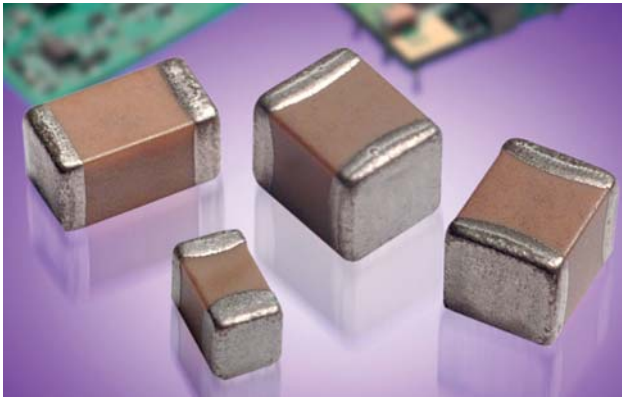


# X7R Dielectric

## General Specifications



X7R formulations are called "temperature stable" ceramics and fall into EIA Class II materials. X7R is the most popular of these intermediate dielectric constant materials. Its temperature variation of capacitance is within  $\pm 15\%$  from  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ . This capacitance change is non-linear.

Capacitance for X7R varies under the influence of electrical operating conditions such as voltage and frequency.

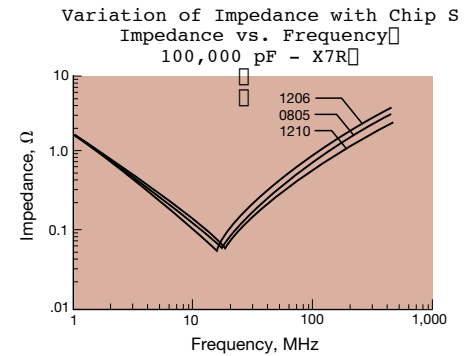
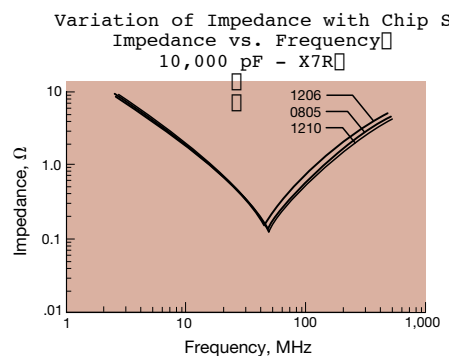
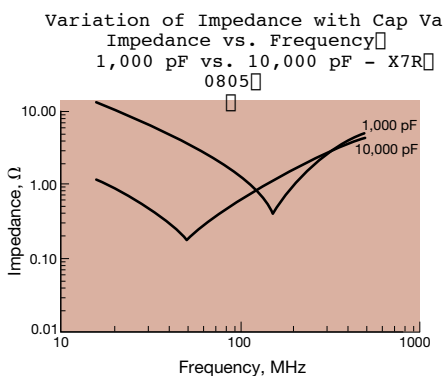
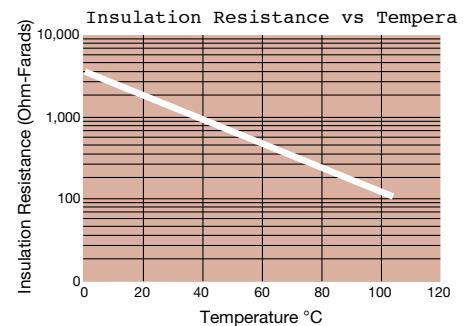
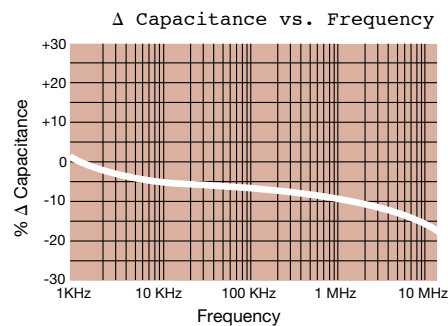
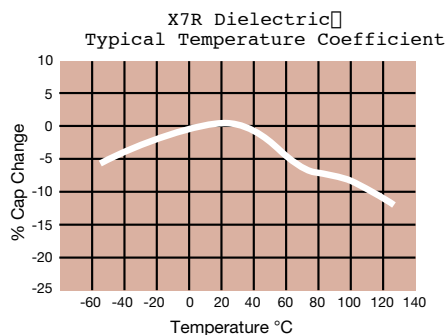
X7R dielectric chip usage covers the broad spectrum of industrial applications where known changes in capacitance due to applied voltages are acceptable.



