C	0.885 x 2.140	29.0	9.5	5.29	8.27	15.4
5600	676D568M012HP1C	0.885 x 2.640	22.4	7.6	6.55	10.11	12.9
6800	676D688M012HS1C	0.885 x 3.140	18.5	6.4	7.82	11.88	11.3
8200	676D828M012HT1C	0.885 x 3.640	15.8	5.6	9.06	13.58	10.3
1800	676D188M012JE1C	1.010 x 1.140	65.9	21.3	2.91	4.70	31.7
3900	676D398M012JJ1C	1.010 x 1.640	33.4	11.2	4.76	7.42	18.6
5600	676D568M012JL1C	1.010 x 2.140	23.0	8.0	6.40	9.75	14.4
8200	676D828M012JP1C	1.010 x 2.640	17.9	6.5	7.95	11.80	12.5
10000	676D109M012JS1C	1.010 x 3.140	14.9	5.5	9.42	13.83	11.2
12000	676D129M012JT1C	1.010 x 3.640	12.9	4.9	10.77	15.64	10.4
16 VOLTS DC WORKING; 20 VDC SURGE							
560	676D567M016GE1C	0.760 x 1.140	144.0	43.1	1.60	2.75	58.0
1200	676D128M016GJ1C	0.760 x 1.640	72.0	22.7	2.61	4.37	31.5
1800	676D188M016GL1C	0.760 x 2.140	49.0	16.2	3.55	5.79	23.1
2200	676D228M016GP1C	0.760 x 2.640	38.0	13.0	4.44	7.08	18.9
2700	676D278M016GS1C	0.760 x 3.140	31.0	11.1	5.30	8.27	16.4
3300	676D338M016GT1C	0.760 x 3.640	26.0	9.9	6.13	9.38	14.9
820	676D827M016HE1C	0.885 x 1.140	86.0	26.0	2.19	3.90	36.8
1800	676D188M016HJ1C	0.885 x 1.640	47.0	13.6	3.55	6.20	20.7
2700	676D278M016HL1C	0.885 x 2.140	30.0	9.6	4.76	8.23	15.5
3300	676D338M016HP1C	0.885 x 2.640	24.0	7.6	6.01	10.11	12.9
4700	676D478M016HS1C	0.885 x 3.140	20.0	6.4	7.21	11.88	11.3
5600	676D568M016HT1C	0.885 x 3.640	17.0	5.6	8.29	13.58	10.3
1200	676D128M016JE1C	1.010 x 1.140	74.0	21.3	2.70	4.70	31.7
2200	676D228M016JJ1C	1.010 x 1.640	37.0	11.2	4.37	7.42	18.6
3300	676D338M016JL1C	1.010 x 2.140	25.0	8.0	5.88	9.75	14.4
4700	676D478M016JP1C	1.010 x 2.640	20.0	6.5	7.31	11.80	12.5
5600	676D568M016JS1C	1.010 x 3.140	17.0	5.5	8.68	13.83	11.2
6800	676D688M016JT1C	1.010 x 3.640	15.0	4.9	9.98	15.64	10.4
20 VOLTS DC WORKING; 30 VDC SURGE							
560	676D567M020GE1C	0.760 x 1.140	144.0	43.1	1.60	2.75	58.0
1200	676D128M020GJ1C	0.760 x 1.640	72.0	22.7	2.61	4.37	31.5
1800	676D188M020GL1C	0.760 x 2.140	49.0	16.2	3.56	5.79	23.1
2200	676D228M020GP1C	0.760 x 2.640	38.0	13.0	4.44	7.08	18.9
2700	676D278M020GS1C	0.760 x 3.140	31.0	11.1	5.30	8.27	16.4
3300	676D338M020GT1C	0.760 x 3.640	26.0	9.9	6.13	9.38	14.9

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D ± 0.015 x L ± 0.062	@ +25°C (mΩ) 120Hz Max.	@ +25°C (mΩ) 20k-100kHz ±30%	Max. Ripple Current +85°C (A) 120Hz	Max. Ripple Current +85°C (A) 20k-100kHz	Max. Impedance (mΩ) @ +25°C, 100kHz
20 VOLTS DC WORKING; 30 VDC SURGE (Cont.)							
820	676D827M020HE1C	0.885 x 1.140	86.0	26.0	2.10	3.90	36.8
1800	676D188M020HJ1C	0.885 x 1.640	44.0	13.6	3.37	6.20	20.7
2700	676D278M020HL1C	0.885 x 2.140	30.0	9.6	4.62	8.23	15.5
3300	676D338M020HP1C	0.885 x 2.640	24.0	7.6	5.80	10.11	12.9
4700	676D478M020HS1C	0.885 x 3.140	20.0	6.4	6.95	11.88	11.3
5600	676D568M020HT1C	0.885 x 3.640	17.0	5.6	8.06	13.58	10.3
1200	676D128M020JE1C	1.010 x 1.140	71.0	21.3	2.62	4.70	31.7
2200	676D228M020JJ1C	1.010 x 1.640	37.0	11.2	4.22	7.42	18.6
3300	676D338M020JL1C	1.010 x 2.140	26.0	8.0	5.68	9.75	14.4
4700	676D478M020JP1C	1.010 x 2.640	20.0	6.5	7.06	11.80	12.5
5600	676D568M020JS1C	1.010 x 3.140	17.0	5.5	8.45	13.83	11.2
6800	676D688M020JT1C	1.010 x 3.640	15.0	4.9	9.76	15.64	10.4
25 VOLTS DC WORKING; 35 VDC SURGE							
560	676D567M025GE1C	0.760 x 1.140	154.0	43.2	1.54	2.74	58.2
1000	676D108M025GJ1C	0.760 x 1.640	77.0	22.7	2.53	4.35	31.5
1500	676D158M025GL1C	0.760 x 2.140	52.0	16.3	3.37	5.77	23.2
2200	676D228M025GP1C	0.760 x 2.640	40.0	13.0	4.29	7.08	18.9
2700	676D278M025GS1C	0.760 x 3.140	33.0	11.1	5.07	8.27	16.4
3300	676D338M025GT1C	0.760 x 3.640	28.0	9.9	5.93	9.38	14.9
820	676D827M025HE1C	0.885 x 1.140	103.0	26.0	2.10	3.90	36.8
1500	676D158M025HJ1C	0.885 x 1.640	52.0	13.6	3.37	6.20	20.7
2200	676D228M025HL1C	0.885 x 2.140	36.0	9.6	4.62	8.23	15.5
3300	676D338M025HP1C	0.885 x 2.640	28.0	7.6	5.80	10.11	12.9
3900	676D398M025HS1C	0.885 x 3.140	23.0	6.4	6.95	11.88	11.3
4700	676D478M025HT1C	0.885 x 3.640	20.0	5.6	8.06	13.58	10.3
1000	676D108M025JE1C	1.010 x 1.140	80.0	21.3	2.62	4.70	31.7
2200	676D228M025JJ1C	1.010 x 1.640	41.0	11.2	4.22	7.42	14.4
3300	676D338M025JL1C	1.010 x 2.140	28.0	8.0	5.68	9.75	14.4
3900	676D398M025JP1C	1.010 x 2.640	22.6	6.5	7.06	11.80	12.5
5600	676D568M025JS1C	1.010 x 3.140	19.0	5.5	8.45	13.83	11.2
6800	676D688M025JT1C	1.010 x 3.640	16.0	4.9	9.76	15.64	10.4
40 VOLTS DC WORKING; 55 VDC SURGE							
330	676D337M040GE1C	0.760 x 1.140	219.0	43.5	1.27	2.74	58.6
680	676D687M040GJ1C	0.760 x 1.640	108.0	22.9	2.11	4.35	31.8
1000	676D108M040GL1C	0.760 x 2.140	73.0	16.3	2.87	5.77	23.2
1200	676D128M040GP1C	0.760 x 2.640	56.0	13.1	3.62	7.05	19.0
1500	676D158M040GS1C	0.760 x 3.140	45.0	11.2	4.23	8.23	16.6
1800	676D188M040GT1C	0.760 x 3.640	38.0	9.9	4.98	9.38	14.9
470	676D477M040HE1C	0.885 x 1.140	142.0	26.3	1.74	3.88	37.2
1000	676D108M040HJ1C	0.885 x 1.640	70.0	13.6	2.85	6.20	20.7
1500	676D158M040HL1C	0.885 x 2.140	46.0	9.6	3.83	8.23	15.5
1800	676D188M040HP1C	0.885 x 2.640	35.0	7.6	4.81	10.11	12.9
2200	676D228M040HS1C	0.885 x 3.140	29.0	6.5	5.77	11.79	11.5
2700	676D278M040HT1C	0.885 x 3.640	25.0	5.7	6.69	13.46	10.4
680	676D687M040JE1C	1.010 x 1.140	111.0	21.6	2.17	4.66	32.1
1200	676D128M040JJ1C	1.010 x 1.640	55.0	11.3	3.54	7.38	18.7
1800	676D188M040JL1C	1.010 x 2.140	38.0	8.1	4.72	9.69	14.5
2700	676D278M040JP1C	1.010 x 2.640	29.0	6.5	5.98	11.80	12.5
3300	676D338M040JS1C	1.010 x 3.140	24.0	5.5	7.08	13.83	11.2
3900	676D398M040JT1C	1.010 x 3.640	21.0	4.9	8.27	15.64	10.4

STANDARD RATINGS

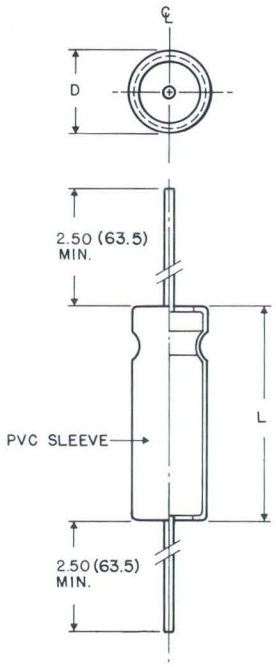
μF	Catalog Number	Nominal Case Size (inches) D ± 0.015	x	L ± 0.062	@ +25°C (mΩ) 120Hz Max.	20k-100kHz ±30%	Max. Ripple Current +85°C (A) 120Hz	20k-100kHz	Max. Impedance (mΩ) @ +25°C, 100kHz
50 VOLTS DC WORKING; 75 VDC SURGE									
220	676D227M050GE1C	0.760	x	1.140	290.0	49.7	1.11	2.56	66.6
470	676D477M050GJ1C	0.760	x	1.640	143.0	25.9	1.83	4.09	35.7
680	676D687M050GL1C	0.760	x	2.140	96.0	18.3	2.50	5.45	25.8
1000	676D108M050GP1C	0.760	x	2.640	72.0	14.6	3.17	6.68	21.0
1200	676D128M050GS1C	0.760	x	3.140	59.0	12.3	3.79	7.85	18.0
1500	676D158M050GT1C	0.760	x	3.640	50.0	10.9	4.41	8.94	16.2
330	676D337M050HE1C	0.885	x	1.140	188.0	30.3	1.50	3.61	42.4
680	676D687M050HJ1C	0.885	x	1.640	92.0	15.6	2.49	5.79	23.3
1000	676D108M050HL1C	0.885	x	2.140	62.0	10.9	3.38	7.72	17.2
1500	676D158M050HP1C	0.885	x	2.640	47.0	8.6	4.24	9.50	14.2
1800	676D188M050HS1C	0.885	x	3.140	38.0	7.2	5.09	11.20	12.4
2200	676D228M050HT1C	0.885	x	3.640	32.0	6.3	5.92	12.81	11.2
470	676D477M050JE1C	1.010	x	1.140	143.0	24.6	1.88	4.37	36.0
1000	676D108M050JJ1C	1.010	x	1.640	71.0	12.8	3.09	6.94	20.6
1500	676D158M050JL1C	1.010	x	2.140	48.0	9.1	4.16	9.14	15.8
1800	676D188M050JP1C	1.010	x	2.640	36.0	7.2	5.22	11.21	13.4
2200	676D228M050JS1C	1.010	x	3.140	28.0	6.2	6.24	13.02	12.1
2700	676D278M050JT1C	1.010	x	3.640	24.0	5.4	7.23	14.90	11.2
63 VOLTS DC WORKING; 85 VDC SURGE									
150	676D157M063GE1C	0.760	x	1.140	400.0	50.3	0.94	2.54	67.4
330	676D337M063GJ1C	0.760	x	1.640	197.0	26.2	1.56	4.07	36.1
470	676D477M063GL1C	0.760	x	2.140	131.0	18.5	2.14	5.42	26.1
560	676D567M063GP1C	0.760	x	2.640	99.0	14.7	2.70	6.66	21.1
820	676D827M063GS1C	0.760	x	3.140	80.0	12.5	3.25	7.79	18.3
1000	676D108M063GT1C	0.760	x	3.640	67.0	11.0	3.82	8.90	16.3
220	676D227M063HE1C	0.885	x	1.140	262.0	30.7	1.26	3.59	42.9
470	676D477M063HJ1C	0.885	x	1.640	128.0	15.8	2.11	5.75	23.1
680	676D687M063HL1C	0.885	x	2.140	85.0	11.0	2.89	7.69	17.3
1000	676D108M063HP1C	0.885	x	2.640	64.0	8.7	3.65	9.44	14.3
1200	676D128M063HS1C	0.885	x	3.140	52.0	7.3	4.37	11.13	12.5
1500	676D158M063HT1C	0.885	x	3.640	43.0	6.4	4.94	12.70	11.3
330	676D337M063JE1C	1.010	x	1.140	198.0	24.1	1.60	4.41	35.3
560	676D567M063JJ1C	1.010	x	1.640	97.0	12.9	2.62	6.91	20.8
1000	676D108M063JL1C	1.010	x	2.140	65.0	9.2	3.59	9.09	16.0
1200	676D128M063JP1C	1.010	x	2.640	49.0	7.3	4.40	11.14	13.5
1500	676D158M063JS1C	1.010	x	3.140	40.0	6.2	5.37	13.02	12.1
1800	676D188M063JT1C	1.010	x	3.640	33.0	5.5	6.14	14.77	11.2

Tubular Axial Lead Capacitors

SPRAGUE®

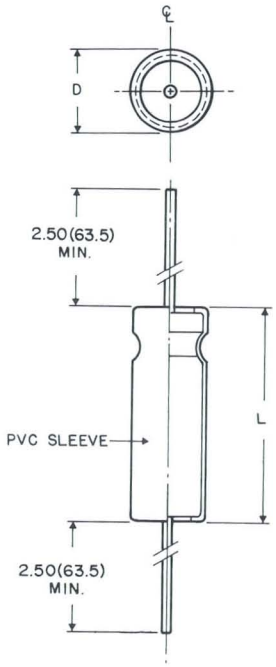
OUTLINE DRAWINGS

TYPE 53D STYLE 6



Dwg. No. A-14,835

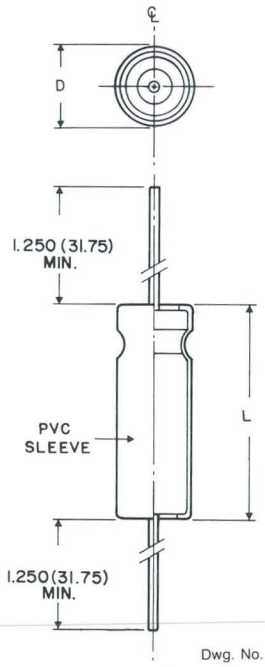
TYPE 53D STYLE 7



Dwg. No. A-14,836

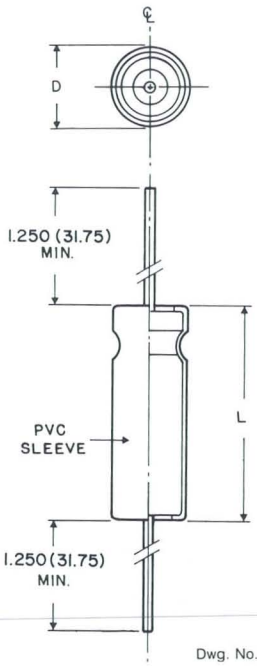
TINNED COPPER LEADS $\frac{0.040}{1.016}$ Diameter (No. 18 AWG)

TYPE 601D STYLES 1, 2



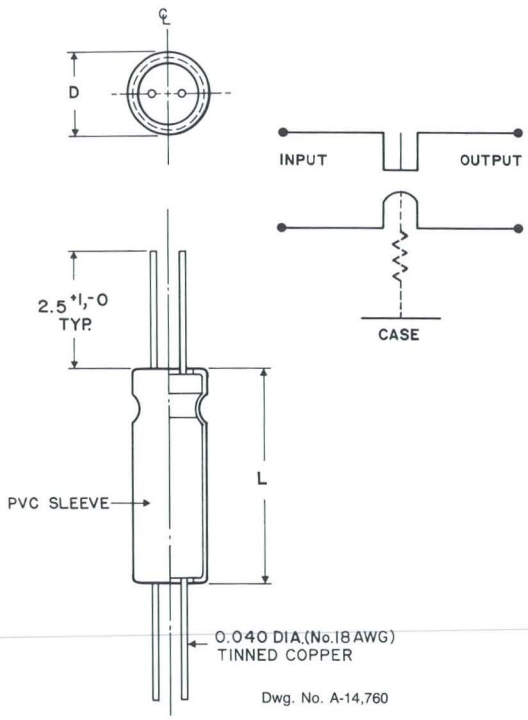
Dwg. No. A-14,837

TYPE 601D STYLES 5, 7



Dwg. No. A-14,838

TYPE 604D



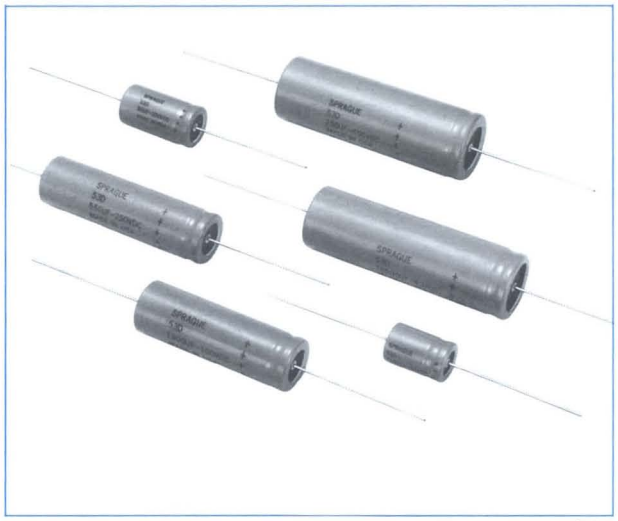
Dwg. No. A-14,760

TINNED COPPER LEADS

$\frac{0.032}{0.81}$ Diameter (No. 20 AWG) — Case Diameter F

$\frac{0.040}{1.016}$ Diameter (No. 18 AWG) — Case Diameter G, H, J

+85°C General Purpose Tubular Axial Lead Aluminum Capacitors


9585

Features —

- General Purpose Capacitor
- Rugged Construction
- Largest CV Ratings in Axial Leaded Capacitor

General Specifications —

Operating Temperature:
−40°C - +85°C.

Voltage Range: 6.3 - 450 VDC.

Capacitance Range: 15μF - 220,000μF.

Capacitance Tolerance: −10%, +50%.

Case Size Range: 0.75″ x 1.125″ - 1.375″ x 4.125″.

Termination: Axial leads.

Life Validation Test: 1000 hrs @ +85°C:
Δ CAP ≤ 15% from initial measurement.
Δ ESR ≤ 1.5x initial specified limit.
Δ DCL ≤ initial specified limit.

Shelf Test: 500 hrs @ +85°C:
Δ CAP ≤ 10% from initial measurement.
Δ ESR ≤ 1.3x initial specified limit.
Δ DCL ≤ 2.0x initial specified limit.

DC Leakage Current:
$I = K\sqrt{CV}$
K = 6.0 @ +25°C; 36.05°C
I in μA, C in μF, V in Volts

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	Multipliers
+75°C	1.4
+65°C	1.7
+45°C & below	2.0

FREQUENCY Hz

WVDC	50-60	300-400	1000 and up
0-50	0.85	1.10	1.15
51-299	0.85	1.15	1.20
300-up	0.80	1.30	1.40

Low Temperature Performance:

Capacitance Ratio $C_{-40°C}/C_{+25°C}$ min. @ 120Hz

Rated Voltage (VDC)	Capacitance Remaining
0 to 40	35
41 to 63	45
64 to 100	60
101 to 350	20
351 to 450	15

ESR Ratio $ESR_{-40°C}/ESR_{+25°C}$ max. @ 120Hz

Rated Voltage (VDC)	Multiplier
0 to 40	60
41 to 63	55
64 to 100	65
101 to 350	180
351 to 450	190

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

53D 562 F 6R3 GE 6

STYLE NUMBER.
6 = PVC SLEEVE (Standard).
7 = PVC SLEEVE WITH RESIN END SEAL.
(Recommended for exposure to halogenated cleaning solvents).

CASE CODE. SEE DIMENSIONS, BELOW.

DC VOLTAGE RATING. EXPRESSED IN VOLTS. 'R' SIGNIFIES A DECIMAL POINT, E.G., 6R3 = 6.3 VOLTS.

CAPACITANCE TOLERANCE. F = −10, +50%.

CAPACITANCE. EXPRESSED IN MICROFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES. THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

DIMENSIONS IN INCHES

Case Code	STYLE 6 STYLE 7 D ± 0.020	STYLE 6 STYLE 7 L ± 0.062	Typical Weight Oz.
GE	0.760	1.141	0.46
GJ	0.760	1.641	0.67
GL	0.760	2.141	0.74
GP	0.760	2.641	0.88
GS	0.760	3.141	1.16
GT	0.760	3.641	1.34
HE	0.885	1.141	0.63
HJ	0.885	1.641	0.95
HL	0.885	2.141	1.02
HP	0.885	2.641	1.38
HS	0.885	3.141	1.73
HT	0.885	3.641	2.08
JE	1.010	1.141	0.81
JJ	1.010	1.641	1.02
JL	1.010	2.141	1.55
JP	1.010	2.641	1.87
JS	1.010	3.141	2.22
JT	1.010	3.641	2.54
KE	1.135	1.141	0.92
KJ	1.135	1.641	1.31
KL	1.135	2.141	1.73
KP	1.135	2.641	2.15
KS	1.135	3.141	2.54
KT	1.135	3.641	2.96
KD	1.135	4.141	3.35
LE	1.260	1.141	1.13
LJ	1.260	1.641	1.62
LL	1.260	2.141	2.11
LP	1.260	2.641	2.65
LS	1.260	3.141	3.14
LT	1.260	3.641	3.63
LD	1.260	4.141	4.16
ME	1.375	1.141	1.38
MJ	1.375	1.641	1.98
ML	1.375	2.141	2.57
MP	1.375	2.641	3.21
MS	1.375	3.141	3.81
MT	1.375	3.641	4.44
MD	1.375	4.141	5.04

DIMENSIONS IN MILLIMETERS

Case Code	STYLE 6 STYLE 7 ± 0.51	STYLE 6 STYLE 7 L ± 1.58	Typical Weight Grams
GE	19.3	29.0	13
GJ	19.3	41.7	19
GL	19.3	54.4	21
GP	19.3	67.1	25
GS	19.3	79.8	33
GT	19.3	92.5	38
HE	22.5	29.0	18
HJ	22.5	41.7	27
HL	22.5	54.4	29
HP	22.5	67.1	39
HS	22.5	79.8	49
HT	22.5	92.5	59
JE	25.7	29.0	23
JJ	25.7	41.7	29
JL	25.7	54.4	44
JP	25.7	67.1	53
JS	25.7	79.8	63
JT	25.7	92.5	72
KE	28.8	29.0	26
KJ	28.8	41.7	37
KL	28.8	54.4	49
KP	28.8	67.1	61
KS	28.8	79.8	72
KT	28.8	92.5	84
KD	28.8	105.2	95
LE	32.0	29.0	32
LJ	32.0	41.7	46
LL	32.0	54.4	60
LP	32.0	67.1	75
LS	32.0	79.8	89
LT	32.0	92.5	103
LD	32.0	105.2	118
ME	35.2	29.0	39
MJ	35.2	41.7	56
ML	35.2	54.4	73
MP	35.2	67.1	91
MS	35.2	79.8	108
MT	35.2	92.5	126
MD	35.2	105.2	143

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size (inches) D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-100kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-100kHz
6.3 VOLTS DC WORKING; 8 VOLTS DC SURGE						
5600	53D562F6R3GE6	0.750 x 1.125	108.0	82.0	1.41	1.61
18000	53D183F6R3GJ6	0.750 x 1.625	77.0	58.0	1.92	2.21
33000	53D333F6R3GP6	0.750 x 2.625	42.0	32.0	3.19	3.64
39000	53D393F6R3GS6	0.750 x 3.125	35.0	26.8	3.76	4.30
47000	53D473F6R3GT6	0.750 x 3.625	30.0	22.9	4.34	4.97
8200	53D822F6R3HE6	0.875 x 1.125	80.0	61.0	1.80	2.05
27000	53D273F6R3HJ6	0.875 x 1.625	54.0	41.0	2.51	2.87
47000	53D473F6R3HP6	0.875 x 2.625	31.0	23.9	4.04	4.60
56000	53D563F6R3HS6	0.875 x 3.125	26.0	20.0	4.74	5.39
68000	53D683F6R3HT6	0.875 x 3.625	23.0	17.7	5.42	6.15
12000	53D123F6R3JE6	1.000 x 1.125	69.0	53.5	2.11	2.39
39000	53D393F6R3JJ6	1.000 x 1.625	44.0	33.9	3.03	3.44
68000	53D683F6R3JP6	1.000 x 2.625	26.0	19.9	4.80	5.44
82000	53D823F6R3JS6	1.000 x 3.125	22.0	17.1	5.61	6.32
100000	53D104F6R3JT6	1.000 x 3.625	20.0	15.6	6.27	7.06
15000	53D153F6R3KE6	1.125 x 1.125	62.0	48.4	2.41	2.72
47000	53D473F6R3KJ6	1.125 x 1.625	39.0	30.5	3.45	3.90
82000	53D823F6R3KP6	1.125 x 2.625	23.0	18.1	5.41	6.11
100000	53D104F6R3KS6	1.125 x 3.125	20.0	15.8	6.24	7.04
120000	53D124F6R3KT6	1.125 x 3.625	18.0	14.0	7.08	7.96
150000	53D154F6R3KD6	1.125 x 4.125	16.0	12.8	7.86	8.81
22000	53D223F6R3ME6	1.375 x 1.125	67.0	54.5	2.65	2.94
68000	53D683F6R3MJ6	1.375 x 1.625	37.0	30.0	4.02	4.46
120000	53D124F6R3MP6	1.375 x 2.625	22.0	18.0	6.23	6.91
150000	53D154F6R3MS6	1.375 x 3.125	18.8	15.4	7.25	8.01
180000	53D184F6R3MT6	1.375 x 3.625	16.7	13.7	8.18	9.03
220000	53D224F6R3MD6	1.375 x 4.125	15.2	12.4	9.06	10.00
10 VOLTS DC WORKING, 12 VOLTS DC SURGE						
4700	53D472F010GE6	0.750 x 1.125	115.0	85.0	1.36	1.5 7
12000	53D123F010GJ6	0.750 x 1.625	85.0	63.0	1.83	2.1 2
27000	53D273F010GP6	0.750 x 2.625	45.0	33.8	3.07	3.5 4
33000	53D333F010GS6	0.750 x 3.125	38.0	28.2	3.63	4.1 9
39000	53D393F010GT6	0.750 x 3.625	32.5	24.4	4.17	4.8 2
6800	53D682F010HE6	0.875 x 1.125	85.0	63.0	1.74	2.0 2
18000	53D183F010HJ6	0.875 x 1.625	60.0	44.9	2.39	2.7 5
39000	53D393F010HP6	0.875 x 2.625	33.2	25.0	3.90	4.4 9
47000	53D473F010HS6	0.875 x 3.125	28.0	21.3	4.58	5.2 5
56000	53D563F010HT6	0.875 x 3.625	24.4	18.6	5.24	6.0 0
10000	53D103F010JE6	1.000 x 1.125	72.0	55.0	2.05	2.3 6
27000	53D273F010JJ6	1.000 x 1.625	47.3	36.0	2.91	3.3 4
47000	53D473F010JP6	1.000 x 2.625	27.0	20.8	4.66	5.3 2
68000	53D683F010JS6	1.000 x 3.125	22.9	17.7	5.46	6.2 1
82000	53D823F010JT6	1.000 x 3.625	20.2	15.6	6.21	7.0 6
12000	53D123F010KE6	1.125 x 1.125	64.0	49.7	2.36	2.6 8
33000	53D333F010KJ6	1.125 x 1.625	41.0	31.6	3.36	3.8 3
68000	53D683F010KP6	1.125 x 2.625	24.2	18.7	5.29	6.0 1
82000	53D823F010KS6	1.125 x 3.125	20.6	16.0	6.16	6.9 9
100000	53D104F010KT6	1.125 x 3.625	18.2	14.2	6.99	7.9 1
120000	53D124F010KD6	1.125 x 4.125	16.8	13.1	7.69	8.7 1

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-100kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-100kHz
10 VOLTS DC WORKING; 12 VOLTS DC SURGE (Cont.)						
18000	53D183F010ME6	1.375 x 1.125	67.0	53.0	2.64	2.9 4
56000	53D563F010MJ6	1.375 x 1.625	3.8	30.0	4.00	4.4 6
100000	53D104F010MP6	1.375 x 2.625	22.2	18.0	6.22	6.9 1
120000	53D124F010MP6	1.375 x 3.125	19.1	15.4	7.19	8.0 1
150000	53D154F010MT6	1.375 x 3.625	16.8	13.7	8.16	9.0 3
180000	53D184F010MD6	1.375 x 4.125	15.3	12.4	9.03	10.0
16 VOLTS DC WORKING, 18 VOLTS DC SURGE						
3900	53D392F016GE6	0.750 x 1.125	119.0	85.0	1.33	1.58
10000	53D103F016GJ6	0.750 x 1.625	82.0	59.0	1.86	2.19
18000	53D183F016GP6	0.750 x 2.625	46.0	33.0	3.04	3.57
22000	53D223F016GS6	0.750 x 3.125	38.0	28.0	3.59	4.21
27000	53D273F016GT6	0.750 x 3.625	33.3	24.3	4.12	4.82
5600	53D562F016HE6	0.875 x 1.125	88.0	64.0	1.71	2.00
15000	53D153F016HJ6	0.875 x 1.625	61.0	43.9	2.37	2.78
27000	53D273F016HP6	0.875 x 2.625	33.8	24.8	3.87	4.51
33000	53D333F016HS6	0.875 x 3.125	28.6	21.1	4.53	5.27
39000	53D393F016HT6	0.875 x 3.625	24.6	18.3	5.22	6.05
8200	53D822F016JE6	1.000 x 1.125	72.0	53.2	2.07	2.40
18000	53D183F016JJ6	1.000 x 1.625	47.5	34.9	2.91	3.39
39000	53D393F016JP6	1.000 x 2.625	27.3	20.4	4.65	5.37
47000	53D473F016JS6	1.000 x 3.125	23.2	17.4	5.43	6.27
56000	53D563F016JT6	1.000 x 3.625	20.3	15.4	6.19	7.11
10000	53D103F016KE6	1.125 x 1.125	64.9	48.9	2.35	2.71
22000	53D223F016KJ6	1.125 x 1.625	41.8	31.2	3.33	3.86
47000	53D473F016KP6	1.125 x 2.625	24.4	18.4	5.26	6.06
56000	53D563F016KS6	1.125 x 3.125	20.8	15.8	6.13	7.04
68000	53D683F016KT6	1.125 x 3.625	18.4	14.0	6.95	7.96
82000	53D823F016KD6	1.125 x 4.125	16.6	12.8	7.74	8.81
15000	53D153F016ME6	1.375 x 1.125	68.3	54.5	2.62	2.94
39000	53D393F016MJ6	1.375 x 1.625	38.0	30.1	3.97	4.46
68000	53D683F016MP6	1.375 x 2.625	22.5	18.0	6.18	6.91
82000	53D823F016MS6	1.375 x 3.125	19.2	15.4	7.17	8.01
100000	53D104F016MT6	1.375 x 3.625	17.1	13.7	8.09	9.03
120000	53D124F016MD6	1.375 x 4.125	15.4	12.4	9.00	10.0
25 VOLTS DC WORKING, 35 VOLTS DC SURGE						
1800	53D182F025GE6	0.750 x 1.125	141.0	91.0	1.23	1.52
3900	53D392F025GJ6	0.750 x 1.625	81.0	53.0	1.86	2.30
6800	53D682F025GP6	0.750 x 2.625	44.0	29.0	3.08	3.77
8200	53D822F025GS6	0.750 x 3.125	37.0	25.0	3.63	4.44
10000	53D103F025GT6	0.750 x 3.625	32.0	22.0	4.18	5.09
2700	53D272F025HE6	0.875 x 1.125	101.0	67.0	1.59	1.96
5600	53D562F025HJ6	0.875 x 1.625	59.0	40.0	2.39	2.92
10000	53D103F025HP6	0.875 x 2.625	33.0	22.0	3.83	4.71
12000	53D123F025HS6	0.875 x 3.125	28.0	19.0	4.53	5.46
15000	53D153F025HT6	0.875 x 3.625	25.0	17.0	5.16	6.19
3900	53D392F025JE6	1.000 x 1.125	81.0	55.0	1.93	2.35
8200	53D822F025JJ6	1.000 x 1.625	48.0	32.0	2.87	3.49
15000	53D153F025JP6	1.000 x 2.625	28.0	19.0	4.55	5.44
18000	53D183F025JS6	1.000 x 3.125	23.0	16.0	5.42	6.44
22000	53D223F025JT6	1.000 x 3.625	20.0	14.0	6.14	7.30

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-100kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-100kHz
25 VOLTS DC WORKING; 35 VOLTS DC SURGE (Cont.)						
4700	53D472F025KE6	1.125 x 1.125	72.0	50.0	2.23	2.67
10000	53D103F025KJ6	1.125 x 1.625	42.0	29.0	3.31	3.95
18000	53D183F025KP6	1.125 x 2.625	25.0	17.0	5.19	6.15
22000	53D223F025KS6	1.125 x 3.125	21.0	15.0	6.06	7.13
27000	53D273F025KT6	1.125 x 3.625	18.0	13.0	6.89	8.08
33000	53D333F025KD6	1.125 x 4.125	16.0	12.0	7.67	8.95
6800	53D682F025ME6	1.375 x 1.125	71.0	55.0	2.56	2.92
15000	53D153F025MJ6	1.375 x 1.625	41.0	32.0	3.80	4.32
27000	53D273F025MP6	1.375 x 2.625	24.0	19.0	5.94	6.72
33000	53D333F025MS6	1.375 x 3.125	20.0	16.0	6.89	7.81
39000	53D393F025MT6	1.375 x 3.625	18.0	14.0	7.82	8.84
47000	53D473F025MD6	1.375 x 4.125	16.0	13.0	8.67	9.76
35 VOLTS DC WORKING, 45 VOLTS DC SURGE						
1500	53D152F035GE6	0.750 x 1.125	152.0	92.0	1.18	1.52
2700	53D272F035GJ6	0.750 x 1.625	86.0	53.0	1.80	2.31
5600	53D562F035GP6	0.750 x 2.625	48.0	30.0	2.97	3.76
6800	53D682F035GS6	0.750 x 3.125	40.0	25.0	3.52	4.44
8200	53D822F035GT6	0.750 x 3.625	34.0	21.0	4.07	5.11
2200	53D222F035HE6	0.875 x 1.125	109.0	67.0	1.54	1.95
3900	53D392F035HJ6	0.875 x 1.625	63.0	39.0	2.32	2.93
6800	53D682F035HP6	0.875 x 2.625	35.0	22.0	3.78	4.72
10000	53D103F035HS6	0.875 x 3.125	29.0	19.0	4.45	5.52
12000	53D123F035HT6	0.875 x 3.625	26.0	17.0	5.06	6.24
3300	53D332F035JE6	1.000 x 1.125	87.0	55.0	1.87	2.34
5600	53D562F035JJ6	1.000 x 1.625	50.0	32.0	2.82	3.50
10000	53D103F035JP6	1.000 x 2.625	30.0	19.0	4.43	5.45
12000	53D123F035JS6	1.000 x 3.125	24.0	16.0	5.27	6.44
15000	53D153F035JT6	1.000 x 3.625	21.0	14.0	5.97	7.22
3900	53D392F035KE6	1.125 x 1.125	76.0	50.0	2.17	2.67
6800	53D682F035KJ6	1.125 x 1.625	44.0	29.0	3.23	3.95
12000	53D123F035KP6	1.125 x 2.625	26.0	17.0	5.08	6.15
15000	53D153F035KS6	1.125 x 3.125	22.0	15.0	5.92	7.13
18000	53D183F035KT6	1.125 x 3.625	19.0	13.0	6.73	8.05
22000	53D223F035KD6	1.125 x 4.125	17.0	12.0	7.49	8.95
5600	53D562F035ME6	1.375 x 1.125	73.0	55.0	2.52	2.92
10000	53D103F035MJ6	1.375 x 1.625	42.0	32.0	3.75	4.32
18000	53D183F035MP6	1.375 x 2.625	25.0	19.0	5.86	6.72
22000	53D223F035MS6	1.375 x 3.125	21.0	16.0	6.83	7.81
27000	53D273F035MT6	1.375 x 3.625	18.0	14.0	7.73	8.84
33000	53D333F035MD6	1.375 x 4.125	16.0	13.0	8.61	9.76
50 VOLTS DC WORKING, 70 VOLTS DC SURGE						
1000	53D102F050GE6	0.750 x 1.125	178.0	93.0	1.09	1.51
1800	53D182F050GJ6	0.750 x 1.625	103.0	54.0	1.66	2.28
3300	53D332F050GP6	0.750 x 2.625	55.0	30.0	2.77	3.75
3900	53D392F050GS6	0.750 x 3.125	46.0	25.0	3.26	4.40
4700	53D472F050GT6	0.750 x 3.625	39.0	22.0	3.78	5.06
1500	53D152F050HE6	0.875 x 1.125	133.0	71.0	1.39	1.90
2700	53D272F050HJ6	0.875 x 1.625	72.0	39.0	2.16	2.92
4700	53D472F050HP6	0.875 x 2.625	40.0	23.0	3.53	4.69
5600	53D562F050HS6	0.875 x 3.125	33.0	19.0	4.18	5.49
6800	53D682F050HT6	0.875 x 3.625	29.0	17.0	4.78	6.24

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-100kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-100kHz
50 VOLTS DC WORKING; 70 VOLTS DC SURGE (Cont.)						
1800	53D182F050JE6	1.000 x 1.125	10.0	56.0	1.75	2.32
3900	53D392F050JJ6	1.000 x 1.625	58.0	33.0	2.62	3.46
6800	53D682F050JP6	1.000 x 2.625	32.0	19.0	4.25	5.50
8200	53D822F050JS6	1.000 x 3.125	27.0	16.0	4.99	6.42
10000	53D103F050JT6	1.000 x 3.625	24.0	14.0	5.69	7.30
2200	53D222F050KE6	1.125 x 1.125	86.0	50.0	2.03	2.65
4700	53D472F050KJ6	1.125 x 1.625	50.0	30.0	3.04	3.93
8200	53D822F050KP6	1.125 x 2.625	28.0	17.0	4.85	6.16
10000	53D103F050KS6	1.125 x 3.125	25.0	15.0	5.59	7.08
12000	53D123F050KT6	1.125 x 3.625	21.0	13.0	6.38	8.02
15000	53D153F050KD6	1.125 x 4.125	19.0	12.0	7.16	8.92
3900	53D392F050ME6	1.375 x 1.125	78.0	55.0	2.46	2.92
6800	53D682F050MJ6	1.375 x 1.625	45.0	32.0	3.64	4.32
12000	53D123F050MP6	1.375 x 2.625	26.0	19.0	5.71	6.70
15000	53D153F050MS6	1.375 x 3.125	22.0	16.0	6.66	7.81
18000	53D183F050MT6	1.375 x 3.625	19.0	14.0	7.55	8.81
22000	53D223F050MD6	1.375 x 4.125	17.0	13.0	8.40	9.76
63 VOLTS DC WORKING, 80 VOLTS DC SURGE						
680	53D681F063GE6	0.750 x 1.125	188.0	106.0	1.23	1.63
1500	53D152F063GJ6	0.750 x 1.625	109.0	53.0	1.61	2.31
2700	53D272F063GP6	0.750 x 2.625	60.0	30.0	2.64	3.74
3300	53D332F063GS6	0.750 x 3.125	50.0	25.0	3.14	4.41
3900	53D392F063GT6	0.750 x 3.625	42.0	21.0	3.66	5.09
1200	53D122F063HE6	0.875 x 1.125	140.0	69.0	1.36	1.93
2200	53D222F063HJ6	0.875 x 1.625	78.0	39.0	2.09	2.94
3900	53D392F063HP6	0.875 x 2.625	44.0	23.0	3.38	4.69
4700	53D472F063HS6	0.875 x 3.125	36.0	19.0	4.03	5.50
5600	53D562F063HT6	0.875 x 3.625	31.0	17.0	4.63	6.26
1500	53D152F063JE6	1.100 x 1.125	110.0	57.0	1.66	2.32
2700	53D272F063JJ6	1.100 x 1.625	63.0	33.0	2.52	3.47
5600	53D562F063JP6	1.100 x 2.625	35.0	19.0	4.09	5.50
6800	53D682F063JS6	1.100 x 3.125	29.0	16.0	4.83	6.42
8200	53D822F063JT6	1.100 x 3.625	25.0	14.0	5.52	7.30
1800	53D182F063KE6	1.125 x 1.125	94.0	51.0	1.95	2.64
3900	53D392F063KJ6	1.125 x 1.625	53.0	29.0	2.94	3.94
6800	53D682F063KP6	1.125 x 2.625	30.0	17.0	4.70	6.16
8200	53D822F063KS6	1.125 x 3.125	25.0	15.0	5.51	7.15
10000	53D103F063KT6	1.125 x 3.625	22.0	13.0	6.25	8.08
12000	53D123F063KD6	1.125 x 4.125	20.0	12.0	6.91	8.92
2700	53D272F063ME6	1.375 x 1.125	81.0	55.0	2.40	2.92
5600	53D562F063MJ6	1.375 x 1.625	47.0	32.0	3.57	4.32
10000	53D103F063MP6	1.375 x 2.625	27.0	19.0	5.62	6.70
12000	53D123F063MS6	1.375 x 3.125	23.0	16.0	6.54	7.81
15000	53D153F063MT6	1.375 x 3.625	20.0	14.0	7.44	8.81
18000	53D183F063MD6	1.375 x 4.125	18.0	13.0	8.28	9.76
100 VOLTS DC WORKING, 135 VOLTS DC SURGE						
270	53D271F100GE6	0.750 x 1.125	452.0	27.0	0.69	1.05
470	53D471F100GJ6	0.750 x 1.625	250.0	107.0	1.06	1.62
1000	53D102F100GP6	0.750 x 2.625	132.0	58.0	1.79	2.70
1200	53D122F100GS6	0.750 x 3.125	112.0	49.0	2.09	3.16
1500	53D152G100GT6	0.750 x 3.625	96.0	42.0	2.43	3.64

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-100kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-100kHz
100 VOLTS DC WORKING; 135 VOLTS DC SURGE (Cont.)						
390	53D391F100HE6	0.875 x 1.125	312.0	135.0	0.91	1.38
680	53D681F100HJ6	0.875 x 1.625	171.0	75.0	1.41	2.13
1500	53D152F100HP6	0.875 x 2.625	91.0	41.0	2.34	3.49
1800	53D182F100HS6	0.875 x 3.125	76.0	34.0	2.77	4.11
2200	53D222F100HT6	0.875 x 3.625	65.0	30.0	3.19	4.71
560	53D561F100JE6	1.000 x 1.125	235.0	104.0	1.14	1.71
1000	53D102F100JJ6	1.000 x 1.625	131.0	59.0	1.75	2.60
1800	53D182F100JP6	1.000 x 2.625	71.0	33.0	2.88	4.21
2200	53D222F100JS6	1.000 x 3.125	59.0	28.0	3.40	4.93
2700	53D272F100JT6	1.000 x 3.625	49.0	24.0	3.96	5.69
680	53D681F100KE6	1.125 x 1.125	192.0	88.0	1.36	2.01
1200	53D122F100KJ6	1.125 x 1.625	112.0	52.0	2.03	2.98
2200	53D222F100KP6	1.125 x 2.625	59.0	28.0	3.38	4.85
2700	53D272F100KS6	1.125 x 3.125	48.0	23.0	4.02	5.72
3300	53D332F100KT6	1.125 x 3.625	42.0	21.0	4.60	6.49
3900	53D392F100KD6	1.125 x 4.125	36.0	18.0	5.20	7.31
1000	53D102F100ME6	1.375 x 1.125	148.0	73.0	1.78	2.53
1800	53D182F100MJ6	1.375 x 1.625	81.0	41.0	2.71	3.81
3900	53D392F100MP6	1.375 x 2.625	45.0	23.0	4.36	5.99
4700	53D472F100MS6	1.375 x 3.125	37.0	20.0	5.15	7.01
5600	53D562F100MT6	1.375 x 3.625	32.0	17.0	5.88	7.94
6800	53D682F100MD6	1.375 x 4.125	28.0	15.0	6.62	8.89
200 VOLTS DC WORKING, 250 VOLTS DC SURGE						
68	53D680F200GE6	0.750 x 1.125	1661.0	580.0	0.36	0.60
120	53D121F200GJ6	0.750 x 1.625	915.0	321.0	0.56	0.94
220	53D221F200GP6	0.750 x 2.625	454.0	161.0	0.97	1.62
280	53D281F200GS6	0.750 x 3.125	378.0	134.0	1.14	1.92
330	53D331F200GT6	0.750 x 3.625	314.0	112.0	1.34	2.25
100	53D101F200HE6	0.875 x 1.125	1110.0	391.0	0.48	0.81
180	53D181F200HJ6	0.875 x 1.625	579.0	205.0	0.77	1.29
330	53D331F200HP6	0.875 x 2.625	307.0	110.0	1.28	2.14
390	53D391F200HS6	0.875 x 3.125	249.0	90.0	1.53	2.56
470	53D471F200HT6	0.875 x 3.625	210.0	76.0	1.79	2.96
150	53D151F200JE6	1.000 x 1.125	804.0	286.0	0.62	1.03
270	53D271F200JJ6	1.000 x 1.625	426.0	153.0	0.97	1.62
470	53D471F200JP6	1.000 x 2.625	228.0	83.0	1.61	2.66
680	53D681F200JS6	1.000 x 3.125	183.0	67.0	1.93	3.18
820	53D821F200JT6	1.000 x 3.625	154.0	57.0	2.24	3.68
180	53D181F200KE6	1.125 x 1.125	649.0	234.0	0.74	1.24
330	53D331F200KJ6	1.125 x 1.625	338.0	123.0	1.17	1.94
560	53D561F200KP6	1.125 x 2.625	182.0	67.0	1.92	3.16
680	53D681F200KS6	1.125 x 3.125	146.0	55.0	2.31	3.76
1000	53D102F200KT6	1.125 x 3.625	124.0	47.0	2.67	4.34
1200	53D122F200KD6	1.125 x 4.125	107.0	41.0	3.04	4.92
270	53D271F200ME6	1.375 x 1.125	455.0	169.0	1.02	1.66
470	53D471F200MJ6	1.375 x 1.625	234.0	89.0	1.60	2.59
820	53D821F200MP6	1.375 x 2.625	125.0	49.0	2.62	4.19
1000	53D102F200MS6	1.375 x 3.125	101.0	40.0	3.11	4.95
1200	53D122F200MT6	1.375 x 3.625	90.0	36.0	3.51	5.72
1800	53D182F200MD6	1.375 x 4.125	77.0	31.0	4.01	6.32

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-100kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-100kHz
250 VOLTS DC WORKING, 300 VOLTS DC SURGE						
56	53D560F250GE6	0.750 x 1.125	1959.0	636.0	0.33	0.58
100	53D101F250GJ6	0.750 x 1.625	1015.0	331.0	0.53	0.92
180	53D181F250GP6	0.750 x 2.625	541.0	178.0	0.89	1.54
220	53D221F250GS6	0.750 x 3.125	433.0	143.0	1.07	1.86
270	53D271F250GT6	0.750 x 3.625	361.0	119.0	1.25	2.17
82	53D820F250HE6	0.875 x 1.125	1299.0	425.0	0.45	0.78
150	53D151F250HJ6	0.875 x 1.625	733.0	241.0	0.68	1.19
270	53D271F250HP6	0.875 x 2.625	365.0	121.0	1.18	2.04
330	53D331F250HS6	0.875 x 3.125	292.0	98.0	1.42	2.45
390	53D391F250HT6	0.875 x 3.625	244.0	82.0	1.66	2.85
120	53D121F250JE6	1.000 x 1.125	945.0	312.0	0.57	0.99
220	53D221F250JJ6	1.000 x 1.625	523.0	174.0	0.88	1.52
390	53D391F250JP6	1.000 x 2.625	268.0	90.0	1.48	2.55
470	53D471F250JS6	1.000 x 3.125	216.0	74.0	1.78	3.04
560	53D561F250JT6	1.000 x 3.625	182.0	62.0	2.07	3.53
150	53D151F250KE6	1.125 x 1.125	770.0	47.0	0.68	4.47
270	53D271F250KJ6	1.125 x 1.625	408.0	137.0	1.07	1.83
470	53D471F250KP6	1.125 x 2.625	214.0	73.0	1.78	3.03
560	53D561F250KS6	1.125 x 3.125	170.0	59.0	2.14	3.63
820	53D821F250KT6	1.125 x 3.625	143.0	50.0	2.48	4.19
1000	53D102F250KD6	1.125 x 4.125	124.0	44.0	2.82	4.74
220	53D221F250ME6	1.375 x 1.125	525.0	181.0	0.95	1.61
390	53D391F250MJ6	1.375 x 1.625	272.0	95.0	1.48	2.50
680	53D681F250MP6	1.375 x 2.625	145.0	52.0	2.43	4.09
820	53D821F250MS6	1.375 x 3.125	118.0	43.0	2.89	4.78
1000	53D102F250MT6	1.375 x 3.625	100.0	37.0	3.34	5.50
1500	53D152F250MD6	1.375 x 4.125	94.0	34.0	3.64	6.00
350 VOLTS DC WORKING; 400 VOLTS DC SURGE						
22	53D220F350GE6	0.750 x 1.125	6680.0	3570.0	0.178	0.243
47	53D470F350GJ6	0.750 x 1.625	3390.0	1810.0	0.289	0.395
82	53D820F350GP6	0.750 x 2.625	1710.0	918.0	0.498	0.680
100	53D101F350GS6	0.750 x 3.125	1470.0	787.0	0.581	0.793
120	53D121F350GT6	0.750 x 3.625	1220.0	655.0	0.681	0.930
39	53D390F350HE6	0.875 x 1.125	4180.0	2240.0	0.248	0.340
68	53D680F350HJ6	0.875 x 1.625	2140.0	1150.0	0.399	0.550
120	53D121F350HP6	0 875 x 2.625	1140.0	612.0	0.666	0.910
150	53D151F350HS6	0 875 x 3.125	924.0	497.0	0.797	1.09
180	53D181F350HT6	0 875 x 3.625	777.0	418.0	0.928	1.27
47	53D470F350JE6	1.000 x 1.125	3170.0	1700.0	0.311	0.424
100	53D101F350JJ6	1.000 x 1.625	1600.0	860.0	0.500	0.682
180	53D181F350JP6	1.000 x 2.625	828.0	455.0	0.844	1.15
220	53D221F350JS6	1.000 x 3.125	676.0	364.0	1.00	1.37
270	53D271F350JT6	1.000 x 3.625	571.0	308.0	1.17	1.59
56	53D560F350KE6	1.125 x 1.125	2510.0	1340.0	0.377	0.515
120	53D121F350KJ6	1.125 x 1.625	1260.0	678.0	0.607	0.830
220	53D221F350KP6	1.125 x 2.625	680.0	367.0	1.00	1.36
270	53D271F350KS6	1.125 x 3.125	534.0	288.0	1.21	1.65
330	53D331F350KT6	1.125 x 3.625	453.0	245.0	1.40	1.91
390	53D391F350KD6	1.125 x 4.125	384.0	207.0	1.61	2.19

STANDARD RATINGS

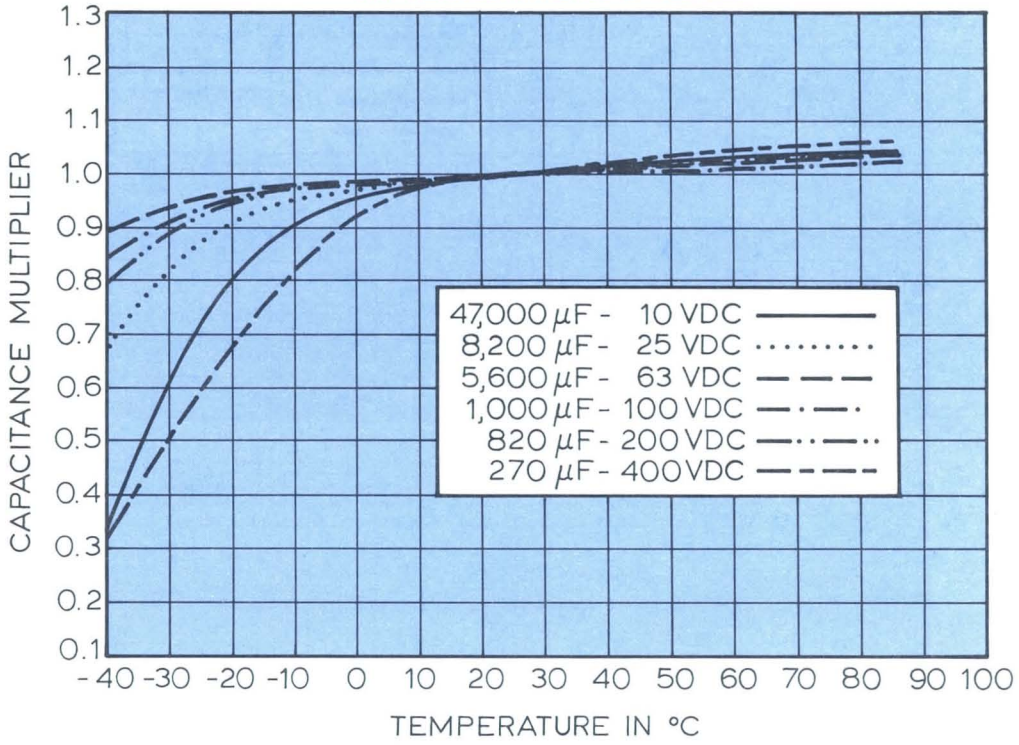
μF	Catalog Number	Nominal Case Size (inches) D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-100kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-100kHz
350 VOLTS DC WORKING; 400 VOLTS DC SURGE (Cont.)						
100	53D101F350ME6	1.375 x 1.125	1640.0	883.0	0.536	0.729
180	53D181F350MJ6	1.375 x 1.625	848.0	458.0	0.841	1.14
330	53D331F350MP6	1.375 x 2.625	445.0	241.0	1.39	1.89
390	53D391F350MS6	1.375 x 3.125	352.0	192.0	1.68	2.27
470	53D471F350MT6	1.375 x 3.625	297.0	162.0	1.94	2.63
560	53D561F350MD6	1.375 x 4.125	257.0	140.0	2.20	2.98
400 VOLTS DC WORKING; 450 VOLTS DC SURGE						
18	53D180F400GE6	0.750 x 1.125	9718.0	5384.0	0.15	0.20
39	53D390F400GJ6	0.750 x 1.625	4546.0	2519.0	0.25	0.34
68	53D680F400GP6	0.750 x 2.625	2209.0	1225.0	0.44	0.59
82	53D820F400GS6	0.750 x 3.125	1756.0	974.0	0.53	0.71
100	53D101F400GT6	0.750 x 3.625	1559.0	865.0	0.60	0.81
27	53D270F400HE6	0.875 x 1.125	6156.0	3413.0	0.21	0.28
56	53D560F400HJ6	0.875 x 1.625	2910.0	1614.0	0.34	0.46
120	53D121F400HP6	0.875 x 2.625	1435.0	796.0	0.59	0.80
150	53D151F400HS6	0.875 x 3.125	1210.0	672.0	0.70	0.94
180	53D181F400HT6	0.875 x 3.625	982.0	546.0	0.83	1.11
39	53D390F400JE6	1.000 x 1.125	4634.0	2570.0	0.26	0.35
68	53D680F400JJ6	1.000 x 1.625	2171.0	1205.0	0.43	0.58
150	53D151F400JP6	1.000 x 2.625	1131.0	628.0	0.72	0.97
180	53D181F400JS6	1.000 x 3.125	878.0	488.0	0.88	1.18
220	53D221F400JT6	1.000 x 3.625	718.0	400.0	0.04	1.39
47	53D470F400KE6	1.125 x 1.125	3717.0	2063.0	0.31	0.42
100	53D101F400KJ6	1.125 x 1.625	1697.0	943.0	0.52	0.70
180	53D181F400KP6	1.125 x 2.625	838.0	466.0	0.90	1.20
220	53D221F400KS6	1.125 x 3.125	691.0	384.0	1.06	1.43
270	53D271F400KT6	1.125 x 3.625	567.0	316.0	1.25	1.68
330	53D331F400KD6	1.125 x 4.125	481.0	268.0	1.44	1.92
68	53D680F400ME6	1.375 x 1.125	2408.0	1340.0	0.44	0.59
150	53D151F400MJ6	1.375 x 1.625	1160.0	647.0	0.72	0.96
270	53D271F400MP6	1.375 x 2.625	574.0	320.0	1.22	1.64
330	53D331F400MS6	1.375 x 3.125	446.0	250.0	1.49	1.99
390	53D391F400MT6	1.375 x 3.625	373.0	209.0	1.73	2.31
470	53D471F400MD6	1.375 x 4.125	321.0	180.0	1.97	2.63
450 VOLTS DC WORKING; 525 VOLTS DC SURGE						
15	53D150F450GE6	0.750 x 1.125	10276.0	5483.0	0.14	0.20
33	53D330F450GJ6	0.750 x 1.625	4789.0	2556.0	0.24	0.33
68	53D680F450GP6	0.750 x 2.625	2322.0	1240.0	0.43	0.59
82	53D820F450GS6	0.750 x 3.125	1848.0	987.0	0.52	0.71
100	53D101F450GT6	0.750 x 3.625	1534.0	820.0	0.61	0.83
22	53D220F450HE6	0.875 x 1.125	6463.0	3450.0	0.20	0.27
47	53D470F450HJ6	0.875 x 1.625	3049.0	1628.0	0.33	0.46
100	53D101F450HP6	0.875 x 2.625	1488.0	796.0	0.58	0.80
120	53D121F450HS6	0.875 x 3.125	1224.0	655.0	0.69	0.95
150	53D151F450HT6	0.875 x 3.625	1047.0	560.0	0.80	1.09
33	53D330F450JE6	1.000 x 1.125	4863.0	2598.0	0.25	0.34
68	53D680F450JJ6	1.000 x 1.625	2238.0	1197.0	0.42	0.58
120	53D121F450JP6	1.000 x 2.625	1138.0	609.0	0.72	0.98
150	53D151F450JS6	1.000 x 3.125	922.0	494.0	0.86	1.18
180	53D181F450JT6	1.000 x 3.625	738.0	395.0	1.03	1.40

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-100kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-100kHz
450 VOLTS DC WORKING; 525 VOLTS DC SURGE (Cont.)						
39	53D390F450KE6	1.125 x 1.125	3901.0	2086.0	0.30	0.41
82	53D820F450KJ6	1.125 x 1.625	1770.0	948.0	0.51	0.70
180	53D181F450KP6	1.125 x 2.625	874.0	468.0	0.88	1.20
220	53D221F450KS6	1.125 x 3.125	706.0	379.0	1.05	1.44
270	53D271F450KT6	1.125 x 3.625	593.0	318.0	1.22	1.67
330	53D331F450KD6	1.125 x 4.125	511.0	274.0	1.39	1.90
68	53D680F450ME6	1.375 x 1.125	2495.0	1338.0	0.43	0.59
120	53D121F450MJ6	1.375 x 1.625	1262.0	677.0	0.69	0.94
270	53D271F450MP6	1.375 x 2.625	559.0	322.0	1.20	1.63
330	53D331F450MS6	1.375 x 3.125	468.0	252.0	1.45	1.98
390	53D391F450MT6	1.375 x 3.625	394.0	213.0	1.68	2.29
470	53D471F450MD6	1.375 x 4.125	333.0	180.0	1.93	2.63

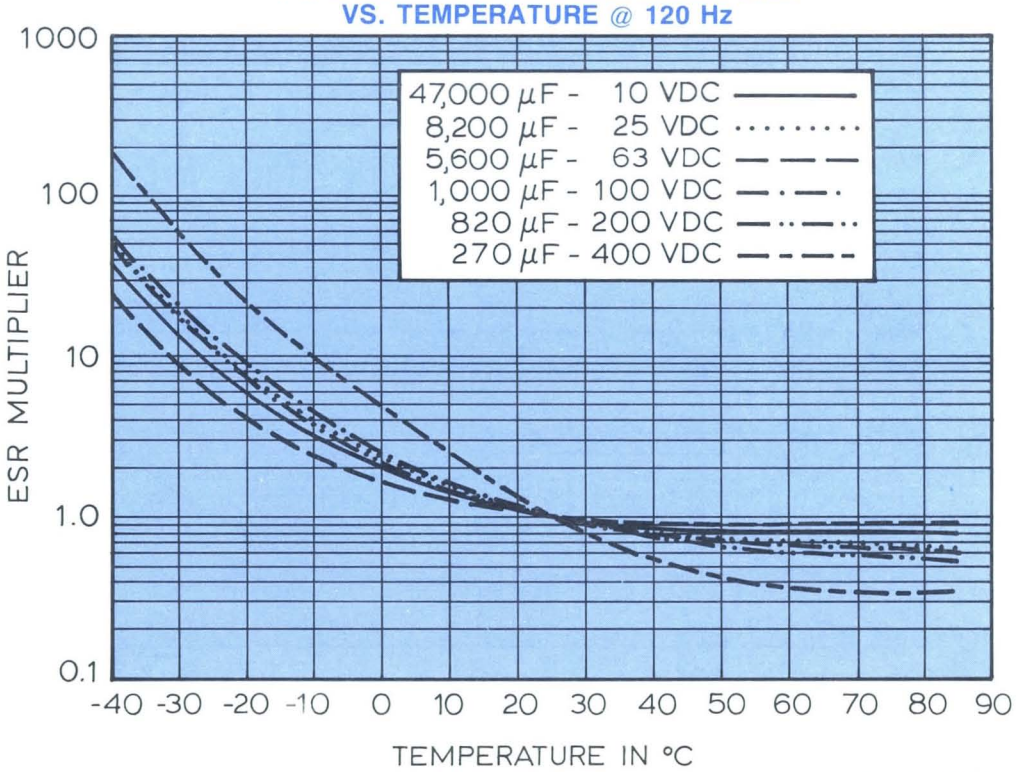
TYPICAL CURVES

TYPE 53D — TYPICAL CAPACITANCE MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,728

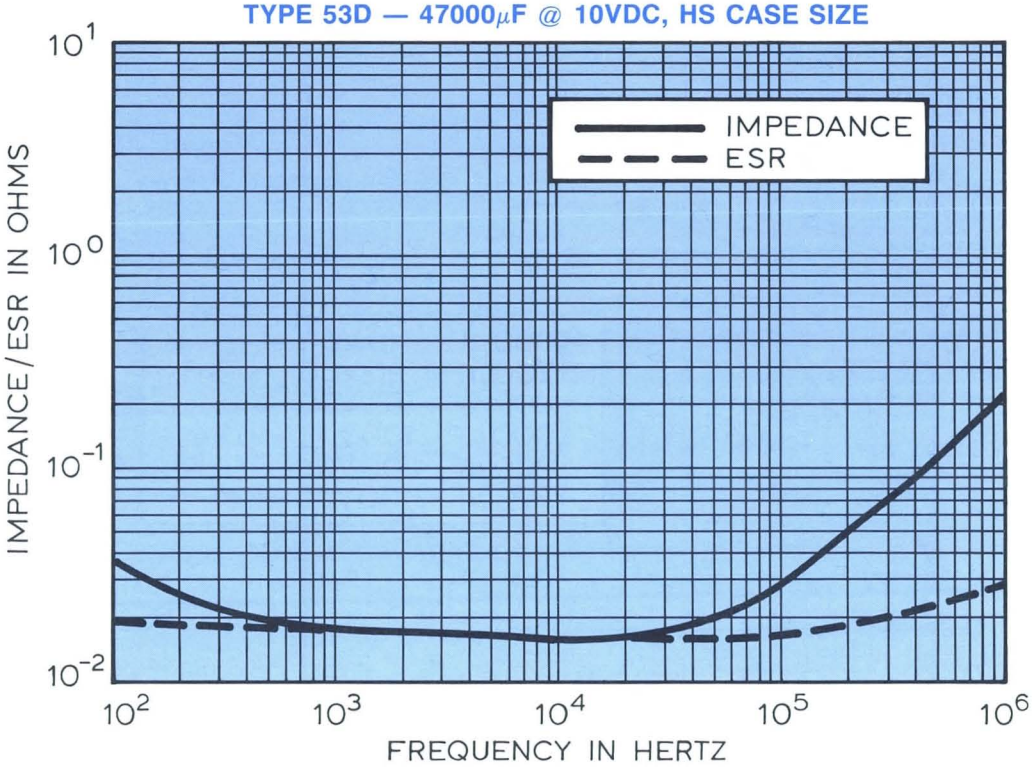
TYPE 53D — TYPICAL ESR MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,721

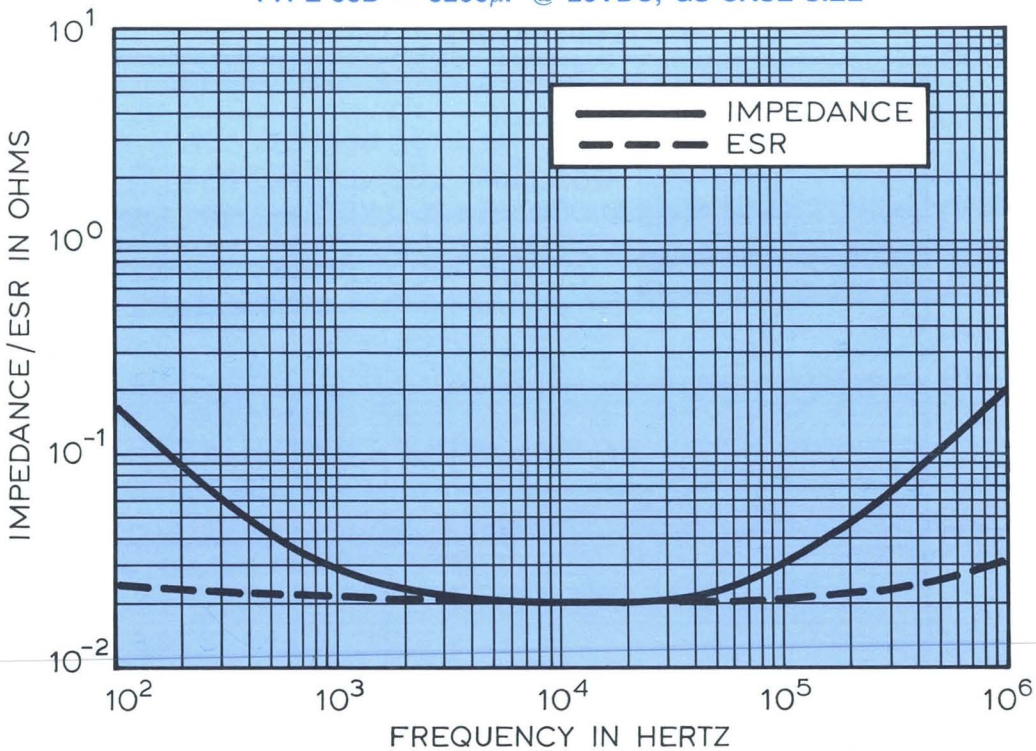
TYPICAL CURVES @ +25°C

TYPE 53D — 47000μF @ 10VDC, HS CASE SIZE



Dwg. No. A-14,643

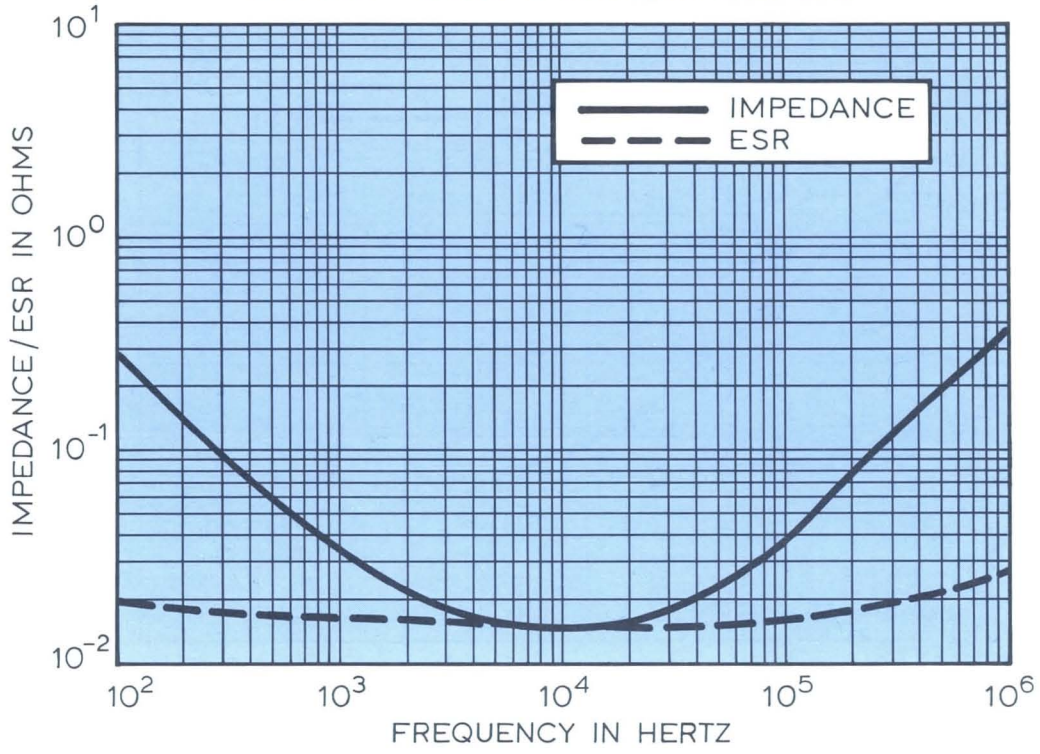
TYPE 53D — 8200μF @ 25VDC, GS CASE SIZE



Dwg. No. A-14,644

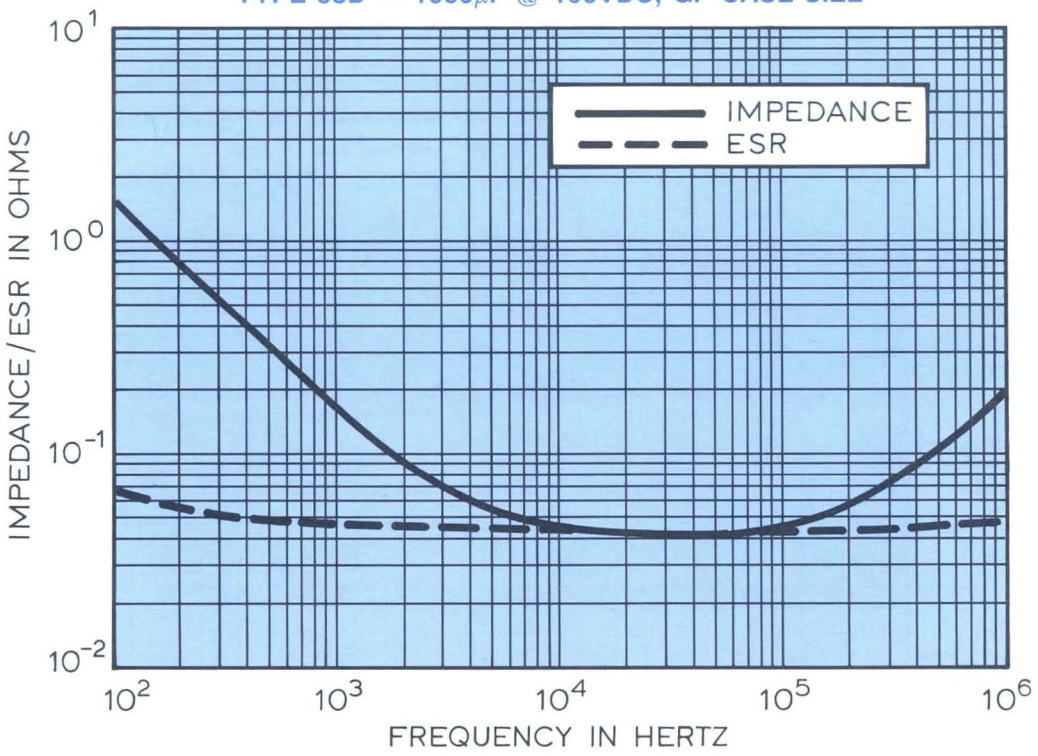
TYPICAL CURVES @ +25°C

TYPE 53D — 5600μF @ 63VDC, HT CASE SIZE



Dwg. No. A-14,645

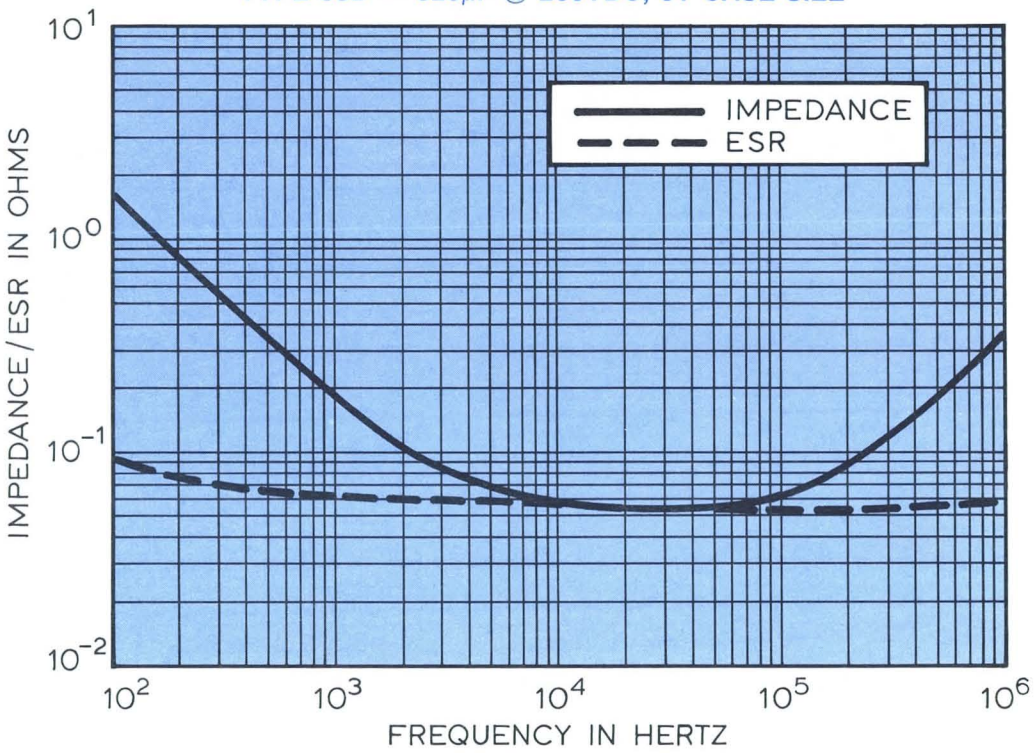
TYPE 53D — 1000μF @ 100VDC, GP CASE SIZE



Dwg. No. A-14,646

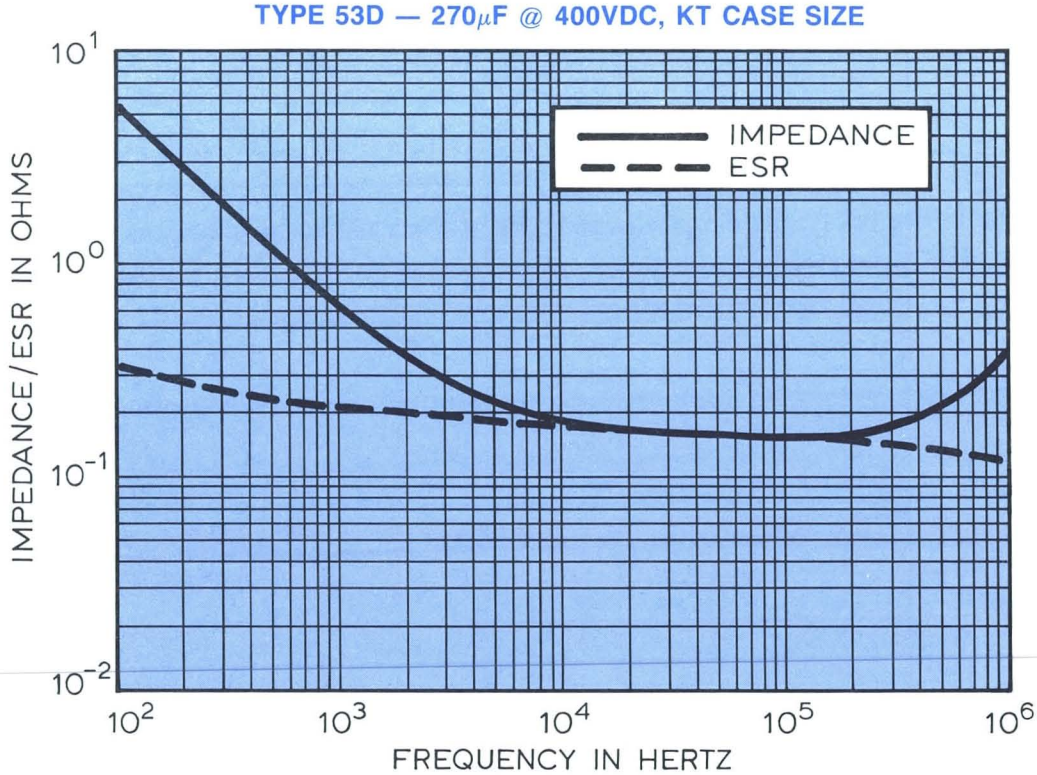
TYPICAL CURVES @ +25°C

TYPE 53D — 820μF @ 200VDC, JT CASE SIZE



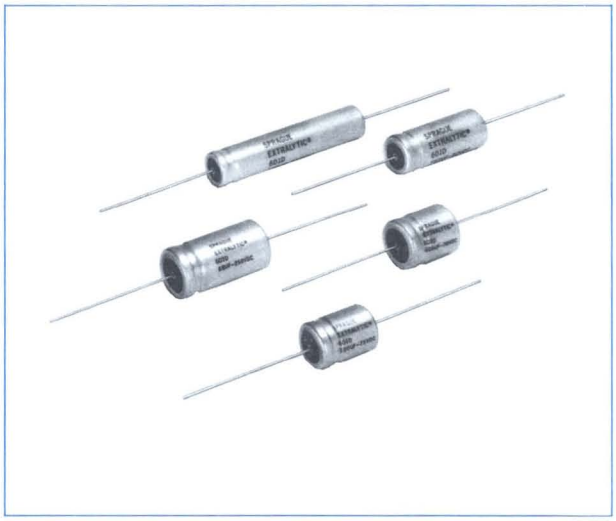
Dwg. No. A-14,647

TYPE 53D — 270μF @ 400VDC, KT CASE SIZE



Dwg. No. A-14,648

+105°C Tubular Axial Lead Aluminum Capacitors



9567

Features —

- Temperature Range –55°C to +105°C
- Military Version — MIL-C-39018/03
- Long Life
- Low ESR

General Specifications —

Operating Temperature:
–55°C - +105°C.

