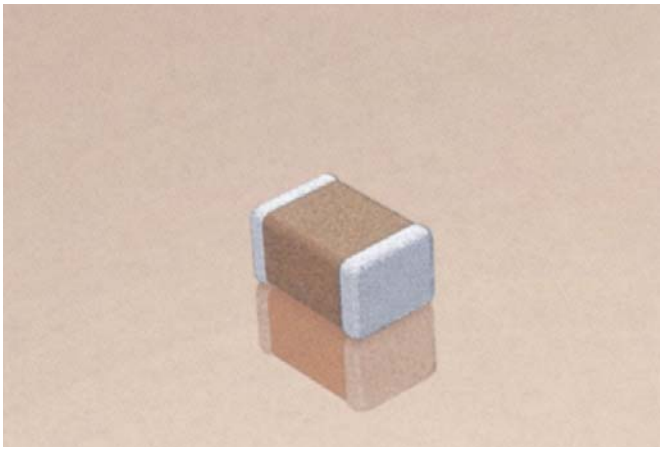
# X7R Dielectric

## 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 ±15% from -55°C to +125°C. This capacitance change is non-linear.

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

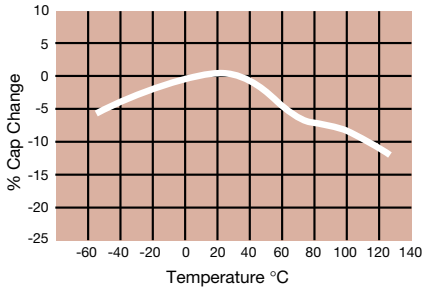
X7R dielectric chip usage covers the broad spectrum of industrial applications where known changes in capacitance due to applied voltages are acceptable.

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

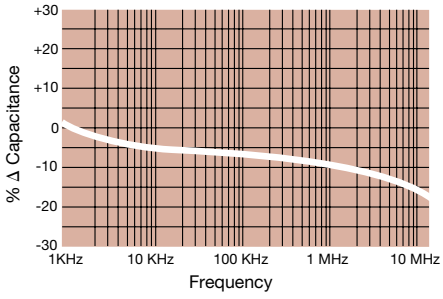
| 0805 | 5 | C | 103 | M | A | T | 2 | A |
|---|---|---|---|---|---|---|---|---|
| **Size** (L" x W") | **Voltage**<br>4V = 4<br>6.3V = 6<br>10V = Z<br>16V = Y<br>25V = 3<br>50V = 5<br>100V = 1<br>200V = 2<br>500V = 7 | **Dielectric**<br>X7R = C | **Capacitance Code (In pF)**<br>2 Sig. Digits + Number of Zeros | **Capacitance Tolerance**<br>J = ± 5%<br>K = ±10%<br>M = ± 20% | **Failure Rate**<br>A = Not Applicable | **Terminations**<br>T = Plated Ni and Sn<br>7 = Gold Plated*<br>Z = FLEXITERM™**<br><br>*Optional termination<br><br>**See FLEXITERM™ X7R section | **Packaging**<br>2 = 7" Reel<br>4 = 13" Reel<br>7 = Bulk Cass.<br>9 = Bulk<br><br>**Contact Factory For Multiples** | **Special Code**<br>A = Std. Product |

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

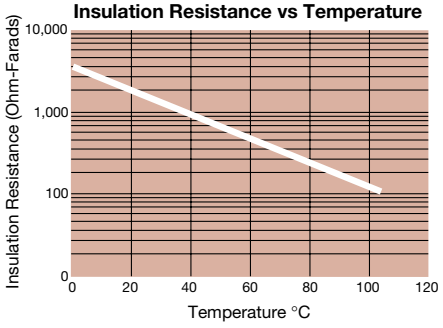
**X7R Dielectric**
**Typical Temperature Coefficient**