### PART NUMBER (see page 2 for complete part number explanation)

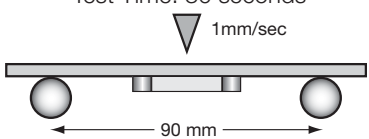
| 0805                                 | 5                                                                                                                    | C                            | 103                                                                | M                                                                                                                                                               | A                                         | T                                                                                                                                                                             | 2                                               | A                                       |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------|------------------------------|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|-----------------------------------------|
| <b>Size</b><br>(L" x W")             | <b>Voltage</b><br>4V = 4<br>6.3V = 6<br>10V = Z<br>16V = Y<br>25V = 3<br>50V = 5<br>100V = 1<br>200V = 2<br>500V = 7 | <b>Dielectric</b><br>X7R = C | <b>Capacitance Code (In pF)</b><br>2 Sig. Digits + Number of Zeros | <b>Capacitance Tolerance</b><br>J = $\pm 5\%^*$<br>K = $\pm 10\%$<br>M = $\pm 20\%$<br><br>* $\leq 1\mu\text{F}$ only,<br>contact factory for additional values | <b>Failure Rate</b><br>A = Not Applicable | <b>Terminations</b><br>T = Plated Ni and Sn<br>7 = Gold Plated*<br>Z = FLEXITERM <sup>®</sup> **<br><br>*Optional termination<br><br>**See FLEXITERM <sup>®</sup> X7R section | <b>Packaging</b><br>2 = 7" Reel<br>4 = 13" Reel | <b>Special Code</b><br>A = Std. Product |
| <b>Contact Factory For Multiples</b> |                                                                                                                      |                              |                                                                    |                                                                                                                                                                 |                                           |                                                                                                                                                                               |                                                 |                                         |

NOTE: Contact factory for availability of Termination and Tolerance Options for Specific Part Numbers.  
Contact factory for non-specified capacitance values.