Voltage Range: 5 - 300 VDC.

Capacitance Range: 12μF - 39,000μF.

Capacitance Tolerance: –10%, +50%.

Case Size Range: 0.625″ x 1.125″ - 1.0″ x 3.625″.

Termination: Axial lead.

Life Validation Test: 2000 hrs @ +105°C:
Δ CAP ≤ 15% from initial measurement.
Δ ESR ≤ 1.25x initial specified limit.
Δ DCL ≤ initial specified limit.

Shelf Test: 500 hrs @ +105°C:
Δ CAP ≤ 10% from initial measurement.
Δ ESR ≤ 1.15x initial specified limit.
Δ DCL ≤ 2x initial specified limit.

DC Leakage Current:
$I = K\sqrt{CV}$
K = .05 @ +25°C; = 3.0 @ +105°C
I in μA, C in μF, V in Volts

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	Multipliers
+105°C	0.4
+65°C	1.4
+45°C	1.7
+25°C	2.0

FREQUENCY Hz

Rated WVDC	50-60	300-400	1000 and up
0-60	0.85	1.10	1.15
61-250	0.83	1.15	1.20

Low Temperature Performance:
Capacitance Ratio $C_{-55°C}/C_{+25°C}$ min. @ 120Hz

Rated Voltage (VDC)	Capacitance Remaining
0 to 25	75
26 to 100	80
101 to 250	85

ESR Ratio $ESR_{-55°C}/ESR_{+25°C}$ max. @ 120Hz

Rated Voltage (VDC)	Multiplier
0 to 9	10
10 to 40	12
41 to 250	18

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

601D 152 F 005 FE 1

STYLE NUMBER.
1 = PVC SLEEVE (Standard).
2 = POLYESTER SLEEVE.
5 = POLYESTER SLEEVE WITH RESIN END SEAL.
7 = PVC SLEEVE WITH RESIN END SEAL.
(Recommended for exposure to halogenated cleaning solvents).

CASE CODE. SEE DIMENSIONS, BELOW.

DC VOLTAGE RATING. EXPRESSED IN VOLTS. 'R' SIGNIFIES A DECIMAL POINT, E.G., 7R5 = 7.5 VOLTS.

CAPACITANCE TOLERANCE. F = −10, +50%.

CAPACITANCE. EXPRESSED IN MICROFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

DIMENSIONS IN INCHES

Case Code	STYLE 1, 2 Insulating Sleeve		STYLE 5, 7 Insulating Sleeve, Coated End-Seal		Typical Weight Oz.
	D ± 0.020	L ± 0.062	D ± 0.020	L ± 0.062	
FE	0.635	1.141	0.635	1.187	0.32
FJ	0.635	1.641	0.635	1.687	0.39
FL	0.635	2.141	0.635	2.187	0.53
FP	0.635	2.641	0.635	2.687	0.63
FS	0.635	3.141	0.635	3.187	0.88
FT	0.635	3.641	0.635	3.687	0.98
GE	0.760	1.141	0.760	1.187	0.46
GJ	0.760	1.641	0.760	1.687	0.67
GL	0.760	2.141	0.760	2.187	0.74
GP	0.760	2.641	0.760	2.687	0.88
GS	0.760	3.141	0.760	3.187	1.16
GT	0.760	3.641	0.760	3.687	1.33
HE	0.885	1.141	0.885	1.187	0.63
HJ	0.885	1.641	0.885	1.687	0.95
HL	0.885	2.141	0.885	2.187	1.02
HP	0.885	2.641	0.885	2.687	1.37
HS	0.885	3.141	0.885	3.187	1.72
HT	0.885	3.641	0.885	3.687	2.07
JE	1.010	1.141	1.010	1.187	0.81
JJ	1.010	1.641	1.010	1.687	1.02
JL	1.010	2.141	1.010	2.187	1.54
JP	1.010	2.641	1.010	2.687	1.86
JS	1.010	3.141	1.010	3.187	2.21
JT	1.010	3.641	1.010	3.687	2.52

DIMENSIONS IN MILLIMETERS

Case Code	STYLE 1, 2 Insulating Sleeve		STYLE 5, 7 Insulating Sleeve, Coated End-Seal		Typical Weight Grams
	D ± 0.51	L ± 1.58	D ± 0.51	L ± 1.58	
FE	16.1	29.0	16.1	30.2	9
FJ	16.1	41.7	16.1	42.9	11
FL	16.1	54.4	16.1	55.6	15
FP	16.1	67.1	16.1	68.3	18
FS	16.1	79.8	16.1	81.0	25
FT	16.1	92.5	16.1	93.7	28
GE	19.3	29.0	19.3	30.2	13
GJ	19.3	41.7	19.3	42.9	19
GL	19.3	54.4	19.3	55.6	21
GP	19.3	67.1	19.3	68.3	25
GS	19.3	79.8	19.3	81.0	33
GT	19.3	92.5	19.3	93.7	38
HE	22.5	29.0	22.5	30.2	18
HJ	22.5	41.7	22.5	42.9	27
HL	22.5	54.4	22.5	55.6	29
HP	22.5	67.1	22.5	68.3	39
HS	22.5	79.8	22.5	81.0	49
HT	22.5	92.5	22.5	93.7	59
JE	25.7	29.0	25.7	30.2	23
JJ	25.7	41.7	25.7	42.9	29
JL	25.7	54.4	25.7	55.6	44
JP	25.7	67.1	25.7	68.3	53
JS	25.7	79.8	25.7	81.0	63
JT	25.7	92.5	25.7	93.7	72

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Inches D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-100kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-100kHz
6.3 VOLTS DC WORKING; 8 VOLTS DC SURGE						
1500	601D152F6R3FE1	0.625 x 1.125	311.0	227.0	1.04	1.22
2700	601D272F6R3FJ1	0.625 x 1.625	148.0	108.0	1.76	2.05
3900	601D392F6R3FL1	0.625 x 2.125	98.0	72.0	2.41	2.81
5600	601D562F6R3FP1	0.625 x 2.625	74.0	55.0	3.05	3.54
6800	601D682F6R3FS1	0.625 x 3.125	60.0	44.0	3.66	4.25
8200	601D822F6R3FT1	0.625 x 3.625	51.0	38.0	4.26	4.94
2700	601D272F6R3GE1	0.750 x 1.125	169.0	124.0	1.58	1.84
5600	601D562F6R3GJ1	0.750 x 1.625	83.0	61.0	2.60	3.02
8200	601D822F6R3GL1	0.750 x 2.125	57.0	42.0	3.52	4.07
10000	601D103F6R3GP1	0.750 x 2.625	43.0	32.0	4.40	5.09
12000	601D123F6R3GS1	0.750 x 3.125	37.0	28.0	5.13	5.91
15000	601D153F6R3GT1	0.750 x 3.625	31.0	23.0	5.98	6.89
3900	601D392F6R3HE1	0.875 x 1.125	118.0	88.0	2.09	2.42
8200	601D822F6R3HJ1	0.875 x 1.625	59.0	44.0	3.38	3.90
12000	601D123F6R3HL1	0.875 x 2.125	42.0	31.0	4.47	5.15
15000	601D153F6R3HP1	0.875 x 2.625	33.0	24.0	5.54	6.37
18000	601D183F6R3HS1	0.875 x 3.125	27.0	20.0	6.56	7.50
22000	601D223F6R3HT1	0.875 x 3.625	23.0	18.0	7.52	8.61
5600	601D562F6R3JE1	1.000 x 1.125	93.0	69.0	2.57	2.96
10000	601D103F6R3JJ1	1.000 x 1.625	49.0	36.0	4.05	4.66
18000	601D183F6R3JL1	1.000 x 2.125	33.0	25.0	5.44	6.23
22000	601D223F6R3JP1	1.000 x 2.625	26.0	20.0	6.72	7.68
27000	601D273F6R3JS1	1.000 x 3.125	22.0	17.0	7.86	8.91
33000	601D333F6R3JT1	1.000 x 3.625	19.0	15.0	8.98	10.18
7.5 VOLTS DC WORKING; 10 VOLTS DC SURGE						
1200	601D122F7R5FE1	0.625 x 1.125	307.0	220.0	1.05	1.24
2700	601D272F7R5FJ1	0.625 x 1.625	151.0	109.0	1.74	2.05
3900	601D392F7R5FL1	0.625 x 2.125	101.0	73.0	2.37	2.80
4700	601D472F7R5FP1	0.625 x 2.625	77.0	56.0	3.00	3.52
6800	601D682F7R5FS1	0.625 x 3.125	63.0	46.0	3.59	4.22
8200	601D822F7R5FT1	0.625 x 3.625	52.0	38.0	4.20	4.92
2200	601D222F7R5GE1	0.750 x 1.125	174.0	126.0	1.56	1.84
4700	601D472F7R5GJ1	0.750 x 1.625	87.0	63.0	2.55	2.99
6800	601D682F7R5GL1	0.750 x 2.125	59.0	43.0	3.46	4.04
10000	601D103F7R5GP1	0.750 x 2.625	45.0	33.0	4.33	5.06
12000	601D123F7R5GS1	0.750 x 3.125	37.0	27.7	5.14	5.98
15000	601D153F7R5GT1	0.750 x 3.625	33.0	24.3	5.88	6.82
3300	601D332F7R5HE1	0.875 x 1.125	123.0	90.0	2.05	2.40
6800	601D682F7R5HJ1	0.875 x 1.625	62.0	45.3	3.32	3.88
10000	601D103F7R5HL1	0.875 x 2.125	45.0	33.5	4.32	5.02
15000	601D153F7R5HP1	0.875 x 2.625	34.0	25.4	5.45	6.31
18000	601D183F7R5HS1	0.875 x 3.125	28.0	20.8	6.51	7.52
22000	601D223F7R5HT1	0.875 x 3.625	24.4	18.4	7.41	8.53
4700	601D472F7R5JE1	1.000 x 1.125	95.0	71.0	2.53	2.94
10000	601D103F7R5JJ1	1.000 x 1.625	49.0	36.6	4.04	4.68
15000	601D153F7R5JL1	1.000 x 2.125	34.0	25.7	5.37	6.21
22000	601D223F7R5JP1	1.000 x 2.625	27.0	20.3	6.12	7.62
27000	601D273F7R5JS1	1.000 x 3.125	22.5	17.2	7.79	8.91
33000	601D333F7R5JT1	1.000 x 3.625	19.6	15.0	8.91	10.2

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Inches D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-100kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-100kHz
10 VOLTS DC WORKING; 15 VOLTS DC SURGE						
1000	601D102F010FE1	0.625 x 1.125	332.0	233.0	1.00	1.21
2200	601D222F010FJ1	0.625 x 1.625	157.0	111.0	1.70	2.03
3300	601D332F010FL1	0.625 x 2.125	106.0	75.0	2.31	2.76
4700	601D472F010FP1	0.625 x 2.625	80.0	57.0	2.94	3.50
5600	601D562F010FS1	0.625 x 3.125	65.0	47.0	3.52	4.17
6800	601D682F010FT1	0.625 x 3.625	55.0	39.0	4.11	4.87
2200	601D222F010GE1	0.750 x 1.125	182.0	129.0	1.53	1.81
3900	601D392F010GJ1	0.750 x 1.625	91.0	65.0	2.50	2.96
6800	601D682F010GL1	0.750 x 2.125	61.0	44.0	3.40	4.03
8200	601D822F010GP1	0.750 x 2.625	47.0	34.0	4.25	5.01
10000	601D103F010GS1	0.750 x 3.125	41.0	29.0	5.00	5.82
12000	601D123F010GT1	0.750 x 3.625	35.0	25.0	5.72	6.71
3300	601D332F010HE1	0.875 x 1.125	127.0	90.0	2.02	2.39
5600	601D562F010HJ1	0.875 x 1.625	64.0	46.0	3.26	3.84
8200	601D822F010HL1	0.875 x 2.125	44.0	32.0	4.38	5.14
12000	601D123F010HP1	0.875 x 2.625	36.0	26.0	5.30	6.22
15000	601D153F010HS1	0.875 x 3.125	29.0	20.0	6.43	7.50
18000	601D183F010HT1	0.875 x 3.625	25.0	18.0	7.37	8.56
3900	601D392F010JE1	1.000 x 1.125	99.0	71.0	2.49	2.93
8200	601D822F010JJ1	1.000 x 1.625	50.0	37.0	4.00	4.67
13000	601D133F010JL1	1.000 x 2.125	36.0	26.0	5.27	6.15
18000	601D183F010JP1	1.000 x 2.625	28.0	21.0	6.45	7.49
22000	601D223F010JS1	1.000 x 3.125	23.0	17.0	7.68	8.86
27000	601D273F010JT1	1.000 x 3.625	20.0	15.0	8.75	10.08
15 VOLTS DC WORKING; 20 VOLTS DC SURGE						
820	601D821F015FE1	0.625 x 1.125	349.0	230.0	0.99	1.21
1800	601D182F015FJ1	0.625 x 1.625	175.0	116.0	1.62	1.98
2700	601D272F015FL1	0.625 x 2.125	115.0	77.0	2.23	2.73
3300	601D332F015FP1	0.625 x 2.625	87.0	58.0	2.83	3.45
3900	601D392F015FS1	0.625 x 3.125	71.0	48.0	3.37	4.11
4700	601D472F015FT1	0.625 x 3.625	60.0	40.0	3.94	4.79
1500	601D152F015GE1	0.750 x 1.125	198.0	132.0	1.47	1.79
3300	601D332F015GJ1	0.750 x 1.625	98.0	66.0	2.40	2.92
4700	601D472F015GL1	0.750 x 2.125	67.0	45.0	3.26	3.95
5600	601D562F015GP1	0.750 x 2.625	51.0	35.0	4.07	4.93
8200	601D822F015GS1	0.750 x 3.125	42.0	29.0	4.87	5.86
10000	601D103F015GT1	0.750 x 3.625	36.0	25.0	5.64	6.78
2200	601D222F015HE1	0.875 x 1.125	139.0	94.0	1.93	2.34
4700	601D472F015HJ1	0.875 x 1.625	70.0	48.0	3.12	3.77
6800	601D682F015HL1	0.875 x 2.125	48.0	33.0	4.20	5.05
10000	601D103F015HP1	0.875 x 2.625	37.0	26.0	5.23	6.27
12000	601D123F015HS1	0.875 x 3.125	31.0	22.0	6.19	7.38
15000	601D153F015HT1	0.875 x 3.625	27.0	19.0	7.06	8.40
3300	601D332F015JE1	1.000 x 1.125	108.0	75.0	2.38	2.87
6800	601D682F015JJ1	1.000 x 1.625	55.0	38.0	3.83	4.59
10000	601D103F015JL1	1.000 x 2.125	38.0	27.0	5.10	6.09
12000	601D123F015JP1	1.000 x 2.625	30.0	22.0	6.25	7.40
18000	601D183F015JS1	1.000 x 3.125	25.0	18.0	7.33	8.67
22000	601D223F015JT1	1.000 x 3.625	22.0	16.0	8.50	9.98

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size Inches D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-100kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-100kHz
25 VOLTS DC WORKING; 40 VOLTS DC SURGE						
560	601D561F025FE1	0.625 x 1.125	383.0	237.0	0.941	1.20
1000	601D102F025FJ1	0.625 x 1.625	198.0	124.0	1.52	1.92
1500	601D152F025FL1	0.625 x 2.125	125.0	78.0	2.14	2.71
2200	601D222F025FP1	0.625 x 2.625	96.0	61.0	2.68	3.38
2700	601D272F025FS1	0.625 x 3.125	78.0	50.0	3.22	4.04
3300	601D332F025FT1	0.652 x 3.625	65.0	41.0	3.79	4.75
1000	601D102F025GE1	0.750 x 1.125	213.0	134.0	1.41	1.78
1800	601D182F025GJ1	0.750 x 1.625	110.0	70.0	2.27	2.85
2700	601D272F025GL1	0.750 x 2.125	73.0	47.0	3.11	3.89
3900	601D392F025GP1	0.750 x 2.625	56.0	36.0	3.91	4.87
4700	601D472F025GS1	0.750 x 3.125	45.0	29.0	4.68	5.80
5600	601D562F025GT1	0.750 x 3.625	38.0	25.0	5.43	6.70
1500	601D152F025HE1	0.875 x 1.125	157.0	100.0	1.81	2.27
2700	601D272F025HJ1	0.875 x 1.625	76.0	49.0	2.98	3.72
3900	601D392F025HL1	0.875 x 2.125	52.0	34.0	4.04	5.01
5600	601D562F025HP1	0.875 x 2.625	40.0	26.0	5.04	6.20
6800	601D682F025HS1	0.875 x 3.125	33.0	22.0	6.00	7.33
8200	601D822F025HT1	0.875 x 3.625	28.0	19.0	6.91	8.42
1800	601D182F025JE1	1.000 x 1.125	117.0	76.0	2.28	2.83
3900	601D392F025JJ1	1.000 x 1.625	59.0	39.0	3.70	4.55
5600	601D562F025JL1	1.000 x 2.125	40.0	27.0	4.96	6.07
8200	601D822F025JP1	1.000 x 2.625	31.0	21.0	6.14	7.44
10000	601D103F025JS1	1.000 x 3.125	27.0	18.0	7.15	8.64
12000	601D123F025JT1	1.000 x 3.625	23.0	16.0	8.21	9.89
40 VOLTS DC WORKING; 60 VOLTS DC SURGE						
270	601D201F040FE1	0.625 x 1.125	480	244	0.84	1.18
560	601D561F040FJ1	0.625 x 1.625	231.0	118.0	1.40	1.96
820	601D821F040FL1	0.625 x 2.125	154.0	79.0	1.93	2.68
1200	601D122F040FP1	0.625 x 2.625	118.0	61.0	2.42	3.35
1500	601D152F040FS1	0.625 x 3.125	95.0	50.0	2.91	4.02
1800	601D182F040FT1	0.625 x 3.625	80.0	42.0	3.40	4.67
560	601D561F040GE1	0.750 x 1.125	266.0	137.0	1.26	1.75
1000	601D102F040GJ1	0.750 x 1.625	133.0	70.0	2.06	2.84
1800	601D182F040GL1	0.750 x 2.125	87.0	46.0	2.84	3.89
2200	601D222F040GP1	0.750 x 2.625	68.0	36.0	3.52	4.80
2700	601D272F040GS1	0.750 x 3.125	54.0	29.0	4.25	5.75
3300	601D332F040GT1	0.750 x 3.625	46.0	25.0	4.95	6.67
820	601D821F040HE1	0.875 x 1.125	182.0	96.0	1.68	2.31
1800	601D182F040HJ1	0.875 x 1.625	91.0	49.0	2.73	3.72
2200	601D222F040HL1	0.875 x 2.125	62.0	34.0	3.67	4.94
3300	601D332F040HP1	0.875 x 2.625	47.0	26.0	4.61	6.17
3900	601D392F040HS1	0.875 x 3.125	39.0	22.0	5.46	7.26
4700	601D472F040HT1	0.875 x 3.625	33.0	19.0	6.33	8.35
1000	601D102F040JE1	1.000 x 1.125	146.0	79.0	2.04	2.77
2200	601D222F040JJ1	1.000 x 1.625	71.0	39.0	3.35	4.49
3300	601D332F040JL1	1.000 x 2.125	48.0	27.0	4.52	5.99
4700	601D472F040JP1	1.000 x 2.625	37.0	21.0	5.62	7.37
5600	601D562F040JS1	1.000 x 3.125	30.0	18.0	6.66	8.67
6800	601D682F040JT1	1.000 x 3.625	26.0	15.0	7.66	9.92

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Inches D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-100kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-100kHz
50 VOLTS DC WORKING; 75 VOLTS DC SURGE						
270	601D271F050FE1	0.625 x 1.125	519	241	0.81	1.19
470	601D471F050FJ1	0.625 x 1.625	249.0	117.0	1.35	1.98
680	601D681F050FL1	0.625 x 2.125	165.0	78.0	1.87	2.71
1000	601D102F050FP1	0.625 x 2.625	128.0	61.0	2.33	3.37
1200	601D122F050FS1	0.625 x 3.125	107.0	51.0	2.76	3.97
1500	601D152F050FT1	0.625 x 3.625	87.0	42.0	3.28	4.70
470	601D471F050GE1	0.750 x 1.125	285.0	135.0	1.22	1.77
1000	601D102F050GJ1	0.750 x 1.625	139.0	67.0	2.02	2.90
1500	601D152F050GL1	0.750 x 2.125	95.0	47.0	2.73	3.90
1800	601D182F050GP1	0.750 x 2.625	71.0	35.0	3.45	4.90
2200	601D222F050GS1	0.750 x 3.125	60.0	30.0	4.08	5.75
2700	601D272F050GT1	0.750 x 3.625	50.0	25.0	4.76	6.67
680	601D681F050HE1	0.875 x 1.125	196.0	95.0	1.62	2.32
1500	601D152F050HJ1	0.875 x 1.625	99.0	49.0	2.63	3.72
2200	601D222F050HL1	0.875 x 2.125	67.0	34.0	3.55	4.99
2700	601D272F050HP1	0.875 x 2.625	51.0	27.0	4.44	6.17
3300	601D332F050HS1	0.875 x 3.125	42.0	22.0	5.28	7.29
3900	601D392F050HT1	0.875 x 3.625	36.0	19.0	6.12	8.38
1000	601D102F050JE1	1.000 x 1.125	148.0	75.0	2.03	2.86
1800	601D182F050JJ1	1.000 x 1.625	77.0	40.0	3.23	4.50
2700	601D272F050JL1	1.000 x 2.125	52.0	28.0	4.37	6.00
3900	601D392F050JP1	1.000 x 2.625	40.0	22.0	5.44	7.40
4700	601D472F050JS1	1.000 x 3.125	33.0	18.0	6.47	8.69
5600	601D562F050JT1	1.000 x 3.625	28.0	16.0	7.45	9.92
60 VOLTS DC WORKING; 90 VOLTS DC SURGE						
220	601D221F060FE1	0.625 x 1.125	563	250	0.78	1.16
470	601D471F060FJ1	0.625 x 1.625	269.0	121.0	1.30	1.94
680	601D681F060FL1	0.625 x 2.125	178.0	80.0	1.80	2.67
820	601D821F060FP1	0.625 x 2.625	134.0	61.0	2.27	3.36
1000	601D102F060FS1	0.625 x 3.125	111.0	51.0	2.70	3.98
1200	601D122F060FT1	0.625 x 3.625	95.0	44.0	3.13	4.59
390	601D391F060GE1	0.750 x 1.125	304.0	138.0	1.18	1.75
820	601D821F060GJ1	0.750 x 1.625	150.0	69.0	1.94	2.86
1200	601D122F060GL1	0.750 x 2.125	105.0	49.0	2.59	3.79
1500	601D152F060GP1	0.750 x 2.625	80.0	38.0	3.26	4.73
1800	601D182F060GS1	0.750 x 3.125	62.0	30.0	3.99	5.75
2200	601D222F060GT1	0.750 x 3.625	53.0	26.0	4.62	6.62
680	601D681F060HE1	0.875 x 1.125	210.0	98.0	1.57	2.30
1200	601D122F060HJ1	0.875 x 1.625	109.0	52.0	2.50	3.63
1800	601D182F060HL1	0.875 x 2.125	70.0	34.0	3.47	4.97
2200	601D222F060HP1	0.875 x 2.625	54.0	27.0	4.31	6.13
2700	601D272F060HS1	0.875 x 3.125	45.0	23.0	5.12	7.21
3900	601D392F060HT1	0.875 x 3.625	38.0	19.0	5.98	8.33
820	601D821F060JE1	1.000 x 1.125	158.0	76.0	1.97	2.83
1800	601D182F060JJ1	1.000 x 1.625	81.0	40.0	3.14	4.46
2700	601D272F060JL1	1.000 x 2.125	55.0	28.0	4.25	5.97
3300	601D332F060JP1	1.000 x 2.625	42.0	22.0	5.31	7.35
3900	601D392F060JS1	1.000 x 3.125	34.0	18.0	6.31	8.64
4700	601D472F060JT1	1.000 x 3.625	29.0	16.0	7.29	9.89

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size Inches D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-100kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-100kHz
100 VOLTS DC WORKING; 150 VOLTS DC SURGE						
68	601D680F100FE1	0.625 x 1.125	1714	727	.444	.683
120	601D121F100FJ1	0.625 x 1.625	869.0	370.0	.725	1.11
180	601D181F100FL1	0.625 x 2.125	561.0	240.0	1.01	1.55
270	601D271F100FP1	0.625 x 2.625	415.0	178.0	1.29	1.97
330	601D331F100FS1	0.625 x 3.125	330.0	142.0	1.57	2.39
390	601D391F100FT1	0.625 x 3.625	274.0	118.0	1.84	2.80
120	601D121F100GE1	0.750 x 1.125	986.0	421.0	.656	1.00
270	601D271F100GJ1	0.750 x 1.625	461.0	198.0	1.11	1.69
390	601D391F100GL1	0.750 x 2.125	302.0	131.0	1.53	2.33
470	601D471F100GP1	0.750 x 2.625	230.0	100.0	1.92	2.91
560	601D561F100GS1	0.750 x 3.125	183.0	80.0	2.33	3.52
680	601D681F100GT1	0.750 x 3.625	152.0	67.0	2.73	4.11
180	601D181F100HE1	0.875 x 1.125	632.0	273.0	0.903	1.38
390	601D391F100HJ1	0.875 x 1.625	308.0	134.0	1.49	2.25
560	601D561F100HL1	0.875 x 2.125	205.0	90.0	2.03	3.06
680	601D681F100HP1	0.875 x 2.625	155.0	68.0	2.56	3.84
820	601D821F100HS1	0.875 x 3.125	124.0	56.0	3.08	4.60
1000	601D102F100HT1	0.875 x 3.625	108.0	48.0	3.53	5.26
270	601D271F100JE1	1.000 x 1.125	469.0	205.0	1.14	1.73
470	601D471F100JJ1	1.000 x 1.625	226.0	100.0	1.88	2.83
820	601D821F100JL1	1.000 x 2.125	152.0	68.0	2.56	3.82
1000	601D102F100JP1	1.000 x 2.625	120.0	54.0	3.14	4.67
1200	601D122F100JS1	1.000 x 3.125	93.0	43.0	3.83	5.66
1500	601D152F100JT1	1.000 x 3.625	81.0	37.0	4.37	6.45
150 VOLTS DC WORKING; 200 VOLTS DC SURGE						
33	601D330F150FE1	0.625 x 1.125	3518.0	1485.0	0.310	0.478
68	601D680F150FJ1	0.625 x 1.625	1677.0	709.0	0.522	0.802
100	601D101F150FL1	0.625 x 2.125	1114.0	472.0	0.718	1.10
120	601D121F150FP1	0.625 x 2.625	842.0	357.0	0.907	1.39
150	601D151F150FS1	0.625 x 3.125	672.0	286.0	1.10	1.68
180	601D181F150FT1	0.625 x 3.625	560.0	238.0	1.29	1.97
56	601D560F150GE1	0.750 x 1.125	2089.0	884.0	0.451	0.693
100	601D101F150GJ1	0.750 x 1.625	1033.0	438.0	0.740	1.14
150	601D151F150GL1	0.750 x 2.125	683.0	291.0	1.02	1.56
220	601D221F150GP1	0.750 x 2.625	511.0	218.0	1.29	1.97
270	601D271F150GS1	0.750 x 3.125	409.0	175.0	1.56	2.38
330	601D331F150GT1	0.750 x 3.625	341.0	146.0	1.82	2.78
82	601D820F150HE1	0.875 x 1.125	1395.0	593.0	0.608	0.932
150	601D151F150HJ1	0.875 x 1.625	695.0	297.0	0.989	1.51
270	601D271F150HL1	0.875 x 2.125	451.0	193.0	1.37	2.09
330	601D331F150HP1	0.875 x 2.625	345.0	148.0	1.71	2.61
390	601D391F150HS1	0.875 x 3.125	273.0	118.0	2.08	3.16
470	601D471F150HT1	0.875 x 3.625	226.0	98.0	2.44	3.70
100	601D101F150JE1	1.000 x 1.125	1082.0	463.0	0.753	1.15
220	601D221F150JJ1	1.000 x 1.625	502.0	216.0	1.26	1.93
330	601D331F150JL1	1.000 x 2.125	328.0	142.0	1.74	2.64
470	601D477F150JP1	1.000 x 2.625	244.0	107.0	2.20	3.33
560	601D567F150JS1	1.000 x 3.125	195.0	86.0	2.65	4.00
680	601D687F150JT1	1.000 x 3.625	165.0	73.0	3.07	4.63

STANDARD RATINGS

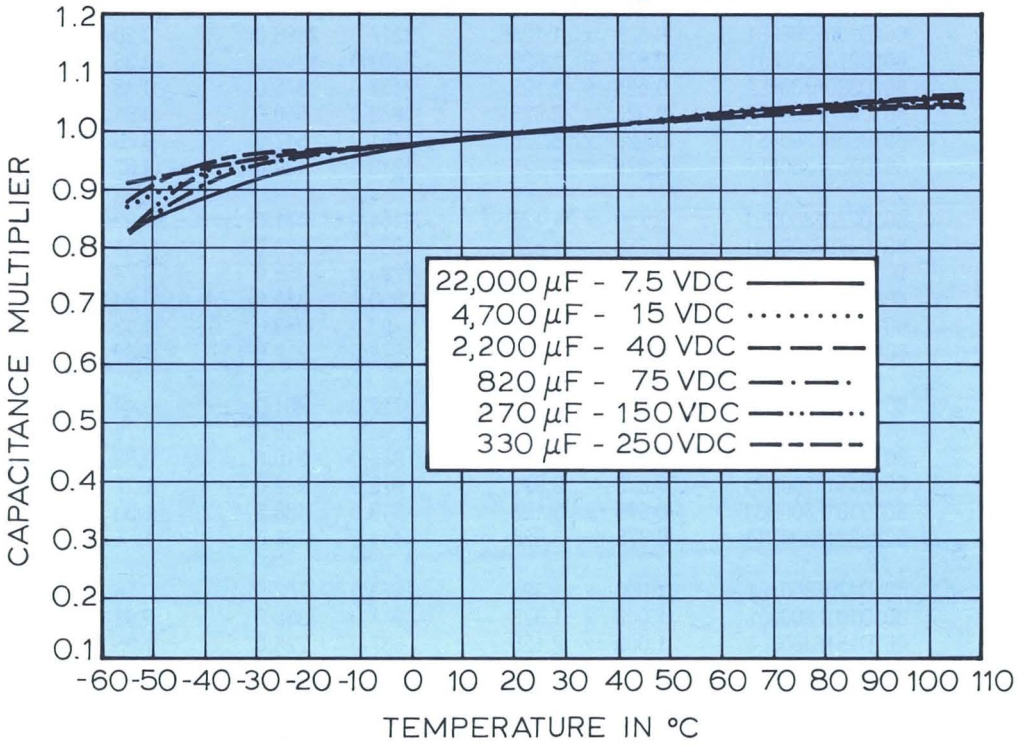
µF	Catalog Number	Nominal Case Size Inches D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-100kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-100kHz
200 VOLTS DC WORKING; 250 VOLTS DC SURGE						
27	601D270F200FE1	0.625 x 1.125	3985.0	1501.0	0.292	0.48
56	601D560F200FJ1	0.625 x 1.625	1892.0	714.0	0.491	0.80
82	601D820F200FL1	0.625 x 2.125	1242.0	469.0	0.680	1.11
100	601D101F200FP1	0.625 x 2.625	925.0	350.0	0.865	1.41
120	601D121F200FS1	0.625 x 3.125	761.0	288.0	1.032	1.67
150	601D151F200FT1	0.625 x 3.625	651.0	248.0	1.19	1.94
47	601D470F200GE1	0.750 x 1.125	2354.0	889.0	0.424	0.69
82	601D820F200GJ1	0.750 x 1.625	1142.0	433.0	0.704	1.14
120	601D121F200GL1	0.750 x 2.125	774.0	294.0	0.956	1.55
180	601D181F200GP1	0.750 x 2.625	578.0	220.0	1.21	1.96
220	601D221F200GS1	0.750 x 3.125	462.0	176.0	1.46	2.37
270	601D271F200GT1	0.750 x 3.625	385.0	147.0	1.71	2.77
68	601D680F200HE1	0.875 x 1.125	1569.0	596.0	0.573	0.930
120	601D121F200HJ1	0.875 x 1.625	787.0	300.0	0.930	1.51
180	601D181F200HL1	0.875 x 2.125	521.0	199.0	1.27	2.06
270	601D271F200HP1	0.875 x 2.625	390.0	150.0	1.61	2.59
330	601D331F200HS1	0.875 x 3.125	302.0	117.0	1.97	3.17
390	601D391F200HT1	0.875 x 3.625	254.0	98.0	2.30	3.69
82	601D820F200JE1	1.000 x 1.125	1128.0	432.0	0.737	1.19
180	601D181F200JJ1	1.000 x 1.625	560.0	216.0	1.20	1.93
270	601D271F200JL1	1.000 x 2.125	365.0	141.0	1.65	2.64
390	601D391F200JP1	1.000 x 2.625	278.0	108.0	2.06	3.29
470	601D471F200JS1	1.000 x 3.125	221.0	87.0	2.49	3.97
560	601D561F200JT1	1.000 x 3.625	183.0	72.0	2.91	4.63
250 VOLTS DC WORKING; 300 VOLTS DC SURGE						
15	601D150F250FE1	0.625 x 1.125	7136.0	2854.0	0.22	0.34
33	601D330F250FJ1	0.625 x 1.625	3228.0	1292.0	0.38	0.59
47	601D470F250FL1	0.625 x 2.125	2132.0	854.0	0.52	0.82
68	601D680F250FP1	0.625 x 2.625	1591.0	638.0	0.66	1.04
82	601D820F250FS1	0.625 x 3.125	1270.0	510.0	0.80	1.26
100	601D101F250FT1	0.625 x 3.625	1057.0	425.0	0.94	1.48
27	601D270F250GE1	0.750 x 1.125	3614.0	1449.0	0.34	0.54
56	601D560F250GJ1	0.750 x 1.625	1721.0	691.0	0.57	0.90
100	601D101F250GL1	0.750 x 2.125	1130.0	454.0	0.79	1.25
120	601D121F250GP1	0.750 x 2.625	880.0	354.0	0.98	1.55
150	601D151F250GS1	0.750 x 3.125	690.0	278.0	1.20	1.88
180	601D181F250GT1	0.750 x 3.625	568.0	230.0	1.41	2.22
47	601D470F250HE1	0.875 x 1.125	2369.0	953.0	0.47	0.74
100	601D101F250HJ1	0.875 x 1.625	1148.0	463.0	0.77	1.21
150	601D151F250HL1	0.875 x 2.125	753.0	304.0	1.06	1.67
180	601D181F250HP1	0.875 x 2.625	574.0	232.0	1.33	2.08
220	601D221F250HS1	0.875 x 3.125	464.0	188.0	1.59	2.50
270	601D271F250HT1	0.875 x 3.625	375.0	153.0	1.89	2.96
56	601D560F250JE1	1.000 x 1.125	1708.0	689.0	0.60	0.94
120	601D121F250JJ1	1.000 x 1.625	829.0	336.0	0.98	1.54
180	601D181F250JL1	1.000 x 2.125	548.0	223.0	1.34	2.11
270	601D271F250JP1	1.000 x 2.625	410.0	167.0	1.69	2.65
330	601D331F250JS1	1.000 x 3.125	328.0	134.0	2.04	3.18
390	601D391F250JT1	1.000 x 3.625	274.0	112.0	2.38	3.71

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Inches D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-100kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-100kHz
300 VOLTS DC WORKING; 350 VOLTS DC SURGE						
12	601D120F300FE1	0.625 x 1.125	8217.0	2896.0	0.20	0.34
27	601D270F300FJ1	0.625 x 1.625	3809.0	1344.0	0.35	0.58
39	601D390F300FL1	0.625 x 2.125	2479.0	875.0	0.48	0.81
47	601D470F300FP1	0.625 x 2.625	1839.0	650.0	0.61	1.03
56	601D560F300FS1	0.625 x 3.125	1461.0	517.0	0.75	1.25
68	601D680F300FT1	0.625 x 3.625	1213.0	430.0	0.87	1.47
22	601D220F300GE1	0.750 x 1.125	4164.0	1471.0	0.32	0.54
47	601D470F300GJ1	0.750 x 1.625	1931.0	683.0	0.54	0.91
68	601D680F300GL1	0.750 x 2.125	1294.0	459.0	0.74	1.24
100	601D101F300GP1	0.750 x 2.625	953.0	338.0	0.94	1.58
120	601D121F300GS1	0.750 x 3.125	795.0	283.0	1.12	1.87
150	601D151F300GT1	0.750 x 3.625	672.0	239.0	1.30	2.17
33	601D330F300HE1	0.875 x 1.125	2712.0	961.0	0.44	0.73
68	601D680F300HJ1	0.875 x 1.625	1296.0	460.0	0.72	1.22
100	601D101F300HL1	0.875 x 2.125	886.0	316.0	0.98	1.64
150	601D151F300HP1	0.875 x 2.625	679.0	242.0	1.22	2.04
180	601D181F300HS1	0.875 x 3.125	519.0	186.0	1.50	2.51
220	601D221F300HT1	0.875 x 3.625	441.0	158.0	1.74	2.91
47	601D470F300JE1	1.000 x 1.125	1973.0	702.0	0.56	0.93
100	601D101F300JJ1	1.000 x 1.625	947.0	338.0	0.92	1.54
150	601D151F300JL1	1.000 x 2.125	637.0	228.0	1.25	2.08
180	601D181F300JP1	1.000 x 2.625	468.0	169.0	1.59	2.64
220	601D221F300JS1	1.000 x 3.125	386.0	139.0	1.88	3.13
270	601D271F300JT1	1.000 x 3.625	318.0	115.0	2.21	3.67

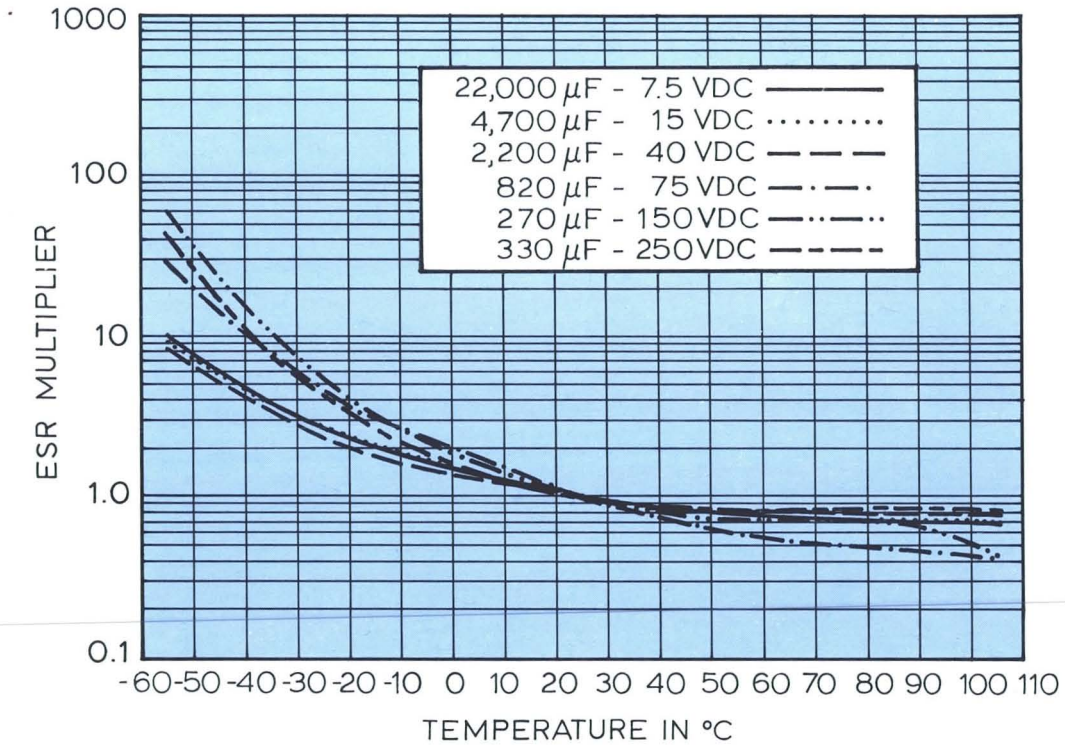
TYPICAL CURVES

TYPE 601D — TYPICAL CAPACITANCE MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,726

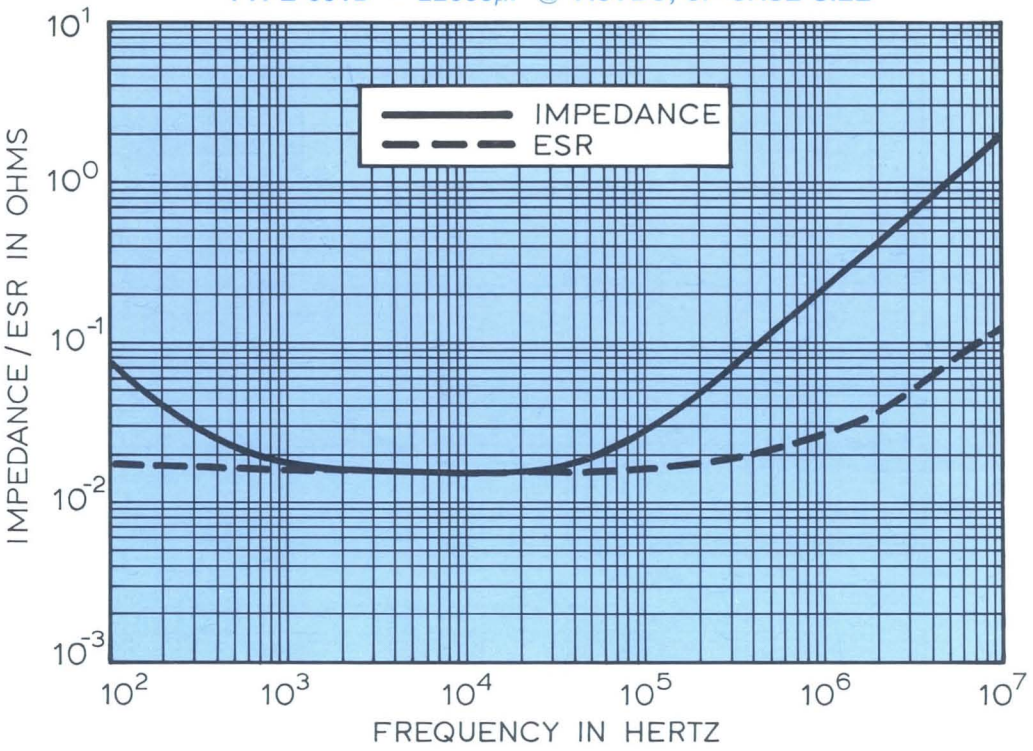
TYPE 601D — TYPICAL ESR MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,719

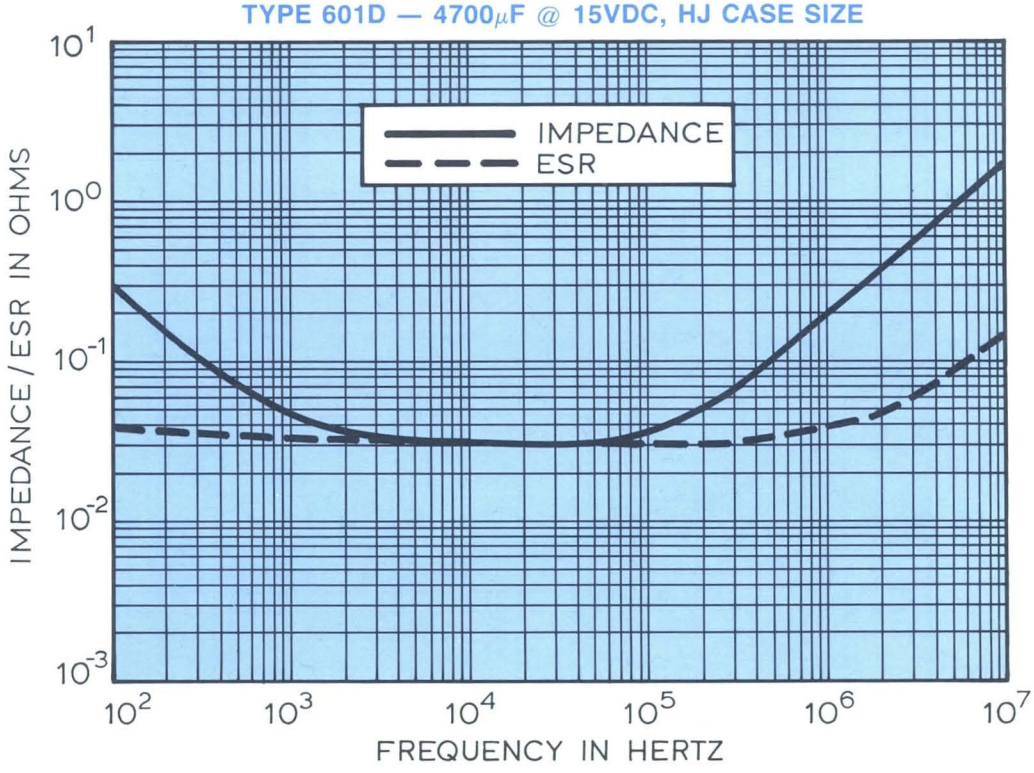
TYPICAL CURVES @ +25°C

TYPE 601D — 22000μF @ 7.5VDC, JP CASE SIZE



Dwg. No. A-14,663

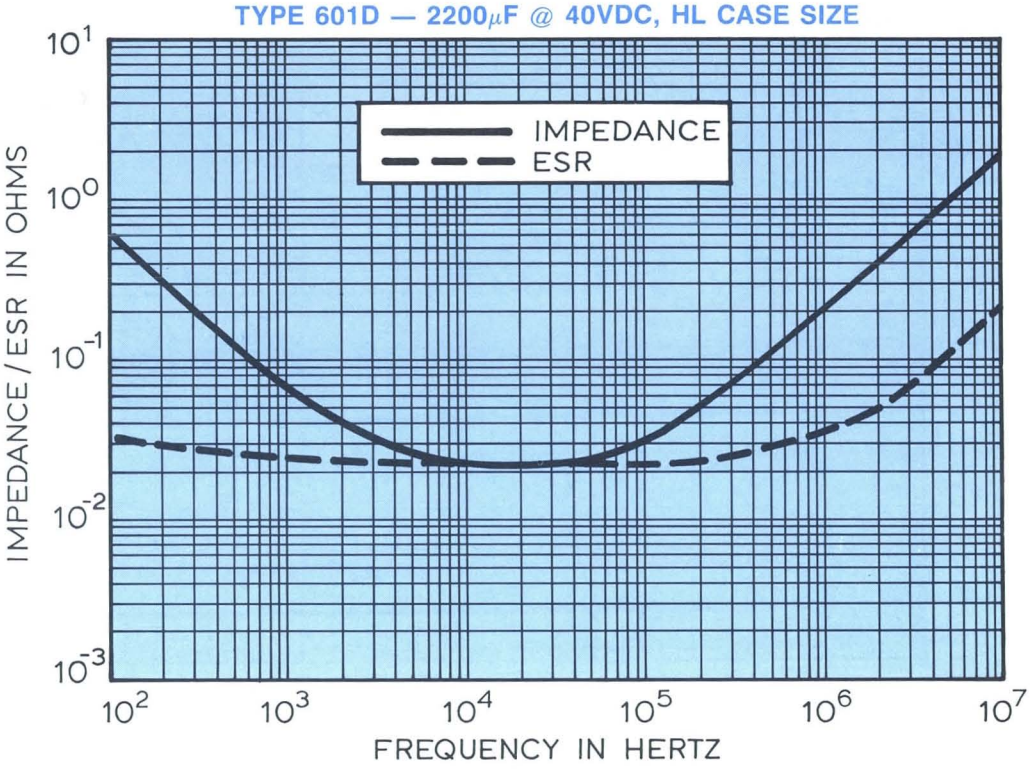
TYPE 601D — 4700μF @ 15VDC, HJ CASE SIZE



Dwg. No. A-14,662

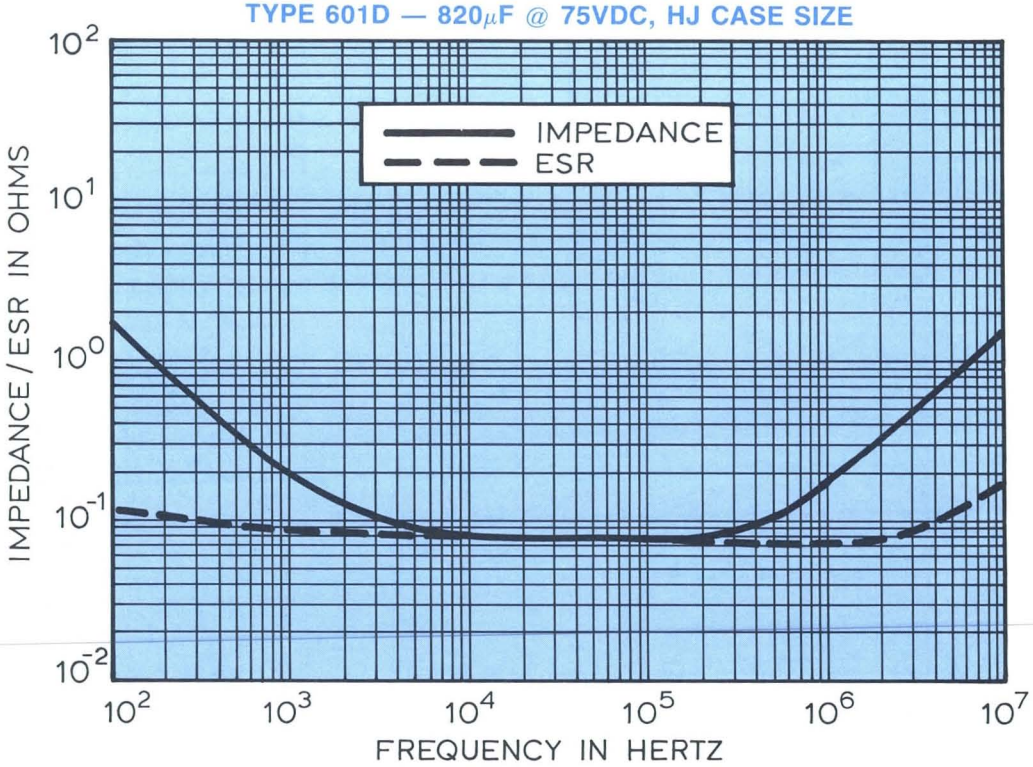
TYPICAL CURVES @ +25°C

TYPE 601D — 2200μF @ 40VDC, HL CASE SIZE



Dwg. No. A-14,661

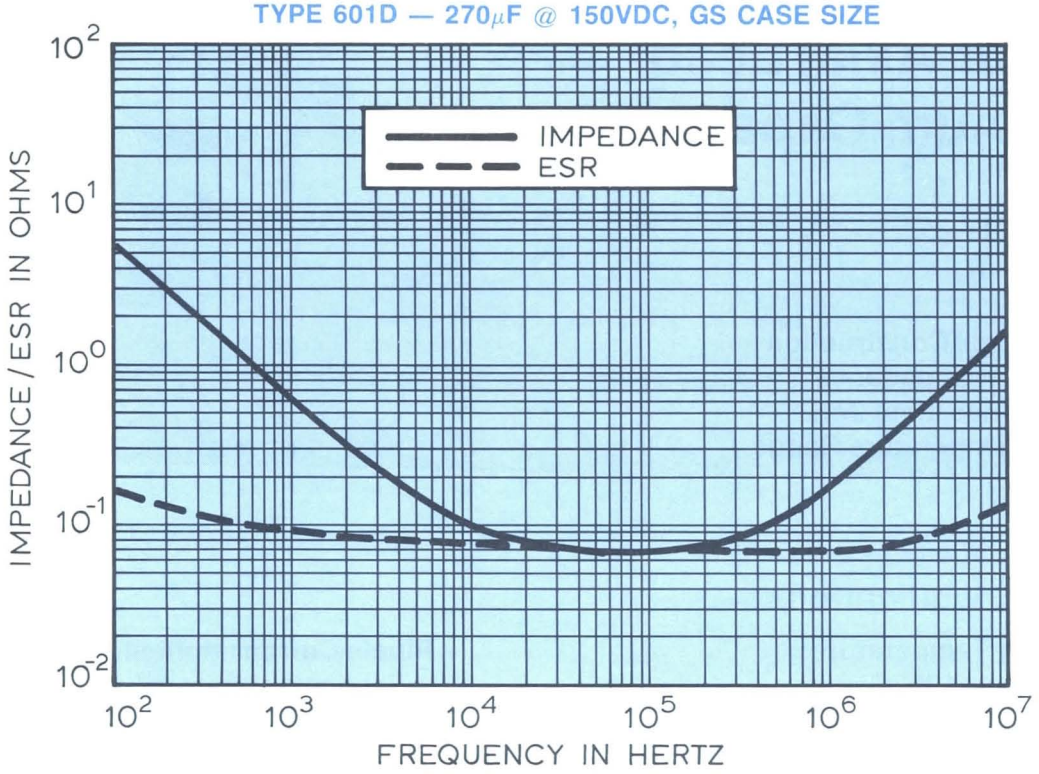
TYPE 601D — 820μF @ 75VDC, HJ CASE SIZE



Dwg. No. A-14,660

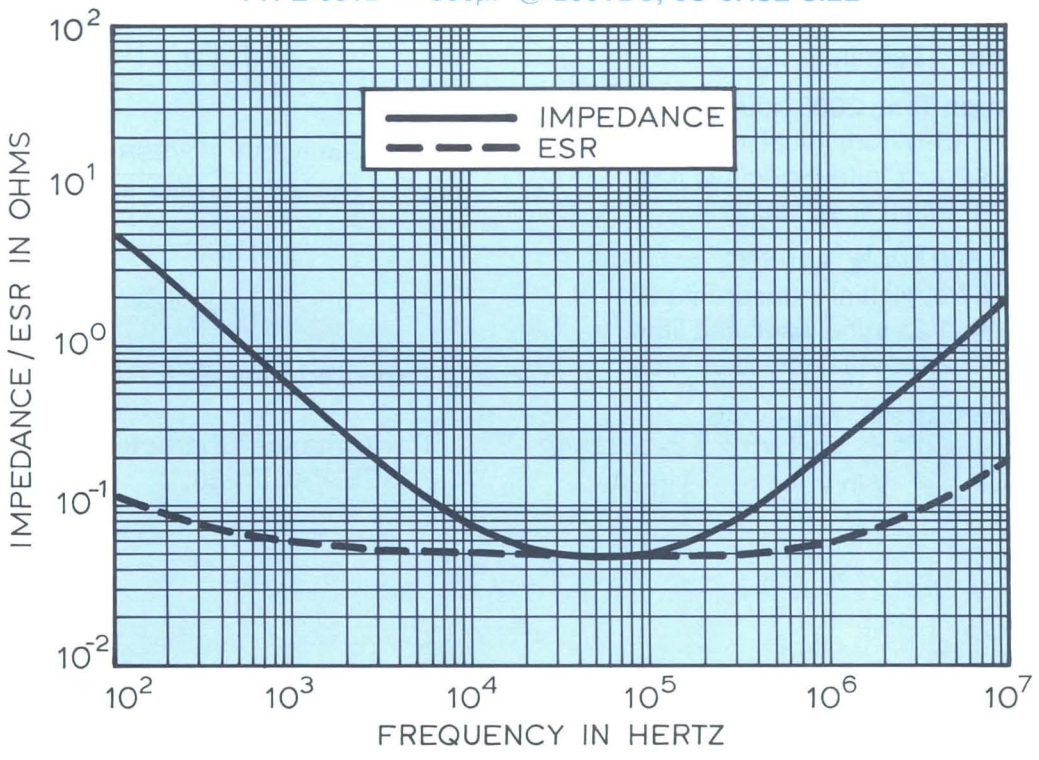
TYPICAL CURVES @ +25°C

TYPE 601D — 270μF @ 150VDC, GS CASE SIZE



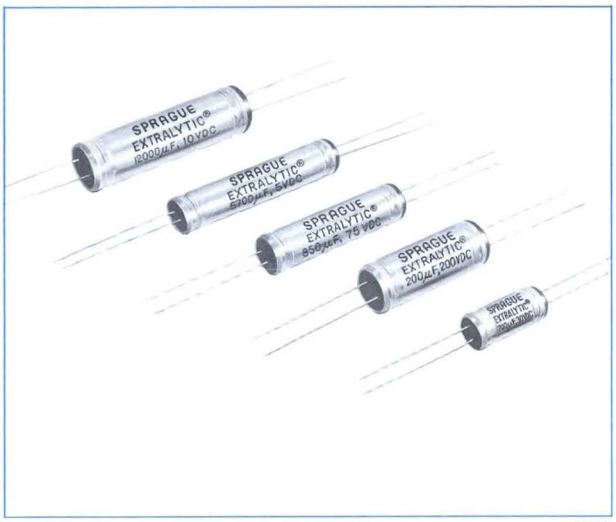
Dwg. No. A-14,665

TYPE 601D — 330μF @ 250VDC, JS CASE SIZE



Dwg. No. A-14,664

4-Terminal Tubular Axial Lead Aluminum Capacitors



9910

Features —

- 4-Terminal Construction
- Very Low Impedance
- Inductance Limit 2nH
- Wide Temperature Range

General Specifications —

Operating Temperature:
– 55°C - + 105°C.

Voltage Range: 5 - 200 VDC.

Capacitance Range: 47µF - 22,000µF.

Capacitance Tolerance: –10, +50%.

Case Size Range: 0.812″ x 1.843″ - 1.062″ x 3.843″

Termination: 4-Terminal.

Life Validation Test: 2000 hours @ +105°C:
Δ CAP ±15% from initial measurement.
Δ ESR < 1.5x initial specified limit.
Δ DCL < initial specified limit.

Shelf Test: 500 hrs @ +105°C:
C < 10% from initial measurement.
Δ ESR < 1.2x initial specified limit.
Δ DCL < 2.0x initial specified limit.

DC Leakage Current: $I = k\sqrt{CE}$
k is a constant: 0.5 @ –25°C, 3.0 @ +105°C
C in µF V in Volts I in µA

Ripple Current Multipliers:
For ripple current values, see Engineering Bulletin 3458A or call the factory.

Low Temperature Performance:
Capacitance Ratio $C^{-55°C}/C^{+25°C}$ min. @ 120Hz

Rated Voltage (VDC)	Capacitance Remaining
5-50	75%
51 up	80%

ESR Ratio $ESR^{-55°C}/ESR^{+25°C}$ max. @ 120Hz

Rated Voltage (VDC)	Multiplier
5-50	12
51 up	18

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

604D 272 F 005 GJ 6

STYLE NUMBER.
6 = OUTER INSULATION WITH SUPPLEMENTARY POLYMER COATED END SEALS

CASE CODE. SEE TABLE DIMENSIONS

DC VOLTAGE RATING. EXPRESSED IN VOLTS. "R" IS A DECIMAL POINT.

CAPACITANCE TOLERANCE F = 10, +50%

CAPACITANCE. EXPRESSED IN MICROFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

TABLE OF DIMENSIONS (inches)

	Bare Case		Outer Insulation With Polymer Coated End Seals		Lead Spacing
Case Code	D ±0.031	L ±0.062	D ±0.031	L Max.	S ±.015
GJ	0.750	1.625	0.812	1.843	0.250
GL	0.750	2.125	0.812	2.343	0.250
GP	0.750	2.625	0.812	2.843	0.250
GS	0.750	3.125	0.812	3.343	0.250
GT	0.750	3.625	0.812	3.843	0.250
HJ	0.875	1.125	0.937	1.343	0.300
HL	0.875	2.625	0.937	2.843	0.300
HP	0.875	2.125	0.937	2.343	0.300
HS	0.875	3.625	0.937	3.843	0.300
HT	0.875	3.125	0.937	3.343	0.300
JJ	1.000	1.625	1.062	1.843	0.400
JL	1.000	2.125	1.062	2.343	0.400
JP	1.000	2.625	1.062	2.843	0.400
JS	1.000	3.125	1.062	3.343	0.400
JT	1.000	3.625	1.062	3.843	0.400

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size D ± 0.031 x L ± 0.062	Max. ESR @ +25°C, 120Hz (Ω)	Max. Ripple Current @ +85°C, 100kHz 20A Load (A)	Max. Impedance @ +25°C, 100kHz (Ω)
5 VOLTS DC WORKING; 7 VOLTS DC SURGE					
2700	604D272F005GJ6	0.750 x 1.625	0.146	1.50	0.110
3300	604D332F005GL6	0.750 x 2.125	0.106	1.80	0.080
3900	604D392F005HJ6	0.875 x 1.625	0.095	1.90	0.071
4700	604D472F005GP6	0.750 x 2.625	0.080	2.50	0.060
5600	604D562F005HL6	0.875 x 2.125	0.070	2.50	0.053
6800	604D682F005GS6	0.750 x 3.125	0.062	3.10	0.047
6800	604D682F005HP6	0.875 x 2.625	0.052	3.20	0.039
8200	604D822F005JL6	1.000 x 2.125	0.049	3.50	0.037
10000	604D103F005HS6	0.875 x 3.125	0.040	4.00	0.030
15000	604D153F005JP6	1.000 x 2.625	0.035	4.60	0.026
18000	604D183F005JS6	1.000 x 3.125	0.027	5.60	0.020
22000	604D223F005JT6	1.000 x 3.625	0.022	7.00	0.017
7.5 VOLTS DC WORKING; 10 VOLTS DC SURGE					
2200	604D222F7R5GJ6	0.750 x 1.625	0.175	1.40	0.130
3300	604D332F7R5HJ6	0.875 x 1.625	0.117	1.80	0.087
3900	604D392F7R5GP6	0.750 x 2.625	0.093	2.40	0.070
4700	604D472F7R5HL6	0.875 x 2.125	0.080	2.40	0.059
5600	604D562F7R5JJ6	1.000 x 1.625	0.073	2.40	0.055
5600	604D626F7R5GS6	0.750 x 3.125	0.070	3.00	0.053
6800	604D682F7R5HP6	0.875 x 2.625	0.061	3.10	0.046
6800	604D682F7R5JL6	1.000 x 2.125	0.057	3.30	0.043
8200	604D822F7R5HS6	0.875 x 3.125	0.047	3.80	0.035
12000	604D123F7R5JP6	1.000 x 2.625	0.039	4.40	0.029
15000	604D153F7R5JS6	1.000 x 3.125	0.032	5.30	0.024
18000	604D183F7R5JT6	1.000 x 3.625	0.025	6.60	0.019
10 VOLTS DC WORKING; 15 VOLTS DC SURGE					
1800	604D182F010GJ6	0.750 x 1.625	0.195	1.30	0.144
2700	604D272F010GL6	0.750 x 2.125	0.144	1.70	0.107
2700	604D272F010HJ6	0.875 x 1.625	0.127	1.70	0.094
3300	604D332F010GP6	0.750 x 2.625	0.110	2.20	0.082
3900	604D392F010HL6	0.875 x 2.125	0.092	2.20	0.068
4700	604D472F010GS6	0.750 x 3.125	0.081	2.80	0.060
5600	604D562F010HP6	0.875 x 2.625	0.069	2.90	0.051
5600	604D562F010JL6	1.000 x 2.125	0.065	3.20	0.048
6800	604D682F010HS6	0.875 x 3.125	0.053	3.60	0.039
8200	604D822F010JP6	1.000 x 2.625	0.044	4.10	0.033
10000	604D103F010JS6	1.000 x 3.125	0.034	5.00	0.025
15000	604D153F010JT6	1.000 x 3.625	0.028	6.20	0.021
16 VOLTS DC WORKING; 20 VOLTS DC SURGE					
1500	604D152F016GJ6	0.750 x 1.625	0.207	1.20	0.149
2200	604D222F016GL6	0.750 x 2.125	0.153	1.60	0.110
2200	604D222F016HJ6	0.875 x 1.625	0.138	1.60	0.100
3300	604D332F016HL6	0.875 x 2.125	0.107	2.00	0.077
3900	604D392F016GS6	0.750 x 3.125	0.085	2.60	0.061
4700	604D472F016JL6	1.000 x 2.125	0.069	2.90	0.050
5600	604D562F016HS6	0.875 x 3.125	0.056	3.30	0.041
6800	604D682F016JP6	1.000 x 2.625	0.048	3.90	0.035
8200	604D822F016HT6	0.875 x 3.625	0.046	4.10	0.033
10000	604D103F016JS6	1.000 x 3.125	0.036	4.70	0.026
12000	604D123F016JT6	1.000 x 3.625	0.029	5.90	0.021
20 VOLTS DC WORKING; 25 VOLTS DC SURGE					
1200	604D122F020GJ6	0.750 x 1.625	0.240	1.20	0.170
1800	604D182F020HJ6	0.875 x 1.625	0.160	1.50	0.110
2200	604D222F020GP6	0.750 x 2.625	0.132	2.00	0.092
2700	604D272F020HL6	0.875 x 2.125	0.120	1.90	0.084
3300	604D332F020GS6	0.750 x 3.125	0.100	2.50	0.070
3900	604D392F020HP6	0.875 x 2.625	0.085	2.60	0.060
4700	604D472F020JL6	1.000 x 2.125	0.078	2.70	0.055

STANDARD RATINGS

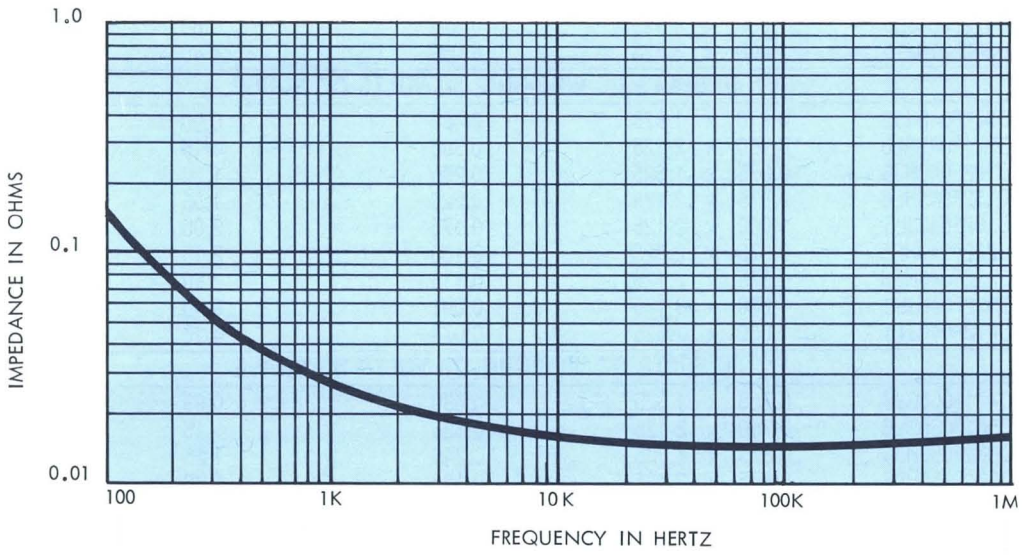
μF	Catalog Number	Nominal Case Size D ± 0.031 x L ± 0.062	Max. ESR @ +25°C, 120Hz (Ω)	Max. Ripple Current @ +85°C, 100kHz 20A Load (A)	Max. Impedance @ +25°C, 100kHz (Ω)
20 VOLTS DC WORKING; 25 VOLTS DC SURGE (Cont.)					
5600	604D562F020HS6	0.875 x 3.125	0.064	3.80	0.045
6800	604D682F020JP6	1.000 x 2.625	0.055	3.50	0.039
8200	604D822F020JS6	1.000 x 3.125	0.042	4.50	0.030
10000	604D103F020JT6	1.000 x 3.625	0.034	5.50	0.024
25 VOLTS DC WORKING; 30 VOLTS DC SURGE					
1000	604D102F025GJ6	0.750 x 1.625	0.320	1.05	0.224
1200	604D122F025GL6	0.750 x 2.125	0.240	1.40	0.168
1800	604D182F025GP6	0.750 x 2.625	0.180	1.75	0.126
2200	604D222F025HL6	0.875 x 2.125	0.145	1.90	0.102
2700	604D272F025JL6	1.000 x 2.125	0.116	2.40	0.081
3300	604D332F025HP6	0.875 x 2.625	0.108	3.00	0.072
4700	604D472F025JP6	1.000 x 2.625	0.080	3.25	0.056
6800	604D682F025JS6	1.000 x 3.125	0.062	4.00	0.043
8200	604D822F025JT6	1.000 x 3.625	0.051	4.65	0.036
30 VOLTS DC WORKING; 40 VOLTS DC SURGE					
820	604D821F030GJ6	0.750 x 1.625	0.380	1.00	0.262
1000	604D102F030GL6	0.750 x 2.125	0.295	1.25	0.204
1500	604D152F030GP6	0.750 x 2.625	0.204	1.70	0.141
1800	604D182F030HL6	0.875 x 2.125	0.165	1.75	0.114
2200	604D222F030JL6	1.000 x 2.125	0.133	2.25	0.092
2700	604D272F030HP6	0.875 x 2.625	0.120	2.35	0.083
3300	604D332F030JP6	1.000 x 2.625	0.095	3.00	0.056
3900	604D392F030HS6	0.875 x 3.125	0.088	2.90	0.061
4700	604D472F030JS6	1.000 x 3.125	0.074	3.60	0.051
5600	604D562F030JT6	1.000 x 3.625	0.059	4.40	0.041
40 VOLTS DC WORKING; 50 VOLTS DC SURGE					
680	604D681F040GJ6	0.750 x 1.625	0.480	0.90	0.322
820	604D821F040GL6	0.750 x 2.125	0.380	1.15	0.255
1000	604D102F040HJ6	0.875 x 1.625	0.295	1.20	0.197
1500	604D152F040HL6	0.875 x 2.125	0.220	1.55	0.147
1800	604D182F040JL6	1.000 x 2.125	0.175	2.05	0.117
2200	604D222F040HP6	0.875 x 2.625	0.155	2.15	0.104
3300	604D332F040HS6	0.875 x 3.125	0.115	2.60	0.077
3900	604D392F040JS6	1.000 x 3.125	0.091	3.40	0.061
4700	604D472F040JT6	1.000 x 3.625	0.074	4.10	0.050
50 VOLTS DC WORKING; 75 VOLTS DC SURGE					
470	604D471F050GJ6	0.750 x 1.625	0.430	0.93	0.280
560	604D561F050GL6	0.750 x 2.125	0.325	1.15	0.212
680	604D681F050HJ6	0.875 x 1.625	0.245	1.25	0.160
820	604D821F050HL6	0.875 x 2.125	0.185	1.60	0.120
1000	604D102F050JL6	1.000 x 2.125	0.150	2.10	0.098
1200	604D122F050HP6	0.875 x 2.625	0.130	2.15	0.085
1500	604D152F050JP6	1.000 x 2.625	0.108	2.80	0.070
2200	604D222F050JS6	1.000 x 3.125	0.081	3.40	0.053
3300	604D332F050JT6	1.000 x 3.625	0.065	4.25	0.042
75 VOLTS DC WORKING; 100 VOLTS DC SURGE					
220	604D221F075GJ6	0.750 x 1.625	0.650	0.78	0.384
270	604D271F075GL6	0.750 x 2.125	0.500	1.00	0.295
390	604D391F075HJ6	0.875 x 1.625	0.370	1.10	0.218
560	604D561F075HL6	0.875 x 2.125	0.290	1.40	0.171
680	604D681F075JL6	1.000 x 2.125	0.230	1.85	0.136
820	604D821F075HP6	0.875 x 2.625	0.200	1.95	0.118
1000	604D102F075HS6	0.875 x 3.125	0.153	2.25	0.090
1500	604D152F075JS6	1.000 x 3.125	0.130	2.95	0.077
1800	604D182F075JT6	1.000 x 3.625	0.100	3.55	0.059

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size D ± 0.031 x L ± 0.062	Max. ESR @ +25°C, 120Hz (Ω)	Max. Ripple Current @ +85°C, 100kHz 20A Load (A)	Max. Impedance @ +25°C, 100kHz (Ω)
100 VOLTS DC WORKING; 125 VOLTS DC SURGE					
150	604D151F100GJ6	0.750 x 1.625	1.000	0.70	0.530
180	604D181F100GL6	0.750 x 2.125	0.765	0.90	0.405
270	604D271F100HJ6	0.875 x 1.625	0.565	0.93	0.300
390	604D391F100HL6	0.875 x 2.125	0.435	1.20	0.230
470	604D471F100JL6	1.000 x 2.215	0.340	1.55	0.180
560	604D561F100HP6	0.875 x 2.625	0.300	1.60	0.159
820	604D821F100JP6	1.000 x 2.625	0.235	2.10	0.125
1000	604D102F100JS6	1.000 x 3.125	0.185	2.65	0.098
1200	604D122F100JT6	1.000 x 3.625	0.150	3.15	0.080
200 VOLTS DC WORKING; 250 VOLTS DC SURGE					
47	604D470F200GJ6	0.750 x 1.625	2.600	0.60	0.780
82	604D820F200GJ6	0.750 x 1.625	1.530	0.75	0.460
120	604D121F200HL6	0.875 x 2.125	1.300	0.95	0.390
180	604D181F200HP6	0.875 x 2.625	0.865	1.25	0.259
220	604D221F200JP6	1.000 x 2.625	0.650	1.67	0.195
270	604D271F200HT6	0.875 x 3.625	0.520	1.90	0.156
390	604D391F200JT6	1.000 x 3.625	0.405	2.50	0.122

TYPICAL CURVE @ +25°C

10,000μF, 10 WVDC



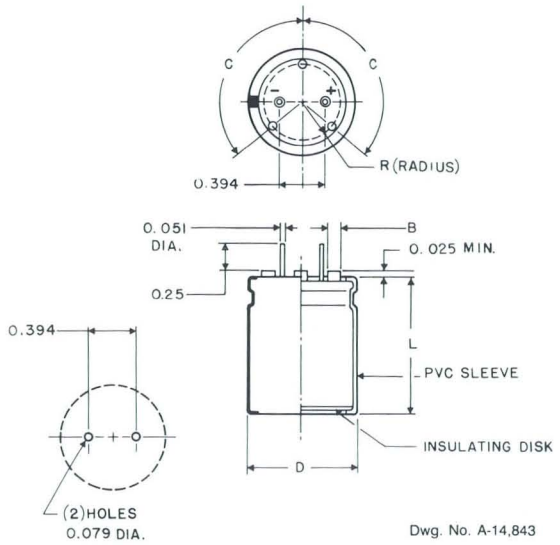
DWG. NO. A-9600

Snap Mount Capacitors

SPRAGUE®

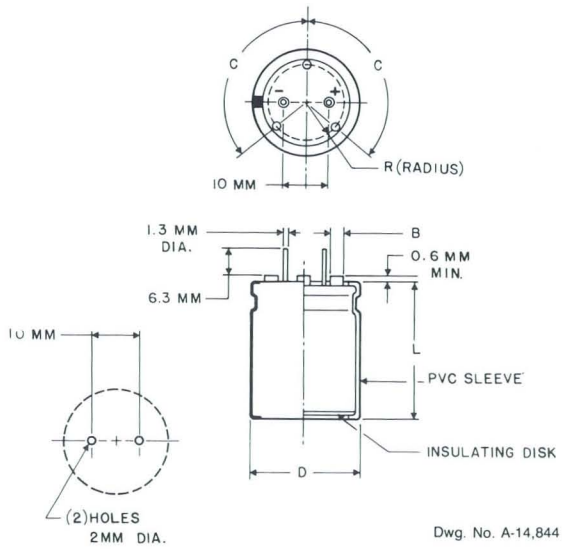
OUTLINE DRAWINGS

STYLE A (INCHES)



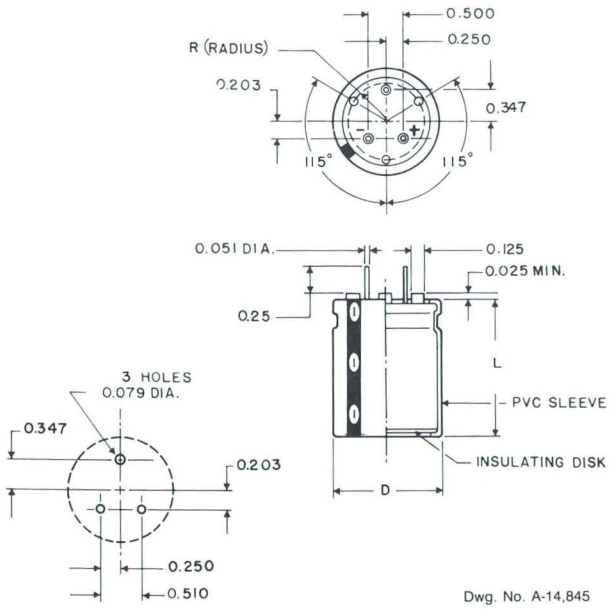
Dwg. No. A-14,843

STYLE A (MILLIMETERS)



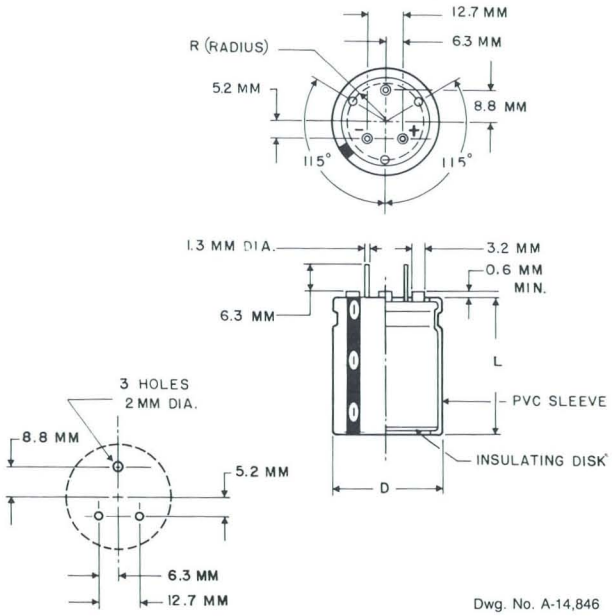
Dwg. No. A-14,844

STYLE B (INCHES)



Dwg. No. A-14,845

STYLE B (MILLIMETERS)



Dwg. No. A-14,846

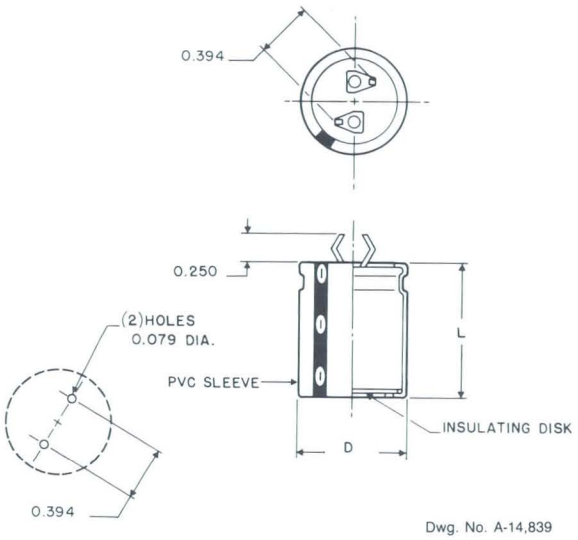
CIRCUIT BOARD MOUNT TERMINAL DIMENSIONS*

DIAMETER			STYLE A DIMENSIONS					STYLE B DIMENSIONS	
D mm	D in.	CODE	B mm	B in.	R mm	R in.	C	R mm	R in.
25	1.00	J	2.4	0.093	7.6	0.301	140	N/A	N/A
30	1.18	K	3.2	0.125	9.2	0.363	120	9.9	0.391
35	1.38	M	3.2	0.125	11.6	0.458	120	11.6	0.458

*Note: Style A & B not available in 22 mm dia. units.

