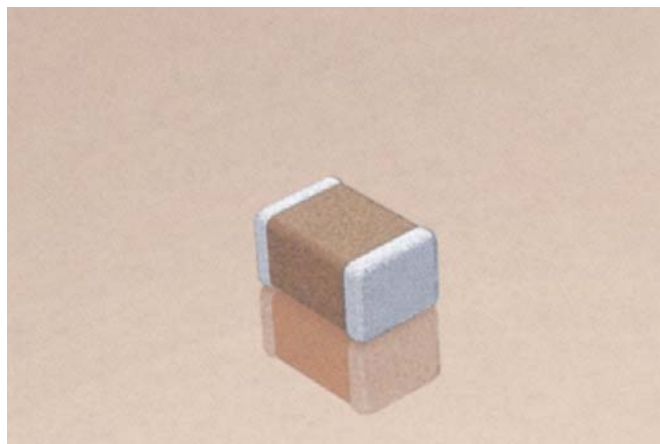


# X7R Dielectric

## 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.

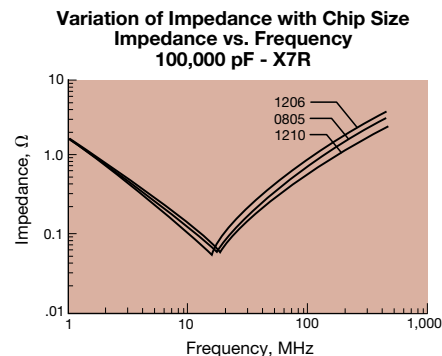
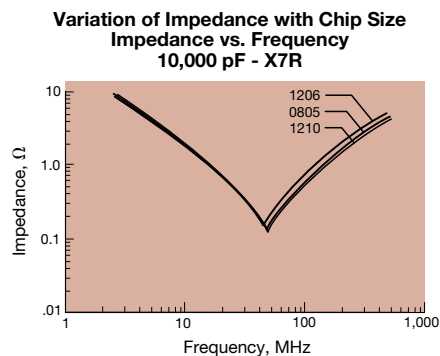
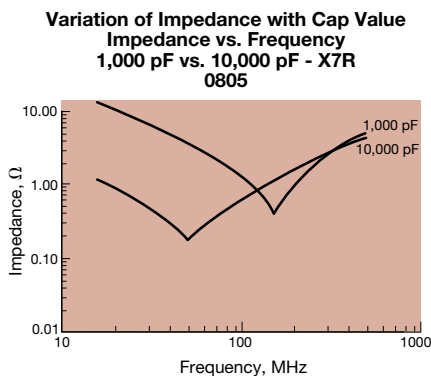
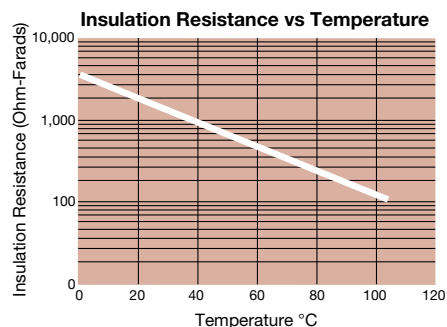
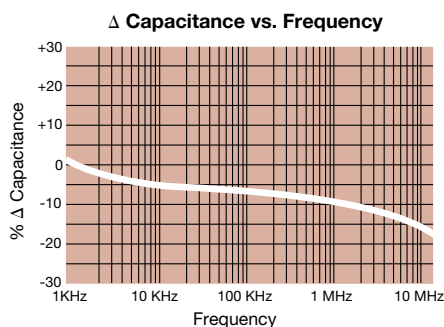
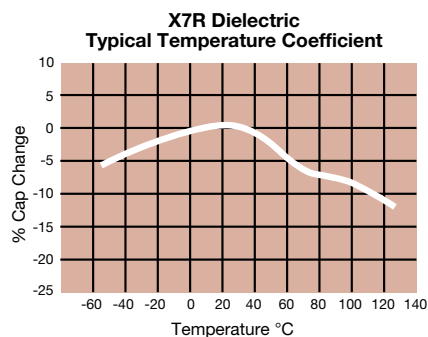
Capacitance for X7R varies under the influence of electrical operating conditions such as voltage and frequency.

