

# 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, 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®**<br><br>*Optional termination<br>**See FLEXITERM® X7R section | <b>Packaging</b><br>2 = 7" Reel<br>4 = 13" Reel<br>7 = Bulk Cass.<br>9 = Bulk | <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.



## 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                                                                                                                                 | Freq.: 1.0 kHz $\pm$ 10%<br>Voltage: 1.0Vrms $\pm$ .2V                                                                                                                                                                                                          |                    |
| Dissipation Factor                   |                       | $\leq 2.5\%$ for $\geq 50V$ DC rating<br>$\leq 3.0\%$ for 25V DC rating<br>$\leq 3.5\%$ for 25V and 16V DC rating<br>$\leq 5.0\%$ for $\leq 10V$ DC rating |                                                                                                                                                                                                                                                                 |                    |
| Insulation Resistance                |                       | 100,000M $\Omega$ or 1000M $\Omega$ - $\mu$ F,<br>whichever is less                                                                                        | Charge device with rated voltage for<br>120 $\pm$ 5 secs @ room temp/humidity                                                                                                                                                                                   |                    |
| Dielectric Strength                  |                       | No breakdown or visual defects                                                                                                                             | Charge device with 300% of rated voltage for<br>1-5 seconds, w/charge and discharge current<br>limited to 50 mA (max)<br>Note: Charge device with 150% of rated<br>voltage for 500V devices.                                                                    |                    |
| Resistance to<br>Flexure<br>Stresses | Appearance            | No defects                                                                                                                                                 | Deflection: 2mm<br>Test Time: 30 seconds<br><br>1mm/sec<br>90 mm                                                                                                             |                    |
|                                      | Capacitance Variation | $\leq \pm 12\%$                                                                                                                                            |                                                                                                                                                                                                                                                                 |                    |
|                                      | Dissipation Factor    | Meets Initial Values (As Above)                                                                                                                            |                                                                                                                                                                                                                                                                 |                    |
|                                      | Insulation Resistance | $\geq$ Initial Value x 0.3                                                                                                                                 |                                                                                                                                                                                                                                                                 |                    |
| Solderability                        |                       | $\geq 95\%$ of each terminal should be covered<br>with fresh solder                                                                                        | Dip device in eutectic solder at 230 $\pm$ 5°C<br>for 5.0 $\pm$ 0.5 seconds                                                                                                                                                                                     |                    |
| Resistance to<br>Solder Heat         | Appearance            | No defects, <25% leaching of either end terminal                                                                                                           | Dip device in eutectic solder at 260°C for 60<br>seconds. Store at room temperature for 24 $\pm$ 2<br>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<br>Shock                     | Appearance            | No visual defects                                                                                                                                          | Step 1: -55°C $\pm$ 2°                                                                                                                                                                                                                                          | 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°                                                                                                                                                                                                                                         | 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<br>24 $\pm$ 2 hours at room temperature                                                                                                                                                                                   |                    |
| Load Life                            | Appearance            | No visual defects                                                                                                                                          | Charge device with 1.5 rated voltage ( $\leq 10V$ ) in<br>test chamber set at 125°C $\pm$ 2°C<br>for 1000 hours (+48, -0)<br><br>Remove from test chamber and stabilize<br>at room temperature for 24 $\pm$ 2 hours<br>before measuring.                        |                    |
|                                      | Capacitance Variation | $\leq \pm 12.5\%$                                                                                                                                          |                                                                                                                                                                                                                                                                 |                    |