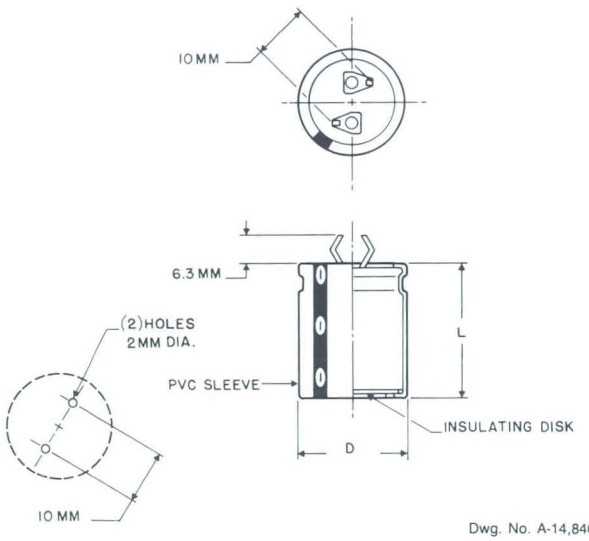
OUTLINE DRAWINGS

STYLE D (INCHES)



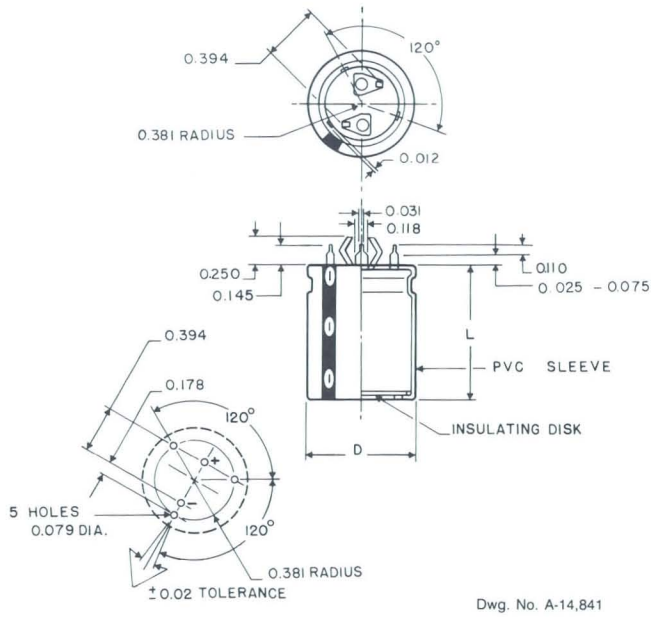
Dwg. No. A-14,839

STYLE D (MILLIMETERS)



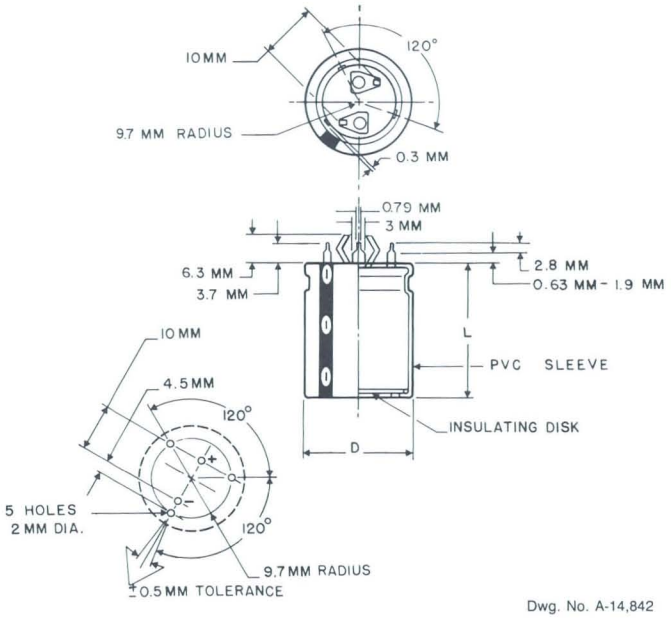
Dwg. No. A-14,840

STYLE N (INCHES)



Dwg. No. A-14,841

STYLE N (MILLIMETERS)



Dwg. No. A-14,842

+85°C Snap Mount Aluminum Capacitors


9911

Features —

- High Ripple Capability
- Molded Cover Available in 2 and 3 Terminal Design With Stand-offs
- Optional Metal Mounting Ring

General Specifications —

Operating Temperature: −40°C - +85°C.

Voltage Range: 6.3 - 250 VDC.

Capacitance Range: 82μF - 56,000μF.

Capacitance Tolerance: −10%, +30%; ±20%.

Case Size Range: 22 x 25mm - 35 x 80mm.

Termination: Snap mount or 2 & 3 terminal straight leads.

Life Validation Test: 2000 hrs @ +85°C:
- Δ CAP ≤ 15% from initial measurement.
- Δ ESR ≤ 1.5x initial specified limit.
- Δ DCL ≤ initial specified limit.

Shelf Test: 500 hrs @ +85°C:
- Δ CAP ≤ 15% from initial measurement.
- Δ ESR ≤ 1.3x initial specified limit.
- Δ DCL ≤ 2x initial specified limit.

DC Leakage Current:
$I = K\sqrt{CV}$
K = 4.0 @ +25°C
I in μa, C in μF, V in Volts

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	+55°C	+65°C	+75°C	+85°C
Multipliers	2.0	1.7	1.4	1.0

FREQUENCY Hz

Rated VDC	50-60	300-1000	Above 1000
0-49	0.85	1.10	1.15
50-199	0.83	1.15	1.20
200-250	0.80	1.30	1.40

ESL (Typical values @ 1MHz-10MHz):

Nominal Diameter (mm)	Typical ESL (nH)
22	6
25	8
30	10
35	12

Expected Life: SEE PAGE 270.

Performance Characteristics: SEE PAGE 266.

Note: Type 80D Original Ratings are recommended for replacement applications only. For new designs, see Types 81D and 82D on pages 181 and 195.

Catalog Numbering System

80D 682 P 6R3 HA 2 D

LEAD CODE. D = 2 PIN SNAP IN (Standard).
A = 2 LEAD MOLDED COVER WITH STANDOFF FEATURE.
B = KEYED POLARITY 3 LEAD MOLDED COVER WITH STANDOFF FEATURE.
N = KEYED POLARITY MOUNTING RING WITH STANDOFF FEATURE.

CASE STYLE. 2 = PVC INSULATING SLEEVE (Standard).
5 = PVC SLEEVE WITH RESIN END SEAL.
(Required for exposure to halogenated cleaning solvents).

CASE CODE. SEE DIMENSIONS, BELOW.

DC VOLTAGE RATING. EXPRESSED IN VOLTS. AN 'R' IS USED TO SIGNIFY A DECIMAL POINT (6R3 = 6.3 VOLTS).

CAPACITANCE TOLERANCE. P = −10, +30%.

CAPACITANCE. EXPRESSED IN MICROFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES. THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

DIMENSIONS

	MILLIMETERS		INCHES	
CASE CODE	DIAMETER D +1/-0	LENGTH L ± 2	DIAMETER D, +0.04/-0	LENGTH L, ±0.08
HA	22	25	0.87	1.00
HB	22	30	0.87	1.18
HD	22	40	0.87	1.57
JA	25	25	1.00	1.00
JB	25	30	1.00	1.18
JC	25	35	1.00	1.38
JD	25	40	1.00	1.57
JE	25	50	1.00	2.00
KA	30	25	1.18	1.00
KB	30	30	1.18	1.18
KC	30	35	1.18	1.38
KD	30	40	1.18	1.57
KE	30	50	1.18	2.00
MB	35	30	1.38	1.18
MC	35	35	1.38	1.38
MD	35	40	1.38	1.57
ME	35	50	1.38	2.00
MF	35	63	1.38	2.50
MG	35	80	1.38	3.18

ORIGINAL RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 10-40kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 10-40kHz
6.3 VOLTS DC WORKING; 8 VOLTS DC SURGE						
6800	80D682P6R3HA2D	22 x 25	108.0	101.0	2.8	3.0
10000	80D103P6R3HB2D	22 x 30	81.0	76.0	3.4	3.6
10000	80D103P6R3JA2D	25 x 25	90.0	85.0	3.1	3.2
12000	80D123P6R3JB2D	25 x 30	68.0	64.0	3.7	3.9
15000	80D153P6R3HD2D	22 x 40	52.0	49.0	4.6	4.9
15000	80D153P6R3KA2D	30 x 25	80.0	76.0	3.2	3.3
18000	80D183P6R3JC2D	25 x 35	55.0	52.0	4.3	4.5
22000	80D223P6R3JD2D	25 x 40	44.0	42.0	5.0	5.2
22000	80D223P6R3KB2D	30 x 30	61.0	58.0	3.9	4.0
27000	80D273P6R3JE2D	25 x 50	35.0	33.0	6.1	6.4
27000	80D273P6R3KC2D	30 x 35	49.0	47.0	4.6	4.7
27000	80D273P6R3MB2D	35 x 30	34.0	32.0	6.4	6.7
33000	80D333P6R3KD2D	30 x 40	40.0	38.0	5.3	5.4
39000	80D473P6R3MC2D	35 x 35	31.0	30.0	6.5	6.6
47000	80D473P6R3KE2D	30 x 50	31.0	30.0	6.5	6.6
47000	80D473P6R3MD2D	35 x 40	22.0	21.0	8.5	8.9
56000	80D563P6R3ME2D	35 x 50	17.0	17.0	10.0	10.0
10 VOLTS DC WORKING; 12 VOLTS DC SURGE						
5600	80D562P010HA2D	22 x 25	111.0	101.0	2.7	3.0
6800	80D682P010HB2D	22 x 30	84.0	76.0	3.3	3.6
8200	80D822P010JA2D	25 x 25	93.0	85.0	3.0	3.2
10000	80D103P010JB2D	25 x 30	70.0	64.0	3.6	3.9
12000	80D123P010HD2D	22 x 40	54.0	49.0	4.4	4.9
12000	80D123P010JC2D	25 x 35	56.0	52.0	4.2	4.5
12000	80D123P010KA2D	30 x 25	82.0	76.0	3.2	3.3
15000	80D153P010JD2D	25 x 40	45.0	42.0	4.9	5.2
15000	80D153P010KB2D	30 x 30	62.0	58.0	3.9	4.0
18000	80D183P010KC2D	30 x 35	50.0	47.0	4.5	4.7
22000	80D223P010JE2D	25 x 50	35.0	33.0	6.0	6.4
22000	80D223P010MB2D	35 x 30	35.0	32.0	6.3	6.7
27000	80D273P010KD2D	30 x 40	40.0	38.0	5.2	5.4
27000	80D273P010MC2D	35 x 35	28.0	26.0	7.3	7.7
33000	80D273P010KE2D	30 x 50	32.0	30.0	6.4	6.6
33000	80D333P010MD2D	35 x 40	23.0	21.0	8.3	8.7
47000	80D473P010ME2D	35 x 50	18.0	17.0	10.0	10.0
16 VOLTS DC WORKING; 20 VOLTS DC SURGE						
3900	80D392P016HA2D	22 x 25	113.0	99.0	2.5	2.8
5600	80D562P016HB2D	22 x 30	85.0	74.0	3.0	3.4
5600	80D562P016JA2D	25 x 25	97.0	86.0	2.7	3.0
8200	80D822P016HD2D	22 x 40	55.0	48.0	4.1	4.7
8200	80D822P016JB2D	25 x 30	73.0	65.0	3.3	3.6
8200	80D822P016KA2D	30 x 25	91.0	84.0	2.8	3.0
10000	80D103P016JC2D	25 x 35	59.0	53.0	3.9	4.2
12000	80D123P016JD2D	25 x 40	47.0	42.0	4.5	4.9
12000	80D123P016KB2D	30 x 30	69.0	63.0	3.5	3.6
15000	80D153P016JE2D	25 x 50	37.0	33.0	5.6	6.0
15000	80D153P016KC2D	30 x 35	55.0	51.0	4.0	4.2
15000	80D153P016MB2D	35 x 30	37.0	33.0	5.7	6.2

ORIGINAL RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 10-40kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 10-40kHz
16 VOLTS DC WORKING; 20 VOLTS DC SURGE (Cont.)						
18000	80D183P016KD2D	30 x 40	45.0	41.0	4.7	4.9
22000	80D223P016KE2D	30 x 50	35.0	32.0	5.8	6.1
22000	80D223P016MC2D	35 x 35	30.0	27.0	6.7	7.2
27000	80D273P016MD2D	35 x 40	24.0	21.0	7.7	8.3
33000	80D333P016ME2D	35 x 50	19.0	17.0	9.4	10.0
25 VOLTS DC WORKING; 30 VOLTS DC SURGE						
2700	80D272P025HA2D	22 x 25	120.0	99.0	2.4	2.8
3300	80D332P025HB2D	22 x 30	90.0	74.0	2.9	3.4
3900	80D392P025JA2D	25 x 25	102.0	86.0	2.6	3.0
4700	80D472P025JB2D	25 x 30	76.0	65.0	3.2	3.6
5600	80D562P025HD2D	22 x 40	58.0	48.0	4.0	4.7
5600	80D562P025JC2D	25 x 35	62.0	53.0	3.7	4.2
5600	80D562P025KA2D	30 x 25	94.0	84.0	2.8	3.0
6800	80D682P025KB2D	30 x 30	71.0	63.0	3.4	3.6
8200	80D822P025JD2D	25 x 40	49.0	42.0	4.4	4.9
10000	80D102P025JE2D	25 x 50	39.0	33.0	5.4	6.0
10000	80D103P025KC2D	30 x 35	57.0	51.0	4.0	4.2
10000	80D103P025MB2D	35 x 30	38.0	33.0	5.5	6.2
12000	80D123P025KD2D	30 x 40	46.0	41.0	4.6	4.9
12000	80D123P025MC2D	35 x 35	31.0	27.0	6.5	7.2
15000	80D153P025KE2D	30 x 50	36.0	32.0	5.7	6.1
15000	80D153P025MD2D	35 x 40	25.0	21.0	7.5	8.3
22000	80D223P025ME2D	35 x 50	19.0	17.0	9.1	10.0
35 VOLTS DC WORKING; 44 VOLTS DC SURGE						
1800	80D182P035HA2D	22 x 25	128.0	99.0	2.2	2.8
2700	80D272P035HB2D	22 x 30	96.0	74.0	2.7	3.4
2700	80D272P035JA2D	25 x 25	108.0	87.0	2.5	3.0
3900	80D392P035HD2D	22 x 40	62.0	48.0	3.7	4.7
3900	80D392P035JB2D	25 x 30	81.0	65.0	3.0	3.6
3900	80D392P035KA2D	30 x 25	98.0	84.0	2.7	3.0
4700	80D472P035JC2D	25 x 35	65.0	53.0	3.6	4.2
5600	80D562P035JD2D	25 x 40	52.0	42.0	4.2	4.9
5600	80D562P035KB2D	30 x 30	74.0	63.0	3.3	3.6
6800	80D682P035JE2D	25 x 50	41.0	33.0	5.2	6.0
6800	80D682P035KC2D	30 x 35	60.0	51.0	3.8	4.2
8200	80D822P035KD2D	30 x 40	48.0	41.0	4.5	4.9
8200	80D822P035MB2D	35 x 30	40.0	33.0	5.3	6.2
10000	80D103P035MC2D	35 x 35	33.0	27.0	6.2	7.2
12000	80D123P035KE2D	30 x 50	37.0	32.0	5.5	6.1
12000	80D123P035MD2D	35 x 40	26.0	22.0	7.2	8.3
15000	80D153P035ME2D	35 x 50	20.0	17.0	8.8	10.0
50 VOLTS DC WORKING; 63 VOLTS DC SURGE						
1200	80D122P050HA2D	22 x 25	144.0	99.0	2.8	2.0
1500	80D152P050HB2D	22 x 30	108.0	74.0	2.4	3.4
1500	80D152P050JA2D	25 x 25	119.0	87.0	2.3	3.0
2200	80D222P050HD2D	22 x 40	69.0	48.0	3.4	4.7
2200	80D222P050JB2D	25 x 30	89.0	65.0	2.8	3.6
2200	80D222P050KA2D	30 x 25	106.0	84.0	2.6	3.0

ORIGINAL RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 10-40kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 10-40kHz
50 VOLTS DC WORKING; 63 VOLTS DC SURGE (Cont)						
2700	80D272P050JC2D	25 x 35	72.0	53.0	3.3	4.2
3300	80D332P050JD2D	25 x 40	57.0	42.0	3.9	4.9
3300	80D332P020KB2D	30 x 30	79.0	63.0	3.1	3.6
3900	80D392P050JE2D	25 x 50	45.0	33.0	4.8	6.0
3900	80D392P050KC2D	30 x 35	64.0	51.0	3.7	4.2
4700	80D472P050KD2D	30 x 40	51.0	41.0	4.3	4.9
4700	80D472P050MB2D	35 x 30	44.0	33.0	4.9	6.2
5600	80D562P050MC2D	35 x 35	36.0	27.0	5.8	7.2
6800	80D682P050KE2D	30 x 50	40.0	32.0	5.3	6.1
6800	80D682P050MD2D	35 x 40	29.0	22.0	6.7	8.3
8200	80D822P050ME2D	35 x 50	22.0	17.0	8.2	10.0
63 VOLTS DC WORKING; 79 VOLTS DC SURGE						
820	80D821P063HA2D	22 x 25	132.0	82.0	2.0	3.0
1200	80D122P063HB2D	22 x 30	99.0	62.0	2.4	3.6
1200	80D122P063JA2D	25 x 25	109.0	72.0	2.3	3.2
1500	80D152P063JB2D	25 x 30	82.0	55.0	2.8	3.8
1800	80D182P063HD2D	22 x 40	63.0	40.0	3.4	4.9
1800	80D182P063JC2D	25 x 35	66.0	45.0	3.3	4.5
1800	80D182P063KA2D	30 x 25	196.0	71.0	2.6	3.2
2200	80D222P063JD2D	25 x 40	53.0	36.0	3.9	5.2
2200	80D222P063KB2D	30 x 30	72.0	54.0	3.2	3.9
2700	80D272P063KC2D	30 x 35	58.0	44.0	3.8	4.5
3300	80D332P063JE2D	25 x 50	41.0	28.0	4.9	6.3
3300	80D332P063MB2D	35 x 30	40.0	28.0	5.0	6.6
3900	80D392P063KD2D	30 x 40	47.0	36.0	4.4	5.2
3900	80D392P063MC2D	35 x 35	33.0	23.0	5.8	7.6
4700	80D472P063KE2D	30 x 50	36.0	28.0	5.4	6.4
5600	80D562P063MD2D	35 x 40	26.0	18.0	6.8	8.7
6800	80D682P063ME2D	35 x 50	21.0	15.0	8.3	10.0
80 VOLTS DC WORKING; 100 VOLTS DC SURGE						
680	80D681P080HA2D	22 x 25	201.0	138.0	1.8	2.7
820	80D821P080HB2D	22 x 30	150.0	103.0	2.2	3.3
820	80D821P080JA2D	25 x 25	158.0	113.0	2.1	2.9
1200	80D122P080JB2D	25 x 30	118.0	85.0	2.6	3.6
1200	80D122P080KA2D	30 x 25	129.0	98.0	2.5	3.1
1500	80D152P080HD2D	22 x 40	95.0	66.0	3.0	4.5
1500	80D152P080JC2D	25 x 35	95.0	68.0	3.0	4.2
1800	80D182P080JD2D	25 x 40	75.0	55.0	3.6	4.8
1800	80D182P080KB2D	30 x 30	96.0	74.0	3.0	3.7
2200	80D222P080KC2D	30 x 35	78.0	60.0	3.5	4.3
2700	80D272P080JE2D	25 x 50	58.0	42.0	4.4	5.9
2700	80D272P080KD2D	30 x 40	62.0	48.0	4.1	5.0
2700	80D272P080MB2D	35 x 30	58.0	42.0	4.6	6.2
3300	80D332P080MC2D	35 x 35	46.0	34.0	5.3	7.1
3900	80D392P080KE2D	30 x 50	48.0	37.0	5.1	6.2
3900	80D392P080MD2D	35 x 40	37.0	27.0	6.2	8.2
5600	80D562P080ME2D	35 x 50	29.0	21.0	7.7	10.0

ORIGINAL RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 10-40kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 10-40kHz
100 VOLTS DC WORKING; 125 VOLTS DC SURGE						
390	80D391P100HA2D	22 x 25	241.0	138.0	1.5	2.7
560	80D561P100HB2D	22 x 30	179.0	103.0	1.8	3.3
560	80D561P100JA2D	25 x 25	187.0	113.0	1.8	2.9
680	80D681P100JB2D	25 x 30	139.0	85.0	2.2	3.5
820	80D821P100HD2D	22 x 40	113.0	66.0	2.6	4.4
820	80D821P100JC2D	25 x 35	112.0	68.0	2.7	4.2
820	80D821P100KA2D	30 x 25	148.0	98.0	2.2	3.1
1000	80D102P100KB2D	30 x 30	111.0	74.0	2.7	3.7
1200	80D122P100JD2D	25 x 40	89.0	55.0	3.1	4.8
1200	80D122P100KC2D	30 x 35	89.0	60.0	3.2	4.3
1500	80D152P100JE2D	25 x 50	68.0	42.0	3.9	5.9
1500	80D152P100MB2D	35 x 30	100.0	74.0	3.0	3.7
1800	80D182P100KD2D	30 x 40	71.0	48.0	3.7	5.0
1800	80D182P100MC2D	35 x 35	80.0	60.0	3.6	4.4
2200	80D222P100KE2D	30 x 50	55.0	37.0	4.7	6.2
2200	80D222P100MD2D	35 x 40	64.0	48.0	4.2	5.1
3300	80D332P100ME2D	35 x 50	50.0	37.0	5.2	6.2
200 VOLTS DC WORKING; 250 VOLTS DC SURGE						
100	80D101P200HA2D	22 x 25	1057.0	505.0	0.75	2.2
120	80D121P200HB2D	22 x 30	782.0	374.0	0.9	2.7
150	80D151P200JA2D	25 x 25	660.0	375.0	1.3	3.2
180	80D181P200JB2D	25 x 30	493.0	284.0	1.5	3.8
220	80D221P200HD2D	22 x 40	488.0	234.0	1.3	3.7
220	80D221P200JC2D	25 x 35	395.0	229.0	1.8	4.4
220	80D221P200KA2D	30 x 25	460.0	272.0	1.7	3.6
270	80D271P200JD2D	25 x 40	312.0	182.0	2.2	5.2
270	80D271P200KB2D	30 x 30	346.0	206.0	2.0	4.3
330	80D331P200KC2D	30 x 35	278.0	165.0	2.4	4.9
390	80D391P200JE2D	25 x 50	239.0	139.0	2.7	6.3
390	80D391P200MB2D	35 x 30	263.0	163.0	2.5	4.5
470	80D471P200MB2D	35 x 30	226.0	135.0	2.5	4.5
470	80D471P200KD2D	30 x 40	220.0	131.0	2.8	5.7
560	80D561P200KE2D	30 x 50	169.0	101.0	3.5	7.0
560	80D561P200MC2D	35 x 35	212.0	132.0	2.9	5.2
680	80D681P200KD2D	30 x 40	248.0	127.0	2.1	4.7
680	80D681P200MD2D	35 x 40	167.0	105.0	3.5	6.1
820	80D821P200ME2D	35 x 50	130.0	82.0	4.3	7.4
1000	80D102P200MD2D	35 x 40	190.0	104.0	2.7	5.0
1000	80D102P200ME2D	35 x 50	144.0	81.0	3.4	6.6
1200	80D122P200ME2D	35 x 50	141.0	75.0	3.4	6.6
250 VOLTS DC WORKING; 300 VOLTS DC SURGE						
82	80D820P250HA2D	22 x 25	1163.0	556.0	0.7	2.2
100	80D101P250JA2D	25 x 25	720.0	377.0	1.1	3.2
120	80D121P250HB2D	22 x 30	861.0	412.0	0.85	2.7
150	80D151P250JB2D	25 x 30	541.0	284.0	1.4	3.8
150	80D151P250KA2D	30 x 25	504.0	272.0	1.5	3.6
180	80D181P250HD2D	22 x 40	537.0	258.0	1.2	3.7
180	80D181P250JC2D	25 x 35	435.0	229.0	1.7	4.4

ORIGINAL RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 10-40kHz	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 10-40kHz
250 VOLTS DC WORKING; 300 VOLTS DC SURGE (Cont.)						
220	80D221P250JD2D	25 x 40	343.0	182.0	2.0	5.2
220	80D221P250KB2D	30 x 30	380.0	206.0	1.9	4.3
270	80D271P250KC2D	30 x 35	305.0	166.0	2.2	4.9
330	80D331P250JE2D	25 x 50	263.0	140.0	2.5	6.3
330	80D331P250KD2D	30 x 40	241.0	131.0	2.6	5.7
330	80D331P250MB2D	35 x 30	287.0	163.0	2.3	4.5
390	80D391P250MC2D	35 x 35	231.0	132.0	2.7	5.2
470	80D471P250KE2D	30 x 50	185.0	101.0	3.2	7.0
470	80D471P250MD2D	35 x 40	183.0	101.0	3.2	6.1
680	80D681P250ME2D	35 x 50	191.0	81.0	4.0	7.4

+105°C Snap Mount Aluminum Capacitors

9862

Features —

- **Operating Temperature to +105°C**
- **High Ripple Current Capability**
- **Low ESR**

General Specifications —

Operating Temperature:
−40°C - +105°C.

Voltage Range: 6.3 - 400 VDC.

Capacitance Range: 47μF - 180,000μF.

Capacitance Tolerance: ±20%.

Case Size Range: 22 x 25mm - 35 x 80mm.

Termination: Snap mount.

Life Validation Test: 2000 hrs @ +105°C:
Δ CAP ≤ 15% from initial measurement.
Δ ESR ≤ 1.5x initial specified limit.
Δ DCL ≤ initial specified limit.

Shelf Test: 500 hrs @ +85°C:
Δ CAP ≤ 15% from initial measurement.
Δ ESR ≤ 1.3x initial specified limit.
Δ DCL ≤ 2x initial specified limit.

DC Leakage Current:
$I = K\sqrt{CV}$
K = 4.0 @ +25°C
I in μa, C in μF, V in Volts

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	+55°C	+65°C	+75°C	+85°C	+95°C	+105°C
Multipliers	1.6	1.4	1.2	1.0	.70	.50

FREQUENCY Hz

Rated VDC	50-60	300-1000	Above 1000
0-49	0.85	1.10	1.15
50-199	0.83	1.15	1.20
200-250	0.80	1.30	1.40

ESL (Typical values @ 1MHz-10MHz):

Nominal Diameter (mm)	Typical ESL (nH)
22	6
25	8
30	10
35	12

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

81D 822 M 6R3 HA 2 D

LEAD CODE. D = 2 PIN SNAP IN (Standard).
A = 2 LEAD MOLDED COVER WITH STANDOFF FEATURE.
B = KEYED POLARITY 3 LEAD MOLDED COVER WITH STANDOFF FEATURE.
N = KEYED POLARITY MOUNTING RING WITH STANDOFF FEATURE.

CASE STYLE. 2 = PVC INSULATING SLEEVE (Standard).
5 = PVC SLEEVE WITH RESIN END SEAL.
(Required for exposure to halogenated cleaning solvents).

CASE CODE. SEE DIMENSIONS, BELOW.

DC VOLTAGE RATING. EXPRESSED IN VOLTS. AN 'R' INDICATES A DECIMAL POINT, E.G., 6R3 = 6.3 VOLTS.

CAPACITANCE TOLERANCE. M = ±20%.

CAPACITANCE. EXPRESSED IN MICROFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

DIMENSIONS

	MILLIMETERS		INCHES	
CASE CODE	DIAMETER D +1/-0	LENGTH L ± 2	DIAMETER D +0.04/-0	LENGTH L ±0.08
HA	22	25	0.87	1.00
HB	22	30	0.87	1.18
HD	22	40	0.87	1.57
JA	25	25	1.00	1.00
JB	25	30	1.00	1.18
JC	25	35	1.00	1.38
JD	25	40	1.00	1.57
JE	25	50	1.00	2.00
KA	30	25	1.18	1.00
KB	30	30	1.18	1.18
KC	30	35	1.18	1.38
KD	30	40	1.18	1.57
KE	30	50	1.18	2.00
MB	35	30	1.38	1.18
MC	35	35	1.38	1.38
MD	35	40	1.38	1.57
ME	35	50	1.38	2.00
MF	35	63	1.38	2.50
MG	35	80	1.38	3.18

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
6.3 VOLTS DC WORKING; 8 VOLTS DC SURGE						
8200	81D822M6R3HA2D	22 x 25	87.0	68.0	3.15	3.57
18000	81D183M6R3HB2D	22 x 30	79.0	61.0	3.49	4.01
27000	81D273M6R3HD2D	22 x 40	52.0	40.0	4.85	5.52
12000	81D123M6R3JA2D	25 x 25	73.0	58.0	3.71	4.20
27000	81D273M6R3JB2D	25 x 30	65.0	50.0	4.21	4.78
33000	81D333M6R3JC2D	25 x 35	52.0	41.0	4.98	6.28
39000	81D393M6R3JD2D	25 x 40	42.0	33.0	6.07	6.85
56000	81D563M6R3JE2D	25 x 50	33.0	26.0	7.19	7.95
18000	81D183M6R3KA2D	30 x 25	66.0	54.0	4.39	4.91
39000	81D393M6R3KB2D	30 x 30	51.0	41.0	5.31	5.94
47000	81D473M6R3KC2D	30 x 35	41.0	33.0	6.25	7.04
68000	81D683M6R3KD2D	30 x 40	33.0	27.0	7.38	8.16
82000	81D823M6R3KE2D	30 x 50	27.0	21.0	8.89	10.00
56000	81D563M6R3MB2D	35 x 30	31.0	25.0	7.60	8.45
68000	81D683M6R3MC2D	35 x 35	26.0	20.0	8.66	9.81
82000	81D823M6R3MD2D	35 x 40	21.0	16.3	10.20	11.50
100000	81D104M6R3ME2D	35 x 50	17.0	13.5	12.20	13.60
150000	81D154M6R3MF2D	35 x 63	13.3	10.6	15.30	16.10
180000	81D184M6R3MG2D	35 x 80	11.0	9.0	18.10	20.10
7.5 VOLTS DC WORKING; 9 VOLTS DC SURGE						
8200	81D822M7R5HA2D	22 x 25	88.0	68.0	3.14	3.56
18000	81D183M7R5HB2D	22 x 30	79.0	61.0	3.52	4.01
27000	81D273M7R5HD2D	22 x 40	52.0	40.0	4.85	5.53
10000	81D103M7R5JA2D	25 x 25	75.0	58.0	3.67	4.20
22000	81D223M7R5JB2D	25 x 30	66.0	51.0	4.21	4.78
27000	81D273M7R5JC2D	25 x 35	52.0	40.0	4.98	5.67
33000	81D333M7R5JD2D	25 x 40	42.0	33.0	6.07	6.85
47000	81D473M7R5JE2D	25 x 50	33.0	26.0	7.19	8.18
18000	81D183M7R5KA2D	30 x 25	66.0	54.0	4.44	4.91
33000	81D333M7R5KB2D	30 x 30	52.0	40.0	5.31	6.05
47000	81D473M7R5KC2D	30 x 35	42.0	33.0	6.26	7.05
56000	81D563M7R5KD2D	30 x 40	33.8	27.0	7.38	8.16
68000	81D683M7R5KE2D	30 x 50	26.8	21.0	8.89	10.00
47000	81D473M7R5MB2D	35 x 30	32.0	25.0	7.43	8.45
56000	81D563M7R5MC2D	35 x 35	26.0	20.0	8.75	9.96
68000	81D683M7R5MD2D	35 x 40	21.0	16.4	10.10	11.50
100000	81D104M7R5ME2D	35 x 50	17.0	13.0	12.10	13.90
120000	81D124M7R5MF2D	35 x 63	14.0	11.0	15.00	16.90
180000	81D184M7R5MG2D	35 x 80	11.0	9.0	18.10	19.90
10 VOLTS DC WORKING; 12 VOLTS DC SURGE						
6800	81D682M010HA2D	22 x 25	92.0	70.0	3.07	3.52
12000	81D123M010HB2D	22 x 30	85.0	64.0	3.40	3.91
22000	81D223M010HD2D	22 x 40	54.0	41.0	4.78	5.52
10000	81D103M010JA2D	25 x 25	74.0	57.0	3.71	4.26
18000	81D183M010JB2D	25 x 30	67.0	51.0	4.16	4.78
22000	81D223M010JC2D	25 x 35	55.0	42.0	4.84	5.05
27000	81D273M010JD2D	25 x 40	44.4	34.0	5.87	6.70
39000	81D393M010JE2D	25 x 50	34.6	26.0	7.04	8.18

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
10 VOLTS DC WORKING; 12 VOLTS DC SURGE (Cont.)						
15000	81D153M010KA2D	30 x 25	67.0	54.0	4.39	4.91
27000	81D273M010KB2D	30 x 30	53.0	41.0	5.24	5.94
39000	81D393M010KC2D	30 x 35	43.0	34.0	6.14	6.89
47000	81D473M010KD2D	30 x 40	34.7	27.0	7.22	8.16
56000	81D563M010KE2D	30 x 50	27.7	21.0	8.89	10.00
39000	81D393M010MB2D	35 x 30	33.0	26.0	7.36	8.28
47000	81D473M010MC2D	35 x 35	27.0	21.0	8.56	9.71
56000	81D563M010MD2D	35 x 40	22.0	17.0	9.89	11.20
82000	81D823M010ME2D	35 x 50	17.1	13.4	12.10	13.70
100000	81D104M010MF2D	35 x 63	14.1	11.0	14.90	16.90
150000	81D154M010MG2D	35 x 80	11.1	9.0	18.10	19.90
12 VOLTS DC WORKING; 14 VOLTS DC SURGE						
6800	81D682M012HA2D	22 x 25	92.0	70.0	3.07	3.52
12000	81D123M012HB2D	22 x 30	89.0	67.0	3.31	3.82
18000	81D183M012HD2D	22 x 40	56.0	42.0	4.65	5.42
10000	81D103M012JA2D	25 x 25	75.0	57.0	3.67	4.26
18000	81D183M012JB2D	25 x 30	68.0	51.0	4.11	4.78
22000	81D223M012JC2D	25 x 35	54.8	42.0	4.84	5.57
27000	81D273M012JD2D	25 x 40	44.5	34.0	5.87	6.70
33000	81D333M012JE2D	25 x 50	34.9	26.0	6.93	7.95
12000	81D123M012KA2D	30 x 25	72.0	54.0	4.21	4.91
27000	81D273M012KB2D	30 x 30	53.0	41.0	5.24	5.94
33000	81D333M012KC2D	30 x 35	42.9	33.0	6.14	7.05
39000	81D393M012KD2D	30 x 40	35.0	27.0	7.10	8.16
56000	81D563M012KE2D	30 x 50	27.7	22.0	8.70	9.74
33000	81D333M012MB2D	35 x 30	33.0	25.0	7.36	8.45
47000	81D473M012MC2D	35 x 35	27.0	21.0	8.56	9.71
56000	81D563M012MD2D	35 x 40	22.0	17.0	9.89	11.20
68000	81D683M012ME2D	35 x 50	17.2	13.3	12.10	13.80
100000	81D104M012MF2D	35 x 63	13.7	11.0	15.10	16.90
120000	81D124M012MG2D	35 x 80	11.3	9.0	17.90	19.90
16 VOLTS DC WORKING; 20 VOLTS DC SURGE						
5600	81D562M016HA2D	22 x 25	96.0	71.0	2.12	2.46
10000	81D103M016HB2D	22 x 30	86.0	63.0	3.37	3.96
15000	81D153M016HD2D	22 x 40	57.7	42.0	4.59	5.42
8200	81D822M016JA2D	25 x 25	77.0	58.0	3.64	4.21
12000	81D123M016JB2D	25 x 30	71.0	53.0	4.03	4.65
15000	81D153M016JC2D	25 x 35	58.0	43.0	4.72	5.47
22000	81D223M016JD2D	25 x 40	44.8	33.0	5.87	6.85
27000	81D273M016JE2D	25 x 50	35.0	26.0	6.92	8.04
12000	81D123M016KA2D	30 x 25	67.7	54.0	4.34	4.91
22000	81D223M016KB2D	30 x 30	53.7	41.0	5.24	5.94
27000	81D273M016KC2D	30 x 35	43.8	33.0	6.04	7.05
33000	81D333M016KD2D	30 x 40	35.3	27.0	7.07	8.16
39000	81D393M016KE2D	30 x 50	28.0	21.8	8.66	9.74
27000	81D273M016MB2D	35 x 30	35.0	26.0	7.14	8.28
33000	81D333M016MC2D	35 x 35	28.0	21.0	8.42	9.71
47000	81D473M016MD2D	35 x 40	23.0	17.0	9.70	11.20
56000	81D563M016ME2D	35 x 50	17.5	13.3	12.00	13.80
68000	81D683M016MF2D	35 x 63	15.2	11.0	14.40	16.90
100000	81D104M016MG2D	35 x 80	11.2	9.0	18.00	19.90

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
25 VOLTS DC WORKING; 30 VOLTS DC SURGE						
3300	81D332M025HA2D	22 x 25	110.0	76.0	2.81	3.38
4700	81D472M025HB2D	22 x 30	85.0	58.0	3.40	4.11
8200	81D822M025HD2D	22 x 40	54.0	37.0	4.78	5.74
4700	81D472M025JA2D	25 x 25	86.0	60.0	3.44	4.15
6800	81D682M025JB2D	25 x 30	67.0	47.0	4.16	4.93
8200	81D822M025JC2D	25 x 35	54.0	38.0	4.91	5.78
10000	81D103M025JD2D	25 x 40	43.4	31.0	5.97	7.02
15000	81D153M025JE2D	25 x 50	33.9	24.0	7.04	8.44
6800	81D682M025KA2D	30 x 25	71.0	54.0	4.25	4.91
10000	81D103M025KB2D	30 x 30	54.0	41.0	5.24	5.94
12000	81D123M025KC2D	30 x 35	44.0	33.0	6.04	7.05
15000	81D153M025KD2D	30 x 40	36.4	27.0	7.07	8.16
22000	81D223M025KE2D	30 x 50	28.1	22.0	8.66	9.74
12000	81D123M025MB2D	35 x 30	35.0	25.0	7.14	8.45
18000	81D183M025MC2D	35 x 35	28.0	20.0	8.13	9.96
22000	81D183M025MD2D	35 x 40	23.0	17.0	9.41	11.20
27000	81D223M025ME2D	35 x 50	17.5	13.0	12.00	13.90
33000	81D333M025MF2D	35 x 63	14.0	10.0	15.00	17.70
47000	81D473M025MG2D	35 x 80	11.2	9.0	18.00	19.90
35 VOLTS DC WORKING; 40 VOLTS DC SURGE						
2200	81D222M035HA2D	22 x 25	121.0	76.0	2.67	3.38
3300	81D332M035HB2D	22 x 30	92.0	57.0	3.26	4.16
4700	81D472M035HD2D	22 x 40	59.0	37.0	4.54	5.74
3300	81D332M035JA2D	25 x 25	95.0	62.0	3.28	4.05
4700	81D472M035JB2D	25 x 30	72.0	47.0	3.98	4.93
5600	81D562M035JC2D	25 x 35	58.0	38.0	4.72	5.78
6800	81D682M035JD2D	25 x 40	46.6	30.0	5.77	7.19
10000	81D103M035JE2D	25 x 50	36.3	24.0	6.89	8.44
4700	81D472M035KA2D	30 x 25	75.0	54.0	4.13	4.84
6800	81D682M035KB2D	30 x 30	57.0	41.0	5.10	5.94
8200	81D822M035KC2D	30 x 35	46.6	33.0	5.94	7.05
12000	81D123M035KD2D	30 x 40	37.7	27.0	6.92	8.16
15000	81D153M035KE2D	30 x 50	30.5	22.0	8.44	9.74
10000	81D103M035MB2D	35 x 30	36.0	24.0	7.04	8.63
12000	81D123M035MC2D	35 x 35	29.3	20.0	5.82	9.45
15000	81D153M035MD2D	35 x 40	25.0	16.3	9.29	11.50
18000	81D183M035ME2D	35 x 50	19.0	13.0	11.50	13.90
27000	81D273M035MF2D	35 x 63	15.0	10.0	14.50	17.70
33000	81D333M035MG2D	35 x 80	12.0	9.0	17.30	19.90
40 VOLTS DC WORKING; 50 VOLTS DC SURGE						
1800	81D182M040HA2D	22 x 25	130.0	77.0	2.57	3.35
2700	81D272M040HB2D	22 x 30	99.0	59.0	3.13	4.06
4700	81D472M040HD2D	22 x 40	63.0	38.0	4.32	5.63
2700	81D272M040JA2D	25 x 25	101.0	62.0	3.18	4.05
3900	81D392M040JB2D	25 x 30	76.0	47.0	3.91	4.93
4700	81D472M040JC2D	25 x 35	62.0	39.0	4.55	5.78
5600	81D562M040JD2D	25 x 40	49.0	31.0	5.60	7.02
8200	81D822M040JE2D	25 x 50	38.6	24.0	6.62	8.44

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
40 VOLTS DC WORKING; 50 VOLTS DC SURGE (Cont.)						
3900	81D392M040KA2D	30 x 25	79.0	54.0	4.05	4.91
5600	81D562M040KB2D	30 x 30	60.0	41.0	4.97	5.94
6800	81D682M040KC2D	30 x 35	49.0	33.0	5.76	7.05
10000	81D103M040KD2D	30 x 40	39.4	27.0	6.66	8.16
12000	81D123M040KE2D	30 x 50	31.1	22.0	8.23	9.74
8200	81D822M040MB2D	35 x 30	39.0	24.0	6.47	8.63
10000	81D103M040MC2D	35 x 35	31.0	20.0	8.01	9.96
12000	81D123M040MD2D	35 x 40	25.0	16.0	9.29	11.60
15000	81D153M040ME2D	35 x 50	21.0	13.0	10.90	13.90
22000	81D223M040MF2D	35 x 63	16.0	10.6	14.00	17.20
27000	81D273M040MG2D	35 x 80	13.0	9.0	16.70	19.90
50 VOLTS DC WORKING; 63 VOLTS DC SURGE						
1200	81D122M050HA2D	22 x 25	148.0	79.0	2.41	3.29
1800	81D182M050HB2D	22 x 30	108.0	58.0	3.00	4.11
2700	81D272M050HD2D	22 x 40	70.0	38.0	4.18	5.63
1800	81D182M050JA2D	25 x 25	110.0	62.0	3.05	4.05
2200	81D222M050JB2D	25 x 30	85.0	48.0	3.69	4.93
2700	81D272M050JC2D	25 x 35	68.0	38.0	4.34	5.89
3900	81D392M050JD2D	25 x 40	53.6	31.0	5.36	7.02
4700	81D472M050JE2D	25 x 50	42.0	24.0	6.38	8.44
2700	81D272M050KA2D	30 x 25	85.0	54.0	3.87	4.84
3900	81D392M050KB2D	30 x 30	65.0	41.0	4.74	5.94
4700	81D472M050KC2D	30 x 35	53.0	33.0	5.51	7.05
5600	81D562M050KD2D	30 x 40	42.4	27.7	6.43	7.94
6800	81D682M050KE2D	30 x 50	33.0	22.0	8.04	9.74
4700	81D472M050MB2D	35 x 30	43.0	24.0	6.45	8.63
5600	81D562M050MC2D	35 x 35	34.0	20.0	7.64	9.96
6800	81D682M050MD2D	35 x 40	28.0	16.0	8.79	11.61
10000	81D103M050ME2D	35 x 50	22.0	13.0	10.76	13.97
12000	81D123M050MF2D	35 x 63	17.3	10.5	13.48	17.33
18000	81D183M050MG2D	35 x 80	14.0	9.0	16.14	19.98
63 VOLTS DC WORKING; 79 VOLTS DC SURGE						
1000	81D102M063HA2D	22 x 25	151.0	75.0	2.39	3.39
1500	81D152M063HB2D	22 x 30	118.0	59.0	2.87	4.06
2200	81D222M063HD2D	22 x 40	74.0	38.0	4.06	5.63
1500	81D152M063JA2D	25 x 25	121.0	63.0	2.90	4.05
1800	81D182M063JB2D	25 x 30	88.0	46.0	3.61	5.02
2200	81D222M063JC2D	25 x 35	72.0	38.0	4.21	5.78
3300	81D332M063JD2D	25 x 40	57.0	30.0	5.22	7.19
3900	81D392M063JE2D	25 x 50	44.0	24.0	6.16	8.44
2200	81D222M063KA2D	30 x 25	90.0	54.0	3.78	4.85
2700	81D272M063KB2D	30 x 30	73.0	41.0	4.45	5.95
3900	81D392M063KC2D	30 x 35	55.0	33.0	5.44	7.05
4700	81D472M063KD2D	30 x 40	44.0	27.0	6.32	8.16
5600	81D562M063KE2D	30 x 50	37.0	22.0	7.55	9.75
3900	81D392M063MB2D	35 x 30	45.0	24.0	6.26	8.50
4700	81D472M063MC2D	35 x 35	36.0	20.0	7.42	9.96
5600	81D562M063MD2D	35 x 40	32.0	16.0	8.29	11.60
8200	81D822M063ME2D	35 x 50	23.0	13.0	10.52	13.97
10000	81D103M063MF2D	35 x 63	18.4	10.4	13.10	17.42
15000	81D153M063MG2D	35 x 80	14.1	9.0	18.05	19.98

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
75 VOLTS DC WORKING; 90 VOLTS DC SURGE						
680	81D681M075HA2D	22 x 25	261.0	151.0	1.82	2.34
1000	81D102M075HB2D	22 x 30	194.0	113.0	2.24	2.95
1500	81D152M075HD2D	22 x 40	130.0	76.0	3.06	4.02
1000	81D102M075JA2D	25 x 25	194.0	114.0	2.29	2.96
1500	81D152M075JB2D	25 x 30	147.0	87.0	2.79	3.64
1800	81D182M075JC2D	25 x 35	119.0	71.0	3.28	4.26
2200	81D222M075JD2D	25 x 40	92.0	55.0	4.09	5.29
2700	81D272M075JE2D	25 x 50	72.0	43.0	4.55	6.27
1500	81D152M075KA2D	30 x 25	145.0	89.0	2.98	3.81
2200	81D222M075KB2D	30 x 30	106.0	66.0	3.71	4.74
2700	81D272M075KC2D	30 x 35	85.0	53.0	4.31	5.52
3300	81D332M075KD2D	30 x 40	67.0	42.0	5.16	6.55
3900	81D392M075KE2D	30 x 50	56.0	33.0	6.12	8.05
2700	81D272M075MB2D	35 x 30	75.0	44.0	4.88	6.36
3300	81D332M075MC2D	35 x 35	59.0	35.0	5.81	7.53
3900	81D392M075MD2D	35 x 40	47.0	28.0	6.78	8.79
5600	81D562M075ME2D	35 x 50	36.0	22.0	8.39	10.72
6800	81D682M075MF2D	35 x 63	28.0	17.3	10.63	13.48
10000	81D103M075MG2D	35 x 80	22.0	14.0	12.85	16.14
80 VOLTS DC WORKING; 100 VOLTS DC SURGE						
680	81D681M080HA2D	22 x 25	268.0	150.0	1.79	2.39
820	81D821M080HB2D	22 x 30	203.0	114.0	2.19	2.93
1500	81D152M080HD2D	22 x 40	131.0	74.0	3.04	4.06
1000	81D102M080JA2D	25 x 25	200.0	114.0	2.25	2.99
1200	81D122M080JB2D	25 x 30	160.0	91.0	2.69	3.58
1500	81D152M080JC2D	25 x 35	126.0	72.0	3.20	4.26
1800	81D182M080JD2D	25 x 40	99.0	57.0	3.93	5.22
2700	81D272M080JE2D	25 x 50	75.0	44.0	4.73	6.16
1500	81D152M080KA2D	30 x 25	147.0	87.0	2.55	3.84
1800	81D182M080KB2D	30 x 30	109.0	66.0	3.66	4.69
2200	81D222M080KC2D	30 x 35	86.0	52.0	4.35	5.59
2700	81D272M080KD2D	30 x 40	74.0	42.0	4.90	6.55
3900	81D392M080KE2D	30 x 50	54.0	33.0	6.29	8.05
2700	81D272M080MB2D	35 x 30	75.0	44.0	4.88	6.36
3300	81D332M080MC2D	35 x 35	61.0	35.0	5.67	7.50
3900	81D392M080MD2D	35 x 40	48.0	28.0	6.67	8.80
5600	81D562M050ME2D	35 x 50	37.0	22.0	8.29	10.72
6800	81D682M080MF2D	35 x 63	29.0	17.0	10.43	13.60
10000	81D103M080MG2D	35 x 80	23.0	13.5	12.60	16.40
100 VOLTS DC WORKING; 125 VOLTS DC SURGE						
390	81D391M100HA2D	22 x 25	343.0	151.0	1.58	2.39
470	81D471M100HB2D	22 x 30	258.0	114.0	1.94	2.93
820	81D821M100HD2D	22 x 40	161.0	72.0	2.75	4.10
560	81D561M100JA2D	25 x 25	253.0	115.0	2.00	2.97
680	81D681M100JB2D	25 x 30	188.0	86.0	2.48	3.67
820	81D821M100JC2D	25 x 35	150.0	69.0	2.92	4.30
1200	81D122M100JD2D	25 x 40	125.0	57.0	3.49	5.15
1500	81D152M100JE2D	25 x 50	90.0	42.0	4.32	6.38

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
100 VOLTS DC WORKING; 125 VOLTS DC SURGE (Cont.)						
820	81D821M100KA2D	30 x 25	178.0	86.0	2.68	3.87
1000	81D102M100KB2D	30 x 30	136.0	66.0	3.28	4.69
1500	81D152M100KC2D	30 x 35	106.0	52.0	3.90	5.59
1800	81D182M100KD2D	30 x 40	86.0	42.0	4.55	6.55
2200	81D222M100KE2D	30 x 50	66.0	33.0	5.69	8.05
1500	81D152M100MB2D	35 x 30	98.0	44.0	4.26	6.36
1800	81D182M100MC2D	35 x 35	79.0	36.0	5.00	7.35
2200	81D222M100MD2D	35 x 40	61.0	28.0	5.92	8.80
2700	81D272M100ME2D	35 x 50	46.0	22.0	6.74	10.72
3900	81D392M100MF2D	35 x 63	36.0	17.2	9.35	13.54
4700	81D472M100MG2D	35 x 80	28.0	13.5	11.41	16.40
160 VOLTS DC WORKING; 200 VOLTS DC SURGE						
180	81D181M160HA2D	22 x 25	741.0	392.0	1.14	1.57
220	81D221M160HB2D	22 x 30	551.0	291.0	1.41	1.94
390	81D391M160HD2D	22 x 40	344.0	184.0	1.99	2.72
220	81D221M160JA2D	25 x 25	548.0	296.0	1.44	1.96
330	81D331M160JB2D	25 x 30	411.0	221.0	1.77	2.42
390	81D391M160JC2D	25 x 35	326.0	176.0	2.11	2.86
470	81D471M160JD2D	25 x 40	256.0	139.0	2.59	3.51
680	81D681M160JE2D	25 x 50	194.0	107.0	3.12	4.18
390	81D391M160KA2D	30 x 25	374.0	211.0	1.96	2.61
470	81D471M160KB2D	30 x 30	278.0	157.0	2.43	3.22
680	81D681M160KC2D	30 x 35	222.0	128.0	2.85	3.77
820	81D821M160KD2D	30 x 40	175.0	99.0	3.38	4.47
1000	81D102M160KE2D	30 x 50	136.0	77.0	4.16	5.51
680	81D681M160MB2D	35 x 30	221.0	130.0	3.02	3.94
820	81D821M160MC2D	35 x 35	176.0	104.0	3.56	4.62
1200	81D122M160MD2D	35 x 40	139.0	83.0	4.18	5.42
1500	81D152M160ME2D	35 x 50	107.0	64.0	5.15	6.65
1800	81D182M160MF2D	35 x 63	82.0	50.0	5.72	7.31
2700	81D272M160MG2D	35 x 80	62.0	38.0	8.07	10.3
200 VOLTS DC WORKING; 250 VOLTS DC SURGE						
150	81D151M200HA2D	22 x 25	1012.0	361.0	0.982	1.64
220	81D221M200HB2D	22 x 30	594.0	255.0	1.37	2.09
330	81D331M200HD2D	22 x 40	381.0	165.0	1.91	2.91
220	81D221M200JA2D	25 x 25	625.0	272.0	1.37	2.08
270	81D271M200JB2D	25 x 30	525.0	190.0	1.59	2.62
390	81D391M200JC2D	25 x 35	341.0	151.0	2.08	3.12
470	81D471M200JD2D	25 x 40	272.0	120.0	2.49	3.81
560	81D561M200JE2D	25 x 50	205.0	91.0	3.06	4.58
330	81D331M200KA2D	30 x 25	498.0	192.0	1.71	2.77
470	81D471M200KB2D	30 x 30	294.0	136.0	2.39	3.51
560	81D561M200KC2D	30 x 35	279.0	107.0	2.57	4.18
680	81D681M200KD2D	30 x 40	221.0	87.0	3.02	4.83
1000	81D102M200KE2D	30 x 50	142.0	67.0	4.09	5.95
560	81D561M200MB2D	35 x 30	287.0	116.0	2.67	4.19
820	81D821M200MC2D	35 x 35	189.0	93.0	3.47	4.94
1000	81D102M200MD2D	35 x 40	149.0	74.0	4.07	5.78
1200	81D122M200ME2D	35 x 50	116.0	58.0	5.01	7.07
1800	81D182M200MF2D	35 x 63	89.0	45.0	6.37	8.93
2200	81D222M200MG2D	35 x 80	68.0	36.0	7.88	10.70

STANDARD RATINGS

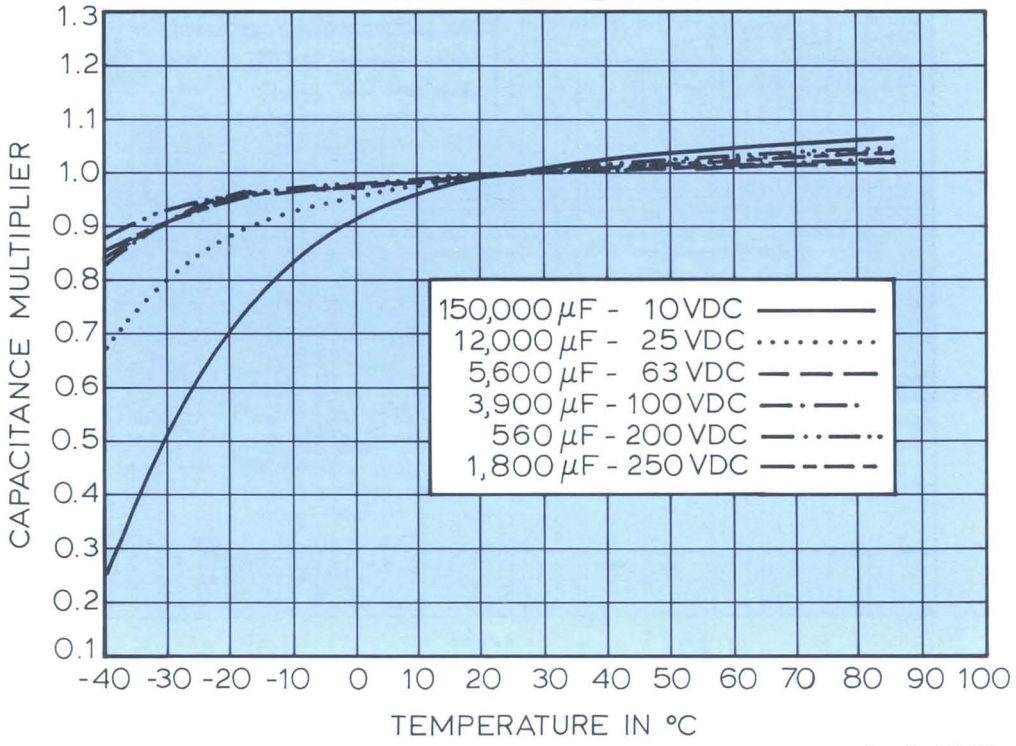
μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
250 VOLTS DC WORKING; 300 VOLTS DC SURGE						
120	81D121M250HA2D	22 x 25	1077.0	385.0	0.96	1.61
180	81D181M250HB2D	22 x 30	722.0	261.0	1.24	2.06
220	81D221M250HD2D	22 x 40	558.0	166.0	1.57	2.89
180	81D181M250JA2D	25 x 25	753.0	275.0	1.25	2.05
220	81D221M250JB2D	25 x 30	513.0	189.0	1.61	2.64
270	81D271M250JC2D	25 x 35	494.0	151.0	1.71	3.12
330	81D331M250JD2D	25 x 40	382.0	121.0	2.12	3.81
470	81D471M250JE2D	25 x 50	243.0	93.0	2.81	4.54
270	81D271M250KA2D	30 x 25	500.0	194.0	1.66	2.75
330	81D331M250KB2D	30 x 30	398.0	135.0	2.04	3.52
390	81D391M250KC2D	30 x 35	328.0	109.0	2.37	4.12
560	81D561M250KD2D	30 x 40	283.0	87.0	3.06	4.83
680	81D681M250KE2D	30 x 50	198.0	67.0	3.47	5.99
470	81D471M250MB2D	35 x 30	281.0	117.0	2.71	4.17
560	81D561M250MC2D	35 x 35	271.0	94.0	2.89	4.89
680	81D681M250MD2D	35 x 40	209.0	74.0	3.44	5.78
1000	81D102M250MD2D	35 x 50	132.0	58.0	4.69	7.07
1200	81D122M250MF2D	35 x 63	108.0	46.0	5.78	8.77
1500	81D152M250MG2D	35 x 80	93.0	35.0	6.69	10.80
300 VOLTS DC WORKING; 350 VOLTS DC SURGE						
68	81D680M300HA2D	22 x 25	3100.0	1800.0	0.475	0.634
100	81D101M300HB2D	22 x 30	2090.0	1210.0	0.622	0.829
120	81D121M300HD2D	22 x 40	1340.0	780.0	0.878	1.146
100	81D101M300JA2D	25 x 25	2180.0	1270.0	0.634	0.817
150	81D151M300JB2D	25 x 30	1490.0	870.0	0.805	1.378
180	81D181M300JC2D	25 x 35	1160.0	680.0	1.183	1.537
220	81D221M300JD2D	25 x 40	900.0	520.0	1.464	1.927
270	81D271M300JE2D	25 x 50	670.0	390.0	1.781	2.33
150	81D151M300KA2D	30 x 25	1530.0	900.0	0.841	1.098
220	81D221M300KB2D	30 x 30	970.0	570.0	1.122	1.464
270	81D271M300KC2D	30 x 35	780.0	460.0	1.317	1.72
330	81D331M300KD2D	30 x 40	600.0	350.0	1.573	2.061
470	81D471M300KE2D	30 x 50	440.0	260.0	2.000	2.61
270	81D271M300MB2D	35 x 30	750.0	450.0	1.415	1.83
330	81D331M300MC2D	35 x 35	590.0	350.0	1.683	2.196
470	81D471M300MD2D	35 x 40	450.0	270.0	2.013	2.598
560	81D561M300ME2D	35 x 50	340.0	200.0	2.513	3.269
820	81D821M300MF2D	35 x 63	250.0	150.0	3.257	4.209
1000	81D102M300MG2D	35 x 80	190.0	110.0	4.758	5.282
350 VOLTS DC WORKING; 400 VOLTS DC SURGE						
56	81D560M350HA2D	22 x 25	5110.0	2710.0	0.463	0.634
82	81D820M350HB2D	22 x 30	3550.0	1890.0	0.597	0.817
120	81D121M350HD2D	22 x 40	1990.0	1060.0	0.866	1.174
82	81D820M350JA2D	25 x 25	3550.0	1890.0	0.597	0.817
120	81D121M350JB2D	25 x 30	2420.0	1290.0	0.768	1.049
150	81D151M350JC2D	25 x 35	1990.0	1060.0	0.927	1.256
180	81D181M350JD2D	25 x 40	1650.0	880.0	1.134	1.549
220	81D221M350JE2D	25 x 50	1110.0	580.0	1.390	1.891

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
350 VOLTS DC WORKING; 400 VOLTS DC SURGE (Cont.)						
120	81D121M350KA2D	30 x 25	2420.0	1290.0	0.829	1.134
180	81D181M350KB2D	30 x 30	1650.0	880.0	1.061	1.427
220	81D221M350KC2D	30 x 35	1320.0	710.0	1.268	1.732
270	81D271M350KD2D	30 x 40	910.0	480.0	1.525	2.061
330	81D331M350KE2D	30 x 50	730.0	390.0	1.915	2.586
220	81D221M350MB2D	35 x 30	1110.0	580.0	1.329	1.793
270	81D271M350MC2D	35 x 35	910.0	480.0	1.598	2.159
330	81D331M350MD2D	35 x 40	730.0	390.0	1.939	2.598
470	81D471M350ME2D	35 x 50	510.0	270.0	2.440	3.269
680	81D681M350MF2D	35 x 63	420.0	220.0	3.135	4.209
820	81D821M350MG2D	35 x 80	290.0	150.0	3.904	5.160
385 VOLTS DC WORKING; 415 VOLTS DC SURGE						
47	81D470M385HA2D	22 x 25	3450.0	1800.0	0.463	0.634
68	81D680M385HB2D	22 x 30	2320.0	1210.0	0.597	0.817
120	81D121M385HD2D	22 x 40	1400.0	730.0	0.854	1.183
68	81D680M385JA2D	25 x 25	2430.0	1280.0	0.597	0.817
100	81D101M385JB2D	25 x 30	1650.0	870.0	0.768	1.049
120	81D121M385JC2D	25 x 35	1340.0	700.0	0.902	1.244
180	81D181M385JD2D	25 x 40	1020.0	540.0	1.122	1.537
220	81D221M385JE2D	25 x 50	780.0	410.0	1.342	1.854
120	81D121M385KA2D	30 x 25	1580.0	830.0	0.829	1.146
150	81D151M385KB2D	30 x 30	1130.0	600.0	1.037	1.427
220	81D221M385KC2D	30 x 35	852.0	450.0	1.268	1.732
270	81D271M385KD2D	30 x 40	670.0	360.0	1.488	2.037
330	81D331M385KE2D	30 x 50	500.0	265.0	1.878	2.586
220	81D221M385MB2D	35 x 30	880.0	460.0	1.305	1.805
270	81D271M385MC2D	35 x 35	660.0	350.0	1.598	2.183
330	81D331M385MD2D	35 x 40	510.0	270.0	1.891	2.598
470	81D471M385ME2D	35 x 50	380.0	200.0	2.379	3.269
560	81D561M385MF2D	35 x 63	288.0	150.0	3.037	4.209
820	81D821M385MG2D	35 x 80	210.0	110.0	3.818	5.282
400 VOLTS DC WORKING; 450 VOLTS DC SURGE						
47	81D470M400HA2D	22 x 25	5110.0	2710.0	0.414	0.549
68	81D680M400HB2D	22 x 30	3550.0	1890.0	0.536	0.707
100	81D101M400HD2D	22 x 40	2420.0	1290.0	0.768	1.012
68	81D680M400JA2D	25 x 25	4230.0	2250.0	0.536	0.707
100	81D101M400JB2D	25 x 30	2920.0	1550.0	0.683	0.902
120	81D121M400JC2D	25 x 35	2420.0	1290.0	0.817	1.085
150	81D151M400JD2D	25 x 40	1650.0	880.0	1.000	1.1329
220	81D221M400JE2D	25 x 50	1320.0	710.0	1.207	1.632
100	81D101M400KA2D	30 x 25	2420.0	1290.0	0.744	0.988
150	81D151M400KB2D	30 x 30	1650.0	880.0	0.927	1.220
180	81D181M400KC2D	30 x 35	1320.0	710.0	1.146	1.500
220	81D221M400KD2D	30 x 40	1110.0	580.0	1.476	1.781
330	81D331M400KE2D	30 x 50	730.0	390.0	1.683	2.244
180	81D181M400MB2D	35 x 30	1320.0	710.0	1.183	1.573
270	81D271M400MC2D	35 x 35	1110.0	580.0	1.415	1.866
330	81D331M400MD2D	35 x 40	730.0	390.0	1.695	2.257
390	81D391M400ME2D	35 x 50	610.0	320.0	2.110	2.818
560	81D561M400MF2D	35 x 63	420.0	220.0	2.757	3.647
820	81D821M400MG2D	35 x 80	350.0	180.0	3.440	4.526

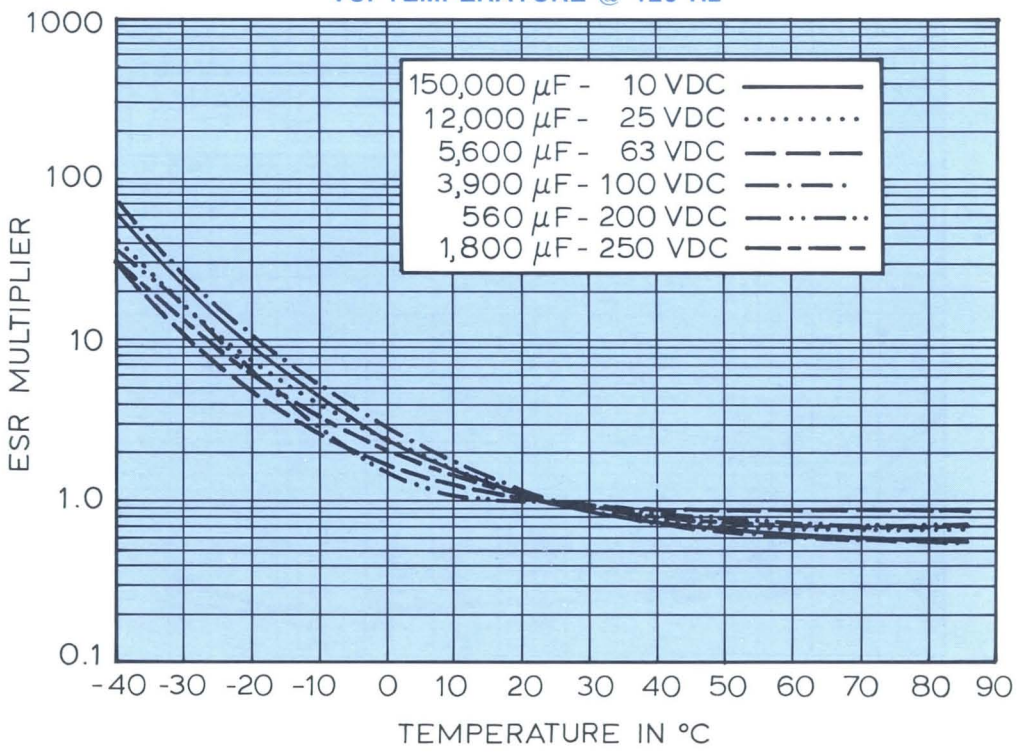
TYPICAL CURVES

TYPE 81D — TYPICAL CAPACITANCE RATIO VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,880