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

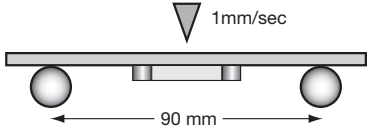
### PART NUMBER (see page 2 for complete part number explanation)

| 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 | <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> ** | <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 |
|                          |                                                                                                                      |                              |                                                                    |                                                                                                                         |                                           | *Optional termination<br>**See FLEXITERM <sup>®</sup> X7R section                                | <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<br>For Cap > 10 $\mu$ F, 0.5Vrms @ 120Hz                                                                                                                                                     |                    |
| Dissipation Factor             |                       | $\leq$ 2.5% for $\geq$ 50V DC rating<br>$\leq$ 3.0% for 25V DC rating<br>$\leq$ 3.5% for 16V DC rating<br>$\leq$ 5.0% for $\leq$ 10V DC rating |                                                                                                                                                                                                                                                     |                    |
| Insulation Resistance          |                       | 100,000M $\Omega$ or 1000M $\Omega$ - $\mu$ F, whichever is less                                                                               |                                                                                                                                                                                                                                                     |                    |
| 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 x 0.3                                                                                                                     |                                                                                                                                                                                                                                                     |                    |
| Solderability                  |                       | $\geq$ 95% of each terminal should be covered with fresh solder                                                                                | Dip device in eutectic solder at 230 $\pm$ 5°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°                                                                                                                                                                                                                              | 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 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°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 x 2.0 (See Above)                                                                                                         |                                                                                                                                                                                                                                                     |                    |
|                                | Insulation Resistance | $\geq$ Initial Value x 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°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 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           |             | 0201                           |                 |                 | 0402                           |                 |    | 0603                           |                 |                 |                 |                 |                 |                 | 0805                           |    |    |    |    |     |     | 1206                           |    |    |    |    |     |     |     |
|----------------|-------------|--------------------------------|-----------------|-----------------|--------------------------------|-----------------|----|--------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--------------------------------|----|----|----|----|-----|-----|--------------------------------|----|----|----|----|-----|-----|-----|
| Soldering      |             | Reflow Only                    |                 |                 | Reflow Only                    |                 |    | Reflow Only                    |                 |                 |                 |                 |                 |                 | Reflow/Wave                    |    |    |    |    |     |     | Reflow/Wave                    |    |    |    |    |     |     |     |
| Packaging      |             | All Paper                      |                 |                 | All Paper                      |                 |    | All Paper                      |                 |                 |                 |                 |                 |                 | Paper/Embossed                 |    |    |    |    |     |     | Paper/Embossed                 |    |    |    |    |     |     |     |
| (L) Length     | MM<br>(in.) | 0.60 ± 0.03<br>(0.024 ± 0.001) |                 |                 | 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.) | 0.30 ± 0.03<br>(0.011 ± 0.001) |                 |                 | 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.) | 0.15 ± 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) |    |    |    |    |     |     |     |
| WVDC           |             | 10                             | 16              | 25              | 16                             | 25              | 50 | 6.3                            | 10              | 16              | 25              | 50              | 100             | 200             | 6.3                            | 10 | 16 | 25 | 50 | 100 | 200 | 6.3                            | 10 | 16 | 25 | 50 | 100 | 200 | 500 |
| Cap<br>(pF)    | 100         | A                              | A               | A               |                                |                 |    |                                |                 |                 |                 |                 |                 |                 |                                |    |    |    |    |     |     |                                |    |    |    |    |     |     |     |
