

# 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.

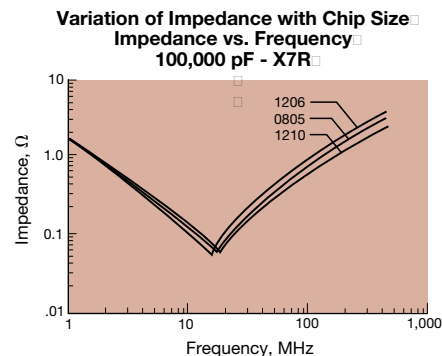
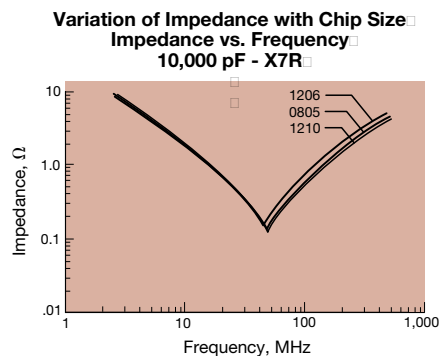
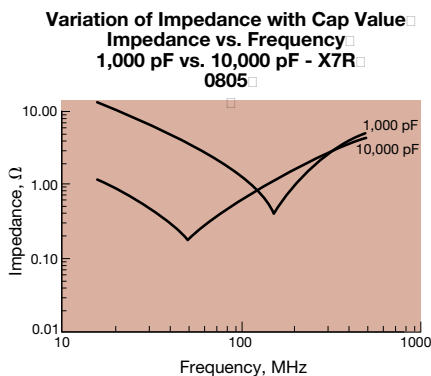
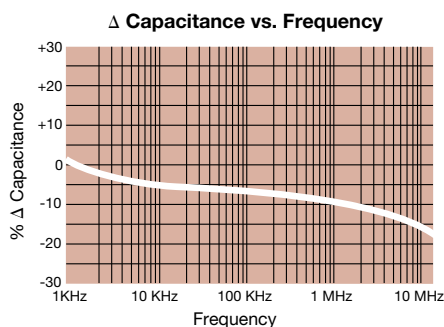
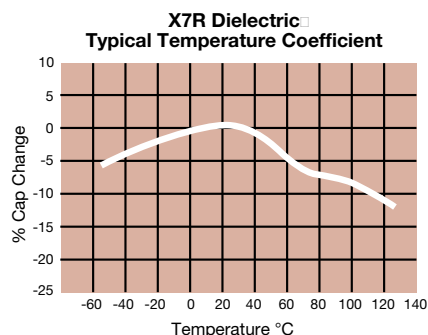
X7R dielectric chip usage covers the broad spectrum of industrial applications where known changes in capacitance due to applied voltages are acceptable.



### 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 <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 1. Schematic representation of the experimental design. The figure shows a sequence of events: a stimulus (a word) is presented, followed by a response (a button press), and then a feedback (a light or sound). The sequence is repeated for multiple trials.

\*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 (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      | Z                           |                | K              | K              | P                           |                | M                           | M              |    | X   | X                           | X  | M   | P |
|                       |          | 0.22                        | J              | J              | J              | J              | P      | Z                           |                | K              | K              | P                           |                | M                           | M              |    | X   | X                           | X  | M   | P |
|                       |          | 0.33                        | J              | J              | J              | J              | Q      |                             |                | K              | M              | X                           |                | M                           | M              |    | X   | X                           | X  | M   | P |
|                       |          | 0.47                        | M              | M              | M              | M              | Q      |                             |                | K              | P              |                             |                | M                           | M              |    | X   | X                           | X  | M   | P |
|                       |          | 0.68                        | M              | M              | P              | X              | X      |                             |                | M              | Q              |                             |                | M                           | P              |    | X   | X                           |    | M   | P |
|                       |          | 1.0                         | N              | N              | P              | X              | Z      |                             |                | M              | X              |                             |                | M                           | P              |    | X   | X                           |    | M   | P |
|                       |          | 1.5                         | N              | N              | Z              | Z              | Z      |                             |                | Z              | Z              |                             |                |                             |                |    | X   | X                           |    | M   | X |
|                       |          | 2.2                         | X              | X              | Z              | Z              | Z      |                             |                | Z              | Z              |                             |                | M                           |                |    | X   | X                           |    | M   |   |
|                       |          | 3.3                         | X              | X              | Z              | Z              |        |                             |                | Z              |                |                             |                |                             |                |    | X   | Z                           |    |     |   |
|                       |          | 4.7                         | X              | X              | Z              | Z              |        |                             |                | Z              |                |                             |                |                             |                |    | X   | Z                           |    |     |   |
|                       |          | 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 Max. Thickness |          | A 0.33 (0.013)              | C 0.56 (0.022) | E 0.71 (0.028) | G 0.90 (0.035) | J 0.94 (0.037) |        | K 1.02 (0.040)              | M 1.27 (0.050) | N 1.40 (0.055) | P 1.52 (0.060) | Q 1.78 (0.070)              | X 2.29 (0.090) | Y 2.54 (0.100)              | Z 2.79 (0.110) |    |     |                             |    |     |   |
| PAPER                 |          |                             |                |                |                |                | EMBOSS |                             |                |                |                |                             |                |                             |                |    |     |                             |    |     |   |

\*Optional Specifications – Contact factory