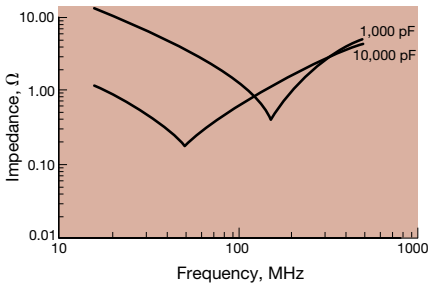

**Δ Capacitance vs. Frequency**



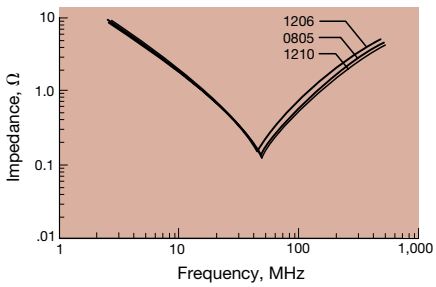

**Insulation Resistance vs Temperature**



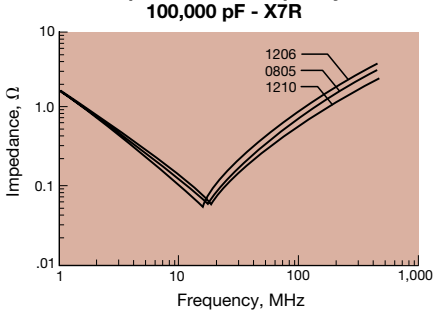

**Variation of Impedance with Cap Value**
**Impedance vs. Frequency**
**1,000 pF vs. 10,000 pF - X7R**
**0805**




**Variation of Impedance with Chip Size**
**Impedance vs. Frequency**
**10,000 pF - X7R**

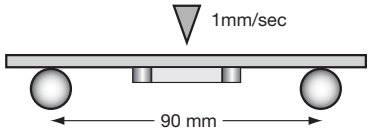



**Variation of Impedance with Chip Size**
**Impedance vs. Frequency**
**100,000 pF - X7R**



# X7R Dielectric

## Specifications and Test Methods

| Parameter/Test | | X7R Specification Limits | Measuring Conditions | |
|---|---|---|---|---|
| **Operating Temperature Range** | | -55ºC to +125ºC | Temperature Cycle Chamber | |
| **Capacitance** | | Within specified tolerance | Freq.: 1.0 kHz ± 10%<br>Voltage: 1.0Vrms ± .2V<br>For Cap > 10 µF, 0.5Vrms @ 120Hz | |
| **Dissipation Factor** | | ≤ 2.5% for ≥ 50V DC rating<br>≤ 3.0% for 25V DC rating<br>≤ 3.5% for 16V DC rating<br>≤ 5.0% for ≤ 10V DC rating | | |
| **Insulation Resistance** | | 100,000MΩ or 1000MΩ - µF, whichever is less | Charge device with rated voltage for 120 ± 5 secs @ room temp/humidity | |
| **Dielectric Strength** | | No breakdown or visual defects | Charge device with 300% of rated voltage for 1-5 seconds, w/charge and discharge current limited to 50 mA (max)<br>Note: Charge device with 150% of rated voltage for 500V devices. | |
| **Resistance to Flexure Stresses** | Appearance | No defects | Deflection: 2mm<br>Test Time: 30 seconds<br>  | |
| | Capacitance Variation | ≤ ±12% | | |
| | Dissipation Factor | Meets Initial Values (As Above) | | |
| | Insulation Resistance | ≥ Initial Value x 0.3 | | |
| **Solderability** | | ≥ 95% of each terminal should be covered with fresh solder | Dip device in eutectic solder at 230 ± 5ºC for 5.0 ± 0.5 seconds | |
| **Resistance to Solder Heat** | Appearance | No defects, <25% leaching of either end terminal | Dip device in eutectic solder at 260ºC for 60 seconds. Store at room temperature for 24 ± 2 hours before measuring electrical properties. | |
| | Capacitance Variation | ≤ ±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: -55ºC ± 2º | 30 ± 3 minutes |
| | Capacitance Variation | ≤ ±7.5% | Step 2: Room Temp | ≤ 3 minutes |
| | Dissipation Factor | Meets Initial Values (As Above) | Step 3: +125ºC ± 2º | 30 ± 3 minutes |
| | Insulation Resistance | Meets Initial Values (As Above) | Step 4: Room Temp | ≤ 3 minutes |
| | Dielectric Strength | Meets Initial Values (As Above) | Repeat for 5 cycles and measure after 24 ± 2 hours at room temperature | |
| **Load Life** | Appearance | No visual defects | Charge device with 1.5 rated voltage (≤ 10V) in test chamber set at 125ºC ± 2ºC for 1000 hours (+48, -0)<br><br>Remove from test chamber and stabilize at room temperature for 24 ± 2 hours before measuring. | |
| | Capacitance Variation | ≤ ±12.5% | | |
| | Dissipation Factor | ≤ Initial Value x 2.0 (See Above) | | |
| | Insulation Resistance | ≥ 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 85ºC ± 2ºC/ 85% ± 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 ± 2 hours before measuring. | |
| | Capacitance Variation | ≤ ±12.5% | | |
| | Dissipation Factor | ≤ Initial Value x 2.0 (See Above) | | |
| | Insulation Resistance | ≥ 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 | 0.60 ± 0.03 | | 1.00 ± 0.10 | | | 1.60 ± 0.15 | | | | | | | 2.01 ± 0.20 | | | | | | | 3.20 ± 0.20 | | | | | | | |
