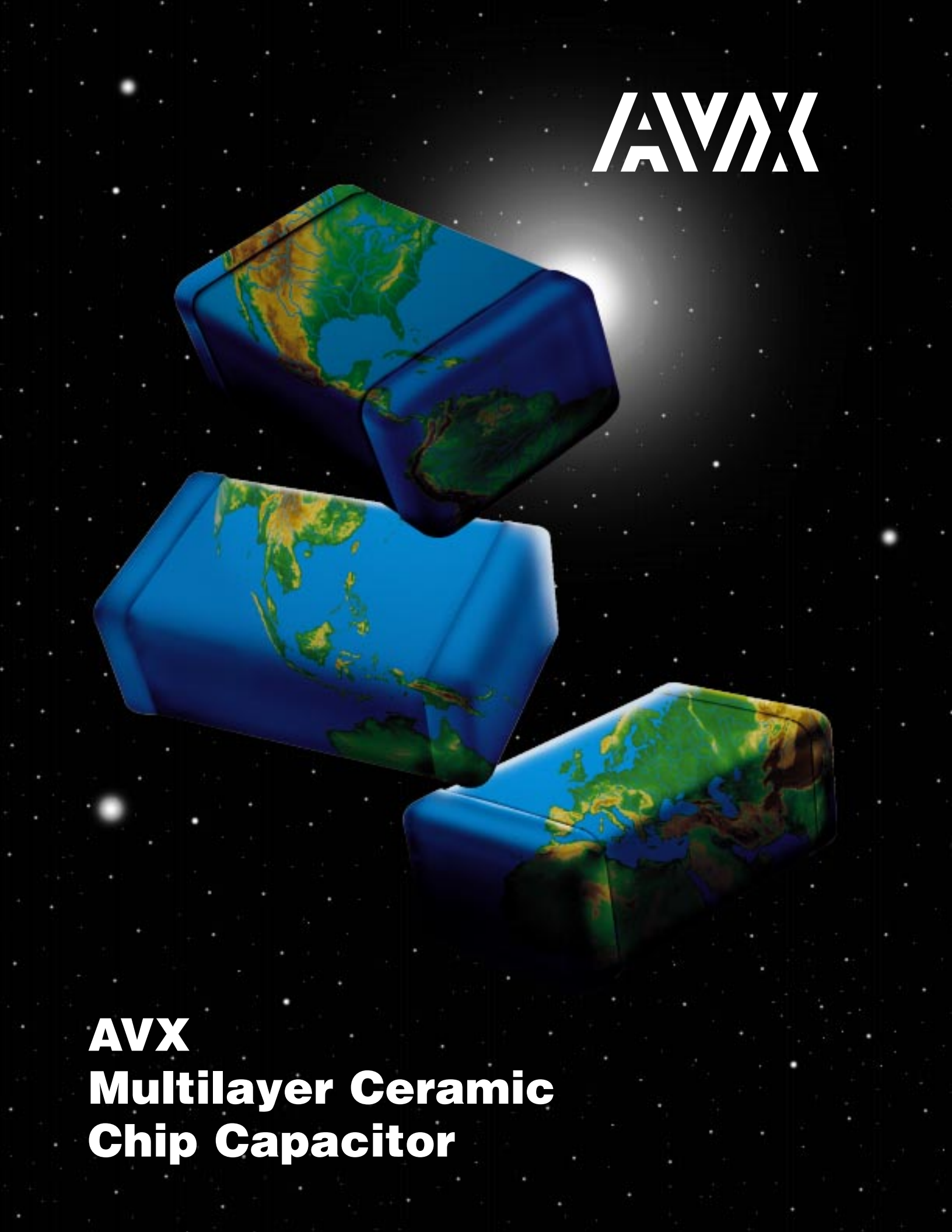


# AVX
# Multilayer Ceramic
# Chip Capacitor

# Ceramic Chip Capacitors

## Table of Contents

# Basic Capacitor Formulas

**I. Capacitance (farads)**

English: $C = \frac{.224\ K\ A}{T_D}$

Metric: $C = \frac{.0884\ K\ A}{T_D}$

**II. Energy stored in capacitors (Joules, watt - sec)**

$E = \frac{1}{2}CV^2$

**III. Linear charge of a capacitor (Amperes)**

$I = C\ \frac{dV}{dt}$

**IV. Total Impedance of a capacitor (ohms)**

$Z = \sqrt{R_S^2 + (X_C - X_L)^2}$

**V. Capacitive Reactance (ohms)**

$x_C = \frac{1}{2\ \pi\ fC}$

**VI. Inductive Reactance (ohms)**

$x_L = 2\ \pi\ fL$

**VII. Phase Angles:**

Ideal Capacitors: Current leads voltage 90°
Ideal Inductors: Current lags voltage 90°
Ideal Resistors: Current in phase with voltage

**VIII. Dissipation Factor (%)**

D.F.= tan δ (loss angle) = $\frac{E.S.R.}{X_C}$ = (2 πfC) (E.S.R.)

**IX. Power Factor (%)**

P.F. = Sine δ (loss angle) = Cos $\phi$ (phase angle)
P.F. = (when less than 10%) = DF

**X. Quality Factor (dimensionless)**

Q = Cotan δ (loss angle) = $\frac{1}{D.F.}$

**XI. Equivalent Series Resistance (ohms)**

E.S.R. = (D.F.) (Xc) = (D.F.) / (2 π fC)

**XII. Power Loss (watts)**

Power Loss = (2 π $fCV^2$) (D.F.)

**XIII. KVA (Kilowatts)**

KVA = 2 π $fCV^2$ x $10^{-3}$

**XIV. Temperature Characteristic (ppm/°C)**

T.C. = $\frac{Ct - C_{25}}{C_{25}\ (T_t - 25)} \times 10^6$

**XV. Cap Drift (%)**

C.D. = $\frac{C_1 - C_2}{C_1} \times 100$

**XVI. Reliability of Ceramic Capacitors**

$\frac{L_o}{L_t} = \left(\frac{V_t}{V_o}\right)^X \left(\frac{T_t}{T_o}\right)^Y$

**XVII. Capacitors in Series (current the same)**

Any Number: $\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2}$ --- $\frac{1}{C_N}$

Two: $C_T = \frac{C_1\ C_2}{C_1 + C_2}$

**XVIII. Capacitors in Parallel (voltage the same)**

$C_T = C_1 + C_2$ --- + $C_N$

**XIX. Aging Rate**

A.R. = %Δ C/decade of time

**XX. Decibels**

db = 20 log $\frac{V_1}{V_2}$

## METRIC PREFIXES

| | |
|---|---|
| Pico | X $10^{-12}$ |
| Nano | X $10^{-9}$ |
| Micro | X $10^{-6}$ |
| Milli | X $10^{-3}$ |
| Deci | X $10^{-1}$ |
| Deca | X $10^{+1}$ |
| Kilo | X $10^{+3}$ |
| Mega | X $10^{+6}$ |
| Giga | X $10^{+9}$ |
| Tera | X $10^{+12}$ |

## SYMBOLS

| | | | | | |
|---|---|---|---|---|---|
| K | = Dielectric Constant | f | = frequency | $L_t$ | = Test life |
| A | = Area | L | = Inductance | $V_t$ | = Test voltage |
| $T_D$ | = Dielectric thickness | δ | = Loss angle | $V_o$ | = Operating voltage |
| V | = Voltage | $\phi$ | = Phase angle | $T_t$ | = Test temperature |
| t | = time | X & Y | = exponent effect of voltage and temp. | $T_o$ | = Operating temperature |
| $R_S$ | = Series Resistance | $L_o$ | = Operating life | | |

# How to Order

## Part Number Explanation

### EXAMPLE: 08055A101JAT2A

**0805** — Size (L" x W")
**0402**
0504
**0603**
**0805**
1005
0907
**1206**
**1210**
1505
1805
1808
**1812**
**1825**
2225
3640

**5** — **Voltage**
10V = Z
16V = Y
25V = 3
50V = 5
100V = 1
200V = 2
250V = V
500V = 7
600V = C
1000V = A
1500V = S
2000V = G
2500V = W
3000V = H
4000V = J
5000V = K

**A** — **Dielectric**
C0G (NP0) = A
X7R = C
X5R = D
Z5U = E
Y5V = G

**101** — **Capacitance Code**
(2 significant digits + no. of zeros)
Examples:
10 pF = 100
100 pF = 101
1,000 pF = 102
22,000 pF = 223
220,000 pF = 224
1 µF = 105
For values below 10 pF, use "R" in place of decimal point, e.g., 9.1 pfd = 9R1.

**J** — **Capacitance Tolerance**
C = ±.25 pF*
D = ±.50 pF*
F = ±1% (≥ 25 pF)
G = ±2% (≥ 13 pF)
J = ±5%
K = ±10%
M = ±20%
Z = +80%, -20%
P = +100%, -0%

**A** — **Failure Rate**
A = Not Applicable

**T** — **Terminations**
**Standard:**
T = Ni and Tin Plated
Others:
7 = Plated Ni Gold Plated
1 = Pd/Ag

**2** — **Packaging****
**Recommended:**
2 = 7" Reel
4 = 13" Reel
Others:
7 = Bulk Cassette
9 = Bulk

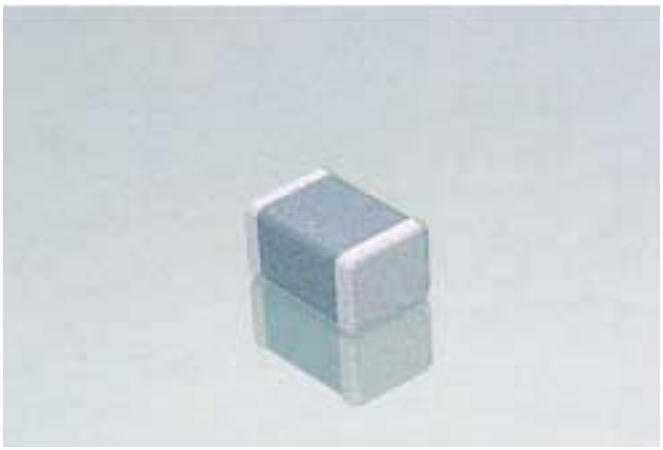
**A** — **Special** Code**
A = Standard Product
**Non-Standard**
P = Embossed unmarked
M = Embossed marked
E = Standard packaging marked
**Low Profile Chips Only**
Max. Thickness
T = .66mm (.026")
S = .56mm (.022")
R = .46mm (.018")

* C&D tolerances for ≤10 pF values.
** Standard Tape and Reel material depends upon chip size and thickness. See individual part tables for tape material type for each capacitance value.

Note: Unmarked product is standard. Marked product is available on special request, please contact AVX. Standard packaging is shown in the individual tables. Non-standard packaging is available on special request, please contact AVX.

# C0G (NP0) Dielectric

## General Specifications



C0G (NP0) is the most popular formulation of the "temperature-compensating," EIA Class I ceramic materials. Modern C0G (NP0) formulations contain neodymium, samarium and other rare earth oxides.

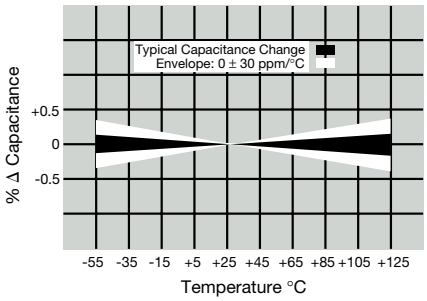
C0G (NP0) ceramics offer one of the most stable capacitor dielectrics available. Capacitance change with temperature is 0 ±30ppm/°C which is less than ±0.3% Δ C from -55°C to +125°C. Capacitance drift or hysteresis for C0G (NP0) ceramics is negligible at less than ±0.05% versus up to ±2% for films. Typical capacitance change with life is less than ±0.1% for C0G (NP0), one-fifth that shown by most other dielectrics. C0G (NP0) formulations show no aging characteristics.

The C0G (NP0) formulation usually has a "Q" in excess of 1000 and shows little capacitance or "Q" changes with frequency. Their dielectric absorption is typically less than 0.6% which is similar to mica and most films.

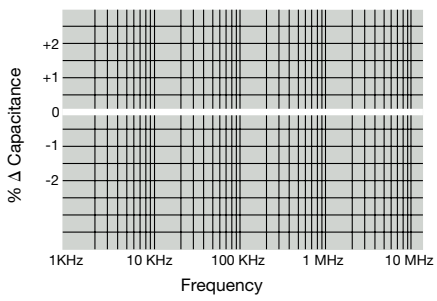
## PART NUMBER (see page 3 for complete part number explanation)

| 0805 | 5 | A | 101 | J | A | T | 2 | A |
|---|---|---|---|---|---|---|---|---|
| **Size** (L" x W") | **Voltage** 10V = Z, 16V = Y, 25V = 3, 50V = 5, 100V = 1, 200V = 2 | **Dielectric** C0G (NP0) = A | **Capacitance Code** 2 Sig. Digits + Number of Zeros | **Capacitance Tolerance** B = ±.10 pF, C = ±.25 pF, D = ±.50 pF, F = ±1% (≥ 25 pF), G = ±2% (≥ 13 pF), J = ±5%, K = ±10% | **Failure Rate** A = Not Applicable | **Terminations** T = Plated Ni and Solder | **Packaging** 2 = 7" Reel, 4 = 13" Reel. **Contact Factory For Multiples** | **Special Code** A = Std. Product |

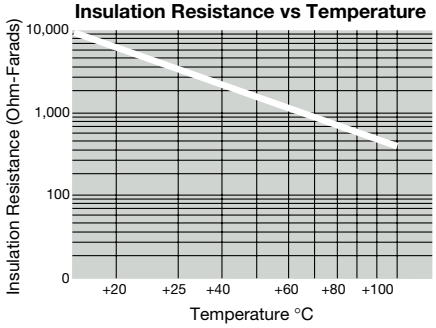
**Temperature Coefficient**



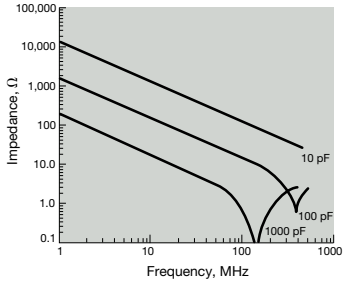

**Δ Capacitance vs. Frequency**



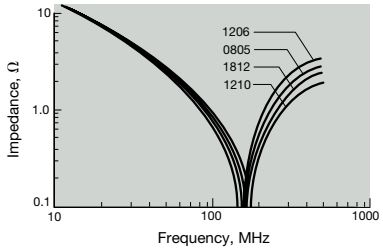

**Insulation Resistance vs Temperature**



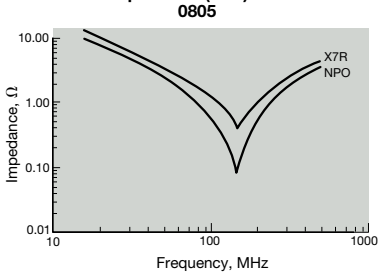

**Variation of Impedance with Cap Value**
**Impedance vs. Frequency**
**0805 - C0G (NP0)**
**10 pF vs. 100 pF vs. 1000 pF**




**Variation of Impedance with Chip Size**
**Impedance vs. Frequency**
**1000 pF - C0G (NP0)**

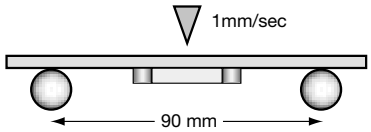



**Variation of Impedance with Ceramic Formulation**
**Impedance vs. Frequency**
**1000 pF - C0G (NP0) vs X7R**
**0805**



# C0G (NP0) Dielectric

## Specifications and Test Methods

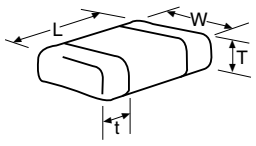
| Parameter/Test | | NP0 Specification Limits | Measuring Conditions | |
|---|---|---|---|---|
| **Operating Temperature Range** | | -55ºC to +125ºC | Temperature Cycle Chamber | |
| **Capacitance** | | Within specified tolerance | Freq.: 1.0 MHz ± 10% for cap ≤ 1000 pF<br>1.0 kHz ± 10% for cap > 1000 pF<br>Voltage: 1.0Vrms ± .2V | |
| **Q** | | <30 pF: Q≥ 400+20 x Cap Value<br>≥30 pF: Q≥ 1000 | | |
| **Insulation Resistance** | | 100,000MΩ or 1000MΩ - µF,<br>whichever is less | Charge device with rated voltage for<br>60 ± 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) | |
| **Resistance to Flexure Stresses** | Appearance | No defects | Deflection: 2mm<br>Test Time: 30 seconds<br>  | |
| | Capacitance Variation | ±5% or ±.5 pF, whichever is greater | | |
| | Q | 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 | ≤ ±2.5% or ±.25 pF, whichever is greater | | |
| | Q | 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 | ≤ ±2.5% or ±.25 pF, whichever is greater | Step 2: Room Temp | ≤ 3 minutes |
| | Q | 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 hours at room temperature | |
| **Load Life** | Appearance | No visual defects | Charge device with twice rated voltage 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 hours before measuring. | |
| | Capacitance Variation | ≤ ±3.0% or ± .3 pF, whichever is greater | | |
| | Q (C=Nominal Cap) | ≥ 30 pF: Q≥ 350<br>≥10 pF, <30 pF: Q≥ 275 +5C/2<br><10 pF: Q≥ 200 +10C | | |
| | 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 for 24 ± 2 hours before measuring. | |
| | Capacitance Variation | ≤ ±5.0% or ± .5 pF, whichever is greater | | |
| | Q | ≥ 30 pF: Q≥ 350<br>≥10 pF, <30 pF: Q≥ 275 +5C/2<br><10 pF: Q≥ 200 +10C | | |
| | Insulation Resistance | ≥ Initial Value x 0.3 (See Above) | | |
| | Dielectric Strength | Meets Initial Values (As Above) | | |