# X7R Dielectric

## Specifications and Test Methods

| Parameter/Test                 |                       | X7R Specification Limits                                                                                                                                     | Measuring Conditions                                                                                                                                                                                                                                        |                    |
|--------------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Operating Temperature Range    |                       | -55°C to +125°C                                                                                                                                              | Temperature Cycle Chamber                                                                                                                                                                                                                                   |                    |
| Capacitance                    |                       | Within specified tolerance                                                                                                                                   |                                                                                                                                                                                                                                                             |                    |
| Dissipation Factor             |                       | $\leq 10\%$ for $\geq 50V$ DC rating<br>$\leq 12.5\%$ for 25V DC rating<br>$\leq 12.5\%$ for 25V and 16V DC rating<br>$\leq 12.5\%$ for $\leq 10V$ DC rating | Freq.: 1.0 kHz $\pm 10\%$<br>Voltage: 1.0Vrms $\pm .2V$                                                                                                                                                                                                     |                    |
| Insulation Resistance          |                       | 100,000M $\Omega$ or 1000M $\Omega$ - $\mu F$ , whichever is less                                                                                            | Charge device with rated voltage for 120 $\pm 5$ secs @ room temp/humidity                                                                                                                                                                                  |                    |
| Dielectric Strength            |                       | No breakdown or visual defects                                                                                                                               | Charge device with 300% of rated voltage for 1-5 seconds, w/charge and discharge current limited to 50 mA (max)<br>Note: Charge device with 150% of rated voltage for 500V devices.                                                                         |                    |
| Resistance to Flexure Stresses | Appearance            | No defects                                                                                                                                                   | Deflection: 2mm<br>Test Time: 30 seconds<br>                                                                                                                             |                    |
|                                | Capacitance Variation | $\leq \pm 12\%$                                                                                                                                              |                                                                                                                                                                                                                                                             |                    |
|                                | Dissipation Factor    | Meets Initial Values (As Above)                                                                                                                              |                                                                                                                                                                                                                                                             |                    |
|                                | Insulation Resistance | $\geq$ Initial Value $\times 0.3$                                                                                                                            |                                                                                                                                                                                                                                                             |                    |
| Solderability                  |                       | $\geq 95\%$ of each terminal should be covered with fresh solder                                                                                             | Dip device in eutectic solder at 230 $\pm 5^\circ C$ for 5.0 $\pm 0.5$ seconds                                                                                                                                                                              |                    |
| Resistance to Solder Heat      | Appearance            | No defects, <25% leaching of either end terminal                                                                                                             | Dip device in eutectic solder at 260°C for 60 seconds. Store at room temperature for 24 $\pm 2$ hours before measuring electrical properties.                                                                                                               |                    |
|                                | Capacitance Variation | $\leq \pm 7.5\%$                                                                                                                                             |                                                                                                                                                                                                                                                             |                    |
|                                | Dissipation Factor    | Meets Initial Values (As Above)                                                                                                                              |                                                                                                                                                                                                                                                             |                    |
|                                | Insulation Resistance | Meets Initial Values (As Above)                                                                                                                              |                                                                                                                                                                                                                                                             |                    |
|                                | Dielectric Strength   | Meets Initial Values (As Above)                                                                                                                              |                                                                                                                                                                                                                                                             |                    |
| Thermal Shock                  | Appearance            | No visual defects                                                                                                                                            | Step 1: -55°C $\pm 2^\circ$                                                                                                                                                                                                                                 | 30 $\pm 3$ minutes |
|                                | Capacitance Variation | $\leq \pm 7.5\%$                                                                                                                                             | Step 2: Room Temp                                                                                                                                                                                                                                           | $\leq 3$ minutes   |
|                                | Dissipation Factor    | Meets Initial Values (As Above)                                                                                                                              | Step 3: +125°C $\pm 2^\circ$                                                                                                                                                                                                                                | 30 $\pm 3$ minutes |
|                                | Insulation Resistance | Meets Initial Values (As Above)                                                                                                                              | Step 4: Room Temp                                                                                                                                                                                                                                           | $\leq 3$ minutes   |
|                                | Dielectric Strength   | Meets Initial Values (As Above)                                                                                                                              | Repeat for 5 cycles and measure after 24 $\pm 2$ hours at room temperature                                                                                                                                                                                  |                    |
| Load Life                      | Appearance            | No visual defects                                                                                                                                            | Charge device with 1.5 rated voltage ( $\leq 10V$ ) in test chamber set at 125°C $\pm 2^\circ C$ for 1000 hours (+48, -0)<br><br>Remove from test chamber and stabilize at room temperature for 24 $\pm 2$ hours before measuring.                          |                    |
|                                | Capacitance Variation | $\leq \pm 12.5\%$                                                                                                                                            |                                                                                                                                                                                                                                                             |                    |
|                                | Dissipation Factor    | $\leq$ Initial Value $\times 2.0$ (See Above)                                                                                                                |                                                                                                                                                                                                                                                             |                    |
|                                | Insulation Resistance | $\geq$ Initial Value $\times 0.3$ (See Above)                                                                                                                |                                                                                                                                                                                                                                                             |                    |
|                                | Dielectric Strength   | Meets Initial Values (As Above)                                                                                                                              |                                                                                                                                                                                                                                                             |                    |
| Load Humidity                  | Appearance            | No visual defects                                                                                                                                            | Store in a test chamber set at 85°C $\pm 2^\circ C$ / 85% $\pm 5\%$ relative humidity for 1000 hours (+48, -0) with rated voltage applied.<br><br>Remove from chamber and stabilize at room temperature and humidity for 24 $\pm 2$ hours before measuring. |                    |
|                                | Capacitance Variation | $\leq \pm 12.5\%$                                                                                                                                            |                                                                                                                                                                                                                                                             |                    |
|                                | Dissipation Factor    | $\leq$ Initial Value $\times 2.0$ (See Above)                                                                                                                |                                                                                                                                                                                                                                                             |                    |
|                                | Insulation Resistance | $\geq$ Initial Value $\times 0.3$ (See Above)                                                                                                                |                                                                                                                                                                                                                                                             |                    |
|                                | Dielectric Strength   | Meets Initial Values (As Above)                                                                                                                              |                                                                                                                                                                                                                                                             |                    |