| | (in.) | (0.024 ± 0.001) | | (0.040 ± 0.004) | | | (0.063 ± 0.006) | | | | | | | (0.079 ± 0.008) | | | | | | | (0.126 ± 0.008) | | | | | | | |
| (W) Width | MM | 0.30 ± 0.03 | | 0.50 ± 0.10 | | | 0.81 ± 0.15 | | | | | | | 1.25 ± 0.20 | | | | | | | 1.60 ± 0.20 | | | | | | | |
| | (in.) | (0.011 ± 0.001) | | (0.020 ± 0.004) | | | (0.032 ± 0.006) | | | | | | | (0.049 ± 0.008) | | | | | | | (0.063 ± 0.008) | | | | | | | |
| (t) Terminal | MM | 0.15 ± 0.05 | | 0.25 ± 0.15 | | | 0.35 ± 0.15 | | | | | | | 0.50 ± 0.25 | | | | | | | 0.50 ± 0.25 | | | | | | | |
| | (in.) | (0.006 ± 0.002) | | (0.010 ± 0.006) | | | (0.014 ± 0.006) | | | | | | | (0.020 ± 0.010) | | | | | | | (0.020 ± 0.010) | | | | | | | |
| | WVDC | 10 | 16 | 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 (pF) | 100 | A | A | | | | | | | | G | G | G | | J | J | J | J | J | J | | | | | | | | K |
| | 150 | A | A | | | | | | | | G | G | G | | J | J | J | J | J | J | | | | | | | | K |
| | 220 | A | A | | | C | | | | | G | G | G | | J | J | J | J | J | J | | | | | | | | K |
| | 330 | A | A | | | C | | | | | G | G | G | | J | J | J | J | J | J | | | | | | | | K |
| | 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 | | | J | J | J | J | J | J | | J | J | J | J | J | J | M |
| | 2200 | A | | | | C | | | | | G | G | | | J | J | J | J | J | J | | J | J | J | J | J | J | M |
| | 3300 | A | | | C | C | | | | | G | G | | | J | J | J | J | J | J | | J | J | J | J | J | J | M |
| | 4700 | A | | | C | | | | | | G | G | | | J | J | J | J | J | J | | J | J | J | J | J | J | M |
| | 6800 | A | | C | C | | | | | | G | G | | | J | J | J | J | J | J | | J | J | J | J | J | J | P |
| Cap (µF) | 0.010 | A | | C | | | | | | G | G | G | | | J | J | J | J | J | J | | J | J | J | J | J | J | P |
| | 0.015 | | | C | | | | | | G | G | | | | J | J | J | J | J | | J | J | J | J | J | M | |
| | 0.022 | | | C | | | | | | G | G | | | | J | J | J | J | J | N | J | J | J | J | J | M | |
| | 0.033 | | | | | | | | | G | G | | | | J | J | J | J | N | | J | J | J | J | J | M | |
| | 0.047 | | | | | | | | G | G | G | | | | J | J | J | J | N | | J | J | J | J | J | M | |
| | 0.068 | | | | | | | | G | G | G | | | | J | J | J | J | N | | J | J | J | J | J | P | |
| | 0.10 | | | | | | | G | G | G | G | | | | J | J | J | J | N | | J | J | J | J | M | | |
| | 0.15 | | | | | | | G | | | | | | | J | J | J | N | | | J | J | J | J | Q | | |
| | 0.22 | | | | | | | G | | | | | | | J | J | N | N | | | J | J | J | J | Q | | |
| | 0.33 | | | | | | | | | | | | | | N | N | N | N | | | J | J | M | P | Q | | |
| | 0.47 | | | | | | | | | | | | | | N | N | N | N | | | M | M | M | P | | | |
| | 0.68 | | | | | | | | | | | | | | N | N | N | | | | M | M | Q | Q | | | |
| | 1.0 | | | | | | | J | J | | | | | | N | N | N | | | | M | M | Q | Q | | | |
| | 1.5 | | | | | | | | | | | | | | | | | | | | P | Q | Q | | | | |
| | 2.2 | | | | | | J | | | | | | | | | | N | | | | Q | Q | Q | | | | |
| | 3.3 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4.7 | | | | | | | | | | | | | | P | P | | | | | | | Q | | | | |
| | 10 | | | | | | | | | | | | | P | | | | | | | Q | Q | | | | | |
| | 22 | | | | | | | | | | | | | | | | | | | | Q | | | | | | |
| | 47 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 100 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | WVDC | 10 | 16 | 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 (0.013) | 0.56 (0.022) | 0.71 (0.028) | 0.86 (0.034) | 0.94 (0.037) | 1.02 (0.040) | 1.27 (0.050) | 1.40 (0.055) | 1.52 (0.060) | 1.78 (0.070) | 2.29 (0.090) | 2.54 (0.100) | 2.79 (0.110) |
| | PAPER | | | | | EMBOSSED | | | | | | | |

