



Engineering Bulletin

3521C

Supersedes No. 3521B

Type 151D

Non-Polarized Solid-Electrolyte TANTALEX® Capacitors

THE MINIATURE SIZE, excellent electrical characteristics, and outstanding service life of solid-electrolyte tantalum capacitors are available in a non-polarized construction to supplement the original polarized design – the Sprague Type 150D Tantalex capacitor.

A Wide Variety of Applications

The non-polarized design, known as Sprague Type 151D, permits the use of solid-electrolyte tantalum capacitors in many new applications, such as phase-splitting capacitors for small low-voltage motors, in servo systems, in low-frequency tuned circuits, in crossover networks, in bypass applications where high ripple voltages are encountered, and in many types of circuits in which there are reversals of polarity greater in magnitude than those which may be applied to a polarized capacitor.

Type 151D non-polar capacitors may be used at full-rated operating voltages up to 85 C and with appropriate derating to 125 C. With additional derating, they may be used in straight alternating current circuits.

Construction Features

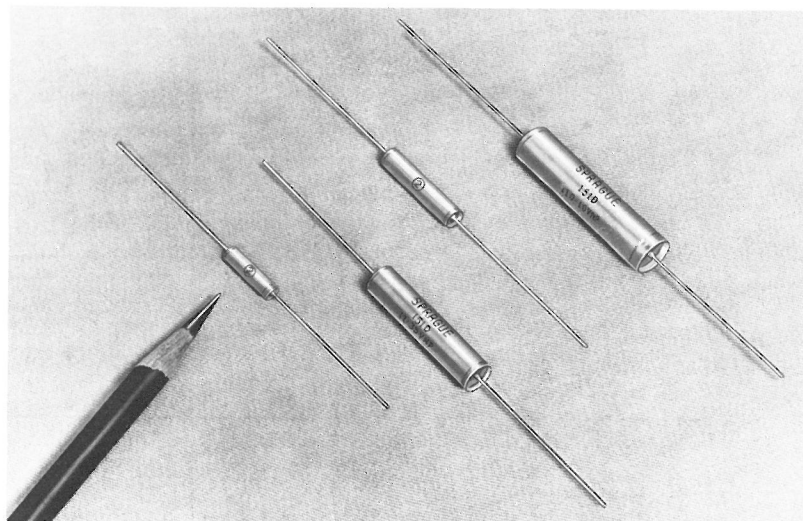
Each Sprague Type 151D capacitor consists basically of two hermetically-sealed, metal-clad polarized sections, with their cathodes connected back-to-back, enclosed within an outer thin metal tube. This results in a single homogeneous capacitor insofar as outward appearance is concerned. Where required, supplementary insulating sleeve of polyester film is applied.

Performance and Application Data

Detailed performance characteristics of Type 151D non-polarized solid-electrolyte Tantalex capacitors are given on pages 8 through 10 of this bulletin. Curves showing typical variations in parameters with temperature and frequency, are given on page 7, while a "Guide to Application" follows on pages 10 through 12.

Type 151D non-polarized Tantalex capacitors are manufactured to the same rigid standard of quality control as are all Sprague Tantalex capacitors. This assures the user of a uniformly reliable product.

THE PENCIL POINTS TO A .11 μ F, 35 VOLT NP TYPE 151D SOLID-ELECTROLYTE TANTALEX CAPACITOR. THE PHOTOGRAPH IS ACTUAL SIZE. THE SMALLEST CAPACITOR IS ONLY 0.146" DIA. BY 0.540" LONG.

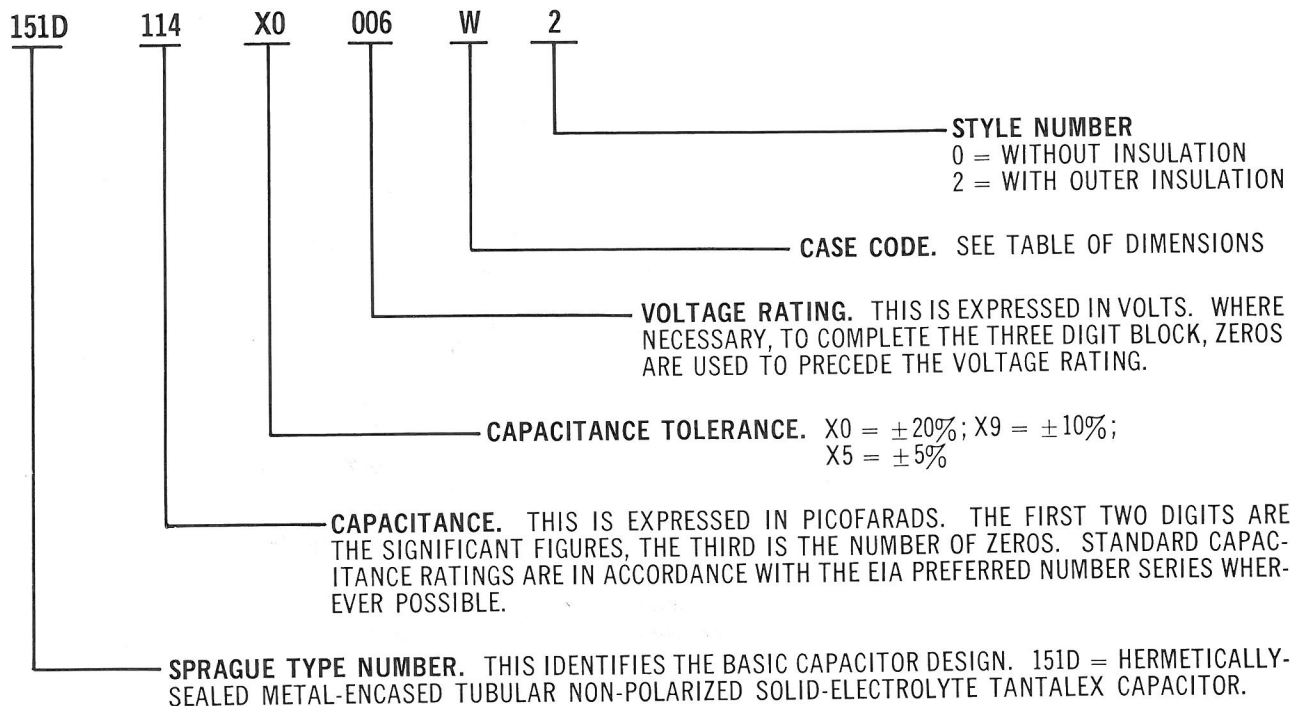


SPRAGUE ELECTRIC COMPANY

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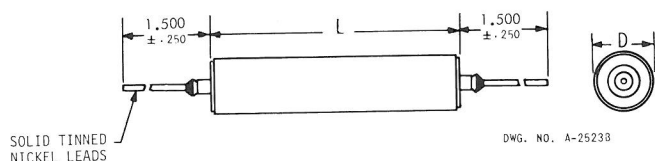
Catalog Numbering System

ALWAYS SPECIFY BY COMPLETE CATALOG NUMBER, SUCH AS:



Inch To Millimeter Conversion

| | | | |
|-----------|----------|-----------|---------|
| 0.010 in. | 0.254 mm | 0.361 in. | 9.17 mm |
| 0.015 | 0.381 | 0.376 | 9.55 |
| 0.020 | 0.508 | 0.540 | 13.72 |
| 0.025 | 0.635 | 0.575 | 14.61 |
| 0.031 | 0.787 | 0.915 | 23.24 |
| 0.146 | 3.71 | 0.955 | 24.26 |
| 0.161 | 4.09 | 1.320 | 33.53 |
| 0.192 | 4.88 | 1.350 | 34.29 |
| 0.207 | 5.26 | 1.500 | 38.10 |
| 0.250 | 6.35 | 1.520 | 38.61 |
| 0.299 | 7.59 | 1.550 | 39.37 |
| 0.314 | 7.98 | | |



DIMENSIONS IN INCHES

| Case Code | Bare Can | | With Outer Insulation* | | Lead Size |
|-----------|------------------|------------------|---------------------------|------------------|-------------------------|
| | D ± 0.010 | L ± 0.031 | D $+0.010$ -0.015 | L ± 0.031 | |
| W | 0.146 | 0.540 | 0.161 | 0.575 | 0.020 Dia. (No. 24 AWG) |
| X | 0.192 | 0.915 | 0.207 | 0.955 | 0.020 Dia. (No. 24 AWG) |
| Y | 0.299 | 1.320 | 0.314 | 1.350 | 0.025 Dia. (No. 22 AWG) |
| Z | 0.361 | 1.520 | 0.376 | 1.550 | 0.025 Dia. (No. 22 AWG) |

*When a shrinkfitted insulation is used, it shall lap over the ends of the capacitor body.