# C0G (NP0) Dielectric

## Capacitance Range

### PREFERRED SIZES ARE SHADED

| SIZE | | 0201 | | | 0402 | | | 0603 | | | | 0805 | | | | | 1206 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Soldering | | Reflow Only | | | Reflow Only | | | Reflow/Wave | | | | 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 | 25 | 16 | 25 | 50 | 6.3 | 25 | 50 | 100 | 16 | 25 | 50 | 100 | 200 | 16 | 25 | 50 | 100 | 200 |
| Cap (pF) | 0.5 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 1.0 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 1.2 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 1.5 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 1.8 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 2.2 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 2.7 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 3.3 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 3.9 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 4.7 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 5.6 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 6.8 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 8.2 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 10 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 12 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 15 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 18 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 22 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 27 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 33 | A | A | A | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 39 | A | A | | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 47 | A | A | | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 56 | A | A | | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 68 | A | A | | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 82 | A | | | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 100 | A | | | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 120 | | | | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 150 | | | | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 180 | | | | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 220 | | | | C | C | C | G | G | G | G | E | E | E | E | J | J | J | J | J | J |
| | 270 | | | | C | | | G | G | G | G | E | E | E | J | M | J | J | J | J | J |
| | 330 | | | | C | | | G | G | G | G | E | E | E | J | M | J | J | J | J | J |
| | 390 | | | | | | | G | G | G | | J | J | J | J | M | J | J | J | J | J |
| | 470 | | | | | | | G | G | G | | J | J | J | J | M | J | J | J | J | J |
| | 560 | | | | | | | G | G | G | | J | J | J | J | | J | J | J | J | J |
| | 680 | | | | | | | G | G | G | | J | J | J | J | | J | J | J | J | J |
| | 820 | | | | | | | G | G | G | | J | J | J | J | | J | J | J | J | M |
| | 1000 | | | | | | | G | G | G | | J | J | J | J | | J | J | J | J | Q |
| | 1200 | | | | | | | G | | | | J | J | J | | | J | J | J | J | Q |
| | 1500 | | | | | | | G | | | | J | J | J | | | J | J | J | M | Q |
| | 1800 | | | | | | | G | | | | J | J | J | | | J | J | M | M | |
| | 2200 | | | | | | | | | | | J | J | M | | | J | J | M | P | |
| | 2700 | | | | | | | | | | | J | J | M | | | J | J | M | P | |
| | 3300 | | | | | | | | | | | N | N | | | | J | J | M | P | |
| | 3900 | | | | | | | | | | | N | N | | | | J | J | M | P | |
| | 4700 | | | | | | | | | | | N | N | | | | J | J | M | P | |
| | 5600 | | | | | | | | | | | N | | | | | J | J | M | | |
| | 6800 | | | | | | | | | | | N | | | | | M | M | | | |
| | 8200 | | | | | | | | | | | N | | | | | M | M | | | |
| Cap (µF) | 0.010 | | | | | | | | | | | N | | | | | M | M | | | |
| | 0.012 | | | | | | | | | | | | | | | | | | | | |
| | 0.015 | | | | | | | | | | | | | | | | M | | | | |
| | 0.018 | | | | | | | | | | | | | | | | | | | | |
| | 0.022 | | | | | | | | | | | | | | | | | | | | |
| | 0.027 | | | | | | | | | | | | | | | | | | | | |
| | 0.033 | | | | | | | | | | | | | | | | | | | | |
| | 0.039 | | | | | | | | | | | | | | | | | | | | |
| | 0.047 | | | | | | | | | | | | | | | | | | | | |
| | 0.068 | | | | | | | | | | | | | | | | | | | | |
| | 0.082 | | | | | | | | | | | | | | | | | | | | |
| | 0.1 | | | | | | | | | | | | | | | | | | | | |
| WVDC | | 10 | 16 | 25 | 16 | 25 | 50 | 6.3 | 25 | 50 | 100 | 16 | 25 | 50 | 100 | 200 | 16 | 25 | 50 | 100 | 200 |
| 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 | | | | | | | |

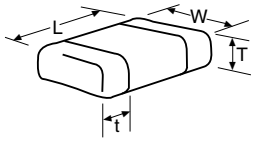
Contact Factory for Multiples

# C0G (NP0) Dielectric

## Capacitance Range

### PREFERRED SIZES ARE SHADED

| SIZE | | 1210 | | | | 1812 | | | | 1825 | | | 2220 | | | 2225 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Soldering | | Reflow/Wave | | | | 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) | | | (0.224 ± 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 | | 25 | 50 | 100 | 200 | 25 | 50 | 100 | 200 | 50 | 100 | 200 | 50 | 100 | 200 | 50 | 100 | 200 |
| Cap (pF) | 0.5 | | | | | | | | | | | | | | | | | |
| | 1.0 | | | | | | | | | | | | | | | | | |
| | 1.2 | | | | | | | | | | | | | | | | | |
| | 1.5 | | | | | | | | | | | | | | | | | |
| | 1.8 | | | | | | | | | | | | | | | | | |
| | 2.2 | | | | | | | | | | | | | | | | | |
| | 2.7 | | | | | | | | | | | | | | | | | |
| | 3.3 | | | | | | | | | | | | | | | | | |
| | 3.9 | | | | | | | | | | | | | | | | | |
| | 4.7 | | | | | | | | | | | | | | | | | |
| | 5.6 | | | | | | | | | | | | | | | | | |
| | 6.8 | | | | | | | | | | | | | | | | | |
| | 8.2 | | | | | | | | | | | | | | | | | |
| | 10 | | | | | | | | | | | | | | | | | |
| | 12 | | | | | | | | | | | | | | | | | |
| | 15 | | | | | | | | | | | | | | | | | |
| | 18 | | | | | | | | | | | | | | | | | |
| | 22 | | | | | | | | | | | | | | | | | |
| | 27 | | | | | | | | | | | | | | | | | |
| | 33 | | | | | | | | | | | | | | | | | |
| | 39 | | | | | | | | | | | | | | | | | |
| | 47 | | | | | | | | | | | | | | | | | |
| | 56 | | | | | | | | | | | | | | | | | |
| | 68 | | | | | | | | | | | | | | | | | |
| | 82 | | | | | | | | | | | | | | | | | |
| | 100 | | | | | | | | | | | | | | | | | |
| | 120 | | | | | | | | | | | | | | | | | |
| | 150 | | | | | | | | | | | | | | | | | |
| | 180 | | | | | | | | | | | | | | | | | |
| | 220 | | | | | | | | | | | | | | | | | |
| | 270 | | | | | | | | | | | | | | | | | |
| | 330 | | | | | | | | | | | | | | | | | |
| | 390 | | | | | | | | | | | | | | | | | |
| | 470 | | | | | | | | | | | | | | | | | |
| | 560 | J | J | J | J | | | | | | | | | | | | | |
| | 680 | J | J | J | J | | | | | | | | | | | | | |
| | 820 | J | J | J | J | | | | | | | | | | | | | |
| | 1000 | J | J | J | J | K | K | K | K | M | M | M | X | X | X | P | P | P |
| | 1200 | J | J | J | J | K | K | K | K | M | M | M | X | X | X | P | P | P |
| | 1500 | J | J | J | M | K | K | K | K | M | M | M | X | X | X | P | P | P |
| | 1800 | J | J | J | M | K | K | K | K | M | M | M | X | X | X | P | P | P |
| | 2200 | J | J | M | Q | K | K | K | K | M | M | M | X | X | X | P | P | P |
| | 2700 | J | J | M | Q | K | K | K | P | M | M | M | X | X | X | P | P | P |
| | 3300 | J | J | M | | K | K | K | P | M | M | M | X | X | X | P | P | P |
| | 3900 | J | J | M | | K | K | K | P | M | M | M | X | X | X | P | P | P |
| | 4700 | J | J | M | | K | K | K | P | M | M | M | X | X | X | P | P | P |
| | 5600 | J | J | M | | K | M | M | P | M | M | M | X | X | X | P | P | P |
| | 6800 | J | J | | | K | M | M | X | M | M | M | X | X | X | P | P | P |
| | 8200 | J | J | | | K | P | X | X | M | M | M | X | X | X | P | P | P |
| Cap (µF) | 0.010 | N | N | | | K | P | X | X | M | M | | X | X | X | P | P | P |
| | 0.012 | | | | | K | P | X | | M | M | | X | X | X | P | P | P |
| | 0.015 | | | | | M | P | X | | M | M | | X | X | X | P | P | Y |
| | 0.018 | | | | | M | | | | P | M | | X | X | X | P | P | Y |
| | 0.022 | | | | | M | | | | P | | | X | X | | P | Y | Y |
| | 0.027 | | | | | M | | | | | | | X | X | | P | Y | Y |
| | 0.033 | | | | | M | | | | | | | X | X | | P | Y | Y |
| | 0.039 | | | | | M | | | | | | | | | | P | Y | Y |
| | 0.047 | | | | | | | | | | | | | | | P | | |
| | 0.068 | | | | | | | | | | | | | | | P | | |
| | 0.082 | | | | | | | | | | | | | | | | | |
| | 0.1 | | | | | | | | | | | | | | | | | |
| WVDC | | 25 | 50 | 100 | 200 | 25 | 50 | 100 | 200 | 50 | 100 | 200 | 50 | 100 | 200 | 50 | 100 | 200 |
| 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 | | | | | | | |

Contact Factory for Multiples

# C0G (NP0) Capacitors for RF/Microwave

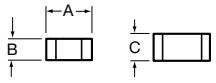
## Ultra Low ESR, "U" Series, C0G (NP0) Chip Capacitors

## GENERAL INFORMATION

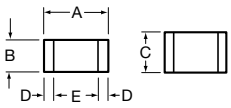
"U" Series capacitors are C0G (NP0) chip capacitors specially designed for "Ultra" low ESR for applications in the communications market. Max ESR and effective capacitance are met on each value producing lot to lot uniformity. Sizes available are EIA chip sizes 0603, 0805, and 1210.

## DIMENSIONS: inches (millimeters)

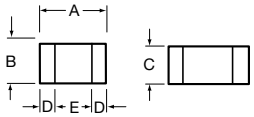
**0402**



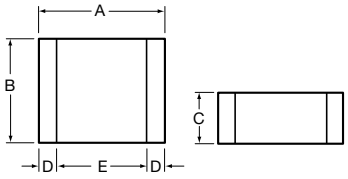

**0603**




**0805**




**1210**




**inches (mm)**

| Size | A | B | C | D | E |
|---|---|---|---|---|---|
| 0402 | 0.039 ± 0.004 (1.00 ± 0.10) | 0.020 ± 0.004 (0.50 ± 0.10) | 0.024 (0.60) max. | N/A | N/A |
| 0603 | 0.060 ± 0.010 (1.52 ± 0.25) | 0.030 ± 0.010 (0.76 ± 0.25) | 0.036 (0.91) max. | 0.010 ± 0.005 (0.25 ± 0.13) | 0.030 (0.76) min. |
| 0805 | 0.079 ± 0.008 (2.01 ± 0.20) | 0.049 ± 0.008 (1.25 ± 0.20) | 0.040 ± 0.005 (1.02 ± 0.127) | 0.020 ± 0.010 (0.51 ± 0.255) | 0.020 (0.51) min. |
| 1210 | 0.126 ± 0.008 (3.2 ± 0.20) | 0.098 ± 0.008 (2.49 ± 0.20) | 0.050 ± 0.005 (1.27 ± 0.127) | 0.025 ± 0.015 (0.635 ± 0.381) | 0.040 (1.02) min. |

## HOW TO ORDER

| 0805 | 1 | U | 100 | J | A | T | 2 | A |
|---|---|---|---|---|---|---|---|---|

**Case Size**
0402
0603
0805
1210

**Voltage Code**
3 = 25V
5 = 50V
1 = 100V
2 = 200V

**Dielectric = Ultra Low ESR**

**Capacitance**
EIA Capacitance Code in pF.
First two digits = significant figures or "R" for decimal place.
Third digit = number of zeros or after "R" significant figures.

**Capacitance Tolerance Code**
B = ±0.1 pF
C = ±0.25 pF
D = ±0.5 pF
F = ±1%
G = ±2%
J = ±5%
K = ±10%
M = ±20%

**Failure Rate Code**
A = Not Applicable

**Termination**
T= Plated Ni and Solder

**Packaging Code**
2 = 7" Reel
4 = 13" Reel
9 = Bulk

**Special Code**
A = Standard

## ELECTRICAL CHARACTERISTICS

**Capacitance Values and Tolerances:**
Size 0402 - 0.2 pF to 15 pF @ 1 MHz
Size 0603 - 1.0 pF to 47 pF @ 1 MHz
Size 0805 - 1.6 pF to 160 pF @ 1 MHz
Size 1210 - 2.4 pF to 1000 pF @ 1 MHz

**Temperature Coefficient of Capacitance (TC):**
0 ± 30 ppm/°C (-55° to +125°C)

**Insulation Resistance (IR):**
$10^{12}$ Ω min. @ 25°C and rated WVDC
$10^{11}$ Ω min. @ 125°C and rated WVDC

**Working Voltage (WVDC):**

| Size | | Working Voltage |
|---|---|---|
| 0402 | - | 25 WVDC |
| 0603 | - | 200, 100, 50 WVDC |
| 0805 | - | 200, 100 WVDC |
| 1210 | - | 200, 100 WVDC |

**Dielectric Working Voltage (DWV):**
250% of rated WVDC

**Equivalent Series Resistance Typical (ESR):**

| | | |
|---|---|---|
| 0402 | - | See Performance Curve, page 9 |
| 0603 | - | See Performance Curve, page 9 |
| 0805 | - | See Performance Curve, page 9 |
| 1210 | - | See Performance Curve, page 9 |

**Marking:** Laser marking EIA J marking standard (except 0603) (capacitance code and tolerance upon request).

**MILITARY SPECIFICATIONS**
Meets or exceeds the requirements of MIL-C-55681

# C0G (NP0) Capacitors for RF/Microwave

## Ultra Low ESR, “U” Series, C0G (NP0) Chip Capacitors

## CAPACITANCE RANGE

| Cap (pF) | Available Tolerance | Size 0402 | 0603 | 0805 | 1210 |
|---|---|---|---|---|---|
| 0.2 | B,C | 25V | N/A | N/A | N/A |
| 0.3 | ↕ | ↓ | ↓ | ↓ | ↓ |
| 0.4 | ↕ | ↓ | ↓ | ↓ | ↓ |
| 0.5 | B,C | ↓ | ↓ | ↓ | ↓ |
| 0.6 | B,C,D | ↓ | ↓ | ↓ | ↓ |
| 0.7 | ↕ | ↓ | ↓ | ↓ | ↓ |
| 0.8 | ↕ | ↓ | ↓ | ↓ | ↓ |
| 0.9 | B,C,D | ↓ | ↓ | ↓ | ↓ |

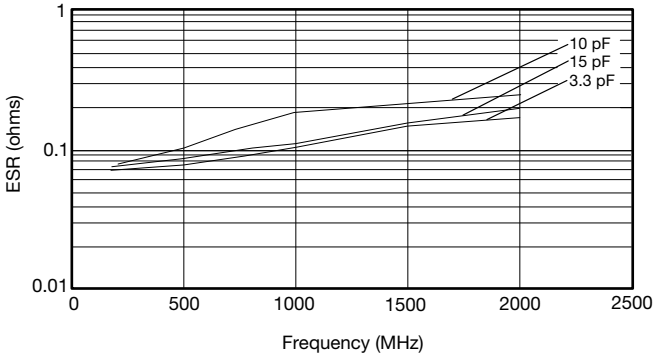
| Cap (pF) | Available Tolerance | Size 0402 | 0603 | 0805 | 1210 |
|---|---|---|---|---|---|
| 1.0 | B,C,D | 25V | 200V | N/A | N/A |
| 1.1 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 1.2 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 1.3 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 1.4 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 1.5 | ↑ | ↓ | ↓ | 200 | ↓ |
| 1.6 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 1.7 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 1.8 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 1.9 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 2.0 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 2.1 | ↑ | ↓ | ↓ | ↓ | 200 |
| 2.2 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 2.4 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 2.7 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 3.0 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 3.3 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 3.6 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 3.9 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 4.3 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 4.7 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 5.1 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 5.6 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 6.2 | B,C,D | ↓ | ↓ | ↓ | ↓ |
| 6.8 | B,C,J,K,M | ↓ | ↓ | ↓ | ↓ |

| Cap (pF) | Available Tolerance | Size 0402 | 0603 | 0805 | 1210 |
|---|---|---|---|---|---|
| 7.5 | B,C,J,K,M | 25V | 200V | 200V | 200V |
| 8.2 | ↓ | ↓ | ↓ | ↓ | ↓ |
| 9.1 | B,C,J,K,M | ↓ | ↓ | ↓ | ↓ |
| 10 | F,G,J,K,M | ↓ | ↓ | ↓ | ↓ |
| 11 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 12 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 13 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 15 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 18 | ↑ | N/A | 100 | ↓ | ↓ |
| 20 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 22 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 24 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 27 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 30 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 33 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 36 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 39 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 43 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 47 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 51 | ↑ | ↓ | 50 | ↓ | ↓ |
| 56 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 68 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 75 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 82 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 91 | F,G,J,K,M | ↓ | ↓ | 100 | ↓ |