# X7R Dielectric

## Capacitance Range

### PREFERRED SIZES ARE SHADED

| SIZE         |             | 0101*                           | 0201                           |    |    |    | 0402                           |    |    |    | 0603                           |     |    |    | 0805                           |    |     |     | 1206                           |    |    |    |    |     |     |     |
|--------------|-------------|---------------------------------|--------------------------------|----|----|----|--------------------------------|----|----|----|--------------------------------|-----|----|----|--------------------------------|----|-----|-----|--------------------------------|----|----|----|----|-----|-----|-----|
| Soldering    |             | Reflow Only                     | Reflow Only                    |    |    |    | Reflow/Wave                    |    |    |    | Reflow/Wave                    |     |    |    | Reflow/Wave                    |    |     |     | Reflow/Wave                    |    |    |    |    |     |     |     |
| Packaging    |             | Paper/Embossed                  | All Paper                      |    |    |    | All Paper                      |    |    |    | All Paper                      |     |    |    | Paper/Embossed                 |    |     |     | Paper/Embossed                 |    |    |    |    |     |     |     |
| (L) Length   | mm<br>(in.) | 0.40 ± 0.02<br>(0.016 ± 0.0008) | 0.60 ± 0.09<br>(0.024 ± 0.004) |    |    |    | 1.00 ± 0.10<br>(0.040 ± 0.004) |    |    |    | 1.60 ± 0.15<br>(0.063 ± 0.006) |     |    |    | 2.01 ± 0.20<br>(0.079 ± 0.008) |    |     |     | 3.20 ± 0.20<br>(0.126 ± 0.008) |    |    |    |    |     |     |     |
| (W) Width    | mm<br>(in.) | 0.20 ± 0.02<br>(0.008 ± 0.0008) | 0.30 ± 0.09<br>(0.011 ± 0.004) |    |    |    | 0.50 ± 0.10<br>(0.020 ± 0.004) |    |    |    | 0.81 ± 0.15<br>(0.032 ± 0.006) |     |    |    | 1.25 ± 0.20<br>(0.049 ± 0.008) |    |     |     | 1.60 ± 0.20<br>(0.063 ± 0.008) |    |    |    |    |     |     |     |
| (t) Terminal | mm<br>(in.) | 0.10± 0.04<br>(0.004 ± 0.0016)  | 0.15 ± 0.05<br>(0.006 ± 0.002) |    |    |    | 0.25 ± 0.15<br>(0.010 ± 0.006) |    |    |    | 0.35 ± 0.15<br>(0.014 ± 0.006) |     |    |    | 0.50 ± 0.25<br>(0.020 ± 0.010) |    |     |     | 0.50 ± 0.25<br>(0.020 ± 0.010) |    |    |    |    |     |     |     |
| WWDC         |             | 16                              | 10                             | 16 | 25 | 50 | 6.3                            | 10 | 16 | 25 | 50                             | 6.3 | 10 | 16 | 25                             | 50 | 100 | 200 | 6.3                            | 10 | 16 | 25 | 50 | 100 | 200 | 500 |
| Cap          | 100         | 101                             | B                              | A  | A  | A  | A                              |    |    | C  | C                              | C   |    |    |                                |    | G   | G   | G                              |    |    |    |    |     |     |     |
| (pF)         | 150         | 151                             | B                              | A  | A  | A  | A                              |    |    | C  | C                              | C   |    |    |                                |    | G   | G   | G                              |    |    |    |    |     |     |     |
|              | 220         | 221                             | B                              | A  | A  | A  | A                              |    |    | C  | C                              | C   |    |    |                                |    | G   | G   | G                              |    |    |    |    |     |     |     |
|              | 330         | 331                             | B                              | A  | A  | A  | A                              |    |    | C  | C                              | C   |    |    |                                |    | G   | G   | G                              |    |    |    |    |     |     |     |
|              | 470         | 471                             | B                              | A  | A  | A  | A                              |    |    | C  | C                              | C   |    |    |                                |    | G   | G   | G                              |    |    |    |    |     |     | K   |
|              | 680         | 681                             | B                              | A  | A  | A  |                                |    |    | C  | C                              | C   |    |    |                                |    | G   | G   | G                              |    |    |    |    |     |     | K   |
|              | 1000        | 102                             | B                              | A  | A  | A  |                                |    | C  | C  | C                              | C   |    |    |                                |    | G   | G   | G                              |    |    |    |    |     |     | K   |
|              | 1500        | 152                             | B                              | A  | A  | A  |                                |    | C  | C  | C                              | C   |    |    |                                |    | G   | G   |                                |    |    |    |    |     |     | M   |
|              | 2200        | 222                             | B                              | A  | A  | A  |                                |    | C  | C  | C                              | C   |    |    |                                |    | G   | G   |                                |    |    |    |    |     |     | M   |
|              | 3300        | 332                             |                                | A  | A  | A  |                                |    | C  | C  | C                              | C   |    |    |                                |    | G   | G   |                                |    |    |    |    |     |     | M   |
|              | 4700        | 472                             |                                | A  | A  | A  |                                |    | C  | C  | C                              | C   |    |    |                                |    | G   | G   |                                |    |    |    |    |     |     | M   |
|              | 6800        | 682                             |                                | A  | A  | A  |                                |    | C  | C  | C                              | C   |    |    |                                |    | G   | G   |                                |    |    |    |    |     |     | P   |