|                | 150         | A                              | A               | A               |                                |                 |    |                                |                 |                 |                 |                 |                 |                 |                                |    |    |    |    |     |     |                                |    |    |    |    |     |     |     |
|                | 220         | A                              | A               | A               |                                |                 | C  |                                |                 |                 |                 |                 |                 |                 |                                |    |    |    |    |     |     |                                |    |    |    |    |     |     |     |
|                | 330         | A                              | A               | A               |                                |                 | C  |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | J   | J   |                                |    |    |    |    |     |     | K   |
| Cap<br>(pF)    | 470         | A                              | A               |                 |                                |                 | C  |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | J   | J   |                                |    |    |    |    |     |     | K   |
|                | 680         | A                              | A               |                 |                                |                 | C  |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | J   | J   |                                |    |    |    |    |     |     | K   |
|                | 1000        | A                              | A               |                 |                                |                 | C  |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | J   | J   |                                |    |    |    |    |     |     | K   |
|                | 1500        | A                              |                 |                 |                                |                 | C  |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | J   | J   |                                |    | J  | J  | J  | J   | J   | M   |
| Cap<br>(pF)    | 2200        | A                              |                 |                 |                                |                 | C  |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | J   | J   |                                |    | J  | J  | J  | J   | J   | M   |
|                | 3300        | A                              |                 |                 |                                |                 | C  |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | J   | J   |                                |    | J  | J  | J  | J   | J   | M   |
|                | 4700        | A                              |                 |                 |                                |                 | C  |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | J   | J   |                                |    | J  | J  | J  | J   | J   | M   |
|                | 6800        | A                              |                 |                 |                                |                 | C  |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | J   | J   |                                |    | J  | J  | J  | J   | J   | P   |
| Cap<br>(µF)    | 0.010       | A                              |                 |                 |                                |                 | C  |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | J   | J   |                                |    | J  | J  | J  | J   | J   | P   |
|                | 0.015       |                                |                 |                 |                                |                 | C  |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | J   | J   |                                |    | J  | J  | J  | J   | J   | M   |
|                | 0.022       |                                |                 |                 |                                |                 | C  |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | J   | J   |                                |    | J  | J  | J  | J   | J   | M   |
|                | 0.033       |                                |                 |                 |                                |                 |    |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | J   | N   |                                |    | J  | J  | J  | J   | J   | M   |
| Cap<br>(µF)    | 0.047       |                                |                 |                 |                                |                 |    |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | J   | N   |                                |    | J  | J  | J  | J   | J   | M   |
|                | 0.068       |                                |                 |                 |                                |                 |    |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | J   | N   |                                |    | J  | J  | J  | J   | J   | P   |
|                | 0.10        |                                |                 |                 |                                |                 |    |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | N   |     |                                | J  | J  | J  | J  | J   | Q   |     |
|                | 0.15        |                                |                 |                 |                                |                 |    |                                |                 |                 |                 | G               | G               | G               |                                | J  | J  | J  | J  | N   |     |                                | J  | J  | J  | J  | J   | Q   |     |
| Cap<br>(µF)    | 0.22        |                                |                 |                 |                                |                 |    |                                |                 |                 |                 | J               |                 |                 |                                | J  | J  | J  | N  | N   |     |                                | J  | J  | J  | J  | J   | Q   |     |