STANDARD RATINGS

For a complete catalog number, the numbers listed in the following table must be followed by a size code and style number selected from the available styles shown on page 2. For example, 151D114X0006W2.

| | | | | | D-C Leakage Current at 25 C (μ A) | Max. DF at 25 C & 120 Hz (%) |
|--------------------------|--------------|---------------------------|-----------------|----------------|--|---------------------------------------|
| μ F | Case Code | Partial Catalog Number | | $\pm 20\%$ Tol | $\pm 10\%$ Tol. | |
| | | $\pm 20\%$ Tol | $\pm 10\%$ Tol. | | | |
| 6 VOLTS NP, 8 NP SURGE | | | | | | |
| .11 | W | 151D114X0006 | 151D114X9006 | 0.5 | 2 | |
| .13 | W | — | 151D134X9006 | 0.5 | 2 | |
| .16 | W | 151D164X0006 | 151D164X9006 | 0.5 | 2 | |
| .19 | W | — | 151D194X9006 | 0.5 | 2 | |
| .23 | W | 151D234X0006 | 151D234X9006 | 0.5 | 2 | |
| .28 | W | — | 151D284X9006 | 0.5 | 2 | |
| .34 | W | 151D344X0006 | 151D344X9006 | 0.5 | 2 | |
| .41 | W | — | 151D414X9006 | 0.5 | 2 | |
| .50 | W | 151D504X0006 | 151D504X9006 | 0.5 | 2 | |
| .60 | W | — | 151D604X9006 | 0.5 | 4 | |
| .75 | W | 151D754X0006 | 151D754X9006 | 0.5 | 4 | |
| .90 | W | — | 151D904X9006 | 0.5 | 4 | |
| 1.1 | W | 151D115X0006 | 151D115X9006 | 0.5 | 4 | |
| 1.3 | W | — | 151D135X9006 | 0.5 | 4 | |
| 1.6 | W | 151D165X0006 | 151D165X9006 | 0.5 | 4 | |
| 1.9 | W | — | 151D195X9006 | 0.5 | 4 | |
| 2.3 | W | 151D235X0006 | 151D235X9006 | 0.5 | 4 | |
| 2.8 | W | — | 151D285X9006 | 0.5 | 4 | |
| 3.4 | W | 151D345X0006 | 151D345X9006 | 0.5 | 6 | |
| 4.1 | X | — | 151D415X9006 | 0.8 | 6 | |
| 5.0 | X | 151D505X0006 | 151D505X9006 | 0.9 | 6 | |
| 6.0 | X | — | 151D605X9006 | 1.0 | 6 | |
| 7.5 | X | 151D755X0006 | 151D755X9006 | 1.4 | 6 | |
| 9.0 | X | — | 151D905X9006 | 1.6 | 6 | |
| 11 | X | 151D116X0006 | 151D116X9006 | 2.0 | 6 | |
| 13 | X | — | 151D136X9006 | 2.5 | 6 | |
| 16 | X | 151D166X0006 | 151D166X9006 | 3.0 | 6 | |
| 19 | X | — | 151D196X9006 | 3.0 | 6 | |
| 23 | X | 151D236X0006 | 151D236X9006 | 3.0 | 6 | |
| 28 | X | — | 151D286X9006 | 3.0 | 6 | |
| 30 | X | 151D306X0006 | 151D306X9006 | 5.0 | 6 | |
| 34 | Y | 151D346X0006 | 151D346X9006 | 5.0 | 6 | |
| 41 | Y | — | 151D416X9006 | 5.0 | 6 | |
| 50 | Y | 151D506X0006 | 151D506X9006 | 6.0 | 8 | |
| 60 | Y | 151D606X0006 | 151D606X9006 | 7.0 | 8 | |
| 75 | Y | 151D756X0006 | 151D756X9006 | 9.0 | 8 | |
| 90 | Y | 151D906X0006 | 151D906X9006 | 11.0 | 8 | |
| 110 | Z | 151D117X0006 | 151D117X9006 | 13.0 | 8 | |
| 130 | Z | 151D137X0006 | 151D137X9006 | 13.0 | 8 | |
| 160 | Z | 151D167X0006 | 151D167X9006 | 15.0 | 8 | |
| 10 VOLTS NP, 13 NP SURGE | | | | | | |
| .11 | W | 151D114X0010 | 151D114X9010 | 0.5 | 2 | |
| .13 | W | — | 151D134X9010 | 0.5 | 2 | |
| .16 | W | 151D164X0010 | 151D164X9010 | 0.5 | 2 | |
| .19 | W | — | 151D194X9010 | 0.5 | 2 | |
| .23 | W | 151D234X0010 | 151D234X9010 | 0.5 | 2 | |
| .28 | W | — | 151D284X9010 | 0.5 | 2 | |
| .34 | W | 151D344X0010 | 151D344X9010 | 0.5 | 2 | |
| .41 | W | — | 151D414X9010 | 0.5 | 2 | |
| .50 | W | 151D504X0015 | 151D504X9015 | 0.5 | 2 | |
| .60 | W | — | 151D604X9015 | 0.6 | 4 | |
| .75 | W | 151D754X0015 | 151D754X9015 | 0.6 | 4 | |
| .90 | W | — | 151D904X9015 | 0.6 | 4 | |
| 1.1 | W | 151D115X0015 | 151D115X9015 | 0.6 | 4 | |
| 1.3 | W | — | 151D135X9015 | 0.6 | 4 | |
| 1.6 | W | 151D165X0015 | 151D165X9015 | 0.8 | 4 | |
| 1.9 | X | — | 151D195X9015 | 0.9 | 4 | |
| 2.3 | X | 151D235X0015 | 151D235X9015 | 1.0 | 4 | |
| 2.8 | X | — | 151D285X9015 | 1.3 | 4 | |
| 3.4 | X | 151D345X0015 | 151D345X9015 | 1.5 | 6 | |
| 4.1 | X | — | 151D415X9015 | 1.8 | 6 | |

| | | | | | D-C Leakage Current at 25 C (μ A) | Max. DF at 25 C & 120 Hz (%) |
|----------------------------------|--------------|---------------------------|-----------------|-----------------|--|---------------------------------------|
| μ F | Case Code | Partial Catalog Number | | $\pm 20\%$ Tol. | $\pm 10\%$ Tol. | |
| | | $\pm 20\%$ Tol. | $\pm 10\%$ Tol. | | | |
| 10 VOLTS NP, 13 NP SURGE (Cont.) | | | | | | |
| .50 | W | 151D504X0010 | 151D504X9010 | 0.5 | 2 | |
| .60 | W | — | 151D604X9010 | 0.5 | 4 | |
| .75 | W | 151D754X0010 | 151D754X9010 | 0.5 | 4 | |
| .90 | W | — | 151D904X9010 | 0.5 | 4 | |
| 1.1 | W | 151D115X0010 | 151D115X9010 | 0.6 | 4 | |
| 1.3 | W | — | 151D135X9010 | 0.6 | 4 | |
| 1.6 | W | 151D165X0010 | 151D165X9010 | 0.6 | 4 | |
| 1.9 | W | — | 151D195X9010 | 0.6 | 4 | |
| 2.3 | W | 151D235X0010 | 151D235X9010 | 0.7 | 4 | |
| 2.8 | X | — | 151D285X9010 | 0.9 | 4 | |
| 3.4 | X | 151D345X0010 | 151D345X9010 | 1.0 | 6 | |
| 4.1 | X | — | 151D415X9010 | 1.2 | 6 | |
| 5.0 | X | 151D505X0010 | 151D505X9010 | 1.5 | 6 | |
| 6.0 | X | — | 151D605X9010 | 1.8 | 6 | |
| 7.5 | X | 151D755X0010 | 151D755X9010 | 2.5 | 6 | |
| 9.0 | X | — | 151D905X9010 | 3.0 | 6 | |
| 11 | X | 151D116X0010 | 151D116X9010 | 3.5 | 6 | |
| 13 | X | — | 151D136X9010 | 4.0 | 6 | |
| 16 | X | 151D166X0010 | 151D166X9010 | 5.0 | 6 | |
| 19 | X | — | 151D196X9010 | 5.0 | 6 | |
| 20 | X | 151D206X0010 | 151D206X9010 | 5.0 | 6 | |
| 23 | Y | 151D236X0010 | 151D236X9010 | 5.0 | 6 | |
| 28 | Y | — | 151D286X9010 | 6.0 | 6 | |
| 34 | Y | 151D346X0010 | 151D346X9010 | 7.0 | 6 | |
| 41 | Y | — | 151D416X9010 | 8.0 | 6 | |
| 50 | Y | 151D506X0010 | 151D506X9010 | 10.0 | 8 | |
| 60 | Y | 151D606X0010 | 151D606X9010 | 12.0 | 8 | |
| 75 | Z | 151D756X0010 | 151D756X9010 | 15.0 | 8 | |
| 90 | Z | — | 151D906X9010 | 18.0 | 8 | |
| 110 | Z | 151D117X0010 | 151D117X9010 | 20.0 | 8 | |
| 15 VOLT NP, 20 NP SURGE | | | | | | |
| .11 | W | 151D114X0015 | 151D114X9015 | 0.5 | 2 | |
| .13 | W | — | 151D134X9015 | 0.5 | 2 | |
| .16 | W | 151D164X0015 | 151D164X9015 | 0.5 | 2 | |
| .19 | W | — | 151D194X9015 | 0.5 | 2 | |
| .23 | W | 151D234X0015 | 151D234X9015 | 0.5 | 2 | |
| .28 | W | — | 151D284X9015 | 0.5 | 2 | |
| .34 | W | 151D344X0015 | 151D344X9015 | 0.5 | 2 | |
| .41 | W | — | 151D414X9015 | 0.5 | 2 | |
| .50 | W | 151D504X0015 | 151D504X9015 | 0.5 | 2 | |
| .60 | W | — | 151D604X9015 | 0.6 | 4 | |
| .75 | W | 151D754X0015 | 151D754X9015 | 0.6 | 4 | |
| .90 | W | — | 151D904X9015 | 0.6 | 4 | |
| 1.1 | W | 151D115X0015 | 151D115X9015 | 0.6 | 4 | |
| 1.3 | W | — | 151D135X9015 | 0.6 | 4 | |
| 1.6 | W | 151D165X0015 | 151D165X9015 | 0.8 | 4 | |
| 1.9 | X | — | 151D195X9015 | 0.9 | 4 | |
| 2.3 | X | 151D235X0015 | 151D235X9015 | 1.0 | 4 | |
| 2.8 | X | — | 151D285X9015 | 1.3 | 4 | |
| 3.4 | X | 151D345X0015 | 151D345X9015 | 1.5 | 6 | |
| 4.1 | X | — | 151D415X9015 | 1.8 | 6 | |

Any preferred number capacitance rating listed is available in $\pm 5\%$ capacitance tolerance on special order. To specify $\pm 5\%$ capacitors, change the digit following the "X" in the capacitance code to the figure "5."