| Cap          | 0.01        | 103                             |                                | A  | A  | A  |                                |    | C  | C  | C                              | C   |    |    |                                |    | G   | G   | G                              |    |    |    |    |     |     | P   |
| (µF)         | 0.015       | 153                             |                                |    |    |    |                                |    | C  | C  | C                              | C   |    |    |                                |    | G   | G   | G                              |    |    |    |    |     |     | P   |
|              | 0.022       | 223                             |                                |    |    |    |                                |    | C  | C  | C                              | C   |    |    |                                |    | G   | G   | G                              |    |    |    |    |     |     | X   |
|              | 0.033       | 333                             |                                |    |    |    |                                |    | C  | C  | C                              | C   |    |    |                                |    | G   | G   | J                              |    |    |    |    |     |     | X   |
|              | 0.047       | 473                             |                                |    |    |    |                                |    | C  | C  | C                              | C   |    |    |                                |    | G   | G   | G                              |    |    |    |    |     |     |     |
|              | 0.068       | 683                             |                                |    |    |    |                                |    | C  | C  | C                              | C   |    |    |                                |    | G   | G   | G                              |    |    |    |    |     |     |     |
|              | 0.1         | 104                             |                                |    |    |    |                                |    | C  | C  | C                              | C   |    |    |                                |    | G   | G   | G                              |    |    |    |    |     |     | P   |
|              | 0.15        | 154                             |                                |    |    |    |                                |    |    |    |                                |     |    |    |                                |    | G   | G   | G                              |    |    |    |    |     |     |     |
|              | 0.22        | 224                             |                                |    |    |    |                                |    | C  |    |                                |     |    |    |                                |    | G   | G   | J                              | J  |    |    |    |     |     |     |
|              | 0.33        | 334                             |                                |    |    |    |                                |    |    |    |                                |     |    |    |                                |    | J   | J   | J                              | J  |    |    |    |     |     |     |
|              | 0.47        | 474                             |                                |    |    |    |                                |    | C  |    |                                |     |    |    |                                |    | J   | J   | J                              | J  |    |    |    |     |     |     |
|              | 0.68        | 684                             |                                |    |    |    |                                |    |    |    |                                |     |    |    |                                |    | J   | J   | J                              |    |    |    |    |     |     |     |
|              | 1.0         | 105                             |                                |    |    |    |                                |    | C  |    |                                |     |    |    |                                |    | J   | J   | J                              | J  |    |    |    |     |     |     |
|              | 2.2         | 225                             |                                |    |    |    |                                |    |    |    |                                |     |    |    |                                |    | J   | J   | J                              |    |    |    |    |     |     |     |
|              | 4.7         | 475                             |                                |    |    |    |                                |    |    |    |                                |     |    |    |                                |    | J   | J   | J                              |    |    |    |    |     |     |     |
|              | 10          | 106                             |                                |    |    |    |                                |    |    |    |                                |     |    |    |                                |    |     |     |                                |    |    |    |    |     |     |     |
|              | 22          | 226                             |                                |    |    |    |                                |    |    |    |                                |     |    |    |                                |    |     |     |                                |    |    |    |    |     |     |     |
|              | 47          | 476                             |                                |    |    |    |                                |    |    |    |                                |     |    |    |                                |    |     |     |                                |    |    |    |    |     |     |     |
|              | 100         | 107                             |                                |    |    |    |                                |    |    |    |                                |     |    |    |                                |    |     |     |                                |    |    |    |    |     |     |     |
| WWDC         |             | 16                              | 10                             | 16 | 25 | 50 | 6.3                            | 10 | 16 | 25 | 50                             | 6.3 | 10 | 16 | 25                             | 50 | 100 | 200 | 6.3                            | 10 | 16 | 25 | 50 | 100 | 200 | 500 |
| SIZE         |             | 0101                            | 0201                           |    |    |    | 0402                           |    |    |    | 0603                           |     |    |    | 0805                           |    |     |     | 1206                           |    |    |    |    |     |     |     |