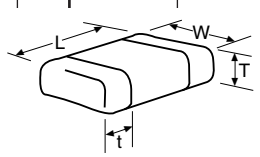
= Under Development

# 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 | 3.20 ± 0.20 | | | | | | | | 4.50 ± 0.30 | | | | 4.50 ± 0.30 | | 5.70 ± 0.40 | | | | 5.72 ± 0.25 | |
| | (in.) | (0.126 ± 0.008) | | | | | | | | (0.177 ± 0.012) | | | | (0.177 ± 0.012) | | (0.225 ± 0.016) | | | | (0.225 ± 0.010) | |
| (W) Width | MM | 2.50 ± 0.20 | | | | | | | | 3.20 ± 0.20 | | | | 6.40 ± 0.40 | | 5.00 ± 0.40 | | | | 6.35 ± 0.25 | |
| | (in.) | (0.098 ± 0.008) | | | | | | | | (0.126 ± 0.008) | | | | (0.252 ± 0.016) | | (0.197 ± 0.016) | | | | (0.250 ± 0.010) | |
| (t) Terminal | MM | 0.50 ± 0.25 | | | | | | | | 0.61 ± 0.36 | | | | 0.61 ± 0.36 | | 0.64 ± 0.39 | | | | 0.64 ± 0.39 | |
| | (in.) | (0.020 ± 0.010) | | | | | | | | (0.024 ± 0.014) | | | | (0.024 ± 0.014) | | (0.025 ± 0.015) | | | | (0.025 ± 0.015) | |
| | WVDC | 6.3 | 10 | 16 | 25 | 50 | 100 | 200 | 500 | 50 | 100 | 200 | 500 | 50 | 100 | 6.3 | 50 | 100 | 200 | 50 | 100 |
| Cap | 100 | | | | | | | | | | | | | | | | | | | | |
| (pF) | 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 | 0.010 | | J | J | J | J | J | J | M | K | K | K | K | M | M | X | X | X | X | M | P |
| (µF | 0.015 | | J | J | J | J | J | J | P | K | K | K | P | M | M | X | X | X | X | M | P |
| | 0.022 | | J | J | J | J | J | J | Q | K | K | K | P | M | M | X | X | X | X | M | P |
| | 0.033 | | J | J | J | J | J | J | | K | K | K | X | M | M | X | X | X | X | M | P |
| | 0.047 | | J | J | J | J | J | J | | K | K | K | Z | M | M | X | X | X | X | M | P |
| | 0.068 | | J | J | J | J | J | M | | K | K | K | | M | M | X | X | X | X | M | P |
| | 0.10 | | J | J | J | J | J | M | | K | K | K | | M | M | X | X | X | X | M | P |
| | 0.15 | | J | J | J | J | M | | | K | K | P | | M | M | X | X | X | X | M | P |
| | 0.22 | | J | J | J | J | P | | | K | K | P | | M | M | X | X | X | | M | P |
| | 0.33 | | J | J | J | J | Z | | | K | M | | | M | M | X | X | X | | M | P |
| | 0.47 | | M | M | M | M | Z | | | K | P | | | M | M | X | X | X | | M | P |
| | 0.68 | | M | M | P | X | Z | | | M | Q | | | M | | X | X | X | | M | P |
| | 1.0 | | N | N | P | X | Z | | | M | X | | | M | | | X | Z | | M | P |
| | 1.5 | | N | N | Z | Z | | | | Z | Z | | | M | | | X | Z | | M | X |
| | 2.2 | | Z | Z | Z | Z | | | | Z | Z | | | | | | | | | M | |
| | 3.3 | | Z | Z | Z | Z | | | | Z | | | | | | | | | | | |
| | 4.7 | | Z | Z | Z | Z | | | | Z | | | | | | | | | | | |
| | 10 | | Z | Z | Z | | | | | | | | | | | | Z | | | | |
| | 22 | | Z | Z | | | | | | | | | | | | | | | | | |
| | 47 | | | | | | | | | | | | | | | | | | | | |
| | 100 | | | | | | | | | | | | | | | | | | | | |
| | WVDC | 6.3 | 10 | 16 | 25 | 50 | 100 | 200 | 500 | 50 | 100 | 200 | 500 | 50 | 100 | 6.3 | 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) | 0.86 (0.034) | 0.94 (0.037) | 1.02 (0.040) | 1.27 (0.050) | 1.40 (0.055) | 1.52 (0.060) | 1.78 (0.070) | 2.29 (0.090) | 2.54 (0.100) | 2.79 (0.110) |
| | PAPER | | | | | EMBOSSED | | | | | | | |

= Under Development