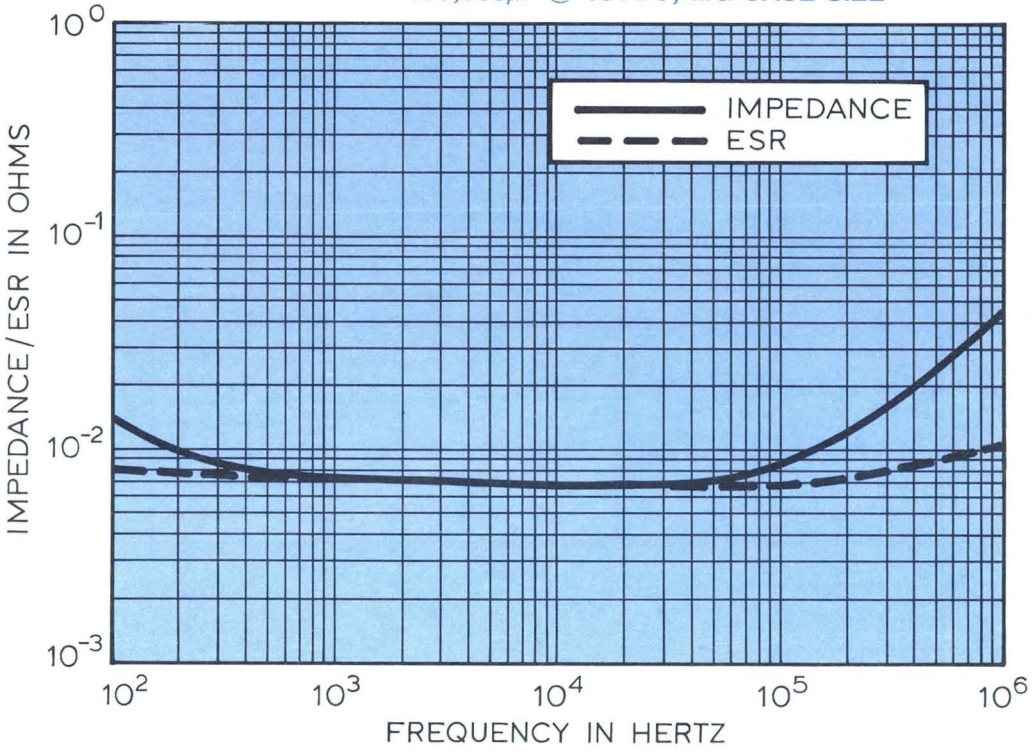
TYPE 81D — TYPICAL ESR MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,718

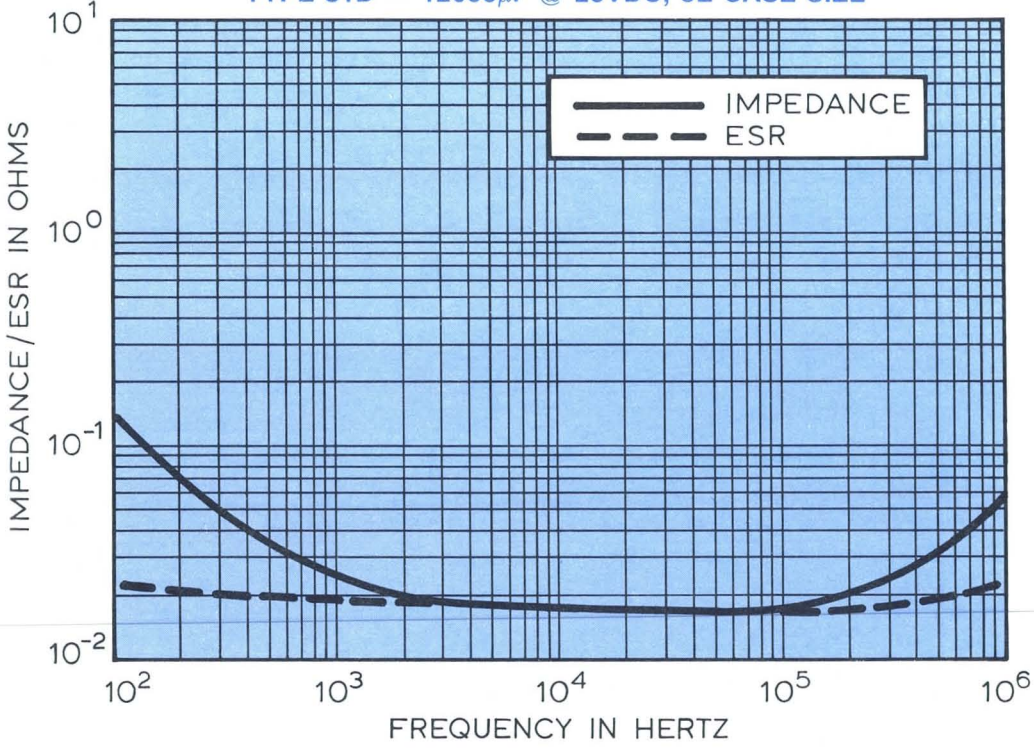
TYPICAL CURVES @ +25°C

TYPE 81D — 150,000μF @ 10VDC, MG CASE SIZE



Dwg. No. A-14,668

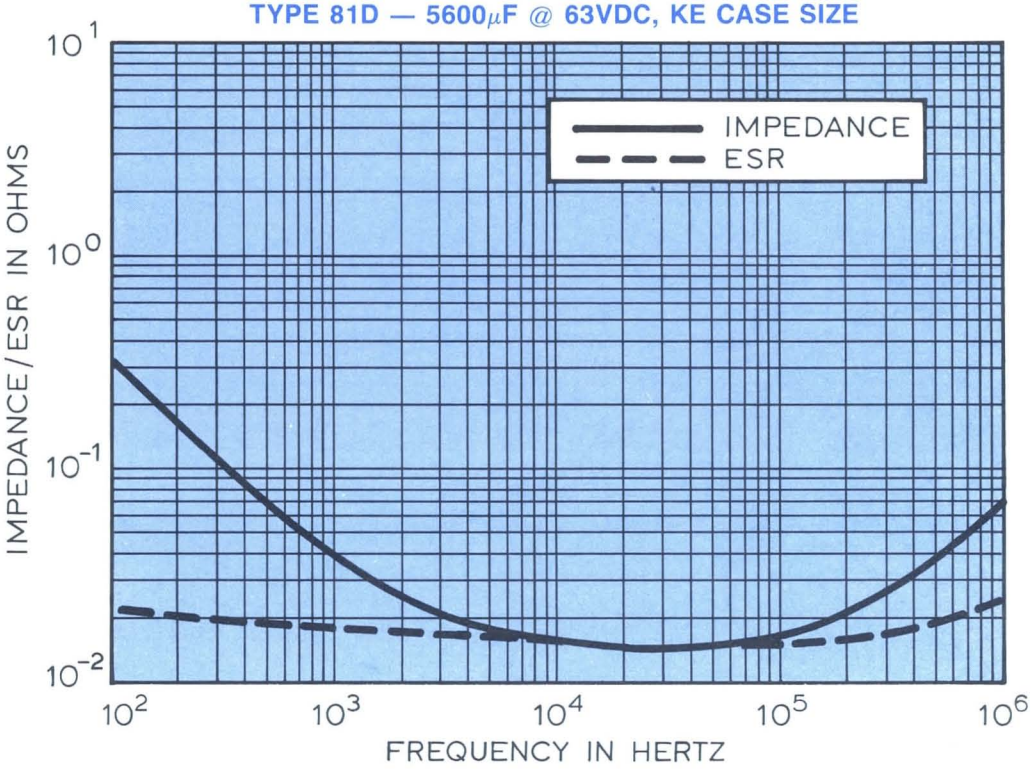
TYPE 81D — 12000μF @ 25VDC, JE CASE SIZE



Dwg. No. A-14,667

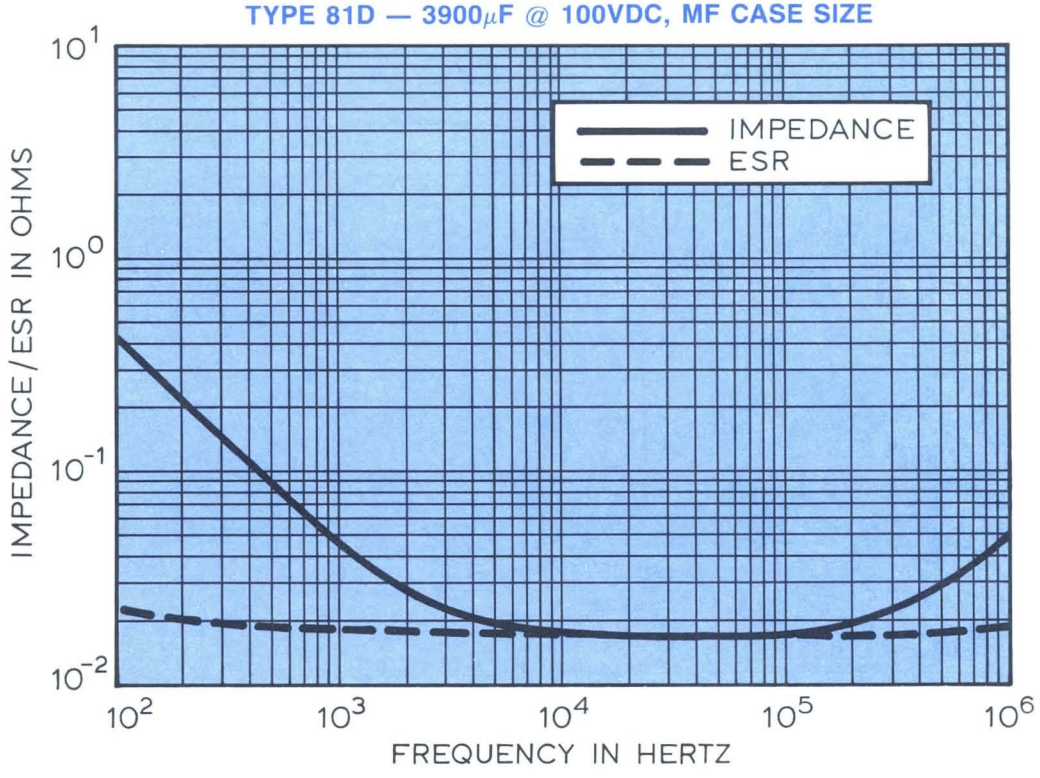
TYPICAL CURVES @ +25°C

TYPE 81D — 5600μF @ 63VDC, KE CASE SIZE



Dwg. No. A-14,666

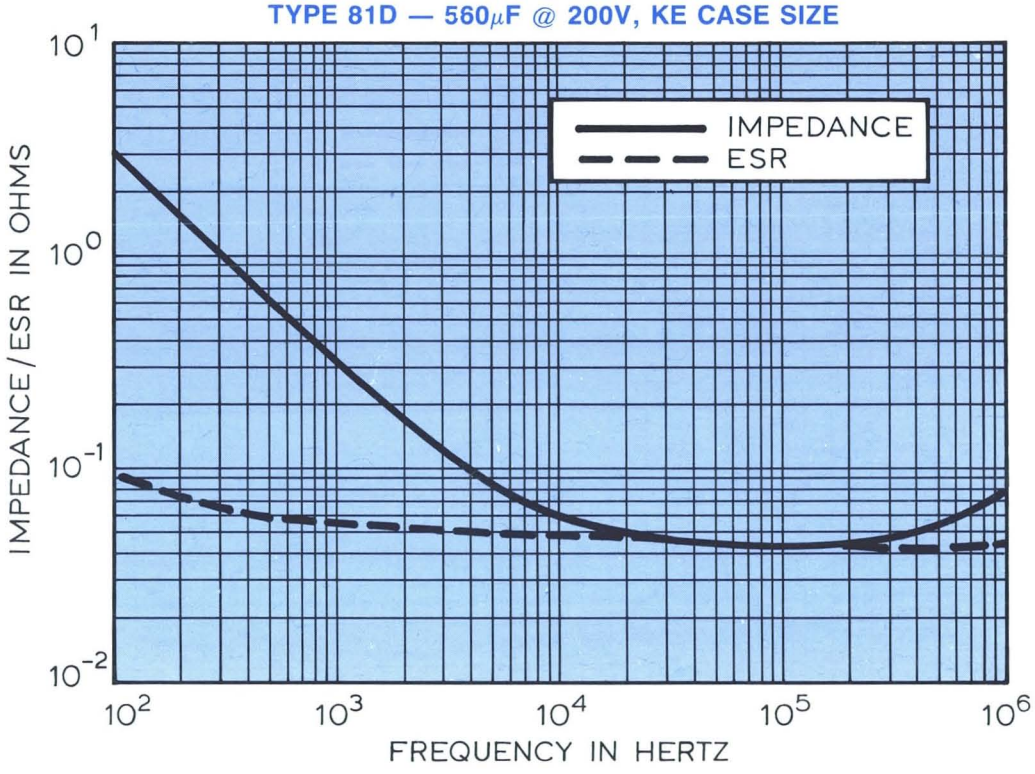
TYPE 81D — 3900μF @ 100VDC, MF CASE SIZE



Dwg. No. A-14,671

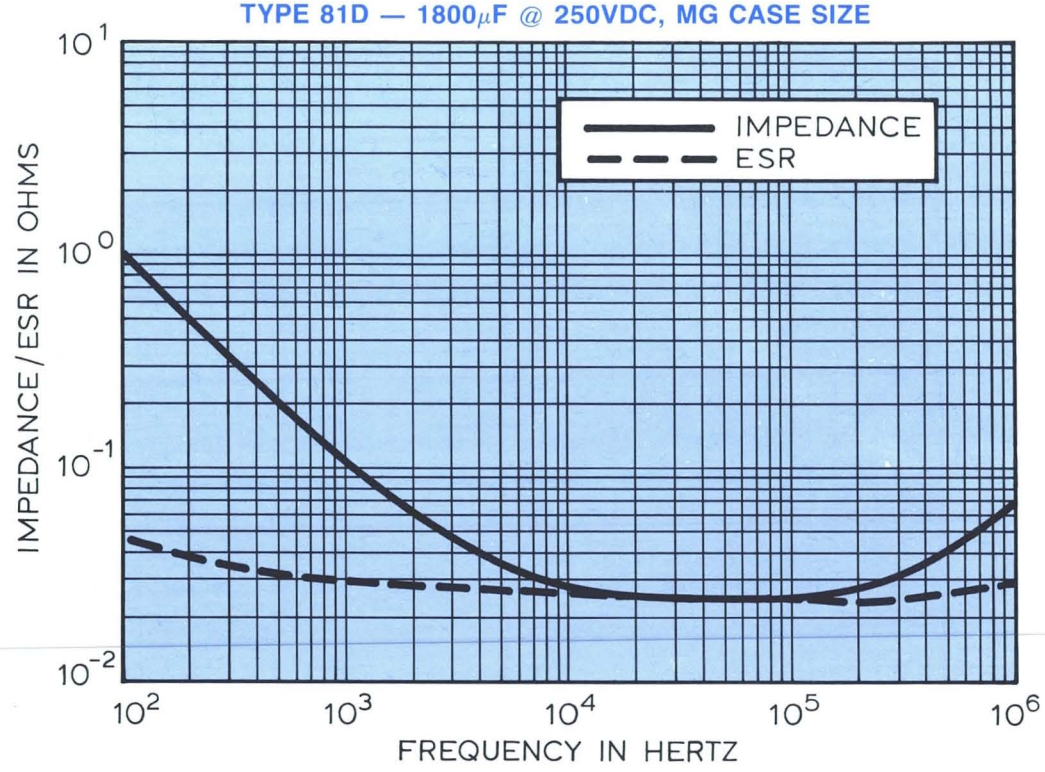
TYPICAL CURVES @ +25°C

TYPE 81D — 560μF @ 200V, KE CASE SIZE



Dwg. No. A-14,670

TYPE 81D — 1800μF @ 250VDC, MG CASE SIZE



Dwg. No. A-14,669

+85°C General Purpose Snap Mount Aluminum Capacitors

9861

Features —

- **Economical**
- **General Purpose Design**
- **Wide Voltage Range**
- **Optional Metal Mounting Ring**
- **Molded Cover Available in 2 or 3 Terminal Design with Standoffs**

General Specifications —

Operating Temperature:
−40°C - +85°C.

Voltage Range: 6.3 - 450 VDC.

Capacitance Range: 39μF - 180,000μF.

Capacitance Tolerance: ±20%.

Case Size Range: 22 x 25mm - 35 x 80mm.

Termination: Snap lock.

Life Validation Test: 2000 hrs @ +85°C:
Δ CAP ≤ 15% from initial measurement.
Δ ESR ≤ 1.5x initial specified limit.
Δ DCL ≤ initial specified limit.

Shelf Test: 500 hrs @ +85°C:
Δ CAP ≤ 15% from initial measurement.
Δ ESR ≤ 1.3x initial specified limit.
Δ DCL ≤ 2x initial specified limit.

DC Leakage Current:
$I = K\sqrt{CV}$
K = 4.0 @ +25°C
I in μa, C in μF, V in Volts

Ripple Current Multipliers:

TEMPERATURE

Ambient Temp.	+55°C	+65°C	+75°C	+85°C
Multipliers	2.0	1.7	1.4	1.0

FREQUENCY (HZ)

Rated VDC	50-60	300-1000	Above 1000
16-49	0.85	1.10	1.15
50-199	0.83	1.15	1.20
200-400	0.80	1.30	1.40

ESL (Typical values @ 1MHz-10MHz):

Nominal Diameter (mm)	Typical ESL (nH)
22	6
25	8
30	10
35	12

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

82D 822 M 6R3 HA 2 D

LEAD CODE. D = 2 PIN SNAP IN (Standard).
A = 2 LEAD MOLDED COVER WITH STANDOFF FEATURE.
B = KEYED POLARITY 3 LEAD MOLDED COVER WITH STANDOFF FEATURE.
N = KEYED POLARITY MOUNTING RING WITH STANDOFF FEATURE.

CASE STYLE. 2 = PVC INSULATING SLEEVE (Standard).
5 = PVC SLEEVE WITH RESIN END SEAL.
(Required for exposure to halogenated cleaning solvents).

CASE CODE. SEE DIMENSIONS.

DC VOLTAGE RATING. EXPRESSED IN VOLTS. AN 'R' INDICATES A DECIMAL POINT. FOR EXAMPLE, 6R3 = 6.3 VOLTS.

CAPACITANCE TOLERANCE. M = ±20%.

CAPACITANCE. EXPRESSED IN MICROFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

DIMENSIONS

CASE CODE	MILLIMETERS DIAMETER D +1/-0	MILLIMETERS LENGTH L ± 2	INCHES DIAMETER D +0.04/-0	INCHES LENGTH L ±0.08
HA	22	25	0.87	1.00
HB	22	30	0.87	1.18
HD	22	40	0.87	1.57
JA	25	25	1.00	1.00
JB	25	30	1.00	1.18
JC	25	35	1.00	1.38
JD	25	40	1.00	1.57
JE	25	50	1.00	2.00
KA	30	25	1.18	1.00
KB	30	30	1.18	1.18
KC	30	35	1.18	1.38
KD	30	40	1.18	1.57
KE	30	50	1.18	2.00
MB	35	30	1.38	1.18
MC	35	35	1.38	1.38
MD	35	40	1.38	1.57
ME	35	50	1.38	2.00
MF	35	63	1.38	2.50
MG	35	80	1.38	3.18

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
6.3 VOLTS DC WORKING; 8 VOLTS DC SURGE						
8200	82D822M6R3HA2D	22 x 25	87.0	68.0	2.23	2.52
18000	82D183M6R3HB2D	22 x 30	79.0	61.0	2.47	2.84
27000	82D273M6R3HD2D	22 x 40	52.0	40.0	3.43	3.90
12000	82D123M6R3JA2D	25 x 25	73.0	58.0	2.62	2.97
27000	82D273M6R3JB2D	25 x 30	65.0	50.0	2.97	3.39
33000	82D333M6R3JC2D	25 x 35	52.0	41.0	3.52	3.94
39000	82D393M6R3JD2D	25 x 40	42.0	33.0	4.29	4.85
56000	82D563M6R3JE2D	25 x 50	33.0	26.0	5.09	5.62
18000	82D183M6R3KA2D	30 x 25	66.0	54.0	3.11	3.48
39000	82D393M6R3KB2D	30 x 30	51.0	41.0	3.76	4.20
47000	82D473M6R3KC2D	30 x 35	41.0	33.0	4.42	4.98
68000	82D683M6R3KD2D	30 x 40	33.0	27.0	5.22	5.77
82000	82D823M6R3KE2D	30 x 50	27.0	21.0	6.29	7.13
56000	82D563M6R3MB2D	35 x 30	31.0	25.0	5.37	5.97
68000	82D683M6R3MC2D	35 x 35	26.0	20.0	6.12	6.94
82000	82D823M6R3MD2D	35 x 40	21.0	16.3	7.24	8.17
100000	82D104M6R3ME2D	35 x 50	17.0	13.5	8.66	9.68
150000	82D154M6R3MF2D	35 x 63	13.3	10.6	10.80	12.20
180000	82D184M6R3MG2D	35 x 80	11.0	9.0	12.80	14.20
7.5 VOLTS DC WORKING; 9 VOLTS DC SURGE						
8200	82D822M7R5HA2D	22 x 25	88.0	68.0	2.22	2.52
18000	82D183M7R5HB2D	22 x 30	79.0	61.0	2.49	2.83
27000	82D273M7R5HD2D	22 x 40	52.0	40.0	3.43	3.90
10000	82D103M7R5JA2D	25 x 25	75.0	58.0	2.60	2.97
22000	82D223M7R5JB2D	25 x 30	66.0	51.0	2.97	3.38
27000	82D273M7R5JC2D	25 x 35	52.0	40.0	3.13	3.57
33000	82D333M7R5JD2D	25 x 40	42.0	33.0	4.29	4.85
47000	82D473M7R5JE2D	25 x 50	33.0	26.0	5.09	5.79
18000	82D183M7R5KA2D	30 x 25	66.0	54.0	3.14	3.47
33000	82D333M7R5KB2D	30 x 30	52.0	40.0	3.76	4.28
47000	82D473M7R5KC2D	30 x 35	42.0	33.0	4.42	4.98
56000	82D563M7R5KD2D	30 x 40	33.8	27.0	5.22	5.77
68000	82D683M7R5KE2D	30 x 50	26.8	21.0	6.29	7.13
47000	82D473M7R5MB2D	35 x 30	32.0	25.0	5.25	5.97
56000	82D563M7R5MC2D	35 x 35	26.0	20.0	6.19	7.04
68000	82D683M7R5MD2D	35 x 40	21.0	16.4	7.16	8.13
100000	82D104M7R5ME2D	35 x 50	17.0	13.0	8.62	9.87
120000	82D124M7R5MF2D	35 x 63	14.0	11.0	10.60	11.90
180000	82D184M7R5MG2D	35 x 80	11.0	9.0	12.80	14.10
10 VOLTS DC WORKING; 12 VOLTS DC SURGE						
6800	82D682M010HA2D	22 x 25	92.0	70.0	2.17	2.49
12000	82D123M010HB2D	22 x 30	85.0	64.0	2.40	2.77
22000	82D223M010HD2D	22 x 40	54.0	41.0	3.38	3.91
10000	82D103M010JA2D	25 x 25	74.0	57.0	2.62	3.01
18000	82D183M010JB2D	25 x 30	67.0	51.0	2.94	3.38
22000	82D223M010JC2D	25 x 35	55.0	42.0	3.42	3.94
27000	82D273M010JD2D	25 x 40	44.4	34.0	4.15	4.74
39000	82D393M010JE2D	25 x 50	34.6	26.0	4.97	5.79

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
10 VOLTS DC WORKING; 12 VOLTS DC SURGE (Cont.)						
15000	82D153M010KA2D	30 x 25	67.0	54.0	3.10	3.47
27000	82D273M010KB2D	30 x 30	53.0	41.0	3.70	4.20
39000	82D393M010KC2D	30 x 35	43.0	34.0	4.34	4.87
47000	82D473M010KD2D	30 x 40	34.7	27.0	5.10	5.77
56000	82D563M010KE2D	30 x 50	27.7	21.0	6.29	7.13
39000	82D393M010MB2D	35 x 30	33.0	26.0	5.21	5.85
47000	82D473M010MC2D	35 x 35	27.0	21.0	6.05	6.87
56000	82D563M010MD2D	35 x 40	22.0	17.0	7.00	7.96
82000	82D823M010ME2D	35 x 50	17.1	13.4	8.62	9.73
100000	82D104M010MF2D	35 x 63	14.1	11.0	10.50	11.90
150000	82D154M010MG2D	35 x 80	11.1	9.0	12.80	14.10
12 VOLTS DC WORKING; 14 VOLTS DC SURGE						
6800	82D682M012HA2D	22 x 25	92.0	70.0	2.17	2.49
12000	82D123M012HB2D	22 x 30	89.0	67.0	2.34	2.70
18000	82D183M012HD2D	22 x 40	56.0	42.0	3.29	3.83
10000	82D103M012JA2D	25 x 25	75.0	57.0	2.60	3.01
18000	82D183M012JB2D	25 x 30	68.0	51.0	2.91	3.38
22000	82D223M012JC2D	25 x 35	54.8	42.0	3.42	3.94
27000	82D273M012JD2D	25 x 40	44.5	34.0	4.15	4.74
33000	82D333M012JE2D	25 x 50	34.9	26.0	4.90	5.62
15000	82D153M012KA2D	30 x 25	67.0	54.0	3.10	3.47
27000	82D273M012KB2D	30 x 30	53.0	41.0	3.71	4.20
33000	82D333M012KC2D	30 x 35	42.9	33.0	4.42	4.98
39000	82D393M012KD2D	30 x 40	35.0	27.0	5.02	5.77
56000	82D563M012KE2D	30 x 50	27.7	22.0	6.15	6.89
33000	82D333M012MB2D	35 x 30	33.0	25.0	5.20	5.97
47000	82D473M012MC2D	35 x 35	27.0	21.0	6.05	6.87
56000	82D563M012MD2D	35 x 40	22.0	17.0	7.00	7.96
68000	82D683M012ME2D	35 x 50	17.2	13.3	8.57	9.78
100000	82D104M012MF2D	35 x 63	13.7	11.0	10.70	11.90
120000	82D124M012MG2D	35 x 80	11.3	9.0	12.60	14.10
16 VOLTS DC WORKING; 20 VOLTS DC SURGE						
5600	82D562M016HA2D	22 x 25	96.0	71.0	2.12	2.46
10000	82D103M016HB2D	22 x 30	86.0	63.0	2.38	2.80
15000	82D153M016HD2D	22 x 40	57.7	42.0	3.25	3.83
8200	82D822M016JA2D	25 x 25	77.0	58.0	2.57	2.97
12000	82D123M016JB2D	25 x 30	71.0	53.0	2.85	3.29
15000	82D153M016JC2D	25 x 35	58.0	43.0	3.33	3.87
22000	82D223M016JD2D	25 x 40	44.8	33.0	4.15	4.85
27000	82D273M016JE2D	25 x 50	35.0	26.0	4.89	5.69
12000	82D123M016KA2D	30 x 25	67.7	54.0	3.07	3.47
22000	82D223M016KB2D	30 x 30	53.7	41.0	3.70	4.20
27000	82D273M016KC2D	30 x 35	43.8	33.0	4.27	4.98
33000	82D333M016KD2D	30 x 40	35.3	27.0	5.00	5.77
39000	82D393M016KE2D	30 x 50	28.0	21.8	6.12	6.89
27000	82D273M016MB2D	35 x 30	35.0	26.0	5.05	5.85
33000	82D333M016MC2D	35 x 35	28.0	21.0	5.96	6.87
47000	82D473M016MD2D	35 x 40	23.0	17.0	6.86	6.65
56000	82D563M016ME2D	35 x 50	17.5	13.3	8.51	9.78
82000	82D823M016MF2D	35 x 63	14.0	11.0	10.60	11.90
100000	82D104M016MG2D	35 x 80	11.2	9.0	12.70	14.10

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
25 VOLTS DC WORKING; 30 VOLTS DC SURGE						
3300	82D332M025HA2D	22 x 25	110.0	76.0	1.98	2.39
4700	82D472M025HB2D	22 x 30	85.0	58.0	2.40	2.91
8200	82D822M025HD2D	22 x 40	54.0	37.0	3.38	4.06
4700	82D472M025JA2D	25 x 25	86.0	60.0	2.43	2.93
6800	82D682M025JA2D	25 x 30	67.0	47.0	2.94	3.49
8200	82D822M025JC2D	25 x 35	54.0	38.0	3.47	4.09
10000	82D103M025JD2D	25 x 40	43.4	31.0	4.22	4.96
15000	82D153M025JE2D	25 x 50	33.9	24.0	4.97	5.96
6800	82D682M025KA2D	30 x 25	71.0	54.0	3.00	3.47
10000	82D103M025KB2D	30 x 30	54.0	41.0	3.70	4.20
12000	82D123M025KC2D	30 x 35	44.0	33.0	4.27	4.98
15000	82D153M025KD2D	30 x 40	36.4	27.0	5.00	5.77
22000	82D223M025KE2D	30 x 50	28.1	22.0	6.12	6.89
12000	82D123M025MB2D	35 x 30	35.0	25.0	5.05	5.97
18000	82D183M025MC2D	35 x 35	28.0	20.0	5.96	7.04
22000	82D223M025MD2D	35 x 40	23.0	17.0	6.84	7.96
27000	82D273M025ME2D	35 x 50	17.5	13.0	8.51	9.87
33000	82D333M025MF2D	35 x 63	14.0	10.0	10.60	12.50
47000	82D473M025MG2D	35 x 80	11.2	9.0	12.70	14.10
35 VOLTS DC WORKING; 40 VOLTS DC SURGE						
2200	82D222M035HA2D	22 x 25	121.0	76.0	1.88	2.39
3300	82D332M035HB2D	22 x 30	92.0	57.0	2.30	2.94
4700	82D472M035HD2D	22 x 40	59.0	37.0	3.21	4.06
3300	82D332M035JA2D	25 x 25	95.0	62.0	2.32	2.86
4700	82D472M035JB2D	25 x 30	72.0	47.0	2.82	3.49
5600	82D562M035JC2D	25 x 35	58.0	38.0	3.33	4.09
6800	82D682M035JD2D	25 x 40	46.6	30.0	4.08	5.08
10000	82D103M035JE2D	25 x 50	36.3	24.0	4.87	5.96
4700	82D472M035KA2D	30 x 25	75.0	54.0	2.92	3.42
6800	82D682M035KB2D	30 x 30	57.0	41.0	3.60	4.20
8200	82D822M035KC2D	30 x 35	46.6	33.0	4.20	4.98
12000	82D123M035KD2D	30 x 40	37.7	27.0	4.89	5.77
15000	82D153M035KE2D	30 x 50	30.5	22.0	5.96	6.89
10000	82D103M035MB2D	35 x 30	36.0	24.0	4.97	6.10
12000	82D123M035MC2D	35 x 35	29.3	20.0	5.82	7.04
15000	82D153M035MD2D	35 x 40	25.0	16.3	6.57	8.13
18000	82D183M035ME2D	35 x 50	19.0	13.0	8.17	9.87
27000	82D273M035MF2D	35 x 63	15.0	10.0	10.20	12.50
33000	82D333M035MG2D	35 x 80	12.0	9.0	12.20	14.10
40 VOLTS DC WORKING; 50 VOLTS DC SURGE						
1800	82D182M040HA2D	22 x 25	130.0	77.0	1.82	2.37
2700	82D272M040HB2D	22 x 30	99.0	59.0	2.21	2.87
4700	82D472M040HD2D	22 x 40	63.0	38.0	3.09	3.98
2700	82D272M040JA2D	25 x 25	101.0	62.0	2.25	2.86
3900	82D392M040JB2D	25 x 30	76.0	7.0	2.76	3.49
4700	82D472M040JC2D	25 x 35	62.0	39.0	3.21	4.09
5600	82D562M040JD2D	25 x 40	49.0	31.0	3.96	4.96
8200	82D822M040JE2D	25 x 50	38.6	24.0	4.68	5.96

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
40 VOLTS DC WORKING; 50 VOLTS DC SURGE (Cont.)						
3900	82D392M040KA2D	30 x 25	79.0	54.0	2.86	3.47
5600	82D562M040KB2D	30 x 30	60.0	41.0	3.51	4.20
6800	82D682M040KC2D	30 x 35	49.0	33.0	4.07	4.98
10000	82D103M040KD2D	30 x 40	39.4	27.0	4.71	5.77
12000	82D123M040KE2D	30 x 50	31.1	22.0	5.82	6.89
8200	82D822M040MB2D	35 x 30	39.0	24.0	4.78	6.10
10000	82D103M040MC2D	35 x 35	31.0	20.0	5.66	7.04
12000	82D123M040MD2D	35 x 40	25.0	16.0	6.57	8.21
15000	82D153M040ME2D	35 x 50	21.0	13.0	7.76	9.87
22000	82D223M040MF2D	35 x 63	16.0	10.6	9.91	12.20
27000	82D273M040MG2D	35 x 80	13.0	9.0	11.80	14.10
50 VOLTS DC WORKING; 63 VOLTS DC SURGE						
1200	82D122M050HA2D	22 x 25	148.0	79.0	1.71	2.32
1800	82D182M050HB2D	22 x 30	108.0	58.0	2.12	2.90
2700	82D272M050HD2D	22 x 40	70.0	38.0	2.96	3.98
1800	82D182M050JA2D	25 x 25	110.0	62.0	2.15	2.86
2200	82D222M050JB2D	25 x 30	85.0	48.0	2.61	3.49
2700	82D272M050JC2D	25 x 35	68.0	38.0	3.07	4.17
3900	82D392M050JD2D	25 x 40	53.6	31.0	3.79	4.96
5600	82D562M050JE2D	25 x 50	42.0	24.0	4.51	5.96
2700	82D272M050KA2D	30 x 25	85.0	54.0	2.73	3.42
3900	82D392M050KB2D	30 x 30	65.0	41.0	3.35	4.20
4700	82D472M050KC2D	30 x 35	53.0	33.0	3.89	4.98
5600	82D562M050KD2D	30 x 40	42.4	27.7	4.54	5.61
8200	82D822M050KE2D	30 x 50	33.0	22.0	5.69	6.89
4700	82D472M050MB2D	35 x 30	43.0	24.0	4.56	6.10
5600	82D562M050MC2D	35 x 35	34.0	20.0	5.40	7.04
6800	82D682M050MD2D	35 x 40	28.0	16.0	6.21	8.21
10000	82D103M050ME2D	35 x 50	22.0	13.0	7.60	9.87
12000	82D123M050MF2D	35 x 63	17.3	10.5	9.53	12.20
18000	82D183M050MG2D	35 x 80	14.0	9.0	11.40	14.10
63 VOLTS DC WORKING; 79 VOLTS DC SURGE						
1000	82D102M063HA2D	22 x 25	151.0	75.0	1.69	2.39
1500	82D152M063HB2D	22 x 30	118.0	59.0	2.03	2.87
2200	82D222M063HD2D	22 x 40	74.0	38.0	2.87	3.98
1500	82D152M063JA2D	25 x 25	121.0	63.0	2.05	2.86
1800	82D182M063JB2D	25 x 30	88.0	46.0	2.54	3.54
2200	82D222M063JC2D	25 x 35	72.0	38.0	2.97	4.09
3300	82D332M063JD2D	25 x 40	57.0	30.0	3.69	5.08
3900	82D392M063JE2D	25 x 50	44.0	24.0	4.35	5.96
2200	82D222M063KA2D	30 x 25	90.0	54.0	2.67	3.42
3300	82D332M063KB2D	30 x 30	68.0	41.0	3.28	4.20
3900	82D392M063KC2D	30 x 35	55.0	33.0	3.84	4.98
4700	82D472M063KD2D	30 x 40	44.0	27.0	4.47	5.77
6800	82D682M063KE2D	30 x 50	34.0	22.0	5.56	6.89
3900	82D392M063MB2D	35 x 30	45.0	24.0	4.42	6.10
4700	82D472M063MC2D	35 x 35	36.0	20.0	5.24	7.04
6800	82D682M063MD2D	35 x 40	29.0	16.0	6.10	8.21
8200	82D822M063ME2D	35 x 50	23.0	13.0	7.43	9.87
10000	82D103M063MF2D	35 x 63	18.4	10.4	9.26	12.30
15000	82D153M063MG2D	35 x 80	14.1	9.0	11.30	14.10

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
75 VOLTS DC WORKING; 90 VOLTS DC SURGE						
680	82D681M075HA2D	22 x 25	261.0	151.0	1.28	1.64
1000	82D102M075HB2D	22 x 30	194.0	113.0	1.58	2.08
1500	82D152M075HD2D	22 x 40	130.0	76.0	2.16	2.84
1000	82D102M075JA2D	25 x 25	194.0	114.0	1.62	2.11
1500	82D152M075JB2D	25 x 30	147.0	87.0	1.97	2.57
1800	82D182M075JC2D	25 x 35	119.0	71.0	2.31	3.01
2200	82D222M075JD2D	25 x 40	92.0	55.0	2.88	3.73
2700	82D272M075JE2D	25 x 50	72.0	43.0	3.21	4.59
1500	82D152M075KA2D	30 x 25	145.0	89.0	2.10	2.69
2200	82D222M075KB2D	30 x 30	106.0	66.0	2.62	3.35
2700	82D272M075KC2D	30 x 35	85.0	53.0	3.04	3.89
3300	82D332M075KD2D	30 x 40	67.0	42.0	3.65	4.62
4700	82D472M075KE2D	30 x 50	52.0	33.0	4.51	5.69
2700	82D272M075MB2D	35 x 30	75.0	44.0	3.45	4.50
3300	82D332M075MC2D	35 x 35	59.0	35.0	4.10	5.32
4700	82D472M075MD2D	35 x 40	47.0	28.0	4.79	6.21
5600	82D562M075ME2D	35 x 50	36.0	22.0	5.93	7.58
6800	82D682M075MF2D	35 x 63	28.0	17.3	7.51	9.53
10000	82D103M075MG2D	35 x 80	22.0	14.0	9.08	11.40
80 VOLTS DC WORKING; 100 VOLTS DC SURGE						
680	82D681M080HA2D	22 x 25	268.0	150.0	1.26	1.69
820	82D821M080HB2D	22 x 30	203.0	114.0	1.54	2.07
1500	82D152M080HD2D	22 x 40	131.0	74.0	2.15	2.87
1000	82D102M080JA2D	25 x 25	200.0	114.0	1.59	2.11
1200	82D122M080JB2D	25 x 30	160.0	91.0	1.90	2.52
1500	82D152M080JC2D	25 x 35	126.0	72.0	2.26	3.01
1800	82D182M080JD2D	25 x 40	99.0	57.0	2.77	3.69
2700	82D272M080JE2D	25 x 50	75.0	44.0	3.34	4.35
1500	82D152M080KA2D	30 x 25	147.0	87.0	2.08	2.71
1800	82D182M080KB2D	30 x 30	109.0	66.0	2.58	3.31
2200	82D222M080KC2D	30 x 35	86.0	52.0	3.07	3.95
3300	82D332M080KD2D	30 x 40	69.0	42.0	3.57	4.62
3900	82D392M080KE2D	30 x 50	54.0	33.0	4.44	5.69
2700	82D272M080MB2D	35 x 30	75.0	44.0	3.45	4.50
3300	82D332M080MC2D	35 x 35	61.0	35.0	4.00	5.30
3900	82D392M080MD2D	35 x 40	48.0	28.0	4.71	6.21
5600	82D562M080ME2D	35 x 50	37.0	22.0	5.86	7.58
6800	82D682M080MF2D	35 x 63	29.0	17.0	7.37	9.61
10000	82D103M080MG2D	35 x 80	23.0	13.5	8.90	11.50
100 VOLTS DC WORKING; 125 VOLTS DC SURGE						
390	82D391M100HA2D	22 x 25	343.0	151.0	1.12	1.69
470	82D471M100HB2D	22 x 30	258.0	114.0	1.37	2.07
820	82D821M100HD2D	22 x 40	161.0	72.0	1.94	2.90
560	82D561M100JA2D	25 x 25	253.0	115.0	1.41	2.10
680	82D681M100JB2D	25 x 30	188.0	86.0	1.75	2.59
820	82D821M100JC2D	25 x 35	150.0	69.0	2.06	3.04
1200	82D122M100JD2D	25 x 40	125.0	57.0	2.46	3.64
1500	82D152M100JE2D	25 x 50	90.0	42.0	3.05	4.51

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
100 VOLTS DC WORKING; 125 VOLTS DC SURGE (Cont.)						
820	82D821M100KA2D	30 x 25	178.0	86.0	1.89	2.73
1000	82D102M100KB2D	30 x 30	136.0	66.0	2.31	3.31
1500	82D152M100KC2D	30 x 35	106.0	52.0	2.75	3.95
1800	82D182M100KD2D	30 x 40	86.0	42.0	3.21	4.62
2200	82D222M100KE2D	30 x 50	66.0	33.0	4.02	5.69
1500	82D152M100MB2D	35 x 30	98.0	44.0	3.01	4.50
1800	82D182M100MC2D	35 x 35	79.0	36.0	3.53	5.19
2200	82D222M100MD2D	35 x 40	61.0	28.0	4.18	6.21
2700	82D272M100ME2D	35 x 50	46.0	22.0	4.76	7.58
3900	82D392M100MF2D	35 x 63	36.0	17.2	6.61	9.57
4700	82D472M100MG2D	35 x 80	28.0	13.5	8.07	11.50
160 VOLTS DC WORKING; 200 VOLTS DC SURGE						
180	82D181M160HA2D	22 x 25	741.0	392.0	0.809	1.11
220	82D221M160HB2D	22 x 30	551.0	291.0	1.00	1.37
390	82D391M160HD2D	22 x 40	344.0	184.0	1.41	1.93
220	82D221M160JA2D	25 x 25	548.0	296.0	1.02	1.39
330	82D331M160JB2D	25 x 30	411.0	221.0	1.26	1.71
390	82D391M160JC2D	25 x 35	326.0	176.0	1.49	2.03
470	82D471M160JD2D	25 x 40	256.0	139.0	1.83	2.49
680	82D681M160JE2D	25 x 50	194.0	107.0	2.21	2.96
390	82D391M160KA2D	30 x 25	374.0	211.0	1.39	1.85
470	82D471M160KB2D	30 x 30	278.0	157.0	1.72	2.28
680	82D681M160KC2D	30 x 35	222.0	128.0	2.02	2.67
820	82D821M160KD2D	30 x 40	175.0	99.0	2.39	3.17
1000	82D102M160KE2D	30 x 50	136.0	77.0	2.95	3.91
680	82D681M160MB2D	35 x 30	221.0	130.0	2.14	2.79
820	82D821M160MC2D	35 x 35	176.0	104.0	2.52	3.28
1200	82D122M160MD2D	35 x 40	139.0	83.0	2.96	3.84
1500	82D152M160ME2D	35 x 50	107.0	64.0	3.65	4.72
1800	82D182M160MF2D	35 x 63	82.0	50.0	4.64	5.99
2700	82D272M160MG2D	35 x 80	62.0	38.0	5.72	7.31
200 VOLTS DC WORKING; 250 VOLTS DC SURGE						
150	82D151M200HA2D	22 x 25	1012.0	361.0	0.697	1.17
220	82D221M200HB2D	22 x 30	594.0	255.0	0.967	1.48
330	82D331M200HD2D	22 x 40	381.0	165.0	1.35	2.06
220	82D221M200JA2D	25 x 25	625.0	272.0	0.967	1.46
270	82D271M200JB2D	25 x 30	525.0	191.0	1.12	1.85
390	82D391M200JC2D	25 x 35	341.0	151.0	1.47	2.22
470	82D471M200JD2D	25 x 40	271.0	121.0	1.79	2.68
560	82D561M200JE2D	25 x 50	205.0	91.0	2.17	3.25
330	82D331M200KA2D	30 x 25	498.0	192.0	1.21	1.96
470	82D471M200KB2D	30 x 30	294.0	136.0	1.64	2.48
560	82D561M200KC2D	30 x 35	279.0	107.0	1.82	2.95
680	82D681M200KD2D	30 x 40	221.0	87.0	2.14	3.41
1000	82D102M200KE2D	30 x 50	142.0	67.0	2.89	4.22
560	82D561M200MB2D	35 x 30	287.0	116.0	1.89	2.97
820	82D821M200MC2D	35 x 35	189.0	93.0	2.46	3.51
1000	82D102M200MD2D	35 x 40	149.0	74.0	2.88	3.41
1200	82D122M200ME2D	35 x 50	116.0	58.0	3.54	5.01
1800	82D182M200MF2D	35 x 63	89.0	45.0	4.51	6.35
2200	82D222M200MG2D	35 x 80	68.0	30.0	5.58	7.58

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
250 VOLTS DC WORKING; 300 VOLTS DC SURGE						
120	82D121M250HA2D	22 x 25	1077.0	385.0	68.00	1.17
180	82D181M250HB2D	22 x 30	722.0	261.0	88.00	1.52
220	82D221M250HD2D	22 x 40	558.0	166.0	1.12	2.12
180	82D181M250JA2D	25 x 25	753.0	275.0	0.89	1.51
220	82D221M250JB2D	25 x 30	513.0	189.0	1.13	1.94
270	82D271M250JC2D	25 x 35	494.0	151.0	1.21	2.31
330	82D331M250JD2D	25 x 40	382.0	121.0	1.51	2.79
470	82D471M250JE2D	25 x 50	243.0	93.0	1.99	3.35
270	82D271M250KA2D	30 x 25	500.0	194.0	1.21	2.02
330	82D331M250KB2D	30 x 30	398.0	135.0	1.44	2.58
390	82D391M250KC2D	30 x 35	328.0	109.0	1.68	3.03
560	82D561M250KD2D	30 x 40	283.0	87.0	2.16	3.54
680	82D681M250KE2D	30 x 50	198.0	67.0	2.46	4.41
470	82D471M250MB2D	35 x 30	281.0	117.0	1.92	3.07
560	82D561M250MC2D	35 x 35	270.0	94.0	2.06	3.62
680	82D681M250MD2D	35 x 40	209.0	74.0	2.43	4.26
1000	82D102M250ME2D	35 x 50	132.0	58.0	3.32	5.21
1200	82D122M250MF2D	35 x 63	108.0	40.0	4.09	6.49
1500	82D152M250MG2D	35 x 80	93.0	35.0	4.73	8.01
300 VOLTS DC WORKING; 350 VOLTS DC SURGE						
68	82D680M300HA2D	22 x 25	3100.0	1800.0	0.39	0.52
100	82D101M300HB2D	22 x 30	2090.0	1210.0	0.51	0.68
120	82D121M300HD2D	22 x 40	1340.0	780.0	0.72	0.94
100	82D101M300JA2D	25 x 25	2180.0	1270.0	0.52	0.67
150	82D151M300JB2D	25 x 30	1490.0	870.0	0.66	1.13
180	82D181M300JC2D	25 x 35	1160.0	680.0	0.97	1.26
220	82D221M300JD2D	25 x 40	900.0	520.0	1.20	1.58
270	82D271M300JE2D	25 x 50	670.0	390.0	1.46	1.91
150	82D151M300KA2D	30 x 25	1530.0	900.0	0.69	0.90
220	82D221M300KB2D	30 x 30	970.0	570.0	0.92	1.20
270	82D271M300KC2D	30 x 35	780.0	460.0	1.08	1.41
330	82D331M300KD2D	30 x 40	600.0	350.0	1.29	1.69
470	82D471M300KE2D	30 x 50	440.0	260.0	1.64	2.14
270	82D271M300MB2D	35 x 30	750.0	450.0	1.16	1.50
330	82D331M300MC2D	35 x 35	590.0	350.0	1.38	1.80
470	82D471M300MD2D	35 x 40	450.0	270.0	1.65	2.13
560	82D561M300ME2D	35 x 50	340.0	200.0	2.06	2.68
820	82D821M300MF2D	35 x 63	250.0	150.0	2.67	3.45
1000	82D102M300MG2D	35 x 80	190.0	110.0	3.29	4.33
350 VOLTS DC WORKING; 400 VOLTS DC SURGE						
56	82D560M350HA2D	22 x 25	3360.0	1800.0	0.38	0.52
82	82D820M300HB2D	22 x 30	2270.0	1220.0	0.49	0.67
120	82D121M350HD2D	22 x 40	1390.0	740.0	0.71	0.96
82	82D820M350JA2D	25 x 25	2370.0	1280.0	0.49	0.67
120	82D121M350JB2D	25 x 30	1620.0	880.0	0.63	0.86
150	82D151M350JC2D	25 x 35	1270.0	690.0	0.76	1.03
180	82D181M350JD2D	25 x 40	990.0	540.0	0.93	1.27
220	82D221M350JE2D	25 x 50	727.0	395.0	1.14	1.55

STANDARD RATINGS

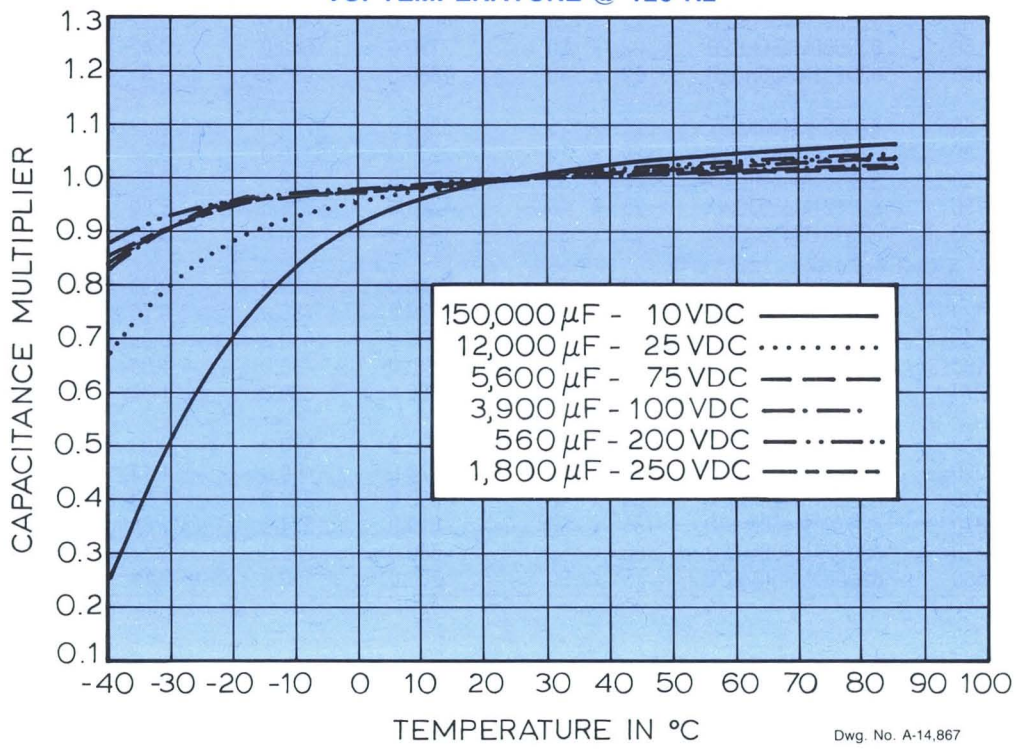
μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
350 VOLTS DC WORKING; 400 VOLTS DC SURGE (Cont.)						
120	82D121M350KA2D	30 x 25	1550.0	840.0	0.68	0.93
180	82D181M350KB2D	30 x 30	1100.0	600.0	0.87	1.17
220	82D221M350KC2D	30 x 35	838.0	450.0	1.04	1.42
270	82D271M350KD2D	30 x 40	645.0	350.0	1.25	1.69
330	82D331M350KE2D	30 x 50	480.0	265.0	1.57	2.12
220	82D221M350MB2D	35 x 30	850.0	470.0	1.09	1.47
270	82D271M350MC2D	35 x 35	660.0	360.0	1.31	1.77
330	82D331M350MD2D	35 x 40	485.0	270.0	1.59	2.13
470	82D471M350ME2D	35 x 50	360.0	200.0	2.00	2.68
680	82D681M350MF2D	35 x 63	270.0	150.0	2.57	3.45
820	82D821M350MG2D	35 x 80	202.0	115.0	3.20	4.23
385 VOLTS DC WORKING; 415 VOLTS DC SURGE						
47	82D470M385HA2D	22 x 25	3450.0	1800.0	0.38	0.52
68	82D680M385HB2D	22 x 30	2320.0	1210.0	0.49	0.67
120	82D121M385HD2D	22 x 40	1400.0	730.0	0.70	0.97
68	82D680M385JA2D	25 x 25	2430.0	1280.0	0.49	0.67
100	82D101M385JB2D	25 x 30	1650.0	870.0	0.63	0.86
120	82D121M385JC2D	25 x 35	1340.0	700.0	0.74	1.02
180	82D181M385JD2D	25 x 40	1020.0	540.0	0.92	1.26
220	82D221M385JE2D	25 x 50	780.0	410.0	1.10	1.52
120	82D121M385KA2D	30 x 25	1580.0	830.0	0.68	0.94
150	82D151M385KB2D	30 x 30	1130.0	600.0	0.85	1.17
220	82D221M385KC2D	30 x 35	852.0	450.0	1.04	1.42
270	82D271M385KD2D	30 x 40	670.0	360.0	1.22	1.67
330	82D331M385KE2D	30 x 50	500.0	265.0	1.54	2.12
220	82D221M385MB2D	35 x 30	880.0	460.0	1.07	1.48
270	82D271M385MC2D	35 x 35	660.0	350.0	1.31	1.79
330	82D331M385MD2D	35 x 40	510.0	270.0	1.55	2.13
470	82D471M385ME2D	35 x 50	380.0	200.0	1.95	2.68
560	82D561M385MF2D	35 x 63	288.0	150.0	2.49	3.45
820	82D821M385MG2D	35 x 80	210.0	110.0	3.13	4.33
400 VOLTS DC WORKING; 450 VOLTS DC SURGE						
47	82D470M400HA2D	22 x 25	4310.0	2450.0	0.34	0.45
68	82D680M400HB2D	22 x 30	2890.0	1640.0	0.44	0.58
100	82D101M400HD2D	22 x 40	1740.0	990.0	0.63	0.83
68	82D680M400JA2D	25 x 25	3020.0	1720.0	0.44	0.58
100	82D101M400JB2D	25 x 30	2060.0	1176.0	0.56	0.74
120	82D121M400JC2D	25 x 35	1600.0	910.0	0.67	0.89
150	82D151M400JD2D	25 x 40	1280.0	730.0	0.82	1.09
220	82D221M400JE2D	25 x 50	960.0	540.0	0.99	1.33
100	82D101M400KA2D	30 x 25	1980.0	1120.0	0.61	0.81
150	82D151M400KB2D	30 x 30	1430.0	820.0	0.76	1.00
180	82D181M400KC2D	30 x 35	1040.0	600.0	0.94	1.23
220	82D221M400KD2D	30 x 40	820.0	470.0	1.10	1.46
330	82D331M400KE2D	30 x 50	620.0	350.0	1.38	1.84
180	82D181M400MB2D	35 x 30	1070.0	610.0	0.97	1.29
270	82D271M400MC2D	35 x 35	840.0	480.0	1.16	1.53
330	82D331M400MD2D	35 x 40	630.0	360.0	1.39	1.85
390	82D391M400ME2D	35 x 50	480.0	270.0	1.73	2.31
560	82D561M400MF2D	35 x 63	350.0	200.0	2.26	2.99
820	82D821M400MG2D	35 x 80	260.0	150.0	2.82	3.71

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size Millimeters D x L	Max. ESR @ +25°C (mΩ) 120Hz	Max. ESR @ +25°C (mΩ) 20k-40k	Max. Ripple Current @ +85°C (A) 120Hz	Max. Ripple Current @ +85°C (A) 20k-40k
450 VOLTS DC WORKING; 500 VOLTS DC SURGE						
39	82D390M450HA2D	22 x 25	4690.0	2460.0	0.32	0.45
56	82D560M450HB2D	22 x 30	3120.0	1640.0	0.42	0.58
100	82D101M450HD2D	22 x 40	1880.0	990.0	0.61	0.83
56	82D560M450JA2D	25 x 25	3280.0	1730.0	0.42	0.58
82	82D820M450JB2D	25 x 30	2230.0	1170.0	0.54	0.75
100	82D101M450JC2D	25 x 35	1730.0	915.0	0.65	0.89
120	82D121M450JD2D	25 x 40	1360.0	720.0	0.80	1.09
180	82D181M450JE2D	25 x 50	1040.0	550.0	0.96	1.31
82	82D820M450KA2D	30 x 25	2120.0	1120.0	0.59	0.81
120	82D121M450KB2D	30 x 30	1470.0	780.0	0.75	1.03
150	82D151M450KC2D	30 x 35	1150.0	610.0	0.89	1.22
180	82D181M450KD2D	30 x 40	910.0	480.0	1.05	1.44
270	82D271M450KE2D	30 x 50	680.0	360.0	1.32	1.82
150	82D151M450MB2D	35 x 30	1170.0	620.0	0.93	1.28
220	82D221M450MC2D	35 x 35	870.0	460.0	1.14	1.56
270	82D271M450MD2D	35 x 40	690.0	370.0	1.33	1.82
330	82D331M450ME2D	35 x 50	510.0	274.0	1.68	2.29
470	82D471M450MF2D	35 x 63	380.0	205.0	2.17	2.95
680	82D681M450MG2D	35 x 80	280.0	150.0	2.71	3.71

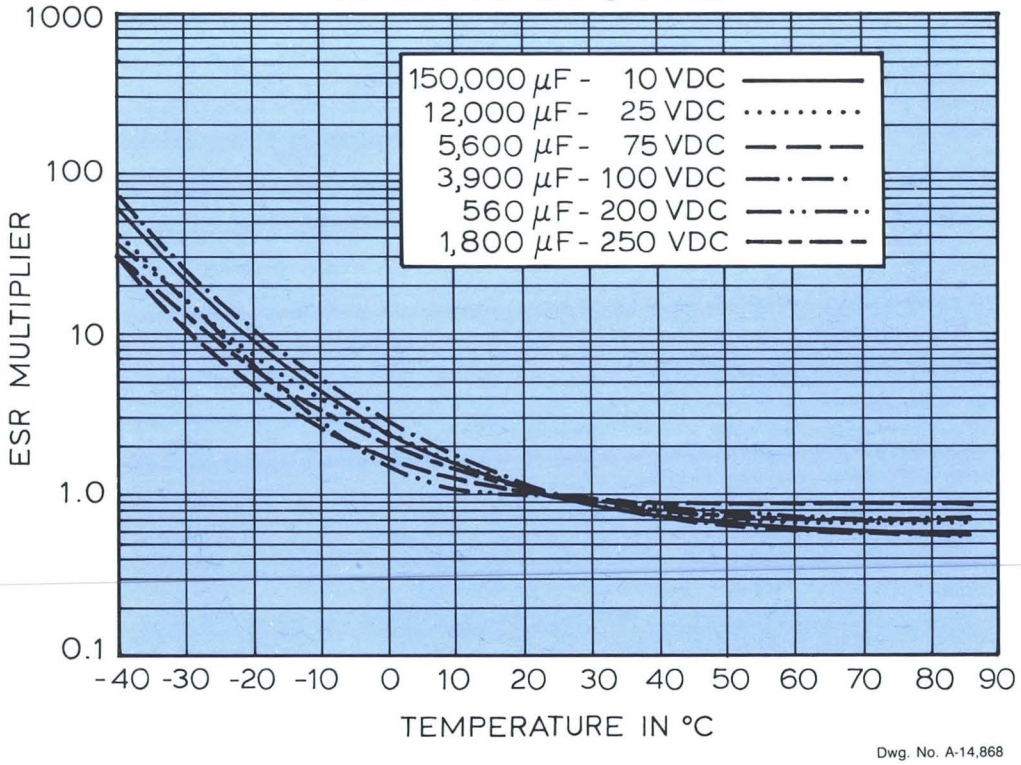
TYPICAL CURVES

TYPE 82D — TYPICAL CAPACITANCE RATIO VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,867

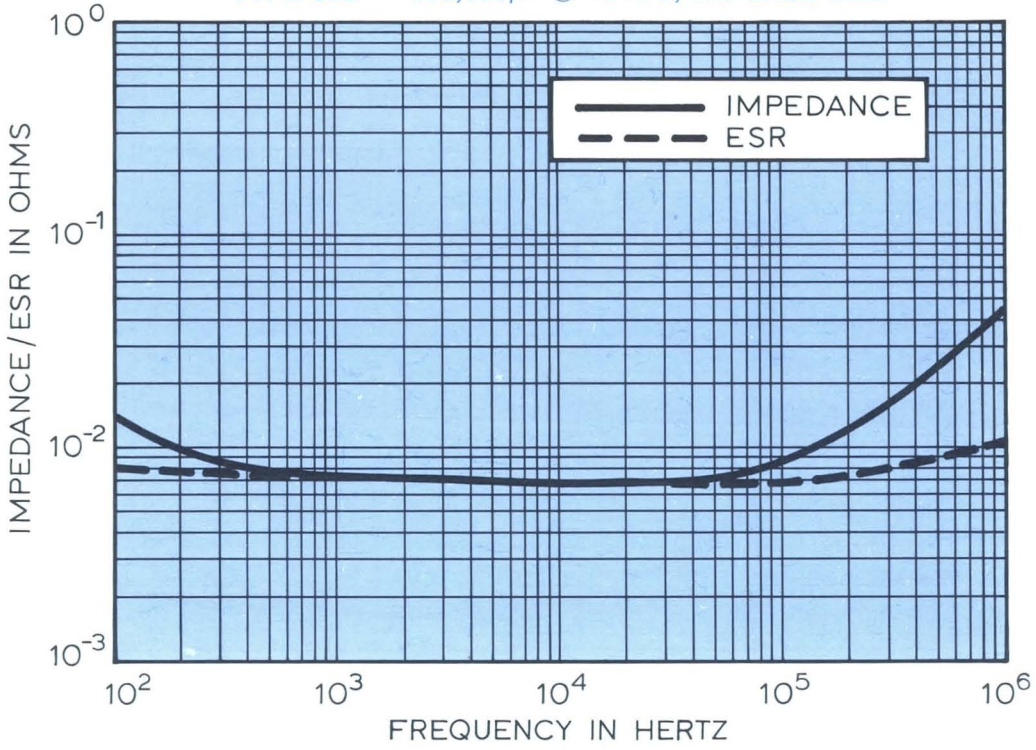
TYPE 82D — TYPICAL ESR MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,868

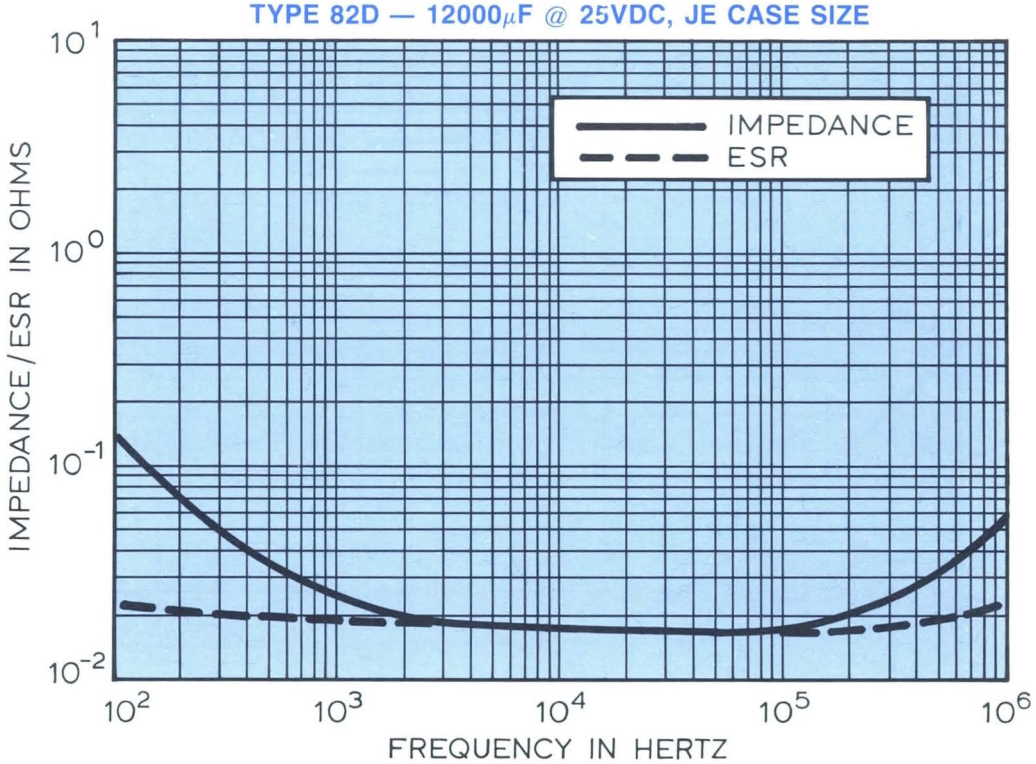
TYPICAL CURVES @ +25°C

TYPE 82D — 150,000μF @ 10VDC, MG CASE SIZE



Dwg. No. A-14,869

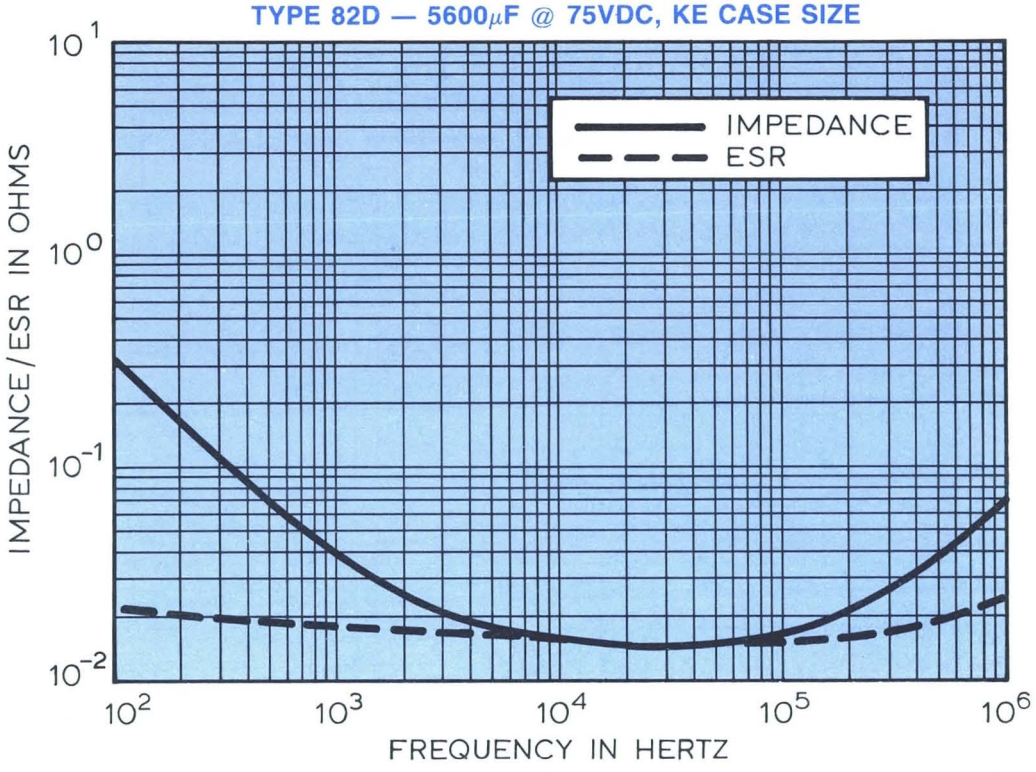
TYPE 82D — 12000μF @ 25VDC, JE CASE SIZE



Dwg. No. A-14,870

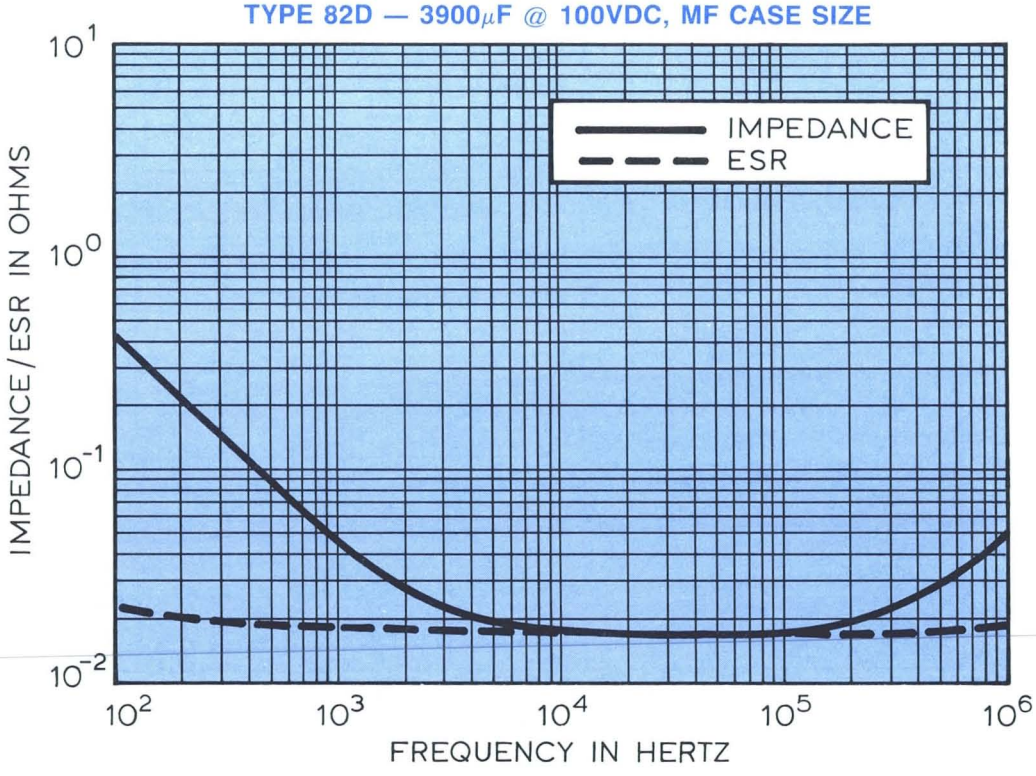
TYPICAL CURVES @ +25°C

TYPE 82D — 5600μF @ 75VDC, KE CASE SIZE



Dwg. No. A-14,871

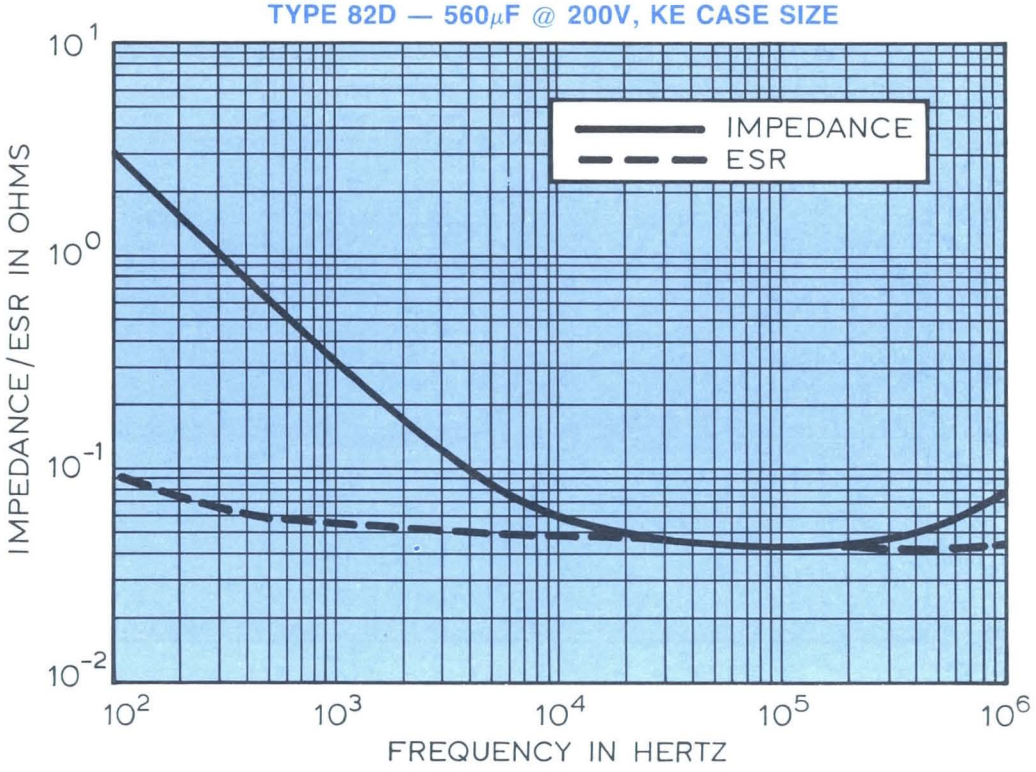
TYPE 82D — 3900μF @ 100VDC, MF CASE SIZE



Dwg. No. A-14,872

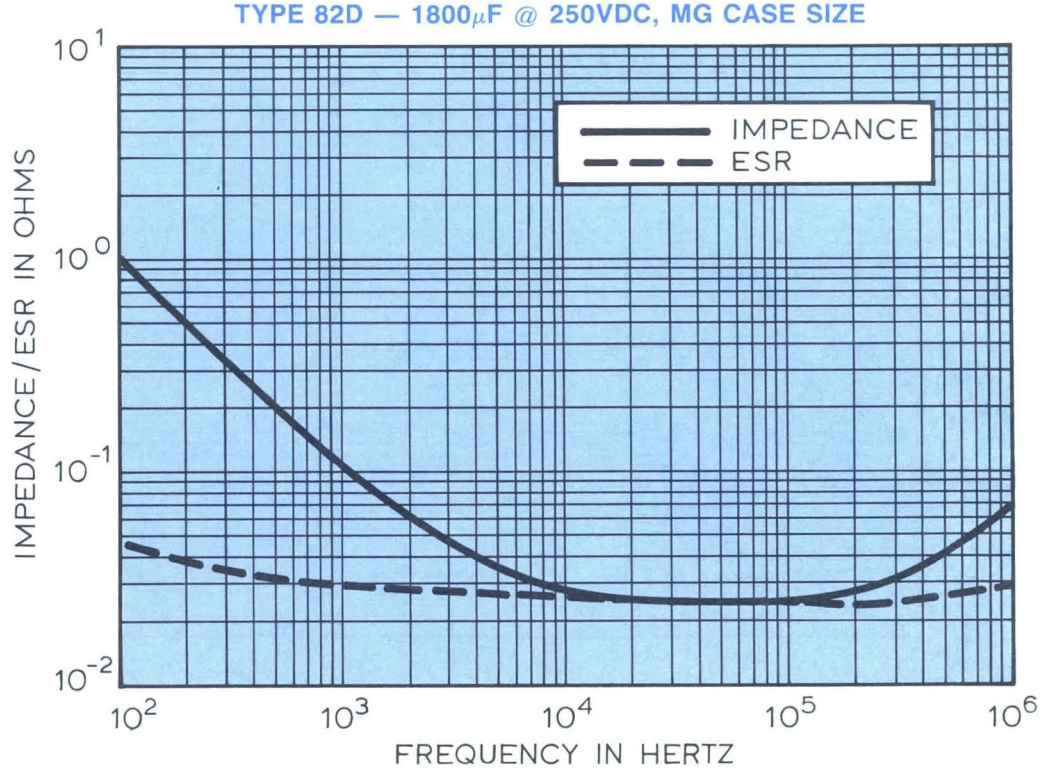
TYPICAL CURVES @ +25°C

TYPE 82D — 560μF @ 200V, KE CASE SIZE



Dwg. No. A-14,873

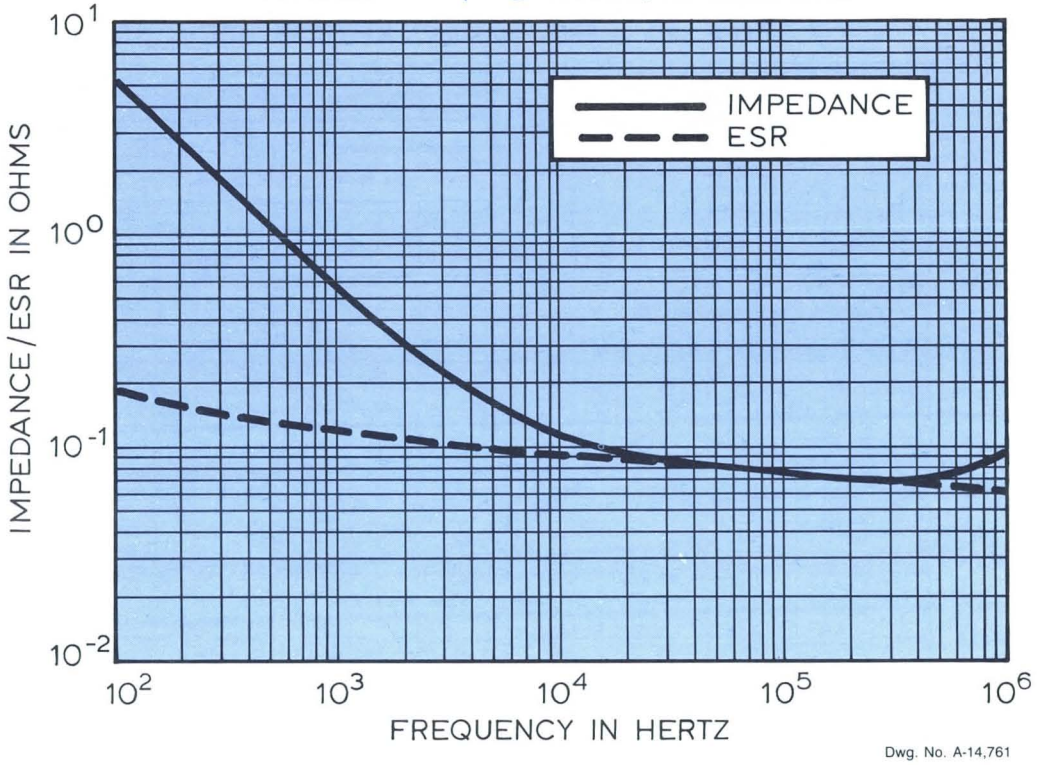
TYPE 82D — 1800μF @ 250VDC, MG CASE SIZE



Dwg. No. A-14,874

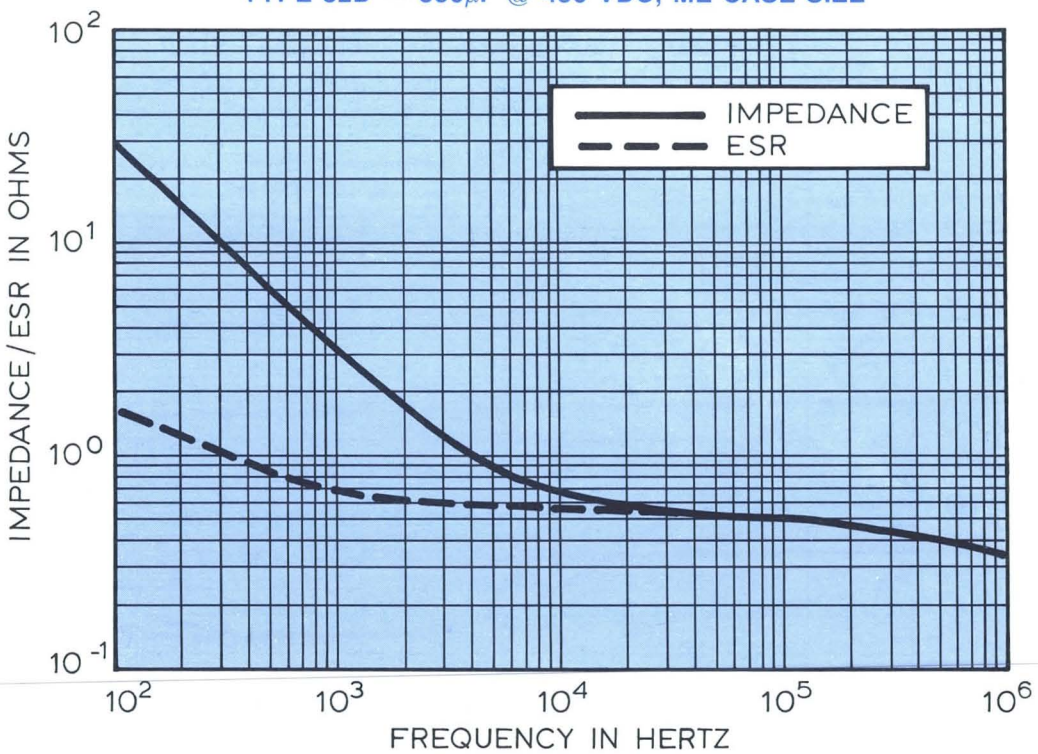
TYPICAL CURVES @ +25°C

TYPE 82D — 68μF @ 385VDC, JB CASE SIZE



Dwg. No. A-14,761

TYPE 82D — 330μF @ 450 VDC, ME CASE SIZE

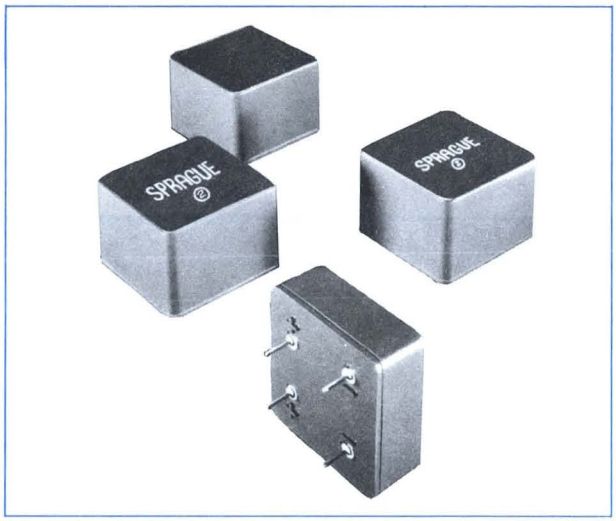


Dwg. No. A-14,762

Rectangular Plastic Case Capacitors

SPRAGUE®

Plastic Case Plug-In Design Aluminum Capacitors



9838

Features —

- **Low Profile Plastic Case SMPS Output Capacitor**
- **Lowest ESR Available**
- **True 4 Terminal Design for Minimum ESL**
- **Polarity Proof**
- **Dual Pack Design Available for SMPS Input Filters**

General Specifications —

Operating Temperature:
−40°C - +85°C.