| Letter         | A               | B               | C               | E               | G               | J               | K               | M               | N               | P               | Q               | X               | Y               | Z               |
|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Max. Thickness | 0.33<br>(0.013) | 0.22<br>(0.009) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.90<br>(0.035) | 0.94<br>(0.037) | 1.02<br>(0.040) | 1.27<br>(0.050) | 1.40<br>(0.055) | 1.52<br>(0.060) | 1.80<br>(0.071) | 2.29<br>(0.090) | 2.54<br>(0.100) | 2.79<br>(0.110) |
| PAPER          |                 |                 |                 |                 |                 |                 | EMBOSSED        |                 |                 |                 |                 |                 |                 |                 |

PAPER and EMBOSSED available for 01005

NOTE: Contact factory for non-specified capacitance values

\*EIA 01005

\*\*Contact Factory for Specifications

# X7R Dielectric

## Capacitance Range

PREFERRED SIZES ARE SHADED

| SIZE           |          | 1210                        |              |              |              |              |              | 1812                        |              |              |              |              |              | 1825                        |              |     | 2220                        |    |    |     |     | 2225                        |    |     |     |   |
|----------------|----------|-----------------------------|--------------|--------------|--------------|--------------|--------------|-----------------------------|--------------|--------------|--------------|--------------|--------------|-----------------------------|--------------|-----|-----------------------------|----|----|-----|-----|-----------------------------|----|-----|-----|---|
| Soldering      |          | Reflow Only                 |              |              |              |              |              | Reflow Only                 |              |              |              |              |              | Reflow Only                 |              |     | Reflow Only                 |    |    |     |     | Reflow Only                 |    |     |     |   |
| Packaging      |          | Paper/Embossed              |              |              |              |              |              | All Embossed                |              |              |              |              |              | All Embossed                |              |     | All Embossed                |    |    |     |     | All Embossed                |    |     |     |   |
| (L) Length     | mm (in.) | 3.20 ± 0.20 (0.126 ± 0.008) |              |              |              |              |              | 4.50 ± 0.30 (0.177 ± 0.012) |              |              |              |              |              | 4.50 ± 0.30 (0.177 ± 0.012) |              |     | 5.70 ± 0.40 (0.225 ± 0.016) |    |    |     |     | 5.72 ± 0.25 (0.225 ± 0.010) |    |     |     |   |
| (W) Width      | mm (in.) | 2.50 ± 0.20 (0.098 ± 0.008) |              |              |              |              |              | 3.20 ± 0.20 (0.126 ± 0.008) |              |              |              |              |              | 6.40 ± 0.40 (0.252 ± 0.016) |              |     | 5.00 ± 0.40 (0.197 ± 0.016) |    |    |     |     | 6.35 ± 0.25 (0.250 ± 0.010) |    |     |     |   |
| (t) Terminal   | mm (in.) | 0.50 ± 0.25 (0.020 ± 0.010) |              |              |              |              |              | 0.61 ± 0.36 (0.024 ± 0.014) |              |              |              |              |              | 0.61 ± 0.36 (0.024 ± 0.014) |              |     | 0.64 ± 0.39 (0.025 ± 0.015) |    |    |     |     | 0.64 ± 0.39 (0.025 ± 0.015) |    |     |     |   |
| WVDC           |          | 10                          | 16           | 25           | 50           | 100          | 200          | 500                         | 16           | 25           | 50           | 100          | 200          | 500                         | 50           | 100 | 200                         | 25 | 50 | 100 | 200 | 500                         | 50 | 100 | 200 |   |
| Cap            | 100      | 101                         |              |              |              |              |              |                             |              |              |              |              |              |                             |              |     |                             |    |    |     |     |                             |    |     |     |   |
| (pF)           | 150      | 151                         |              |              |              |              |              |                             |              |              |              |              |              |                             |              |     |                             |    |    |     |     |                             |    |     |     |   |
|                | 220      | 221                         |              |              |              |              |              |                             |              |              |              |              |              |                             |              |     |                             |    |    |     |     |                             |    |     |     |   |
|                | 330      | 331                         |              |              |              |              |              |                             |              |              |              |              |              |                             |              |     |                             |    |    |     |     |                             |    |     |     |   |
|                | 470      | 471                         |              |              |              |              |              |                             |              |              |              |              |              |                             |              |     |                             |    |    |     |     |                             |    |     |     |   |
|                | 680      | 681                         |              |              |              |              |              |                             |              |              |              |              |              |                             |              |     |                             |    |    |     |     |                             |    |     |     |   |