STANDARD RATINGS - (Cont.)

For a complete catalog number, the numbers listed in the following table must be followed by a size code and style number selected from the available styles shown on page 2. For example, 151D505X0015X2.

| μF | Case Code | Partial Catalog Number | | D-C Leakage Current at 25 C (μA) | Max. DF at 25 C & 120 Hz (%) |
|--------------------------|-----------|----------------------------------|--------------|----------------------------------|------------------------------|
| | | ±20% Tol. | ±10% Tol. | | |
| | | 15 VOLTS NP, 20 NP SURGE (Cont.) | | | |
| 5.0 | X | 151D505X0015 | 151D505X9015 | 2.5 | 6 |
| 6.0 | X | — | 151D605X9015 | 3.0 | 6 |
| 7.5 | X | 151D755X0015 | 151D755X9015 | 3.5 | 6 |
| 9.0 | X | — | 151D905X9015 | 3.5 | 6 |
| 11 | X | 151D116X0015 | 151D116X9015 | 4.0 | 6 |
| 13 | Y | — | 151D136X9015 | 5.0 | 6 |
| 16 | Y | 151D166X0015 | 151D166X9015 | 6.0 | 6 |
| 19 | Y | — | 151D196X9015 | 6.0 | 6 |
| 23 | Y | 151D236X0015 | 151D236X9015 | 7.0 | 6 |
| 28 | Y | — | 151D286X9015 | 7.0 | 6 |
| 34 | Y | 151D346X0015 | 151D346X9015 | 9.0 | 6 |
| 41 | Z | — | 151D416X9015 | 9.0 | 6 |
| 50 | Z | 151D506X0015 | 151D506X9015 | 10.0 | 8 |
| 60 | Z | — | 151D606X9015 | 13.0 | 8 |
| 75 | Z | 151D756X0015 | 151D756X9015 | 15.0 | 8 |
| 20 VOLTS NP, 26 NP SURGE | | | | | |
| .0023 | W | 151D232X0020 | 151D232X9020 | 0.5 | 2 |
| .0028 | W | — | 151D282X9020 | 0.5 | 2 |
| .0034 | W | 151D342X0020 | 151D342X9020 | 0.5 | 2 |
| .0041 | W | — | 151D412X9020 | 0.5 | 2 |
| .005 | W | 151D502X0020 | 151D502X9020 | 0.5 | 2 |
| .006 | W | — | 151D602X9020 | 0.5 | 2 |
| .0075 | W | 151D752X0020 | 151D752X9020 | 0.5 | 2 |
| .009 | W | — | 151D902X9020 | 0.5 | 2 |
| .011 | W | 151D113X0020 | 151D113X9020 | 0.5 | 2 |
| .013 | W | — | 151D133X9020 | 0.5 | 2 |
| .016 | W | 151D163X0020 | 151D163X9020 | 0.5 | 2 |
| .019 | W | — | 151D193X9020 | 0.5 | 2 |
| .023 | W | 151D233X0020 | 151D233X9020 | 0.5 | 2 |
| .028 | W | — | 151D283X9020 | 0.5 | 2 |
| .034 | W | 151D343X0020 | 151D343X9020 | 0.5 | 2 |
| .041 | W | — | 151D413X9020 | 0.5 | 2 |
| .05 | W | 151D503X0020 | 151D503X9020 | 0.5 | 2 |
| .06 | W | — | 151D603X9020 | 0.5 | 2 |
| .075 | W | 151D753X0020 | 151D753X9020 | 0.5 | 2 |
| .09 | W | — | 151D903X9020 | 0.5 | 2 |
| .11 | W | 151D114X0020 | 151D114X9020 | 0.5 | 2 |
| .13 | W | — | 151D134X9020 | 0.5 | 2 |
| .16 | W | 151D164X0020 | 151D164X9020 | 0.5 | 2 |
| .19 | W | — | 151D194X9020 | 0.5 | 2 |
| .23 | W | 151D234X0020 | 151D234X9020 | 0.5 | 2 |
| .28 | W | — | 151D284X9020 | 0.5 | 2 |
| .34 | W | 151D344X0020 | 151D344X9020 | 0.5 | 2 |
| .41 | W | — | 151D414X9020 | 0.5 | 2 |
| .50 | W | 151D504X0020 | 151D504X9020 | 0.5 | 2 |
| .60 | W | — | 151D604X9020 | 0.6 | 4 |
| .75 | W | 151D754X0020 | 151D754X9020 | 0.6 | 4 |
| .90 | W | — | 151D904X9020 | 0.6 | 4 |
| 1.1 | W | 151D115X0020 | 151D115X9020 | 0.7 | 4 |
| 1.3 | X | — | 151D135X9020 | 0.8 | 4 |
| 1.6 | X | 151D165X0020 | 151D165X9020 | 1.0 | 4 |
| 1.9 | X | — | 151D195X9020 | 1.2 | 4 |
| 2.3 | X | 151D235X0020 | 151D235X9020 | 1.4 | 4 |
| 2.8 | X | — | 151D285X9020 | 1.7 | 4 |
| 3.4 | X | 151D345X0020 | 151D345X9020 | 2.0 | 6 |
| 4.1 | X | — | 151D415X9020 | 2.0 | 6 |
| 5.0 | X | 151D505X0020 | 151D505X9020 | 3.0 | 6 |
| 6.0 | X | — | 151D605X9020 | 3.5 | 6 |
| 7.5 | X | 151D755X0020 | 151D755X9020 | 4.0 | 6 |
| 9.0 | Y | — | 151D905X9020 | 4.0 | 6 |

| μF | Case Code | Partial Catalog Number | | D-C Leakage Current at 25 C (μA) | Max. DF at 25 C & 120 Hz (%) |
|--------------------------|-----------|-----------------------------------|--------------|----------------------------------|------------------------------|
| | | ±20% Tol. | ±10% Tol. | | |
| | | 20 VOLTS, NP, 26 NP SURGE (Cont.) | | | |
| 11 | Y | 151D116X0020 | 151D116X9020 | 4.0 | 6 |
| 13 | Y | — | 151D136X9020 | 5.0 | 6 |
| 16 | Y | 151D166X0020 | 151D166X9020 | 5.0 | 6 |
| 19 | Y | — | 151D196X9020 | 6.0 | 6 |
| 23 | Y | 151D236X0020 | 151D236X9020 | 7.0 | 6 |
| 28 | Z | — | 151D286X9020 | 8.5 | 6 |
| 34 | Z | 151D346X0020 | 151D346X9020 | 10.0 | 6 |
| 41 | Z | — | 151D416X9020 | 12.0 | 6 |
| 50 | Z | 151D506X0020 | 151D506X9020 | 15.0 | 8 |
| 35 VOLTS NP, 46 NP SURGE | | | | | |
| .0023 | W | 151D232X0035 | 151D232X9035 | 0.5 | 2 |
| .0028 | W | — | 151D282X9035 | 0.5 | 2 |
| .0034 | W | 151D342X0035 | 151D342X9035 | 0.5 | 2 |
| .0041 | W | — | 151D412X9035 | 0.5 | 2 |
| .005 | W | 151D502X0035 | 151D502X9035 | 0.5 | 2 |
| .006 | W | — | 151D602X9035 | 0.5 | 2 |
| .0075 | W | 151D752X0035 | 151D752X9035 | 0.5 | 2 |
| .009 | W | — | 151D902X9035 | 0.5 | 2 |
| .011 | W | 151D113X0035 | 151D113X9035 | 0.5 | 2 |
| .013 | W | — | 151D133X9035 | 0.5 | 2 |
| .016 | W | 151D163X0035 | 151D163X9035 | 0.5 | 2 |
| .019 | W | — | 151D193X9035 | 0.5 | 2 |
| .023 | W | 151D233X0035 | 151D233X9035 | 0.5 | 2 |
| .028 | W | — | 151D283X9035 | 0.5 | 2 |
| .034 | W | 151D343X0035 | 151D343X9035 | 0.5 | 2 |
| .041 | W | — | 151D413X9035 | 0.5 | 2 |
| .050 | W | 151D503X0035 | 151D503X9035 | 0.5 | 2 |
| .060 | W | — | 151D603X9035 | 0.5 | 2 |
| .075 | W | 151D753X0035 | 151D753X9035 | 0.5 | 2 |
| .090 | W | — | 151D903X9035 | 0.5 | 2 |
| .11 | W | 151D114X0035 | 151D114X9035 | 0.5 | 2 |
| .13 | W | — | 151D134X9035 | 0.5 | 2 |
| .16 | W | 151D164X0035 | 151D164X9035 | 0.5 | 2 |
| .19 | W | — | 151D194X9035 | 0.5 | 2 |
| .23 | W | 151D234X0035 | 151D234X9035 | 0.5 | 2 |
| .28 | W | — | 151D284X9035 | 0.5 | 2 |
| .34 | W | 151D344X0035 | 151D344X9035 | 0.5 | 2 |
| .41 | W | — | 151D414X9035 | 0.5 | 2 |
| .50 | W | 151D504X0035 | 151D504X9035 | 0.5 | 2 |
| .60 | X | — | 151D604X9035 | 0.6 | 4 |
| .75 | X | 151D754X0035 | 151D754X9035 | 0.8 | 4 |
| .90 | X | — | 151D904X9035 | 1.0 | 4 |
| 1.1 | X | 151D115X0035 | 151D115X9035 | 1.2 | 4 |
| 1.3 | X | — | 151D135X9035 | 1.4 | 4 |
| 1.6 | X | 151D165X0035 | 151D165X9035 | 1.7 | 4 |
| 1.9 | X | — | 151D195X9035 | 2.0 | 4 |
| 2.3 | X | 151D235X0035 | 151D235X9035 | 2.5 | 4 |
| 2.8 | X | — | 151D285X9035 | 2.5 | 4 |
| 3.4 | X | 151D345X0035 | 151D345X9035 | 3.0 | 6 |
| 4.1 | Y | — | 151D415X9035 | 3.5 | 6 |
| 5.0 | Y | 151D505X0035 | 151D505X9035 | 4.0 | 6 |
| 6.0 | Y | — | 151D605X9035 | 4.0 | 6 |
| 7.5 | Y | 151D755X0035 | 151D755X9035 | 6.0 | 6 |
| 9.0 | Y | — | 151D905X9035 | 6.0 | 6 |
| 11 | Y | 151D116X0035 | 151D116X9035 | 7.0 | 6 |
| 13 | Z | — | 151D136X9035 | 7.0 | 6 |
| 16 | Z | 151D166X0035 | 151D166X9035 | 8.0 | 6 |
| 19 | Z | — | 151D196X9035 | 10.0 | 6 |
| 23 | Z | 151D236X0035 | 151D236X9035 | 10.0 | 6 |