|                                      | Dissipation Factor    | $\leq$ Initial Value x 2.0 (See Above)                                                                                                                     |                                                                                                                                                                                                                                                                 |                    |
|                                      | Insulation Resistance | $\geq$ Initial Value x 0.3 (See Above)                                                                                                                     |                                                                                                                                                                                                                                                                 |                    |
|                                      | Dielectric Strength   | Meets Initial Values (As Above)                                                                                                                            |                                                                                                                                                                                                                                                                 |                    |
| Load<br>Humidity                     | Appearance            | No visual defects                                                                                                                                          | Store in a test chamber set at 85°C $\pm$ 2°C/<br>85% $\pm$ 5% relative humidity for 1000 hours<br>(+48, -0) with rated voltage applied.<br><br>Remove from chamber and stabilize at<br>room temperature and humidity for<br>24 $\pm$ 2 hours before measuring. |                    |
|                                      | Capacitance Variation | $\leq \pm 12.5\%$                                                                                                                                          |                                                                                                                                                                                                                                                                 |                    |
|                                      | Dissipation Factor    | $\leq$ Initial Value x 2.0 (See Above)                                                                                                                     |                                                                                                                                                                                                                                                                 |                    |
|                                      | Insulation Resistance | $\geq$ Initial Value x 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    | 0.40 ± 0.02      | 0.60 ± 0.03     |    |    |    | 1.00 ± 0.10     |    |    |    | 1.60 ± 0.15     |     |    |    | 2.01 ± 0.20     |    |     |     | 3.20 ± 0.20     |    |    |    |    |     |     |     |
|              | (in.) | (0.016 ± 0.0008) | (0.024 ± 0.001) |    |    |    | (0.040 ± 0.004) |    |    |    | (0.063 ± 0.006) |     |    |    | (0.079 ± 0.008) |    |     |     | (0.126 ± 0.008) |    |    |    |    |     |     |     |
| (W) Width    | mm    | 0.20 ± 0.02      | 0.30 ± 0.03     |    |    |    | 0.50 ± 0.10     |    |    |    | 0.81 ± 0.15     |     |    |    | 1.25 ± 0.20     |    |     |     | 1.60 ± 0.20     |    |    |    |    |     |     |     |
|              | (in.) | (0.008 ± 0.0008) | (0.011 ± 0.001) |    |    |    | (0.020 ± 0.004) |    |    |    | (0.032 ± 0.006) |     |    |    | (0.049 ± 0.008) |    |     |     | (0.063 ± 0.008) |    |    |    |    |     |     |     |
| (t) Terminal | mm    | 0.20 ± 0.02      | 0.15 ± 0.05     |    |    |    | 0.25 ± 0.15     |    |    |    | 0.35 ± 0.15     |     |    |    | 0.50 ± 0.25     |    |     |     | 0.50 ± 0.25     |    |    |    |    |     |     |     |
|              | (in.) | (0.008 ± 0.0008) | (0.006 ± 0.002) |    |    |    | (0.010 ± 0.006) |    |    |    | (0.014 ± 0.006) |     |    |    | (0.020 ± 0.010) |    |     |     | (0.020 ± 0.010) |    |    |    |    |     |     |     |
| WVDC         |       | 10               | 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              | A               | A  | A  | A  |                 |    | C  | C  |                 |     |    |    | G               | G  | G   |     |                 |    |    |    |    |     |     |     |
| (pF)         | 150   | 151              | A               | A  | A  | A  |                 |    | C  | C  |                 |     |    |    | G               | G  | G   |     |                 |    |    |    |    |     |     |     |
|              | 220   | 221              | A               | A  | A  | A  |                 |    | C  | C  |                 |     |    |    | G               | G  | G   |     |                 |    |    |    |    |     |     |     |
|              | 330   | 331              | A               | A  | A  | A  |                 |    | C  | C  |                 |     |    |    | G               | G  | G   |     | J               | J  | J  | J  | J  | J   |     | K   |
|              | 470   | 471              | A               | A  | A  | A  | A               |    | C  | C  |                 |     |    |    | G               | G  | G   |     | J               | J  | J  | J  | J  | J   |     | K   |
|              | 680   | 681              | A               | A  | A  | A  |                 |    | C  | C  |                 |     |    |    | G               | G  | G   |     | J               | J  | J  | J  | J  | J   |     | K   |
|              | 1000  | 102              | A               | A  | A  | A  |                 |    | C  | C  | C               |     |    |    | G               | G  | G   |     | J               | J  | J  | J  | J  | J   |     | K   |
|              | 1500  | 152              |                 | A  | A  |    |                 |    | C  | C  | C               |     |    |    | G               | G  |     |     | J               | J  | J  | J  | J  | J   |     | M   |
|              | 2200  | 222              |                 | A  | A  |    |                 |    | C  | C  | C               |     |    |    | G               | G  |     |     | J               | J  | J  | J  | J  | J   |     | M   |