|                | 1000     | 102                         |              |              |              |              |              |                             |              |              |              |              |              |                             |              |     |                             |    |    |     |     |                             |    |     |     |   |
|                | 1500     | 152                         | J            | J            | J            | J            | J            | J                           | M            |              |              |              |              |                             |              |     |                             |    |    |     |     |                             |    |     |     |   |
|                | 2200     | 222                         | J            | J            | J            | J            | J            | J                           | M            |              |              |              |              |                             |              |     |                             |    |    |     |     |                             |    |     |     |   |
|                | 3300     | 332                         | J            | J            | J            | J            | J            | J                           | M            |              |              |              |              |                             |              |     |                             |    |    |     |     |                             |    |     |     |   |
|                | 4700     | 472                         | J            | J            | J            | J            | J            | J                           | M            |              |              |              |              |                             |              |     |                             |    |    |     |     |                             |    |     |     |   |
|                | 6800     | 682                         | J            | J            | J            | J            | J            | J                           | M            |              |              |              |              |                             |              |     |                             |    |    |     |     |                             |    |     |     |   |
| Cap            | 0.01     | 103                         | J            | J            | J            | J            | J            | J                           | M            |              | K            | K            | K            | K                           | K            | M   | M                           | M  |    | X   | X   | X                           | X  | M   | P   | P |
| (μF)           | 0.015    | 153                         | J            | J            | J            | J            | J            | J                           | P            |              | K            | K            | K            | K                           | P            | M   | M                           | M  |    | X   | X   | X                           | X  | M   | P   | P |
|                | 0.022    | 223                         | J            | J            | J            | J            | J            | J                           | Q            |              | K            | K            | K            | K                           | P            | M   | M                           | M  |    | X   | X   | X                           | X  | M   | P   | P |
|                | 0.033    | 333                         | J            | J            | J            | J            | J            | J                           | Q            |              | K            | K            | K            | K                           | X            | M   | M                           | M  |    | X   | X   | X                           | X  | M   | P   | P |
|                | 0.047    | 473                         | J            | J            | J            | J            | J            | J                           | Q            |              | K            | K            | K            | K                           | Z            | M   | M                           | M  |    | X   | X   | X                           | X  | M   | P   | P |
|                | 0.068    | 683                         | J            | J            | J            | J            | J            | M                           | Q            |              | K            | K            | K            | K                           | Z            | M   | M                           | M  |    | X   | X   | X                           | X  | M   | P   | P |
|                | 0.1      | 104                         | J            | J            | J            | J            | J            | M                           | X            |              | K            | K            | K            | K                           | Z            | M   | M                           | M  |    | X   | X   | X                           | X  | M   | P   | P |
|                | 0.15     | 154                         | J            | J            | J            | J            | M            | Z                           |              |              | K            | K            | K            | P                           | Z            | M   | M                           | M  |    | X   | X   | X                           | X  | M   | P   | X |
|                | 0.22     | 224                         | J            | J            | J            | J            | P            | Z                           |              |              | K            | K            | K            | P                           | Z            | M   | M                           | M  |    | X   | X   | X                           | X  | M   | P   | X |
|                | 0.33     | 334                         | J            | J            | J            | J            | Q            |                             |              |              | K            | K            | M            | X                           |              | M   | M                           |    |    | X   | X   | X                           | X  | M   | P   | X |