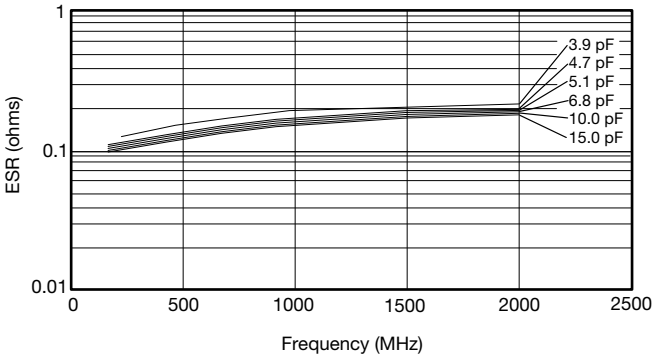
| Cap (pF) | Available Tolerance | Size 0402 | 0603 | 0805 | 1210 |
|---|---|---|---|---|---|
| 100 | F,G,J,K,M | N/A | 50V | 100V | 200V |
| 110 | ↑ | ↓ | N/A | ↓ | ↓ |
| 120 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 130 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 140 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 150 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 160 | ↑ | ↓ | ↓ | N/A | ↓ |
| 180 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 200 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 220 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 270 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 300 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 330 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 360 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 390 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 430 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 470 | ↑ | ↓ | ↓ | ↓ | 100 |
| 510 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 560 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 620 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 680 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 750 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 820 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 910 | ↑ | ↓ | ↓ | ↓ | ↓ |
| 1000 | F,G,J,K,M | ↓ | ↓ | ↓ | ↓ |

## ULTRA LOW ESR, “U” SERIES

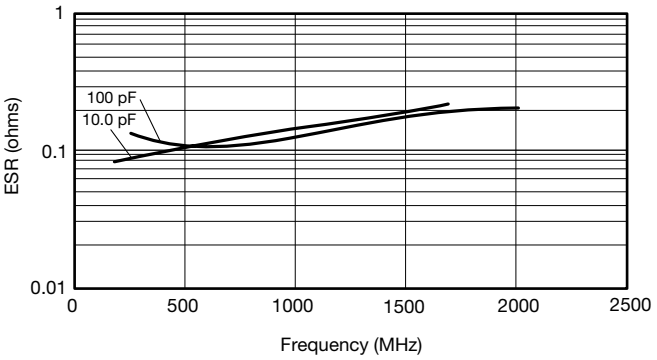
**TYPICAL ESR vs. FREQUENCY**
**0402 “U” SERIES**



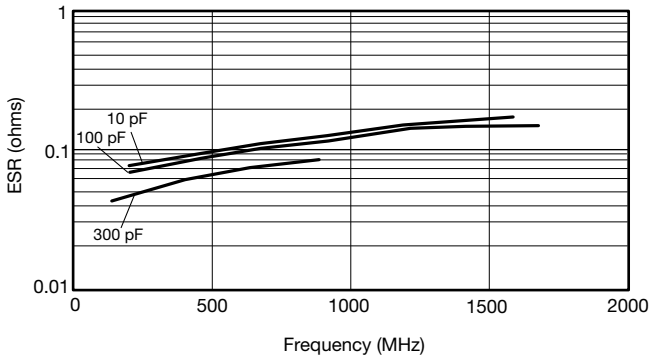

**TYPICAL ESR vs. FREQUENCY**
**0603 “U” SERIES**



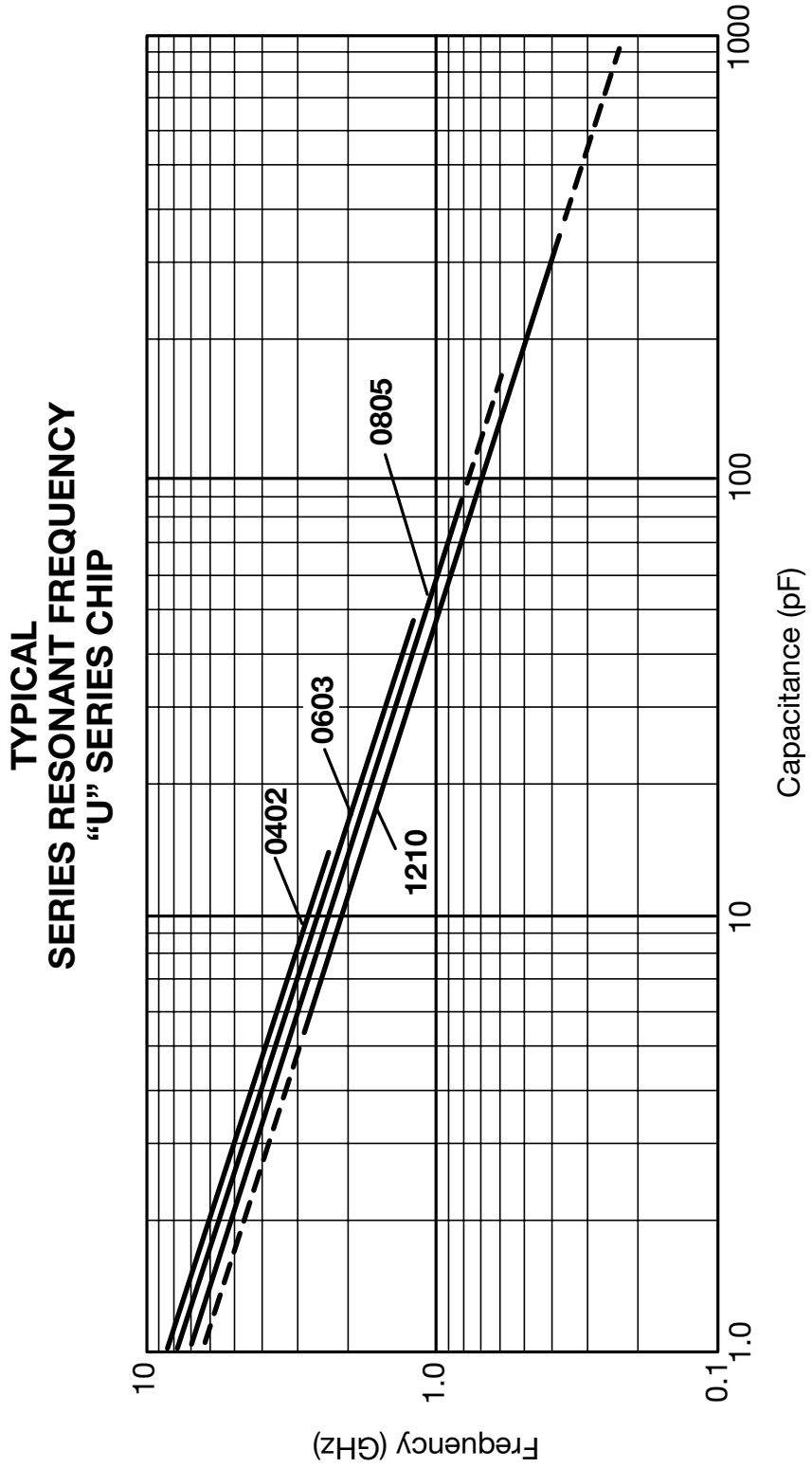

**TYPICAL ESR vs. FREQUENCY**
**0805 “U” SERIES**




**TYPICAL ESR vs. FREQUENCY**
**1210 “U” SERIES**

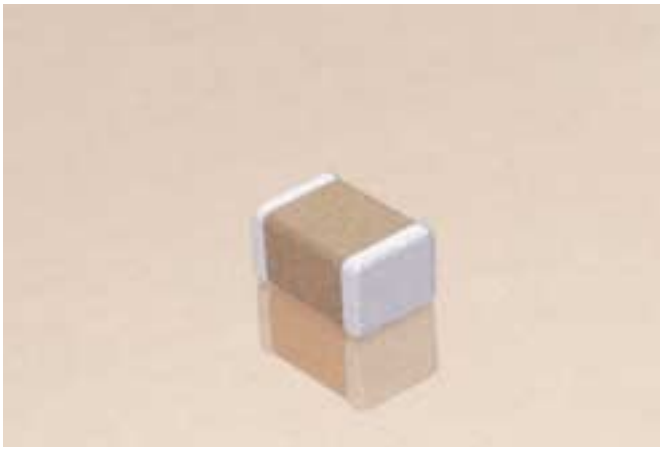



**ESR Measured on the Boonton 34A**


TYPICAL
SERIES RESONANT FREQUENCY
“U” SERIES CHIP
0805
0603
0402
1210
1000
100
10
1.0
Capacitance (pF)
10
1.0
0.1
Frequency (GHz)

# 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.

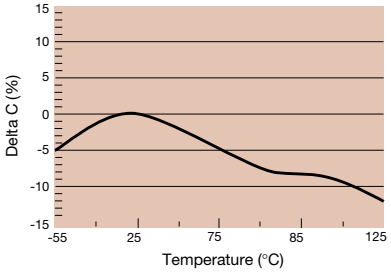
Capacitance for X7R varies under the influence of electrical operating conditions such as voltage and frequency.

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

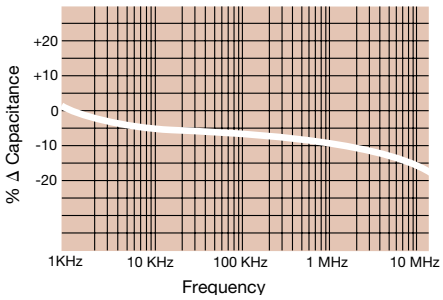
## PART NUMBER (see page 3 for complete part number explanation)

| 0805 | 5 | C | 103 | M | A | T | 2 | A |
|---|---|---|---|---|---|---|---|---|
| **Size** (L" x W") | **Voltage** 6.3V = 6, 10V = Z, 16V = Y, 25V = 3, 50V = 5, 100V = 1 | **Dielectric** X7R = C | **Capacitance Code** 2 Sig. Digits + Number of Zeros | **Capacitance Tolerance** Preferred J = ± 5%, K = ±10%, M = ± 20% | **Failure Rate** A = Not Applicable | **Terminations** T = Plated Ni and Solder | **Packaging** 2 = 7" Reel, 4 = 13" Reel. **Contact Factory For Multiples** | **Special Code** A = Std. Product |

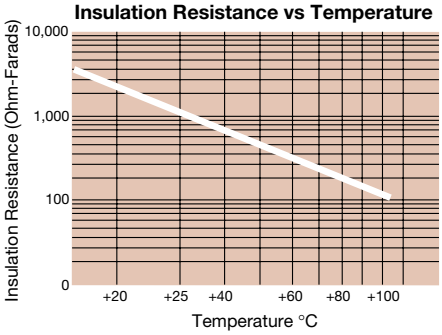
**X7R TC**
**Temperature Coefficient**



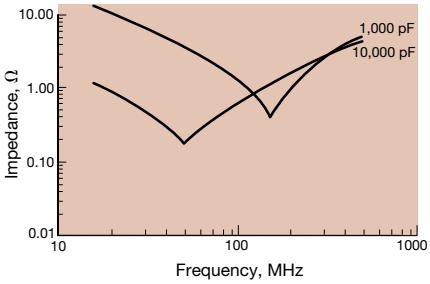

**Δ Capacitance vs. Frequency**



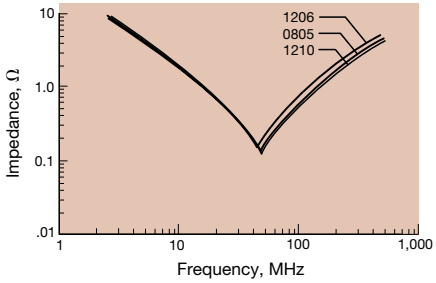

**Insulation Resistance vs Temperature**



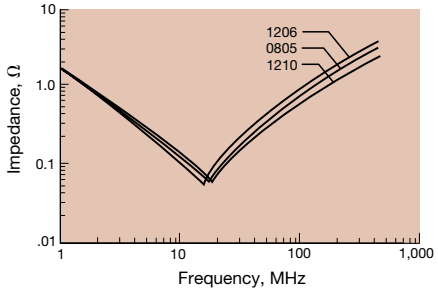

**Variation of Impedance with Cap Value**
**Impedance vs. Frequency**
**1,000 pF vs. 10,000 pF - X7R**
**0805**




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

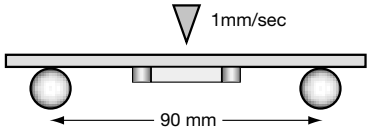



**Variation of Impedance with Chip Size**
**Impedance vs. Frequency**
**100,000 pF - X7R**



# X7R Dielectric

## Specifications and Test Methods

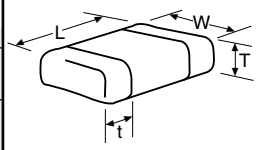
| Parameter/Test | | X7R Specification Limits | Measuring Conditions | |
|---|---|---|---|---|
| **Operating Temperature Range** | | -55ºC to +125ºC | Temperature Cycle Chamber | |
| **Capacitance** | | Within specified tolerance | Freq.: 1.0 kHz ± 10%<br>Voltage: 1.0Vrms ± .2V | |
| **Dissipation Factor** | | ≤ 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 60 ± 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) | |
| **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 twice rated voltage 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/Wave | | | | | | | 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 | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 50 | 100 | 200 | 10 | 16 | 25 | 50 | 100 | 200 | 10 | 16 | 25 | 50 | 100 | 200 |
| Cap (pF) | 100 | A | A | C | C | C | C | C | | | | | | | | | | | | | | | | | | | |
| | 120 | A | A | C | C | C | C | C | | | | | | | | | | | | | | | | | | | |
| | 150 | A | A | C | C | C | C | C | | | | | | | | | | | | | | | | | | | |
| | 180 | A | A | C | C | C | C | C | G | G | G | G | G | G | G | | | | | | | | | | | | |
| | 220 | A | A | C | C | C | C | C | G | G | G | G | G | G | G | | | | | | | | | | | | |
| | 270 | A | A | C | C | C | C | C | G | G | G | G | G | G | G | E | E | E | E | E | E | | | | | | |
| | 330 | A | A | C | C | C | C | C | G | G | G | G | G | G | G | E | E | E | E | E | E | | | | | | |
| | 390 | A | A | C | C | C | C | C | G | G | G | G | G | G | G | E | E | E | E | E | E | | | | | | |
| | 470 | A | A | C | C | C | C | C | G | G | G | G | G | G | G | E | E | E | E | E | E | | | | | | |
| | 560 | A | A | C | C | C | C | C | G | G | G | G | G | G | G | E | E | E | E | E | E | | | | | | |
| | 680 | A | A | C | C | C | C | C | G | G | G | G | G | G | G | E | E | E | E | E | E | | | | | | |
| | 820 | A | A | C | C | C | C | C | G | G | G | G | G | G | G | E | E | E | E | E | E | | | | | | |
| | 1000 | A | A | C | C | C | C | C | G | G | G | G | G | G | G | E | E | E | E | E | E | J | J | J | J | J | J |
| | 1200 | | | C | C | C | C | C | G | G | G | G | G | G | | E | E | E | E | E | E | J | J | J | J | J | J |
| | 1500 | | | C | C | C | C | C | G | G | G | G | G | G | | E | E | E | E | E | J | J | J | J | J | J | J |
| | 1800 | | | C | C | C | C | C | G | G | G | G | G | G | | E | E | E | E | E | J | J | J | J | J | J | J |
| | 2200 | | | C | C | C | C | C | G | G | G | G | G | G | | E | E | E | E | E | J | J | J | J | J | J | J |
| | 2700 | | | C | C | C | C | C | G | G | G | G | G | G | | E | E | E | E | E | J | J | J | J | J | J | J |
| | 3300 | | | C | C | C | C | C | G | G | G | G | G | G | | E | E | E | E | E | J | J | J | J | J | J | J |
| | 3900 | | | C | C | C | C | C | G | G | G | G | G | G | | E | E | E | E | E | J | J | J | J | J | J | J |
| | 4700 | | | C | C | C | C | C | G | G | G | G | G | G | | E | E | E | E | E | J | J | J | J | J | J | J |
| | 5600 | | | C | C | C | C | | G | G | G | G | G | G | | E | E | E | E | J | J | J | J | J | J | J | J |
| | 6800 | | | C | C | C | C | | G | G | G | G | G | G | | E | E | E | E | J | J | J | J | J | J | J | J |
| | 8200 | | | C | C | C | C | | G | G | G | G | G | G | | E | E | E | E | J | J | J | J | J | J | J | J |
| Cap. (µF) | 0.010 | | | C | C | C | | | G | G | G | G | G | G | | E | E | E | E | J | J | J | J | J | J | J | J |
| | 0.012 | | | C | C | C | | | G | G | G | G | G | G | | J | J | J | J | J | J | J | J | J | J | J | M |
| | 0.015 | | | C | C | C | | | G | G | G | G | G | G | | J | J | J | J | J | J | J | J | J | J | J | M |
| | 0.018 | | | C | C | C | | | G | G | G | G | G | | | J | J | J | J | J | M | J | J | J | J | J | M |
| | 0.022 | | | C | C | C | | | G | G | G | G | G | | | J | J | J | J | J | M | J | J | J | J | J | M |
| | 0.027 | | | C | C | C | | | G | G | G | G | G | | | J | J | J | J | J | M | J | J | J | J | J | M |
| | 0.033 | | | C | C | | | | G | G | G | G | G | | | J | J | J | J | M | | J | J | J | J | J | M |
| | 0.039 | | | C | C | | | | G | G | G | G | G | | | J | J | J | J | M | | J | J | J | J | J | M |
| | 0.047 | | | | | | | | G | G | G | G | | | | J | J | J | J | M | | J | J | J | J | J | M |
| | 0.056 | | | | | | | | G | G | G | G | | | | J | J | J | J | | | J | J | J | J | J | P |
| | 0.068 | | | | | | | | G | G | G | G | | | | J | J | J | J | | | J | J | J | J | J | P |
| | 0.082 | | | | | | | | G | G | G | G | | | | J | J | J | J | | | J | J | J | J | M | |
| | 0.10 | | | | | | | | G | G | G | G | | | | J | J | J | J | J | | J | J | J | J | M | |
| | 0.12 | | | | | | | | G | G | G | G | | | | J | J | J | J | M | | J | J | J | J | | |
| | 0.15 | | | | | | | | G | G | G | G | | | | J | J | J | J | | | J | J | J | J | | |
| | 0.18 | | | | | | | | G | G | | | | | | J | J | M | | | | J | J | J | J | | |
| | 0.22 | | | | | | | | G | G | | | | | | J | J | M | | | | J | J | J | J | | |
| | 0.27 | | | | | | | | | | | | | | | M | M | | | | | J | J | J | M | | |
| | 0.33 | | | | | | | | | | | | | | | M | M | | | | | J | J | M | M | | |
| | 0.47 | | | | | | | | | | | | | | | N | M | | | | | M | M | M | | | |
| | 0.56 | | | | | | | | | | | | | | | N | M | | | | | M | M | Q | | | |
| | 0.68 | | | | | | | | | | | | | | | N | | | | | | M | M | Q | | | |
| | 0.82 | | | | | | | | | | | | | | | N | | | | | | M | M | Q | | | |
| | 1.0 | | | | | | | | | | | | | | | N | | | | | | M | M | Q | | | |
| | 1.2 | | | | | | | | | | | | | | | | | | | | | P | | | | | |
| | 1.5 | | | | | | | | | | | | | | | | | | | | | P | | | | | |
| | 1.8 | | | | | | | | | | | | | | | | | | | | | P | | | | | |
| | 2.2 | | | | | | | | | | | | | | | | | | | | | Q | | | | | |
| | 3.3 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4.7 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 10 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 22 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 47 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 100 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WVDC | | 10 | 16 | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 50 | 100 | 200 | 10 | 16 | 25 | 50 | 100 | 200 | 10 | 16 | 25 | 50 | 100 | 200 |
| 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 | | | | | | | |

