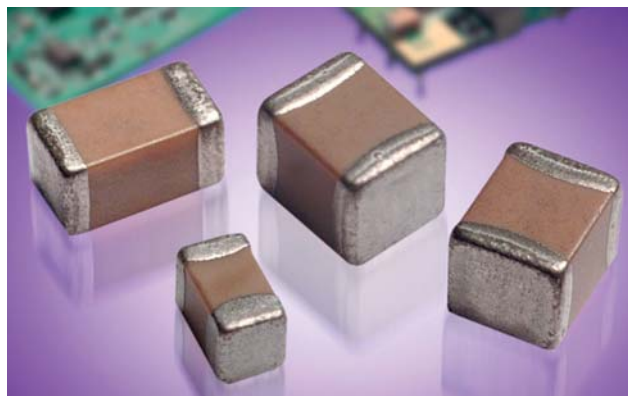


# X7R Dielectric

## General Specifications



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

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

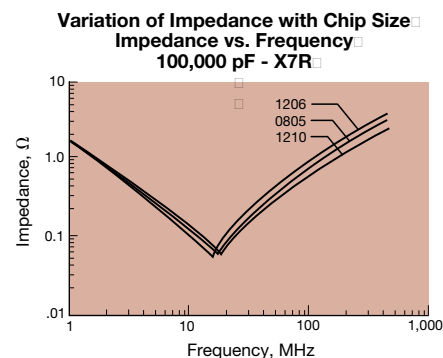
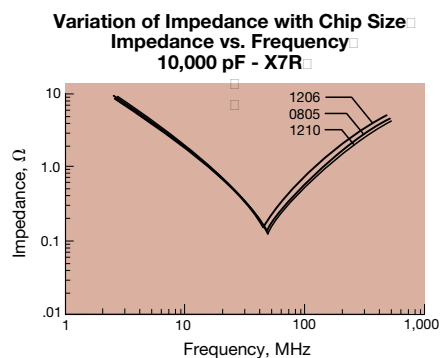
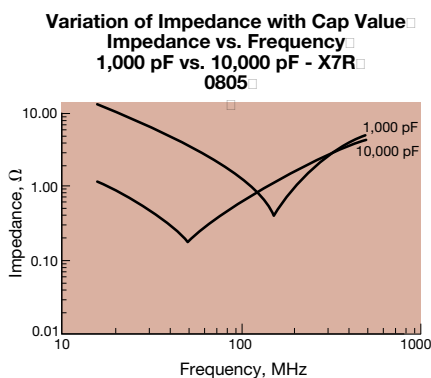
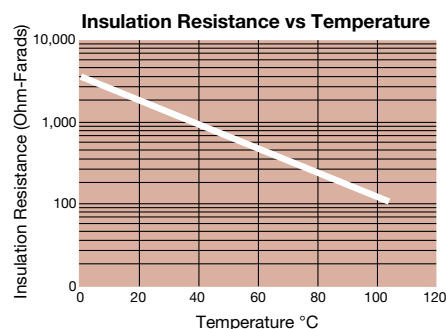
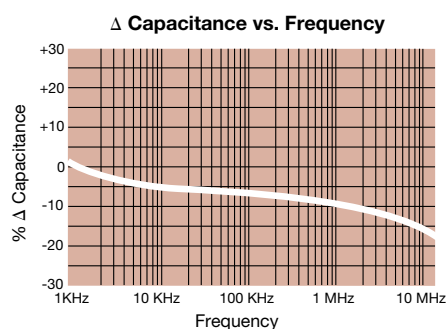
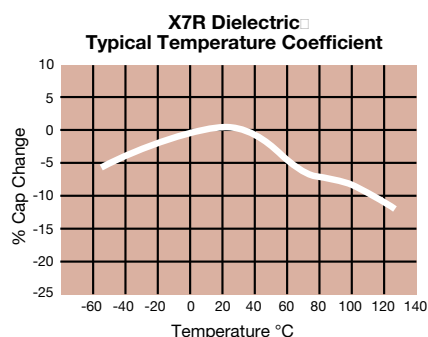
X7R dielectric chip usage covers the broad spectrum of industrial applications where known changes in capacitance due to applied voltages are acceptable.