Any preferred number capacitance rating listed is available in $\pm 5\%$ capacitance tolerance on special order. To specify $\pm 5\%$ capacitors, change the digit following the "X" in the capacitance code to the figure "5."

STANDARD RATINGS (Cont.)

For a complete catalog number, the numbers listed in the following table must be followed by a size code and style number selected from the available styles shown on page 2. For example, 151D232X0050W2.

| μF | Case Code | Partial Catalog Number | | D-C Leakage Current at 25 C (μA) | Max. DF at 25 C & 120 Hz (%) |
|--------------------------|-----------|------------------------|--------------|----------------------------------|------------------------------|
| | | ±20% Tol. | ±10% Tol. | | |
| 50 VOLTS NP, 65 NP SURGE | | | | | |
| .0023 | W | 151D232X0050 | 151D232X9050 | 0.5 | 2 |
| .0028 | W | — | 151D282X9050 | 0.5 | 2 |
| .0034 | W | 151D342X0050 | 151D342X9050 | 0.5 | 2 |
| .0041 | W | — | 151D412X9050 | 0.5 | 2 |
| .005 | W | 151D502X0050 | 151D502X9050 | 0.5 | 2 |
| .006 | W | — | 151D602X9050 | 0.5 | 2 |
| .0075 | W | 151D752X0050 | 151D752X9050 | 0.5 | 2 |
| .009 | W | — | 151D902X9050 | 0.5 | 2 |
| .011 | W | 151D113X0050 | 151D113X9050 | 0.5 | 2 |
| .013 | W | — | 151D133X9050 | 0.5 | 2 |
| .016 | W | 151D163X0050 | 151D163X9050 | 0.5 | 2 |
| .019 | W | — | 151D193X9050 | 0.5 | 2 |
| .023 | W | 151D233X0050 | 151D233X9050 | 0.5 | 2 |
| .028 | W | — | 151D283X9050 | 0.5 | 2 |
| .034 | W | 151D343X0050 | 151D343X9050 | 0.5 | 2 |
| .041 | W | — | 151D413X9050 | 0.5 | 2 |
| .05 | W | 151D503X0050 | 151D503X9050 | 0.5 | 2 |
| .06 | W | — | 151D603X9050 | 0.5 | 2 |
| .075 | W | 151D753X0050 | 151D753X9050 | 0.5 | 2 |
| .09 | W | — | 151D903X9050 | 0.5 | 2 |
| .11 | W | 151D114X0050 | 151D114X9050 | 0.5 | 2 |
| .13 | W | — | 151D134X9050 | 0.5 | 2 |
| .16 | W | 151D164X0050 | 151D164X9050 | 0.5 | 2 |
| .19 | W | — | 151D194X9050 | 0.5 | 2 |
| .23 | W | 151D234X0050 | 151D234X9050 | 0.5 | 2 |
| .28 | W | — | 151D284X9050 | 0.5 | 2 |
| .34 | W | 151D344X0050 | 151D344X9050 | 0.5 | 2 |
| .41 | W | — | 151D414X9050 | 0.5 | 2 |
| .50 | W | 151D504X0050 | 151D504X9050 | 0.8 | 2 |
| .60 | X | — | 151D604X9050 | 0.9 | 4 |
| .75 | X | 151D754X0050 | 151D754X9050 | 1.2 | 4 |
| .90 | X | — | 151D904X9050 | 1.4 | 4 |
| 1.1 | X | 151D115X0050 | 151D115X9050 | 1.7 | 4 |
| 1.3 | X | — | 151D135X9050 | 2.0 | 4 |
| 1.6 | X | 151D165X0050 | 151D165X9050 | 2.5 | 4 |
| 1.9 | X | — | 151D195X9050 | 3.0 | 4 |
| 2.3 | X | 151D235X0050 | 151D235X9050 | 3.5 | 4 |
| 2.8 | Y | — | 151D285X9050 | 4.5 | 4 |
| 3.4 | Y | 151D345X0050 | 151D345X9050 | 4.5 | 6 |
| 4.1 | Y | — | 151D415X9050 | 5.0 | 6 |
| 5.0 | Y | 151D505X0050 | 151D505X9050 | 5.0 | 6 |
| 6.0 | Y | — | 151D605X9050 | 6.0 | 6 |
| 7.5 | Y | 151D755X0050 | 151D755X9050 | 6.0 | 6 |
| 9.0 | Y | — | 151D905X9050 | 7.0 | 6 |
| 11.0 | Z | 151D116X0050 | 151D116X9050 | 8.0 | 6 |
| 60 VOLTS NP, 78 NP SURGE | | | | | |
| .0023 | W | 151D232X0060 | 151D232X9060 | 0.5 | 2 |
| .0028 | W | — | 151D282X9060 | 0.5 | 2 |
| .0034 | W | 151D342X0060 | 151D342X9060 | 0.5 | 2 |
| .0041 | W | — | 151D412X9060 | 0.5 | 2 |
| .005 | W | 151D502X0060 | 151D502X9060 | 0.5 | 2 |
| .006 | W | — | 151D602X9060 | 0.5 | 2 |
| .0075 | W | 151D752X0060 | 151D752X9060 | 0.5 | 2 |
| .009 | W | — | 151D902X9060 | 0.5 | 2 |
| .011 | W | 151D113X0075 | 151D113X9075 | 0.5 | 2 |
| .013 | W | — | 151D133X9075 | 0.5 | 2 |
| .016 | W | 151D163X0075 | 151D163X9075 | 0.5 | 2 |
| .019 | W | — | 151D193X9075 | 0.5 | 2 |

| μF | Case Code | Partial Catalog Number | | D-C Leakage Current at 25 C (μA) | Max. DF at 25 C & 120 Hz (%) |
|----------------------------------|-----------|------------------------|--------------|----------------------------------|------------------------------|
| | | ±20% Tol. | ±10% Tol. | | |
| 60 VOLTS NP, 78 NP SURGE (Cont.) | | | | | |
| .011 | W | 151D113X0060 | 151D113X9060 | 0.5 | 2 |
| .013 | W | — | 151D133X9060 | 0.5 | 2 |
| .016 | W | 151D163X0060 | 151D163X9060 | 0.5 | 2 |
| .019 | W | — | 151D193X9060 | 0.5 | 2 |
| .023 | W | 151D233X0060 | 151D233X9060 | 0.5 | 2 |
| .028 | W | — | 151D283X9060 | 0.5 | 2 |
| .034 | W | 151D343X0060 | 151D343X9060 | 0.5 | 2 |
| .041 | W | — | 151D413X9060 | 0.5 | 2 |
| .05 | W | 151D503X0060 | 151D503X9060 | 0.5 | 2 |
| .06 | W | — | 151D603X9060 | 0.5 | 2 |
| .075 | W | 151D753X0060 | 151D753X9060 | 0.5 | 2 |
| .09 | W | — | 151D903X9060 | 0.5 | 2 |
| .11 | W | 151D114X0060 | 151D114X9060 | 0.5 | 2 |
| .13 | W | — | 151D134X9060 | 0.5 | 2 |
| .16 | W | 151D164X0060 | 151D164X9060 | 0.5 | 2 |
| .19 | W | — | 151D194X9060 | 0.5 | 2 |
| .23 | W | 151D234X0060 | 151D234X9060 | 0.5 | 2 |
| .28 | W | — | 151D284X9060 | 0.5 | 2 |
| .34 | W | 151D344X0060 | 151D344X9060 | 0.5 | 2 |
| .41 | X | — | 151D414X9060 | 0.5 | 2 |
| .50 | X | 151D504X0060 | 151D504X9060 | 0.5 | 2 |
| .60 | X | — | 151D604X9060 | 0.5 | 4 |
| .75 | X | 151D754X0060 | 151D754X9060 | 0.9 | 4 |
| .90 | X | — | 151D904X9060 | 1.0 | 4 |
| 1.1 | X | 151D115X0060 | 151D115X9060 | 1.3 | 4 |
| 1.3 | X | — | 151D135X9060 | 1.5 | 4 |
| 1.6 | X | 151D165X0060 | 151D165X9060 | 2.0 | 4 |
| 1.9 | X | — | 151D195X9060 | 2.0 | 4 |
| 2.3 | Y | 151D235X0060 | 151D235X9060 | 3.0 | 4 |
| 2.8 | Y | — | 151D285X9060 | 3.5 | 4 |
| 3.4 | Y | 151D345X0060 | 151D345X9060 | 4.0 | 6 |
| 4.1 | Y | — | 151D415X9060 | 5.0 | 6 |
| 5.0 | Y | 151D505X0060 | 151D505X9060 | 6.0 | 6 |
| 6.0 | Z | — | 151D605X9060 | 7.5 | 6 |
| 7.5 | Z | 151D755X0060 | 151D755X9060 | 9.0 | 6 |
| 9.0 | Z | — | 151D905X9060 | 11.0 | 6 |
| 11.0 | Z | 151D116X0060 | 151D116X9060 | 13.0 | 6 |
| 75 VOLTS NP, 97 NP SURGE | | | | | |
| .0023 | W | 151D232X0075 | 151D232X9075 | 0.5 | 2 |
| .0028 | W | — | 151D282X9075 | 0.5 | 2 |
| .0034 | W | 151D342X0075 | 151D342X9075 | 0.5 | 2 |
| .0041 | W | — | 151D412X9075 | 0.5 | 2 |
| .005 | W | 151D502X0075 | 151D502X9075 | 0.5 | 2 |
| .006 | W | — | 151D602X9075 | 0.5 | 2 |
| .0075 | W | 151D752X0075 | 151D752X9075 | 0.5 | 2 |
| .009 | W | — | 151D902X9075 | 0.5 | 2 |
| .011 | W | 151D113X0075 | 151D113X9075 | 0.5 | 2 |
| .013 | W | — | 151D133X9075 | 0.5 | 2 |
| .016 | W | 151D163X0075 | 151D163X9075 | 0.5 | 2 |
| .019 | W | — | 151D193X9075 | 0.5 | 2 |