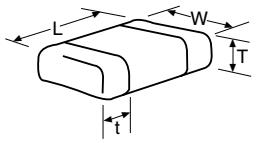
Contact Factory for Multiples

# X7R Dielectric

## Capacitance Range

### PREFERRED SIZES ARE SHADED

| SIZE | | 1210 | | | | | 1812 | | | | 1825 | | 2220 | | | 2225 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Soldering | | Reflow/Wave | | | | | 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 | | 5.7 ± 0.40 | | | 5.72 ± 0.25 | |
| | (in.) | (0.126 ± 0.008) | | | | | (0.177 ± 0.012) | | | | (0.177 ± 0.012) | | (0.224 ± 0.016) | | | (0.225 ± 0.010) | |
| (W) Width | MM | 2.50 ± 0.20 | | | | | 3.20 ± 0.20 | | | | 6.40 ± 0.40 | | 5.0 ± 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 | | 10 | 16 | 25 | 50 | 100 | 16 | 25 | 50 | 100 | 50 | 100 | 50 | 100 | 200 | 50 | 100 |
| Cap (pF) | 100 | | | | | | | | | | | | | | | | |
| | 120 | | | | | | | | | | | | | | | | |
| | 150 | | | | | | | | | | | | | | | | |
| | 180 | | | | | | | | | | | | | | | | |
| | 220 | | | | | | | | | | | | | | | | |
| | 270 | | | | | | | | | | | | | | | | |
| | 330 | | | | | | | | | | | | | | | | |
| | 390 | | | | | | | | | | | | | | | | |
| | 470 | | | | | | | | | | | | | | | | |
| | 560 | | | | | | | | | | | | | | | | |
| | 680 | | | | | | | | | | | | | | | | |
| | 820 | | | | | | | | | | | | | | | | |
| | 1000 | J | J | J | J | J | | | | | | | | | | | |
| | 1200 | J | J | J | J | J | | | | | | | | | | | |
| | 1500 | J | J | J | J | J | | | | | | | | | | | |
| | 1800 | J | J | J | J | J | | | | | | | | | | | |
| | 2200 | J | J | J | J | J | | | | | | | | | | | |
| | 2700 | J | J | J | J | J | | | | | | | | | | | |
| | 3300 | J | J | J | J | J | | | | | | | | | | | |
| | 3900 | J | J | J | J | J | | | | | | | | | | | |
| | 4700 | J | J | J | J | J | | | | | | | | | | | |
| | 5600 | J | J | J | J | J | | | | | | | | | | | |
| | 6800 | J | J | J | J | J | | | | | | | | | | | |
| | 8200 | J | J | J | J | J | | | | | | | | | | | |
| Cap. (µF) | 0.010 | J | J | J | J | J | | | K | K | M | M | X | X | X | M | M |
| | 0.012 | J | J | J | J | J | | | K | K | M | M | X | X | X | M | M |
| | 0.015 | J | J | J | J | J | | | K | K | M | M | X | X | X | M | M |
| | 0.018 | J | J | J | J | J | | | K | K | M | M | X | X | X | M | M |
| | 0.022 | J | J | J | J | J | | | K | K | M | M | X | X | X | M | M |
| | 0.027 | J | J | J | J | J | | | K | K | M | M | X | X | X | M | M |
| | 0.033 | J | J | J | J | J | | | K | K | M | M | X | X | X | M | M |
| | 0.039 | J | J | J | J | J | | | K | K | M | M | X | X | X | M | M |
| | 0.047 | J | J | J | J | J | | | K | K | M | M | X | X | X | M | M |
| | 0.056 | J | J | J | J | J | | | K | K | M | M | X | X | X | M | M |
| | 0.068 | J | J | J | J | J | | | K | K | M | M | X | X | X | M | M |
| | 0.082 | J | J | J | J | J | | | K | K | M | M | X | X | X | M | M |
| | 0.10 | J | J | J | J | J | | | K | K | M | M | X | X | X | M | M |
| | 0.12 | J | J | J | J | M | | | K | K | M | M | X | X | X | M | M |
| | 0.15 | J | J | J | J | M | | | K | K | M | M | X | X | X | M | M |
| | 0.18 | J | J | J | J | P | | | K | K | M | M | X | X | X | M | M |
| | 0.22 | J | J | J | J | P | | | K | K | M | M | X | X | X | M | M |
| | 0.27 | J | J | J | J | | | | K | M | M | M | X | X | | M | M |
| | 0.33 | J | J | J | J | | | | K | M | M | M | X | X | | M | M |
| | 0.47 | M | M | M | M | | | | K | P | M | M | X | X | | M | M |
| | 0.56 | M | M | M | | | | | M | Q | M | | X | X | | M | M |
| | 0.68 | M | M | P | | | | | M | Q | M | | X | X | | M | M |
| | 0.82 | M | M | P | | | | | M | | M | | X | | | M | M |
| | 1.0 | N | N | P | X | | | | M | | M | | X | | | M | M |
| | 1.2 | N | N | | | | | | | | M | | X | | | M | P |
| | 1.5 | N | N | | | | | | | | M | | | | | M | P |
| | 1.8 | N | N | | | | | | | | | | | | | M | |
| | 2.2 | | | X | | | | | | | | | | | | M | |
| | 3.3 | | | | | | | | | | | | | | | | |
| | 4.7 | Q | Z | | | | | | | | | | | | | | |
| | 10 | Z | | | | | Z | | | | | | | | | | |
| | 22 | | | | | | | | | | | | | | | | |
| | 47 | | | | | | | | | | | | | | | | |
| | 100 | | | | | | | | | | | | | | | | |
| WVDC | | 10 | 16 | 25 | 50 | 100 | 16 | 25 | 50 | 100 | 50 | 100 | 50 | 100 | 200 | 50 | 100 |
| SIZE | | 1210 | | | | | 1812 | | | | 1825 | | 2220 | | | 2225 | |

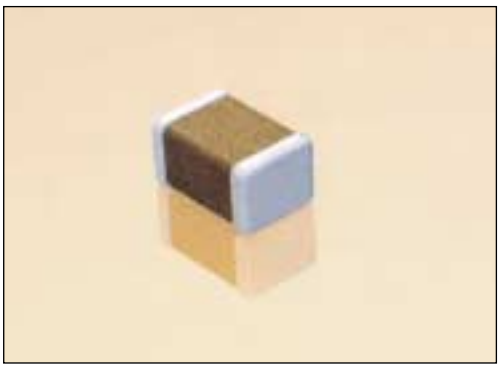



| Letter | A | C | E | G | J | K | M | N | P | Q | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. Thickness | 0.33 (0.013) | 0.56 (0.022) | 0.71 (0.028) | 0.86 (0.034) | 0.94 (0.037) | 1.02 (0.040) | 1.27 (0.050) | 1.40 (0.055) | 1.52 (0.060) | 1.78 (0.070) | 2.29 (0.090) | 2.54 (0.100) | 2.79 (0.110) |
| | PAPER | | | | | EMBOSSED | | | | | | | |

Contact Factory for Multiples

# X5R Dielectric

## General Specifications



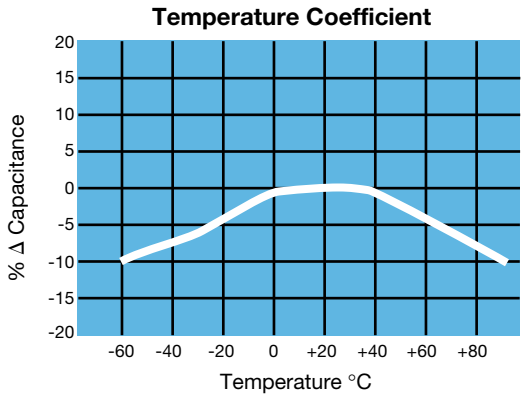
## GENERAL DESCRIPTION

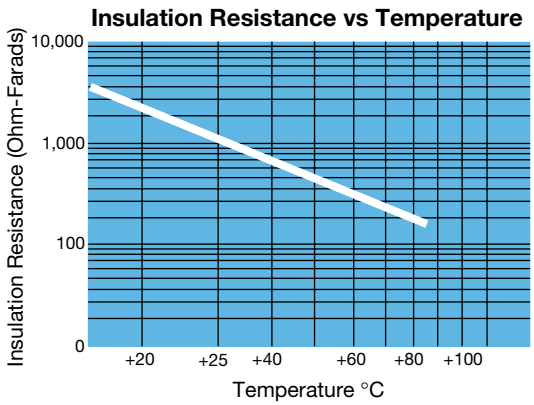
- General Purpose Dielectric for Ceramic Capacitors
- EIA Class II Dielectric
- Temperature variation of capacitance is within ±15% from -55°C to +85°C
- Well suited for decoupling and filtering applications
- Available in High Capacitance values (up to 100µF)

## HOW TO ORDER

| 2220 | 6 | D | 107 | M | A | T | 2 | A |
|---|---|---|---|---|---|---|---|---|
| **Size** LxW | **Voltage** 6 = 6.3V Z = 10V Y = 16V 3 = 25V 5 = 50V | **Dielectric** D = X5R | **Capacitance Code** 2 Sig. Digits + Number of Zeros | **Capacitance Tolerance** J = ±5% K = ±10% M = ±20% | **Failure Rate** A = N/A | **Termination Code** T = Ni/Sn | **Packaging Code** 2 = 7" Reel 4 = 13" Reel | **Special Code** A = Std. |

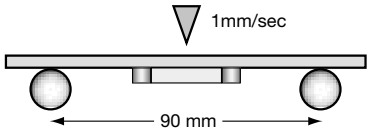
## TYPICAL ELECTRICAL CHARACTERISTICS



# X5R Dielectric

## Specifications and Test Methods

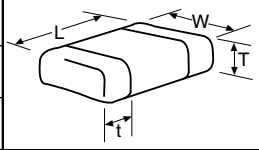
| Parameter/Test | | X5R Specification Limits | Measuring Conditions | |
|---|---|---|---|---|
| **Operating Temperature Range** | | -55ºC to +85ºC | Temperature Cycle Chamber | |
| **Capacitance** | | Within specified tolerance | Freq.: 1.0 kHz ± 10%<br>Voltage: 1.0Vrms ± .2V<br>For Cap > 10 µF, 0.5Vrms @ 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 500MΩ - µF, whichever is less | Charge device with rated voltage for 60 ± 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) | |
| **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: +85ºC ± 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 twice rated voltage in test chamber set at 85ºC ± 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) | | |

# X5R Dielectric

## Capacitance Range

### PREFERRED SIZES ARE SHADED

| SIZE | 0201 | 0402 | | | 0603 | | | | 0805 | | | | 1206 | | | | 1210 | | | | 1812 | | | | 2220 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Soldering** | Reflow Only | Reflow Only | | | Reflow/Wave | | | | Reflow/Wave | | | | Reflow/Wave | | | | Reflow/Wave | | | | Reflow Only | | | | Reflow Only |
| **Packaging** | All Paper | All Paper | | | All Paper | | | | Paper/Embossed | | | | Paper/Embossed | | | | Paper/Embossed | | | | All Embossed | | | | All Embossed |
| (L) Length MM | 0.60 ± 0.03 | 1.00 ± 0.10 | | | 1.60 ± 0.15 | | | | 2.01 ± 0.20 | | | | 3.20 ± 0.20 | | | | 3.20 ± 0.20 | | | | 4.50 ± 0.30 | | | | 5.70 ± 0.40 |
| (in.) | (0.024 ± 0.001) | (0.040 ± 0.004) | | | (0.063 ± 0.006) | | | | (0.079 ± 0.008) | | | | (0.126 ± 0.008) | | | | (0.126 ± 0.008) | | | | (0.177 ± 0.012) | | | | (0.225 ± 0.016) |
| (W) Width MM | 0.30 ± 0.03 | 0.50 ± 0.10 | | | 0.81 ± 0.15 | | | | 1.25 ± 0.20 | | | | 1.60 ± 0.20 | | | | 2.50 ± 0.20 | | | | 3.20 ± 0.20 | | | | 5.00 ± 0.40 |
| (in.) | (0.011 ± 0.001) | (0.020 ± 0.004) | | | (0.032 ± 0.006) | | | | (0.049 ± 0.008) | | | | (0.063 ± 0.008) | | | | (0.098 ± 0.008) | | | | (0.126 ± 0.008) | | | | (0.197 ± 0.016) |
| (T) Max. Thickness MM | 0.30 ± 0.03 | 0.60 | | | 0.90 | | | | 1.30 | | | | 1.50 | | | | 1.70 | | | | 1.70 | | | | 2.30 |
| (in.) | (0.011 ± 0.001) | (0.024) | | | (0.035) | | | | (0.051) | | | | (0.059) | | | | (0.010) | | | | (0.067) | | | | (0.090) |
| (t) Terminal MM | 0.15 ± 0.05 | 0.25 ± 0.15 | | | 0.35 ± 0.15 | | | | 0.50 ± 0.25 | | | | 0.50 ± 0.25 | | | | 0.50 ± 0.25 | | | | 0.61 ± 0.36 | | | | 0.64 ± 0.39 |
| (in.) | (0.006 ± 0.002) | (0.010 ± 0.006) | | | (0.014 ± 0.006) | | | | (0.020 ± 0.010) | | | | (0.020 ± 0.010) | | | | (0.020 ± 0.010) | | | | (0.024 ± 0.014) | | | | (0.025 ± 0.015) |
| WVDC | 10 | 6.3 | 10 | 16 | 6.3 | 10 | 16 | 25 | 6.3 | 10 | 16 | 25 | 6.3 | 10 | 16 | 25 | 6.3 | 10 | 16 | 25 | 6.3 | 10 | 16 | 25 | 6.3 |
| Cap (pF) 100 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 150 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 220 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 330 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 470 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 680 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1000 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1200 | A | | | | | | | | | | | | | | | | | | | | | | | | |
| 1500 | A | | | | | | | | | | | | | | | | | | | | | | | | |
| 1800 | A | | | | | | | | | | | | | | | | | | | | | | | | |
| 2200 | A | | | | | | | | | | | | | | | | | | | | | | | | |
| 2700 | A | | | | | | | | | | | | | | | | | | | | | | | | |
| 3300 | A | | | | | | | | | | | | | | | | | | | | | | | | |
| 3900 | A | | | | | | | | | | | | | | | | | | | | | | | | |
| 4700 | A | | | | | | | | | | | | | | | | | | | | | | | | |
| 5600 | A | | | | | | | | | | | | | | | | | | | | | | | | |
| 6800 | A | | | | | | | | | | | | | | | | | | | | | | | | |
| 8200 | A | | | | | | | | | | | | | | | | | | | | | | | | |
| Cap. (µF) 0.010 | A | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.012 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.015 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.018 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.022 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.027 | | | C | C | | | | | | | | | | | | | | | | | | | | | |
| 0.033 | | | C | C | | | | | | | | | | | | | | | | | | | | | |
| 0.039 | | | C | C | | | | | | | | | | | | | | | | | | | | | |
| 0.047 | | | C | C | | | | | | | | | | | | | | | | | | | | | |
| 0.056 | | | C | | | | | G | | | | | | | | | | | | | | | | | |
| 0.068 | | | C | | | | | G | | | | | | | | | | | | | | | | | |
| 0.082 | | | C | | | | | G | | | | | | | | | | | | | | | | | |
| 0.10 | | C | C | | | | G | G | | | | | | | | | | | | | | | | | |
| 0.12 | | C | | | | | G | G | | | | | | | | | | | | | | | | | |
| 0.15 | | C | | | | | G | G | | | | | | | | | | | | | | | | | |
| 0.18 | | C | | | G | G | G | G | | | | | | | | | | | | | | | | | |
| 0.22 | | C | | | G | G | G | G | | | | | | | | | | | | | | | | | |
| 0.27 | | | | | G | G | G | G | | | | | | | | | | | | | | | | | |
| 0.33 | | | | | G | G | G | | | | N | N | | | | | | | | | | | | | |
| 0.47 | | | | | G | G | G | | | | N | N | | | | | | | | | | | | | |
| 0.56 | | | | | G | G | G | | | | N | N | | | | M | | | | | | | | | |
| 0.68 | | | | | G | G | | | | | N | N | | | | M | | | | | | | | | |
| 0.82 | | | | | G | G | | | | | N | N | | | | M | | | | | | | | | |
| 1.0 | | | | | G | G | | | | N | N | N | | | | Q | | | | | | | | | |
| 1.2 | | | | | G | | | | | N | | | | | Q | | | | | | | | | | |
| 1.5 | | | | | G | | | | | N | | | | | Q | | | | | | | | | | |
| 1.8 | | | | | G | | | | | N | | | | | Q | | | | | | | | | | |
| 2.2 | | | | | G | | | | | N | | | | Q | | | | | | X | | | | | |
| 3.3 | | | | | | | | | | N | | | | Q | | | | Q | Q | Z | | | | | |
| 4.7 | | | | | | | | | N | N | | | | Q | | | | Q | Q | Z | | | | | |
| 6.8 | | | | | | | | | N | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | N | | | | Q | Q | | | X | X | X | | | Z | | Z | |
| 22 | | | | | | | | | | | | | Q | | | | Z | X | | | | | | | |
| 47 | | | | | | | | | | | | | | | | | | | | | Z | | | | |
| 100 | | | | | | | | | | | | | | | | | | | | | | | | | Z |
| WVDC | 10 | 6.3 | 10 | 16 | 6.3 | 10 | 16 | 25 | 6.3 | 10 | 16 | 25 | 6.3 | 10 | 16 | 25 | 6.3 | 10 | 16 | 25 | 6.3 | 10 | 16 | 25 | 6.3 |
| **SIZE** | **0201** | **0402** | | | **0603** | | | | **0805** | | | | **1206** | | | | **1210** | | | | **1812** | | | | **2220** |