Voltage Range: 3 - 450 VDC.

Capacitance Range: 56μF - 47,000μF.

Capacitance Tolerance: ±20%.

Case Size Range: 1.625″ x 1.625″ x 0.690″ - 1.625″ x 1.625″ x 1.576″.

Termination: 4 radial leads.

Life Validation Test: 2000 hrs @ +85°C:
Δ CAP ≤ 20% from initial measurement.
Δ ESR ≤ 1.5x initial specified limit.
Δ DCL ≤ initial specified limit.

Shelf Test: 500 hrs @ +85°C:
Δ CAP ≤ 15% from initial measurement.
Δ ESR ≤ 1.3x initial specified limit.
Δ DCL ≤ 2x initial specified limit.

DC Leakage Current:
$I = K\sqrt{CV}$
K = 4.0 @ +25°C
I in μa, C in μF, V in Volts

Ripple Current Multipliers:

	TEMPERATURE			
Ambient Temp.	+55°C	+65°C	+75°C	+85°C
Multipliers	2.0	1.7	1.4	1.0

ESL (Typical values @ 1MHz-10MHz):

Case Code	Typical ESL (nH)
BA	5
BB	9

Expected Life: SEE PAGE 270.

Performance Characteristics:
SEE PAGE 266.

Catalog Numbering System

88D 153 M 6R3 B A

CASE HEIGHT. A = 0.690″ (17.5 mm)
B = 1.181″ (30 mm)
C = 1.576″ (40 mm)

CONFIGURATION. B = SINGLE SECTION CAPACITOR.
C = DUAL SECTION CAPACITOR.

DC VOLTAGE RATING. EXPRESSED IN VOLTS. 'R' IS USED TO INDICATE A DECIMAL POINT. FOR EXAMPLE: 6R3 = 6.3 VOLTS.

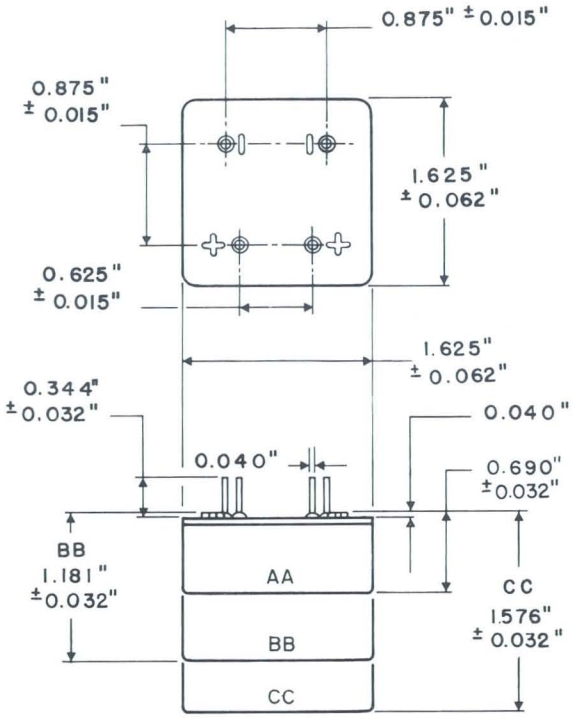
CAPACITANCE TOLERANCE. M = ±20% (Standard).

CAPACITANCE. EXPRESSED IN MICROFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS. FOR DUAL SECTION UNITS THE CAPACITANCE RATING IS THE SAME FOR EACH SECTION.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.

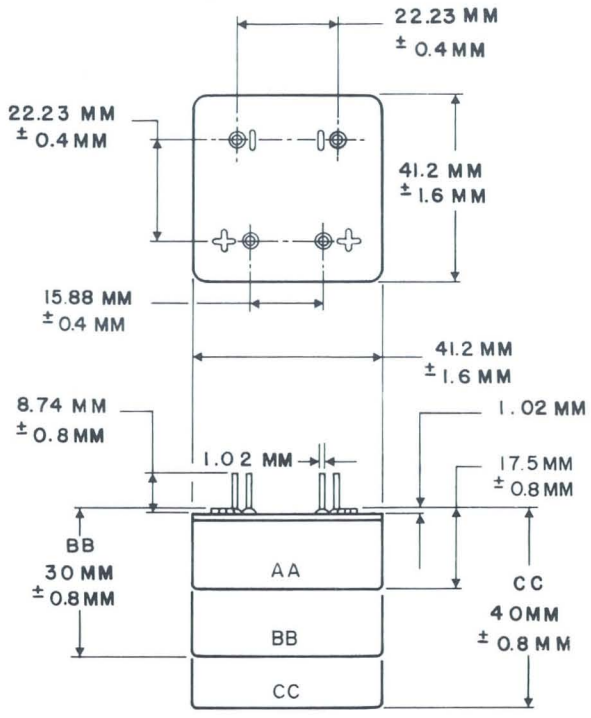
DIMENSIONS

TYPE 88D (INCHES)

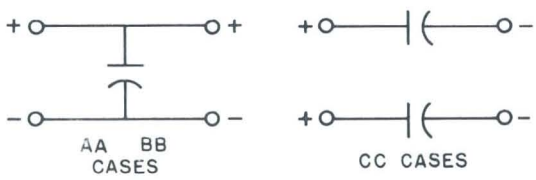


Dwg. No. A-14,847

TYPE 88D (MILLIMETERS)



Dwg. No. A-14,848



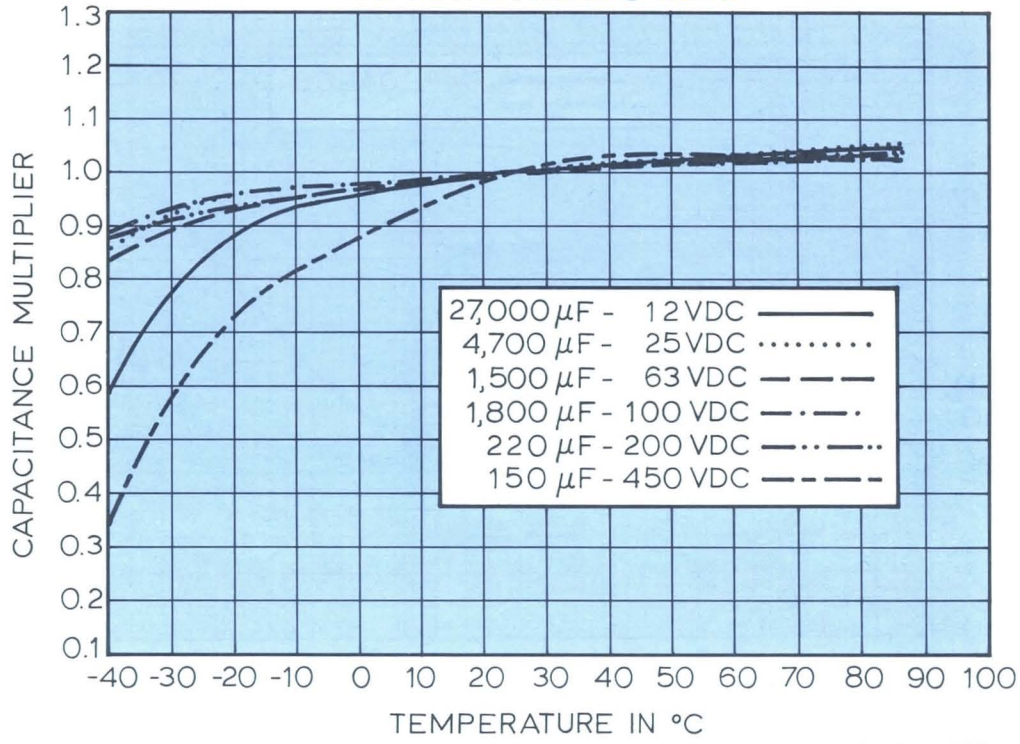
Dwg. No. A-14,849

STANDARD RATINGS

WVDC	VDC Surge	µF	Catalog Number	ESR Ohms @ +25°C 120Hz Max.	ESR Ohms @ +25°C 20k-500kHz ±30%	Max. Ripple Current Amperes @ +85°C 120Hz	Max. Ripple Current Amperes @ +85°C 20k-500kHz	Max. Impedance Ohms @ 100kHz, +25°C
SINGLE SECTION — BA CASE								
3	4	18000	88D183M003BA	0.0202	0.0133	5.25	5.68	0.0188
6.3	8	15000	88D153M6R3BA	0.0213	0.0133	5.11	5.68	0.0188
7.5	9	12000	88D123M7R5BA	0.0224	0.0133	4.99	5.68	0.0188
12	16	10000	88D103M012BA	0.0237	0.0133	4.86	5.68	0.0188
16	18	8200	88D822M016BA	0.0251	0.0133	4.72	5.68	0.0188
20	25	6800	88D682M020BA	0.0257	0.0137	4.66	5.60	0.0176
25	35	4700	88D472M025BA	0.0265	0.0140	4.59	5.53	0.0179
30	40	3900	88D392M030BA	0.0288	0.0140	4.40	5.53	0.0179
35	45	3300	88D332M035BA	0.0314	0.0140	4.22	5.53	0.0179
40	50	2700	88D272M040BA	0.0349	0.0140	4.00	5.53	0.0179
50	65	2200	88D222M050BA	0.0414	0.0156	3.67	5.25	0.0200
63	75	1500	88D152M063BA	0.0526	0.0156	3.26	5.25	0.0200
75	95	1200	88D122M075BA	0.0725	0.0256	2.78	4.10	0.0343
100	125	680	88D681M100BA	0.1046	0.0263	2.31	4.04	0.0347
160	200	270	88D271M160BA	0.3599	0.0803	1.30	2.74	0.1084
200	250	220	88D221M200BA	0.4559	0.0807	1.15	2.73	0.1089
250	300	150	88D151M250BA	0.5788	0.0813	1.02	2.72	0.1098
360	400	82	88D820M360BA	1.5370	0.4906	0.62	1.11	0.6623
400	475	68	88D680M400BA	2.1450	0.7151	0.56	1.09	0.9654
450	525	56	88D560M450BA	2.4057	0.7515	0.53	1.06	1.0146
SINGLE SECTION — BB CASE								
3	4	47000	88D473M003BB	0.0119	0.0092	7.92	8.20	0.0119
6.3	8	39000	88D393M6R3BB	0.0123	0.0092	7.78	8.20	0.0119
7.5	9	33000	88D333M7R5BB	0.0131	0.0092	7.54	8.20	0.0119
12	16	27000	88D273M012BB	0.0132	0.0092	7.51	8.20	0.0119
16	18	18000	88D183M016BB	0.0143	0.0092	7.22	8.20	0.0119
20	25	15000	88D153M020BB	0.0140	0.0095	7.30	7.78	0.0121
25	35	12000	88D123M025BB	0.0149	0.0095	7.08	7.78	0.0121
30	40	10000	88D103M030BB	0.0157	0.0095	6.88	7.78	0.0121
35	45	8200	88D822M035BB	0.0168	0.0095	6.65	7.78	0.0121
40	50	6800	88D682M040BB	0.0183	0.0095	6.39	7.78	0.0121
50	65	5600	88D562M050BB	0.0207	0.0100	6.00	7.59	0.0128
63	75	3900	88D392M063BB	0.0248	0.0100	5.49	7.59	0.0128
75	95	3300	88D332M075BB	0.0312	0.0142	4.88	6.36	0.0181
100	125	1800	88D182M100BB	0.0419	0.0142	4.22	6.36	0.0181
160	200	680	88D681M160BB	0.1481	0.0378	2.34	3.77	0.0486
200	250	560	88D561M200BB	0.1657	0.0380	2.20	3.72	0.0487
250	300	470	88D471M250BB	0.1783	0.0381	2.13	3.72	0.0490
360	400	220	88D221M360BB	0.5088	0.1250	1.26	2.07	0.1688
400	475	180	88D181M400BB	0.8067	0.2874	1.05	1.62	0.3875
450	525	150	88D151M450BB	0.8949	0.3158	0.99	1.55	0.4253
DUAL SECTION — CC CASE								
200	250	470 + 470	88D471M200CC	0.2214	0.0562	1.48	2.40	0.0759
200	250	560 + 560	88D561M200CC	0.1966	0.0560	1.58	2.42	0.0756
200	250	680 + 680	88D681M200CC	0.1760	0.0570	1.66	2.38	0.0760
250	300	330 + 330	88D331M250CC	0.2875	0.0593	1.30	2.34	0.0801
250	300	390 + 390	88D391M250CC	0.2537	0.0584	1.39	2.37	0.0788
250	300	470 + 470	88D471M250CC	0.2254	0.0588	1.47	2.34	0.0780

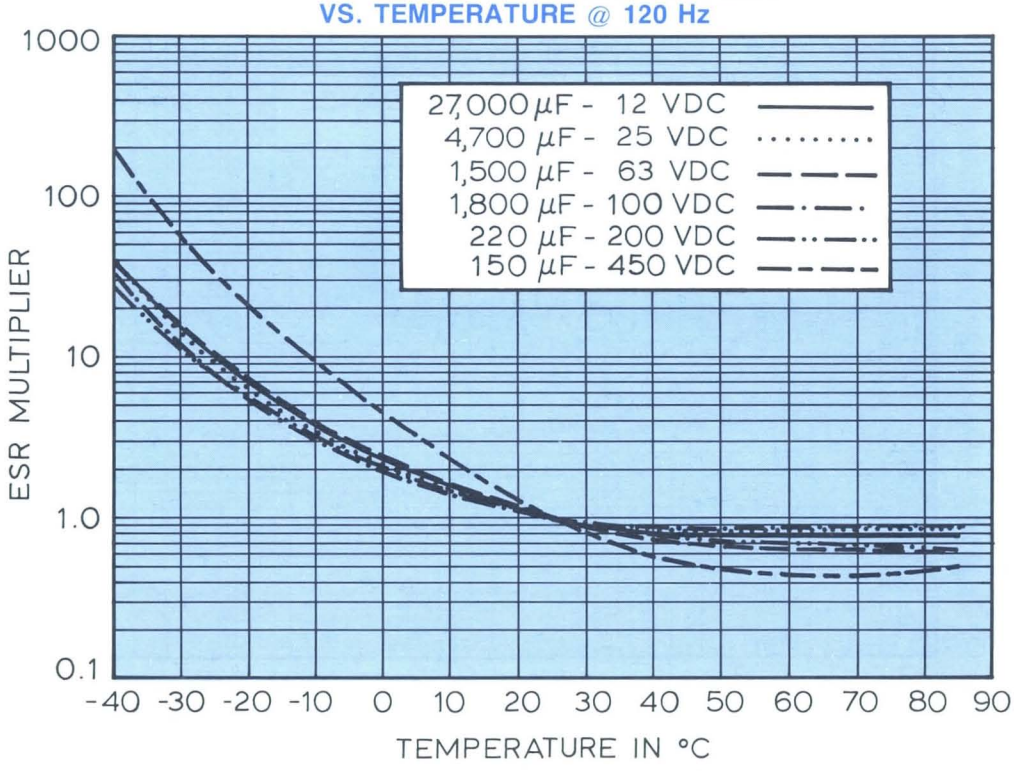
TYPICAL CURVES

TYPE 88D — TYPICAL CAPACITANCE MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,727

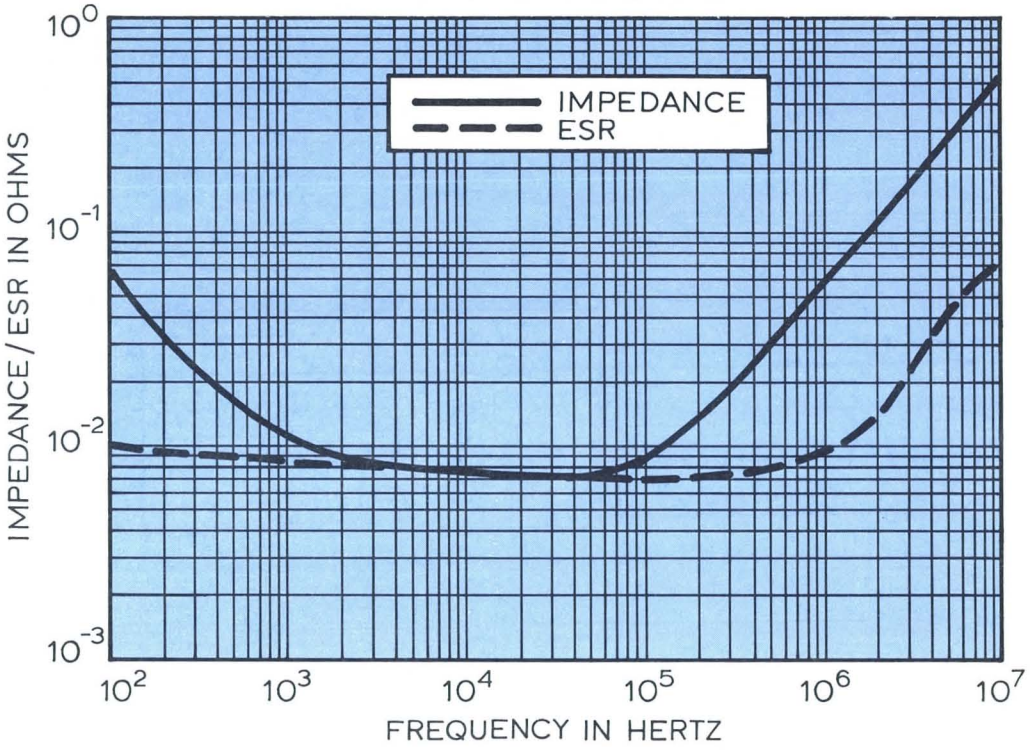
TYPE 88D — TYPICAL ESR MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,720

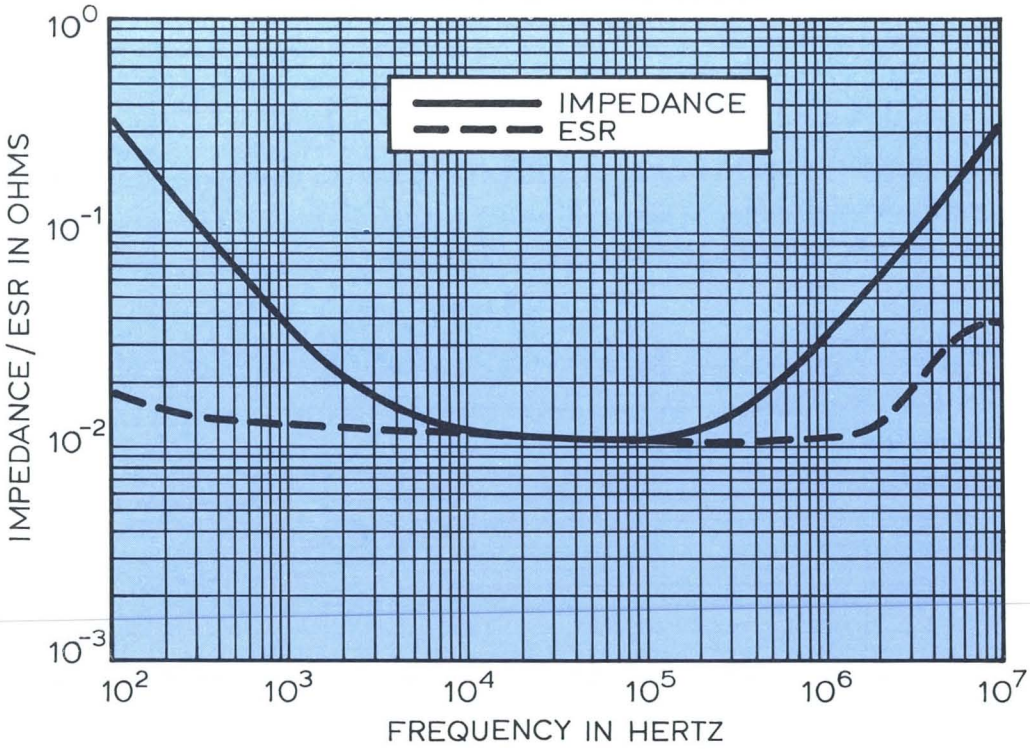
TYPICAL CURVES @ +25°C

TYPE 88D — 27000μF @ 12VDC, BB CASE SIZE



Dwg. No. A-14,675

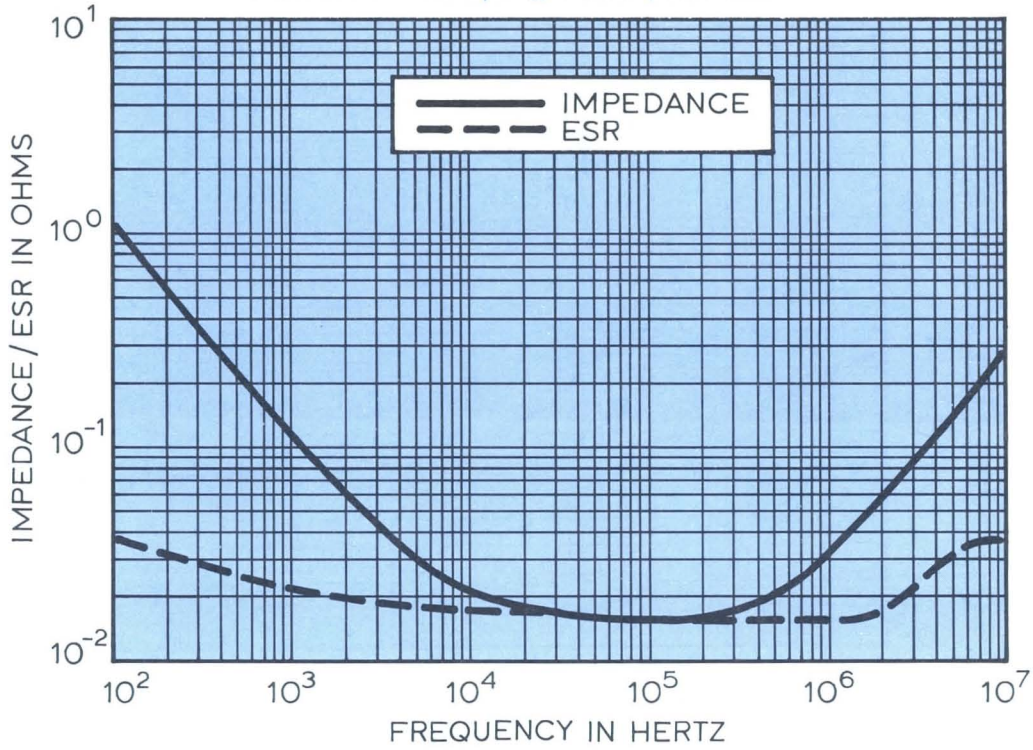
TYPE 88D — 4700μF @ 25VDC, BA CASE SIZE



Dwg. No. A-14,674

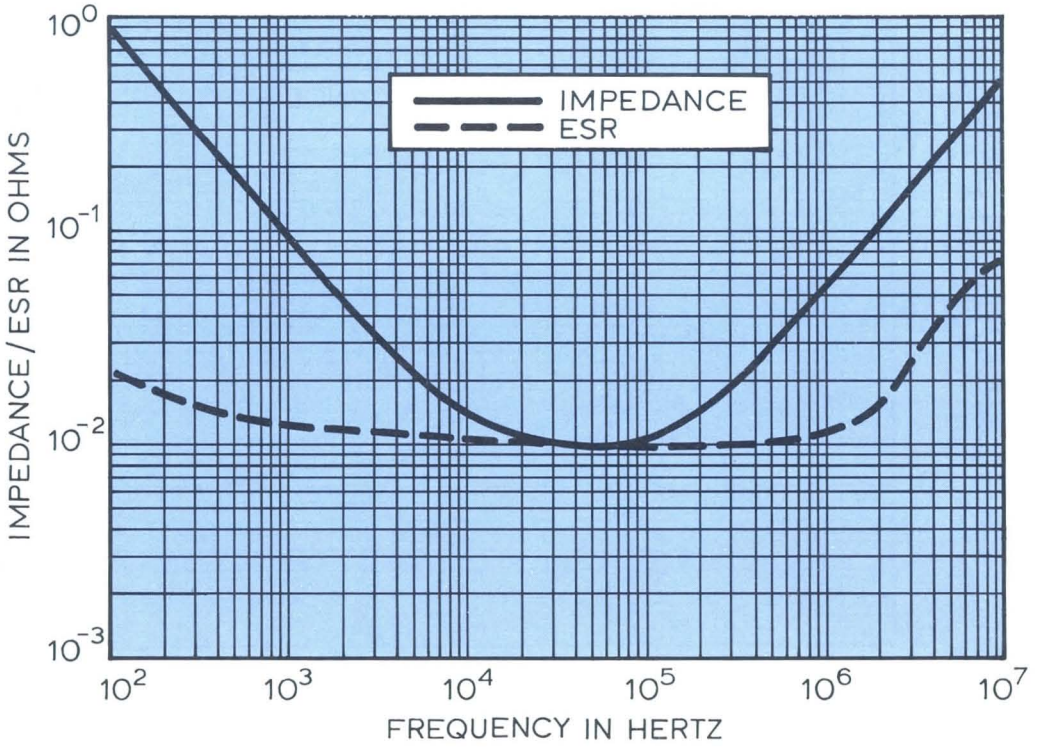
TYPICAL CURVES @ +25°C

TYPE 88D — 1500μF @ 63VDC, BA CASE SIZE



Dwg. No. A-14,673

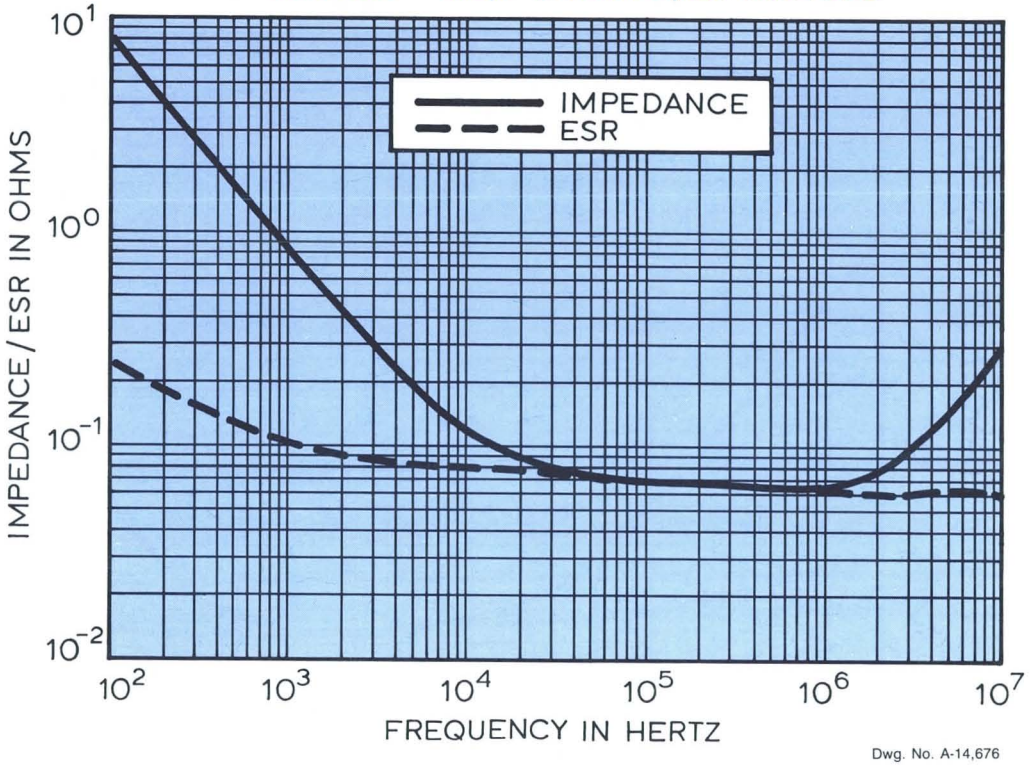
TYPE 88D — 1800μF @ 100VDC, BB CASE SIZE



Dwg. No. A-14,672

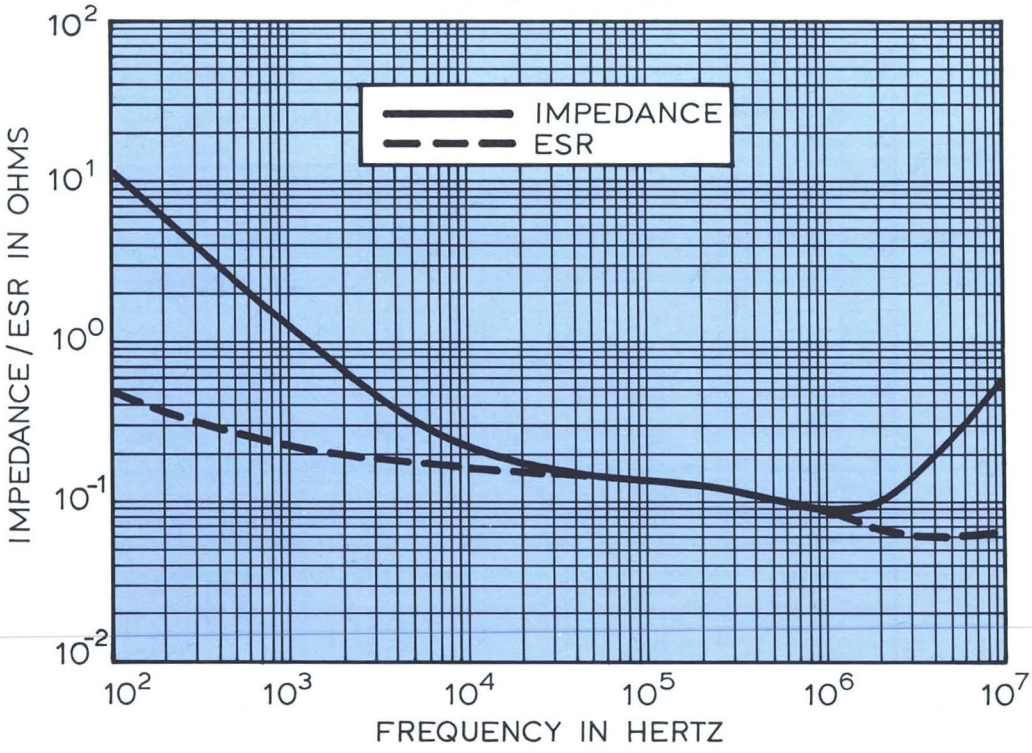
TYPICAL CURVES @ +25°C

TYPE 88D — 220μF @ 200VDC, BA CASE SIZE



Dwg. No. A-14,676

TYPE 88D — 150μF @ 450VDC, BB CASE SIZE



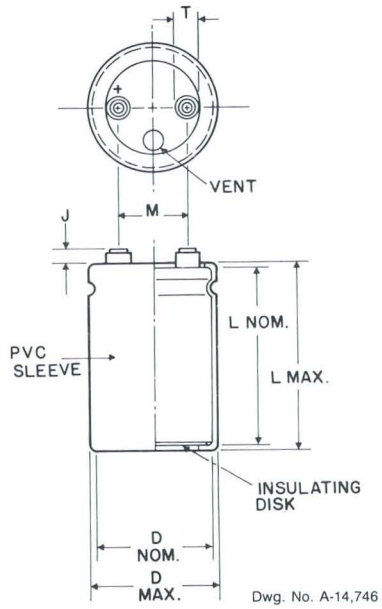
Dwg. No. A-14,677

Large Can Capacitors

SPRAGUE®

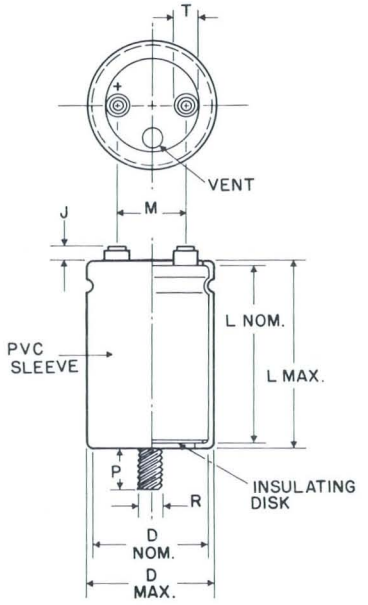
OUTLINE DRAWING

TYPES 36DY, 602D, 622D SCREW-INSERT TERMINALS



Dwg. No. A-14,746

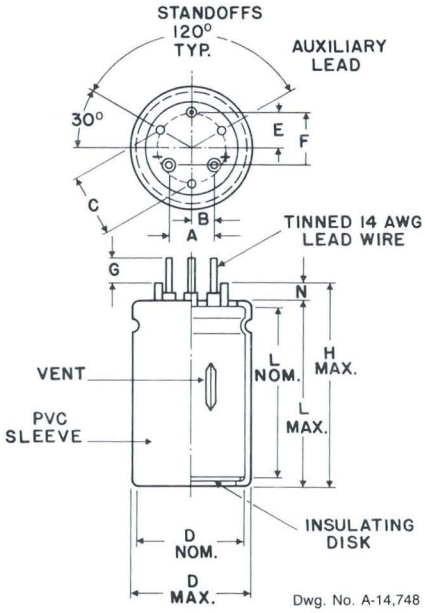
TYPES 36DM, 602DM, 622DM SCREW-INSERT TERMINALS



Dwg. No. A-14,747

WITH STUD-MOUNT FEATURE (NOT AVAILABLE ON "DJ" CASE CODE SIZE AND "E" DIAMETER CASES)

TYPES 36DY, 602D, 622D CODE P VERTICAL MOUNT



Dwg. No. A-14,748

CIRCUIT BOARD VERTICAL MOUNT AVAILABLE ON "A", "E" AND "B" DIAMETER CODES ONLY (≤2.0 inch — 51 mm-dia.)

TERMINAL DIMENSIONS

Terminal Code	Thread	Inches			Millimeters			Notes
		Thread Depth	Height J ± 0.032	Diameter T ± 0.032	Thread Depth	Height J ± 0.8	Diameter T ± 0.8	
A	10-32 NF-28	0.219	0.063	0.313	5.6	1.6	8.0	All Sizes
B	10-32 NF-28	0.375	0.250	0.313	9.5	6.4	8.0	All Sizes
D	1/4-28 NF-28	0.344	0.093	0.688	8.7	2.4	17.5	C & D Dia. Codes Only
I	M5	0.375	0.250	0.438	9.5	6.4	11.1	602D, 622D Series Only
N	M5	0.219	0.063	0.313	5.6	1.6	8.0	36DM Series Only
T	M5	0.375	0.250	0.438	9.5	6.4	11.1	36DM Series Only

STUD DIMENSIONS

Case Diameter	R Thread	P ±1.0mm Height
A	M8	12
B, C, D	M12	16
E	N/A	N/A

DIMENSIONS FOR LARGE CAN CAPACITORS (36DY/DM, 602D/DM, 622D/DM)

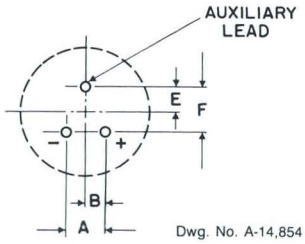
DIMENSIONS IN INCHES

Case Code	Nominal		With Insulating Sleeve			Terminal Spacing
	D ± 0.032″	L ± 0.063″	D Max.	L Max.	(P Term) H Max.	M ± 0.016″
AN	1.375	1.625	1.453	1.750	1.849	0.500
AY	1.375	1.875	1.453	2.000	1.099	0.500
AA	1.375	2.125	1.453	2.250	1.349	0.500
AM	1.375	2.625	1.453	2.750	1.849	0.500
AB	1.375	3.125	1.453	3.250	1.349	0.500
AL	1.375	3.625	1.453	3.750	1.849	0.500
AC	1.375	4.125	1.453	4.250	1.349	0.500
AD	1.375	4.625	1.453	4.750	1.849	0.500
AE	1.375	5.125	1.453	5.250	1.349	0.500
AF	1.375	5.625	1.453	5.750	1.849	0.500
EN	1.750	1.625	1.828	1.750	1.849	0.750
EY	1.750	1.875	1.828	2.000	2.099	0.750
EA	1.750	2.125	1.828	2.250	2.349	0.750
EM	1.750	2.625	1.828	2.750	2.849	0.750
EB	1.750	3.125	1.828	3.250	3.349	0.750
EL	1.750	3.625	1.828	3.750	3.849	0.750
EC	1.750	4.125	1.828	4.250	4.349	0.750
ED	1.750	4.625	1.828	4.750	4.849	0.750
EE	1.750	5.125	1.828	5.250	5.349	0.750
EF	1.750	5.625	1.828	5.750	5.849	0.750
BY	2.000	1.875	2.078	2.000	2.099	0.875
BA	2.000	2.125	2.078	2.250	2.349	0.875
BM	2.000	2.625	2.078	2.750	2.849	0.875
BB	2.000	3.125	2.078	3.250	3.349	0.875
BL	2.000	3.625	2.078	3.750	3.849	0.875
BC	2.000	4.125	2.078	4.250	4.349	0.875
BD	2.000	4.625	2.078	4.750	4.849	0.875
BE	2.000	5.125	2.078	5.250	5.349	0.875
BF	2.000	5.625	2.078	5.750	5.849	0.875
CB	2.500	3.125	2.578	3.250	N/A	1.125
CL	2.500	3.625	2.578	3.750	N/A	1.125
CC	2.500	4.125	2.578	4.250	N/A	1.125
CD	2.500	4.625	2.578	4.750	N/A	1.125
CE	2.500	5.125	2.578	5.250	N/A	1.125
CF	2.500	5.625	2.578	5.750	N/A	1.125
DB	3.000	3.125	3.078	3.250	N/A	1.250
DL	3.000	3.625	3.078	3.750	N/A	1.250
DG	3.000	4.125	3.078	4.250	N/A	1.250
DD	3.000	4.625	3.078	4.750	N/A	1.250
DE	3.000	5.125	3.078	5.250	N/A	1.250
DF	3.000	5.625	3.078	5.750	N/A	1.250
DJ	3.000	8.625	3.078	8.750	N/A	1.250

DIMENSIONS IN MILLIMETERS

Case Code	Nominal		With Insulating Sleeve			Terminal Spacing	Typical Weight
	D ± 1mm	L ± 1mm	D Max.	L Max.	(P Term) H Max.	M ± 0.4mm	(Grams)
AN	35	41	36.9	44.5	47.0	12.7	43
AY	35	48	36.9	50.8	53.3	12.7	54
AA	35	54	36.9	57.2	59.7	12.7	63
AM	35	67	36.9	69.9	72.4	12.7	82
AB	35	79	36.9	82.6	85.1	12.7	105
AL	35	92	36.9	95.3	97.8	12.7	122
AC	35	105	36.9	108.0	110.5	12.7	129
AD	35	117	36.9	120.7	123.2	12.7	162
AE	35	130	36.9	133.4	125.9	12.7	179
AF	35	143	36.9	146.1	148.6	12.7	201
EN	44	41	46.4	44.5	47.0	19.1	71
EY	44	48	46.4	50.8	53.3	19.1	88
EA	44	54	46.4	57.2	59.7	19.1	102
EM	44	67	46.4	69.9	72.4	19.1	133
EB	44	79	46.4	82.6	85.1	19.1	167
EL	44	92	46.4	95.3	97.8	19.1	198
EC	44	105	46.4	108.0	110.5	19.1	230
ED	44	117	46.4	120.7	123.2	19.1	252
EE	44	130	46.4	133.4	135.9	19.1	269
EF	44	143	46.4	146.1	148.6	19.1	318
BY	51	48	52.8	50.8	53.3	22.2	113
BA	51	54	52.8	57.2	59.7	22.2	133
BM	51	67	52.8	69.9	72.4	22.2	176
BB	51	79	52.8	82.6	85.1	22.2	213
BL	51	92	52.8	95.3	97.8	22.2	261
BC	51	105	52.8	108.0	110.5	22.2	381
BD	51	117	52.8	120.7	123.2	22.2	326
BE	51	130	52.8	133.4	135.9	22.2	337
BF	51	143	52.8	146.1	148.6	22.2	408
CB	64	79	65.5	82.6	N/A	28.6	329
CL	64	92	65.5	95.3	N/A	28.6	400
CC	64	105	65.5	108.0	N/A	28.6	473
CD	64	117	65.5	120.7	N/A	28.6	562
CE	64	130	65.5	133.4	N/A	28.6	607
CF	64	143	65.5	146.1	N/A	28.6	675
DB	76	79	78.2	82.6	N/A	31.8	496
DL	76	92	78.2	95.3	N/A	31.8	598
DG	76	105	78.2	108.0	N/A	31.8	700
DD	76	117	78.2	120.7	N/A	31.8	802
DE	76	130	78.2	133.4	N/A	31.8	944
DF	76	143	78.2	146.1	N/A	31.8	1004
DJ	76	219	78.2	222.3	N/A	31.8	1403

LARGE CAN CIRCUIT BOARD LAYOUT (BOTTOM VIEW)



Dwg. No. A-14,854

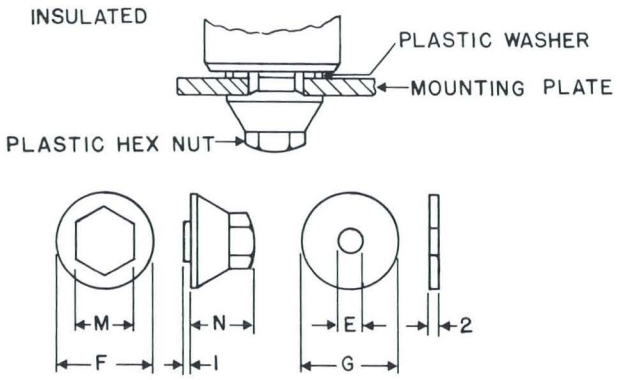
CIRCUIT BOARD MOUNT "P" TERMINAL DIMENSIONS

Inches Nominal Case Diameter	A ± 0.032	B ± 0.032	C* ± 0.032	E ± 0.032	F ± 0.032	G* ± 0.020	N Min.
1.375	0.500	0.250	0.937	0.375	0.550	0.312	0.050
1.750	0.700	0.350	1.350	0.525	0.900	0.312	0.050
2.000	0.800	0.400	1.400	0.575	1.000	0.312	0.050

Millimeters Nominal Case Diameter	A ± 0.8	B ± 0.8	C* ± 0.8	E ± 0.8	F ± 0.8	G* ± 0.5	N Min.
35	12.7	6.4	23.8	9.5	14.0	7.9	1.3
44	17.8	8.9	31.8	13.3	22.9	7.9	1.3
51	20.3	10.2	38.1	14.6	25.4	7.9	1.3

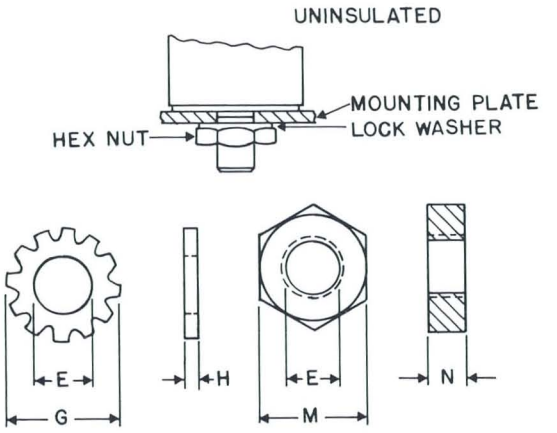
*Refer to outline drawing for code P on page 220.

LARGE CAN MOUNTING KITS (INSULATED) FIGURE 2



Dwg. No. A-14,858

LARGE CAN MOUNTING KITS (UNINSULATED) FIGURE 3



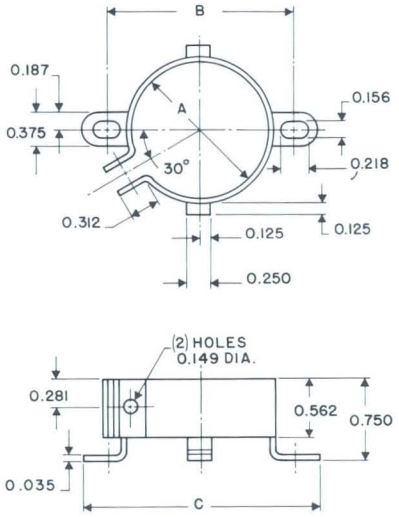
Dwg. No. A-14,857

MOUNTING KITS

Type	Part Number	E	F	G	H	M	N	Figure Number
Insulated M8	50-8	8.4	25	25.0	—	17	15	2
Uninsulated M8	50-8A	8.4	—	14.0	0.8	13	4	3
Insulated M12	50-8B	13.0	30	25.0	—	19	20	2
Uninsulated M12	50-8C	13.0	—	20.5	1.0	19	7	3

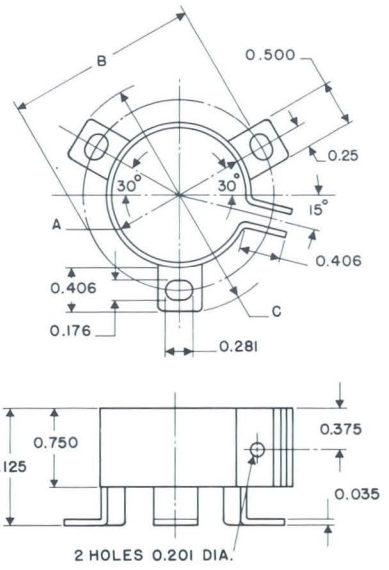
LARGE CAN BRACKETS (INCHES)

FIGURE 1



Dwg. No. A-14,749

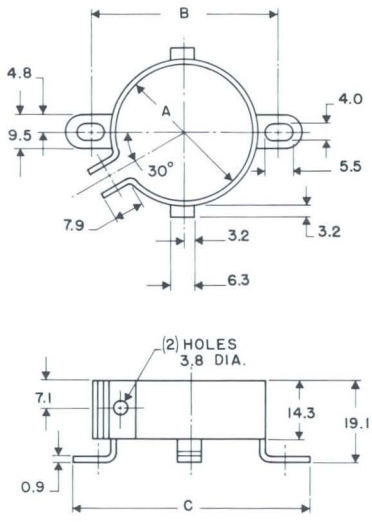
FIGURE 2



Dwg. No. A-14,855

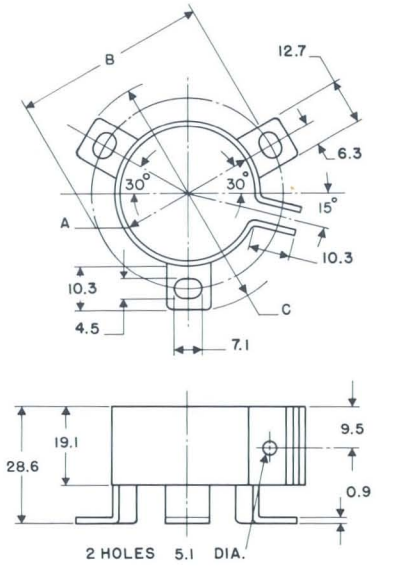
LARGE CAN BRACKETS (MILLIMETERS)

FIGURE 1



Dwg. No. A-14,750

FIGURE 2



Dwg. No. A-14,856

BRACKETS

Type	Part Number	A	B	C	Figure Number
2 Feet	4586-97A	1.375	1.781	2.218	1
3 Feet	4586-48	2.000	2.500	2.875	2
3 Feet	4586-1	2.500	3.000	3.375	2
3 Feet	4586-2	3.000	3.500	3.875	2

+85°C Large Can Aluminum Capacitors


9912

Features —

- The Industry Standard for Large Can Aluminum Capacitors
- Ideal for High Wattage Power Supplies and Energy Storage Applications
- Capacitance Values to 2.2 Farads
- Largest CV Available
- Highest Voltage Available
- Metric Threads and Stud Mount Versions Included

General Specifications —

Operating Temperature: −40°C - +85°C.

Voltage Range: 6.3 - 450 VDC.

Capacitance Range: 100μF - 2.2F.

Capacitance Tolerance: −10%, +50%.

Case Size Range: 1.375″ x 1.625″ - 3.0″ x 8.675″.

Termination: Screw terminals and solderable terminals.

Life Validation Test: 2000 hours at +85°C:
- Δ CAP ≤ 15% from initial measurement.
- Δ ESR ≤ 1.5x initial specified limit.
- Δ DCL ≤ initial specified limit.

Shelf Test: 500 hours at +85°C:
- Δ CAP ≤ 15% from initial measurement.
- Δ ESR ≤ 1.2x initial specified limit.
- Δ DCL ≤ 2x initial specified limit.

DC Leakage Current: $I = K\sqrt{CV}$
K = 4.0 at +25°C; 32.0 at +85°C.
C in μF, V in Volts, I in μA

Ripple Current Multipliers:

TEMPERATURE

Ambient Temperature	Multipliers
+85°C	1.0
+75°C	1.4
+65°C	1.7
+55°C & below	2.0

FREQUENCY Hz

Rated WVDC	120	400	1000 & Up
0-50	1.0	1.05	1.10
51-100	1.0	1.10	1.15
150-300	1.0	1.15	1.25
301-450	1.0	1.20	1.30

Expected Life: SEE PAGE 270.

Performance Characteristics: SEE PAGE 266.

Note: Type 36DE and Type 36DX are not recommended for new design. For technical information see Sprague Engineering Bulletin nos. 3431E and 3432.

Catalog Numbering System

36DY/DM **393** **F** **6R3** **AN** **2** **A**

LEAD CODE: A = LOW INSERT 10-32 SCREW THREAD (Standard)
B = HIGH INSERT 10-32 SCREW THREAD
D = HIGH CURRENT ¼-28 SCREW THREAD
N = LOW INSERT M5 SCREW THREAD
P = KEYED POLARITY & LEAD PCB MOUNT
T = HIGH INSERT M5 SCREW THREAD

CASE STYLE: 2 = PVC INSULATING SLEEVE (Standard)
5 = PVC SLEEVE WITH RESIN END SEAL
(Optional on P Lead Code) Required for exposure to halogenated cleaning solvents.

CASE CODE. SEE DIMENSIONS, PAGE 221.

DC VOLTAGE RATING. EXPRESSED IN VOLTS. THE LETTER 'R' IS USED TO INDICATE A DECIMAL POINT.

CAPACITANCE TOLERANCE. F = −10%, +50%

CAPACITANCE. EXPRESSED IN MICROFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.
36DY = STANDARD CASE
36DM = STUD MOUNT CASE

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inch) D x L	Max. ESR 120Hz, +25°C (mΩ)	Max. Ripple Current 120Hz, +85°C (A)
6.3 VOLTS DC WORKING; 8 VOLTS DC SURGE				
39,000	36DY393F6R3AN2A	1.375 x 1.625	50	4.27
68,000	36DY683F6R3AA2A	1.375 x 2.125	32	5.92
82,000	36DY823F6R3AM2A	1.375 x 2.625	24	7.39
120,000	36DY124F6R3AB2A	1.375 x 3.125	20	8.70
150,000	36DY154F6R3AL2A	1.375 x 3.625	17.0	9.96
180,000	36DY184F6R3AD2A	1.375 x 4.625	14.0	12.3
220,000	36DY224F6R3AE2A	1.375 x 5.125	13.0	13.3
82,000	36DY823F6R3BY2A	2.000 x 1.875	25	8.03
120,000	36DY124F6R3BA2A	2.000 x 2.125	19.5	9.52
180,000	36DY184F6R3BM2A	2.000 x 2.625	14.0	12.1
220,000	36DY224F6R3BB2A	2.000 x 3.125	11.2	14.4
270,000	36DY274F6R3BL2A	2.000 x 3.625	9.6	16.5
330,000	36DY334F6R3BC2A	2.000 x 4.125	8.5	18.5
390,000	36DY394F6R3BD2A	2.000 x 4.625	7.7	20.3
560,000	36DY564F6R3BF2A	2.000 x 5.625	6.6	23.8
390,000	36DY394F6R3CB2A	2.500 x 3.125	6.3	22.2
560,000	36DY564F6R3CC2A	2.500 x 4.125	5.0	27.6
680,000	36DY684F6R3CD2A	2.500 x 4.625	4.5	30.4
820,000	36DY824F6R3CF2A	2.500 x 5.625	4.1	34.4
680,000	36DY684F6R3DL2A	3.000 x 3.625	5.5	28.1
820,000	36DY824F6R3DC2A	3.000 x 4.125	4.9	31.2
1,000,000	36DY105F6R3DD2A	3.000 x 4.625	4.5	34.0
1,200,000	36DY125F6R3DE2A	3.000 x 5.125	4.3	36.2
2,200,000	36DY225F6R3DJ2A	3.000 x 8.625	3.4	50.0
10 VOLTS DC WORKING; 12 VOLTS DC SURGE				
27,000	36DY273F010AN2A	1.375 x 1.625	50	4.23
47,000	36DY473F010AA2A	1.375 x 2.125	32	5.86
68,000	36DY683F010AM2A	1.375 x 2.625	24	7.31
82,000	36DY823F010AB2A	1.375 x 3.125	19.8	8.65
100,000	36DY104F010AL2A	1.375 x 3.625	17.2	9.87
120,000	36DY124F010AC2A	1.375 x 4.125	15.2	11.1
150,000	36DY154F010AD2A	1.375 x 4.625	14.0	12.2
180,000	36DY184F010AF2A	1.375 x 5.625	12.0	14.3
68,000	36DY683F010BY2A	2.000 x 1.875	26	7.99
82,000	36DY823F010BA2A	2.000 x 2.125	19.7	9.47
120,000	36DY124F010BM2A	2.000 x 2.625	14.1	12.1
180,000	36DY184F010BB2A	2.000 x 3.125	11.2	14.4
220,000	36DY224F010BL2A	2.000 x 3.625	9.6	16.5
270,000	36DY274F010BC2A	2.000 x 4.125	8.6	18.4
390,000	36DY394F010BF2A	2.000 x 5.625	6.7	23.7
270,000	36DY274F010CB2A	2.500 x 3.125	6.4	21.9
470,000	36DY474G010CC2A	2.500 x 4.125	5.0	27.6
680,000	36DY684F010CF2A	2.500 x 5.625	4.2	34.0
560,000	36DY564F010DL2A	3.000 x 3.625	5.5	28.1
680,000	36DY684G010DC2A	3.000 x 4.125	5.0	30.9
820,000	36DY824F010DD2A	3.000 x 4.625	4.5	34.0
1,000,000	36DY105F010DF2A	3.000 x 5.625	4.1	38.4
1,500,000	36DY155F010DJ2A	3.000 x 8.625	3.4	50.0
15 VOLTS DC WORKING; 18 VOLTS DC SURGE				
18,000	36DY183F015AN2A	1.375 x 1.625	52	4.16
33,000	36DY333F015AA2A	1.375 x 2.125	33	5.77
47,000	36DY473F015AM2A	1.375 x 2.625	25	7.19
56,000	36DY563F015AB2A	1.375 x 3.125	20	8.55

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inch) D x L	Max. ESR 120Hz, +25°C (mΩ)	Max. Ripple Current 120Hz, +85°C (A)
15 VOLTS DC WORKING; 18 VOLTS DC SURGE (Cont.)				
68,000	36DY683F015AL2A	1.375 x 3.625	17.5	9.79
82,000	36DY823F015AC2A	1.375 x 4.125	15.7	10.9
100,000	36DY104F015AD2A	1.375 x 4.625	14.2	12.1
120,000	36DY124F015AF2A	1.375 x 5.625	12.5	14.0
39,000	36DY393F015BY2A	2.000 x 1.875	26	7.92
56,000	36DY563F015BA2A	2.000 x 2.125	20	9.40
82,000	36DY823F015BM2A	2.000 x 2.625	14.3	12.0
100,000	36DY104F015BB2A	2.000 x 3.125	11.6	14.2
120,000	36DY124F015BL2A	2.000 x 3.625	9.8	16.3
150,000	36DY154F015BC2A	2.000 x 4.125	8.7	18.3
180,000	36DY184F015BD2A	2.000 x 4.625	7.9	20.0
220,000	36DY224F015BF2A	2.000 x 5.625	6.7	23.6
180,000	36DY184F015CB2A	2.500 x 3.125	6.6	21.7
270,000	36DY274F015CC2A	2.500 x 4.125	5.1	27.3
330,000	36DY334F015CD2A	2.500 x 4.625	4.8	29.4
470,000	36DY474F015CF2A	2.500 x 5.625	4.2	34.0
390,000	36DY394F015DL2A	3.000 x 3.625	5.5	28.1
470,000	36DY474F015DC2A	3.000 x 4.125	5.0	30.9
560,000	36DY564F015DE2A	3.000 x 5.125	4.3	36.2
680,000	36DY684F015DF2A	3.000 x 5.625	4.1	38.4
1,000,000	36DY105F015DJ2A	3.000 x 8.625	3.4	50.0
25 VOLTS DC WORKING; 30 VOLTS DC SURGE				
6,800	36DY682F025AN2A	1.375 x 1.625	54	4.08
12,000	36DY123F025AA2A	1.375 x 2.125	35	5.61
18,000	36DY183F025AM2A	1.375 x 2.625	25	7.12
22,000	36DY223F025AB2A	1.375 x 3.125	21	8.42
27,000	36DY273F025AL2A	1.375 x 3.625	18.0	9.65
33,000	36DY333F025AC2A	1.375 x 4.125	15.9	10.9
39,000	36DY393F025AD2A	1.375 x 4.625	14.6	11.9
47,000	36DY473F025AF2A	1.375 x 5.625	12.6	14.0
15,000	36DY153F025BY2A	2.000 x 1.875	28	7.59
22,000	36DY223F025BA2A	2.000 x 2.125	21	9.29
33,000	36DY333F025BM2A	2.000 x 2.625	15.4	11.5
47,000	36DY473F025BB2A	2.000 x 3.125	12.3	13.8
56,000	36DY563F025BL2A	2.000 x 3.625	10.4	15.9
68,000	36DY683F025BC2A	2.000 x 4.125	9.1	17.9
82,000	36DY823F025BD2A	2.000 x 4.625	8.3	19.6
100,000	36DY104F025BF2A	2.000 x 5.625	7.2	22.8
82,000	36DY823F025CB2A	2.500 x 3.125	8.9	18.6
120,000	36DY124F025CC2A	2.500 x 4.125	6.7	23.8
180,000	36DY184F025CF2A	2.500 x 5.625	5.2	30.6
150,000	36DY154F025DL2A	3.000 x 3.625	5.8	27.4
180,000	36DY184F025DC2A	3.000 x 4.125	5.2	30.3
220,000	36DY224F025DE2A	3.000 x 5.125	4.5	35.3
270,000	36DY274F025DF2A	3.000 x 5.625	4.3	37.5
390,000	36DY394F025DJ2A	3.000 x 8.625	3.5	49.5
40 VOLTS DC WORKING; 50 VOLTS DC SURGE				
4,700	36DY472F040AN2A	1.375 x 1.625	59	3.89
6,800	36DY682F040AA2A	1.375 x 2.125	37	5.42
10,000	36DY103F040AM2A	1.375 x 2.625	28	6.84
12,000	36DY123F040AB2A	1.375 x 3.125	23	8.10
15,000	36DY153F040AL2A	1.375 x 3.625	19.4	9.30
18,000	36DY183F040AC2A	1.375 x 4.125	17.2	10.4
22,000	36DY223F040AD2A	1.375 x 4.625	15.5	11.5
27,000	36DY273F040AE2A	1.375 x 5.125	14.2	12.6

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inch) D x L	Max. ESR 120Hz, +25°C (mΩ)	Max. Ripple Current 120Hz, +85°C (A)
40 VOLTS DC WORKING; 50 VOLTS DC SURGE (Cont.)				
10,000	36DY103F040BY2A	2.000 x 1.875	30	7.40
12,000	36DY123F040BA2A	2.000 x 2.125	23	8.84
18,000	36DY183F040BM2A	2.000 x 2.625	16.2	11.3
27,000	36DY273F040BB2A	2.000 x 3.125	12.8	13.5
33,000	36DY333F040BL2A	2.000 x 3.625	10.9	15.5
39,000	36DY393F040BC2A	2.000 x 4.125	9.6	17.4
47,000	36DY473F040BD2A	2.000 x 4.625	8.7	19.1
56,000	36DY563F040BF2A	2.000 x 5.625	7.4	22.5
47,000	36DY473F040CB2A	2.500 x 3.125	9.1	18.4
68,000	36DY683F040CC2A	2.500 x 4.125	7.0	23.3
82,000	36DY823F040CD2A	2.500 x 4.625	6.3	25.7
100,000	36DY104F040CF2A	2.500 x 5.625	5.4	30.0
82,000	36DY823F040DL2A	3.000 x 3.625	6.0	26.9
100,000	36DY104F040DC2A	3.000 x 4.125	5.4	29.7
120,000	36DY124F040DD2A	3.000 x 4.625	5.0	32.2
150,000	36DY154F040DF2A	3.000 x 5.625	4.4	37.1
270,000	36DY274F040DJ2A	3.000 x 8.625	3.6	48.8
50 VOLTS DC WORKING; 65 VOLTS DC SURGE				
3,300	36DY332F050AN2A	1.375 x 1.625	64	3.75
5,600	36DY562F050AA2A	1.375 x 2.125	40	5.25
8,200	36DY822F050AM2A	1.375 x 2.625	29	6.66
10,000	36DY103F050AB2A	1.375 x 3.125	24	7.79
12,000	36DY123F050AL2A	1.375 x 3.625	20	9.07
15,000	36DY153F050AC2A	1.375 x 4.125	18.2	10.1
18,000	36DY183F050AD2A	1.375 x 4.625	16.3	11.3
20,000	36DY203F050AE2A	1.375 x 5.125	15.0	12.3
22,000	36DY223F050AF2A	1.375 x 5.625	14.0	13.2
8,200	36DY822F050BY2A	2.000 x 1.875	31	7.23
10,000	36DY103F050BA2A	2.000 x 2.125	24	8.60
15,000	36DY153F050BM2A	2.000 x 2.625	16.9	11.0
18,000	36DY183F050BB2A	2.000 x 3.125	13.3	13.2
27,000	36DY273F050BL2A	2.000 x 3.625	11.2	15.3
36,000	36DY363F050BD2A	2.000 x 4.625	8.9	18.9
47,000	36DY473F050BF2A	2.000 x 5.625	7.7	22.1
33,000	36DY333F050CB2A	2.500 x 3.125	9.5	18.1
56,000	36DY563F050CC2A	2.500 x 4.125	7.1	23.1
82,000	36DY823F050CF2A	2.500 x 5.625	5.9	29.5
68,000	36DY683F050DL2A	3.000 x 3.625	6.2	26.5
82,000	36DY823F050DC2A	3.000 x 4.125	5.6	29.2
100,000	36DY104F050DE2A	3.000 x 5.125	4.8	34.2
120,000	36DY124F050DF2A	3.000 x 5.625	4.5	36.7
180,000	36DY184F050DJ2A	3.000 x 8.625	3.6	48.8
60 VOLTS DC WORKING; 75 VOLTS DC SURGE				
2,700	36DY272F060AN2A	1.375 x 1.625	69	3.62
4,700	36DY472F060AA2A	1.375 x 2.125	42	5.10
6,800	36DY682F060AM2A	1.375 x 2.625	31	6.47
8,200	36DY822F060AB2A	1.375 x 3.125	25	7.72
10,000	36DY103F060AL2A	1.375 x 3.625	22	8.75
12,000	36DY123F060AC2A	1.375 x 4.125	19.2	9.87

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inch) D x L	Max. ESR 120Hz, +25°C (mΩ)	Max. Ripple Current 120Hz, +85°C (A)
	60 VOLTS DC WORKING; 75 VOLTS DC SURGE (Cont.)			
15,000	36DY153F060AE2A	1.375 x 5.125	15.7	12.0
18,000	36DY183F060AF2A	1.375 x 5.625	14.6	13.0
5,600	36DY562F060BY2A	2.000 x 1.875	32	7.08
8,200	36DY822F060BA2A	2.000 x 2.125	25	8.42
12,000	36DY123F060BM2A	2.000 x 2.625	17.4	10.9
15,000	36DY153F060BB2A	2.000 x 3.125	13.9	13.0
22,000	36DY223F060BL2A	2.000 x 3.625	11.7	15.0
27,000	36DY273F060BD2A	2.000 x 4.625	9.1	18.7
39,000	36DY393F060BF2A	2.000 x 5.625	7.8	21.9
27,000	36DY273F060CB2A	2.500 x 3.125	9.7	17.9
39,000	36DY393F060CC2A	2.500 x 4.125	7.3	22.8
47,000	36DY473F060CD2A	2.500 x 4.625	6.6	25.1
68,000	36DY683F060CF2A	2.500 x 5.625	5.7	29.2
56,000	36DY563F060DL2A	3.000 x 3.625	6.3	26.3
68,000	36DY683F060DD2A	3.000 x 4.625	5.2	31.6
82,000	36DY823F060DE2A	3.000 x 5.125	4.9	33.9
100,000	36DY104F060DF2A	3.000 x 5.625	4.5	36.7
150,000	36DY154F060DJ2A	3.000 x 8.625	3.7	48.2
	75 VOLTS DC WORKING; 95 VOLTS DC SURGE			
1,800	36DY182F075AN2A	1.375 x 1.625	104	2.95
3,300	36DY332F075AA2A	1.375 x 2.125	62	4.19
4,700	36DY472F075AM2A	1.375 x 2.625	44	5.40
5,600	36DY562F075AB2A	1.375 x 3.125	36	6.45
6,800	36DY682F075AL2A	1.375 x 3.625	30	7.50
8,200	36DY822F075AC2A	1.375 x 4.125	26	8.47
10,000	36DY103F075AD2A	1.375 x 4.625	24	9.26
12,000	36DY123F075AE2A	1.375 x 5.125	21	10.3
4,700	36DY472F075BY2A	2.000 x 1.875	47	5.91
5,600	36DY562F075BA2A	2.000 x 2.125	36	6.97
8,200	36DY822F075BM2A	2.000 x 2.625	24	9.19
12,000	36DY123F075BB2A	2.000 x 3.125	18.8	11.1
15,000	36DY153F075BL2A	2.000 x 3.625	15.8	12.9
18,000	36DY183F075BC2A	2.000 x 4.125	13.7	14.5
22,000	36DY223F075BD2A	2.000 x 4.625	12.3	16.1
27,000	36DY273F075BF2A	2.000 x 5.625	10.1	19.3
22,000	36DY223F075CB2A	2.500 x 3.125	12.3	15.9
33,000	36DY333F075CC2A	2.500 x 4.125	8.9	20.7
39,000	36DY393F075CD2A	2.500 x 4.625	8.0	22.8
47,000	36DY473F075CF2A	2.500 x 5.625	6.7	26.9
39,000	36DY393F075DL2A	3.000 x 3.625	10.3	20.5
47,000	36DY473F075DC2A	3.000 x 4.125	8.9	23.2
56,000	36DY563F075DD2A	3.000 x 4.625	8.0	25.5
68,000	36DY683F075DF2A	3.000 x 5.625	6.7	30.0
120,000	36DY124F075DJ2A	3.000 x 8.625	5.0	41.5
	100 VOLTS DC WORKING; 125 VOLTS DC SURGE			
1,000	36DY102F100AN2A	1.375 x 1.625	131	2.61
1,500	36DY152F100AA2A	1.375 x 2.125	79	3.73
1,800	36DY182F100AM2A	1.375 x 2.625	56	4.82
2,700	36DY272F100AB2A	1.375 x 3.125	44	5.79
3,900	36DY392F100AL2A	1.375 x 3.625	37	6.78
4,700	36DY472F100AC2A	1.375 x 4.125	32	7.68
5,600	36DY562F100AE2A	1.375 x 5.125	25	9.43
6,800	36DY682F100AF2A	1.375 x 5.625	23	10.3