Any preferred number capacitance rating listed is available in ±5% capacitance tolerance on special order. To specify ±5% capacitors, change the digit following the "X" in the capacitance code to the figure "5."

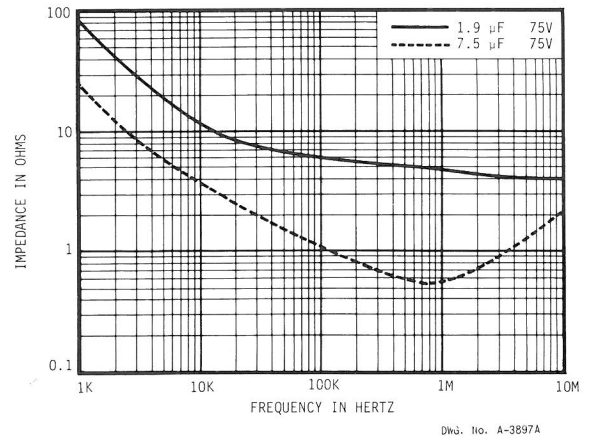
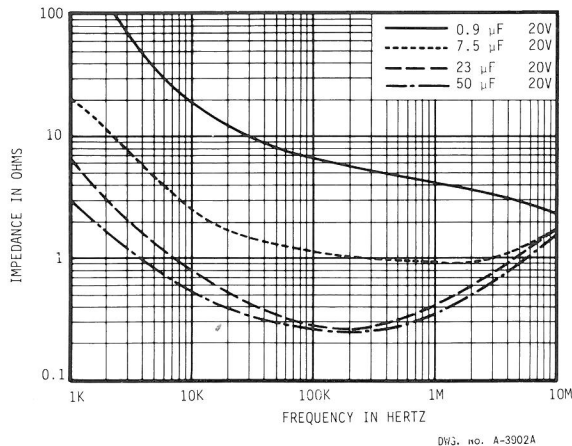
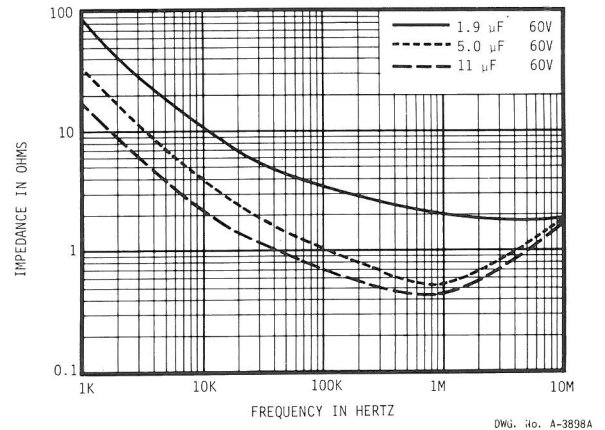
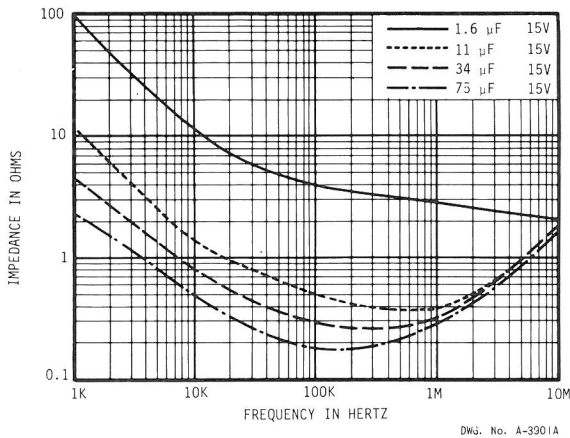
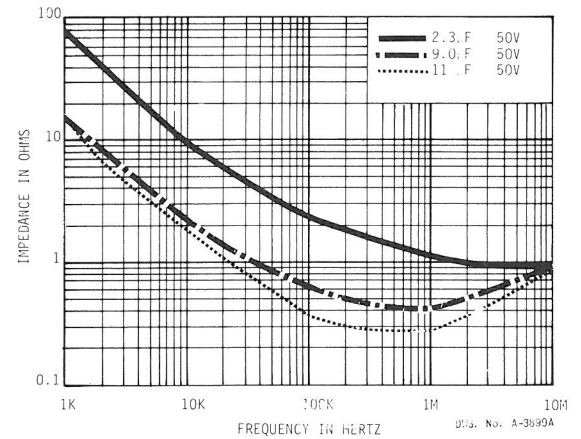
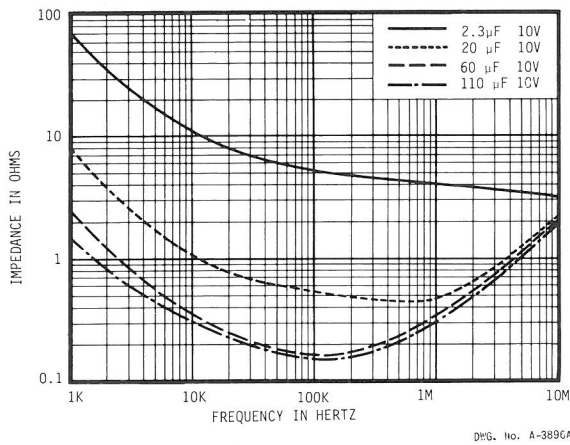
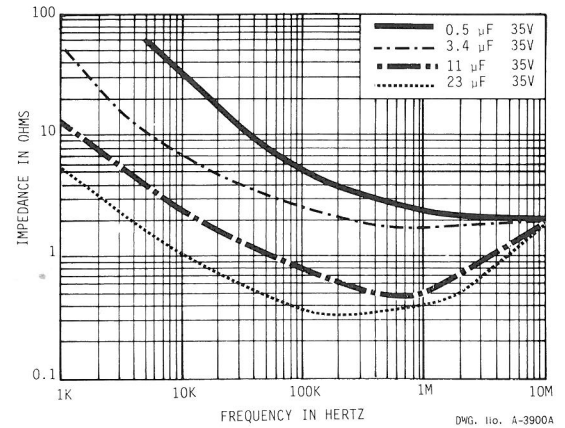
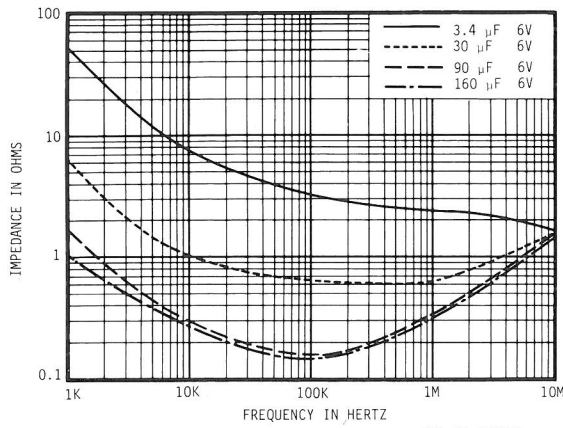
STANDARD RATINGS - (Cont.)