|              | 3300  | 332              |                 | A  | A  |    |                 |    | C  | C  | C               |     |    |    | G               | G  |     |     | J               | J  | J  | J  | J  | J   |     | M   |
|              | 4700  | 472              |                 | A  | A  |    |                 |    | C  | C  | C               |     |    |    | G               | G  |     |     | J               | J  | J  | J  | J  | J   |     | M   |
|              | 6800  | 682              |                 | A  | A  |    |                 |    | C  | C  | C               |     |    |    | G               | G  |     |     | J               | J  | J  | J  | J  | J   |     | P   |
| Cap          | 0.01  | 103              |                 | A  | A  |    |                 |    | C  | C  | C               |     |    |    | G               | G  | G   |     | J               | J  | J  | J  | J  | J   |     | P   |
| (µF)         | 0.015 | 153              |                 |    |    |    |                 |    | C  | C  | C               |     |    |    | G               | G  | G   |     | J               | J  | J  | J  | J  | J   |     | M   |
|              | 0.022 | 223              |                 |    |    |    |                 |    | C  | C  | C               |     |    |    | G               | G  | G   |     | J               | J  | J  | J  | J  | N   |     | M   |
|              | 0.033 | 333              |                 |    |    |    |                 |    | C  | C  | C               |     |    |    | G               | G  |     |     | J               | J  | J  | J  | J  |     |     | M   |
|              | 0.047 | 473              |                 |    |    |    |                 |    | C  | C  | C               |     |    |    | G               | G  | G   |     | J               | J  | J  | J  | N  |     |     | M   |
|              | 0.068 | 683              |                 |    |    |    |                 |    | C  | C  | C               |     |    |    | G               | G  | G   |     | J               | J  | J  | J  | N  |     |     | P   |
|              | 0.1   | 104              |                 |    |    |    |                 |    | C  | C  | C               |     |    |    | G               | G  | G   | G   | J               | J  | J  | J  | N  |     |     | P   |
|              | 0.15  | 154              |                 |    |    |    |                 |    |    |    |                 |     |    |    | G               | G  | G   | G   | J               | J  | J  | N  | N  |     |     | Q   |
|              | 0.22  | 224              |                 |    |    |    |                 |    |    |    |                 |     |    |    | G               | G  | J   | J   | J               | N  | N  | N  |    |     |     | Q   |
|              | 0.33  | 334              |                 |    |    |    |                 |    |    |    |                 |     |    |    | J               | J  | J   | J   | N               | N  | N  |    |    |     |     | Q   |
|              | 0.47  | 474              |                 |    |    |    |                 |    |    |    |                 |     |    |    | J               | J  | J   | J   | N               | N  | N  |    |    |     |     | Q   |
|              | 0.68  | 684              |                 |    |    |    |                 |    |    |    |                 |     |    |    | J               | J  | J   | J   | N               | N  | N  |    |    |     |     | Q   |
|              | 1.0   | 105              |                 |    |    |    |                 |    |    |    |                 |     |    |    | J               | J  | J   | J   | N               | N  | N  |    |    |     |     | Q   |
|              | 2.2   | 225              |                 |    |    |    |                 |    |    |    |                 |     |    |    | J               | J  | J   | J   | N               | N  | N  |    |    |     |     | Q   |
|              | 4.7   | 475              |                 |    |    |    |                 |    |    |    |                 |     |    |    |                 |    |     |     | P               | P  | P  | P  |    |     |     | Q   |
|              | 10    | 106              |                 |    |    |    |                 |    |    |    |                 |     |    |    |                 |    |     |     | P               | P  |    |    |    |     |     | Q   |
|              | 22    | 226              |                 |    |    |    |                 |    |    |    |                 |     |    |    |                 |    |     |     |                 |    |    |    |    |     |     | Q   |
|              | 47    | 476              |                 |    |    |    |                 |    |    |    |                 |     |    |    |                 |    |     |     |                 |    |    |    |    |     |     | Q   |
|              | 100   | 107              |                 |    |    |    |                 |    |    |    |                 |     |    |    |                 |    |     |     |                 |    |    |    |    |     |     | Q   |
| WVDC         |       | 10               | 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) | 1.78<br>(0.070) | 2.29<br>(0.090) | 2.54<br>(0.100) | 2.79<br>(0.110) |
| PAPER          |                 |                 |                 |                 |                 |                 | EMBOSS          |                 |                 |                 |                 |                 |                 |                 |

NOTE: Contact factory for non-specified capacitance values

\*EIA 01005

# 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   |                             |              | 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            |              | 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            |              |              | 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   |   |  |
|                | 2.2      | 225                         | X            | X            | Z            | Z            | Z            |     |                             |              | Z            | Z            | Z            |              |              |                             |     |    |                             | X   | X   |     |    | M                           | X   |   |  |
|                | 3.3      | 335                         | X            | X            | Z            | Z            |              |     |                             |              | Z            | Z            | Z            |              |              |                             |     |    |                             | X   | Z   |     |    |                             |     |   |  |
|                | 4.7      | 475                         | X            | X            | 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

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