|                | 0.33        |                                |                 |                 |                                |                 |    |                                |                 |                 |                 |                 |                 |                 |                                | N  | N  | N  | N  | N   |     |                                | J  | J  | M  | P  | Q   | Q   |     |
|                | 0.47        |                                |                 |                 |                                |                 |    |                                |                 |                 |                 |                 |                 |                 |                                | N  | N  | N  | N  | N   |     |                                | M  | N  | M  | P  | Q   | Q   |     |
|                | 0.68        |                                |                 |                 |                                |                 |    |                                |                 |                 |                 |                 |                 |                 |                                | N  | N  | N  | N  | N   |     |                                | M  | M  | Q  | Q  | Q   | Q   |     |
| Cap<br>(µF)    | 1.0         |                                |                 |                 |                                |                 |    |                                |                 |                 |                 | J               | J               |                 |                                | N  | N  | N  |    |     |     |                                | M  | M  | Q  | Q  | Q   |     |     |
|                | 1.5         |                                |                 |                 |                                |                 |    |                                |                 |                 |                 |                 |                 |                 |                                |    |    |    |    |     |     |                                | M  | Q  | Q  | Q  | Q   |     |     |
|                | 2.2         |                                |                 |                 |                                |                 |    |                                |                 |                 |                 | J               |                 |                 |                                |    |    |    |    |     |     |                                | P  | Q  | Q  | Q  |     |     |     |
|                | 3.3         |                                |                 |                 |                                |                 |    |                                |                 |                 |                 |                 |                 |                 |                                |    |    |    |    |     |     |                                | Q  | Q  | Q  |    |     |     |     |
| Cap<br>(µF)    | 4.7         |                                |                 |                 |                                |                 |    |                                |                 |                 |                 |                 |                 |                 |                                | P  | P  | P  |    |     |     |                                |    | Q  | Q  | Q  |     |     |     |
|                | 10          |                                |                 |                 |                                |                 |    |                                |                 |                 |                 |                 |                 |                 |                                |    |    |    |    |     |     |                                | Q  | Q  | Q  |    |     |     |     |
|                | 22          |                                |                 |                 |                                |                 |    |                                |                 |                 |                 |                 |                 |                 |                                |    |    |    |    |     |     |                                | Q  |    |    |    |     |     |     |
|                | 47          |                                |                 |                 |                                |                 |    |                                |                 |                 |                 |                 |                 |                 |                                |    |    |    |    |     |     |                                |    |    |    |    |     |     |     |
| 100            |             |                                |                 |                 |                                |                 |    |                                |                 |                 |                 |                 |                 |                 |                                |    |    |    |    |     |     |                                |    |    |    |    |     |     |     |
| WVDC           |             | 10                             | 16              | 25              | 16                             | 25              | 50 | 6.3                            | 10              | 16              | 25              | 50              | 100             | 200             | 6.3                            | 10 | 16 | 25 | 50 | 100 | 200 | 6.3                            | 10 | 16 | 25 | 50 | 100 | 200 | 500 |
| SIZE           |             | 0201                           |                 |                 | 0402                           |                 |    | 0603                           |                 |                 |                 |                 |                 |                 | 0805                           |    |    |    |    |     |     | 1206                           |    |    |    |    |     |     |     |
| Letter         |             | A                              | C               | E               | G                              | J               |    | K                              | M               | N               | P               | Q               | X               | Y               | Z                              |    |    |    |    |     |     |                                |    |    |    |    |     |     |     |
| Max. Thickness |             | 0.33<br>(0.013)                | 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                         |                 |                 |                 |                 |                 |                 |                                |    |    |    |    |     |     |                                |    |    |    |    |     |     |     |