| 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** | | | | | | | |

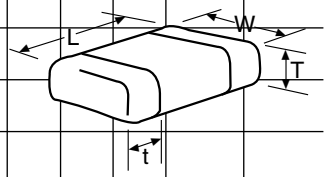
Contact Factory for Multiples

# X5R Dielectric

## Capacitance Range

### PREFERRED SIZES ARE SHADED

| SIZE | | 1210 | | | | 1812 | | | | 2220 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Soldering | | Reflow/Wave | | | | Reflow Only | | | | Reflow Only | |
| Packaging | | Paper/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) | | | | 5.70 ± 0.40 (0.224 ± 0.016) | |
| (W) Width | MM (in.) | 2.50 ± 0.20 (0.098 ± 0.008) | | | | 3.20 ± 0.20 (0.126 ± 0.008) | | | | 5.0 ± 0.40 (0.197 ± 0.016) | |
| (t) Terminal | MM (in.) | 0.50 ± 0.25 (0.020 ± 0.010) | | | | 0.61 ± 0.36 (0.024 ± 0.014) | | | | 0.64 ± 0.39 (0.025 ± 0.015) | |
| WVDC | | 6.3 | 10 | 16 | 25 | 6.3 | 10 | 16 | 25 | 6.3 | 50 |
| Cap (pF) | 100 | | | | | | | | | | |
| | 150 | | | | | | | | | | |
| | 220 | | | | | | | | | | |
| | 330 | | | | | | | | | | |
| | 470 | | | | | | | | | | |
| | 680 | | | | | | | | | | |
| | 1000 | | | | | | | | | | |
| | 1200 | | | | | | | | | | |
| | 1500 | | | | | | | | | | |
| | 1800 | | | | | | | | | | |
| | 2200 | | | | | | | | | | |
| | 2700 | | | | | | | | | | |
| | 3300 | | | | | | | | | | |
| | 3900 | | | | | | | | | | |
| | 4700 | | | | | | | | | | |
| | 5600 | | | | | | | | | | |
| | 6800 | | | | | | | | | | |
| | 8200 | | | | | | | | | | |
| Cap. (µF) | 0.010 | | | | | | | | | | |
| | 0.012 | | | | | | | | | | |
| | 0.015 | | | | | | | | | | |
| | 0.018 | | | | | | | | | | |
| | 0.022 | | | | | | | | | | |
| | 0.027 | | | | | | | | | | |
| | 0.033 | | | | | | | | | | |
| | 0.039 | | | | | | | | | | |
| | 0.047 | | | | | | | | | | |
| | 0.056 | | | | | | | | | | |
| | 0.068 | | | | | | | | | | |
| | 0.082 | | | | | | | | | | |
| | 0.10 | | | | | | | | | | |
| | 0.12 | | | | | | | | | | |
| | 0.15 | | | | | | | | | | |
| | 0.18 | | | | | | | | | | |
| | 0.22 | | | | | | | | | | |
| | 0.27 | | | | | | | | | | |
| | 0.33 | | | | | | | | | | |
| | 0.47 | | | | | | | | | | |
| | 0.56 | | | | | | | | | | |
| | 0.68 | | | | | | | | | | |
| | 0.82 | | | | | | | | | | |
| | 1.0 | N | N | N | N | | | | | | |
| | 1.2 | | | | | | | | | | |
| | 1.5 | | | | | | | | | | |
| | 1.8 | | | | | | | | | | |
| | 2.2 | X | X | X | X | | | | | | |
| | 3.3 | | | | | | | | | | |
| | 4.7 | Q | Q | Q | Z | | | | | | |
| | 6.8 | | | | | | | | | | |
| | 10 | X | X | Z | | | | | Z | | |
| | 22 | Z | X | | | | Z | | | | |
| | 47 | | | | | | | | | | |
| | 100 | | | | | | | | | Z | |
| WVDC | | 6.3 | 10 | 16 | 25 | 6.3 | 10 | 16 | 25 | 6.3 | 50 |
| SIZE | | 1210 | | | | 1812 | | | | 2220 | |




| 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 | | | | | | | |

Contact Factory for Multiples

# Y5V Dielectric

## General Specifications

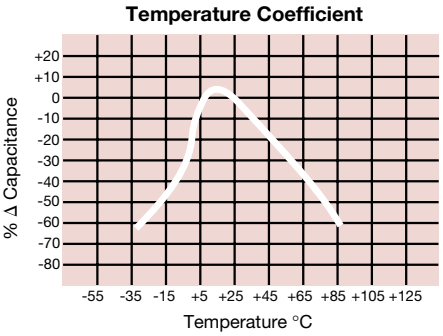
Y5V formulations are for general-purpose use in a limited temperature range. They have a wide temperature characteristic of +22% –82% capacitance change over the operating temperature range of –30°C to +85°C.

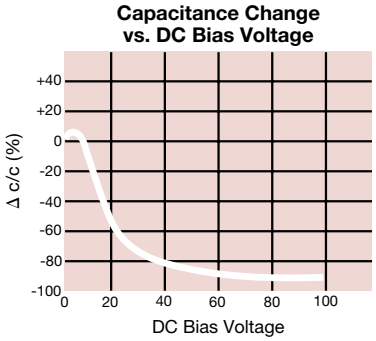
Y5V's high dielectric constant allows the manufacture of the highest capacitance value in a given case size.

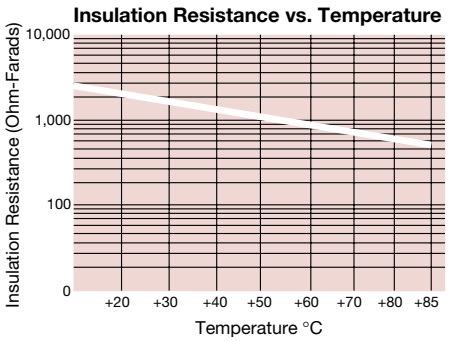
These characteristics make Y5V ideal for decoupling applications within limited temperature range.

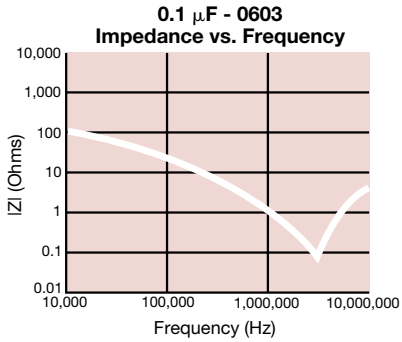
## PART NUMBER (see page 3 for complete part number explanation)

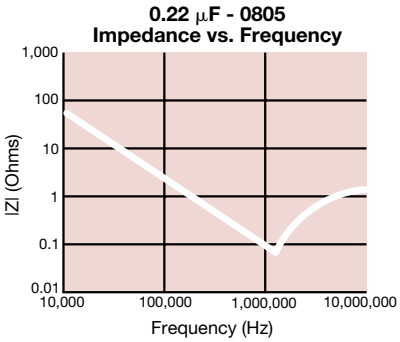
| 0805 | 3 | G | 104 | Z | A | T | 2 | A |
|---|---|---|---|---|---|---|---|---|
| **Size** (L" x W") | **Voltage** 6.3V = 6, 10V = Z, 16V = Y, 25V = 3, 50V = 5 | **Dielectric** Y5V = G | **Capacitance Code** 2 Sig. Digits + Number of Zeros | **Capacitance Tolerance** Z = +80 –20% | **Failure Rate** A = Not Applicable | **Terminations** T = Plated Ni and Solder | **Packaging** 2 = 7" Reel, 4 = 13" Reel | **Special Code** A = Std. Product |

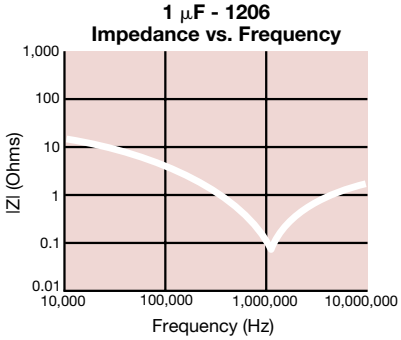


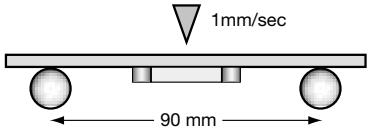



# Y5V Dielectric

## Specifications and Test Methods

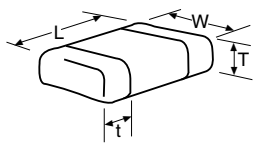
| Parameter/Test | | Y5V Specification Limits | Measuring Conditions | |
|---|---|---|---|---|
| **Operating Temperature Range** | | -30ºC to +85ºC | Temperature Cycle Chamber | |
| **Capacitance** | | Within specified tolerance | Freq.: 1.0 kHz ± 10%<br>Voltage: 1.0Vrms ± .2V<br>For Cap > 10 µF, 0.5Vrms @ 120Hz | |
| **Dissipation Factor** | | ≤ 5.0% for ≥ 50V DC rating<br>≤ 7.0% for ≥ 25V DC rating<br>≤ 9.0% for ≥ 16V DC rating<br>≤ 12.5% for ≥ 10V DC rating | | |
| **Insulation Resistance** | | 100,000MΩ or 500MΩ - µF, whichever is less | Charge device with rated voltage for 60 ± 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) | |
| **Resistance to Flexure Stresses** | Appearance | No defects | Deflection: 2mm<br>Test Time: 30 seconds<br>  | |
| | Capacitance Variation | ≤ ±30% | | |
| | Dissipation Factor | Meets Initial Values (As Above) | | |
| | Insulation Resistance | ≥ Initial Value x 0.1 | | |
| **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 | ≤ ±20% | | |
| | 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: -30ºC ± 2º | 30 ± 3 minutes |
| | Capacitance Variation | ≤ ±20% | Step 2: Room Temp | ≤ 3 minutes |
| | Dissipation Factor | Meets Initial Values (As Above) | Step 3: +85ºC ± 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 twice rated voltage in test chamber set at 85ºC ± 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 | ≤ ±30% | | |
| | Dissipation Factor | ≤ Initial Value x 1.5 (See Above) | | |
| | Insulation Resistance | ≥ Initial Value x 0.1 (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 | ≤ ±30% | | |
| | Dissipation Factor | ≤ Initial Value x 1.5 (See above) | | |
| | Insulation Resistance | ≥ Initial Value x 0.1 (See Above) | | |
| | Dielectric Strength | Meets Initial Values (As Above) | | |

# Y5V Dielectric

## Capacitance Range

### PREFERRED SIZES ARE SHADED

| SIZE | | 0201 | | 0402 | | | | | 0603 | | | | 0805 | | | | 1206 | | | | 1210 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Soldering | | Reflow Only | | Reflow Only | | | | | Reflow/Wave | | | | Reflow/Wave | | | | Reflow/Wave | | | | Reflow/Wave | | | |
| Packaging | | All Paper | | All Paper | | | | | All Paper | | | | Paper/Embossed | | | | 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 | | | | 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) | | | | (0.126 ± 0.008) | | | |
| (W) Width | MM | 0.30 ± 0.03 | | 0.50 ± 0.10 | | | | | .81 ± 0.15 | | | | 1.25 ± 0.20 | | | | 1.60 ± 0.20 | | | | 2.50 ± 0.20 | | | |
| | (in.) | (0.011 ± 0.001) | | (0.020 ± 0.004) | | | | | (0.032 ± 0.006) | | | | (0.049 ± 0.008) | | | | (0.063 ± 0.008) | | | | (0.098 ± 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 | | | | .50 ± 0.25 | | | |
| | (in.) | (0.006 ± 0.002) | | (0.010 ± 0.006) | | | | | (0.014 ± 0.006) | | | | (0.020 ± 0.010) | | | | (0.020 ± 0.010) | | | | (0.020 ± 0.010) | | | |
| WVDC | | 6.3 | 10 | 6.3 | 10 | 16 | 25 | 50 | 10 | 16 | 25 | 50 | 10 | 16 | 25 | 50 | 10 | 16 | 25 | 50 | 10 | 16 | 25 | 50 |
| Cap (pF) | 2200 | 1000 pF A | 1000 pF A | | | | | | | | | | | | | | | | | | | | | |
| | 2700 | A | A | | | | | | | | | | | | | | | | | | | | | |
| | 3300 | A | A | | | | | | | | | | | | | | | | | | | | | |
| | 3900 | A | A | | | | | | | | | | | | | | | | | | | | | |
| | 4700 | A | A | C | C | C | C | C | | | | | | | | | | | | | | | | |
| | 5600 | A | A | C | C | C | C | C | | | | | | | | | | | | | | | | |
| | 6800 | A | A | C | C | C | C | C | | | | | | | | | | | | | | | | |
| | 8200 | A | A | C | C | C | C | C | | | | | | | | | | | | | | | | |
| Cap (µF) | 0.010 | A | A | C | C | C | C | C | G | G | G | G | E | E | E | E | | | | | | | | |
| | 0.012 | A | | C | C | C | C | C | G | G | G | G | E | E | E | E | | | | | | | | |
| | 0.015 | A | | C | C | C | C | C | G | G | G | G | E | E | E | E | | | | | | | | |
| | 0.018 | A | | C | C | C | C | C | G | G | G | G | E | E | E | E | | | | | | | | |
| | 0.022 | A | | C | C | C | C | C | G | G | G | G | E | E | E | E | | | | | | | | |
| | 0.027 | A | | C | C | C | C | | G | G | G | G | E | E | E | E | | | | | | | | |
| | 0.033 | A | | C | C | C | C | | G | G | G | G | E | E | E | E | | | | | | | | |
| | 0.039 | A | | C | C | C | | | G | G | G | G | E | E | E | E | | | | | | | | |
| | 0.047 | A | | C | C | C | | | G | G | G | G | E | E | E | E | J | J | J | J | | | | |
| | 0.056 | | | C | C | C | | | G | G | G | G | E | E | E | E | J | J | J | J | | | | |
| | 0.068 | | | C | C | C | | | G | G | G | G | E | E | E | E | J | J | J | J | | | | |
| | 0.082 | | | C | C | C | | | G | G | G | G | E | E | E | E | J | J | J | J | | | | |
| | 0.10 | | | C | C | C | | | G | G | G | G | E | E | E | E | J | J | J | J | J | J | J | J |
| | 0.12 | | | C | C | | | | G | G | G | | J | J | J | J | J | J | J | J | J | J | J | J |
| | 0.15 | | | C | C | | | | G | G | G | | J | J | J | J | J | J | J | J | J | J | J | J |
| | 0.18 | | | C | C | | | | G | G | G | | J | J | J | J | J | J | J | J | J | J | J | J |
| | 0.22 | | | C | C | | | | G | G | G | | J | J | J | J | J | J | J | J | J | J | J | J |
| | 0.27 | | | | | | | | G | G | | | J | J | J | M | J | J | J | J | J | J | J | J |
| | 0.33 | | | | | | | | G | G | | | J | J | M | M | J | J | J | J | J | J | J | J |
| | 0.39 | | | | | | | | G | G | | | J | J | M | | J | J | J | J | J | J | J | J |
| | 0.47 | | | | | | | | G | G | | | J | J | N | | J | J | J | J | J | J | J | J |
| | 0.56 | | | | | | | | G | G | | | J | J | N | | J | J | J | J | J | J | J | J |
| | 0.68 | | | | | | | | G | G | | | J | J | N | | J | J | J | J | J | J | J | J |
| | 0.82 | | | | | | | | G | G | | | M | M | N | | J | J | J | J | J | J | J | J |
| | 1.0 | | | | | | | | G | G | | | N | N | N | | J | J | J | J | J | J | J | J |
| | 1.2 | | | | | | | | | | | | N | N | | | J | J | M | | J | J | J | M |
| | 1.5 | | | | | | | | | | | | N | N | | | M | M | M | | J | J | J | M |
| | 1.8 | | | | | | | | | | | | N | N | | | M | M | M | | J | J | J | |
| | 2.2 | | | | | | | | | | | | N | N | | | M | M | M | | J | J | J | |
| | 2.7 | | | | | | | | | | | | N | | | | M | M | | | M | M | M | |
| | 3.3 | | | | | | | | | | | | N | | | | M | M | | | P | P | | |
| | 3.9 | | | | | | | | | | | | N | | | | P | P | | | P | P | | |
| | 4.7 | | | | | | | | | | | | P | | | | P | P | | | P | P | N | |
| | 5.6 | | | | | | | | | | | | | | | | Q | | | | Q | Q | | |
| | 6.8 | | | | | | | | | | | | | | | | Q | | | | Q | Q | | |
| | 8.2 | | | | | | | | | | | | | | | | Q | | | | Q | Q | | |
| | 10.0 | | | | | | | | | | | | | | | | Q | | | | Q | Q | X | |
| | 12.0 | | | | | | | | | | | | | | | | | | | | X | | | |
| | 15.0 | | | | | | | | | | | | | | | | | | | | X | | | |
| | 18.0 | | | | | | | | | | | | | | | | | | | | X | | | |
| | 22.0 | | | | | | | | | | | | | | | | | | | | X | | | |
| | 47.0 | | | | | | | | | | | | | | | | | | | | | | | |
| | 100.0 | | | | | | | | | | | | | | | | | | | | | | | |
| WVDC | | 6.3 | 10 | 6.3 | 10 | 16 | 25 | 50 | 10 | 16 | 25 | 50 | 10 | 16 | 25 | 50 | 10 | 16 | 25 | 50 | 10 | 16 | 25 | 50 |
| SIZE | | 0201 | | 0402 | | | | | 0603 | | | | 0805 | | | | 1206 | | | | 1210 | | | |




| 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 | | | | | | | |

Contact Factory for Multiples

# Low Profile Chips

## Z5U & Y5V Dielectric

## PART NUMBER (see page 3 for complete information and options)

| 1206 | 3 | E | 224 | Z | A | T | 2 | T |
|---|---|---|---|---|---|---|---|---|
| **Size** (L" x W") | **Voltage** 25V = 3 | **Dielectric** Z5U = E Y5V = G | **Capacitance Code** | **Capacitance Tolerance** Z = +80/-20% | **Failure Rate** A = Not Applicable | **Terminations** T = Plated Ni and Solder | **Packaging** 2 = 7" Reel 4 = 13" Reel | **Thickness** T = .026" Max. S = .022" Max. R = .018" Max. |