For a complete catalog number, the numbers listed in the following table must be followed by a size code and style number selected from the available styles shown on page 2. For example, 151D233X0075W2.

| μF | Case Code | Partial Catalog Number | | D-C Leakage Current at 25 C (μA) | Max. DF at 25 C & 120 Hz (%) |
|------------------------------------|-----------|------------------------|--------------|----------------------------------|------------------------------|
| | | ±20% Tol. | ±10% Tol. | | |
| 75 VOLTS NP, 97 NP SURGE (Cont.) | | | | | |
| .023 | W | 151D233X0075 | 151D233X9075 | 0.5 | 2 |
| .028 | W | — | 151D283X9075 | 0.5 | 2 |
| .034 | W | 151D343X0075 | 151D343X9075 | 0.5 | 2 |
| .041 | W | — | 151D413X9075 | 0.5 | 2 |
| .05 | W | 151D503X0075 | 151D503X9075 | 0.5 | 2 |
| .06 | W | — | 151D603X9075 | 0.5 | 2 |
| .075 | W | 151D753X0075 | 151D753X9075 | 0.5 | 2 |
| .09 | W | — | 151D903X9075 | 0.5 | 2 |
| .11 | W | 151D114X0075 | 151D114X9075 | 0.5 | 2 |
| .13 | W | — | 151D134X9075 | 0.5 | 2 |
| .16 | W | 151D164X0075 | 151D164X9075 | 0.5 | 2 |
| .19 | W | — | 151D194X9075 | 0.5 | 2 |
| .23 | W | 151D234X0075 | 151D234X9075 | 0.5 | 2 |
| .28 | W | — | 151D284X9075 | 0.5 | 2 |
| .34 | W | 151D344X0075 | 151D344X9075 | 0.5 | 2 |
| .41 | X | — | 151D414X9075 | 0.5 | 2 |
| .50 | X | 151D504X0075 | 151D504X9075 | 0.5 | 2 |
| .60 | X | — | 151D604X9075 | 0.5 | 4 |
| .75 | X | 151D754X0075 | 151D754X9075 | 1.0 | 4 |
| .90 | X | — | 151D904X9075 | 1.0 | 4 |
| 1.1 | X | 151D115X0075 | 151D115X9075 | 1.5 | 4 |
| 1.3 | X | — | 151D135X9075 | 1.5 | 4 |
| 1.6 | X | 151D165X0075 | 151D165X9075 | 2.0 | 4 |
| 1.9 | X | — | 151D195X9075 | 2.0 | 4 |
| 2.3 | Y | 151D235X0075 | 151D235X9075 | 4.0 | 4 |
| 2.8 | Y | — | 151D285X9075 | 4.0 | 4 |
| 3.4 | Y | 151D345X0075 | 151D345X9075 | 6.0 | 6 |
| 4.1 | Y | — | 151D415X9075 | 6.0 | 6 |
| 5.0 | Y | 151D505X0075 | 151D505X9075 | 8.0 | 6 |
| 6.0 | Z | — | 151D605X9075 | 10.0 | 6 |
| 7.5 | Z | 151D755X0075 | 151D755X9075 | 12.0 | 6 |
| 100 VOLTS NP, 130 NP SURGE | | | | | |
| .0023 | W | 151D232X0100 | 151D232X9100 | 0.5 | 2 |
| .0028 | W | — | 151D282X9100 | 0.5 | 2 |
| .0034 | W | 151D342X0100 | 151D342X9100 | 0.5 | 2 |
| .0041 | W | — | 151D412X9100 | 0.5 | 2 |
| .005 | W | 151D502X0100 | 151D502X9100 | 0.5 | 2 |
| .006 | W | — | 151D602X9100 | 0.5 | 2 |
| .0075 | W | 151D752X0100 | 151D752X9100 | 0.5 | 2 |
| .009 | W | — | 151D902X9100 | 0.5 | 2 |
| .011 | W | 151D113X0100 | 151D113X9100 | 0.5 | 2 |
| .013 | W | — | 151D133X9100 | 0.5 | 2 |
| .016 | W | 151D163X0100 | 151D163X9100 | 0.5 | 2 |
| .019 | W | — | 151D193X9100 | 0.5 | 2 |
| .023 | W | 151D233X0100 | 151D233X9100 | 0.5 | 2 |
| .028 | W | — | 151D283X9100 | 0.5 | 2 |
| .034 | W | 151D343X0100 | 151D343X9100 | 0.5 | 2 |
| .041 | W | — | 151D413X9100 | 0.5 | 2 |
| .050 | W | 151D503X0100 | 151D503X9100 | 0.5 | 2 |
| .060 | W | — | 151D603X9100 | 0.5 | 2 |
| .075 | W | 151D753X0100 | 151D753X9100 | 0.5 | 2 |
| .090 | W | — | 151D903X9100 | 0.5 | 2 |
| 100 VOLTS NP, 130 NP SURGE (Cont.) | | | | | |
| .11 | W | 151D114X0100 | 151D114X9100 | 0.5 | 2 |
| .13 | W | — | 151D134X9100 | 0.5 | 2 |
| .16 | W | 151D164X0100 | 151D164X9100 | 0.5 | 2 |
| .19 | W | — | 151D194X9100 | 0.5 | 2 |
| .23 | W | 151D234X0100 | 151D234X9100 | 0.5 | 2 |
| .28 | W | — | 151D284X9100 | 0.5 | 2 |
| .34 | X | 151D344X0100 | 151D344X9100 | 0.5 | 2 |
| .41 | X | — | 151D414X9100 | 0.5 | 2 |
| .50 | X | 151D504X0100 | 151D504X9100 | 0.5 | 2 |
| .60 | X | — | 151D604X9100 | 0.5 | 4 |
| .75 | X | 151D754X0100 | 151D754X9100 | 0.6 | 4 |
| .90 | X | — | 151D904X9100 | 0.6 | 4 |
| 1.1 | X | 151D115X0100 | 151D115X9100 | 0.6 | 4 |
| 1.3 | X | — | 151D135X9100 | 0.6 | 4 |
| 1.6 | Y | 151D165X0100 | 151D165X9100 | 2.5 | 4 |
| 1.9 | Y | 151D195X0100 | 151D195X9100 | 3.0 | 4 |
| 2.3 | Y | 151D235X0100 | 151D235X9100 | 4.0 | 4 |
| 2.8 | Y | 151D285X0100 | 151D285X9100 | 4.0 | 4 |
| 3.4 | Y | 151D345X0100 | 151D345X9100 | 6.0 | 6 |
| 125 VOLTS NP, 140 NP SURGE | | | | | |
| .0023 | W | 151D232X0125 | 151D232X9125 | 1.0 | 2 |
| .0028 | W | — | 151D282X9125 | 1.0 | 2 |
| .0034 | W | 151D342X0125 | 151D342X9125 | 1.0 | 2 |
| .0041 | W | — | 151D412X9125 | 1.0 | 2 |
| .005 | W | 151D502X0125 | 151D502X9125 | 1.0 | 2 |
| .006 | W | — | 151D602X9125 | 1.0 | 2 |
| .0075 | W | 151D752X0125 | 151D752X9125 | 1.0 | 2 |
| .009 | W | — | 151D902X9125 | 1.0 | 2 |
| .011 | W | 151D113X0125 | 151D113X9125 | 1.0 | 2 |
| .013 | W | — | 151D133X9125 | 1.0 | 2 |
| .016 | W | 151D163X0125 | 151D163X9125 | 1.0 | 2 |
| .019 | W | — | 151D193X9125 | 1.0 | 2 |
| .023 | W | 151D233X0125 | 151D233X9125 | 1.0 | 2 |
| .028 | W | — | 151D283X9125 | 1.0 | 2 |
| .034 | W | 151D343X0125 | 151D343X9125 | 1.0 | 2 |
| .041 | W | — | 151D413X9125 | 1.0 | 2 |
| .05 | W | 151D503X0125 | 151D503X9125 | 1.0 | 2 |
| .06 | W | — | 151D603X9125 | 1.0 | 2 |
| .07 | W | 151D703X0125 | 151D703X9125 | 1.0 | 2 |
| .09 | W | — | 151D903X9125 | 1.0 | 2 |
| .11 | W | 151D114X0125 | 151D114X9125 | 1.0 | 2 |
| .13 | W | — | 151D134X9125 | 1.0 | 2 |
| .16 | W | 151D164X0125 | 151D164X9125 | 1.0 | 2 |
| .19 | W | — | 151D194X9125 | 1.5 | 2 |
| .23 | W | 151D234X0125 | 151D234X9125 | 1.5 | 2 |
| .28 | X | — | 151D284X9125 | 1.6 | 2 |
| .34 | X | 151D344X0125 | 151D344X9125 | 1.8 | 2 |
| .41 | X | — | 151D414X9125 | 2.0 | 2 |
| .50 | X | 151D504X0125 | 151D504X9125 | 2.2 | 2 |
| .60 | X | — | 151D604X9125 | 2.4 | 4 |
| .75 | X | 151D754X0125 | 151D754X9125 | 2.6 | 4 |
| .90 | X | — | 151D904X9125 | 2.8 | 4 |
| 1.1 | X | 151D115X0125 | 151D115X9125 | 3.0 | 4 |

Any preferred number capacitance rating listed is available in $\pm 5\%$ capacitance tolerance on special order. To specify $\pm 5\%$ capacitors, change the digit following the "X" in the capacitance code to the figure "5."

TYPICAL CURVES OF IMPEDANCE AS A FUNCTION OF FREQUENCY AT 25 C



PERFORMANCE CHARACTERISTICS

1. Operating Temperature. These capacitors are designed to operate over a temperature range of -55°C to $+85^{\circ}\text{C}$ with no voltage derating.

1.1 These capacitors may be operated up to $+125^{\circ}\text{C}$ with derating as shown in the table below:

| 85 C | | 125 C | |
|---------------|---------------|---------------|---------------|
| Rated Voltage | Surge Voltage | Rated Voltage | Surge Voltage |
| 6 | 8 | 4 | 5 |
| 10 | 13 | 7 | 9 |
| 15 | 20 | 10 | 12 |
| 20 | 26 | 13 | 16 |
| 35 | 46 | 23 | 28 |
| 50 | 65 | 33 | 40 |
| 60 | 78 | 40 | 50 |
| 75 | 98 | 50 | 64 |
| 100 | 130 | 67 | 86 |
| 125 | 140 | 82 | 94 |

2. Working Voltage. The working voltage is the maximum operating voltage for continuous duty at the rated temperature.

3. Surge Voltage. The surge rating is the maximum voltage to which the capacitors should be subjected under any conditions. This includes transients and peak ripple at highest line voltage.