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size (inch) D x L	Max. ESR 120Hz, +25°C (mΩ)	Max. Ripple Current 120Hz, +85°C (A)
100 VOLTS DC WORKING; 125 VOLTS DC SURGE (Cont.)				
2,200	36DY222F100BY2A	2.000 x 1.875	59	5.27
2,700	36DY272F100BA2A	2.000 x 2.125	46	6.19
4,700	36DY472F100BM2A	2.000 x 2.625	30	8.29
5,600	36DY562F100BB2A	2.000 x 3.125	23	10.0
8,200	36DY822F100BL2A	2.000 x 3.625	18.9	11.8
10,000	36DY103F100BC2A	2.000 x 4.125	16.3	13.3
12,000	36DY123F100BF2A	2.000 x 5.625	12.3	17.5
10,000	36DY103F100CB2A	2.500 x 3.125	14.8	14.5
15,000	36DY153F100CC2A	2.500 x 4.125	10.4	19.1
18,000	36DY183F100CD2A	2.500 x 4.625	9.5	20.9
22,000	36DY223F100CF2A	2.500 x 5.625	7.8	25.0
18,000	36DY183F100DL2A	3.000 x 3.625	11.2	19.7
22,000	36DY223F100DC2A	3.000 x 4.125	9.7	22.2
27,000	36DY273F100DD2A	3.000 x 4.625	8.7	24.4
33,000	36DY333F100DE2A	3.000 x 5.125	7.9	26.7
56,000	36DY563F100DJ2A	3.000 x 8.625	5.4	39.9
150 VOLTS DC WORKING; 175 VOLTS DC SURGE				
390	36DY391F150AN2A	1.375 x 1.625	245	1.56
680	36DY681F150AA2A	1.375 x 2.125	141	2.27
1,000	36DY102F150AM2A	1.375 x 2.625	96	2.99
1,200	36DY122F150AB2A	1.375 x 3.125	80	3.51
1,500	36DY152F150AL2A	1.375 x 3.625	64	4.18
1,800	36DY182F150AC2A	1.375 x 4.125	53	4.85
2,200	36DY222F150AE2A	1.375 x 5.125	43	5.92
2,700	36DY272F150AF2A	1.375 x 5.625	35	6.84
820	36DY821F150BY2A	2.000 x 1.875	153	2.66
1,200	36DY122F150BA2A	2.000 x 2.125	104	3.37
1,800	36DY182F150BM2A	2.000 x 2.625	70	4.42
2,200	36DY222F150BB2A	2.000 x 3.125	57	5.22
2,700	36DY272F150BL2A	2.000 x 3.625	46	6.16
3,300	36DY332F150BC2A	2.000 x 4.125	38	7.13
3,900	36DY392F150BD2A	2.000 x 4.625	32	8.14
5,600	36DY562F150BF2A	2.000 x 5.625	22	10.66
3,900	36DY392F150CB2A	2.500 x 3.125	31	8.16
5,600	36DY562F150CC2A	2.500 x 4.125	22	10.73
10,000	36DY103F150CF2A	2.500 x 5.625	12	16.43
8,200	36DY822F150DL2A	3.000 x 3.625	20	12.04
10,000	36DY103F150DC2A	3.000 x 4.125	17	13.68
12,000	36DY123F150DE2A	3.000 x 5.125	14	16.36
22,000	36DY223F150DJ2A	3.000 x 8.625	8	26.75
200 VOLTS DC WORKING; 250 VOLTS DC SURGE				
330	36DY331F200AN2A	1.375 x 1.625	254	1.54
560	36DY661F200AA2A	1.375 x 2.125	150	2.20
820	36DY821F200AM2A	1.375 x 2.625	102	2.90
1,000	36DY102F200AB2A	1.375 x 3.125	84	3.43
1,200	36DY122F200AL2A	1.375 x 3.625	70	4.00
1,500	36DY152F200AC2A	1.375 x 4.125	56	4.72
1,800	36DY182F200AE2A	1.375 x 5.125	47	5.66
2,200	36DY222F200AF2A	1.375 x 5.625	38	6.56
680	36DY681F200BY2A	2.000 x 1.875	158	2.62
1,000	36DY102F200BA2A	2.000 x 2.125	108	3.30
1,500	36DY152F200BM2A	2.000 x 2.625	72	4.36
1,800	36DY182F200BB2A	2.000 x 3.125	60	5.09

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inch) D x L	Max. ESR 120Hz, +25°C (mΩ)	Max. Ripple Current 120Hz, +85°C (A)
200 VOLTS DC WORKING; 250 VOLTS DC SURGE (Cont.)				
2,200	36DY222F200BL2A	2.000 x 3.625	49	5.97
2,700	36DY272F200BC2A	2.000 x 4.125	40	6.95
3,300	36DY332F200BD2A	2.000 x 4.625	33	8.02
4,700	36DY472F200BF2A	2.000 x 5.625	23	10.42
3,300	36DY332F200CB2A	2.500 x 3.125	32	8.03
4,700	36DY472F200CC2A	2.500 x 4.125	22	10.73
5,600	36DY562F200CD2A	2.500 x 4.625	19	12.07
8,200	36DY822F200CF2A	2.500 x 5.625	13	15.79
6,800	36DY682F200DL2A	3.000 x 3.625	20	12.04
8,200	36DY822F200DD2A	3.000 x 4.625	17	14.27
10,000	36DY103F200DE2A	3.000 x 5.125	14	16.36
12,000	36DY123F200DF2A	3.000 x 5.625	11	19.14
18,000	36DY183F200DJ2A	3.000 x 8.625	8	26.75
250 VOLTS DC WORKING; 300 VOLTS DC SURGE				
270	36DY271F250AN2A	1.375 x 1.625	275	1.48
470	36DY471F250AA2A	1.375 x 2.125	158	2.15
560	36DY561F250AM2A	1.375 x 2.625	132	2.55
820	36DY821F250AB2A	1.375 x 3.125	90	3.31
1,000	36DY102F250AL2A	1.375 x 3.625	74	3.89
1,200	36DY122F250AC2A	1.375 x 4.125	62	4.49
1,500	36DY152F250AE2A	1.375 x 5.125	49	5.54
1,800	36DY182F250AF2A	1.375 x 5.625	41	6.32
560	36DY561F250BY2A	2.000 x 1.875	165	2.56
820	36DY821F250BA2A	2.000 x 2.125	113	3.23
1,200	36DY122F250BM2A	2.000 x 2.625	77	4.21
1,500	36DY152F250BB2A	2.000 x 3.125	62	5.01
1,800	36DY182F250BL2A	2.000 x 3.625	51	5.85
2,200	36DY222F250BC2A	2.000 x 4.125	42	6.78
2,700	36DY272F250BD2A	2.000 x 4.625	34	7.90
3,300	36DY332F250BF2A	2.000 x 5.625	29	9.44
2,700	36DY272F250CB2A	2.500 x 3.125	34	7.79
3,900	36DY392F250CC2A	2.500 x 4.125	23	10.49
4,700	36DY472F250CD2A	2.500 x 4.625	19	12.07
5,600	36DY562F250CF2A	2.500 x 5.625	16	14.23
4,700	36DY472F250DL2A	3.000 x 3.625	24	10.99
5,600	36DY562F250DC2A	3.000 x 4.125	20	12.61
6,800	36DY682F250DD2A	3.000 x 4.625	17	14.27
8,200	36DY822F250DE2A	3.000 x 5.125	14	16.35
10,000	36DY103F250DF2A	3.000 x 5.625	11	19.14
15,000	36DY153F250DJ2A	3.000 x 8.625	8	26.75
350 VOLTS DC WORKING; 400 VOLTS DC SURGE				
150	36DY151F350AN2A	1.375 x 1.625	853	0.84
220	36DY221F350AA2A	1.375 x 2.125	681	1.12
330	36DY331F350AM2A	1.375 x 2.625	388	1.49
470	36DY471F350AB2A	1.375 x 3.125	272	1.91
560	36DY561F350AL2A	1.375 x 3.625	228	2.21
680	36DY681F350AC2A	1.375 x 4.125	188	2.58
820	36DY821F350AE2A	1.375 x 5.125	156	3.11
1,000	36DY102F350AF2A	1.375 x 5.625	128	3.58

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size (inch) D x L	Max. ESR 120Hz, +25°C (mΩ)	Max. Ripple Current 120Hz, +85°C (A)
350 VOLTS DC WORKING; 400 VOLTS DC SURGE (Cont.)				
330	36DY331F350BY2A	2.000 x 1.875	412	1.62
470	36DY471F350BA2A	2.000 x 2.125	289	2.02
680	36DY681F350BM2A	2.000 x 2.625	200	2.61
820	36DY821F350BB2A	2.000 x 3.125	166	3.06
1,000	36DY102F350BL2A	2.000 x 3.625	136	3.58
1,200	36DY122F350BC2A	2.000 x 4.125	113	4.13
1,500	36DY152F350BD2A	2.000 x 4.625	91	4.83
1,800	36DY182F350BF2A	2.000 x 5.625	76	5.73
1,500	36DY152F350CB2A	2.500 x 3.125	90	4.79
2,200	36DY222F350CC2A	2.500 x 4.125	61	6.44
2,700	36DY272F350CD2A	2.500 x 4.625	50	7.44
3,300	36DY332F350CF2A	2.500 x 5.625	41	8.89
2,700	36DY272F350DL2A	3.000 x 3.625	53	7.39
3,300	36DY332F350DC2A	3.000 x 4.125	44	8.50
3,900	36DY392F350DD2A	3.000 x 4.625	37	9.68
4,700	36DY472F350DE2A	3.000 x 5.125	31	10.99
8,200	36DY822F350DJ2A	3.000 x 8.625	18	17.83
400 VOLTS DC WORKING; 450 VOLTS DC SURGE				
120	36DY121F400AN2A	1.375 x 1.625	964	0.79
180	36DY181F400AA2A	1.375 x 2.125	643	1.06
270	36DY271F400AM2A	1.375 x 2.625	429	1.41
330	36DY331F400AB2A	1.375 x 3.125	351	1.68
470	36DY471F400AL2A	1.375 x 3.625	246	2.13
560	36DY561F400AC2A	1.375 x 4.125	207	2.58
680	36DY681F400AE2A	1.375 x 5.125	170	2.98
820	36DY821F400AF2A	1.375 x 5.625	141	3.41
270	36DY271F400BY2A	2.000 x 1.875	466	1.54
330	36DY331F400BA2A	2.000 x 2.125	372	1.78
560	36DY561F400BM2A	2.000 x 2.625	219	2.50
680	36DY681F400BB2A	2.000 x 3.125	181	2.93
820	36DY821F400BL2A	2.000 x 3.625	150	3.41
1,000	36DY102F400BC2A	2.000 x 4.125	123	3.96
1,200	36DY122F400BD2A	2.000 x 4.625	102	4.56
1,500	36DY152F400BF2A	2.000 x 5.625	82	5.52
1,200	36DY122F400CB2A	2.500 x 3.125	101	4.52
1,800	36DY182F400CC2A	2.500 x 4.125	67	5.15
2,200	36DY222F400CD2A	2.500 x 4.625	55	7.09
2,700	36DY272F400CF2A	2.500 x 5.625	45	8.48
2,200	36DY222F400DL2A	3.000 x 3.625	59	7.01
2,700	36DY272F400DC2A	3.000 x 4.125	48	8.14
3,300	36DY332F400DD2A	3.000 x 4.625	39	9.42
3,900	36DY392F400DE2A	3.000 x 5.125	33	10.66
6,800	36DY682F400DJ2A	3.000 x 8.625	19	17.36
450 VOLTS DC WORKING; 525 VOLTS DC SURGE				
100	36DY101F450AN2A	1.375 x 1.625	1048	0.76
180	36DY181F450AA2A	1.375 x 2.125	582	1.12
270	36DY271F450AM2A	1.375 x 2.625	388	1.45
330	36DY331F450AB2A	1.375 x 3.125	317	1.77
390	36DY391F450AL2A	1.375 x 3.625	269	2.04
470	36DY471F450AC2A	1.375 x 4.125	223	2.37
560	36DY561F450AD2A	1.375 x 5.125	187	2.71
680	36DY681F450AE2A	1.375 x 5.625	164	3.13

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inch) D x L	Max. ESR 120Hz, +25°C (mΩ)	Max. Ripple Current 120Hz, +85°C (A)
450 VOLTS DC WORKING; 525 VOLTS DC SURGE (Cont.)				
270	36DY271F450BY2A	2.000 x 1.875	419	1.61
330	36DY331F450BA2A	2.000 x 2.125	343	1.85
470	36DY471F450BM2A	2.000 x 2.625	241	2.38
680	36DY681F450BB2A	2.000 x 3.125	166	3.06
820	36DY821F450BL2A	2.000 x 3.625	138	3.55
1,000	36DY102F450BC2A	2.000 x 4.125	113	4.13
1,200	36DY122F450BD2A	2.000 x 4.625	94	4.75
1,500	36DY152F450BF2A	2.000 x 5.625	75	5.77
1,200	36DY122F450CB2A	2.500 x 3.125	93	4.71
1,800	36DY182F450CC2A	2.500 x 4.125	62	6.39
2,700	36DY272F450CF2A	2.500 x 5.625	42	8.78
2,200	36DY222F450DL2A	3.000 x 3.625	54	7.33
2,700	36DY272F450DC2A	3.000 x 4.125	44	8.50
3,300	36DY332F450DD2A	3.000 x 4.625	36	10.20
3,900	36DY392F450DE2A	3.000 x 5.125	30	11.59
5,600	36DY562F450DJ2A	3.000 x 8.625	21	16.51

MAXIMUM CAPACITANCE VALUES PER CASE SIZE (μF)

Case Code	Size (inch)		VDC																		
	D	L	6.3	7.5	10	15	20	25	30	40	50	60	75	100	150	200	250	300	350	400	450
AN	1.375	1.625	41K	37K	30K	20K	9400	7700	6400	4700	3400	2700	2000	1000	420	350	280	180	150	120	110
AY	1.375	1.875	54K	49K	40K	26K	12K	10K	8800	6400	4800	3900	2800	1400	570	470	380	240	200	160	160
AA	1.375	2.125	68K	62K	50K	33K	15K	12K	10K	7600	5700	4700	3400	1700	710	580	470	300	250	210	190
AM	1.375	2.625	95K	86K	70K	47K	22K	18K	15K	11K	8400	6800	5000	2000	1000	820	660	420	360	290	270
AB	1.375	3.125	120K	110K	91K	60K	28K	23K	19K	14K	10K	8800	6400	3200	1200	1000	850	540	470	380	350
AL	1.375	3.625	150K	130K	110K	73K	34K	29K	24K	17K	13K	10K	7900	4000	1500	1200	1000	670	560	470	430
AC	1.375	4.125	170K	160K	130K	86K	41K	34K	28K	20K	15K	12K	9300	4700	1800	1500	1200	790	680	540	510
AD	1.375	4.625	200K	180K	150K	100K	47K	39K	33K	24K	18K	14K	10K	5400	2100	1700	1400	910	770	630	590
AE	1.375	5.125	230K	210K	170K	110K	53K	44K	37K	27K	20K	16K	12K	6200	2400	2000	1600	1000	880	710	680
AF	1.375	5.625	260K	220K	190K	120K	59K	50K	42K	30K	22K	18K	13K	6900	2700	2200	1800	1100	1000	820	750
EN	1.750	1.625	75K	68K	54K	36K	16K	14K	12K	8700	6500	5300	3900	1900	760	630	510	320	270	220	210
EY	1.750	1.875	99K	89K	73K	48K	22K	19K	16K	11K	8700	7100	5200	2600	1000	840	680	430	370	300	280
EA	1.750	2.125	120K	110K	91K	60K	28K	23K	19K	13K	10K	8200	6000	3000	1200	1000	850	540	460	370	350
EM	1.750	2.625	170K	150K	120K	84K	39K	33K	28K	20K	15K	12K	9100	4600	1700	1400	1100	760	650	530	500
EB	1.750	3.125	220K	200K	160K	100K	50K	43K	36K	26K	19K	16K	11K	5900	2300	1800	1500	980	830	680	640
EL	1.750	3.625	270K	240K	200K	130K	61K	52K	44K	32K	24K	19K	14K	7300	2800	2300	1800	1200	1000	830	790
EC	1.750	4.125	320K	290K	230K	150K	73K	62K	52K	37K	28K	23K	17K	8600	3300	2700	2200	1400	1200	980	930
ED	1.750	4.625	370K	330K	270K	180K	84K	72K	60K	43K	32K	26K	19K	9900	3800	3100	2500	1600	1300	1100	1000
EE	1.750	5.125	420K	380K	310K	200K	95K	81K	68K	49K	37K	30K	22K	11K	4300	3500	2900	1800	1500	1200	1200
EF	1.750	5.625	470K	420K	340K	230K	100K	91K	76K	56K	41K	33K	24K	12K	4800	4000	3200	2000	1700	1400	1300
BY	2.000	1.875	92K	83K	68K	44K	21K	17K	14K	10K	8200	6600	4800	2400	960	790	640	410	350	280	270
BA	2.000	2.125	120K	110K	91K	59K	28K	23K	19K	13K	10K	8300	6200	3000	1200	1000	860	550	470	380	360
BM	2.000	2.625	180K	160K	130K	89K	42K	35K	29K	21K	16K	13K	9700	4900	1900	1500	1200	820	700	570	540
BB	2.000	3.125	240K	220K	180K	110K	57K	47K	39K	28K	21K	17K	13K	6500	2500	2100	1700	1100	930	760	720
BL	2.000	3.625	300K	270K	220K	140K	71K	59K	49K	36K	27K	22K	16K	8200	3200	2600	2100	1300	1100	950	910
BC	2.000	4.125	360K	330K	270K	170K	85K	71K	59K	43K	32K	26K	19K	10K	3800	3100	2500	1600	1400	1100	1000
BD	2.000	4.625	430K	390K	310K	200K	100K	83K	69K	50K	37K	30K	22K	11K	4500	3700	3000	1900	1600	1300	1200
BE	2.000	5.125	490K	440K	360K	230K	110K	95K	79K	57K	43K	35K	26K	13K	5100	4200	3400	2200	1800	1500	1400
BF	2.000	5.625	560K	500K	400K	260K	120K	100K	89K	65K	48K	39K	29K	14K	5800	4700	3800	2400	2100	1700	1600
CB	2.500	3.125	420K	390K	310K	200K	97K	82K	68K	49K	37K	30K	22K	11K	4400	3600	2900	1800	1600	1300	1200
CL	2.500	3.625	520K	470K	390K	250K	120K	100K	85K	62K	46K	37K	28K	14K	5600	4500	3600	2300	2000	1600	1500
CC	2.500	4.125	630K	570K	470K	300K	140K	120K	100K	75K	56K	45K	33K	17K	6600	5400	4400	2800	2400	1900	1800
CD	2.500	4.625	750K	680K	540K	360K	170K	140K	120K	87K	65K	53K	39K	19K	7700	6300	5100	3300	2800	2200	2100
CE	2.500	5.125	840K	760K	620K	410K	190K	160K	130K	99K	74K	60K	44K	22K	8800	7200	5900	3700	3200	2600	2400
CF	2.500	5.625	950K	860K	700K	470K	210K	180K	150K	110K	83K	68K	50K	25K	10K	8200	6600	4200	3600	2900	2700
DB	3.000	3.125	630K	570K	460K	300K	140K	120K	100K	73K	54K	44K	32K	16K	6500	5300	4300	2800	2300	1900	1800
DL	3.000	3.625	790K	710K	580K	390K	180K	150K	120K	91K	68K	56K	41K	20K	8200	6800	5400	3500	2900	2400	2300
DC	3.000	4.125	950K	860K	700K	470K	210K	180K	150K	100K	82K	66K	49K	25K	10K	8000	6500	4200	3500	2900	2700
DD	3.000	4.625	1100K	1000K	820K	540K	250K	210K	170K	120K	95K	78K	57K	29K	11K	9400	7600	4900	4100	3400	3200
DE	3.000	5.125	1200K	1100K	930K	620K	280K	240K	200K	140K	100K	91K	65K	33K	13K	10K	8700	5600	4700	3900	3700
DF	3.000	5.625	1400K	1200K	1000K	690K	320K	270K	220K	160K	120K	100K	75K	37K	14K	12K	10K	6300	5300	4400	4100
DJ	3.000	8.625	2300K	2100K	1700K	1100K	540K	450K	370K	270K	200K	160K	120K	62K	23K	19K	15K	9400	8400	7000	6600

MAXIMUM 120Hz-85°C RIPPLE CURRENT LIMITS FOR MAXIMUM CAPACITANCE VALUES (Amperes)

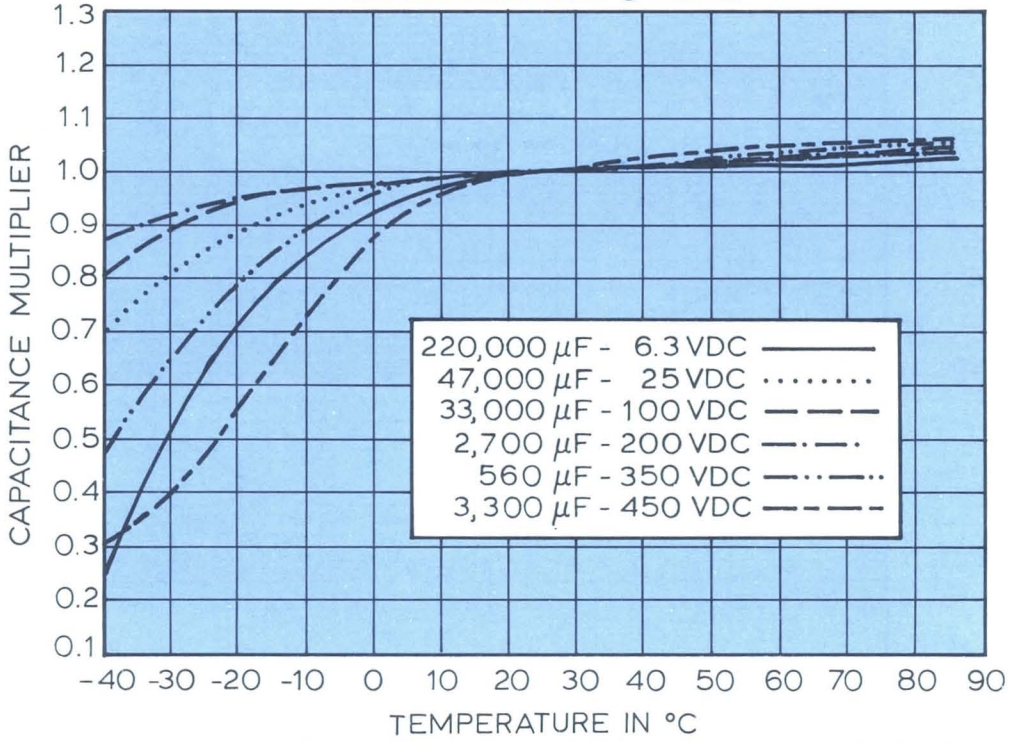
Case Code	Size (inch) D	L	VDC 6.3	7.5	10	15	20	25	30	40	50	60	75	100	150	200	250	300	350	400	450
AN	1.375	1.625	4.27	4.25	4.23	4.16	4.14	4.08	4.03	3.89	3.75	3.62	2.95	2.61	1.51	1.45	1.36	0.76	0.73	0.67	0.65
AY	1.375	1.875	5.12	5.10	5.07	5.00	4.93	4.91	4.88	4.73	4.58	4.45	3.63	3.23	1.85	1.77	1.67	0.93	0.89	0.82	0.83
AA	1.375	2.125	5.92	5.91	5.86	5.77	5.71	5.61	5.53	5.42	5.25	5.10	4.19	3.73	2.17	2.07	1.94	1.08	1.04	0.98	0.95
AM	1.375	2.625	7.39	7.34	7.31	7.19	7.19	7.12	7.02	6.84	6.66	6.47	5.40	4.82	2.79	2.65	2.51	1.39	1.35	1.25	1.23
AB	1.375	3.125	8.70	8.70	8.65	8.55	8.51	8.42	8.30	8.10	7.79	7.72	6.45	5.79	3.28	3.15	3.04	1.71	1.64	1.54	1.51
AL	1.375	3.625	10.0	9.91	9.87	9.79	9.70	9.65	9.60	9.30	9.07	8.75	7.50	6.78	3.87	3.65	3.51	2.01	1.93	1.81	1.77
AC	1.375	4.125	11.1	11.1	11.1	10.9	10.9	10.9	10.7	10.4	10.1	9.87	8.47	7.68	4.45	4.28	4.01	2.31	2.23	2.06	2.04
AD	1.375	4.625	12.3	12.2	12.2	12.1	12.0	11.9	11.8	11.5	11.3	11.0	9.26	8.56	5.02	4.76	4.55	2.61	2.51	2.34	2.31
AE	1.375	5.125	13.3	13.3	13.2	13.0	13.1	13.0	12.9	12.6	12.3	12.0	10.3	9.43	5.57	5.36	5.06	2.85	2.81	2.59	2.57
AF	1.375	5.625	14.4	14.3	14.3	14.0	14.1	14.0	13.9	13.6	13.2	13.0	11.1	10.3	6.12	5.83	5.56	3.11	3.08	2.86	2.83
EN	1.750	1.625	6.88	6.86	6.81	6.68	6.55	6.62	6.55	6.33	6.10	5.92	4.83	4.23	2.23	2.14	2.03	1.16	1.13	1.05	1.04
EY	1.750	1.875	8.23	8.19	8.15	7.99	7.90	7.94	7.85	7.50	7.32	7.11	5.82	5.17	2.68	2.59	2.46	1.42	1.38	1.28	1.26
EA	1.750	2.125	9.37	9.37	9.34	9.21	9.11	9.03	8.89	8.49	8.25	8.05	6.55	5.82	3.09	2.97	2.87	1.67	1.61	1.49	1.48
EM	1.750	2.625	11.7	11.6	11.5	11.4	11.3	11.3	11.2	10.8	10.5	10.2	8.50	7.62	3.94	3.78	3.56	2.14	2.08	1.93	1.91
EB	1.750	3.125	13.7	13.7	13.5	13.2	13.3	13.4	13.2	12.8	12.4	12.1	9.92	9.10	4.81	4.54	4.37	2.59	2.51	2.34	2.31
EL	1.750	3.625	15.6	15.5	15.4	15.2	15.2	15.2	14.9	14.6	14.2	13.8	11.6	10.6	5.58	5.36	5.06	3.04	2.92	2.74	2.72
EC	1.750	4.125	17.4	17.4	17.1	16.9	16.8	16.9	16.8	16.2	15.9	15.5	13.2	12.0	6.33	6.08	5.82	3.46	3.48	3.13	3.11
ED	1.750	4.625	19.1	18.8	18.8	18.6	18.4	18.6	18.3	17.9	17.5	17.0	14.5	13.3	7.07	6.79	6.48	3.87	3.91	3.84	3.39
EE	1.750	5.125	20.6	20.5	20.4	20.2	20.0	20.2	19.9	19.4	19.0	18.6	15.9	14.5	7.79	7.47	7.21	4.28	4.11	3.81	3.86
EF	1.750	5.625	22.1	22.1	21.9	21.7	21.3	21.8	21.3	21.0	20.4	20.0	17.2	15.6	8.51	8.21	7.83	4.68	4.54	4.25	4.18
BY	2.000	1.875	8.03	8.00	7.99	7.92	7.89	7.59	7.53	7.40	7.23	7.08	5.91	5.27	2.73	2.62	2.51	1.49	1.45	1.34	1.34
BA	2.000	2.125	9.52	9.50	9.47	9.40	9.35	9.29	9.20	8.84	8.60	8.42	6.97	6.19	3.23	3.11	3.02	1.81	1.74	1.63	1.62
BM	2.000	2.625	12.1	12.1	12.1	12.0	10.0	11.5	11.5	11.3	11.0	10.9	9.19	8.29	4.28	4.08	3.89	2.39	2.32	2.15	2.14
BB	2.000	3.125	14.4	14.4	14.4	14.2	14.3	13.8	13.7	13.5	13.2	13.0	11.1	10.0	5.22	5.05	4.84	2.94	2.85	2.65	2.63
BL	2.000	3.625	16.5	16.5	16.5	16.3	16.3	15.9	15.8	15.5	15.3	15.0	12.9	11.8	6.14	5.91	5.66	3.41	3.28	3.14	3.11
BC	2.000	4.125	18.5	18.5	18.4	18.3	18.3	17.9	17.7	17.4	17.2	16.9	14.5	13.3	7.01	6.75	6.46	3.95	3.88	3.56	3.47
BD	2.000	4.625	20.3	20.2	20.2	20.0	20.1	19.6	19.6	19.1	18.9	18.7	16.1	14.7	7.87	7.61	7.29	4.49	4.38	4.04	3.96
BE	2.000	5.125	22.1	22.1	21.9	21.9	21.8	21.2	21.1	20.9	20.6	20.2	17.8	16.3	8.67	8.39	8.05	5.02	4.79	4.52	4.45
BF	2.000	5.625	23.8	23.6	23.7	23.6	23.5	22.8	22.8	22.5	22.1	21.9	19.3	17.5	9.48	9.17	8.79	5.45	5.35	4.99	4.93
CB	2.500	3.125	22.2	22.2	21.9	21.7	19.4	18.6	18.6	18.4	18.1	17.9	15.9	14.5	8.16	7.83	7.46	4.38	4.32	4.02	3.94
CL	2.500	3.625	25.0	25.0	24.8	24.6	22.0	21.4	21.2	20.9	20.6	20.5	18.4	16.9	9.51	9.15	8.71	5.21	5.11	4.71	4.65
CC	2.500	4.125	27.6	27.6	27.6	27.3	24.6	23.8	23.8	23.3	23.1	22.8	20.7	19.1	10.8	10.4	10.0	6.01	5.85	5.38	5.34
CD	2.500	4.625	30.4	29.7	29.7	29.4	27.0	26.3	25.9	25.7	25.5	25.1	22.8	20.9	12.1	11.6	11.1	6.81	6.58	6.04	6.02
CE	2.500	5.125	32.4	32.4	32.4	32.0	28.9	28.4	28.1	27.9	27.6	27.4	24.9	22.9	13.3	12.8	12.3	7.49	7.32	6.81	6.69
CF	2.500	5.625	34.4	34.4	34.0	34.0	31.2	30.6	30.0	30.0	29.5	29.2	26.9	25.0	14.5	14.1	11.4	8.25	8.03	7.46	7.34
DB	3.000	3.125	25.2	25.1	24.9	25.0	24.6	24.2	24.2	23.7	23.5	23.2	17.8	17.1	9.75	9.53	9.27	5.95	5.69	5.34	5.31
DL	3.000	3.625	28.1	28.1	28.1	28.1	27.6	27.4	27.1	26.9	26.5	26.3	20.5	19.7	11.3	11.1	10.7	6.97	6.71	6.31	6.28
DC	3.000	4.125	31.2	31.2	30.9	30.9	30.6	30.3	30.3	29.7	29.2	28.9	23.2	22.2	12.8	12.5	12.2	7.97	7.68	7.22	7.12
DD	3.000	4.625	34.0	34.0	34.0	33.3	32.9	32.6	32.6	32.2	31.9	31.6	25.5	24.4	14.2	13.9	13.6	8.94	8.64	8.13	8.05
DE	3.000	5.125	36.2	36.2	36.0	36.2	35.7	35.3	35.4	34.6	34.2	33.9	27.7	26.7	15.7	15.3	15.1	9.91	9.58	9.01	8.96
DF	3.000	5.625	38.4	38.4	38.4	38.4	37.9	37.5	37.5	37.1	36.7	36.7	30.0	28.8	17.0	16.7	16.3	10.9	10.5	9.91	9.76
DJ	3.000	8.625	50.0	50.0	50.0	50.0	49.5	49.5	48.9	48.8	48.8	48.2	41.5	39.9	24.4	24.1	23.5	15.9	15.8	14.8	14.7

MAXIMUM 120Hz-25°C ESR LIMITS FOR MAXIMUM CAPACITANCE RATINGS (Milliohms)

Case Code	Size (inch)		VDC																		
	D	L	6.3	7.5	10	15	20	25	30	40	50	60	75	100	150	200	250	300	350	400	450
AN	1.375	1.625	50	50	50	52	52	54	55	59	64	69	104	131	261	284	322	1042	1138	1340	1140
AY	1.375	1.875	38	39	39	40	41	41	42	45	48	50	76	96	192	211	236	774	845	996	961
AA	1.375	2.125	32	32	32	33	34	35	36	37	40	42	62	79	154	171	191	616	673	756	803
AM	1.375	2.625	24	24	24	25	25	25	26	28	29	31	44	56	110	121	136	438	466	545	563
AB	1.375	3.125	20	20	20	20	21	21	22	23	24	25	36	44	92	99	107	340	364	415	434
AL	1.375	3.625	17.0	17.0	17.2	17.5	18.0	18.0	18.2	19.4	20	22	30	37	74	84	91	275	299	343	353
AC	1.375	4.125	16.0	15.0	15.2	15.7	15.7	15.9	16.3	17.2	18.2	19.2	26	32	63	68	77	233	250	292	298
AD	1.375	4.625	14.0	14.0	14.0	14.2	14.3	14.6	14.8	15.5	16.3	17.2	24	28	55	61	66	203	218	251	258
AE	1.375	5.125	13.0	12.7	13.0	13.3	13.3	13.4	13.6	14.2	15.0	15.7	21	25	49	52	59	185	191	223	227
AF	1.375	5.625	12.0	12.0	12.0	12.5	12.4	12.6	12.7	13.3	14.0	14.6	19.8	23	44	48	53	168	172	198	204
EN	1.750	1.625	26	26	27	28	29	28	29	31	33	35	53	69	166	179	199	604	650	751	758
EY	1.750	1.875	20	20	21	21	22	22	22	24	25	27	40	51	126	135	149	446	471	547	563
EA	1.750	2.125	16.9	16.9	17.0	17.5	17.9	18.2	18.8	21	22	23	35	44	104	112	119	345	377	441	449
EM	1.750	2.625	12.7	12.9	13.2	13.4	13.6	13.5	13.9	14.8	15.8	16.7	24	30	75	81	91	251	261	308	314
EB	1.750	3.125	10.5	10.6	10.8	11.3	11.3	11.1	11.4	12.1	12.9	13.5	20	24	57	64	69	195	209	241	245
EL	1.750	3.625	9.1	9.3	9.4	9.6	9.7	9.7	10.0	10.4	11.0	11.7	16.5	20	48	51	58	160	174	197	199
EC	1.750	4.125	8.2	8.2	8.5	8.7	8.7	8.7	8.8	9.4	9.8	10.3	14.2	17.3	41	44	49	137	145	167	169
ED	1.750	4.625	7.5	7.7	7.7	7.9	8.0	7.9	8.1	8.5	8.9	9.4	12.9	15.5	36	39	43	121	134	149	157
EE	1.750	5.125	7.0	7.1	7.1	7.3	7.4	7.3	7.5	7.9	8.2	8.6	11.7	14.2	33	35	38	107	117	136	132
EF	1.750	5.625	6.6	6.6	6.7	6.8	7.1	6.8	7.1	7.3	7.7	8.0	10.9	13.2	30	32	35	97	103	118	122
BY	2.000	1.875	25	25	26	26	26	28	29	30	31	32	47	59	146	157	172	483	513	603	603
BA	2.000	2.125	19.5	19.6	19.7	20	20	21	21	23	24	25	36	46	113	121	128	358	387	441	448
BM	2.000	2.625	14.0	14.0	14.1	14.3	14.3	15.4	15.6	16.2	16.9	17.4	24	30	74	82	90	239	254	293	297
BB	2.000	3.125	11.2	11.2	11.2	11.6	11.4	12.3	12.5	12.8	13.3	13.9	18.8	23	57	61	66	178	191	219	223
BL	2.000	3.625	9.6	9.6	9.6	9.8	9.8	10.4	10.5	10.9	11.2	11.7	15.8	18.9	46	50	54	151	161	176	179
BC	2.000	4.125	8.5	8.5	8.6	8.7	8.7	9.1	9.3	9.6	9.8	10.2	13.7	16.3	39	42	46	123	128	152	161
BD	2.000	4.625	7.7	7.8	7.8	7.9	7.9	8.3	8.3	8.7	8.9	9.1	12.3	14.8	34	37	40	104	112	129	134
BE	2.000	5.125	7.1	7.1	7.2	7.2	7.3	7.7	7.8	7.9	8.2	8.5	11.0	13.1	31	33	35	91	100	113	116
BF	2.000	5.625	6.6	6.7	6.7	6.7	6.8	7.2	7.2	7.4	7.7	7.8	10.1	12.3	28	29	32	83	87	101	102
CB	2.500	3.125	6.3	6.3	6.4	6.6	8.2	8.9	8.9	9.1	9.5	9.7	12.3	14.8	31	33	37	107	110	127	132
CL	2.500	3.625	5.5	5.5	5.6	5.7	7.1	7.5	7.7	7.9	8.1	8.2	10.2	12.1	25	27	30	84	88	103	106
CC	2.500	4.125	5.0	5.0	5.0	5.1	6.3	6.7	6.7	7.0	7.1	7.3	8.9	10.4	22	23	25	70	74	87	88
CD	2.500	4.625	4.5	4.7	4.7	4.8	5.7	6.0	6.2	6.3	6.4	6.6	8.0	9.5	19	20	22	59	64	75	76
CE	2.500	5.125	4.3	4.3	4.3	4.4	5.4	5.6	5.7	5.8	5.9	6.0	7.3	8.6	17	18	20	53	56	64	67
CF	2.500	5.625	4.1	4.1	4.2	4.2	5.0	5.2	5.4	5.4	5.9	5.7	6.7	7.8	15	16	18	47	50	58	61
DB	3.000	3.125	6.2	6.2	6.3	6.3	6.5	6.7	6.7	7.0	7.1	7.3	12.3	13.4	28	29	30	74	80	91	92
DL	3.000	3.625	5.5	5.5	5.5	5.5	5.7	5.8	5.9	6.0	6.2	6.3	10.3	11.2	23	23	25	59	64	73	73
DC	3.000	4.125	4.9	4.9	5.0	5.0	5.1	5.2	5.2	5.4	5.6	5.7	8.9	9.7	19	20	21	50	54	61	62
DD	3.000	4.625	4.5	4.5	4.5	4.7	4.8	4.9	4.9	5.0	5.1	5.2	8.0	8.7	17	18	19	43	46	52	53
DE	3.000	5.125	4.3	4.3	4.3	4.3	4.4	4.5	4.5	4.7	4.8	4.9	7.3	7.9	15	16	17	38	41	46	46
DF	3.000	5.625	4.1	4.1	4.1	4.1	4.2	4.3	4.3	4.4	4.5	4.5	6.7	7.3	14	14	15	34	37	41	42
DJ	3.000	8.625	3.4	3.4	3.4	3.4	3.5	3.5	3.6	3.6	3.6	3.7	5.0	5.4	10	10	10	23	23	26	26

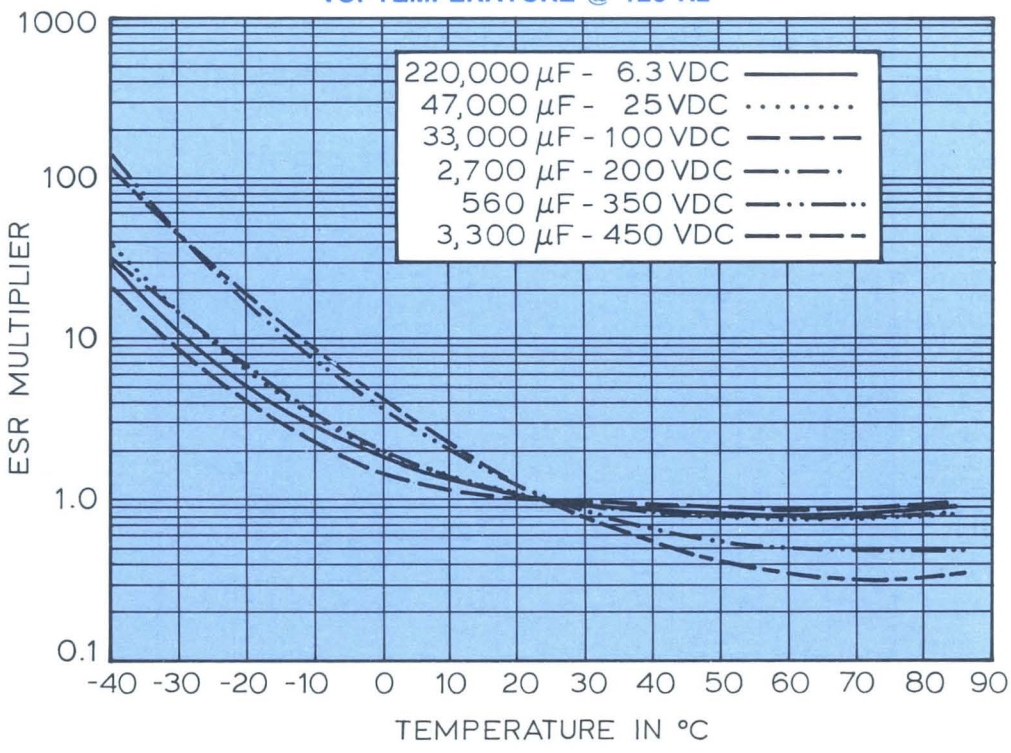
TYPICAL CURVES

TYPE 36DY/DM TYPICAL CAPACITANCE MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,714

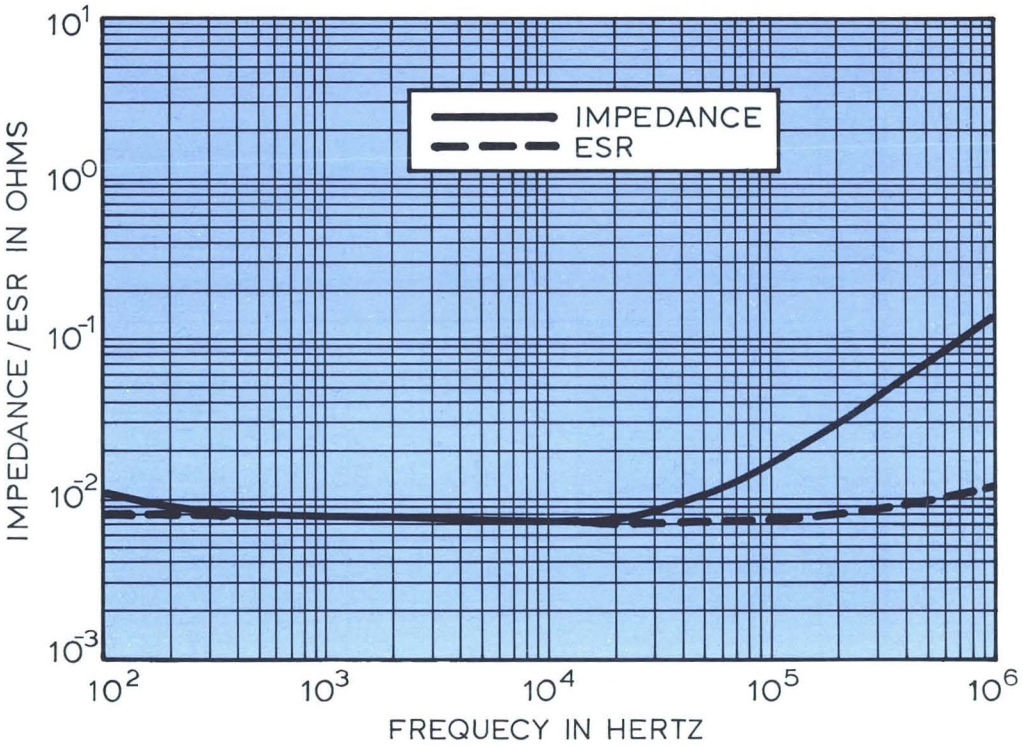
TYPE 36DY/DM — TYPICAL ESR MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,722

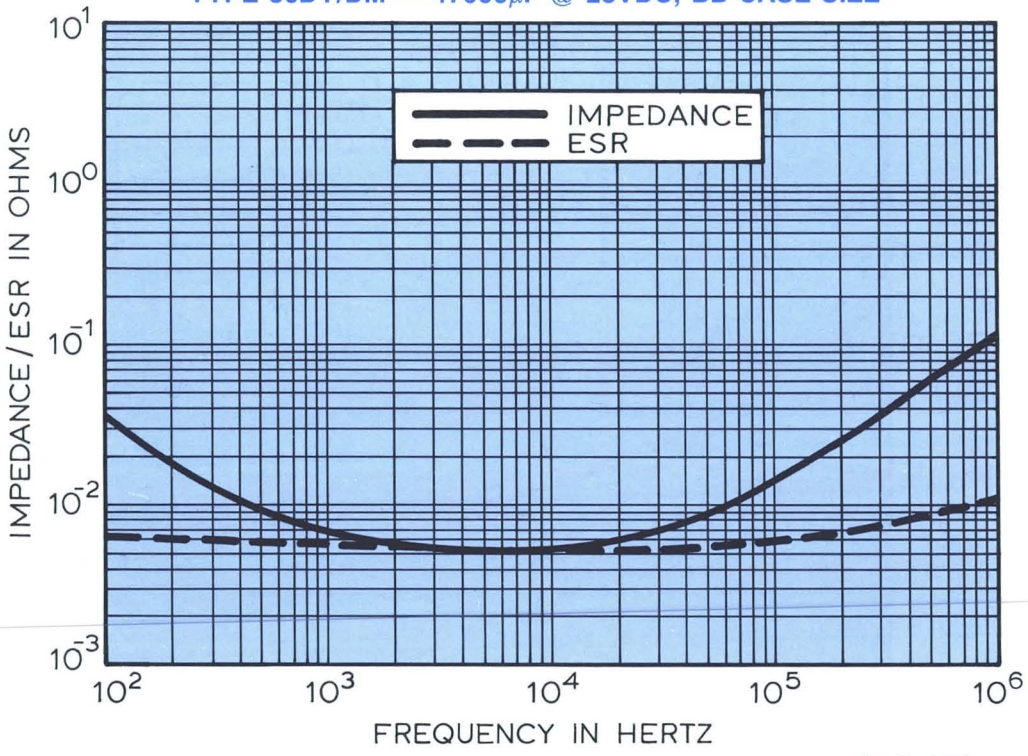
TYPICAL CURVES @ +25°C

TYPE 36DY/DM — 220,000μF @ 6.3 VDC, BB CASE SIZE



Dwg. No. A-14,642

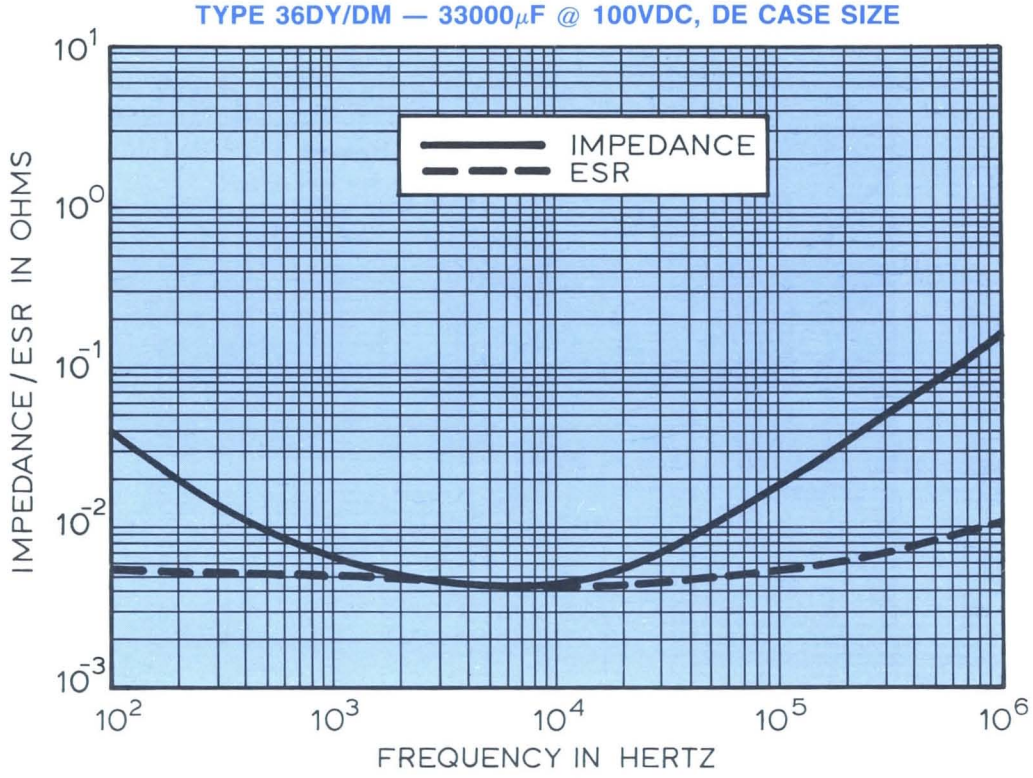
TYPE 36DY/DM — 47000μF @ 25VDC, BB CASE SIZE



Dwg. No. A-14,641

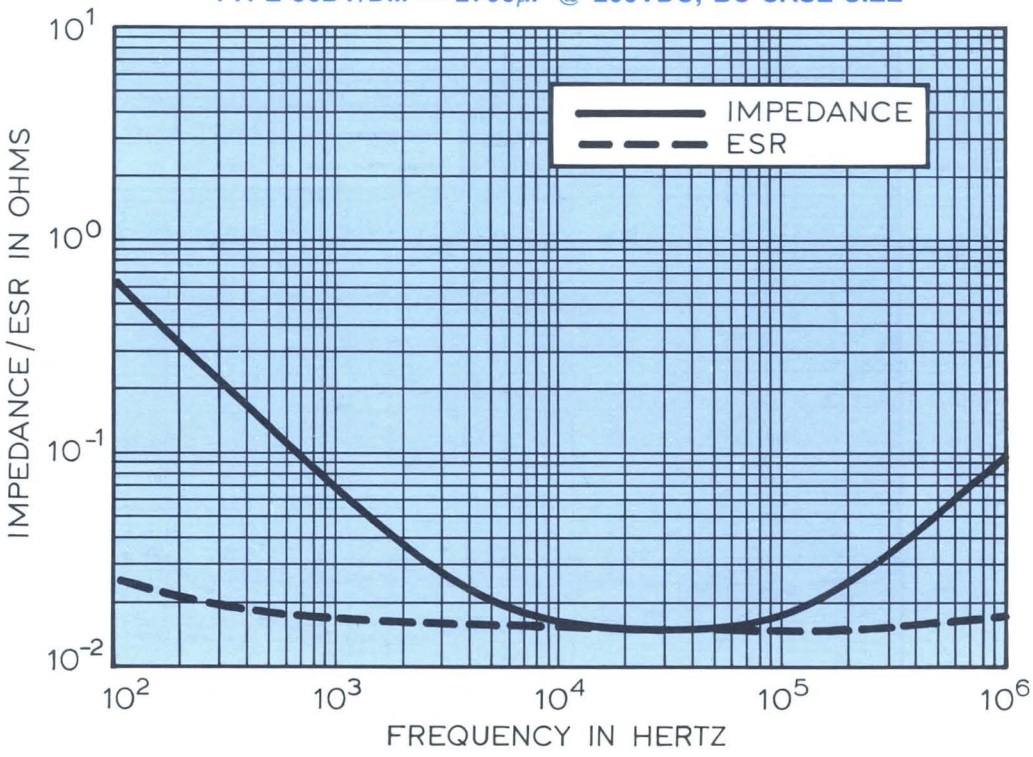
TYPICAL CURVES @ +25°C

TYPE 36DY/DM — 33000μF @ 100VDC, DE CASE SIZE



Dwg. No. A-14,640

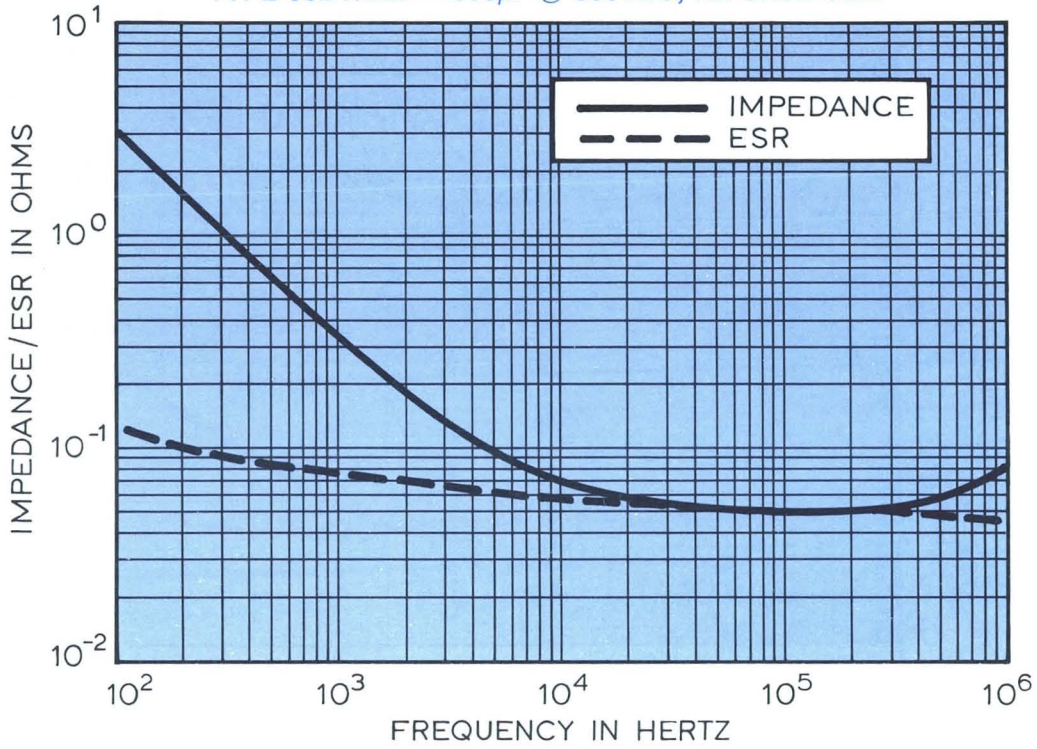
TYPE 36DY/DM — 2700μF @ 200VDC, BC CASE SIZE



Dwg. No. A-14,639

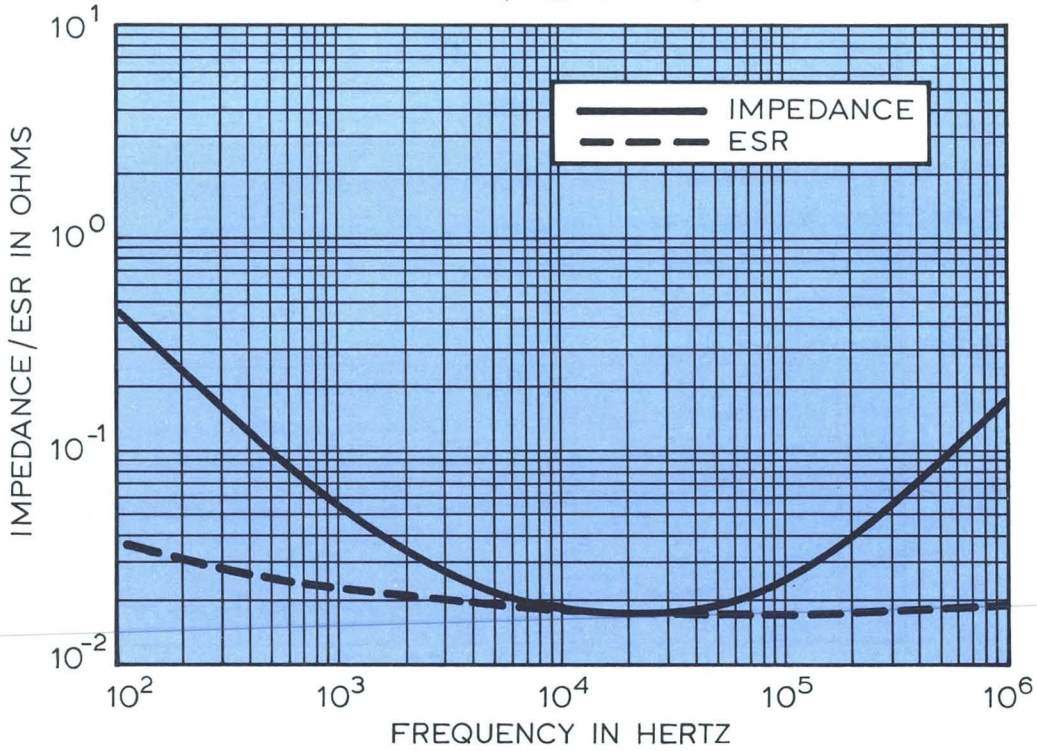
TYPICAL CURVES @ +25°C

TYPE 36DY/DM — 560μF @ 350VDC, AL CASE SIZE



Dwg. No. A-14,638

TYPE 36DY/DM — 3300μF @ 450 VDC, DE CASE SIZE



Dwg. No. A-14,637

+85°C Large Can Aluminum Capacitors

Features —

- For Low Temperature Applications to −55°C
- Mil Version Available — to MIL-C-39018/04
- Stud Mount Available
- Metric Threads Available

9913

General Specifications —

Operating Temperature: −55°C - +85°C.

Voltage Range: 5 - 250 VDC.

Capacitance Range: 180μF - 1F.

Capacitance Tolerance: −10%, +50%.

Case Size Range: 1.375″ x 1.625″ - 3.0″ x 8.675″.

Termination: Screw terminals.

Life Validation Test: 2000 hours at +85°C:
- Δ CAP ≤ 20% from initial measurement.
- Δ ESR ≤ 1.3x initial specified limit.
- Δ DCL ≤ initial specified limit.

Shelf Test: 250 hours at +85°C:
- Δ CAP 15% from initial measurement.
- Δ ESR 1.5x initial specified limit.
- Δ DCL ≤ 2.0x initial specified limit.

DC Leakage Current: $I = K\sqrt{CV}$
K = 1.5 at +25°C; 9.0 at +85°C.
C in μF, V in Volts, I in μA

Ripple Current Multipliers:

TEMPERATURE			
Ambient Temperature			
+75°C	+65°C	+55°C	+45°C & Below
1.22	1.41	1.58	1.73

The rated 120 Hz rms ripple current for capacitors with cases 1⅜″ (34.9 mm) and 2″ (50.8 mm) in diameter must be multiplied by the factors shown in the following table:

WVDC Rated	Frequency in Hz				
	50	60	100	400	1000 & Up
0-50	0.80	0.85	0.98	1.10	1.15
51-250	0.78	0.83	0.96	1.15	1.20

The rated 120 Hz rms ripple current for capacitors with cases 2½″ (63.5 mm) and 3″ (76.2 mm) in diameter must be multiplied by the factors shown in the following table:

WVDC Rated	Frequency in Hz				
	50	60	100	400	1000 & Up
0-50	0.85	0.90	0.99	1.02	1.02
51-250	0.85	0.90	0.98	1.07	1.07

Low Temperature Performance:

Capacitance Ratio $C^{-55°C}/C^{+25°C}$ min. @ 120Hz

Rated Voltage (VDC)	Capacitance Remaining
0 to 9	65
10 to 40	75
41 to 100	80
101 to 250	60

ESR Ratio $ESR^{-55°C}/ESR^{+25°C}$ max. @ 120Hz

Rated Voltage (VDC)	Multiplier
0 to 9	7
10 to 40	3
41 to 250	2

Expected Life: SEE PAGE 270.

Performance Characteristics: SEE PAGE 266.

Catalog Numbering System

602D/DM **183** **F** **005** **AN** **2** **A**

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.
602D = STANDARD CASE
602DM = STUD MOUNT CASE

CAPACITANCE. EXPRESSED IN MICROFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

CAPACITANCE TOLERANCE. F = −10, +50%.

DC VOLTAGE RATING. IN VOLTS. AN 'R' IS USED TO SIGNIFY A DECIMAL POINT.

CASE CODE. SEE DIMENSIONS, PAGE 221.

CASE STYLE: 2 = PVC INSULATING SLEEVE (Standard)
5 = PVC SLEEVE WITH RESIN END SEAL
Required for exposure to
halogenated cleaning solvents.

LEAD CODE: A = LOW INSERT 10-32 SCREW THREAD (Standard)
B = HIGH INSERT 10-32 SCREW THREAD
D = HIGH CURRENT ¼-28 SCREW THREAD
I = HIGH INSERT M5 SCREW THREAD

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D x L	Max. ESR 120Hz, +25°C (mΩ)	Max. Ripple Current 120Hz, +85°C (A)
5 VOLTS DC WORKING; 7 VOLTS DC SURGE				
18,000	602D183F005AN2A	1.375 x 1.625	44.0	5.2
33,000	602D333F005AA2A	1.375 x 2.125	28.0	7.2
39,000	602D393F005AM2A	1.375 x 2.625	22.0	8.9
56,000	602D563F005AB2A	1.375 x 3.125	18.0	10.5
68,000	602D683F005AL2A	1.375 x 3.625	16.0	12.0
82,000	602D823F005AC2A	1.375 x 4.125	14.0	13.4
100,000	602D104F005AD2A	1.375 x 4.625	13.0	14.7
120,000	602D124F005AF2A	1.375 x 5.625	11.0	17.1
39,000	602D393F005BY2A	2.000 x 1.875	23.0	9.7
56,000	602D563F005BA2A	2.000 x 2.125	18.0	11.4
82,000	602D823F005BM2A	2.000 x 2.625	12.9	14.5
120,000	602D124F005BB2A	2.000 x 3.125	10.4	17.2
150,000	602D154F005BL2A	2.000 x 3.625	8.9	19.7
180,000	602D184F005BC2A	2.000 x 4.125	8.0	21.9
270,000	602D274F005BF2A	2.000 x 5.625	6.4	27.9
180,000	602D184F005CB2A	2.500 x 3.125	5.7	26.8
270,000	602D274F005CC2D	2.500 x 4.125	4.5	33.5
330,000	602D334F005CD2D	2.500 x 4.625	4.3	35.9
470,000	602D474F005CF2D	2.500 x 5.625	3.9	40.7
330,000	602D334F005DL2D	3.000 x 3.625	5.1	33.7
390,000	602D394F005DC2D	3.000 x 4.125	4.7	36.7
470,000	602D474F005DD2D	3.000 x 4.625	4.3	40.1
560,000	602D564F005DE2D	3.000 x 5.125	4.1	42.7
680,000	602D684F005DF2D	3.000 x 5.625	3.9	45.4
1,000,000	602D105F005DJ2D	3.000 x 8.625	3.3	50.0
7.5 VOLTS DC WORKING; 10 VOLTS DC SURGE				
15,000	602D153F7R5AN2A	1.375 x 1.625	46.0	5.1
22,000	602D223F7R5AA2A	1.375 x 2.125	29.0	7.1
33,000	602D333F7R5AM2A	1.375 x 2.625	22.0	8.8
47,000	602D473F7R5AB2A	1.375 x 3.125	18.2	10.4
56,000	602D563F7R5AL2A	1.375 x 3.625	15.7	11.9
68,000	602D683F7R5AC2A	1.375 x 4.125	14.1	13.3
82,000	602D823F7R5AE2A	1.375 x 5.125	12.0	15.8
100,000	602D104F7R5AF2A	1.375 x 5.625	11.3	17.0
33,000	602D333F7R5BY2A	2.000 x 1.875	24.0	9.6
47,000	602D473F7R5BA2A	2.000 x 2.125	18.2	11.3
68,000	602D683F7R5BM2A	2.000 x 2.625	13.1	14.4
82,000	602D823F7R5BB2A	2.000 x 3.125	10.5	17.2
100,000	602D104F7R5BL2A	2.000 x 3.625	9.0	19.6
120,000	602D124F7R5BC2A	2.000 x 4.125	8.0	21.9
150,000	602D154F7R5BD2A	2.000 x 4.625	7.3	24.1
180,000	602D184F7R5BF2A	2.000 x 5.625	6.4	27.9
150,000	602D154F7R5CB2A	2.500 x 3.125	5.8	26.6
220,000	602D224F7R5CC2D	2.500 x 4.125	4.7	32.8
270,000	602D274F7R5CD2D	2.500 x 4.625	4.3	35.8
330,000	602D334F7R5CF2D	2.500 x 5.625	4.0	40.2
270,000	602D274F7R5DL2D	3.000 x 3.625	5.1	33.7
330,000	602D334F7R5DC2D	3.000 x 4.125	4.7	36.7
390,000	602D394F7R5DD2D	3.000 x 4.625	4.3	40.1
470,000	602D474F7R5DE2D	3.000 x 5.125	4.1	42.7
820,000	602D824F7R5DJ2D	3.000 x 8.625	3.3	50.0

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D x L	Max. ESR 120Hz, +25°C (mΩ)	Max. Ripple Current 120Hz, +85°C (A)
10 VOLTS DC WORKING; 15 VOLTS DC SURGE				
12,000	602D123F010AN2A	1.375 x 1.625	47.0	5.0
22,000	602D223F010AA2A	1.375 x 2.125	30.0	7.0
27,000	602D273F010AM2A	1.375 x 2.625	23.0	8.7
39,000	602D393F010AB2A	1.375 x 3.125	18.6	10.3
47,000	602D473F010AL2A	1.375 x 3.625	16.2	11.7
56,000	602D563F010AC2A	1.375 x 4.125	14.4	13.1
68,000	602D683F010AD2A	1.375 x 4.625	13.2	14.4
82,000	602D823F010AF2A	1.375 x 5.625	11.4	16.9
27,000	602D273F010BY2A	2.000 x 1.875	24.0	9.5
39,000	602D393F010BA2A	2.000 x 2.125	18.5	11.2
56,000	602D563F010BM2A	2.000 x 2.625	13.2	14.3
82,000	602D823F010BB2A	2.000 x 3.125	10.6	17.1
100,000	602D104F010BL2A	2.000 x 3.625	9.1	19.5
120,000	602D124F010BC2A	2.000 x 4.125	8.1	21.8
180,000	602D184F010BF2A	2.000 x 5.625	6.4	27.9
120,000	602D124F010CB2A	2.500 x 3.125	5.9	26.4
180,000	602D184F010CC2D	2.500 x 4.125	4.8	32.4
220,000	602D224F010CD2D	2.500 x 4.625	4.4	35.4
270,000	602D274F010CF2D	2.500 x 5.625	4.0	40.2
220,000	602D224F010DL2D	3.000 x 3.625	5.1	33.7
270,000	602D274F010DC2D	3.000 x 4.125	4.7	36.7
330,000	602D334F010DD2D	3.000 x 4.625	4.3	40.1
390,000	602D394F010DE2D	3.000 x 5.125	4.1	42.7
470,000	602D474F010DF2D	3.000 x 5.625	4.0	44.8
680,000	602D684F010DJ2D	3.000 x 8.625	3.3	50.0
15 VOLTS DC WORKING; 20 VOLTS DC SURGE				
10,000	602D103F015AN2A	1.375 x 1.625	50.0	4.9
15,000	602D153F015AA2A	1.375 x 2.125	32.0	6.7
22,000	602D223F015AM2A	1.375 x 2.625	24.0	8.4
27,000	602D273F015AB2A	1.375 x 3.125	19.5	10.0
33,000	602D333F015AL2A	1.375 x 3.625	16.9	11.5
39,000	602D393F015AC2A	1.375 x 4.125	15.1	12.8
47,000	602D473F015AD2A	1.375 x 4.625	13.7	14.1
56,000	602D563F015AE2A	1.375 x 5.125	12.7	15.4
22,000	602D223F015BY2A	2.000 x 1.875	26.0	9.2
27,000	602D273F015BA2A	2.000 x 2.125	19.7	10.9
39,000	602D393F015BM2A	2.000 x 2.625	14.1	13.9
56,000	602D563F015BB2A	2.000 x 3.125	11.3	16.5
68,000	602D683F015BL2A	2.000 x 3.625	9.6	19.0
82,000	602D823F015BC2A	2.000 x 4.125	8.6	21.1
100,000	602D104F015BD2A	2.000 x 4.625	7.8	23.3
120,000	602D124F015BE2A	2.000 x 5.625	6.7	27.3
100,000	602D104F015CB2A	2.500 x 3.125	6.4	25.3
150,000	602D154F015CC2D	2.500 x 4.125	5.0	31.8
180,000	602D184F015CD2D	2.500 x 4.625	4.7	34.3
220,000	602D224F015CF2D	2.500 x 5.625	4.2	39.2
180,000	602D184F015DL2D	3.000 x 3.625	5.6	32.1
220,000	602D224F015DC2D	3.000 x 4.125	5.0	35.6
270,000	602D274F015DE2D	3.000 x 5.125	4.4	41.2
330,000	602D334F015DF2D	3.000 x 5.625	4.2	43.8
560,000	602D564F015DJ2D	3.000 x 8.625	3.5	50.0

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D x L	Max. ESR 120Hz, +25°C (mΩ)	Max. Ripple Current 120Hz, +85°C (A)
20 VOLTS DC WORKING; 30 VOLTS DC SURGE				
6,800	602D682F020AN2A	1.375 x 1.625	50.0	4.9
12,000	602D123F020AA2A	1.375 x 2.125	32.0	6.7
15,000	602D153F020AM2A	1.375 x 2.625	24.0	8.4
22,000	602D223F020AB2A	1.375 x 3.125	19.8	15.8
27,000	602D273F020AL2A	1.375 x 3.625	17.1	13.8
33,000	602D333F020AC2A	1.375 x 4.125	15.1	12.8
39,000	602D393F020AE2A	1.375 x 5.125	12.8	15.3
47,000	602D473F020AF2A	1.375 x 5.625	12.0	16.5
15,000	602D153F020BY2A	2.000 x 1.875	26.0	9.1
22,000	602D223F020BA2A	2.000 x 2.125	19.8	10.9
33,000	602D333F020BM2A	2.000 x 2.625	14.1	13.9
39,000	602D393F020BB2A	2.000 x 3.125	11.3	16.5
56,000	602D563F020BL2A	2.000 x 3.625	9.7	18.9
68,000	602D683F020BC2A	2.000 x 4.125	8.6	21.1
100,000	602D104F020BF2A	2.000 x 5.625	6.7	27.3
68,000	602D683F020CB2A	2.500 x 3.125	6.4	25.3
100,000	602D104F020CC2D	2.500 x 4.125	5.1	31.5
120,000	602D124F020CD2D	2.500 x 4.625	4.8	33.9
150,000	602D154F020CF2D	2.500 x 5.625	4.2	39.2
120,000	602D124F020DL2D	3.000 x 3.625	5.6	32.1
150,000	602D154F020DC2D	3.000 x 4.125	5.0	35.6
180,000	602D184F020DD2D	3.000 x 4.625	4.7	38.3
220,000	602D224F020DE2D	3.000 x 5.125	4.4	41.2
390,000	602D394F020DJ2D	3.000 x 8.625	3.5	50.0
25 VOLTS DC WORKING; 40 VOLTS DC SURGE				
5,600	602D562F025AN2A	1.375 x 1.625	52.0	4.7
10,000	602D103F025AA2A	1.375 x 2.125	33.0	6.6
12,000	602D123F025AM2A	1.375 x 2.625	25.0	8.3
18,000	602D183F025AB2A	1.375 x 3.125	20.0	9.8
22,000	602D223F025AL2A	1.375 x 3.625	17.7	11.2
27,000	602D273F025AD2A	1.375 x 4.625	14.3	13.8
33,000	602D333F025AE2A	1.375 x 5.125	13.2	15.1
12,000	602D123F025BY2A	2.000 x 1.875	26.0	9.0
18,000	602D183F025BA2A	2.000 x 2.125	20.0	10.7
27,000	602D273F025BM2A	2.000 x 2.625	14.4	13.7
33,000	602D333F025BB2A	2.000 x 3.125	11.6	16.3
39,000	602D393F025BL2A	2.000 x 3.625	9.8	18.8
47,000	602D473F025BC2A	2.000 x 4.125	8.7	21.0
56,000	602D563F025BD2A	2.000 x 4.625	7.9	23.1
82,000	602D823F025BF2A	2.000 x 5.625	6.8	27.1
56,000	602D563F025CB2A	2.500 x 3.125	6.6	24.9
82,000	602D823F025CC2D	2.500 x 4.125	5.2	31.2
100,000	602D104F025CD2D	2.500 x 4.625	4.9	33.6
120,000	602D124F025CF2D	2.500 x 5.625	4.3	38.8
100,000	602D104F025DL2D	3.000 x 3.625	5.7	31.8
120,000	602D124F025DC2D	3.000 x 4.125	5.1	35.3
150,000	602D154F025DD2D	3.000 x 4.625	4.8	37.9
180,000	602D184F025DE2D	3.000 x 5.125	4.4	41.2
330,000	602D334F025DJ2D	3.000 x 8.625	3.5	50.0

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D x L	Max. ESR 120Hz, +25°C (mΩ)	Max. Ripple Current 120Hz, +85°C (A)
30 VOLTS DC WORKING; 45 VOLTS DC SURGE				
5,600	602D562F030AN2A	1.375 x 1.625	53.0	4.7
8,200	602D822F030AA2A	1.375 x 2.125	33.0	6.6
12,000	602D123F030AM2A	1.375 x 2.625	26.0	8.1
15,000	602D153F030AB2A	1.375 x 3.125	21.0	9.7
18,000	602D183F030AL2A	1.375 x 3.625	17.8	11.2
22,000	602D223F030AC2A	1.375 x 4.125	15.8	12.5
27,000	602D273F030AD2A	1.375 x 4.625	14.4	13.8
33,000	602D333F030AF2A	1.375 x 5.625	12.4	16.2
12,000	602D123F030BY2A	2.000 x 1.875	27.0	9.0
15,000	602D153F030BA2A	2.000 x 2.125	21.0	10.7
22,000	602D223F030BM2A	2.000 x 2.625	14.6	13.6
33,000	602D333F030BB2A	2.000 x 3.125	11.7	16.3
39,000	602D393F030BL2A	2.000 x 3.625	10.0	18.6
47,000	602D473F030BC2A	2.000 x 4.125	8.8	20.9
56,000	602D563F030BD2A	2.000 x 4.625	8.0	23.0
68,000	602D683F030BF2A	2.000 x 5.625	6.8	27.1
56,000	602D563F030CB2A	2.500 x 3.125	6.6	24.9
82,000	602D823F030CC2D	2.500 x 4.125	5.2	31.2
100,000	602D104F030CD2D	2.500 x 4.625	4.8	33.9
120,000	602D124F030CF2D	2.500 x 5.625	4.3	38.8
100,000	602D104F030DL2D	3.000 x 3.625	5.7	31.8
120,000	602D124F030DC2D	3.000 x 4.125	5.1	35.3
150,000	602D154F030DE2D	3.000 x 5.125	4.4	41.2
180,000	602D184F030DF2D	3.000 x 5.625	4.2	43.8
270,000	602D274F030DJ2D	3.000 x 8.625	3.5	50.0
40 VOLTS DC WORKING; 55 VOLTS DC SURGE				
3,300	602D332F040AN2A	1.375 x 1.625	60.0	4.4
5,600	602D562F040AA2A	1.375 x 2.125	37.0	6.2
6,800	602D682F040AM2A	1.375 x 2.625	28.0	7.8
10,000	602D103F040AB2A	1.375 x 3.125	23.0	9.2
12,000	602D123F040AL2A	1.375 x 3.625	19.8	10.6
15,000	602D153F040AD2A	1.375 x 4.625	15.7	13.2
18,000	602D183F040AE2A	1.375 x 5.125	14.6	14.3
6,800	602D682F040BY2A	2.000 x 1.875	29.0	8.6
10,000	602D103F040BA2A	2.000 x 2.125	22.0	10.2
15,000	602D153F040BM2A	2.000 x 2.625	15.8	13.1
18,000	602D183F040BB2A	2.000 x 3.125	12.6	15.7
22,000	602D223F040BL2A	2.000 x 3.625	10.6	18.1
27,000	602D273F040BC2A	2.000 x 4.125	9.4	20.2
33,000	602D333F040BD2A	2.000 x 4.625	8.5	22.3
47,000	602D473F040BF2A	2.000 x 5.625	7.3	26.1
33,000	602D333F040CB2A	2.500 x 3.125	7.3	23.7
47,000	602D473F040CC2A	2.500 x 4.125	5.7	29.8
56,000	602D563F040CD2D	2.500 x 4.625	5.2	32.6
68,000	602D683F040CF2D	2.500 x 5.625	4.5	37.9
56,000	602D563F040DL2D	3.000 x 3.625	5.9	31.3
68,000	602D683F040DC2D	3.000 x 4.125	5.4	34.3
82,000	602D823F040DD2D	3.000 x 4.625	4.9	37.5
100,000	602D104F040DE2D	3.000 x 5.125	4.7	39.9
180,000	602D184F040DJ2D	3.000 x 8.625	3.6	50.0