|                | 0.47     | 474                         | M            | M            | M            | M            | Q            |                             |              |              | K            | K            | P            | X                           |              | M   | M                           |    |    | X   | X   | X                           | X  | M   | P   | X |
|                | 0.68     | 684                         | M            | M            | P            | X            | X            |                             |              |              | M            | M            | Q            |                             |              | M   | P                           |    |    | X   | X   |                             |    | M   | P   | X |
|                | 1.0      | 105                         | N            | N            | P            | X            | Z            |                             |              |              | M            | M            | X            | Z                           |              | M   | P                           |    |    | X   | X   |                             |    | M   | P   | X |
|                | 1.5      | 155                         | N            | N            | Z            | Z            | Z            |                             |              |              | Z            | Z            | Z            |                             |              | M   |                             |    |    | X   | X   |                             |    | M   | X   | Z |
|                | 2.2      | 225                         | X            | X            | Z            | Z            | Z            |                             |              |              | Z            | Z            | Z            |                             |              |     |                             |    |    | X   | X   |                             |    | M   | X   | Z |
|                | 3.3      | 335                         | X            | X            | Z            | Z            | Z            |                             |              |              | Z            | Z            | Z            |                             |              |     |                             |    |    | X   | Z   |                             |    |     |     |   |
|                | 4.7      | 475                         | Z            | Z            | Z            | Z            |              |                             |              |              | Z            | Z            |              |                             |              |     |                             |    |    | X   | Z   |                             |    |     |     |   |
|                | 10       | 106                         | Z            | Z            | Z            | Z            |              |                             |              |              | Z            |              |              |                             |              |     |                             |    |    | Z   | Z   |                             |    |     |     |   |
|                | 22       | 226                         | Z            | Z            | Z            |              |              |                             |              |              |              |              |              |                             |              |     |                             |    |    |     |     |                             |    |     |     |   |
|                | 47       | 476                         | Z            |              |              |              |              |                             |              |              |              |              |              |                             |              |     |                             |    |    |     |     |                             |    |     |     |   |
|                | 100      | 107                         |              |              |              |              |              |                             |              |              |              |              |              |                             |              |     |                             |    |    |     |     |                             |    |     |     |   |
| WVDC           |          | 10                          | 16           | 25           | 50           | 100          | 200          | 500                         | 16           | 25           | 50           | 100          | 200          | 500                         | 50           | 100 | 200                         | 25 | 50 | 100 | 200 | 500                         | 50 | 100 | 200 |   |
| SIZE           |          | 1210                        |              |              |              |              |              | 1812                        |              |              |              |              |              | 1825                        |              |     | 2220                        |    |    |     |     | 2225                        |    |     |     |   |
| Letter         |          | A                           | B            | C            | E            | G            | J            |                             |              |              |              |              |              |                             | K            | M   | N                           | P  | Q  | X   | Y   | Z                           |    |     |     |   |
| Max. Thickness |          | 0.33 (0.013)                | 0.22 (0.009) | 0.56 (0.022) | 0.71 (0.028) | 0.90 (0.035) | 0.94 (0.037) | 1.02 (0.040)                | 1.27 (0.050) | 1.40 (0.055) | 1.52 (0.060) | 1.78 (0.070) | 2.29 (0.090) | 2.54 (0.100)                | 2.79 (0.110) |     |                             |    |    |     |     |                             |    |     |     |   |
| PAPER          |          |                             |              |              |              |              | EMBOSSED     |                             |              |              |              |              |              |                             |              |     |                             |    |    |     |     |                             |    |     |     |   |

NOTE: Contact factory for non-specified capacitance values