3.1 The capacitors shall withstand the surge test voltage applied in series with a 1000 ohm $\pm 10\%$ resistor at the rate of $\frac{1}{2}$ minute on, $5\frac{1}{2}$ minutes off, for 1000 successive test cycles at 85°C . Failure rate shall not be more than 1 out of 6 units tested.

3.2 Following the surge test, the dissipation factor shall meet the initial requirements, the capacitance shall not have changed more than $\pm 10\%$, and the leakage current shall meet the initial requirements at 25°C .

4. Capacitance and Tolerance. Capacitance measurements shall be made by means of a polarized capacitance bridge. The maximum voltage applied to the capacitors during measurement shall be 2 volts rms at 120 Hz at 25°C . If the a-c voltage applied is less than $\frac{1}{2}$ volt rms, no d-c bias is required. Measurement accuracy of the bridge shall be within $\pm 2\%$.

4.1 The capacitance of all capacitors shall be within the specified tolerance limits of the nominal rating.

5. Capacitance Change with Temperature. The allowable capacitance change with temperature from the value measured in section 4 shall be in accordance with the following table:

| WVNP | -55°C | $+85^{\circ}\text{C}$ | $+125^{\circ}\text{C}$ |
|------------------------|-----------------------|-----------------------|------------------------|
| 6, 10, 15 20 and up | -10% -10% | $+8\%$ $+6\%$ | 12% 8% |

6. Dissipation Factor. Measurements shall be made by the bridge method at or referred to a frequency of 120 Hz.

6.1 The dissipation factor, determined from the expression $2\pi fRC$, shall not exceed the values listed in the tables on pages 3 through 6 for each capacitor.

7. Leakage Current. Measurements shall be made at rated working voltage at $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ with an application of a steady source of power, such as a regulated power supply with a 1000 ohm resistance to limit the charging current, connected in series with each capacitor under test. Rated working voltage shall be applied to capacitors for 5 minutes before making leakage current measurements. Units must be stabilized at the rated temperature for 30 minutes prior to application of voltage.

7.1 At 25°C . The leakage current shall not exceed the maximum value specified in the rating tables on pages 3 through 6 for a given capacitor.

7.2 At 85°C . The maximum leakage current for any capacitors shall not exceed that determined from the formula:

$$I = kCE$$

where

I is in microamperes

k is a constant

0.40 at $85^{\circ}\text{C} \pm 3^{\circ}\text{C}$.

C is in microfarads

E is in volts

7.2.1 In no case need the leakage current be less than $6\mu\text{A}$.

7.3 At 125°C . The maximum leakage current for any capacitor shall not exceed that determined from the formula:

$$I = kCE$$

where

I is in microamperes

k is a constant

0.68 at $125^{\circ}\text{C} \pm 3^{\circ}\text{C}$

C is in microfarads

E is the derated voltage for 125°C

7.3.1 In no case need the leakage current be less than $8\mu\text{A}$.

8. Life Test.

8.1 At 85°C . Capacitors shall be capable of withstanding a 2000 hour life test at rated d-c working voltage. Polarity shall be reversed every 125 hours during the life test.

8.1.1 After life test, the leakage current shall not be more than 125% of the original requirements, the dissipation factor shall meet the initial requirement; and the capacitance at 25°C shall not have changed

PERFORMANCE CHARACTERISTICS - (Cont.)

by more than $\pm 10\%$ from the initial value. Not more than 1 failure shall be permitted in 25 units tested.

9. Vibration.

9.1 Low Frequency Vibration. Capacitors shall withstand a simple harmonic motion in a direction perpendicular to the major axis having an amplitude of 0.03" (max. total excursion 0.06") with the frequency being varied uniformly between the approximate limits of 10 to 55 Hz and ratings to be transversed in approximately 1 minute for a total of $1\frac{1}{2}$ hours. During the last half-hour of test, an electrical measurement shall be made to determine intermittent contacts or open or short circuits.

9.1.1 After vibration test, capacitors shall meet the original requirements for leakage current and dissipation factor, and capacitance shall not have changed more than 5% from the original value.

9.2 High Frequency Vibration. Capacitors shall withstand vibration from 55 to 2000 Hz at 20g without internal damage. Rated voltage shall be applied during the test. A cathode-ray oscilloscope or other comparable means shall be used as an indicating device in determining the electrical intermittency during the test. The a-c voltage applied shall not exceed 2 volts, rms.

9.2.1 Capacitors shall be rigidly mounted by means of suitable brackets.

9.2.2 After test, capacitors shall meet the original limits for capacitance, dissipation factor, and leakage current.

10. Pull Test. Leads shall withstand a tensile stress of 3 lbs. (1.4 kg) applied in any direction for 30 seconds.

11. Moisture Resistance. The capacitors shall be tested in accordance with MIL Standard 202, method 106 except that:

- a. Capacitors shall be securely fastened by normal mounting means except during measurements.
- b. Conditioning prior to first cycle not applicable.
- c. Initial measurements not applicable.
- d. Polarization and load not applicable.
- e. Subcycle. Each day, during step 7, capacitors shall be removed from the humidity chamber.
- f. Final measurements. After the final cycle and within 2 to 6 hours after removal of capacitors from the humidity chamber, d-c leakage, capacitance and equivalent series resistance or power factor (as applicable) shall be measured at room temperature and as specified.
- g. Visual examination. Capacitors shall be visually examined for evidence of corrosion.

11.1 Insulating Sleeves. For capacitors with insulating sleeves, the dielectric strength and insulation resistance of the sleeves shall be measured between two wire windings placed around the sleeves $\frac{1}{4}$ " apart where applicable, each winding to consist of two close turns of 0.020" (No. 24 AWG) bare copper wire. For dielectric strength, a d-c test potential of not less than 2000 volts shall be applied for 1 minute between the two windings. For insulation resistance, a d-c test potential of 180 volts shall be applied for 2 minutes between the two windings; insulation resistance of the sleeve shall than be measured.

12. Shelf Test. Capacitors shall withstand a 5000 hour shelf test at a temperature of 85 C with no voltage applied.

12.1 Following the shelf test, the capacitance shall not have changed by more than 5% from the initial value, the dissipation factor shall not exceed 150% of the initial requirement, and the leakage current shall meet the initial requirement.

13. Acceleration. Capacitors shall be subjected to a constant acceleration of 100g for a period of 10 seconds in each of two mutually perpendicular planes. The direction of motion shall be parallel to and perpendicular to the cylindrical axis. During the test, rated d-c voltage shall be applied. A cathode ray oscilloscope or other means shall be used to determine electrical failures during the test. Applied a-c voltage shall not exceed 2 volts, rms.

13.1 Capacitors shall be rigidly mounted by means of suitable brackets.

13.2 After test, capacitors shall meet the initial requirements for capacitance, dissipation factor, and leakage current.

14. Shock. These capacitors shall be shock tested in accordance with MIL-Standard-202, method 213, test condition I except that:

- a. The capacitors shall be rigidly mounted by a suitable bracket.
- b. The rated d-c voltage shall be applied to capacitors under test. A cathode ray oscilloscope or other comparable means shall be used as an indicating device in determining any electrical intermittency during the test. Applied a-c voltage shall not exceed 2 volts, rms.

14.1 After test, capacitors shall meet the initial requirements for capacitance, dissipation factor, and leakage current.

15. Thermal Shock and Immersion. When tested as specified in 15.1 and 15.2, d-c leakage current shall meet the initial requirement when measured in accordance with section 7; capacitance shall not change more than 5% from the value measured prior to test and in accordance with section 4; dissipation factor

PERFORMANCE CHARACTERISTICS - (Cont.)

shall meet the original requirements when measured in accordance with section 6. There shall be no evidence of harmful corrosion and at least 90% of any exposed metallic surface of the capacitor shall be unaffected. There shall be no evidence of dye penetration.

15.1 Thermal Shock. Capacitors shall be tested in accordance with MIL Standard 202, method 107 except that:

- a. Conditioning prior to first cycle shall be 15 minutes at standard temperature.
- b. Test condition B shall be used, except that in step 3, sample units shall be tested at the applicable high test temperature.
- c. Measurements before and after cycling — not applicable.

15.2 Immersion. Following thermal shock, capacitors shall be tested in accordance with MIL Standard 202, method 104 except that:

- a. Test condition B shall be used with the addition of a non-corrosive dye, rhodamine B (tetraethylrhodamine), in both baths.
- b. The temperature of the baths shall be $+65 \pm 5^\circ\text{C}$ and $0 \pm 5^\circ\text{C}$

- c. The duration of each immersion shall be 30 minutes. Change from one solution to the other shall be made in not more than 3 seconds.
- d. Measurements after cycling. Within 30 minutes after removal from final immersion bath, d-c leakage current, capacitance, and dissipation factor shall be measured as specified.
- e. Visual examination. Capacitors shall be visually examined for evidence of corrosion. Capacitors shall then be opened and examined for evidence of penetration of dye.

16. Reduced Pressure. Capacitors shall be stabilized at a reduced pressure of 0.315" mercury (100,000 ft.) for a period of 5 minutes. Rated d-c voltage shall be applied for 1 minute. Capacitors shall not flash over nor shall end seals be damaged by this test, nor should the capacitors be electrically affected insofar as capacitance, equivalent series resistance, or leakage current is concerned.