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D x L	Max. ESR 120Hz, +25°C (mΩ)	Max. Ripple Current 120Hz, +85°C (A)
50 VOLTS DC WORKING; 75 VOLTS DC SURGE				
2,700	602D272F050AN2A	1.375 x 1.625	64.0	4.3
4,700	602D472F050AA2A	1.375 x 2.125	40.0	6.0
5,600	602D562F050AM2A	1.375 x 2.625	30.0	7.6
8,200	602D822F050AB2A	1.375 x 3.125	24.0	9.0
10,000	602D103F050AL2A	1.375 x 3.625	21.0	10.4
12,000	602D123F050AD2A	1.375 x 4.625	16.9	12.7
15,000	602D153F050AE2A	1.375 x 5.125	15.4	13.9
5,600	602D562F050BY2A	2.000 x 1.875	31.0	8.4
8,200	602D822F050BA2A	2.000 x 2.125	24.0	10.0
12,000	602D123F050BM2A	2.000 x 2.625	16.9	12.7
15,000	602D153F050BB2A	2.000 x 3.125	13.3	15.2
18,000	602D183F050BL2A	2.000 x 3.625	11.2	17.6
22,000	602D223F050BC2A	2.000 x 4.125	9.8	19.8
27,000	602D273F050BD2A	2.000 x 4.625	8.8	21.9
33,000	602D333F050BF2A	2.000 x 5.625	7.5	25.8
27,000	602D273F050CB2A	2.500 x 3.125	7.7	23.1
39,000	602D393F050CC2A	2.500 x 4.125	5.9	29.3
47,000	602D473F050CD2D	2.500 x 4.625	5.5	31.7
56,000	602D563F050CF2D	2.500 x 5.625	4.8	36.7
47,000	602D473F050DL2D	3.000 x 3.625	6.2	30.5
56,000	602D563F050DC2D	3.000 x 4.125	5.5	34.0
68,000	602D683F050DD2D	3.000 x 4.625	5.0	37.2
82,000	602D823F050DE2D	3.000 x 5.125	4.8	39.5
150,000	602D154F050DJ2D	3.000 x 8.625	3.6	56.3
63 VOLTS DC WORKING; 90 VOLTS DC SURGE				
1,800	602D182F063AN2A	1.375 x 1.625	71.0	4.1
3,300	602D332F063AA2A	1.375 x 2.125	44.0	5.7
4,700	602D472F063AM2A	1.375 x 2.625	33.0	7.2
5,600	602D562F063AB2A	1.375 x 3.125	26.0	8.6
6,800	602D682F063AL2A	1.375 x 3.625	23.0	9.9
8,200	602D822F063AC2A	1.375 x 4.125	19.8	11.2
10,000	602D103F063AD2A	1.375 x 4.625	18.2	12.3
12,000	602D123F063AE2A	1.375 x 5.125	16.3	13.5
4,700	602D472F063BY2A	2.000 x 1.875	34.0	7.9
5,600	602D562F063BA2A	2.000 x 2.125	26.0	9.5
8,200	602D822F063BM2A	2.000 x 2.625	18.1	12.2
12,000	602D123F063BB2A	2.000 x 3.125	14.6	14.5
15,000	602D153F063BL2A	2.000 x 3.625	12.3	16.8
18,000	602D183F063BC2A	2.000 x 4.125	10.5	19.1
22,000	602D223F063BD2A	2.000 x 4.625	9.5	21.1
27,000	602D273F063BF2A	2.000 x 5.625	8.1	24.8
18,000	602D183F063CB2A	2.500 x 3.125	8.5	22.0
27,000	602D273F063CC2A	2.500 x 4.125	6.4	28.1
33,000	602D333F063CD2D	2.500 x 4.625	5.8	30.8
47,000	602D473F063CF2D	2.500 x 5.625	5.0	35.9
39,000	602D393F063DL2D	3.000 x 3.625	6.4	30.0
47,000	602D473F063DC2D	3.000 x 4.125	5.7	33.4
56,000	602D563F063DD2D	3.000 x 4.625	5.2	36.4
68,000	602D683F063DF2D	3.000 x 5.625	4.5	42.3
120,000	602D124F063DJ2D	3.000 x 8.625	3.7	55.6

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size (inches) D x L	Max. ESR 120Hz, +25°C (mΩ)	Max. Ripple Current 120Hz, +85°C (A)
75 VOLTS DC WORKING; 100 VOLTS DC SURGE				
1,800	602D182F075AN2A	1.375 x 1.625	123.0	3.1
2,700	602D272F075AA2A	1.375 x 2.125	75.0	4.4
3,900	602D392F075AM2A	1.375 x 2.625	55.0	5.6
4,700	602D472F075AB2A	1.375 x 3.125	43.0	6.7
5,600	602D562F075AL2A	1.375 x 3.625	36.0	7.8
6,800	602D682F075AC2A	1.375 x 4.125	32.0	8.8
8,200	602D822F075AD2A	1.375 x 4.625	28.0	9.9
10,000	602D103F075AE2A	1.375 x 5.125	26.0	10.8
3,900	602D392F075BY2A	2.000 x 1.875	57.0	6.1
4,700	602D472F075BA2A	2.000 x 2.125	43.0	7.3
8,200	602D822F075BM2A	2.000 x 2.625	29.0	9.6
10,000	602D103F075BB2A	2.000 x 3.125	24.0	11.3
12,000	602D123F075BL2A	2.000 x 3.625	19.3	13.4
15,000	602D153F075BC2A	2.000 x 4.125	16.3	15.3
18,000	602D183F075BD2A	2.000 x 4.625	14.2	17.2
22,000	602D223F075BF2A	2.000 x 5.625	11.9	20.4
18,000	602D183F075CB2A	2.500 x 3.125	13.6	17.4
27,000	602D273F075CC2A	2.500 x 4.125	9.6	22.9
39,000	602D393F075CF2A	2.500 x 5.625	7.2	29.9
33,000	602D333F075DL2A	3.000 x 3.625	8.9	25.5
39,000	602D393F075DC2A	3.000 x 4.125	7.9	28.3
47,000	602D473F075DD2D	3.000 x 4.625	7.1	31.2
56,000	602D563F075DE2D	3.000 x 5.125	6.5	33.9
100,000	602D104F075DJ2D	3.000 x 8.625	4.7	49.3
100 VOLTS DC WORKING; 150 VOLTS DC SURGE				
680	602D681F100AN2A	1.375 x 1.625	169.0	2.6
1,200	602D122F100AA2A	1.375 x 2.125	104.0	3.7
1,500	602D152F100AM2A	1.375 x 2.625	75.0	4.8
2,200	602D222F100AB2A	1.375 x 3.125	59.0	5.8
2,700	602D272F100AL2A	1.375 x 3.625	49.0	6.7
3,300	602D332F100AD2A	1.375 x 4.625	37.0	8.6
3,900	602D392F100AE2A	1.375 x 5.125	33.0	9.5
4,700	602D472F100AF2A	1.375 x 5.625	30.0	10.4
1,500	602D152F100BY2A	2.000 x 1.875	80.0	5.2
2,200	602D222F100BA2A	2.000 x 2.125	59.0	6.3
3,300	602D332F100BM2A	2.000 x 2.625	40.0	8.2
3,900	602D392F100BB2A	2.000 x 3.125	30.0	10.1
5,600	602D562F100BL2A	2.000 x 3.625	25.0	11.9
6,800	602D682F100BC2A	2.000 x 4.125	21.0	13.5
10,000	602D103F100BF2A	2.000 x 5.625	15.0	18.2
6,800	602D682F100CB2A	2.500 x 3.125	17.5	15.3
10,000	602D103F100CC2A	2.500 x 4.125	12.8	19.8
12,000	602D123F100CD2A	2.500 x 4.625	11.2	22.2
15,000	602D153F100CF2A	2.500 x 5.625	9.1	26.6
12,000	602D123F100DL2A	3.000 x 3.625	11.3	22.6
15,000	602D153F100DC2A	3.000 x 4.125	9.7	25.6
18,000	602D183F100DD2A	3.000 x 4.625	8.7	28.2
22,000	602D223F100DE2D	3.000 x 5.125	8.0	30.6
39,000	602D393F100DJ2D	3.000 x 8.625	5.4	46.0

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D x L	Max. ESR 120Hz, +25°C (mΩ)	Max. Ripple Current 120Hz, +85°C (A)
150 VOLTS DC WORKING; 200 VOLTS DC SURGE				
270	602D271F150AN2A	1.375 x 1.625	359.0	1.8
470	602D471F150AA2A	1.375 x 2.125	210.0	2.6
560	602D561F150AM2A	1.375 x 2.625	149.0	3.3
820	602D821F150AB2A	1.375 x 3.125	117.0	4.1
1,000	602D102F150AL2A	1.375 x 3.625	98.0	4.7
1,200	602D122F150AC2A	1.375 x 4.125	82.0	5.5
1,500	602D152F150AE2A	1.375 x 5.125	67.0	6.7
560	602D561F150BY2A	2.000 x 1.875	159.0	3.6
820	602D821F150BA2A	2.000 x 2.125	119.0	4.4
1,200	602D122F150BM2A	2.000 x 2.625	82.0	5.7
1,500	602D152F150BB2A	2.000 x 3.125	62.0	7.0
1,800	602D182F150BL2A	2.000 x 3.625	50.0	8.3
2,200	602D222F150BC2A	2.000 x 4.125	42.0	9.5
2,700	602D272F150BD2A	2.000 x 4.625	35.0	10.9
3,300	602D332F150BF2A	2.000 x 5.625	28.0	13.2
2,700	602D272F150CB2A	2.500 x 3.125	37.0	10.6
3,900	602D392F150CC2A	2.500 x 4.125	25.0	14.2
4,700	602D472F150CD2A	2.500 x 4.625	22.0	16.0
5,600	602D562F150CF2A	2.500 x 5.625	17.2	19.4
4,700	602D472F150DL2A	3.000 x 3.625	22.0	16.4
5,600	602D562F150DC2A	3.000 x 4.125	18.3	18.6
6,800	602D682F150DD2A	3.000 x 4.625	16.0	20.8
8,200	602D822F150DE2A	3.000 x 5.125	14.3	22.8
15,000	602D153F150DJ2D	3.000 x 8.625	9.5	34.7
200 VOLTS DC WORKING; 250 VOLTS DC SURGE				
220	602D221F200AN2A	1.375 x 1.625	516.0	1.5
330	602D331F200AA2A	1.375 x 2.125	304.0	2.1
470	602D471F200AM2A	1.375 x 2.625	220.0	3.7
560	602D561F200AB2A	1.375 x 3.125	171.0	3.4
820	602D821F200AL2A	1.375 x 3.625	140.0	4.0
1,000	602D102F200AD2A	1.375 x 4.625	104.0	5.1
1,200	602D122F200AE2A	1.375 x 5.125	95.0	5.6
470	602D471F200BY2A	2.000 x 1.875	234.0	3.0
560	602D561F200BA2A	2.000 x 2.125	175.0	3.6
1,000	602D102F200BM2A	2.000 x 2.625	116.0	4.8
1,200	602D122F200BB2A	2.000 x 3.125	88.0	5.9
1,500	602D152F200BL2A	2.000 x 3.625	72.0	6.9
1,800	602D182F200BC2A	2.000 x 4.125	61.0	7.9
2,200	602D222F200BD2A	2.000 x 4.625	51.0	9.1
2,700	602D272F200BF2A	2.000 x 5.625	41.0	11.0
2,200	602D222F200CB2A	2.500 x 3.125	53.0	8.8
3,300	602D332F200CC2A	2.500 x 4.125	35.0	12.0
3,900	602D392F200CD2A	2.500 x 4.625	31.0	13.4
4,700	602D472F200CF2A	2.500 x 5.625	24.0	16.3
3,900	602D392F200DL2A	3.000 x 3.625	30.0	13.8
4,700	602D472F200DC2A	3.000 x 4.125	25.0	15.8
5,600	602D562F200DD2A	3.000 x 4.625	22.0	17.8
6,800	602D682F200DE2A	3.000 x 5.125	19.5	19.6
12,000	602D123F200DJ2A	3.000 x 8.625	12.7	30.0

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D x L	Max. ESR 120Hz, +25°C (mΩ)	Max. Ripple Current 120Hz, +85°C (A)
250 VOLTS DC WORKING; 300 VOLTS DC SURGE				
180	602D181F250AN2A	1.375 x 1.625	552.0	1.4
270	602D271F250AA2A	1.375 x 2.125	324.0	2.1
390	602D391F250AM2A	1.375 x 2.625	231.0	2.7
560	602D561F250AB2A	1.375 x 3.125	182.0	3.2
680	602D681F250AL2A	1.375 x 3.625	149.0	3.8
820	602D821F250AC2A	1.375 x 4.125	126.0	4.4
1,000	602D102F250AE2A	1.375 x 5.125	105.0	5.3
1,200	602D122F250AF2A	1.375 x 5.625	89.0	6.0
390	602D391F250BY2A	2.000 x 1.875	252.0	2.9
560	602D561F250BA2A	2.000 x 2.125	185.0	3.5
820	602D821F250BM2A	2.000 x 2.625	124.0	4.7
1,000	602D102F250BB2A	2.000 x 3.125	96.0	5.7
1,200	602D122F250BL2A	2.000 x 3.625	76.0	6.7
1,500	602D152F250BC2A	2.000 x 4.125	63.0	7.8
1,800	602D182F250BD2A	2.000 x 4.625	54.0	8.8
2,200	602D222F250BF2A	2.000 x 5.625	43.0	10.7
1,800	602D182F250CB2A	2.500 x 3.125	56.0	8.5
2,700	602D272F250CC2A	2.500 x 4.125	38.0	11.5
3,300	602D332F250CD2A	2.500 x 4.625	33.0	13.0
3,900	602D392F250CF2A	2.500 x 5.625	26.0	15.9
3,300	602D332F250DL2A	3.000 x 3.625	32.0	13.5
3,900	602D392F250DC2A	3.000 x 4.125	27.0	15.4
4,700	602D472F250DD2A	3.000 x 4.625	23.0	17.3
5,600	602D562F250DE2A	3.000 x 5.125	21.0	19.1
6,800	602D682F250DF2A	3.000 x 5.625	18.3	20.9
10,000	602D103F250DJ2A	3.000 x 8.625	12.8	29.9

MAXIMUM CAPACITANCE VALUES PER CASE SIZE (μF)

Case Code	Size (inch) D	Size (inch) L	VDC 5	6.3	7.5	10	12	15	20	25	30	40	50	63	75	100	150	200	250
AN	1.375	1.625	20K	17K	15K	13K	12K	10K	7600	6000	5600	3400	2700	2100	1800	750	270	220	190
AY	1.375	1.875	26K	23K	20K	18K	16K	13K	10K	8000	7400	4500	3600	2800	2400	1000	370	290	250
AA	1.375	2.125	33K	29K	26K	22K	20K	16K	12K	10K	9200	5700	4700	3500	3000	1200	470	370	320
AM	1.375	2.625	46K	41K	36K	31K	28K	23K	17K	14K	12K	7900	6400	4900	4200	1700	650	510	450
AB	1.375	3.125	60K	53K	47K	40K	37K	30K	22K	18K	16K	10K	8200	6300	5400	2200	830	660	570
AL	1.375	3.625	73K	65K	56K	49K	45K	37K	27K	22K	20K	12K	10K	7700	6600	2700	1000	820	700
AC	1.375	4.125	87K	77K	68K	58K	53K	43K	33K	26K	24K	14K	11K	9100	7800	3200	1200	960	830
AD	1.375	4.625	100K	89K	78K	68K	61K	50K	38K	30K	27K	17K	13K	10K	9100	3700	1300	1100	960
AE	1.375	5.125	110K	100K	88K	77K	69K	57K	43K	34K	31K	19K	15K	12K	10K	4200	1500	1200	1000
AF	1.375	5.625	120K	110K	100K	86K	78K	63K	48K	38K	35K	21K	17K	13K	11K	4700	1700	1400	1200
EN	1.750	1.625	35K	31K	27K	24K	21K	17K	13K	10K	10K	6200	4900	3700	3200	1300	500	400	340
EY	1.750	1.875	47K	42K	37K	32K	29K	23K	18K	14K	13K	8100	6500	5000	4300	1700	670	530	460
EA	1.750	2.125	59K	53K	46K	40K	36K	29K	22K	17K	16K	10K	8100	6200	5300	2200	840	660	580
EM	1.750	2.625	83K	74K	64K	56K	51K	41K	31K	25K	23K	14K	11K	8800	7500	3100	1100	930	810
EB	1.750	3.125	100K	95K	83K	72K	65K	53K	40K	32K	29K	18K	14K	11K	9700	4000	1500	1200	1000
EL	1.750	3.625	130K	110K	100K	88K	80K	65K	49K	39K	36K	22K	18K	13K	11K	4900	1800	1400	1200
EC	1.750	4.125	150K	130K	120K	100K	95K	77K	58K	47K	42K	26K	21K	16K	14K	5700	2100	1700	1500
ED	1.750	4.625	170K	150K	130K	120K	100K	89K	67K	53K	49K	30K	24K	18K	16K	6600	2500	2000	1700
EE	1.750	5.125	200K	180K	150K	130K	120K	100K	77K	61K	56K	34K	27K	21K	18K	7500	2800	2200	1900
EF	1.750	5.625	220K	200K	170K	150K	130K	110K	86K	68K	62K	38K	31K	23K	20K	8400	3100	2500	2200
BY	2.000	1.875	45K	40K	35K	30K	27K	22K	17K	13K	12K	7500	6200	4700	4100	1600	620	490	420
BA	2.000	2.125	60K	54K	47K	40K	37K	30K	22K	18K	16K	10K	8300	6300	5400	2200	830	650	570
BM	2.000	2.625	91K	81K	70K	62K	55K	45K	34K	27K	25K	15K	12K	9500	8200	3300	1200	1000	850
BB	2.000	3.125	120K	100K	94K	82K	74K	60K	45K	36K	33K	20K	16K	12K	10K	4500	1600	1300	1100
BL	2.000	3.625	150K	130K	110K	100K	93K	76K	57K	45K	41K	25K	20K	15K	13K	5600	2000	1600	1400
BC	2.000	4.125	180K	160K	140K	120K	110K	91K	68K	54K	50K	30K	24K	19K	16K	6800	2400	1900	1700
BD	2.000	4.625	210K	180K	160K	130K	130K	100K	80K	63K	58K	36K	29K	22K	19K	7900	2900	2300	2000
BE	2.000	5.125	240K	210K	180K	160K	140K	120K	91K	72K	67K	41K	33K	25K	21K	9000	3300	2600	2200
BF	2.000	5.625	270K	240K	210K	180K	160K	130K	100K	82K	75K	47K	37K	28K	24K	10K	3700	2900	2500
CB	2.500	3.125	200K	180K	160K	140K	120K	100K	78K	62K	57K	35K	28K	21K	18K	7700	2800	2200	1900
CL	2.500	3.625	250K	230K	200K	170K	150K	130K	98K	78K	71K	44K	35K	27K	23K	9600	3500	2800	2400
CC	2.500	4.125	310K	270K	240K	210K	190K	150K	110K	93K	86K	51K	42K	32K	28K	11K	4200	3400	2900
CD	2.500	4.625	360K	320K	280K	240K	220K	180K	130K	100K	100K	62K	49K	38K	32K	13K	5000	3900	3400
CE	2.500	5.125	410K	370K	320K	280K	250K	200K	150K	120K	110K	70K	57K	43K	37K	15K	5700	4500	3900
CF	2.500	5.625	470K	410K	360K	310K	280K	230K	160K	140K	120K	79K	64K	49K	42K	17K	6400	5100	4400
DB	3.000	3.125	300K	270K	230K	220K	180K	150K	110K	92K	84K	52K	42K	32K	27K	11K	4300	3400	2900
DL	3.000	3.625	380K	340K	290K	250K	230K	190K	140K	110K	100K	65K	52K	40K	34K	14K	5400	4200	3700
DC	3.000	4.125	450K	410K	350K	310K	280K	230K	170K	130K	120K	78K	63K	48K	41K	17K	6400	5100	4400
DD	3.000	4.625	530K	470K	410K	360K	320K	260K	200K	160K	140K	91K	73K	56K	48K	20K	7500	6000	5200
DE	3.000	5.125	620K	540K	470K	410K	370K	300K	230K	180K	160K	100K	84K	64K	56K	22K	8600	6800	5900
DF	3.000	5.625	680K	610K	530K	470K	420K	340K	260K	200K	190K	110K	94K	72K	62K	25K	9700	7700	6800
DJ	3.000	8.625	1000K	1000K	890K	770K	700K	570K	430K	340K	310K	190K	150K	120K	100K	41K	16K	12K	11K

MAXIMUM 120HZ-25°C ESR LIMITS FOR MAXIMUM CAPACITANCE RATINGS (MILLIOHMS)

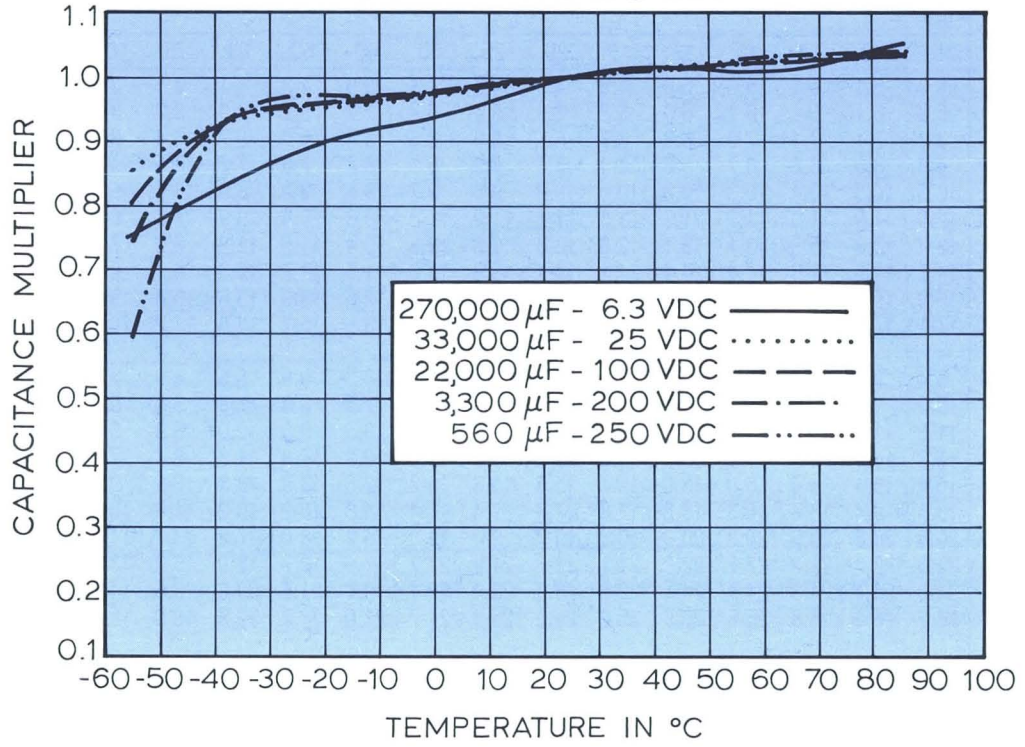
Case Code	Size (inch) D	L	VDC 5	6.3	7.5	10	12	15	20	25	30	40	50	63	75	100	150	200	250
AN	1.375	1.625	44	45	46	47	47	50	50	52	53	60	64	71	123	169	359	516	552
AY	1.375	1.875	34	35	35	36	36	38	38	40	40	46	49	54	93	125	261	388	416
AA	1.375	2.125	28	29	29	30	30	32	32	33	33	37	40	44	75	104	210	304	324
AM	1.375	2.625	22	22	22	23	23	24	24	25	26	28	30	33	55	75	149	220	231
AB	1.375	3.125	18.0	17.9	18.2	18.6	18.6	19.5	19.8	20	21	23	24	26	43	59	117	171	182
AL	1.375	3.625	15.5	15.6	15.7	16.2	16.2	16.9	17.1	17.7	17.8	19.8	21	23	36	49	98	140	149
AC	1.375	4.125	13.9	14.0	14.1	14.4	14.4	15.1	15.1	15.7	15.8	17.7	18.8	19.8	32	42	82	119	126
AD	1.375	4.625	12.7	12.8	12.9	13.2	13.2	13.7	13.7	14.3	14.4	15.7	16.9	18.2	28	37	76	104	110
AE	1.375	5.125	11.8	11.9	12.0	12.1	12.3	12.7	12.8	13.2	13.3	14.6	15.4	16.3	26	33	67	95	105
AF	1.375	5.625	11.1	11.2	11.3	11.4	11.4	11.9	12.0	12.4	12.4	13.5	14.2	15.2	24	30	59	83	89
EN	1.750	1.625	23	24	24	25	25	27	27	29	28	32	34	39	68	95	194	283	308
EY	1.750	1.875	18.0	18.3	18.6	19.2	19.3	21	21	22	22	25	26	29	51	72	144	212	226
EA	1.750	2.125	14.9	15.1	15.5	15.9	16.0	17.0	17.1	18.2	18.1	20	22	24	42	56	115	170	179
EM	1.750	2.625	11.4	11.7	11.9	12.1	12.3	12.9	13.1	13.5	13.6	15.2	16.5	17.8	30	41	87	121	128
EB	1.750	3.125	9.7	9.7	9.8	10.2	10.2	10.6	10.8	11.2	11.3	12.6	13.5	14.7	24	32	65	94	104
EL	1.750	3.625	8.5	8.7	8.7	8.8	8.9	9.3	9.4	9.7	9.7	10.8	11.3	12.7	21	27	54	81	87
EC	1.750	4.125	7.7	7.8	7.8	8.0	8.0	8.3	8.3	8.7	8.8	9.6	10.1	11.1	17.4	23	47	67	70
ED	1.750	4.625	7.1	7.2	7.3	7.3	7.3	7.7	7.7	8.0	8.0	8.7	9.3	10.1	15.6	21	40	57	62
EE	1.750	5.125	6.5	6.6	6.7	6.8	6.8	7.1	7.1	7.3	7.4	8.1	8.5	9.1	14.2	18.5	36	52	56
EF	1.750	5.625	6.2	6.3	6.4	6.4	6.5	6.7	6.7	6.8	7.0	7.5	7.9	8.6	13.1	16.9	33	46	49
BY	2.000	1.875	23	23	24	24	24	26	26	26	27	29	31	34	57	80	159	234	252
BA	2.000	2.125	18.0	18.1	18.2	18.5	18.6	19.7	19.8	20	21	22	24	26	43	59	119	175	185
BM	2.000	2.625	12.9	13.1	13.1	13.2	13.3	14.1	14.1	14.4	14.6	15.8	16.9	18.1	29	40	82	116	124
BB	2.000	3.125	10.4	10.5	10.5	10.6	10.8	11.3	11.3	11.6	11.7	12.6	13.3	14.6	24	30	62	88	96
BL	2.000	3.625	8.9	9.0	9.0	9.1	9.1	9.6	9.7	9.8	10.0	10.6	11.2	12.3	19.3	25	50	72	76
BC	2.000	4.125	8.0	8.0	8.0	8.1	8.1	8.6	8.6	8.7	8.8	9.4	9.8	10.5	16.3	21	42	61	63
BD	2.000	4.625	7.3	7.3	7.3	7.4	7.4	7.8	7.8	7.9	8.0	8.5	8.8	9.5	14.2	18.3	35	51	54
BE	2.000	5.125	6.7	6.7	6.8	6.8	6.8	7.2	7.2	7.3	7.3	7.8	8.2	8.7	13.1	16.4	32	45	49
BF	2.000	5.625	6.4	6.4	6.4	6.4	6.5	6.7	6.7	6.8	6.8	7.3	7.5	8.1	11.9	15.0	28	41	43
CB	2.500	3.125	5.7	5.8	5.8	5.9	6.0	6.4	6.4	6.6	6.6	7.3	7.7	8.5	13.6	17.5	37	53	56
CL	2.500	3.625	5.0	5.1	5.1	5.2	5.4	5.6	5.6	5.7	5.8	6.3	6.6	7.2	11.2	14.4	30	42	45
CC	2.500	4.125	4.5	4.7	4.7	4.8	4.8	5.0	5.1	5.2	5.2	5.7	5.9	6.4	9.6	12.8	25	35	38
CD	2.500	4.625	4.3	4.3	4.3	4.4	4.4	4.7	4.8	4.9	4.8	5.2	5.5	5.8	8.7	11.2	22	31	33
CE	2.500	5.125	4.1	4.1	4.1	4.2	4.2	4.4	4.4	4.5	4.5	4.9	5.0	5.4	7.9	10.1	19.0	27	29
CF	2.500	5.625	3.9	3.9	4.0	4.0	4.0	4.2	4.2	4.3	4.3	4.5	4.8	5.0	7.2	9.1	17.2	24	26
DB	3.000	3.125	5.7	5.8	5.8	5.8	5.8	6.4	6.4	6.5	6.5	6.8	7.1	7.3	10.6	13.7	26	27	40
DL	3.000	3.625	5.1	5.1	5.1	5.1	5.1	5.6	5.6	5.7	5.7	5.9	6.2	6.4	8.9	11.3	22	30	32
DC	3.000	4.125	4.7	4.7	4.7	4.7	4.7	5.0	5.0	5.1	5.1	5.4	5.5	5.7	7.9	9.7	18.3	25	27
DD	3.000	4.625	4.3	4.3	4.3	4.3	4.3	4.7	4.7	4.8	4.8	4.9	5.0	5.2	7.1	8.7	16.0	22	23
DE	3.000	5.125	4.1	4.1	4.1	4.1	4.1	4.4	4.4	4.4	4.4	4.7	4.8	4.9	6.5	8.0	14.3	19.5	21
DF	3.000	5.625	3.9	3.9	3.9	4.0	4.0	4.2	4.2	4.2	4.2	4.4	4.4	4.5	6.0	7.3	12.9	17.4	18.3
DJ	3.000	8.625	3.3	3.3	3.3	3.3	3.3	3.5	3.5	3.5	3.5	3.6	3.6	3.7	4.7	5.4	9.5	12.7	12.8

MAXIMUM 120HZ-85°C RIPPLE CURRENT LIMITS FOR MAXIMUM CAPACITANCE VALUES (AMPERES)

Case Code	Size (inch)		VDC																
	D	L	5	6.3	7.5	10	12	15	20	25	30	40	50	63	75	100	150	200	250
AN	1.375	1.625	5.2	5.1	5.1	5.0	5.0	4.9	4.9	4.7	4.7	3.9	4.3	4.1	3.1	2.6	1.8	1.5	1.4
AY	1.375	1.875	6.3	6.1	6.1	6.1	6.0	5.8	5.8	5.7	5.7	4.7	5.2	4.9	3.7	3.2	2.2	1.8	1.7
AA	1.375	2.125	7.2	7.1	7.1	7.0	6.9	6.7	6.7	6.6	6.6	5.4	6.0	5.7	4.4	3.7	2.6	2.1	2.1
AM	1.375	2.625	8.9	8.8	8.8	8.7	8.6	8.4	8.4	8.3	8.1	6.8	7.6	7.2	5.6	4.8	3.3	3.7	2.7
AB	1.375	3.125	10.5	10.5	10.4	10.3	10.3	10.0	10.0	9.8	9.7	8.1	9.0	8.6	6.7	5.8	4.1	3.4	3.2
AL	1.375	3.625	12.0	11.9	11.9	11.7	11.7	11.5	11.4	11.2	11.2	9.3	10.4	9.9	7.8	6.7	4.7	4.0	3.8
AC	1.375	4.125	13.4	13.3	13.3	13.1	13.1	12.8	12.8	12.6	12.5	10.4	11.5	11.2	8.8	7.7	5.5	4.5	4.4
AD	1.375	4.625	14.7	14.6	14.6	14.4	14.4	14.1	14.1	13.8	13.8	11.5	12.7	12.3	9.9	8.6	6.0	5.1	5.0
AE	1.375	5.125	16.0	15.9	15.8	15.7	15.6	15.4	15.3	15.1	15.0	12.6	13.9	13.5	10.8	9.5	6.7	5.6	5.3
AF	1.375	5.625	17.1	17.0	17.0	16.9	16.9	16.5	16.5	16.2	16.2	13.6	15.1	14.6	11.7	10.4	7.4	6.2	6.0
EN	1.750	1.625	8.4	8.3	8.2	8.1	8.0	7.8	7.8	7.5	7.6	6.3	6.9	6.5	4.9	4.1	2.9	2.4	2.3
EY	1.750	1.875	10.0	9.9	9.8	9.7	9.6	9.3	9.4	9.1	9.1	7.5	8.3	7.8	5.9	5.0	3.5	2.9	2.8
EA	1.750	2.125	11.5	11.4	11.3	11.1	11.1	10.7	10.7	10.4	10.4	8.5	9.5	9.0	6.9	5.9	4.1	3.4	3.3
EM	1.750	2.625	14.2	14.0	13.9	13.8	13.7	13.3	13.2	13.0	13.0	10.8	11.8	11.3	8.7	7.5	5.1	4.3	4.2
EB	1.750	3.125	16.4	16.4	16.4	16.0	16.0	15.7	15.6	15.3	15.2	12.8	13.9	13.3	10.5	9.0	6.3	5.3	5.0
EL	1.750	3.625	18.6	18.4	18.4	18.3	18.2	17.8	17.7	17.4	17.4	14.6	16.2	15.2	11.8	10.5	7.3	6.0	5.8
EC	1.750	4.125	20.6	20.5	20.5	20.3	30.3	19.9	19.9	19.4	19.3	16.2	18.0	17.2	13.7	11.8	8.3	7.0	6.8
ED	1.750	4.625	22.6	22.4	22.2	22.2	22.2	21.7	21.7	21.2	21.2	17.9	19.7	18.9	15.2	13.3	9.5	7.9	7.6
EE	1.750	5.125	24.6	24.4	24.3	24.1	24.1	23.6	23.6	23.2	23.1	19.4	21.5	20.8	16.6	14.6	10.5	8.7	8.4
EF	1.750	5.625	26.2	26.0	25.8	25.8	25.6	25.2	25.2	25.1	24.7	21.0	23.2	22.3	18.0	15.9	11.4	9.6	9.3
BY	2.000	1.875	9.7	9.6	9.6	9.5	9.5	9.2	9.1	9.0	9.0	7.4	8.4	7.9	6.1	5.2	3.6	3.0	2.9
BA	2.000	2.125	11.4	11.4	11.3	11.2	11.2	10.9	10.9	10.7	10.7	8.8	10.0	9.5	7.3	6.3	4.4	3.6	3.5
BM	2.000	2.625	14.5	14.4	14.4	14.3	14.3	13.9	13.9	13.7	13.6	11.3	12.7	12.2	9.6	8.2	5.7	4.8	4.7
BB	2.000	3.125	17.2	17.2	17.2	17.1	16.9	16.5	16.5	16.3	16.3	13.5	15.2	14.5	11.3	10.1	7.0	5.9	5.7
BL	2.000	3.625	19.7	19.6	19.6	19.5	19.5	19.0	18.9	18.8	18.6	15.5	17.6	16.8	13.4	11.9	8.3	6.9	6.7
BC	2.000	4.125	21.9	21.9	21.9	21.8	21.8	21.1	21.1	21.0	20.9	17.4	19.8	19.1	15.3	13.5	9.5	7.9	7.8
BD	2.000	4.625	24.1	24.1	24.1	23.9	23.9	23.3	23.3	23.1	23.0	19.1	21.9	21.1	17.2	15.2	10.9	9.1	8.8
BE	2.000	5.125	26.2	26.2	26.0	26.0	26.0	25.3	25.3	25.1	25.1	20.9	23.8	23.0	18.7	16.7	12.1	10.1	9.7
BF	2.000	5.625	27.9	27.9	27.9	27.9	27.7	27.3	27.3	27.1	27.1	22.5	25.8	24.8	20.4	18.2	13.2	11.0	10.7
CB	2.500	3.125	26.8	26.6	26.6	26.4	26.2	25.3	25.3	24.9	24.9	18.4	23.1	22.0	17.4	15.3	10.6	8.8	8.5
CL	2.500	3.625	30.3	30.0	30.0	29.7	29.1	28.6	28.6	28.3	18.2	20.9	26.3	25.2	20.2	17.8	12.4	10.4	10.0
CC	2.500	4.125	33.5	32.8	32.8	32.4	32.4	31.8	31.5	31.2	31.2	23.3	29.3	28.1	22.9	19.8	14.2	12.0	11.5
CD	2.500	4.625	35.9	35.8	35.8	35.4	35.4	34.3	33.9	33.6	33.9	25.7	31.7	30.8	25.2	22.2	16.0	13.4	13.0
CE	2.500	5.125	38.2	38.2	38.2	37.8	37.8	36.9	36.9	36.5	36.5	27.9	34.6	33.3	27.5	24.3	17.7	14.9	14.4
CF	2.500	5.625	40.7	40.7	40.2	40.2	40.2	39.2	39.2	38.8	38.8	30.0	36.7	35.9	29.9	26.6	19.4	16.3	15.9
DB	3.000	3.125	30.2	30.0	30.0	30.0	30.0	28.5	28.5	28.3	28.3	23.7	27.1	26.7	22.2	19.5	14.1	11.9	11.5
DL	3.000	3.625	33.7	33.7	33.7	33.7	33.7	32.1	32.1	31.8	31.8	26.9	30.5	30.0	25.5	22.6	16.4	13.8	13.5
DC	3.000	4.125	36.7	36.7	36.7	36.7	36.7	35.6	35.6	35.3	35.3	29.7	34.0	33.4	28.3	25.6	18.6	15.8	15.4
DD	3.000	4.625	40.1	40.1	40.1	40.1	40.1	38.3	38.3	37.9	37.9	32.2	37.2	36.4	31.2	28.2	20.8	17.8	17.3
DE	3.000	5.125	42.7	42.7	42.7	42.7	42.7	41.2	41.2	41.2	41.2	34.6	39.5	39.1	33.9	30.6	22.8	19.6	19.1
DF	3.000	5.625	45.4	45.4	45.4	44.8	44.8	43.8	43.8	43.8	43.8	37.1	42.7	42.3	36.6	33.2	24.9	21.5	20.9
DJ	3.000	8.625	58.9	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	48.8	56.3	55.6	49.3	46.0	34.7	30.0	29.9

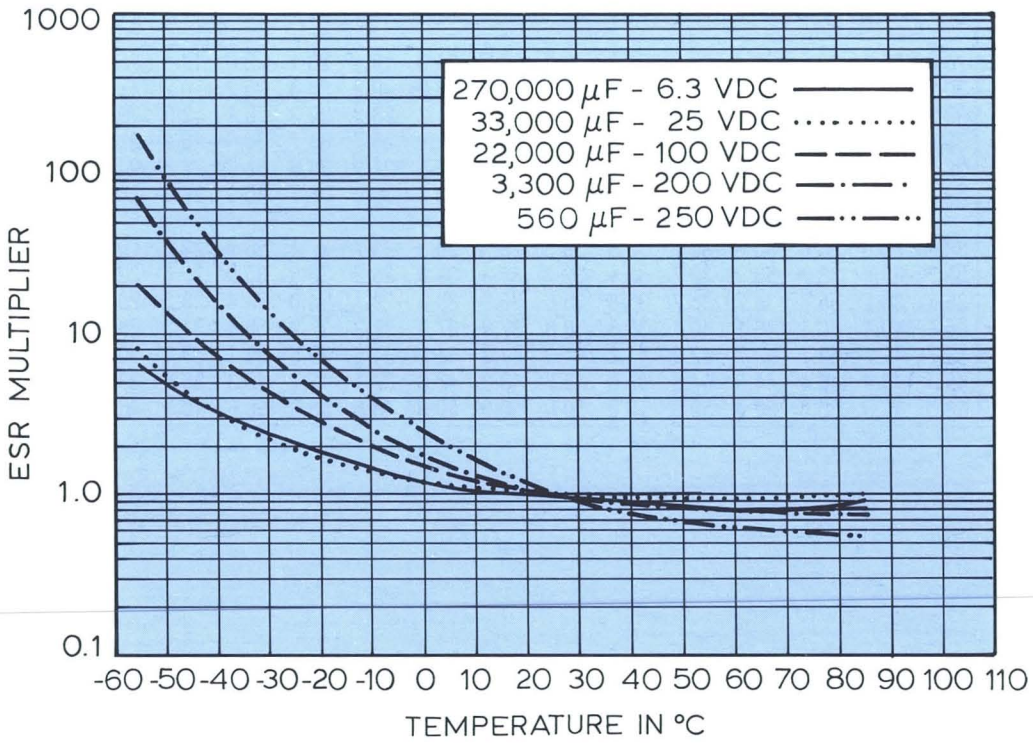
TYPICAL CURVES

TYPE 602D/DM — TYPICAL CAPACITANCE MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,725

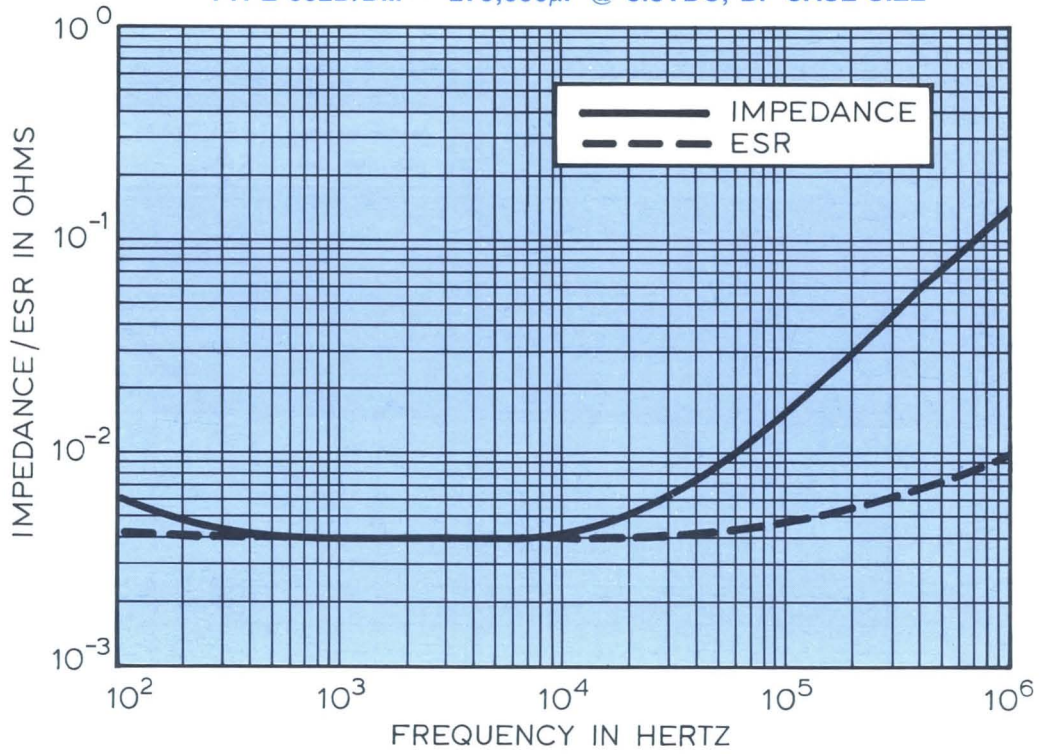
TYPE 602D/DM — TYPICAL ESR MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,716

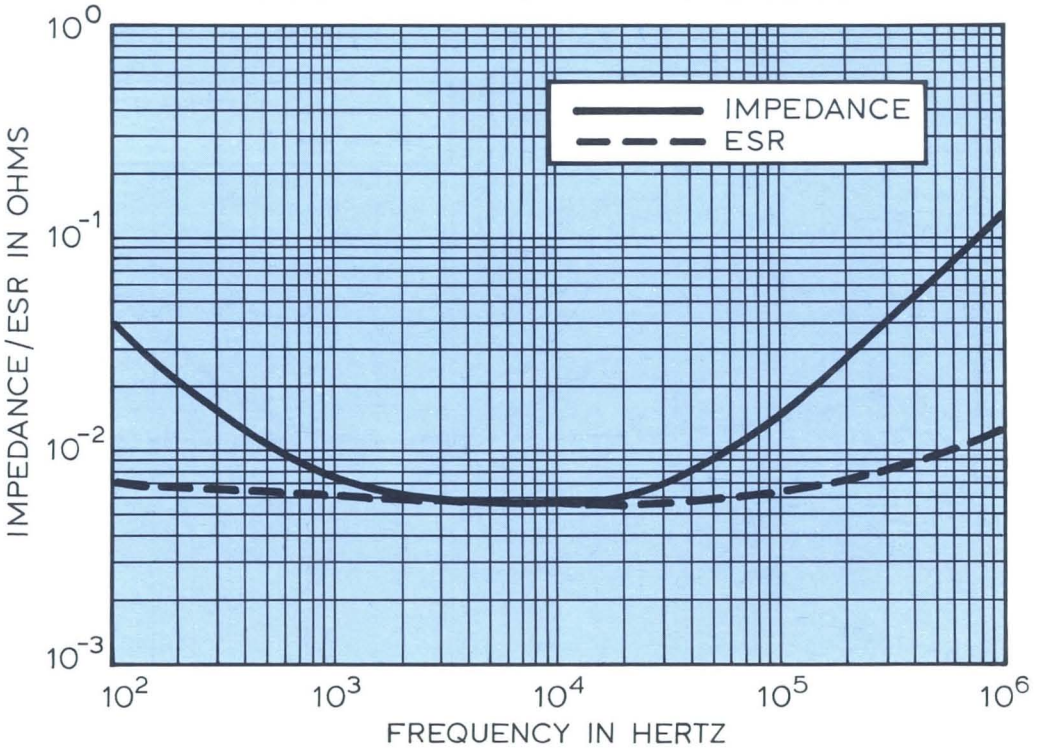
TYPICAL CURVES @ +25°C

TYPE 602D/DM — 270,000μF @ 6.3VDC, BF CASE SIZE



Dwg. No. A-14,649

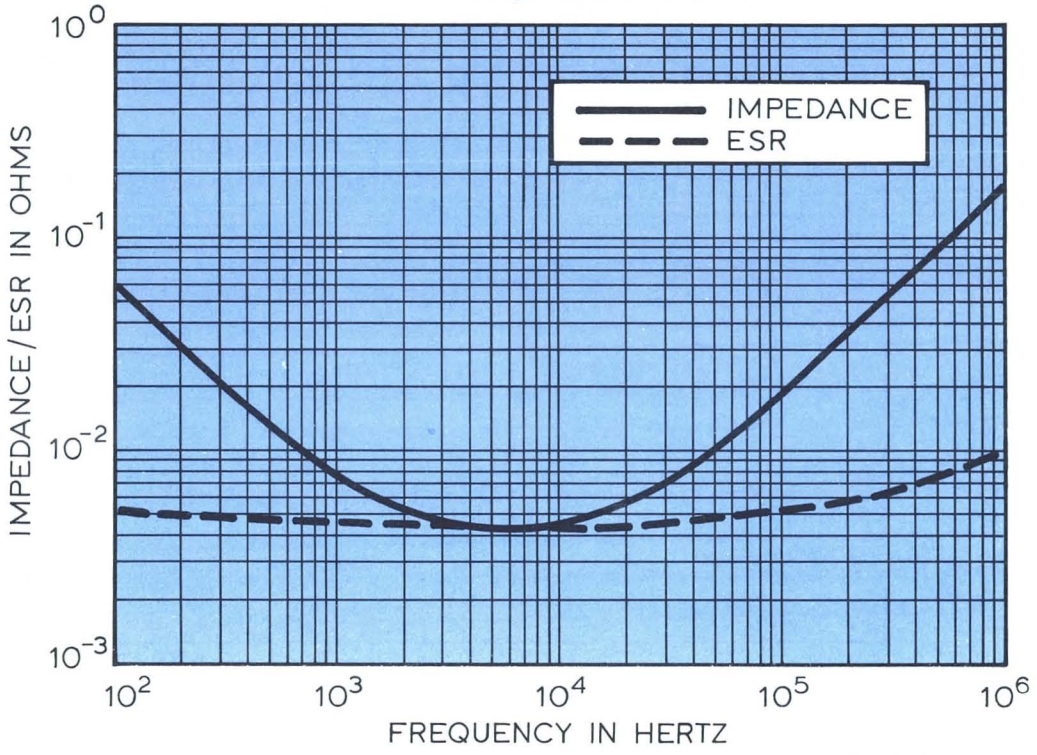
TYPE 602D/DM — 33000μF @ 25VDC, BB CASE SIZE



Dwg. No. A-14,652

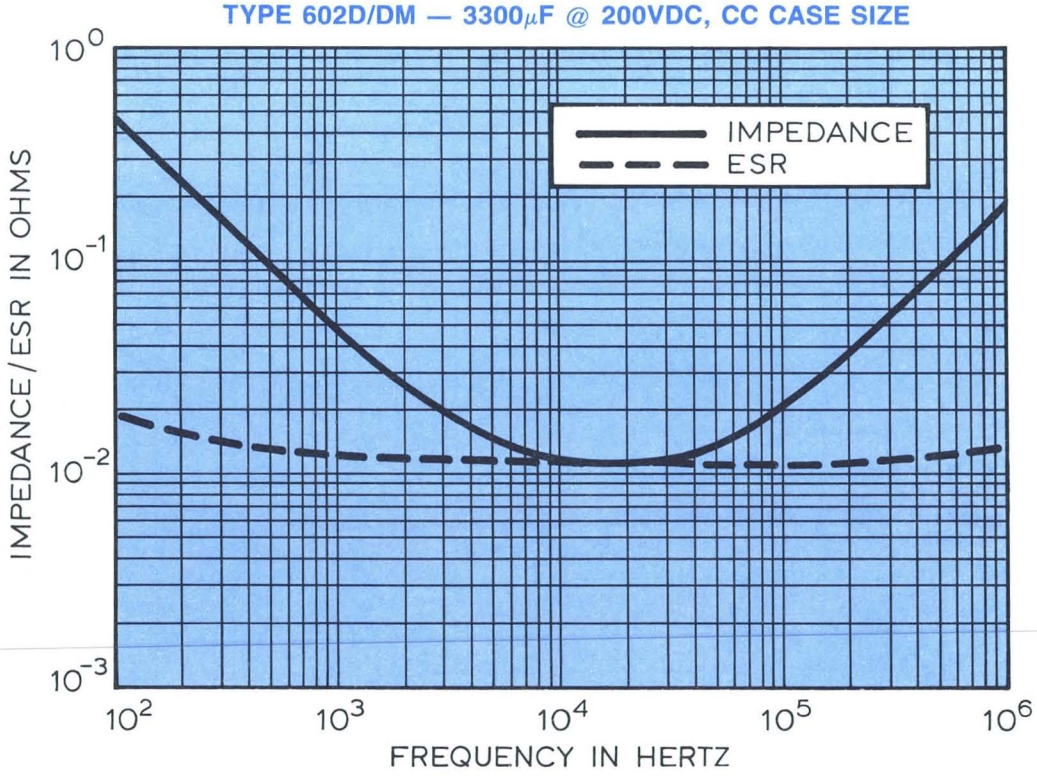
TYPICAL CURVES @ +25°C

TYPE 602D/DM — 22000μF @ 100VDC, DE CASE SIZE



Dwg. No. A-14,651

TYPE 602D/DM — 3300μF @ 200VDC, CC CASE SIZE



Dwg. No. A-14,650

+95°C Large Can Aluminum Capacitors

Features —

- **Ideal for High Frequency SMPS Output Filtering**
- **Symmetrical ESR (±30%) and Capacitance (±20%)**
- **Excellent Ripple Current Capability**
- **Metric Threads and Stud Mount Available**

9914

General Specifications —

Operating Temperature: –55°C - +95°C.

Voltage Range: 5 - 60 VDC.

Capacitance Range: 2300μF - 180,000μF.

Capacitance Tolerance: ±20%.

Case Size Range: 1.375″ x 2.125″ - 2.0″ x 5.625″.

Termination: Screw insert or Solderable Terminals.

Life Validation Test: 1000 hours at +95°C or 2000 hours at +85°C:
- Δ CAP ≤ 15% from initial measurement.
- Δ ESR ≤ 1.3 x initial specified limit.
- Δ DCL ≤ initial specified limit.

Shelf Test: 500 hours at +95°C:
- Δ CAP ≤ 10% from initial measurement.
- Δ ESR ≤ 1.2 x initial specified limit.
- Δ DCL ≤ 2.0 x initial specified limit.

DC Leakage Current: $I = 4.0\sqrt{CV}$
C in μF, V in Volts, I in μA .

Expected Life: SEE PAGE 270.

Performance Characteristics: SEE PAGE 266.

Ripple Current Multipliers:

TEMPERATURE

Ambient Temperature	Multipliers
+85°C	1.0
+75°C	1.4
+65°C	1.7
+55°C & below	2.0

FREQUENCY Hz

Rated WVDC	120	400	1K	5K-100K
5-20	.85	.95	.95	1.0
28-60	.75	.85	.95	1.0

Low Temperature Performance:

Capacitance Ratio $C^{-55°C}/C^{+25°C}$ min. @ 120Hz

Rated Voltage (VDC)	Capacitance Remaining
0 to 9	10
10 to 40	8
41 to 60	6

ESR Ratio $ESR^{-55°C}/ESR^{+25°C}$ max. @ 120Hz

Rated Voltage (VDC)	Multiplier
0 to 9	3
10 to 40	2,5
41 to 60	2

ESL (Typical values @ 1MHz-10MHz):

Nominal Diameter Inches	Nominal Diameter Millimeters	Typical ESL (nH)
1.375	35	12
2.000	50	21

Catalog Numbering System

622D 223 M 005 AA 2 A

LEAD CODE
A = LOW SCREW INSERT (Standard)
B = HIGH SCREW INSERT
P = PWB VERTICAL MOUNT
I = HIGH INSERT M5 SCREW THREAD

CASE STYLE
2 = PLASTIC FILM INSULATING SLEEVE
5 = PLASTIC FILM INSULATING SLEEVE WITH POLYMER COATED END SEAL*

CASE CODE. SEE DIMENSIONS, PAGE 221.

DC VOLTAGE RATING. EXPRESSED IN VOLTS. "R" INDICATES A DECIMAL POINT, FOR EXAMPLE, 7R5 = 7.5 VOLTS.

CAPACITANCE TOLERANCE. M = ±20%.

CAPACITANCE. EXPRESSED IN MICROFARADS. THE FIRST TWO DIGITS ARE SIGNIFICANT FIGURES, THE THIRD IS THE NUMBER OF ZEROS.

SPRAGUE TYPE NUMBER. IDENTIFIES THE BASIC CAPACITOR DESIGN.
622D = STANDARD CASE
622DM = STUD MOUNT CASE

*Available with Terminal "P" only.

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D x L	Max. Ripple Current @ +85°C, 20kHz (A)	Max. ESR ±30% @ +25°C, 20kHz (mΩ)
5 VOLTS DC WORKING; 6 VOLTS DC SURGE				
22,000	622D223M005AA2A	1.375 x 2.125	9.8	5.8
31,000	622D313M005AM2A	1.375 x 2.625	11.4	5.0
40,000	622D403M005AB2A	1.375 x 3.125	13.0	4.5
50,000	622D503M005AL2A	1.375 x 3.625	14.4	4.1
51,000	622D513M005BA2A	2.000 x 2.125	14.0	4.6
59,000	622D593M005AC2A	1.375 x 4.125	15.8	3.8
61,000	622D613M005BM2A	2.000 x 2.625	16.2	4.0
68,000	622D683M005AD2A	1.375 x 4.625	17.3	3.5
77,000	622D773M005AE2A	1.375 x 5.125	19.0	3.2
82,000	622D823M005BB2A	2.000 x 3.125	19.0	3.3
86,000	622D863M005AF2A	1.375 x 5.625	20.4	3.0
100,000	622D104M005BL2A	2.000 x 3.625	21.5	2.9
120,000	622D124M005BC2A	2.000 x 4.125	23.9	2.6
140,000	622D144M005BD2A	2.000 x 4.625	26.1	2.4
160,000	622D164M005BE2A	2.000 x 5.125	27.8	2.3
180,000	622D184M005BF2A	2.000 x 5.625	29.6	2.2
6.3 VOLTS DC WORKING; 8 VOLTS DC SURGE				
19,000	622D193M6R3AA2A	1.375 x 2.125	9.3	6.5
27,000	622D273M6R3AM2A	1.375 x 2.625	11.2	5.1
34,000	622D343M6R3AB2A	1.375 x 3.125	13.0	4.5
42,000	622D423M6R3AL2A	1.375 x 3.625	14.4	4.1
43,000	622D433M6R3BA2A	2.000 x 2.125	14.2	4.5
50,000	622D503M6R3AC2A	1.375 x 4.125	15.8	3.8
52,000	622D523M6R3BM2A	2.000 x 2.625	16.4	3.9
57,000	622D573M6R3AD2A	1.375 x 4.625	17.3	3.5
65,000	622D653M6R3AE2A	1.375 x 5.125	29.0	3.2
70,000	622D703M6R3BB2A	2.000 x 3.125	19.3	3.2
73,000	622D733M6R3AF2A	1.375 x 5.625	20.4	3.0
87,000	622D873M6R3BL2A	2.000 x 3.625	21.9	2.8
100,000	622D104M6R3BC2A	2.000 x 4.125	23.9	2.6
110,000	622D114M6R3BD2A	2.000 x 4.625	26.1	2.4
140,000	622D144M6R3BE2A	2.000 x 5.125	28.4	2.2
150,000	622D154M6R3BF2A	2.000 x 5.625	30.0	2.1
7.5 VOLTS DC WORKING; 9 VOLTS DC SURGE				
18,000	622D183M7R5AA2A	1.375 x 2.125	9.6	6.0
25,000	622D253M7R5AM2A	1.375 x 2.625	11.2	5.2
32,000	622D323M7R5AB2A	1.375 x 3.125	12.8	4.6
39,000	622D393M7R5AL2A	1.375 x 3.625	14.2	4.2
40,000	622D403M7R5BA2A	2.000 x 2.125	14.2	4.5
46,000	622D463M7R5AC2A	1.375 x 4.125	15.6	3.9
48,000	622D483M7R5BM2A	2.000 x 2.625	16.2	4.0
53,000	622D533M7R5AD2A	1.375 x 4.625	17.1	3.6
61,000	622D613M7R5AE2A	1.375 x 5.125	18.7	3.3
65,000	622D653M7R5BB2A	2.000 x 3.125	19.2	3.3
68,000	622D683M7R5AF2A	1.375 x 5.625	20.4	3.0
81,000	622D813M7R5BL2A	2.000 x 3.625	21.5	2.9
97,000	622D973M7R5BC2A	2.000 x 4.125	23.5	2.7
110,000	622D114M7R5BD2A	2.000 x 4.625	25.6	2.5
130,000	622D134M7R5BE2A	2.000 x 5.125	27.8	2.3
140,000	622D144M7R5BF2A	2.000 x 5.625	29.6	2.2

STANDARD RATINGS

μF	Catalog Number	Nominal Case Size (inches) D x L	Max. Ripple Current @ +85°C, 20kHz (A)	Max. ESR ±30% @ +25°C, 20kHz (mΩ)
10 VOLTS DC WORKING; 12 VOLTS DC SURGE				
16,000	622D163M010AA2A	1.375 x 2.125	8.6	7.6
22,000	622D223M010AM2A	1.375 x 2.625	10.4	6.1
28,000	622D283M010AB2A	1.375 x 3.125	12.1	5.2
35,000	622D353M010AL2A	1.375 x 3.625	13.7	4.6
36,000	622D363M010BA2A	2.000 x 2.125	14.0	4.6
41,000	622D413M010AC2A	1.375 x 4.125	14.9	4.3
43,000	622D433M010BM2A	2.000 x 2.625	16.2	4.0
48,000	622D483M010AD2A	1.375 x 4.625	16.3	4.0
54,000	622D543M010AE2A	1.375 x 5.125	17.7	3.7
58,000	622D583M010BB2A	2.000 x 3.125	18.8	3.4
60,000	622D603M010AF2A	1.375 x 5.625	19.0	3.5
72,000	622D723M010BL2A	2.000 x 3.625	21.1	3.0
86,000	622D863M010BC2A	2.000 x 4.125	23.5	2.7
100,000	622D104M010BD2A	2.000 x 4.625	25.6	2.5
110,000	622D114M010BE2A	2.000 x 5.125	27.8	2.3
130,000	622D134M010BF2A	2.000 x 5.625	28.9	2.3
16 VOLTS DC WORKING; 18 VOLTS DC SURGE				
12,000	622D123M016AA2A	1.375 x 2.125	9.3	6.4
18,000	622D183M016AM2A	1.375 x 2.625	10.9	5.5
23,000	622D233M016AB2A	1.375 x 3.125	12.4	4.9
28,000	622D283M016AL2A	1.375 x 3.625	13.9	4.4
29,000	622D293M016BA2A	2.000 x 2.125	14.0	4.6
33,000	622D333M016AC2A	1.375 x 4.125	15.4	4.0
34,000	622D343M016BM2A	2.000 x 2.625	16.2	4.0
38,000	622D383M016AD2A	1.375 x 4.625	16.9	3.7
43,000	622D433M016AE2A	1.375 x 5.125	18.4	3.4
46,000	622D463M016BB2A	2.000 x 3.125	18.8	3.4
48,000	622D483M016AF2A	1.375 x 5.625	20.1	3.1
58,000	622D583M016BL2A	2.000 x 3.625	21.5	2.9
69,000	622D693M016BC2A	2.000 x 4.125	23.5	2.7
81,000	622D813M016BD2A	2.000 x 4.625	25.6	2.5
92,000	622D923M016BE2A	2.000 x 5.125	27.8	2.3
100,000	622D104M016BF2A	2.000 x 5.625	29.6	2.2
20 VOLTS DC WORKING; 22 VOLTS DC SURGE				
10,000	622D103M020AA2A	1.375 x 2.125	9.1	6.6
15,000	622D153M020AM2A	1.375 x 2.625	10.7	5.7
19,000	622D193M020AB2A	1.375 x 3.125	12.3	5.0
23,000	622D233M020AL2A	1.375 x 3.625	13.8	4.5
24,000	622D243M020BA2A	2.000 x 2.125	14.0	4.6
27,000	622D273M020AC2A	1.375 x 4.125	15.3	4.1
29,000	622D293M020BM2A	2.000 x 2.625	16.2	4.0
32,000	622D323M020AD2A	1.375 x 4.625	16.6	3.8
36,000	622D363M020AE2A	1.375 x 5.125	18.1	3.5
38,000	622D383M020BB2A	2.000 x 3.125	18.8	3.4
40,000	622D403M020AF2A	1.375 x 5.625	19.8	3.2
48,000	622D483M020BL2A	2.000 x 3.625	21.5	2.9
57,000	622D573M020BC2A	2.000 x 4.125	23.5	2.7
67,000	622D673M020BD2A	2.000 x 4.625	25.6	2.5
76,000	622D763M020BE2A	2.000 x 5.125	27.8	2.3
86,000	622D863M020BF2A	2.000 x 5.625	29.6	2.2

STANDARD RATINGS

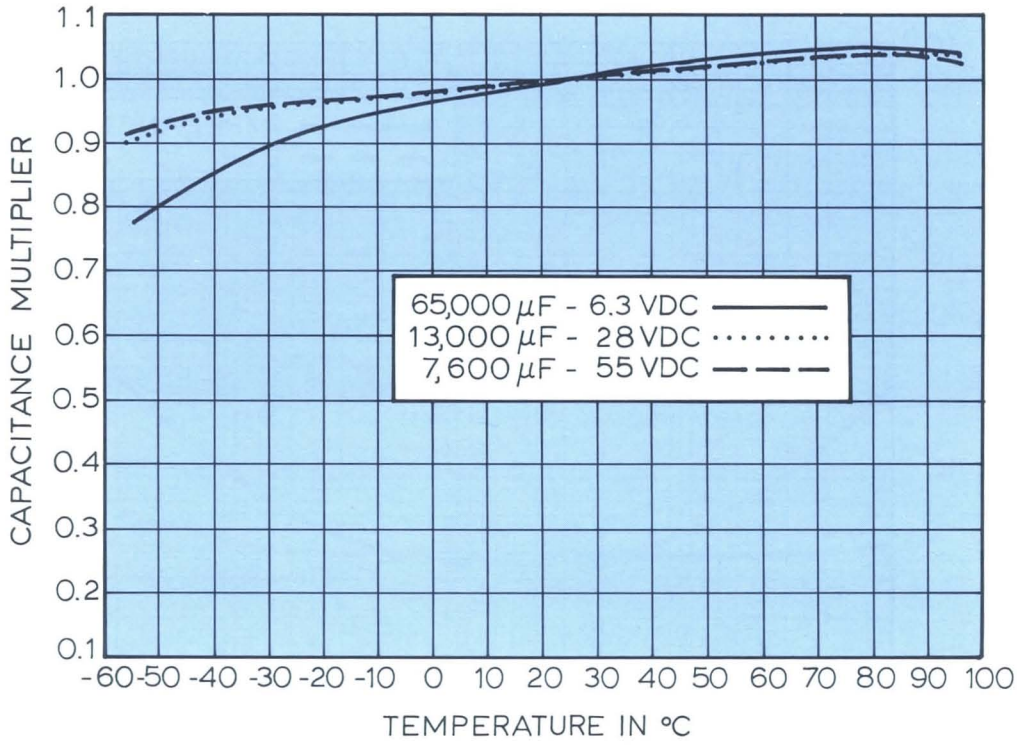
μF	Catalog Number	Nominal Case Size (inches) D x L	Max. Ripple Current @ +85°C, 20kHz (A)	Max. ESR ±30% @ +25°C, 20kHz (mΩ)
		28 VOLTS DC WORKING; 32 VOLTS DC SURGE		
7,400	622D742M028AA2A	1.375 x 2.125	8.8	7.1
10,000	622D103M028AM2A	1.375 x 2.625	10.4	6.1
13,000	622D133M028AB2A	1.375 x 3.125	11.9	5.3
16,000	622D163M028AL2A	1.375 x 3.625	13.3	4.8
17,000	622D173M028BA2A	2.000 x 2.125	14.0	4.6
19,000	622D193M028AC2A	1.375 x 4.125	14.9	4.3
20,000	622D203M028BM2A	2.000 x 2.625	16.2	4.0
22,000	622D223M028AD2A	1.375 x 4.625	16.4	3.9
25,000	622D253M028AE2A	1.375 x 5.125	17.9	3.6
27,000	622D273M028BB2A	2.000 x 3.125	18.8	3.4
28,000	622D283M028AF2A	1.375 x 5.625	19.5	3.3
34,000	622D343M028BL2A	2.000 x 3.625	21.1	3.0
40,000	622D403M028BC2A	2.000 x 4.125	23.5	2.7
47,000	622D473M028BD2A	2.000 x 4.625	25.6	2.5
54,000	622D543M028BE2A	2.000 x 5.125	27.8	2.3
61,000	622D613M028BF2A	2.000 x 5.625	29.6	2.2
		35 VOLTS DC WORKING; 40 VOLTS DC SURGE		
5,800	622D582M035AA2A	1.375 x 2.125	8.6	7.5
8,200	622D822M035AM2A	1.375 x 2.625	10.1	6.4
10,000	622D103M035AB2A	1.375 x 3.125	11.7	5.5
13,000	622D133M035AL2A	1.375 x 3.625	13.1	5.0
13,000	622D133M035BA2A	2.000 x 2.125	14.0	4.6
15,000	622D153M035AC2A	1.375 x 4.125	14.6	4.5
16,000	622D163M035BM2A	2.000 x 2.625	16.2	4.0
17,000	622D173M035AD2A	1.375 x 4.625	16.0	4.1
20,000	622D203M035AE2A	1.375 x 5.125	17.7	3.7
21,000	622D213M035BB2A	2.000 x 3.125	18.5	3.5
22,000	622D223M035AF2A	1.375 x 5.625	19.2	3.4
26,000	622D263M035BL2A	2.000 x 3.625	20.8	3.1
31,000	622D313M035BC2A	2.000 x 4.125	23.5	2.7
37,000	622D373M035BD2A	2.000 x 4.625	25.6	2.5
42,000	622D423M035BE2A	2.000 x 5.125	27.8	2.3
47,000	622D473M035BF2A	2.000 x 5.625	29.6	2.2
		45 VOLTS DC WORKING; 50 VOLTS DC SURGE		
4,200	622D422M045AA2A	1.375 x 2.125	8.4	7.9
5,800	622D582M045AM2A	1.375 x 2.625	10.3	6.2
7,500	622D752M045AB2A	1.375 x 3.125	12.0	5.3
9,200	622D922M045AL2A	1.375 x 3.625	13.5	4.7
9,500	622D952M045BA2A	2.000 x 2.125	14.0	4.6
11,000	622D113M045AC2A	1.375 x 4.125	14.9	4.3
11,000	622D113M045BM2A	2.000 x 2.625	16.4	3.9
12,000	622D123M045AD2A	1.375 x 4.625	16.3	4.0
14,000	622D143M045AE2A	1.375 x 5.125	17.7	3.7
15,000	622D153M045BB2A	2.000 x 3.125	18.8	3.4
16,000	622D163M045AF2A	1.375 x 5.625	18.7	3.6
19,000	622D193M045BL2A	2.000 x 3.625	21.5	2.9
22,000	622D223M045BC2A	2.000 x 4.125	23.9	2.6
26,000	622D263M045BD2A	2.000 x 4.625	25.6	2.5
30,000	622D303M045BE2A	2.000 x 5.125	27.2	2.4
34,000	622D343M045BF2A	2.000 x 5.625	28.9	2.3

STANDARD RATINGS

µF	Catalog Number	Nominal Case Size (inches) D x L	Max. Ripple Current @ +85°C, 20kHz (A)	Max. ESR ±30% @ +25°C, 20kHz (mΩ)
55 VOLTS DC WORKING; 64 VOLTS DC SURGE				
3,400	622D342M055AA2A	1.375 x 2.125	8.0	8.7
4,800	622D482M055AM2A	1.375 x 2.625	9.5	7.3
6,200	622D622M055AB2A	1.375 x 3.125	11.0	6.3
7,600	622D762M055AL2A	1.375 x 3.625	12.3	5.6
7,700	622D772M055BA2A	2.000 x 2.125	14.0	4.6
8,900	622D892M055AC2A	1.375 x 4.125	13.8	5.0
9,200	622D922M055BM2A	2.000 x 2.625	16.2	4.0
10,000	622D103M055AD2A	1.375 x 4.625	15.3	4.5
11,000	622D113M055AE2A	1.375 x 5.125	17.0	4.0
12,000	622D123M055BB2A	2.000 x 3.125	18.5	3.5
14,000	622D143M055AF2A	1.375 x 5.625	18.7	3.6
15,000	622D153M055BL2A	2.000 x 3.625	20.8	3.1
18,000	622D183M055BC2A	2.000 x 4.125	23.5	2.7
21,000	622D213M055BD2A	2.000 x 4.625	25.6	2.5
24,000	622D243M055BE2A	2.000 x 5.125	27.2	2.4
27,000	622D273M055BF2A	2.000 x 5.625	28.9	2.3
60 VOLTS DC WORKING; 70 VOLTS DC SURGE				
2,300	622D232M060AA2A	1.375 x 2.125	8.1	8.6
3,300	622D332M060AM2A	1.375 x 2.625	9.9	6.8
4,200	622D422M060AB2A	1.375 x 3.125	11.4	5.9
5,100	622D512M060AL2A	1.375 x 3.625	12.9	5.2
5,300	622D532M060BA2A	2.000 x 2.125	13.9	4.7
6,100	622D612M060AC2A	1.375 x 4.125	14.5	4.9
6,400	622D642M060BM2A	2.000 x 2.625	16.0	4.1
7,100	622D712M060AD2A	1.375 x 4.625	15.3	4.5
8,000	622D802M060AE2A	1.375 x 5.125	16.8	4.1
8,500	622D852M060BB2A	2.000 x 3.125	18.5	3.5
9,000	622D902M060AF2A	1.375 x 5.625	17.8	4.0
10,000	622D103M060BL2A	2.000 x 3.625	20.5	3.2
12,000	622D123M060BC2A	2.000 x 4.125	22.6	2.9
15,000	622D153M060BD2A	2.000 x 4.625	24.6	2.7
17,000	622D173M060BE2A	2.000 x 5.125	26.1	2.6
19,000	622D193M060BF2A	2.000 x 5.625	28.3	2.4

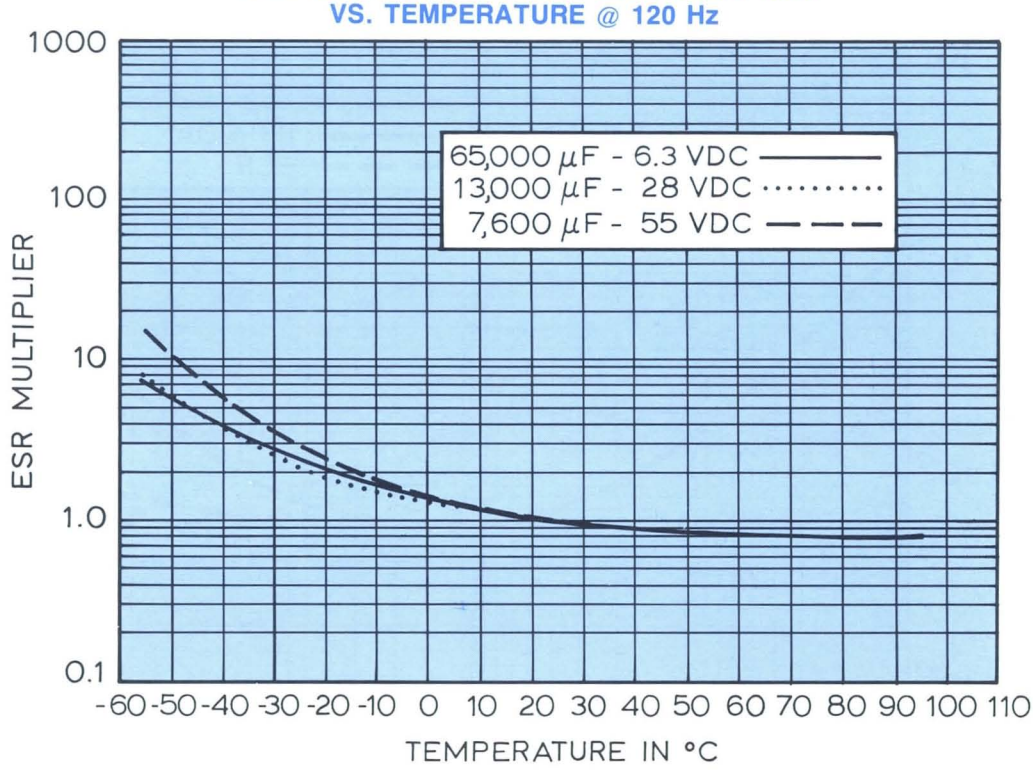
TYPICAL CURVES

TYPE 622D/DM — TYPICAL CAPACITANCE MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,724

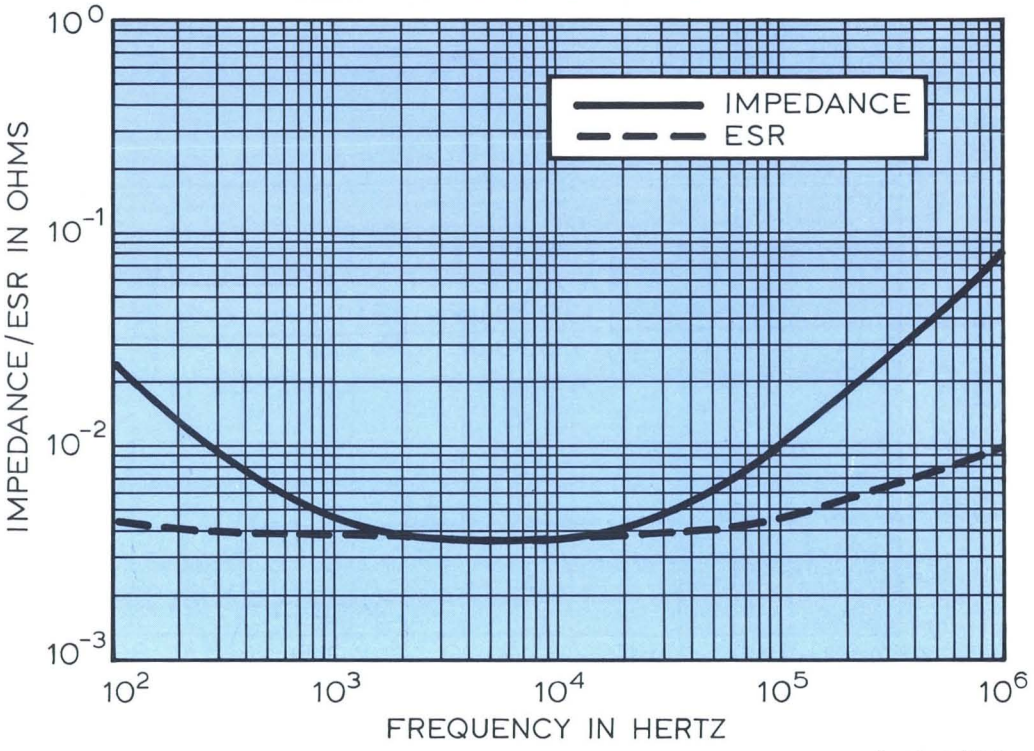
TYPE 622D/DM — TYPICAL ESR MULTIPLIER VS. TEMPERATURE @ 120 Hz



Dwg. No. A-14,717

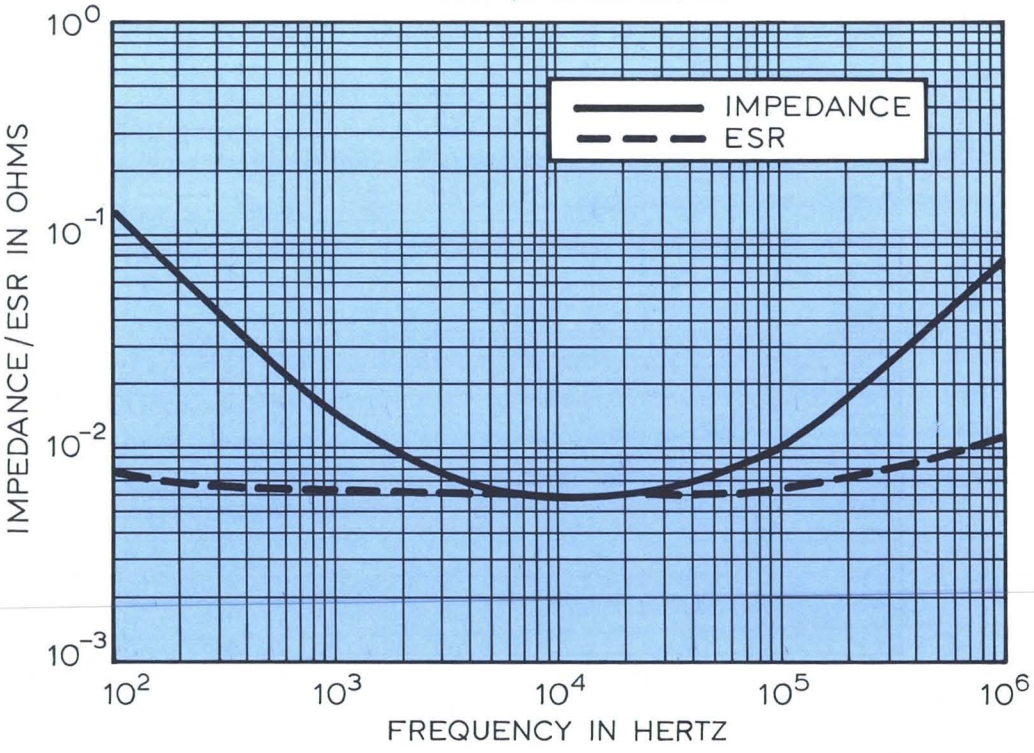
TYPICAL CURVES @ +25°C

TYPE 622D/DM — 65000μF @ 6.3VDC, AE CASE SIZE



Dwg. No. A-14,678

TYPE 622D/DM — 13000μF @ 28VDC, AB CASE SIZE



Dwg. No. A-14,679

Appendices

SPRAGUE®

PERFORMANCE CHARACTERISTICS

1. Capacitance and ESR (DF) Measurement

Measurements are made by the 4 terminal bridge method at 120 Hz and +25°C unless otherwise specified. Test voltage is ≤1 Volts RMS. Capacitance will be within the specified tolerance. ESR (DF) will be within the specified tolerance or be less than the maximum specified limit.