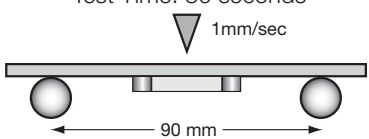
### PART NUMBER (see page 2 for complete part number explanation)

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



**Figure 6.** The effect of the number of iterations on the accuracy of the proposed algorithm. The figure shows two plots side-by-side. The left plot shows the accuracy of the proposed algorithm (in %) versus the number of iterations (from 0 to 100). The right plot shows the accuracy of the proposed algorithm (in %) versus the number of iterations (from 0 to 100).

\*Optional Specifications – Contact factory

# 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<br>(in.)                            | 3.20 ± 0.20<br>(0.126 ± 0.008) |                 |                 |                 |                 |                 | 4.50 ± 0.30<br>(0.177 ± 0.012) |                 |                 |                 | 4.50 ± 0.30<br>(0.177 ± 0.012) |                 | 5.70 ± 0.40<br>(0.225 ± 0.016) |    |    |     | 5.72 ± 0.25<br>(0.225 ± 0.010) |    |     |
| (W) Width      | mm<br>(in.)                            | 2.50 ± 0.20<br>(0.098 ± 0.008) |                 |                 |                 |                 |                 | 3.20 ± 0.20<br>(0.126 ± 0.008) |                 |                 |                 | 6.40 ± 0.40<br>(0.252 ± 0.016) |                 | 5.00 ± 0.40<br>(0.197 ± 0.016) |    |    |     | 6.35 ± 0.25<br>(0.250 ± 0.010) |    |     |
| (t) Terminal   | mm<br>(in.)                            | 0.50 ± 0.25<br>(0.020 ± 0.010) |                 |                 |                 |                 |                 | 0.61 ± 0.36<br>(0.024 ± 0.014) |                 |                 |                 | 0.61 ± 0.36<br>(0.024 ± 0.014) |                 | 0.64 ± 0.39<br>(0.025 ± 0.015) |    |    |     | 0.64 ± 0.39<br>(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<br>(pF)    | 100<br>150<br>220<br>330<br>470<br>680 |                                |                 |                 |                 |                 |                 |                                |                 |                 |                 |                                |                 |                                |    |    |     |                                |    |     |
|                | 1000<br>1500<br>2200                   | J                              | J               | J               | J               | J               | J               | M                              |                 |                 |                 |                                |                 |                                |    |    |     |                                |    |     |
|                | 3300<br>4700<br>6800                   | J                              | J               | J               | J               | J               | J               | M                              |                 |                 |                 |                                |                 |                                |    |    |     |                                |    |     |
| Cap<br>(μF)    | 0.010<br>0.015<br>0.022                | J                              | J               | J               | J               | J               | J               | M                              | K               | K               | K               | K                              | M               | M                              |    | X  | X   | X                              | M  | P   |
|                | 0.033<br>0.047<br>0.068                | J                              | J               | J               | J               | J               | J               | Q                              | K               | K               | K               | X                              | M               | M                              |    | X  | X   | X                              | M  | P   |
|                | 0.10<br>0.15<br>0.22                   | J                              | J               | J               | J               | J               | M               |                                | K               | K               | K               | Z                              | M               | M                              |    | X  | X   | X                              | M  | P   |
|                | 0.33<br>0.47<br>0.68                   | J                              | J               | J               | J               | Q               |                 |                                | K               | M               | X               |                                | M               | M                              |    | X  | X   | X                              | M  | P   |
|                | 1.0<br>1.5<br>2.2                      | N                              | N               | P               | X               | Z               |                 |                                | M               | X               |                 |                                | M               | P                              |    | X  | X   |                                | M  | P   |
|                | 3.3<br>4.7<br>10                       | X                              | X               | Z               | Z               |                 |                 |                                | Z               | Z               |                 |                                |                 |                                |    | X  | Z   |                                |    |     |
|                | 22<br>47<br>100                        | Z*                             | Z*              |                 |                 |                 |                 |                                |                 |                 |                 |                                |                 |                                | Z  |    |     |                                |    |     |
|                | 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<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          |                                |                 |                 |                 |                                |                 |                                |    |    |     |                                |    |     |

\*Optional Specifications – Contact factory