17. Marking. Capacitors shall be marked with the SPRAGUE or (S) trademark, at vendor's option; the Sprague type (151D); rated capacitance and tolerance; rated non-polar working voltage; and the standard EIA date code of manufacture. The Sprague catalog number will not appear on any capacitor since lack of space does not permit its use.

GUIDE TO APPLICATION

1. A-C Ripple Voltage. The maximum allowable ripple voltages may be determined from the following figures.

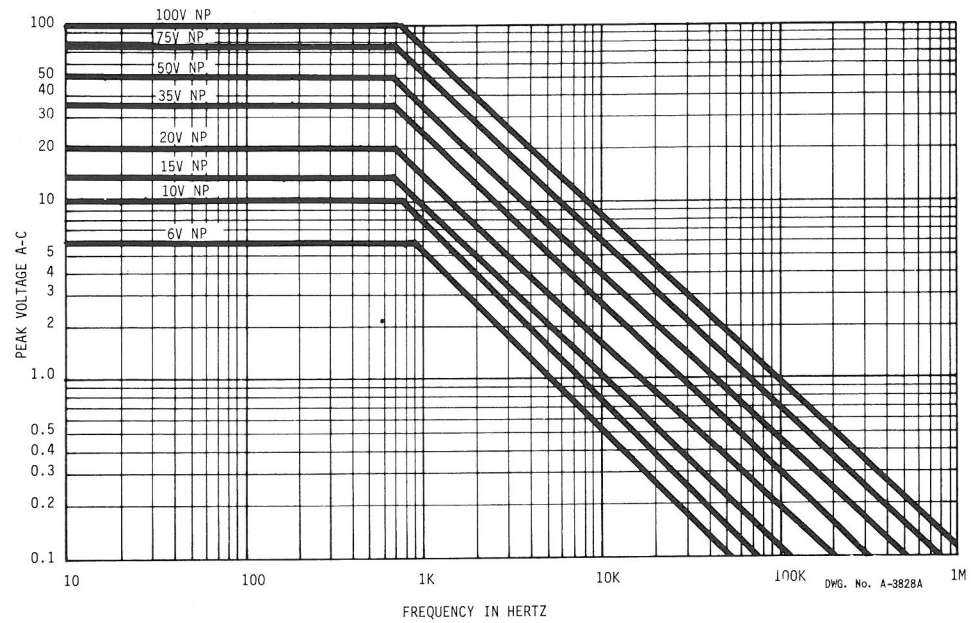
1.1 The sum of the peak a-c voltage plus the d-c voltage shall not exceed the d-c working voltage rating of the capacitor.

1.2 In straight a-c applications where no d-c bias is present, the values of a-c voltage as determined from the figures on page 11 and 12 may be used.

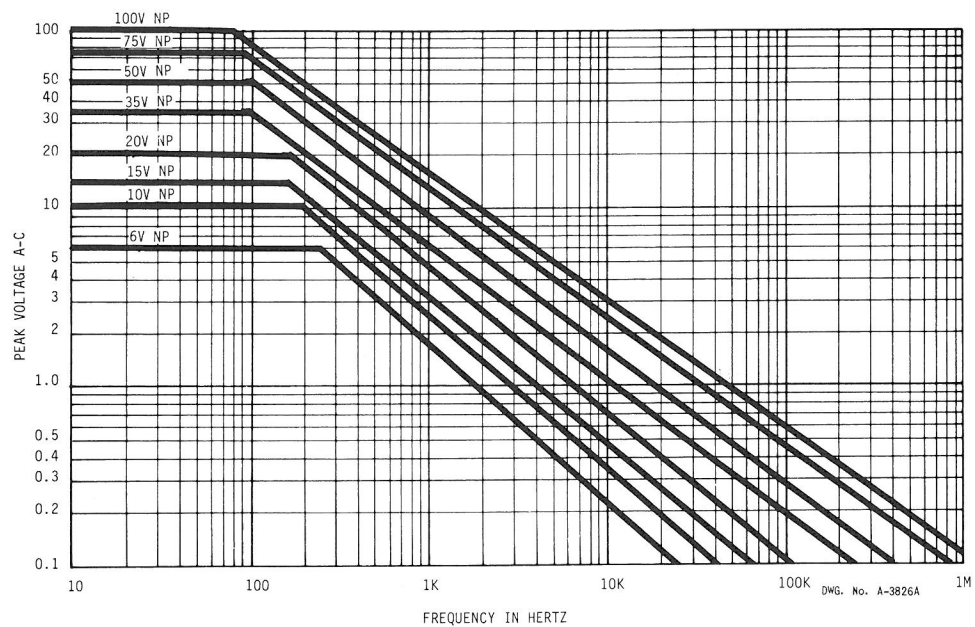
1.3 For derating at higher temperatures, use the following derating factors:

| Temperature | Derating Factor |
|-------------|-----------------|
| 50 C | 0.7 |
| 85 C | 0.5 |
| 125 C | 0.3 |

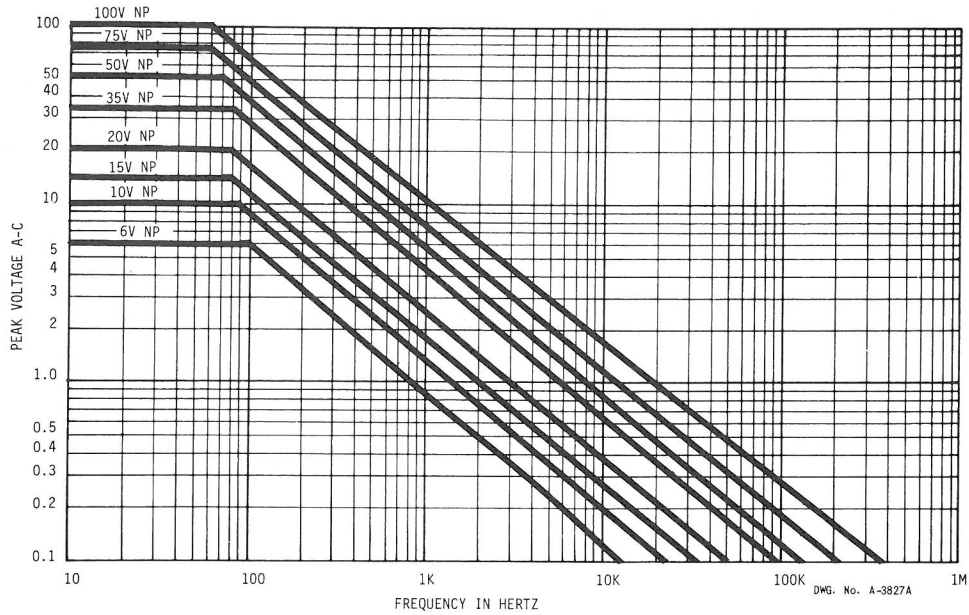
1.4 For a-c values at higher frequencies, refer to the a-c versus frequency curve for the case size desired.



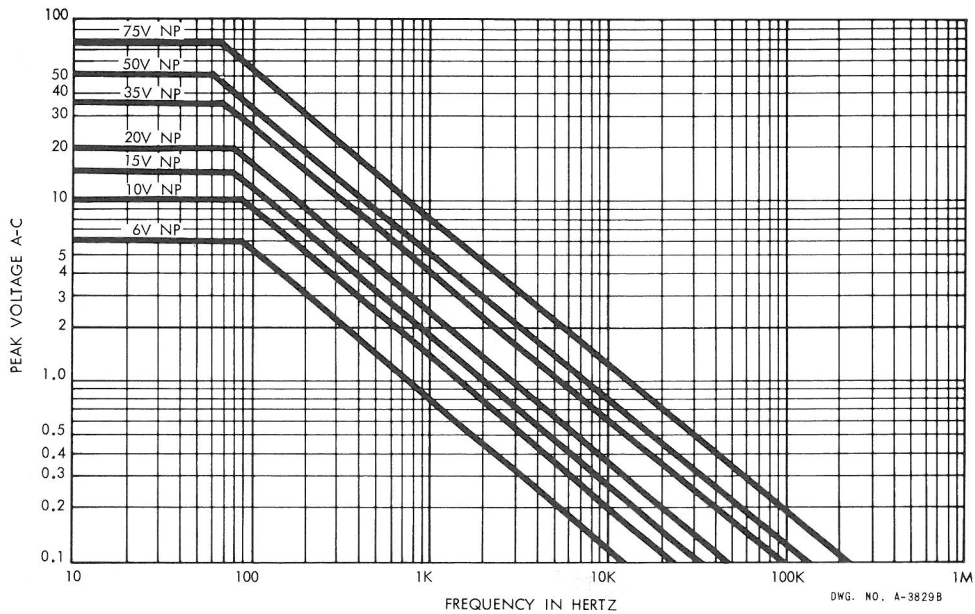
MAXIMUM PERMISSIBLE RIPPLE VOLTAGE AS A FUNCTION OF FREQUENCY
FOR CASE CODE 'W' TYPE 151D CAPACITOR AT +25°C



MAXIMUM PERMISSIBLE RIPPLE VOLTAGE AS A FUNCTION OF FREQUENCY
FOR CASE CODE 'X' TYPE 151D CAPACITOR AT +25°C



MAXIMUM PERMISSIBLE RIPPLE VOLTAGE AS A FUNCTION OF FREQUENCY
FOR CASE CODE 'Y' TYPE 151D CAPACITOR AT +25 C



MAXIMUM PERMISSIBLE RIPPLE VOLTAGE AS A FUNCTION OF FREQUENCY
FOR CASE CODE 'Z' TYPE 151D CAPACITOR AT +25 C

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.

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