2. Leakage Current (DCL) Measurement

Measurements are performed at +25°C, ±5°C by applying rated voltage to the capacitor in series with a current-limiting resistor for the specified period of time. Capacitors are preconditioned by applying rated voltage for 15 minutes, 24 to 48 hours before testing.

The maximum leakage current will not exceed the value calculated from the specified equation, or limits listed in the part number rating charts.

3. Surge Voltage Test

Unless stated differently, Sprague capacitors will withstand rated surge voltage applied in series with a current limiting resistor under the following conditions:

DUTY CYCLE: VOLTAGE ON—½ MINUTE
VOLTAGE OFF—5½ MINUTES

NO. OF CYCLES: 1000

TEST TEMPERATURE: +25°C

CURRENT LIMITING
RESISTOR VALUE: ≤2500μF, 1000Ω
≥2500μF, $R = \frac{2.5 \times 10^6}{C}$
(C in μF, R in Ω)

After completion of the test and stabilization of the capacitor at +25°C, the leakage current will not exceed the initial specified limit.

4. Vibration Test

Unless stated differently, Sprague capacitors are designed to withstand sinusoidal vibration conditions as follows:

FREQUENCY RANGE: 10-55 Hz
TRAVERSED TIME PERIOD: 1 MINUTE
TEST TIME PERIOD: 6 HOURS
MAXIMUM AMPLITUDE: 0.06″ (1.5mm)
MAXIMUM ACCELERATION: 10g
PART POSITIONING: ANY OF 3 AXIS

During the last hour of test, capacitance and ESR measurements will be stable with no evidence of intermittent contacts. Upon completion of test, capacitors will not exhibit loosening of the internal section or other mechanical damage.

5. Terminal/Lead Strength

Screw Insert Terminals can withstand torque pressure for a period of 5-15 seconds as follows:

Screw Thread Terminal	No. of Threads Engaged	Torque (Pounds-Inches) Min	Torque (Pounds-Inches) Max	Torque (NM) Min	Torque (NM) Max
No. 10-32	3	12.0	18.0	1.4	2.0
No. 10-32	6	20.0	25.0	2.3	2.8
No. ¼—28NF-2B	3	30.0	35.0	3.4	4.0
No. ¼—28NF-2B	6	45.0	55.0	5.1	6.2
M4	3	4.0	7.0	0.5	0.8
M4	6	10.0	14.0	1.1	1.6
M5	3	12.0	18.0	1.4	2.0
M5	6	20.0	25.0	2.3	2.8
M8 STUD	—	—	35.0	—	4.0
M12 STUD	—	—	88.0	—	10.0

Unless stated differently, lead wire capacitors can withstand a steady pull applied axially to the leads without breakage as follows:

Wire Size AWG	Wire Size Dia. mm	Tensile Force Lbs	Tensile Force Kg
25—24	0.45—0.5	1.1	0.5
22—20	0.6—0.8	2.2	1.0
18	1.0	5	2.0

Holding Time: 10 seconds

Wire leads will withstand bending at the point of egress from the capacitor, first 90° in one direction, then back to the original position, and then 90° in the opposite direction, without breakage.

6. Vent Test

Capacitors with diameters exceeding 8mm (0.315") incorporate a vent designed to minimize the possibility of an accidental explosion should a capacitor be reverse polarized. Vents may be located in the cover or case depending on the product type.

Vents are tested as follows:

Caution: Operate units in an explosion-proof container!

Capacitors with screw-insert terminals shall be mounted by an approved wrap-around clamp. Capacitors with wire-lead terminals shall be mounted by normal mounting means, secured by the leads. A reverse DC voltage shall be applied. The voltage shall be of sufficient magnitude to produce a current in accordance with the following table.

CV Product	Current (Amp.)
0 to 500K	10
501K to 1000K	20
1001K and up	30

where

C = capacitance in microfarads
V = rated DC voltage

The vent shall operate without explosion or expulsion of the cover from the container. The container shall not rupture at any place other than the vent.

Occurrence of a short or open circuit within the capacitor shall not constitute a failure unless there is also explosive disruption of the capacitor.

7. Marking

The marking information on the capacitor is as follows, space permitting:

SPRAGUE (or Sprague Trademark, ②)
Sprague Type
Nominal Capacitance (μF) and Rated Voltage (VDC)
Capacitance Tolerance or Tolerance Code if more than one (optional tolerance available)
Maximum Operating Temperature
EIA Std Date Code

8. Insulation Test

Unless stated differently, capacitors are prepared for test by placing two wire windings (2 turns each) of 18 AWG (1mm) bare copper wire, spaced 0.025" (6.3mm) apart, around the insulating sleeve:

The insulating sleeve will withstand a dielectric strength test of 2000 Volts DC applied between the windings for one minute, without breakdown.

Insulation resistance, measured with a DC potential of 100 volts, applied between the windings for 2 minutes will be ≥100 megohms.

9. Solderability Test

Unless stated differently, circuit board mountable capacitor leads will retain ≥95% solder-wetting ability under the following conditions:

SOLDER TYPE: Liquid resin-base flux and tin, tin-leaded, or lead alloy solders

SOLDER TEMP: 245°C (+5°C, −0°C)

IMMERSION RATE: 1 inch (25mm)/second

SOLDER BATH HOLD TIME: 5 seconds

WITHDRAWAL RATE: 1 inch (25mm)/second

GUIDE TO APPLICATION

1. Rated Voltage

The rated (or working) voltage is the sum of the DC Voltage and peak AC Voltage which can be continuously applied to the capacitor. Derating the applied voltage will improve the failure rate of the capacitor (see section 10).

2. Reverse Voltage

The DC electrolytic capacitors in this catalog are polarized and must be utilized accordingly. The intermittent application of reverse voltage ≤ 1.5 volts will not cause a significant change in the normal performance characteristics.

3. Energy/Discharge Application

Frequent charge and discharge of voltages into a low resistance may damage capacitors. Upon request, Sprague can offer special designs in most product types for use in these applications.

4. Ripple Current

The RMS value of the maximum allowable AC current is specified by product type at 120Hz and +85°C unless otherwise noted.

Increased frequencies and/or reduced ambient temperatures will improve maximum ripple current capabilities. Frequency and temperature coefficients for typical applications are listed in the product type section.

Some maximum ripple current conditions could exceed the maximum continuous current capabilities of the terminals/leads of the capacitor. Maximum continuous current limitations are as follows:

Product Types	Terminal Code	Max Current
36DY	A, B, I, M, N, T	30 Amps
602DY, 622DY	D (High Current Option)	50 Amps
	P, L	25 Amps
80D, 81D, 82D	ALL	25 Amps

5. Temperature Characteristics

Capacitance, ESR/DF, and Leakage current change with respect to temperature. Specified limits are referenced at +25°C.

Capacitance and leakage current have positive temperature coefficients and ESR/DF exhibit negative temperature coefficients.

The product type sections provide temperature curves or low temperature performance limits for these parameters.

6. Installation Considerations

PCB mountable capacitors with ≤20 AWG (0.8mm) leads may be damaged by excessive solder temperatures and exposure times. Solder temperatures should not exceed +260°C and exposure times limited to 10 seconds or less.

Excessive force applied to leads or terminals of capacitors may cause damage. Refer to Item 5 in the Performance Characteristics section for more information.

Extra terminals are provided on some product types for mounting stability or polarity assurance. These terminals may not be completely isolated from the capacitor and must be electrically isolated on the circuit board, and never connected to the positive or negative terminal.

Larger capacitors or capacitors in series/parallel banks can exhibit high watt-second ratings. Improper design testing or use could result in an explosion or shock hazard. Proper design of capacitor banks must be taken to protect against large fault currents which may occur in the event of a short circuit.

In series application, matching of capacitance values may be necessary to avoid imbalance. Series equalization with shunt resistors (or other) is recommended to compensate for leakage current variances.

7. Storage and Shelf Life

Sprague capacitors can normally be stored 5 years or more at temperatures of ≤ +40°C without significant increase in leakage current or other degradation. Higher storage temperatures will increase leakage current with time. This is a temporary condition which can be corrected by reconditioning.

8. Cleaning Solvents

Halogenated cleaning solvents may damage capacitors or shorten their operating life. Sprague offers resin end seal options on most PCB mountable capacitors to protect against common solvents and cleaning procedures. Some Sprague Aluminum products are solvent resistant without the need for supplementary resin end seals. They can withstand up to 5 minutes exposure to Freon types TE/TES/TMS by immersion, ultrasonic or vapor degreasing. See the product type sections for availability and rated voltage limitations.

9. Expected Life

Expected life is the function of the rate of electrolyte loss by means of vapor transmission through the end seal, and the rate of loss is a function of the operating or storage temperature. The rate of electrolyte loss is relatively insensitive to the operating voltage. At the end of the expected life estimates, electrical parameters should be within the limits specified in the life test product type section information. Expected life charts by product type and case codes are found in Appendix, pages 270-290.

10. Reliability

Reliability is a measure of the failure rate during the expected life period of the capacitor. Failure rates are expressed in %/1000 hours and are in accordance with MIL-STD-690 at a 60% confidence level. They are calculated by multiplying the appropriate failure rate temperature factor with the appropriate failure rate voltage derating factor selected from the following graphs on pages 270 thru 290.

11. Special Designs

Sprague will, upon request, design special capacitors to meet specific needs. Typical custom designs include:

- HIGH VIBRATION CAPABILITY including random vibration capability on some product types and sizes.
- CHARGE-DISCHARGE designs on most product types for photoflash, strobe and welding applications.
- NON POLAR designs for reverse polarity applications.

12. High Altitude Applications

Sprague aluminum capacitors are not significantly affected by reduced atmospheric pressure and can be used at any altitude.

13. Radiation

Sprague aluminum electrolytic capacitors are not subject to the harmful effects of radiation.

ALUMINUM ELECTROLYTIC CAPACITORS -- RELIABILITY, EXPECTED LIFE, AND SHELF CAPABILITY

ABSTRACT

The relationships between reliability during use conditions, mean time to failure, life expectancy and shelf capability of Sprague aluminum electrolytic capacitors are described in practical terms and backed with specific test data. Effects of operating temperature, voltage and ripple current are discussed. Curves are provided to estimate reliability at full-rated or derated operating conditions.

Estimated useful life is tabulated by operating temperature and case size for most Sprague aluminum electrolytic capacitors. Accelerated test conditions for determining life expectancy are discussed. The effect of storage at normal and at high temperatures is described. And, failure modes are described in conjunction with each phase of the typical capacitor life cycle.

INTRODUCTION

Increasingly, more stringent quality measurement systems are being used in the electronics industry. AQL sample plans are being replaced by programs measuring component quality in PPM (Parts Per Million). Product quality specifications seemingly approach perfection. Procedures used to calculate PPM quality levels are based on manufacturers' in-process controls and final inspection results, and by users' data at incoming inspection and equipment assembly.

Initial quality requirements are only part of a good product specification. Reliability and useful life should be considered as well -- to fit the reliability and useful life requirements of end equipment. Data, discussion, curves and tables presented in this paper will help the equipment designer find the correct aluminum electrolytic capacitor to fit the reliability and life requirements for his equipment.

Reliability is a measure of the expected failure rate during the useful life of the capacitor, and is dependent on the operating temperature and voltage. The MTBF (Mean Time Between Failures) is a simple mathematical manipulation of failure rate numbers, and provides information about the expected total unit hours between failures for a large group of capacitors. Neither reliability nor MTBF provide information about the useful life expectancy for individual capacitors.

Useful life expectancy is a function of the rate of electrolyte loss by means of vapor transmission through the end-seal, and the rate of loss is a function of the operating or storage temperature. The rate of electrolyte loss is relatively insensitive to operating voltage, provided the operating voltage does not exceed the rated voltage. Electrolyte loss is not related to the failure rate during the useful life period.

The typical reliability life cycle for aluminum electrolytic capacitors is shown in Figure 1. The plot of failure rate follows a characteristic "bathtub" curve, covering three periods in the typical capacitor life cycle.

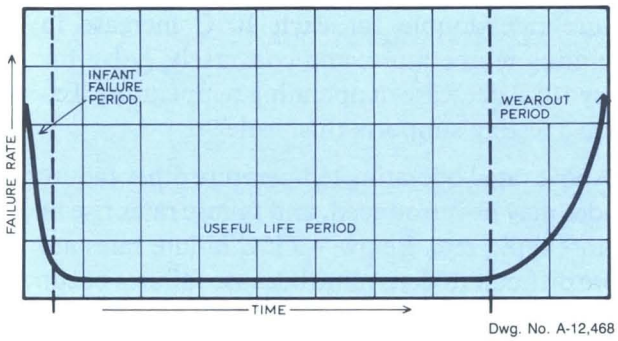


Figure 1

RELIABILITY LIFE CYCLE -- TYPICAL "BATHTUB" CURVE

The first period is the ''Infant Failure'' period, showing a decreasing failure rate. Sprague Electric conditions and screens all capacitors to prevent or remove failures during this period. For all practical purposes infant mortality is not a factor in shipped units.

The second segment in the life cycle is the "Useful Life" period. Failures occur at a constant rate on a random basis with relatively low frequency. Failure modes are related to temperature and voltage stress on the dielectric oxide film. Electrical parameters of capacitors designed and manufactured by Sprague Electric are relatively constant during this period.

Electrolyte vapor transmission through the end-seal occurs on a continuous basis throughout the useful life of the capacitor. This electrolyte loss has no effect on reliability during the useful life period of the life cycle, but when the electrolyte loss approaches 40% of the initial electrolyte content of the capacitor, the electrical parameters deteriorate and the capacitor is considered to have worn out. The final period in the reliability life cycle is the "Wearout" period, exhibiting a rapidly increasing failure rate.

When aluminum electrolytic capaitors were first developed, deterioration "on-the-shelf" was a major problem and frequent replacement of stock parts was necessary. Additionally, use of capacitors for extended periods at small percentages of rated voltage permitted the dielectric oxide film to "deform", just as it would "on-the-shelf". Both problems were solved in the early 1950's with the introduction of high-purity aluminum foil. Oxide-film stability was greatly enhanced and today aluminum electrolytics can be used after storage, and at any percentage of rated voltage, without loss of capacitor quality. However, electrolyte loss through the end-seal does occur during shelf storage and during periods of low-voltage stress in operation, with predictable effects on the useful life of aluminum electrolytic capacitors.

RELIABILITY

Sprague Electric has compiled an extensive data bank of life test results for aluminum electrolytic capacitors. Failure rates have been calculated using these test results and procedures and tables described in MIL-Std-690. The statistical confidence level associated with failure rate qualification for MIL-C-39018 covering aluminum electrolytic capacitors is 60%. The same 60% confidence level is most frequently used for non-military aluminum electrolytic capacitors and is the base used for failure rate data presented in this paper. Failure rates at other confidence levels can be calculated using the actual number of failures observed. This data can be obtained from the Sprague Electric Company.

Failure Modes

Typical failure modes during the infant life period include short circuits caused by foil impurities, manufacturing defects such as burrs on the foil edges or tab connections, breaks or tears in the foil, and breaks or tears in the separator paper. All of these failures are typically removed during manufacturing voltage conditioning.

Short circuits are the most frequent failure mode during the useful life period and are the result of random breakdown of the dielectric oxide film under normal stress. Proper capacitor design and processing will minimize occurrence of such random failures. Short circuits can also be caused by excessive stress, where voltage, temperature or ripple conditions exceed specified maximum levels.

Excessive temperature, and excessive d-c or reverse voltage can also produce internal gas pressure build-up and venting.

Open circuits although infrequent during normal life, can be caused by failure of the internal connections joining capacitor terminals to the aluminum foil. Mechanical connections can develop an oxide film at the contact interface, increasing contact resistance and eventually producing an open circuit. Defective welded connections can also open. Excessive mechanical stress such as high vibration can accelerate this type of failure.

The most frequently observed failure in units returned from field is caused by corrosive attack of the aluminum foil and terminal tabs by halogenated-hydrocarbon cleaning agents absorbed through the capacitor end-seal. Sprague Electric recommends a supplemental epoxy end-seal be ordered for units that may be exposed to halogenated-hydrocarbons during cleaning. For more information on cleaning and solvents, see Sprague Application Note No. 3499.3A.

Continuous application of deep discharge can introduce failure modes not normally observed during d-c or d-c and ripple testing. Special capacitor design modifications are required for rapid and continuous charge/discharge applications such as photoflash or welding. Sprague Electric can provide specially designed capacitors for these applications.

Failure and Temperature

Thermal stress is the major contributor to failure in aluminum electrolytic capacitors. The common rule-of-thumb is that, in the range of +75°C through full-rated temperature, stress and the failure rate double for each 10°C increase in operating temperature, and conversely, halve for every 10°C decrease in operating temperature. Extensive testing supports this "rule".

Above rated operating temperature other failure modes may be introduced, and failure rates rise at a more rapid rate. Below +75°C failure rates are more difficult to determine because failures occur much less frequently. Existing data suggests that the failure rate halves for each 15°C decrease in operating temperature below +75°C.

The capacitor operating temperature is defined as the actual temperature of the capacitor in use and can be determined by adding the ambient temperature to the internal temperature rise (ΔT) caused by the ripple current.

$$T_{(Operating)} = T_{(Ambient)} + \Delta T$$

The temperature rise due to the ripple current can be calculated from the formula:

$$\Delta T = \frac{I^2 R}{KA}$$

where

ΔT = temperature rise in °C,
I = ripple current in rms amperes,
R = equivalent series resistance (ESR) in ohms,
K = a thermal constant 0.006 watts/sq. in./°C,
A = case surface area in sq. in.

Note, the heating effect due to d-c leakage is considered to be negligible.

The operating temperature (ambient $+\Delta T$) is used throughout this paper to determine failure rates and expected life. Figures 2, 3 and 4 show the failure rates in percent per 1000 hours at various operating temperatures, at a 60% confidence level, for popular Sprague aluminum electrolytic capacitors.

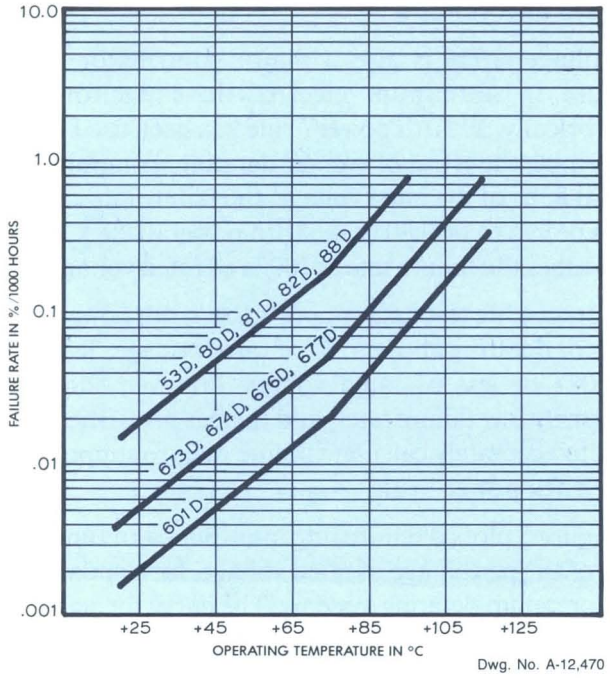


Figure 3

FAILURE RATE - TUBULAR CAPACITORS

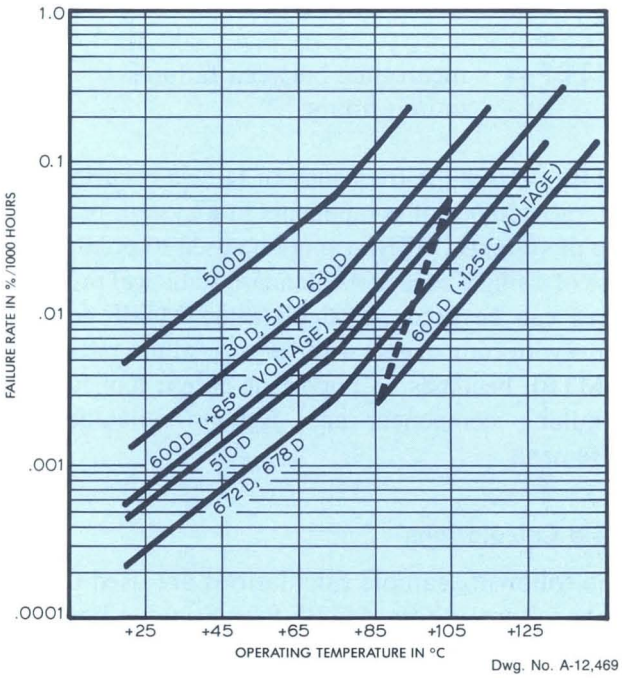


Figure 2

FAILURE RATE - MINIATURE CAPACITORS

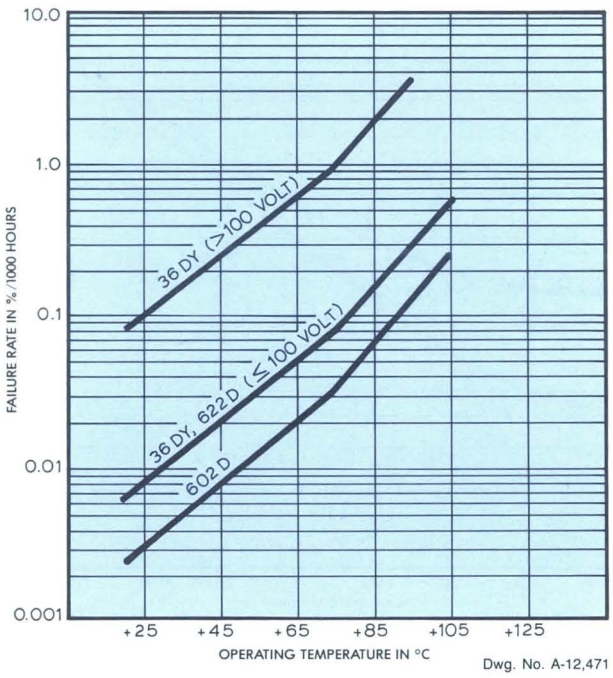


Figure 4

FAILURE RATE - CAN STYLE CAPACITORS

Failure and Voltage

Voltage stress is also a major contributor to failure in aluminum electrolytic capacitors. Historically, a "fifth power" rule has been used to determine the effect of voltage derating. For example, at 80% of the rated voltage, the failure rate can be expected to be 0.80 to the fifth power (0.80^5), or 0.33 times the failure rate at 100% of rated voltage.

Sprague life test data supports the "fifth power" rule for derating above 67% of rated voltage. Tests at 50% or less of rated voltage however, show extremely low failure rates, and there is insufficient data to accurately calculate failure rates to support the "fifth power" rule.

Figure 5 plots a failure rate multiplier as a function of the percentage of rated voltage, for standard and premium derating systems. The curve for standard derating has been conservatively drawn, and shows decreasing improvement for derating from 70% to 30% of rated voltage. The multiplier curve for premium capacitors, which are derated in initial specifications, follows a shallower slope and stabilizes at a higher percentage of rated voltage.

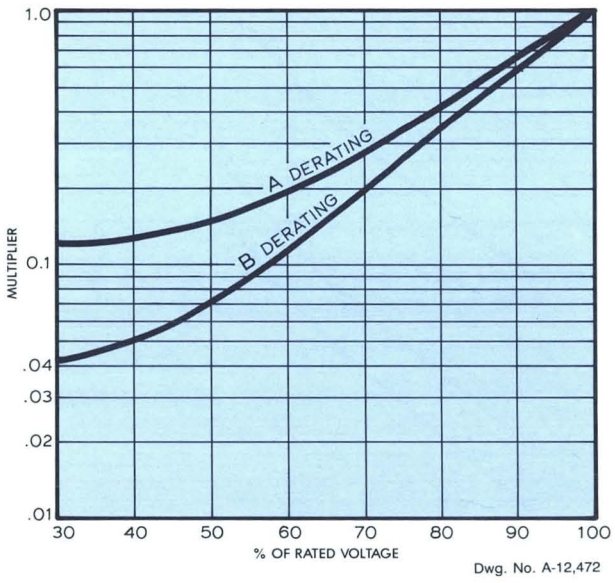


Figure 5

FAILURE RATE MULTIPLIER FOR STANDARD AND PREMIUM CAPACITORS

Table 2

STANDARD AND PREMIUM CAPACITOR TYPES

B		A	
36DE	622D	30D	604D
36DX	623D	32D	672D
53D	636D	510D	672DX
80D		512D	673D
500D		514D	674D
501D		600D	676D
511D		601D	677D
513D		602D	

MTBF

Failures may occur at random during the useful life period, however a specific MTBF (Mean Time Between Failures) figure can be calculated from the capacitor failure rate as follows:

$$MTBF = \frac{10^5}{FR}$$

where

FR = failure rate in %/1000 hours

MTBF = mean time between failures in unit-hours.

MTBF defines the frequency of failure occuring in a large number of components in a system or a group of systems. MTBF cannot be used to predict failure of a single capacitor. Standard statistical procedures can be used to calculate the MTBF for systems with components with varying failure rates. The MTBF becomes an important design tool for determining component and systems reliability requirements.

Sample Calculations

The following sample calculations are used to find the failure rate and MTBF for a Sprague Type 510D capacitor rated at 68 μF and 25 WVDC, operated at 15-volts d-c, +85°C and 0.37 amperes 20 kHz ripple current. The case size is CD and the 20 kHz ESR is 0.84 ohms.

Step 1. Calculate internal temperature rise:

$$\Delta T = \frac{I^2 R}{KA} = \frac{(.37)^2 (.84)}{(.006)(.96)} = +20°C$$

Step 2. Calculate operating temperature:

$$T_{Ambient} + \Delta T = T_{Operating}$$
$$+85°C + 20°C = +105°C$$

Step 3. Find failure rate from Figure 2.

$$FR = 0.045\%/1000 \text{ hours}$$

Step 4. Correct failure rate using premium derating multiplier from Figure 4.

$$\% \text{ Rated Voltage} = \frac{15}{25} = 60\%$$

$$\text{Derating Multiplier} = 0.19$$

$$\text{Corrected FR} = 0.19 \times 0.045$$
$$= 0.0085\%/1000 \text{ hours}$$

Step 5. Calculate MTBF.

$$\text{MTBF} = \frac{10^5}{0.0085} = 11.7 \text{ million unit-hours}$$

EXPECTED LIFE

Gradually, during storage and/or operation, the electrolyte in an aluminum electrolytic capacitor is lost by means of vapor transmission through the end-seal. The rate of loss is directly dependent on the composition of the electrolyte, the effectiveness of the end-seal, and the operating and/or storage temperatures. The expected life of the capacitor is a direct function of the rate of loss of electrolyte. Electrolyte loss can be measured as weight loss.

Weight Loss and Expected Life

Extensive testing shows that weight loss is a straight line function of temperature throughout the useful life of each capacitor type. Figure 6 shows a typical life test run for 10,000 hours with weight loss plotted at five different temperatures.

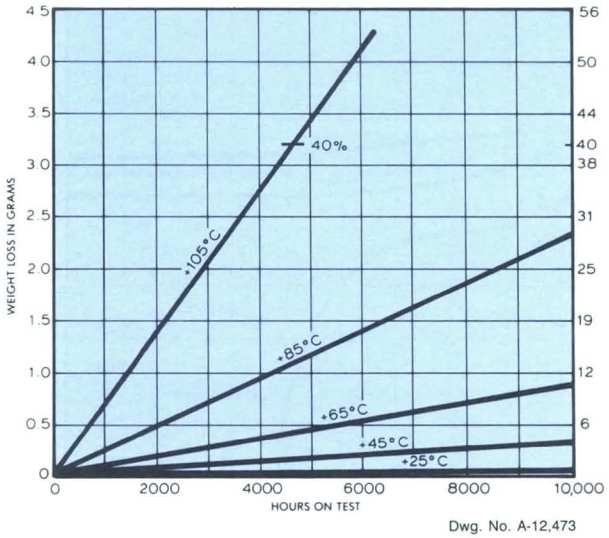


Figure 6

TYPE 604D - 85 μF, 200 VDC
WEIGHT LOSS ON LIFE TEST

Figure 7 and Figure 8 show the effect of this weight loss on ESR and capacitance.

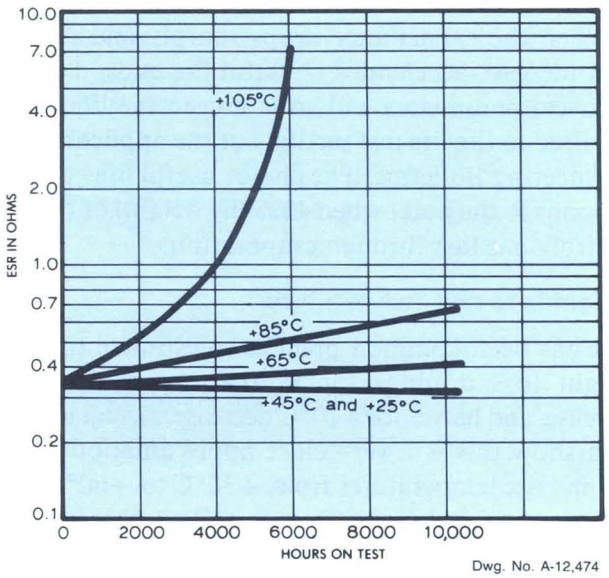


Figure 7

TYPE 604D - 85 μF, 200 VDC
ESR AND LIFE TEST

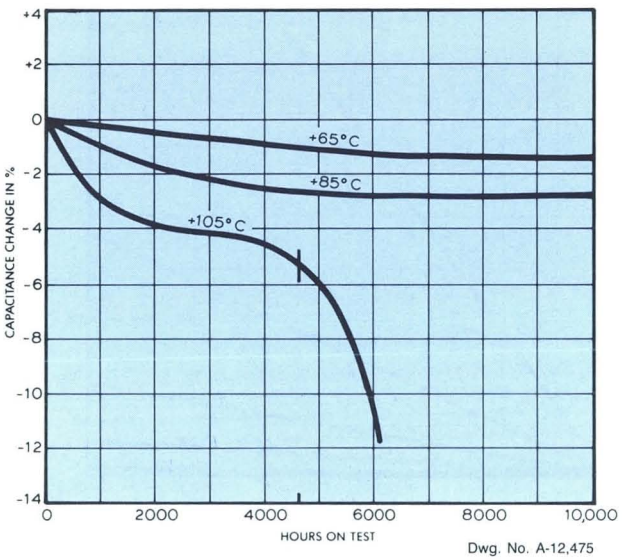


Figure 8

TYPE 604D - 85 μF, 200 VDC
Capacitance and Life Test

The weight loss initially had little effect on the electrical performance of the capacitors. However, after about 40% of the electrolyte had been lost, at about 4,600 hours on the +105°C test, the ESR increased rapidly, the capacitance decreased, and finally the capacitors appeared open.

When the capacitance drops sharply and the ESR increase accelerates -- useful life ends. The electrical parameters will soon exceed the limits specified in the life test sections of the applicable Engineering Bulletins. The end of useful life corresponds to the point when 40% (by weight) of the electrolyte is lost through evaporation.

Weight Loss and Temperature

It has been common practice to estimate that weight loss doubles for a 10°C temperature increase, and halves for a 10°C decrease. Actual test data show this is a very close approximation at normal use temperatures from +30°C to +60°C. However, this system does not follow observed weight loss at higher temperatures. A more accurate model may be devised using Arrhenius' theory of chemical activity. Developed in 1889, the theory defines the level of chemical activity as a function of the base of the natural logarighm to the negative power of E, over temperature in degrees Kelvin.

$$K = Ae^{-E/RT}$$

where

K = chemical reaction rate

A = intercept of activity line (a constant for a given system)

e = natural Log base (2.7183)

E = activation energy

R = gas constant (ergs/°K) (g mole) Boltzmann's constant times Avagadro's number

T = temperature in degrees Kelvin

E/R = slope of activity line (a constant for a given system)

It is standard practice to plot vapor pressures using the Arrhenius model to produce a straight line. For example, Figure 9 uses an abscissa scale based on $e^{-1/T}$ and an ordinate using the standard log scale.

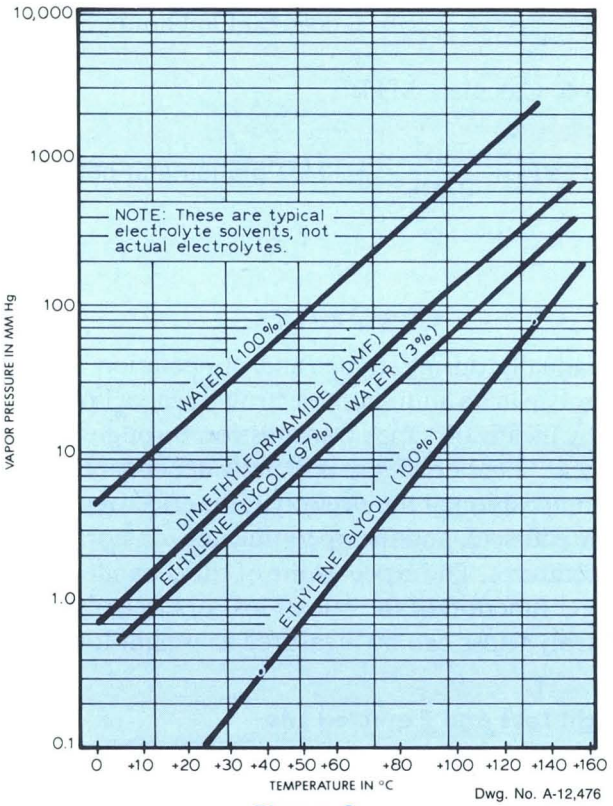


Figure 9

VAPOR PRESSURE
FOR TYPICAL ELECTROLYTE SOLVENTS

Figure 10 uses the same scale to show the weight loss for four typical capacitors, at various temperatures.

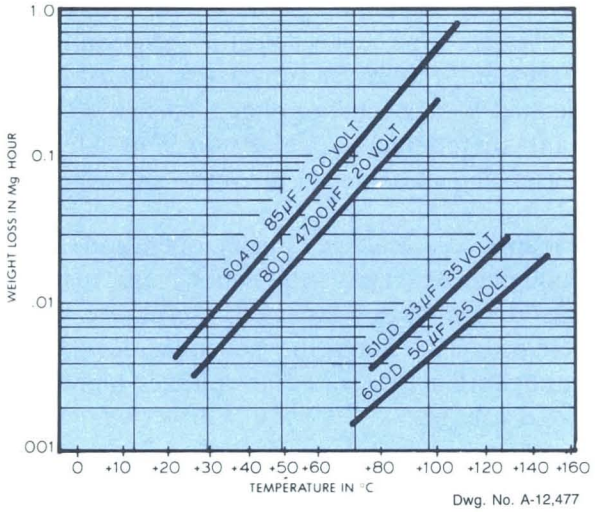


Figure 10

WEIGHT LOSS FOR TYPICAL CAPACITORS

The straight line fit shows that the Arrhenius model can be used to determine weight loss, as follows:

$$W = Ae^{-B/T}$$

where

W = weight loss in mg/hour

A = magnitude constant

e = natural Log base (2.7183)

B = slope constant

T = temperature in degrees Kelvin

Note, our model verifies our initial estimate of double weight loss for a 10°C temperature rise from +30°C to +60°C, and follows our observed data at higher temperatures. For example, the Type 604D plotted in Figure 10 shows a doubling with a 14°C temperature rise near +100°C.

Additional factors affecting weight loss are the relative vapor pressure of the electrolyte and the effectiveness of the capacitor seal. However, the slope of the model will vary only slightly for different capacitor ratings and styles depending on variations in the slope of the vapor pressure curves of the electrolytes.

Weight Loss and Electrolytes

The characteristics of the electrolyte, including relative vapor pressure are important factors affecting operation and life expectancy. Figure 11 shows weight loss for four different electrolytes, in the same rating, with the same case and seal, tested at the same time. The DMF based electrolytes, are obviously more volatile than the glycol based electrolytes. However, these newer DMF based electrolytes produce capacitors which can operate over wider temperature ranges, at higher levels of ripple current, with lower ESR.

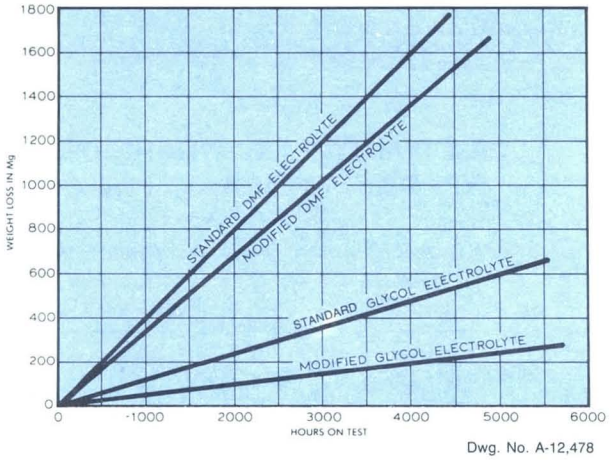


Figure 11

WEIGHT LOSS FOR FOUR ELECTROLYTES

Improved operating characteristics, particularly extended operating temperatures, are as desireable as long expected life. Improved seals slow the loss of the DMF electrolytes, thereby extending the expected life of our newest high-performance capacitors.

Weight Loss and Capacitor Seal

Sprague Electric is continually working to improve capacitor seals, to extend life expectancy and allow capacitor operation at higher temperatures. Our work has produced significant results. For example, Table 3 shows the results of life testing for a standard Type 604D capacitor, and for the same capacitor with an improved seal. The improved seal cut the weight loss by 40%, and extended the expected life by 70%.

Table 3

CAPACITOR SEAL AND WEIGHT LOSS
TYPE 604D - 85 μF, 200 VDC

Seal Type	Weight Loss (Mg/Hr.)		Expected Life (Hrs. × 1000)	
	+85°C	+105°C	+85°C	+105°C
Standard	.240	.680	14	5
Improved	.138	.407	24	8

The size of the capacitor seal has a definite effect on weight loss. Table 4 shows weight loss for several Type 510D capacitors during life test at +125°C. (Although the weight loss increases for the larger diameter units, the initial amount of electrolyte is substantially greater.)

Table 4

CASE DIAMETER AND WEIGHT LOSS
TYPE 510D - 1000 HOURS, +125°C

Case Diameter (Inches)	Weight Loss (Mg/Hr.)
"A" (.256")	.012
"B" (.336")	.023
"C" (.414")	.031

Test data for double-ended capacitors such as the non-polar Type 610D and the four-leaded Type 604D, show weight losses are twice the losses observed for similar size single-ended Type 600D and Type 601D capacitors. Double-ended capacitors have one-half the expected useful life of the same size single-ended capacitors.

Many Sprague aluminum electrolytic capacitors can be ordered with an optional epoxy end-seal added to the standard rubber end-seal. The addition of the epoxy end-seal is recommended to prevent the absorption of halogenated hydrocarbons into the capacitor during cleaning operations. The epoxy end-seal has only a limited long term effect on electrolyte loss by vapor transmission. The tables and data in this paper are based on tests conducted on units which do not have the epoxy end-seal. It should not be assumed that adding the epoxy end-seal will extend the expected useful life or reduce weight loss.

Voltage and Expected Life

D-C operating voltage has a significant effect on reliability, but only a very small effect on expected useful life. Table 5 presents data from a 10,000-hour life test for Type 604D capacitors, tested at five different temperatures, at surge voltage, rated voltage, derated voltage, and no voltage. There is no significant difference in weight loss or electrical parameters measured at the various voltage levels.

When d-c leakage during operation is high enough to generate a significant increase in internal gas pressure, the expected useful life can be reduced. This condition generally occurs when capacitors are operated at voltages higher than rated voltage.

The a-c ripple voltage applied to a capacitor during use generates a ripple current which causes capacitor heating, and therefore affects the weight loss and the expected life. The effect of ripple current on expected life can be determined by calculating the internal temperature rise as discussed previously, adding the ambient temperature and the temperature rise to determine the capacitor operating temperature.

Tables of Expected Useful Life

Expected useful life is tabulated here by case size for major Sprague aluminum electrolytic capacitor family types. The expected life tables are based on data from life testing at full-rated voltage and various temperatures. This data includes electrical measurements taken during high-temperature life-test extended to failure, and weight loss measurements for specific temperatures and case sizes.

The full matrix of expected life limits was calculated using weight loss rates for specific temperatures, and the design weight of electrolytes for specific capacitors. The end of useful life corresponds to the point when 40% (by weight) of the electrolyte has been lost through evaporation.

At the end of useful life, electrical parameters will be within the limits specified in life test sections of the applicable Engineering Bulletins.

Table 5

LIFE TEST - TEMPERATURE AND VOLTAGE STUDY
TYPE 604D - 85 μF, 200 VDC (HP CASE)

Life Test -	2000 Hours			4000 Hours			6000 Hours			8000 Hours			10000 Hours		
	Δ Cap. (%)	ESR (Ω)	Δ Wt. (gm)	Δ Cap. (%)	ESR (Ω)	Δ Wt. (gm)	Δ Cap. (%)	ESR (Ω)	Δ Wt. (gm)	Δ Cap. (%)	ESR (Ω)	Δ Wt. (gm)	Δ Cap. (%)	ESR (Ω)	Δ Wt. (gm)
+105°C															
250 VDC (Surge)	−4.6	0.63	−1.34	−5.2	1.1	−2.91	−12.8	8.2	−4.07	OPENS-					
200 VDC (Rated)	−3.7	0.64	−1.50	−5.0	1.2	−2.89	−14.5	11.5	−4.62	NO					
150 VDC	−3.1	0.57	−1.33	−3.4	0.74	−2.61	−8.0	3.8	−3.57	READINGS					
100 VDC	−4.2	0.54	−1.39	−4.0	0.76	−2.56	−8.1	6.4	−4.29	(Some units open					
0 VDC (Shelf)	−4.1	0.49	−1.33	−5.0	0.95	−3.03	−9.3	5.7	−4.12	at 6000 Hours.)					
+85°C															
250 VDC (Surge)	−2.1	0.48	−0.73	−4.1	0.52	−1.08	−4.0	0.54	−1.50	−2.7	0.71	−1.99	−3.0	0.80	−2.47
200 VDC (Rated)	−2.6	0.41	−0.56	−2.4	0.49	−1.07	−3.2	0.51	−1.41	−3.5	0.62	−1.92	−3.5	0.74	−3.05
150 VDC	−0.8	0.40	−0.48	−1.1	0.44	−1.08	−2.3	0.51	−1.48	−2.0	0.58	−1.66	−2.1	0.58	−2.05
100 VDC	−1.2	0.39	−0.58	−1.8	0.44	−1.12	−2.3	0.47	−1.49	−1.8	0.51	−1.66	−1.9	0.49	−1.86
0 VDC (Shelf)	−1.6	0.35	−0.45	−2.7	0.44	−0.87	−2.6	0.47	−1.26	−3.4	0.56	−1.66	−2.7	0.58	−1.94
+65°C															
250 VDC (Surge)	−0.4	0.37	−0.18	−0.6	0.38	−0.33	−1.6	0.37	−0.56	−1.3	0.41	−0.73	−1.7	0.41	−0.90
200 VDC (Rated)	+0.1	0.36	−0.20	+0.2	0.37	−0.36	−0.7	0.36	−0.55	−0.7	0.40	−0.70	−1.4	0.40	−0.79
+45°C															
0 VDC (Shelf)	−0.5	0.32	−0.09	−0.4	0.31	−0.16	−0.8	0.30	−0.09	−0.9	0.29	−0.25	−0.7	0.31	−0.25
+25°C															
0 VDC (Shelf)	−0.1	0.34	−0.01	−0.4	0.34	−0.01	+0.2	0.34	−0.01	+0.1	0.33	−0.04	−0.3	0.32	−0.02

Note: 20 pieces per test condition. Initial electrolyte weight = 8 grams.

Table 6

TYPE 510D - EXPECTED LIFE (≤ +125°C)
TYPE 511D - EXPECTED LIFE (≤ +105°C)
TYPE 512D - EXPECTED LIFE (≤ +105°C)

Case Code	Case Size (MM) Dia.	Ln.	Life in Hours (K = 1000) at Operating Temperature +125°C	+115°C	+105°C	+95°C	+85°C	+75°C	+65°C	+55°C	+45°C
AA	6	11	2K	3K	5K	9K	15K	27K	48K	86K	160K
BB	8	12	3K	5K	8K	13K	22K	40K	72K	128K	240K
CC	10	13	3K	6K	9K	15K	26K	47K	84K	150K	280K
CG	10	15	4K	7K	10K	17K	30K	54K	96K	170K	320K
CG	10	20	5K	9K	15K	27K	45K	75K	140K	250K	350K

Table 7

TYPE 600D - EXPECTED LIFE
TYPE 610D - See Note*

Case Code	Case Size (IN.) Dia.	Ln.	Life in Hours (K = 1000) at Operating Temperature +125°C	+115°C	+105°C	+95°C	+85°C	+75°C	+65°C	+55°C	+45°C
KD	.281	.937	3K	5K	8K	14K	24K	40K	70K	130K	240K
DD	.375	.937	6K	9K	14K	25K	39K	70K	120K	200K	350K
DE	.375	1.125	8K	13K	20K	34K	56K	95K	160K	280K	350K
DG	.375	1.375	10K	16K	25K	42K	68K	120K	200K	340K	350K
DJ	.375	1.625	12K	20K	32K	52K	82K	148K	240K	350K	350K
DL	.375	2.187	14K	23K	38K	62K	98K	170K	300K	350K	350K
DX	.375	2.687	16K	26K	42K	70K	114K	200K	350K	350K	350K

*Type 610D Expected Life = One-Half Expected Life for Type 600D.

Table 8

TYPE 30D - EXPECTED LIFE (≤ +105°C)
TYPE 500D - EXPECTED LIFE (≤ +85°C)

Case Code	Case Size (IN.) Dia.	Ln.	Life in Hours (K = 1000) at Operating Temperature ——	+105°C	+95°C	+85°C	+75°C	+65°C	+55°C	+45°C
BA	.250	.500		2K	3K	6K	10K	18K	33K	62K
BB	.250	.687		3K	5K	9K	16K	29K	51K	96K
CB	.312	.687		2K	3K	6K	10K	18K	33K	62K
CC	.312	.812		2K	4K	8K	14K	25K	44K	82K
DC	.375	.812		2K	3K	6K	10K	18K	33K	62K
DD	.375	.937		2K	4K	7K	12K	21K	38K	72K
DF	.375	1.250		3K	5K	9K	16K	29K	53K	99K
DH	.375	1.500		4K	7K	12K	22K	38K	68K	128K
EF	.438	1.250		2K	4K	7K	12K	21K	39K	73K
EH	.438	1.500		3K	5K	9K	16K	28K	50K	94K
FF	.485	1.250		3K	5K	8K	15K	27K	48K	90K
FH	.485	1.500		4K	7K	11K	20K	36K	64K	120K
FK	.485	1.750		5K	8K	14K	25K	45K	80K	150K
GF	.625	1.250		2K	4K	7K	12K	21K	38K	72K
GH	.625	1.500		3K	5K	9K	16K	29K	51K	96K
GK	.625	1.750		4K	7K	11K	20K	36K	64K	120K

Table 9

TYPE 672D - EXPECTED LIFE
TYPE 678D - EXPECTED LIFE

Case Code	Case Size (IN.) Dia.	Ln.	Life in Hours (K = 1000) at Operating Temperature ——	+105°C	+95°C	+85°C	+75°C	+65°C	+55°C	+45°C
CC	.399	.532		2K	4K	7K	13K	21K	40K	70K
CD	.399	.640		4K	7K	12K	22K	38K	70K	130K
CG	.399	.815		5K	8K	15K	26K	48K	88K	160K
DM	.500	1.065		5K	9K	15K	27K	49K	90K	164K
DT	.500	1.315		6K	10K	17K	30K	54K	100K	184K
DS	.500	1.690		8K	14K	24K	43K	80K	140K	260K
EK	.635	1.000		6K	10K	18K	32K	56K	104K	190K
ET	.635	1.315		8K	14K	24K	44K	82K	143K	265K
EU	.635	1.570		10K	17K	29K	58K	92K	164K	308K
FU	.713	1.619		10K	18K	30K	54K	97K	173K	325K

Table 10

TYPE 601D - EXPECTED LIFE
TYPE 673D - EXPECTED LIFE
TYPE 674D - EXPECTED LIFE
TYPE 676D - EXPECTED LIFE
TYPE 677D - EXPECTED LIFE
TYPE 604D - SEE NOTE*

Case Code	Case Size (IN.) Dia.	Ln.	Life in Hours (K = 1000) at Operating Temperature ——	+105°C	+95°C	+85°C	+75°C	+65°C	+55°C	+45°C
FE	.625	1.125		2K	3K	6K	10K	18K	32K	60K
FJ	.625	1.625		4K	6K	11K	19K	34K	65K	120K
FL	.625	2.125		6K	10K	18K	30K	50K	95K	175K
FP	.625	2.625		8K	14K	21K	37K	65K	110K	215K
FS	.625	3.125		10K	17K	28K	52K	90K	150K	280K
FT	.625	3.625		11K	19K	36K	62K	105K	190K	360K
GE	.750	1.125		2K	3K	6K	10K	18K	34K	64K
GJ	.750	1.625		4K	6K	12K	20K	36K	68K	128K
GL	.750	2.125		6K	10K	18K	32K	54K	100K	184K
GP	.750	2.625		8K	14K	22K	38K	68K	120K	230K
GS	.750	3.125		10K	18K	30K	54K	94K	160K	300K
GT	.750	3.625		12K	20K	36K	64K	110K	200K	380K
HE	.875	1.125		2K	4K	7K	12K	21K	38K	72K
HJ	.875	1.625		4K	8K	14K	24K	42K	76K	144K
HL	.875	2.125		8K	12K	20K	36K	64K	114K	216K
HP	.875	2.625		9K	16K	28K	48K	84K	152K	290K
HS	.875	3.125		12K	20K	34K	60K	104K	190K	360K
HT	.875	3.625		14K	24K	42K	72K	126K	230K	430K
JE	1.000	1.125		3K	5K	8K	14K	26K	48K	90K
JJ	1.000	1.625		6K	10K	16K	28K	50K	94K	176K
JL	1.000	2.125		8K	14K	24K	40K	72K	132K	244K
JP	1.000	2.625		10K	18K	30K	52K	92K	164K	300K
JS	1.000	3.125		14K	24K	42K	72K	128K	230K	350K
JT	1.000	3.625		16K	26K	46K	82K	146K	260K	350K

*TYPE 604D Expected Life = one half expected life for units listed above.

Table 11

TYPE 53D - EXPECTED LIFE

Case Code	Case Size (IN.) Dia.	Ln.	——	——	Life in Hours (K = 1000) at Operating Temperature +85°C	+75°C	+65°C	+55°C	+45°C
GE	.750	1.125			15K	22K	33K	50K	75K
GJ	.750	1.625			23K	34K	51K	77K	116K
GL	.750	2.125			31K	46K	69K	104K	156K
GP	.750	2.625			39K	58K	87K	131K	197K
GS	.750	3.125			47K	70K	105K	158K	237K
GT	.750	3.625			54K	81K	121K	182K	273K
HE	.875	1.125			17K	25K	38K	57K	86K
HJ	.875	1.625			26K	39K	58K	87K	131K
HL	.875	2.125			36K	54K	81K	121K	182K
HP	.875	2.625			46K	69K	103K	155K	232K
HS	.875	3.125			55K	82K	123K	185K	278K
HT	.875	3.625			63K	94K	141K	212K	318K
JE	1.000	1.125			19K	28K	42K	64K	96K
JJ	1.000	1.625			29K	43K	65K	97K	146K
JL	1.000	2.125			40K	60K	90K	135K	202K
JP	1.000	2.625			51K	76K	114K	172K	258K
JS	1.000	3.125			62K	93K	139K	209K	313K
JT	1.000	3.625			80K	120K	180K	270K	350K
KE	1.125	1.125			21K	31K	47K	70K	106K
KJ	1.125	1.625			32K	48K	72K	108K	162K
KL	1.125	2.125			43K	64K	96K	145K	217K
KP	1.125	2.625			54K	81K	121K	182K	273K
KS	1.125	3.125			67K	100K	150K	226K	339K
KT	1.125	3.625			72K	108K	162K	243K	350K
KD	1.125	4.125			95K	142K	213K	320K	350K
LE	1.250	1.125			23K	34K	51K	77K	116K
LJ	1.250	1.625			35K	52K	78K	118K	177K
LL	1.250	2.125			47K	70K	105K	158K	237K
LP	1.250	2.625			58K	87K	130K	195K	293K
LS	1.250	3.125			72K	108K	162K	243K	350K
LT	1.250	3.625			81K	121K	182K	273K	350K
LD	1.250	4.125			90K	135K	202K	303K	350K
ME	1.375	1.125			25K	37K	56K	84K	126K
MJ	1.375	1.625			37K	55K	83K	124K	187K
ML	1.375	2.125			50K	75K	112K	168K	253K
MP	1.375	2.625			62K	93K	139K	209K	313K
MS	1.375	3.125			76K	114K	171K	256K	350K
MT	1.375	3.625			89K	133K	200K	300K	350K
MD	1.375	4.125			98K	147K	220K	330K	350K

Table 12

TYPE 80D - EXPECTED LIFE
TYPE 81D - EXPECTED LIFE
TYPE 82D - EXPECTED LIFE

Case Code	Case Size (IN.) Dia.	Ln.	Life in Hours (K = 1000) at Operating Temperature ——	——	+85°C	+75°C	+65°C	+55°C	+45°C
HA	22	25			6K	10K	19K	33K	63K
HB	22	30			7K	13K	23K	42K	79K
HD	22	40			10K	19K	34K	61K	114K
JA	25	25			6K	11K	20K	36K	68K
JB	25	30			8K	14K	25K	45K	85K
JC	25	35			9K	17K	30K	55K	103K
JD	25	40			11K	20K	37K	66K	124K
JE	25	50			15K	26K	47K	84K	158K
KA	30	25			8K	14K	25K	46K	86K
KB	30	30			10K	18K	32K	57K	107K
KC	30	35			12K	21K	38K	68K	128K
KD	30	40			14K	26K	46K	82K	147K
KE	30	50			18K	33K	59K	106K	198K
MB	35	30			11K	21K	37K	67K	125K
MC	35	35			14K	25K	45K	80K	150K
MD	35	40			17K	30K	54K	97K	172K
ME	35	50			21K	38K	69K	123K	230K

Table 13

TYPE 32D - EXPECTED LIFE
TYPE 36DX - EXPECTED LIFE
TYPE 36DE - EXPECTED LIFE
TYPE 36DY - EXPECTED LIFE

Case	Case Size (IN.)		Life in Hours (K = 1000) at Operating Temperature						
Code	Dia.	Ln.	--	--	+85°C	+75°C	+65°C	+55°C	+45°C
AA	1.375	2.125			17 K	28 K	50 K	90 K	170 K
AB	1.375	3.125			30 K	50 K	90 K	165 K	310 K
AC	1.375	4.125			54 K	90 K	160 K	190 K	350 K
AE	1.375	5.125			61 K	100 K	180 K	300 K	350 K
AF	1.375	5.625			70 K	110 K	200 K	350 K	350 K
BA	2.000	2.125			21 K	35 K	60 K	110 K	215 K
BB	2.000	3.125			36 K	60 K	105 K	190 K	350 K
BC	2.000	4.125			83 K	140 K	250 K	350 K	350 K
BE	2.000	5.125			91 K	150 K	270 K	350 K	350 K
BF	2.000	5.625			100 K	170 K	300 K	350 K	350 K
CB	2.500	3.125			76 K	125 K	225 K	350 K	350 K
CC	2.500	4.125			93 K	150 K	275 K	350 K	350 K
CE	2.500	5.125			120 K	200 K	350 K	350 K	350 K
CF	2.500	5.625			125 K	210 K	350 K	350 K	350 K
DB	3.000	3.125			85 K	140 K	250 K	350 K	350 K
DC	3.000	4.125			120 K	200 K	350 K	350 K	350 K
DE	3.000	5.125			150 K	250 K	350 K	350 K	350 K
DF	3.000	5.625			165 K	275 K	350 K	350 K	350 K
DJ	3.000	8.625			220 K	350 K	350 K	350 K	350 K

Table 14

TYPE 602D - EXPECTED LIFE*
TYPE 622D - EXPECTED LIFE*

Case	Case Size (IN.)		Life in Hours (K = 1000) at Operating Temperature						
Code	Dia.	Ln.	——	——	+85°C	+75°C	+65°C	+55°C	+45°C
	ALL CASE CODES				12K	21K	38K	68K	128K

*Testing continues. Present data indicates all case sizes will meet the expected life figures listed above. Larger sizes may show longer life.

SHELF LIFE

Electrolyte is lost through the end-seal of an aluminum electrolytic capacitor during storage, just as it is lost during operation. The rate of loss is a function of the temperature, the volatility of the electrolyte, and the effectiveness of the seal. Capacitor shelf-life therefore, is part of the expected useful life, and both are directly related to the rate of loss of the electrolyte.

For example, a capacitor may have an expected useful life of 10 years at +65°C. Kept in storage for 3 years at +65°C, it will have 7 more years of expected useful life at +65°C, and this period may involve storage and/or operation.

Generally, the shelf-life of Sprague aluminum electrolytic capacitors is in excess of 10 years at typical storage temperatures below +40°C.

Storage and D-C Leakage

D-C leakage values will increase during storage. Typically, after several years storage at +40°C and below, d-c leakage can reach two to five times the initial values; at +50°C to +105°C, d-c leakage may reach 10 times the initial value. D-C leakage measurements taken periodically with a 5-minute charge at rated voltage, every 2000 hours for example, will minimize the d-c leakage increase.

We recommend, after extended storage or storage at high temperatures, that capacitors be measured and those that exceed specified initial d-c leakage limits be reconditioned. The initial d-c leakage condition can usually be restored within one hour using a standard reconditioning procedure. See Sprague Application Note No. 3499.1 for specific details.

Shelf Test Evaluation

The following tables present shelf test evaluations at various temperatures for typical Sprague aluminum electrolytic capacitors. The marked electrical stability is characteristic of Sprague aluminum electrolytics.

Table 15

+125°C Life/Shelf Evaluation
TYPE 600D - 68 μF, 50 VDC
(25 pcs. each group)

	+125°C Life Test			+125°C Shelf Test		
Time	Cap. (μF)	D.F. (%)	DCL (μA)	Cap. (μF)	D.F. (%)	DCL (μA)
Initial	83.2	3.2	1.1	84.5	3.2	1.2
120 Hrs.	83.2	3.2	0.6	84.5	2.9	5.4
500 Hrs.	82.5	3.2	0.4	82.4	2.8	4.0
1000 Hrs.	82.4	3.2	0.5	82.1	2.8	4.5
	Room Temperature Storage					
	After Life Test			After Shelf Test		
5 Years	81.9	3.6	0.6	81.6	3.2	3.8
8 Years	81.8	3.7	0.6	82.0	3.4	4.0

Original Bulletin Limits - Cap. = 61.2 - 199 μF
D.F. = 10%
DCL = 5.5 μA

Table 16

HIGH-TEMPERATURE EXTENDED SHELF EVALUATION
TYPE 600D - 50 μF, 25 VDC

KD Case (10 pcs.)	Initial Measurements	500 Hrs.	1000 Hrs.	2000 Hrs.	4000 Hrs.	6000 Hrs.	8000 Hrs.	10000 Hrs.
DCL at +25°C (uA)								
Shelf at +50°C	0.4	2.0	3.0	2.4	4.4	3.2	1.4	1.2
+85°C	0.3	1.5	1.8	2.4	2.7	2.1	1.5	1.1
+105°C	0.4	2.9	3.1	2.4	2.0	1.7	1.4	1.3
+125°C	0.3	3.0	2.9	4.3	9.3	6.6	2.3	-
+150°C	0.3	14.1	14.3	8.5	4.2	-	-	-
Cap. at +25°C (uF)								
Shelf at +50°C	54.7	53.9	53.6	53.2	52.5	51.9	51.1	51.0
+85°C	54.5	53.7	53.6	53.4	53.0	52.6	52.3	52.0
+105°C	54.4	53.2	52.9	52.6	52.2	51.4	50.8	49.9
+125°C	54.3	52.6	52.4	52.2	51.0	46.1	-4/10 Open-	
+150°C	54.1	52.3	52.0	51.1	–	-2/10 Open-		–
D.F. (%)								
Shelf at +50°C	7.0	6.9	6.6	6.9	10.0	14.7	19.9	21.3
+85°C	7.1	6.9	6.9	6.9	7.5	9.2	12.2	15.3
+105°C	7.2	7.0	7.1	7.4	10.2	16.9	24.2	36.1
+125°C	7.3	7.1	7.5	9.1	19.3	70.6	100.0+	–
+150°C	7.3	9.9	9.5	10.7	100.0+	–	–	–

Original Bulletin Limits - Cap. = 45 - 87.5 uF
D.F. = 10%
DCL = 2.5 uA

Table 17

HIGH-TEMPERATURE EXTENDED SHELF EVALUATION
TYPE 600D - 25 μF, 60 VDC

DD Case (10 pcs.)	Initial Measurements	500 Hrs.	1000 Hrs.	2000 Hrs.	4000 Hrs.	6000 Hrs.	8000 Hrs.	10000 Hrs.
DCL at +25°C (uA)								
Shelf at +50°C	0.5	3.7	4.0	5.8	6.0	3.3	2.4	2.3
+85°C	0.7	4.8	4.9	6.8	5.2	5.1	4.1	3.4
+105°C	0.5	5.5	5.1	4.8	2.0	2.9	2.6	3.5
+125°C	0.7	5.9	4.2	10.1	21.5	23.1	12.1	7.6
+150°C	0.5	20.9	14.8	11.3	4.5	1.4	–	–
Cap. at +25°C (uF)								
Shelf at +50°C	24.9	24.3	24.2	24.1	24.0	23.9	23.9	23.8
+85°C	25.3	24.7	24.6	24.6	24.5	24.4	24.3	24.3
+105°C	25.0	24.3	24.2	24.2	24.1	24.1	23.9	23.9
+125°C	25.7	24.8	24.7	24.7	24.6	24.5	24.3	24.0
+150°C	25.1	24.1	24.0	23.8	23.1	15.1	–	–
D.F. (%)								
Shelf at +50°C	2.7	2.4	2.4	2.3	2.5	2.5	3.1	3.3
+85°C	2.6	2.4	2.4	2.3	2.5	2.5	2.6	2.7
+105°C	2.8	2.5	2.5	2.4	2.7	2.6	2.9	3.1
+125°C	2.8	2.5	2.5	2.5	3.0	3.4	5.7	7.1
+150°C	2.8	2.8	2.7	2.7	11.1	83.7	–	–

Original Bulletin Limits - Cap. = 22.5 - 43.75 uF
D.F. = 10%
DCL = 4.0 uA

Table 18

HIGH-TEMPERATURE EXTENDED SHELF EVALUATION
TYPE 600D - 4.0 μF, 350 VDC

DL Case (10 pcs.)	Initial Measurements	500 Hrs.	1000 Hrs.	2000 Hrs.	4000 Hrs.	6000 Hrs.	8000 Hrs.	10000 Hrs.
DCL at +25°C (uA)								
Shelf at +50°C	9.5	10.3	11.8	17.5	24.0	26.0	27.4	29.6
+85°C	11.6	11.9	12.7	14.2	12.6	14.0	24.6	28.0
+105°C	11.0	14.6	16.4	23.0	17.0	19.0	33.0	41.0
+125°C	12.5	28.0	31.0	63.0	141.0	1000.0	--	--
Cap. at +25°C (uF)								
Shelf at +50°C	4.6	4.5	4.5	4.5	4.4	4.4	4.4	4.4
+85°C	4.5	4.5	4.5	4.5	4.5	4.4	4.4	4.4
+105°C	4.6	4.5	4.5	4.4	4.4	4.4	4.4	4.4
+125°C	4.6	4.4	4.4	4.3	4.4	4.3	--	--
D.F. (%)								
Shelf at +50°C	4.7	4.3	4.4	4.5	4.9	5.8	5.8	5.8
+85°C	4.7	4.3	4.4	4.5	4.6	4.7	4.9	5.1
+105°C	4.7	4.4	4.4	4.7	5.2	5.8	6.0	5.8
+125°C	4.9	4.8	5.2	6.2	7.2	13.8	--	--

Original Bulletin Limits - Cap. = 3.6 - 6.0 uF
D.F. = 10%
DCL = 28 uA

Table 19

HIGH-TEMPERATURE EXTENDED SHELF EVALUATION
TYPE 80D - 4700 μF, 20 VDC

JB Case (11 pcs.)	Initial Measurements	500 Hrs.	1000 Hrs.	2000 Hrs.	4000 Hrs.	6000 Hrs.	8000 Hrs.
DCL at +25°C (uA)							
Shelf at +25°C	.06	.06	.05	.06	.06	.05	.04
+45°C	.13	.12	.11	.12	.20	.36	.28
+65°C	.05	.27	.27	.28	.37	.22	.16
+85°C	.05	.36	.27	.18	.25	.16	.12
Cap. at +25°C (uF)							
Shelf at +25°C	4863	4873	4834	4832	4819	4829	4802
+45°C	4835	4804	4781	4767	4714	4615	4593
+65°C	4859	4786	4746	4794	4659	4639	4618
+85°C	4842	4737	4624	4580	4544	4490	4467
D.F. (%)							
Shelf at +25°C	21.3	25.5	27.7	29.8	31.5	21.3	22.6
+45°C	22.3	23.8	25.9	26.2	29.6	40.6	41.5
+65°C	23.8	28.3	29.3	32.1	34.1	42.5	44.9
+85°C	21.0	28.4	27.1	27.8	31.4	55.1	56.9

Original Bulletin Limits - Cap. = 4230 - 6110 uF
D.F. = 30%
DCL = 1.8 mA

Table 20

HIGH-TEMPERATURE EXTENDED SHELF EVALUATION
TYPE 36DE - 460,000 μF 6.3 VDC

CF Case (4 pcs.)	Initial Measurements	500 Hrs.	1000 Hrs.	2000 Hrs.	4000 Hrs.	6000 Hrs.	8000 Hrs.	10000 Hrs.
Cap. at +25°C (uF)	(K = 1000)							
Shelf at +85°C	548K	506K	498K	515K	492K	490K	482K	479K
+95°C	543K	493K	479K	485K	476K	453K	453K	452K
ESR (MΩ)								
Shelf at +85°C	3.28	3.44	3.42	3.59	3.60	3.66	3.52	3.63
+95°C	3.45	3.56	3.70	3.91	3.98	4.09	3.96	3.99
DCL at +25°C (mA)								
Shelf at +85°C	1.61	4.21	4.52	5.11	5.33	5.45	5.77	5.43
+95°C	1.77	4.21	4.93	5.91	6.34	6.59	6.02	5.13

Table 21

HIGH-TEMPERATURE EXTENDED SHELF EVALUATION
TYPE 36DE - 93,000 μF, 40 VDC

CF Case (4 pcs.)	Initial Measurements	500 Hrs.	1000 Hrs.	2000 Hrs.	4000 Hrs.	6000 Hrs.	8000 Hrs.	10000 Hrs.
Cap. at +25°C (uF)	(K = 1000)							
Shelf at +85°C	102K	97.6K	97.2K	97.3K	96.9K	96.0K	95.8K	95.6K
+95°C	103K	99.0K	98.0K	98.3K	97.2K	95.9K	95.7K	95.5K
ESR (MΩ)								
Shelf at +85°C	3.97	3.98	4.05	4.13	4.17	4.20	4.11	4.16
+95°C	3.98	4.07	4.20	4.36	4.39	4.47	4.38	4.43
DCL at +25°C (mA)								
Shelf at +85°C	0.79	1.01	1.08	1.04	1.00	1.08	1.15	1.08
+95°C	0.83	1.11	1.27	1.25	1.43	1.44	1.31	1.17

Table 22

HIGH-TEMPERATURE EXTENDED SHELF EVALUATION
TYPE 36DE - 18,000 μF, 100 VDC

CF Case (4 pcs.)	Initial Measurements	500 Hrs.	1000 Hrs.	2000 Hrs.	4000 Hrs.	6000 Hrs.	8000 Hrs.	10000 Hrs.
Cap. at +25°C (uF)	(K = 1000)							
Shelf at +85°C	22.3K	21.6K	21.6K	21.6K	21.5K	21.4K	21.4K	21.3K
+95°C	22.1K	21.5K	21.5K	21.4K	21.3K	21.2K	21.1K	21.1K
ESR (MΩ)								
Shelf at +85°C	5.56	5.47	5.61	5.69	5.74	5.77	5.60	5.71
+95°C	5.54	5.60	5.79	6.03	6.13	6.17	5.98	6.05
DCL at +25°C (mA)								
Shelf at +85°C	0.44	0.93	0.93	0.89	0.79	0.76	0.77	0.69
+95°C	0.46	1.11	1.03	0.95	0.90	0.90	0.78	0.70

CONCLUSION

We have discussed the relationship between reliability and expected life for Sprague aluminum electrolytic capacitors, and reported on ongoing test programs to measure initial quality parameters, reliability, and long-term expected life.

Initial electrical parameters and incoming inspection quality figures do not provide a complete picture of the effect of components on the life expectancy of assembled equipment. The initial electrical parameters, the reliability, and expected life should all be considered when evaluating capacitors for specific applications. Capacitor type selection can have a great impact on the full lifecycle cost of components.

Weight loss data provides an early indication of expected life, and has been regularly evaluated. The results of our evaluations are tabulated here. Detailed product information covering each of the capacitor types referenced in this paper is available from Sprague Electric Company, Marketing Communications Dept., 41 Hampden Rd., Mansfield, MA 02048. For additional information, consult your local sales office as listed on the inside back cover of this catalog.

Questions concerning the technical aspects of this paper, or of any of the products referenced here should be directed to the Product Marketing Dept., or QAR Dept., Sprague Electric Company, PO Box 1, Lansing, NC 28643.

WARNING! DO NOT MISAPPLY ALUMINUM ELECTROLYTIC CAPACITORS

1. Caution Against Misapplication. Here are the most common forms of misapplication:

(a) Exposure to reverse voltage in excess of specified limits.

(b) Exposure to temperatures above specified limit.

(c) Application of voltage beyond specified surge voltage.

(d) Application of excessive ripple current or voltage. Do not exceed specification limits.

2. Personnel Safety. *Electrical misapplication* of aluminum electrolytic capacitors *may be hazardous.* Personal injury or property damage may result from explosion of a capacitor or from expulsion of electrolyte due to mechanical disruption of a capacitor.

Skin, eye or mouth exposure to electrolytes in aluminum electrolytic capacitors **MUST BE TREATED IMMEDIATELY!**

2.1 Eye Contact. *Contact lenses must be removed at once. Immediately flush the open eye(s) for 15 minutes with large amounts of water.* If pain is experienced, apply 2 drops of 0.5% tetracaine (Pontocaine). *Seek immediate medical attention.*

2.2 Skin or Clothing Contact. *Flush thoroughly with running water* as soon as possible after contact, and then wash with soap and water or a mild detergent.

2.3 Mouth Contact or Accidental Swallowing. *Drink large quantities of water or milk.* Follow with Milk of Magnesia, beaten egg, or vegetable oil. *Call physician immediately.*

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