 = Under Development

# 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                         | 50           | 100          | 200          | 500                         | 50           | 100                         | 25           | 50 | 100 | 200                         | 50 | 100 |   |
| Cap (pF)       |          | 100                         |              |              |              |              |        |                             |              |              |              |                             |              |                             |              |    |     |                             |    |     |   |
|                |          | 150                         |              |              |              |              |        |                             |              |              |              |                             |              |                             |              |    |     |                             |    |     |   |
|                |          | 220                         |              |              |              |              |        |                             |              |              |              |                             |              |                             |              |    |     |                             |    |     |   |
|                |          | 330                         |              |              |              |              |        |                             |              |              |              |                             |              |                             |              |    |     |                             |    |     |   |
|                |          | 470                         |              |              |              |              |        |                             |              |              |              |                             |              |                             |              |    |     |                             |    |     |   |
|                |          | 680                         |              |              |              |              |        |                             |              |              |              |                             |              |                             |              |    |     |                             |    |     |   |
|                |          | 1000                        |              |              |              |              |        |                             |              |              |              |                             |              |                             |              |    |     |                             |    |     |   |
|                |          | 1500                        | J            | J            | J            | J            | J      | J                           | M            |              |              |                             |              |                             |              |    |     |                             |    |     |   |
|                |          | 2200                        | J            | J            | J            | J            | J      | J                           | M            |              |              |                             |              |                             |              |    |     |                             |    |     |   |
|                |          | 3300                        | J            | J            | J            | J            | J      | J                           | M            |              |              |                             |              |                             |              |    |     |                             |    |     |   |
|                |          | 4700                        | J            | J            | J            | J            | J      | J                           | M            |              |              |                             |              |                             |              |    |     |                             |    |     |   |
|                |          | 6800                        | J            | J            | J            | J            | J      | J                           | M            |              |              |                             |              |                             |              |    |     |                             |    |     |   |
| Cap (μF)       |          | 0.010                       | J            | J            | J            | J            | J      | J                           | M            | K            | K            | K                           | K            | M                           | M            |    | X   | X                           | X  | M   | P |
|                |          | 0.015                       | J            | J            | J            | J            | J      | J                           | P            | K            | K            | K                           | P            | M                           | M            |    | X   | X                           | X  | M   | P |
|                |          | 0.022                       | J            | J            | J            | J            | J      | J                           | Q            | K            | K            | K                           | P            | M                           | M            |    | X   | X                           | X  | M   | P |
|                |          | 0.033                       | J            | J            | J            | J            | J      | J                           | Q            | K            | K            | K                           | X            | M                           | M            |    | X   | X                           | X  | M   | P |
|                |          | 0.047                       | J            | J            | J            | J            | J      | J                           |              | K            | K            | K                           | Z            | M                           | M            |    | X   | X                           | X  | M   | P |
|                |          | 0.068                       | J            | J            | J            | J            | J      | M                           |              | K            | K            | K                           | Z            | M                           | M            |    | X   | X                           | X  | M   | P |
|                |          | 0.10                        | J            | J            | J            | J            | J      | M                           |              | K            | K            | K                           | Z            | M                           | M            |    | X   | X                           | X  | M   | P |
|                |          | 0.15                        | J            | J            | J            | J            | M      |                             |              | K            | K            | P                           |              | M                           | M            |    | X   | X                           | X  | M   | P |
|                |          | 0.22                        | J            | J            | J            | J            | P      |                             |              | K            | K            | P                           |              | M                           | M            |    | X   | X                           |    | M   | P |
|                |          | 0.33                        | J            | J            | J            | J            | Z      |                             |              | K            | M            |                             |              | M                           | M            |    | X   | X                           |    | M   | P |
|                |          | 0.47                        | M            | M            | M            | M            | Z      |                             |              | K            | P            |                             |              | M                           | M            |    | X   | X                           |    | M   | P |
|                |          | 0.68                        | M            | M            | P            | X            | Z      |                             |              | M            | Q            |                             |              | M                           | P            |    | X   | X                           |    | M   | P |
|                |          | 1.0                         | N            | N            | P            | X            | Z      |                             |              | M            | X            |                             |              | M                           | P            |    | X   | Z                           |    | M   | P |
|                |          | 1.5                         | N            | N            | Z            | Z            | Z      |                             |              | Z            | Z            |                             |              | M                           |              |    | X   | Z                           |    | M   | X |
|                |          | 2.2                         | X            | X            | Z            | Z            | Z      |                             |              | Z            | Z            |                             |              | M                           |              |    | X   |                             |    | M   |   |
|                |          | 3.3                         | X            | X            | Z            | Z            |        |                             |              | Z            |              |                             |              |                             |              |    | X   |                             |    |     |   |
|                |          | 4.7                         | X            | X            | Z            | Z            |        |                             |              | Z            |              |                             |              |                             |              |    | X   |                             |    |     |   |
|                |          | 10                          | Z            | Z            | Z            |              |        |                             |              |              |              |                             |              |                             |              |    | Z   |                             |    |     |   |
|                |          | 22                          | Z            | Z            |              |              |        |                             |              |              |              |                             |              |                             | Z            |    |     |                             |    |     |   |
|                |          | 47                          |              |              |              |              |        |                             |              |              |              |                             |              |                             |              |    |     |                             |    |     |   |
|                |          | 100                         |              |              |              |              |        |                             |              |              |              |                             |              |                             |              |    |     |                             |    |     |   |
| WVDC           |          | 10                          | 16           | 25           | 50           | 100          | 200    | 500                         | 50           | 100          | 200          | 500                         | 50           | 100                         | 25           | 50 | 100 | 200                         | 50 | 100 |   |
| SIZE           |          | 1210                        |              |              |              |              |        | 1812                        |              |              |              | 1825                        |              | 2220                        |              |    |     | 2225                        |    |     |   |
| Letter         |          | A                           | C            | E            | G            | J            |        | K                           | M            | N            | P            | Q                           | X            | Y                           | Z            |    |     |                             |    |     |   |
| Max. Thickness |          | 0.33 (0.013)                | 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          |          |                             |              |              |              |              | EMBOSS |                             |              |              |              |                             |              |                             |              |    |     |                             |    |     |   |

= Under Development