## PERFORMANCE CHARACTERISTICS

| | |
|---|---|
| **Capacitance Range** | Z5U: .01 – .33µF;<br>Y5V: .01 – .47µF |
| **Capacitance Tolerances** | +80, -20% |
| **Operating Temperature Range** | Z5U: +10°C to +85°C;<br>Y5V: -30°C to +85°C |
| **Temperature Characteristic** | Z5U: +22%, -56%;<br>Y5V: +22%, -82% |
| **Voltage Ratings** | 25 VDC |
| **Dissipation Factor** 25°C, .5 Vrms, 1kHz | Z5U: 4%;<br>Y5V: 7% |
| **Insulation Resistance** | 10,000 megohms min. or 1000 MΩ - µF whichever is less |
| **Dielectric Strength for 5 seconds at 50 mamp max. current** | 250% of rated VDC |
| **Test Voltage** | Z5U: 0.5 ± 0.2 Vrms<br>Y5V: 1.0 Vrms ± 0.2 Vrms |
| **Test Frequency** | 1 KHz |

## CAPACITANCE VALUES FOR VARIOUS THICKNESSES

### Z5U

| SIZE | | 0805 | | | 1206 | | | 1210 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (L) Length | MM (in.) | 2.01 ± .20 (.079 ± .008) | | | 3.2 ± .2 (.126 ± .008) | | | 3.2 ± .2 (.126 ± .008) | | |
| (W) Width | MM (in.) | 1.25 ± .20 (.049 ± .008) | | | 1.6 ± .2 (.063 ± .008) | | | 2.5 ± .2 (.098 ± .008) | | |
| (t) Terminal | MM (in.) | .50 ± .25 (.020 ± .010) | | | .50 ± .25 (.020 ± .010) | | | .50 ± .25 (.020 ± .010) | | |
| (T) Thickness Max. | MM (in.) | .46 (.018) | .56 (.022) | .66 (.026) | .46 (.018) | .56 (.022) | .66 (.026) | .46 (.018) | .56 (.022) | .66 (.026) |
| Cap (µF) | .01<br>.012<br>.015 | | | | | | | | | |
| | .018<br>.022<br>.027 | | | | | | | | | |
| | .033<br>.039<br>.047 | | | | | | | | | |
| | .056<br>.068<br>.082 | | | | | | | | | |
| | .1<br>.12<br>.15 | | | | | | | | | |
| | .18<br>.22<br>.27 | | | | | | | | | |
| | .33<br>.39<br>.47 | | | | | | | | | |

= Paper Tape

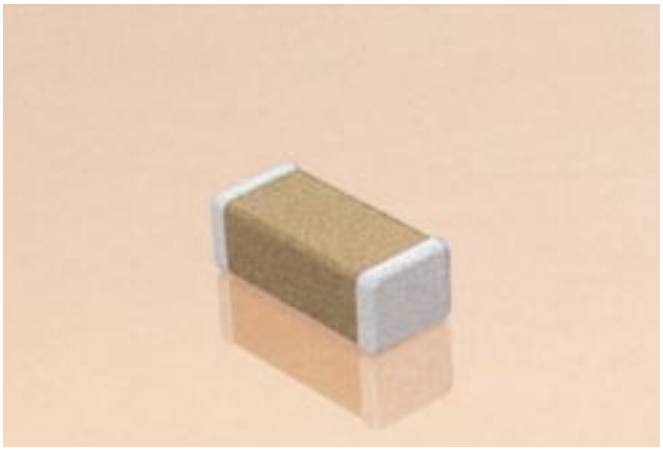
### Y5V

| SIZE | | 0805 | | | 1206 | | | 1210 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (L) Length | MM (in.) | 2.01 ± .20 (.079 ± .008) | | | 3.2 ± .2 (.126 ± .008) | | | 3.2 ± .2 (.126 ± .008) | | |
| (W) Width | MM (in.) | 1.25 ± .20 (.049 ± .008) | | | 1.6 ± .2 (.063 ± .008) | | | 2.5 ± .2 (.098 ± .008) | | |
| (t) Terminal | MM (in.) | .50 ± .25 (.020 ± .010) | | | .50 ± .25 (.020 ± .010) | | | .50 ± .25 (.020 ± .010) | | |
| (T) Thickness Max. | MM (in.) | .46 (.018) | .56 (.022) | .66 (.026) | .46 (.018) | .56 (.022) | .66 (.026) | .46 (.018) | .56 (.022) | .66 (.026) |
| Cap (µF) | .01<br>.012<br>.015 | | | | | | | | | |
| | .018<br>.022<br>.027 | | | | | | | | | |
| | .033<br>.039<br>.047 | | | | | | | | | |
| | .056<br>.068<br>.082 | | | | | | | | | |
| | .1<br>.12<br>.15 | | | | | | | | | |
| | .18<br>.22<br>.27 | | | | | | | | | |
| | .33<br>.39<br>.47 | | | | | | | | | |

= Paper Tape

# High Voltage Chips

## For 500V to 5000V Applications



High value, low leakage and small size are difficult parameters to obtain in capacitors for high voltage systems. AVX special high voltage MLC chips capacitors meet these performance characteristics and are designed for applications such as snubbers in high frequency power converters, resonators in SMPS, and high voltage coupling/DC blocking. These high voltage chip designs exhibit low ESRs at high frequencies.

High voltage chips are typically larger than standard voltage rated chips. These larger sizes require that special precautions be taken in applying these chips in surface mount assemblies. This is due to differences in the coefficient of thermal expansion (CTE) between the substrate materials and chip capacitors.

## PART NUMBER (see page 3 for complete information and options)

| 1808 | A | A | 271 | K | A | 1 | 1 | A |
|---|---|---|---|---|---|---|---|---|
| **AVX Style**<br>1206<br>1210<br>1808<br>1812<br>1825<br>2225<br>3640 | **Voltage**<br>500V = 7<br>600V = C<br>1000V = A<br>1500V = S<br>2000V = G<br>2500V = W<br>3000V = H<br>4000V = J<br>5000V = K | **Temperature Coefficient**<br>C0G = A<br>X7R = C | **Capacitance Code**<br>(2 significant digits + no. of zeros)<br>Examples:<br>10pF = 100<br>100pF = 101<br>1,000pF = 102<br>22,000pF = 223<br>220,000pF = 224<br>1µF = 105 | **Capacitance Tolerance**<br>C0G: J= ±5%<br>K= ±10%<br>M= ±20%<br>X7R: K= ±10%<br>M= ±20%<br>Z= +80% - 20% | **Failure Rate**<br>A=Not applicable | **Termination**<br>1= Pd/Ag<br>T= Plated Ni and Solder | **Packaging**<br>1 = 7" Reel Embossed Tape<br>3 = 13" Reel Embossed Tape<br>9 = Bulk | **Special Code**<br>A = Standard |

# High Voltage Chips

## For 500V to 5000V Applications

## C0G (NP0) Dielectric

### PERFORMANCE CHARACTERISTICS

| | |
|---|---|
| **Capacitance Range** | 100 pF to .047 µF<br>(25°C, 1.0 ±0.2 Vrms at 1kHz) |
| **Capacitance Tolerances** | ±5%, ±10%, ±20% |
| **Dissipation Factor** | 0.1% max. (+25°C, 1.0 ±0.2 Vrms, 1kHz) |
| **Operating Temperature Range** | –55°C to +125°C |
| **Temperature Characteristic** | 0 ±30 ppm/°C (0 VDC) |
| **Voltage Ratings** | 500, 600, 1000, 1500, 2000, 2500, 3000, 4000 & 5000 VDC (+125°C) |
| **Insulation Resistance** (+25°C, at 500 VDC) | 100,000 megohms min. or 1000 MΩ - µF min., whichever is less |
| **Insulation Resistance** (+125°C, at 500 VDC) | 10,000 megohms min. or 100 MΩ - µF min., whichever is less |
| **Dielectric Strength** | 120% rated voltage for 5 seconds at 50 mamp max. current |
| **Thickness** | Dependent upon size, voltage, and capacitance value |

### C0G (NP0) MAXIMUM CAPACITANCE VALUES

| VOLTAGE | 1206 | 1210 | 1808 | 1812 | 1825 | 2225 | 3640 |
|---|---|---|---|---|---|---|---|
| 500 | 680 pF | 1500 pF | 3300 pF | 5600 pF | .012 µF | .018 µF | — |
| 600 | 680 pF | 1500 pF | 3300 pF | 5600 pF | .012 µF | .018 µF | .047 µF |
| 1000 | 330 pF | 680 pF | 1500 pF | 2200 pF | 5600 pF | 8200 pF | .018 µF |
| 1500 | 120 pF | 270 pF | 330 pF | 560 pF | 1500 pF | 1800 pF | 5600 pF |
| 2000 | 68 pF | 120 pF | 270 pF | 470 pF | 1200 pF | 1500 pF | 4700 pF |
| 2500 | — | — | 100 pF | 220 pF | 560 pF | 820 pF | 2700 pF |
| 3000 | — | — | 82 pF | 180 pF | 270 pF | 680 pF | 2200 pF |
| 4000 | — | — | — | — | — | — | 1000 pF |
| 5000 | — | — | — | — | — | — | 680 pF |

## X7R Dielectric

### PERFORMANCE CHARACTERISTICS

| | |
|---|---|
| **Capacitance Range** | 1000 pF to 0.56 µF (25°C, 1.0 ±0.2 Vrms at 1kHz) |
| **Capacitance Tolerances** | ±10%, ±20%, +80% -20% |
| **Dissipation Factor** | 2.5% max. (+25°C, 1.0 ±0.2 Vrms, 1kHz) |
| **Operating Temperature Range** | –55°C to +125°C |
| **Temperature Characteristic** | ±15% (0 VDC) |
| **Voltage Ratings** | 500, 600, 1000, 1500, 2000, 2500, 3000 & 4000 VDC (+125°C) |
| **Insulation Resistance** (+25°C, at 500 VDC) | 100,000 megohms min. or 1000 MΩ - µF min., whichever is less |
| **Insulation Resistance** (+125°C, at 500 VDC) | 10,000 megohms min. or 100 MΩ - µF min., whichever is less |
| **Dielectric Strength** | 120% rated voltage for 5 seconds at 50 mamp max. current |
| **Thickness** | Dependent upon size, voltage, and capacitance value |

### X7R MAXIMUM CAPACITANCE VALUES

| VOLTAGE | 1206 | 1210 | 1808 | 1812 | 1825 | 2225 | 3640 |
|---|---|---|---|---|---|---|---|
| 500 | .015 µF | .027 µF | — | .056 µF | — | — | — |
| 600 | .015 µF | .027 µF | .039 µF | .068 µF | .15 µF | .22 µF | .56 µF |
| 1000 | 4700 pF | 8200 pF | .015 µF | .027 µF | .068 µF | .082 µF | .22 µF |
| 1500 | 1200 pF | 2700 pF | 2700 pF | 5600 pF | .012 µF | .018 µF | .056 µF |
| 2000 | 470 pF | 820 pF | 1500 pF | 3300 pF | 6800 pF | .010 µF | .027 µF |
| 2500 | — | — | 1200 pF | 2200 pF | 5600 pF | 8200 pF | .022 µF |
| 3000 | — | — | — | — | — | 4700 pF | .018 µF |
| 4000 | — | — | — | — | — | — | 5600 pF |

# General Specifications

## Environmental

### THERMAL SHOCK

**Specification**

**Appearance**
No visual defects

**Capacitance Variation**
C0G (NP0): ± 2.5% or ± .25pF, whichever is greater
X7R: ≤ ± 7.5%
Z5U: ≤ ± 20%
Y5V: ≤ ± 20%

**Q, Tan Delta**
To meet initial requirement

**Insulation Resistance**
C0G (NP0), X7R: To meet initial requirement
Z5U, Y5V: ≥ Initial Value x 0.1

**Dielectric Strength**
No problem observed

**Measuring Conditions**

| Step | Temperature °C | Time (minutes) |
|---|---|---|
| 1 | C0G (NP0), X7R: -55° ± 2°<br>Z5U: +10° ± 2°<br>Y5V: -30° ± 2° | 30 ± 3 |
| 2 | Room Temperature | # 3 |
| 3 | C0G (NP0), X7R: +125° ± 2°<br>Z5U, Y5V: +85° ± 2° | 30 ± 3 |
| 4 | Room Temperature | # 3 |

Repeat for 5 cycles and measure after 48 hours ± 4 hours (24 hours for C0G (NP0)) at room temperature.

### IMMERSION

**Specification**

**Appearance**
No visual defects

**Capacitance Variation**
C0G (NP0): ± 2.5% or ± .25pF, whichever is greater
X7R: ≤ ± 7.5%
Z5U: ≤ ± 20%
Y5V: ≤ ± 20%

**Q, Tan Delta**
To meet initial requirement

**Insulation Resistance**
C0G (NP0), X7R: To meet initial requirement
Z5U, Y5V: ≥ Initial Value x 0.1

**Dielectric Strength**
No problem observed

**Measuring Conditions**

| Step | Temperature °C | Time (minutes) |
|---|---|---|
| 1 | +65 +5/-0<br>Pure Water | 15 ± 2 |
| 2 | 0 ± 3<br>NaCl solution | 15 ± 2 |

Repeat cycle 2 times and wash with water and dry. Store at room temperature for 48 ± 4 hours (24 hours for C0G (NP0)) and measure.

### MOISTURE RESISTANCE

**Specification**

**Appearance**
No visual defects

**Capacitance Variation**
C0G (NP0): ± 5% or ± .5pF, whichever is greater
X7R: ≤ ± 10%
Z5U: ≤ ± 30%
Y5V: ≤ ± 30%

**Q, Tan Delta**
C0G (NP0):≥ 30pF.....Q ≥ 350
≥ 10pF, < 30pF.....Q ≥ 275+5C/2
< 10pF .....Q ≥ 200+10C
X7R: Initial requirement + .5%
Z5U: Initial requirement + 1%
Y5V: Initial requirement + 2%

**Insulation Resistance**
≥ Initial Value x 0.3

**Measuring Conditions**

| Step | Temp. °C | Humidity % | Time (hrs) |
|---|---|---|---|
| 1 | +25->+65 | 90-98 | 2.5 |
| 2 | +65 | 90-98 | 3.0 |
| 3 | +65->+25 | 80-98 | 2.5 |
| 4 | +25->+65 | 90-98 | 2.5 |
| 5 | +65 | 90-98 | 3.0 |
| 6 | +65->+25 | 80-98 | 2.5 |
| 7 | +25 | 90-98 | 2.0 |
| 7a | -10 | uncontrolled | – |
| 7b | +25 | 90-98 | – |

Repeat 20 cycles (1-7) and store for 48 hours (24 hours for C0G (NP0)) at room temperature before measuring. Steps 7a & 7b are done on any 5 out of first 9 cycles.

## STEADY STATE HUMIDITY (No Load)

**Specification**

**Appearance**
No visual defects

**Capacitance Variation**
C0G (NP0): ± 5% or ± .5pF, whichever is greater
X7R: ≤ ± 10%
Z5U: ≤ ± 30%
Y5V: ≤ ± 30%

**Q, Tan Delta**
C0G (NP0): ≥ 30pF.....Q ≥ 350
≥ 10pF, < 30pF.....Q ≥ 275+5C/2
< 10pF .....Q ≥ 200+10C
X7R: Initial requirement + .5%
Z5U: Initial requirement + 1%
Y5V: Initial requirement + 2%

**Insulation Resistance**
≥ Initial Value x 0.3

**Measuring Conditions**

Store at 85 ± 5% relative humidity and 85°C for 1000 hours, without voltage. Remove from test chamber and stabilize at room temperature and humidity for 48 ± 4 hours (24 ±2 hours for C0G (NP0)) before measuring.

Charge and discharge currents must be less than 50ma.

## LOAD HUMIDITY

**Specification**

**Appearance**
No visual defects

**Capacitance Variation**
C0G (NP0): ± 5% or ± .5pF, whichever is greater
X7R: ≤ ± 10%
Z5U: ≤ ± 30%
Y5V: ≤ ± 30%

**Q, Tan Delta**
C0G (NP0): ≥ 30pF .....Q ≥ 350
≥ 10pF,< 30pF.....Q ≥ 275+5C/2
< 10pF .....Q ≥ 200+10C
X7R: Initial requirement + .5%
Z5U: Initial requirement + 1%
Y5V: Initial requirement + 2%

**Insulation Resistance**
C0G (NP0), X7R: To meet initial value x 0.3
Z5U, Y5V: ≥ Initial Value x 0.1

Charge devices with rated voltage in test chamber set at 85 ± 5% relative humidity and 85°C for 1000 (+48,-0) hours. Remove from test chamber and stabilize at room temperature and humidity for 48 ± 4 hours (24 ±2 hours for C0G (NP0)) before measuring.

Charge and discharge currents must be less than 50ma.

## LOAD LIFE

**Specification**

**Appearance**
No visual defects

**Capacitance Variation**
C0G (NP0): ± 3% or ± .3pF, whichever is greater
X7R: ≤ ± 10%
Z5U: ≤ ± 30%
Y5V: ≤ ± 30%

**Q, Tan Delta**
C0G (NP0): ≥ 30pF.....Q ≥ 350
≥ 10pF, < 30pF.....Q ≥ 275+5C/2
< 10pF .....Q ≥ 200+10C
X7R: Initial requirement + .5%
Z5U: Initial requirement + 1%
Y5V: Initial requirement + 2%

**Insulation Resistance**
C0G (NP0), X7R: To meet initial value x 0.3
Z5U, Y5V: ≥ Initial Value x 0.1

Charge devices with twice rated voltage in test chamber set at +125°C ± 2°C for C0G (NP0) and X7R, +85° ± 2°C for Z5U, and Y5V for 1000 (+48,-0) hours. Remove from test chamber and stabilize at room temperature for 48 ± 4 hours (24 ±2 hours for C0G (NP0)) before measuring.

Charge and discharge currents must be less than 50ma.

## END TERMINATION ADHERENCE

**Specification**

No evidence of peeling of end terminal

**Measuring Conditions**

After soldering devices to circuit board apply 5N (0.51kg f) for 10 ± 1 seconds, please refer to Figure 1.

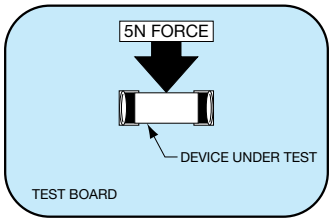



*Figure 1. Terminal Adhesion*

## RESISTANCE TO VIBRATION

**Specification**

**Appearance:**
No visual defects

**Capacitance**
Within specified tolerance

**Q, Tan Delta**
To meet initial requirement

**Insulation Resistance**
C0G (NP0), X7R ≥ Initial Value x 0.3
Z5U, Y5V ≥ Initial Value x 0.1

**Measuring Conditions**

**Vibration Frequency**
10-2000 Hz

**Maximum Acceleration**
20G

**Swing Width**
1.5mm

**Test Time**
X, Y, Z axis for 2 hours each, total 6 hours of test

## SOLDERABILITY

**Specification**

≥ 95% of each termination end should be covered with fresh solder

**Measuring Conditions**

Dip device in eutectic solder at 230 ± 5°C for 2 ± .5 seconds

## BEND STRENGTH

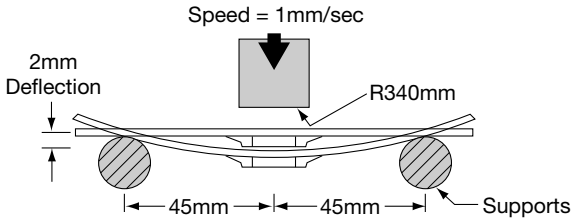



*Figure 2. Bend Strength*

**Specification**

**Appearance:**
No visual defects

**Capacitance Variation**
C0G (NP0): ± 5% or ± .5pF, whichever is larger
X7R: ≤ ± 12%
Z5U: ≤ ± 30%
Y5V: ≤ ± 30%

**Insulation Resistance**
C0G (NP0): ≥ Initial Value x 0.3
X7R: ≥ Initial Value x 0.3
Z5U: ≥ Initial Value x 0.1
Y5V: ≥ Initial Value x 0.1

**Measuring Conditions**

**Please refer to Figure 2**

**Deflection:**
2mm

**Test Time:**
30 seconds

## RESISTANCE TO SOLDER HEAT

**Specification**

**Appearance:**
No serious defects, <25% leaching of either end terminal

**Capacitance Variation**
C0G (NP0): ± 2.5% or ± 2.5pF, whichever is greater
X7R: ≤ ± 7.5%
Z5U: ≤ ± 20%
Y5V: ≤ ± 20%

**Q, Tan Delta**
To meet initial requirement

**Insulation Resistance**
To meet initial requirement

**Dielectric Strength**
No problem observed

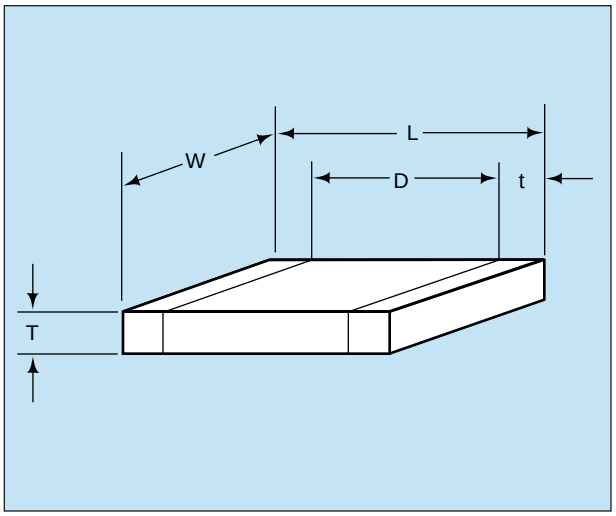
**Measuring Conditions**

Dip device in eutectic solder at 260°C, for 1 minute. Store at room temperature for 48 hours (24 hours for C0G (NP0)) before measuring electrical parameters.

Part sizes larger than 3.20mm x 2.49mm are reheated at 150°C for 30 ±5 seconds before performing test.

# MIL-PRF-55681/Chips

## Part Number Example




## MILITARY DESIGNATION PER MIL-PRF-55681

**Part Number Example**

**(example) CDR01 BP 101 B K S M**

- MIL Style
- Voltage-temperature Limits
- Capacitance
- Rated Voltage
- Capacitance Tolerance
- Termination Finish
- Failure Rate

**MIL Style:** CDR01, CDR02, CDR03, CDR04, CDR05, CDR06

**Voltage Temperature Limits:**
BP = 0 ± 30 ppm/°C without voltage; 0 ± 30 ppm/°C with rated voltage from -55°C to +125°C

BX = ± 15% without voltage; +15 –25% with rated voltage from -55°C to +125°C

**Capacitance:** Two digit figures followed by multiplier (number of zeros to be added) e.g., 101 = 100 pF

**Rated Voltage:** A = 50V, B = 100V

**Capacitance Tolerance:** J ±5%, K ±10%, M ±20%

**Termination Finish:**
M = Palladium Silver
N = Silver Nickel Gold
S = Solder-coated
U = Base Metallization/Barrier Metal/Solder Coated*
W = Base Metallization/Barrier Metal/Tinned (Tin or Tin/Lead Alloy)

*Solder shall have a melting point of 200°C or less.

**Failure Rate Level:** M = 1.0%, P = .1%, R = .01%, S = .001%

**Packaging:** Bulk is standard packaging. Tape and reel per RS481 is available upon request.

## CROSS REFERENCE: AVX/MIL-PRF-55681/CDR01 THRU CDR06*

| Per MIL-PRF-55681 | AVX Style | Length (L) | Width (W) | Thickness (T) | | D | | Termination Band (t) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Max. | Min. | Max. | Min. | Max. | Min. |
| CDR01 | 0805 | .080 ± .015 | .050 ± .015 | .055 | .020 | — | .030 | — | .010 |
| CDR02 | 1805 | .180 ± .015 | .050 ± .015 | .055 | .020 | — | — | .030 | .010 |
| CDR03 | 1808 | .180 ± .015 | .080 ± .018 | .080 | .020 | — | — | .030 | .010 |
| CDR04 | 1812 | .180 ± .015 | .125 ± .015 | .080 | .020 | — | — | .030 | .010 |
| CDR05 | 1825 | .180 $^{+.020}_{-.015}$ | .250 $^{+.020}_{-.015}$ | .080 | .020 | — | — | .030 | .010 |
| CDR06 | 2225 | .225 ± .020 | .250 ± .020 | .080 | .020 | — | — | .030 | .010 |

*For CDR11, 12, 13, and 14 see AVX Microwave Chip Capacitor Catalog

# MIL-PRF-55681/Chips
## Military Part Number Identification
## CDR01 thru CDR06

### CDR01 thru CDR06 to MIL-PRF-55681

| Military Type Designation | Capacitance in pF | Capacitance tolerance | Rated temperature and voltage-temperature limits | WVDC |
|---|---|---|---|---|
| **AVX Style 0805/CDR01** | | | | |
| CDR01BP100B--- | 10 | J,K | BP | 100 |
| CDR01BP120B--- | 12 | J | BP | 100 |
| CDR01BP150B--- | 15 | J,K | BP | 100 |
| CDR01BP180B--- | 18 | J | BP | 100 |
| CDR01BP220B--- | 22 | J,K | BP | 100 |
| CDR01BP270B--- | 27 | J | BP | 100 |
| CDR01BP330B--- | 33 | J,K | BP | 100 |
| CDR01BP390B--- | 39 | J | BP | 100 |
| CDR01BP470B--- | 47 | J,K | BP | 100 |
| CDR01BP560B--- | 56 | J | BP | 100 |
| CDR01BP680B--- | 68 | J,K | BP | 100 |
| CDR01BP820B--- | 82 | J | BP | 100 |
| CDR01BP101B--- | 100 | J,K | BP | 100 |
| CDR01B--121B--- | 120 | J,K | BP,BX | 100 |
| CDR01B--151B--- | 150 | J,K | BP,BX | 100 |
| CDR01B--181B--- | 180 | J,K | BP,BX | 100 |
| CDR01BX221B--- | 220 | K,M | BX | 100 |
| CDR01BX271B--- | 270 | K | BX | 100 |
| CDR01BX331B--- | 330 | K,M | BX | 100 |
| CDR01BX391B--- | 390 | K | BX | 100 |
| CDR01BX471B--- | 470 | K,M | BX | 100 |
| CDR01BX561B--- | 560 | K | BX | 100 |
| CDR01BX681B--- | 680 | K,M | BX | 100 |
| CDR01BX821B--- | 820 | K | BX | 100 |
| CDR01BX102B--- | 1000 | K,M | BX | 100 |
| CDR01BX122B--- | 1200 | K | BX | 100 |
| CDR01BX152B--- | 1500 | K,M | BX | 100 |
| CDR01BX182B--- | 1800 | K | BX | 100 |
| CDR01BX222B--- | 2200 | K,M | BX | 100 |
| CDR01BX272B--- | 2700 | K | BX | 100 |
| CDR01BX332B--- | 3300 | K,M | BX | 100 |
| CDR01BX392A--- | 3900 | K | BX | 50 |
| CDR01BX472A--- | 4700 | K,M | BX | 50 |
| **AVX Style 1805/CDR02** | | | | |
| CDR02BP221B--- | 220 | J,K | BP | 100 |
| CDR02BP271B--- | 270 | J | BP | 100 |
| CDR02BX392B--- | 3900 | K | BX | 100 |
| CDR02BX472B--- | 4700 | K,M | BX | 100 |
| CDR02BX562B--- | 5600 | K | BX | 100 |
| CDR02BX682B--- | 6800 | K,M | BX | 100 |
| CDR02BX822B--- | 8200 | K | BX | 100 |
| CDR02BX103B--- | 10,000 | K,M | BX | 100 |
| CDR02BX123A--- | 12,000 | K | BX | 50 |
| CDR02BX153A--- | 15,000 | K,M | BX | 50 |
| CDR02BX183A--- | 18,000 | K | BX | 50 |
| CDR02BX223A--- | 22,000 | K,M | BX | 50 |

Add appropriate failure rate

Add appropriate termination finish

Capacitance Tolerance

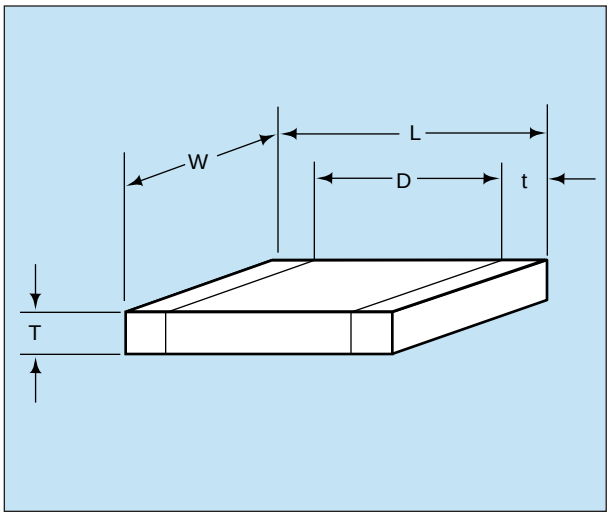
| Military Type Designation | Capacitance in pF | Capacitance tolerance | Rated temperature and voltage-temperature limits | WVDC |
|---|---|---|---|---|
| **AVX Style 1808/CDR03** | | | | |
| CDR03BP331B--- | 330 | J,K | BP | 100 |
| CDR03BP391B--- | 390 | J | BP | 100 |
| CDR03BP471B--- | 470 | J,K | BP | 100 |
| CDR03BP561B--- | 560 | J | BP | 100 |
| CDR03BP681B--- | 680 | J,K | BP | 100 |
| CDR03BP821B-- | 820 | J | BP | 100 |
| CDR03BP102B--- | 1000 | J,K | BP | 100 |
| CDR03BX123B-- | 12,000 | K | BX | 100 |
| CDR03BX153B--- | 15,000 | K,M | BX | 100 |
| CDR03BX183B--- | 18,000 | K | BX | 100 |
| CDR03BX223B--- | 22,000 | K,M | BX | 100 |
| CDR03BX273B--- | 27,000 | K | BX | 100 |
| CDR03BX333B--- | 33,000 | K,M | BX | 100 |
| CDR03BX393A--- | 39,000 | K | BX | 50 |
| CDR03BX473A--- | 47,000 | K,M | BX | 50 |
| CDR03BX563A--- | 56,000 | K | BX | 50 |
| CDR03BX683A--- | 68,000 | K,M | BX | 50 |
| **AVX Style 1812/CDR04** | | | | |
| CDR04BP122B--- | 1200 | J | BP | 100 |
| CDR04BP152B--- | 1500 | J,K | BP | 100 |
| CDR04BP182B--- | 1800 | J | BP | 100 |
| CDR04BP222B--- | 2200 | J,K | BP | 100 |
| CDR04BP272B--- | 2700 | J | BP | 100 |
| CDR04BP332B--- | 3300 | J,K | BP | 100 |
| CDR04BX393B--- | 39,000 | K | BX | 100 |
| CDR04BX473B--- | 47,000 | K,M | BX | 100 |
| CDR04BX563B--- | 56,000 | K | BX | 100 |
| CDR04BX823A--- | 82,000 | K | BX | 50 |
| CDR04BX104A--- | 100,000 | K,M | BX | 50 |
| CDR04BX124A--- | 120,000 | K | BX | 50 |
| CDR04BX154A--- | 150,000 | K,M | BX | 50 |
| CDR04BX184A--- | 180,000 | K | BX | 50 |
| **AVX Style 1825/CDR05** | | | | |
| CDR05BP392B--- | 3900 | J,K | BP | 100 |
| CDR05BP472B--- | 4700 | J,K | BP | 100 |
| CDR05BP562B--- | 5600 | J,K | BP | 100 |
| CDR05BX683B--- | 68,000 | K,M | BX | 100 |
| CDR05BX823B--- | 82,000 | K | BX | 100 |
| CDR05BX104B--- | 100,000 | K,M | BX | 100 |
| CDR05BX124B--- | 120,000 | K | BX | 100 |
| CDR05BX154B--- | 150,000 | K,M | BX | 100 |
| CDR05BX224A--- | 220,000 | K,M | BX | 50 |
| CDR05BX274A--- | 270,000 | K | BX | 50 |
| CDR05BX334A--- | 330,000 | K,M | BX | 50 |
| **AVX Style 2225/CDR06** | | | | |
| CDR06BP682B--- | 6800 | J,K | BP | 100 |
| CDR06BP822B--- | 8200 | J,K | BP | 100 |
| CDR06BP103B--- | 10,000 | J,K | BP | 100 |
| CDR06BX394A--- | 390,000 | K | BX | 50 |
| CDR06BX474A--- | 470,000 | K,M | BX | 50 |

Add appropriate failure rate

Add appropriate termination finish

Capacitance Tolerance

# MIL-PRF-55681/Chips
## Military Part Number Identification
## CDR31 thru CDR35




## MILITARY DESIGNATION PER MIL-PRF-55681

**Part Number Example**

| (example) | CDR31 | BP | 101 | B | K | S | M |
|---|---|---|---|---|---|---|---|
| | MIL Style | Voltage-temperature Limits | Capacitance | Rated Voltage | Capacitance Tolerance | Termination Finish | Failure Rate |

**MIL Style:** CDR31, CDR32, CDR33, CDR34, CDR35

**Voltage Temperature Limits:**
BP = 0 ± 30 ppm/°C without voltage; 0 ± 30 ppm/°C with rated voltage from -55°C to +125°C

BX = ± 15% without voltage; +15 –25% with rated voltage from -55°C to +125°C

**Capacitance:** Two digit figures followed by multiplier (number of zeros to be added) e.g., 101 = 100 pF

**Rated Voltage:** A = 50V, B = 100V

**Capacitance Tolerance:** C ±.25 pF, D ±.5 pF, F ±1% J ±5%, K ±10%, M ±20%

**Termination Finish:**
M = Palladium Silver
N = Silver Nickel Gold
S = Solder-coated
U = Base Metallization/Barrier Metal/Solder Coated*
W = Base Metallization/Barrier Metal/Tinned (Tin or Tin/Lead Alloy)

*Solder shall have a melting point of 200°C or less.

**Failure Rate Level:** M = 1.0%, P = .1%, R = .01%, S = .001%

**Packaging:** Bulk is standard packaging. Tape and reel per RS481 is available upon request.

## CROSS REFERENCE: AVX/MIL-PRF-55681/CDR31 THRU CDR35

| Per MIL-PRF-55681 (Metric Sizes) | AVX Style | Length (L) (mm) | Width (W) (mm) | Thickness (T) | D | Termination Band (t) | |
|---|---|---|---|---|---|---|---|
| | | | | Max. (mm) | Min. (mm) | Max. (mm) | Min. (mm) |
| CDR31 | 0805 | 2.00 | 1.25 | 1.3 | .50 | .70 | .30 |
| CDR32 | 1206 | 3.20 | 1.60 | 1.3 | — | .70 | .30 |
| CDR33 | 1210 | 3.20 | 2.50 | 1.5 | — | .70 | .30 |
| CDR34 | 1812 | 4.50 | 3.20 | 1.5 | — | .70 | .30 |
| CDR35 | 1825 | 4.50 | 6.40 | 1.5 | — | .70 | .30 |

# MIL-PRF-55681/Chips

## Military Part Number Identification CDR31

### CDR31 to MIL-PRF-55681/7

| Military Type Designation 1/ | Capacitance in pF | Capacitance tolerance | Rated temperature and voltage-temperature limits | WVDC |
|---|---|---|---|---|
| **AVX Style 0805/CDR31 (BP)** | | | | |
| CDR31BP1R0B--- | 1.0 | C | BP | 100 |
| CDR31BP1R1B--- | 1.1 | C | BP | 100 |
| CDR31BP1R2B--- | 1.2 | C | BP | 100 |
| CDR31BP1R3B--- | 1.3 | C | BP | 100 |
| CDR31BP1R5B--- | 1.5 | C | BP | 100 |
| CDR31BP1R6B--- | 1.6 | C | BP | 100 |
| CDR31BP1R8B--- | 1.8 | C | BP | 100 |
| CDR31BP2R0B--- | 2.0 | C | BP | 100 |
| CDR31BP2R2B--- | 2.2 | C | BP | 100 |
| CDR31BP2R4B--- | 2.4 | C | BP | 100 |
| CDR31BP2R7B--- | 2.7 | C,D | BP | 100 |
| CDR31BP3R0B--- | 3.0 | C,D | BP | 100 |
| CDR31BP3R3B--- | 3.3 | C,D | BP | 100 |
| CDR31BP3R6B--- | 3.6 | C,D | BP | 100 |
| CDR31BP3R9B--- | 3.9 | C,D | BP | 100 |
| CDR31BP4R3B--- | 4.3 | C,D | BP | 100 |
| CDR31BP4R7B--- | 4.7 | C,D | BP | 100 |
| CDR31BP5R1B--- | 5.1 | C,D | BP | 100 |
| CDR31BP5R6B--- | 5.6 | C,D | BP | 100 |
| CDR31BP6R2B--- | 6.2 | C,D | BP | 100 |
| CDR31BP6R8B--- | 6.8 | C,D | BP | 100 |
| CDR31BP7R5B--- | 7.5 | C,D | BP | 100 |
| CDR31BP8R2B--- | 8.2 | C,D | BP | 100 |
| CDR31BP9R1B--- | 9.1 | C,D | BP | 100 |
| CDR31BP100B--- | 10 | J,K | BP | 100 |
| CDR31BP110B--- | 11 | J,K | BP | 100 |
| CDR31BP120B--- | 12 | J,K | BP | 100 |
| CDR31BP130B--- | 13 | J,K | BP | 100 |
| CDR31BP150B--- | 15 | J,K | BP | 100 |
| CDR31BP160B--- | 16 | J,K | BP | 100 |
| CDR31BP180B--- | 18 | J,K | BP | 100 |
| CDR31BP200B--- | 20 | J,K | BP | 100 |
| CDR31BP220B--- | 22 | J,K | BP | 100 |
| CDR31BP240B--- | 24 | J,K | BP | 100 |
| CDR31BP270B--- | 27 | F,J,K | BP | 100 |
| CDR31BP300B--- | 30 | F,J,K | BP | 100 |
| CDR31BP330B--- | 33 | F,J,K | BP | 100 |
| CDR31BP360B--- | 36 | F,J,K | BP | 100 |
| CDR31BP390B--- | 39 | F,J,K | BP | 100 |
| CDR31BP430B--- | 43 | F,J,K | BP | 100 |
| CDR31BP470B--- | 47 | F,J,K | BP | 100 |
| CDR31BP510B--- | 51 | F,J,K | BP | 100 |
| CDR31BP560B--- | 56 | F,J,K | BP | 100 |
| CDR31BP620B--- | 62 | F,J,K | BP | 100 |
| CDR31BP680B--- | 68 | F,J,K | BP | 100 |
| CDR31BP750B--- | 75 | F,J,K | BP | 100 |
| CDR31BP820B--- | 82 | F,J,K | BP | 100 |
| CDR31BP910B--- | 91 | F,J,K | BP | 100 |

Add appropriate failure rate

Add appropriate termination finish

Capacitance Tolerance

| Military Type Designation 1/ | Capacitance in pF | Capacitance tolerance | Rated temperature and voltage-temperature limits | WVDC |
|---|---|---|---|---|
| **AVX Style 0805/CDR31 (BP) cont'd** | | | | |
| CDR31BP101B--- | 100 | F,J,K | BP | 100 |
| CDR31BP111B--- | 110 | F,J,K | BP | 100 |
| CDR31BP121B--- | 120 | F,J,K | BP | 100 |
| CDR31BP131B--- | 130 | F,J,K | BP | 100 |
| CDR31BP151B--- | 150 | F,J,K | BP | 100 |
| CDR31BP161B--- | 160 | F,J,K | BP | 100 |
| CDR31BP181B--- | 180 | F,J,K | BP | 100 |
| CDR31BP201B--- | 200 | F,J,K | BP | 100 |
| CDR31BP221B--- | 220 | F,J,K | BP | 100 |
| CDR31BP241B--- | 240 | F,J,K | BP | 100 |
| CDR31BP271B--- | 270 | F,J,K | BP | 100 |
| CDR31BP301B--- | 300 | F,J,K | BP | 100 |
| CDR31BP331B--- | 330 | F,J,K | BP | 100 |
| CDR31BP361B--- | 360 | F,J,K | BP | 100 |
| CDR31BP391B--- | 390 | F,J,K | BP | 100 |
| CDR31BP431B--- | 430 | F,J,K | BP | 100 |
| CDR31BP471B--- | 470 | F,J,K | BP | 100 |
| CDR31BP511A--- | 510 | F,J,K | BP | 50 |
| CDR31BP561A--- | 560 | F,J,K | BP | 50 |
| CDR31BP621A--- | 620 | F,J,K | BP | 50 |
| CDR31BP681A--- | 680 | F,J,K | BP | 50 |
| **AVX Style 0805/CDR31 (BX)** | | | | |
| CDR31BX471B--- | 470 | K,M | BX | 100 |
| CDR31BX561B--- | 560 | K,M | BX | 100 |
| CDR31BX681B--- | 680 | K,M | BX | 100 |
| CDR31BX821B--- | 820 | K,M | BX | 100 |
| CDR31BX102B--- | 1,000 | K,M | BX | 100 |
| CDR31BX122B--- | 1,200 | K,M | BX | 100 |
| CDR31BX152B--- | 1,500 | K,M | BX | 100 |
| CDR31BX182B--- | 1,800 | K,M | BX | 100 |
| CDR31BX222B--- | 2,200 | K,M | BX | 100 |
| CDR31BX272B--- | 2,700 | K,M | BX | 100 |
| CDR31BX332B--- | 3,300 | K,M | BX | 100 |
| CDR31BX392B--- | 3,900 | K,M | BX | 100 |
| CDR31BX472B--- | 4,700 | K,M | BX | 100 |
| CDR31BX562A--- | 5,600 | K,M | BX | 50 |
| CDR31BX682A--- | 6,800 | K,M | BX | 50 |
| CDR31BX822A--- | 8,200 | K,M | BX | 50 |
| CDR31BX103A--- | 10,000 | K,M | BX | 50 |
| CDR31BX123A--- | 12,000 | K,M | BX | 50 |
| CDR31BX153A--- | 15,000 | K,M | BX | 50 |
| CDR31BX183A--- | 18,000 | K,M | BX | 50 |

Add appropriate failure rate

Add appropriate termination finish

Capacitance Tolerance

1/ The complete part number will include additional symbols to indicate capacitance tolerance, termination and failure rate level.

# MIL-PRF-55681/Chips

## Military Part Number Identification CDR32

### CDR32 to MIL-PRF-55681/8

| Military Type Designation 1/ | Capacitance in pF | Capacitance tolerance | Rated temperature and voltage-temperature limits | WVDC |
|---|---|---|---|---|
| **AVX Style 1206/CDR32 (BP)** | | | | |
| CDR32BP1R0B--- | 1.0 | C | BP | 100 |
| CDR32BP1R1B--- | 1.1 | C | BP | 100 |
| CDR32BP1R2B--- | 1.2 | C | BP | 100 |
| CDR32BP1R3B--- | 1.3 | C | BP | 100 |
| CDR32BP1R5B--- | 1.5 | C | BP | 100 |
| CDR32BP1R6B--- | 1.6 | C | BP | 100 |
| CDR32BP1R8B--- | 1.8 | C | BP | 100 |
| CDR32BP2R0B--- | 2.0 | C | BP | 100 |
| CDR32BP2R2B--- | 2.2 | C | BP | 100 |
| CDR32BP2R4B--- | 2.4 | C | BP | 100 |
| CDR32BP2R7B--- | 2.7 | C,D | BP | 100 |
| CDR32BP3R0B--- | 3.0 | C,D | BP | 100 |
| CDR32BP3R3B--- | 3.3 | C,D | BP | 100 |
| CDR32BP3R6B--- | 3.6 | C,D | BP | 100 |
| CDR32BP3R9B--- | 3.9 | C,D | BP | 100 |
| CDR32BP4R3B--- | 4.3 | C,D | BP | 100 |
| CDR32BP4R7B--- | 4.7 | C,D | BP | 100 |
| CDR32BP5R1B--- | 5.1 | C,D | BP | 100 |
| CDR32BP5R6B--- | 5.6 | C,D | BP | 100 |
| CDR32BP6R2B--- | 6.2 | C,D | BP | 100 |
| CDR32BP6R8B--- | 6.8 | C,D | BP | 100 |
| CDR32BP7R5B--- | 7.5 | C,D | BP | 100 |
| CDR32BP8R2B--- | 8.2 | C,D | BP | 100 |
| CDR32BP9R1B--- | 9.1 | C,D | BP | 100 |
| CDR32BP100B--- | 10 | J,K | BP | 100 |
| CDR32BP110B--- | 11 | J,K | BP | 100 |
| CDR32BP120B--- | 12 | J,K | BP | 100 |
| CDR32BP130B--- | 13 | J,K | BP | 100 |
| CDR32BP150B--- | 15 | J,K | BP | 100 |
| CDR32BP160B--- | 16 | J,K | BP | 100 |
| CDR32BP180B--- | 18 | J,K | BP | 100 |
| CDR32BP200B--- | 20 | J,K | BP | 100 |
| CDR32BP220B--- | 22 | J,K | BP | 100 |
| CDR32BP240B--- | 24 | J,K | BP | 100 |
| CDR32BP270B--- | 27 | F,J,K | BP | 100 |
| CDR32BP300B--- | 30 | F,J,K | BP | 100 |
| CDR32BP330B--- | 33 | F,J,K | BP | 100 |
| CDR32BP360B--- | 36 | F,J,K | BP | 100 |
| CDR32BP390B--- | 39 | F,J,K | BP | 100 |
| CDR32BP430B--- | 43 | F,J,K | BP | 100 |
| CDR32BP470B--- | 47 | F,J,K | BP | 100 |
| CDR32BP510B--- | 51 | F,J,K | BP | 100 |
| CDR32BP560B--- | 56 | F,J,K | BP | 100 |
| CDR32BP620B--- | 62 | F,J,K | BP | 100 |
| CDR32BP680B--- | 68 | F,J,K | BP | 100 |
| CDR32BP750B--- | 75 | F,J,K | BP | 100 |
| CDR32BP820B--- | 82 | F,J,K | BP | 100 |
| CDR32BP910B--- | 91 | F,J,K | BP | 100 |

Add appropriate failure rate

Add appropriate termination finish

Capacitance Tolerance

| Military Type Designation 1/ | Capacitance in pF | Capacitance tolerance | Rated temperature and voltage-temperature limits | WVDC |
|---|---|---|---|---|
| **AVX Style 1206/CDR32 (BP) cont'd** | | | | |
| CDR32BP101B--- | 100 | F,J,K | BP | 100 |
| CDR32BP111B--- | 110 | F,J,K | BP | 100 |
| CDR32BP121B--- | 120 | F,J,K | BP | 100 |
| CDR32BP131B--- | 130 | F,J,K | BP | 100 |
| CDR32BP151B--- | 150 | F,J,K | BP | 100 |
| CDR32BP161B--- | 160 | F,J,K | BP | 100 |
| CDR32BP181B--- | 180 | F,J,K | BP | 100 |
| CDR32BP201B--- | 200 | F,J,K | BP | 100 |
| CDR32BP221B--- | 220 | F,J,K | BP | 100 |
| CDR32BP241B--- | 240 | F,J,K | BP | 100 |
| CDR32BP271B--- | 270 | F,J,K | BP | 100 |
| CDR32BP301B--- | 300 | F,J,K | BP | 100 |
| CDR32BP331B--- | 330 | F,J,K | BP | 100 |
| CDR32BP361B--- | 360 | F,J,K | BP | 100 |
| CDR32BP391B--- | 390 | F,J,K | BP | 100 |
| CDR32BP431B--- | 430 | F,J,K | BP | 100 |
| CDR32BP471B--- | 470 | F,J,K | BP | 100 |
| CDR32BP511B--- | 510 | F,J,K | BP | 100 |
| CDR32BP561B--- | 560 | F,J,K | BP | 100 |
| CDR32BP621B--- | 620 | F,J,K | BP | 100 |
| CDR32BP681B--- | 680 | F,J,K | BP | 100 |
| CDR32BP751B--- | 750 | F,J,K | BP | 100 |
| CDR32BP821B--- | 820 | F,J,K | BP | 100 |
| CDR32BP911B--- | 910 | F,J,K | BP | 100 |
| CDR32BP102B--- | 1,000 | F,J,K | BP | 100 |
| CDR32BP112A--- | 1,100 | F,J,K | BP | 50 |
| CDR32BP122A--- | 1,200 | F,J,K | BP | 50 |
| CDR32BP132A--- | 1,300 | F,J,K | BP | 50 |
| CDR32BP152A--- | 1,500 | F,J,K | BP | 50 |
| CDR32BP162A--- | 1,600 | F,J,K | BP | 50 |
| CDR32BP182A--- | 1,800 | F,J,K | BP | 50 |
| CDR32BP202A--- | 2,000 | F,J,K | BP | 50 |
| CDR32BP222A--- | 2,200 | F,J,K | BP | 50 |
| **AVX Style 1206/CDR32 (BX)** | | | | |
| CDR32BX472B--- | 4,700 | K,M | BX | 100 |
| CDR32BX562B--- | 5,600 | K,M | BX | 100 |
| CDR32BX682B--- | 6,800 | K,M | BX | 100 |
| CDR32BX822B--- | 8,200 | K,M | BX | 100 |
| CDR32BX103B--- | 10,000 | K,M | BX | 100 |
| CDR32BX123B--- | 12,000 | K,M | BX | 100 |
| CDR32BX153B--- | 15,000 | K,M | BX | 100 |
| CDR32BX183A--- | 18,000 | K,M | BX | 50 |
| CDR32BX223A--- | 22,000 | K,M | BX | 50 |
| CDR32BX273A--- | 27,000 | K,M | BX | 50 |
| CDR32BX333A--- | 33,000 | K,M | BX | 50 |
| CDR32BX393A--- | 39,000 | K,M | BX | 50 |

Add appropriate failure rate

Add appropriate termination finish

Capacitance Tolerance

1/ The complete part number will include additional symbols to indicate capacitance tolerance, termination and failure rate level.

# MIL-PRF-55681/Chips

## Military Part Number Identification CDR33/34/35

### CDR33/34/35 to MIL-PRF-55681/9/10/11

| Military Type Designation 1/ | Capacitance in pF | Capacitance tolerance | Rated temperature and voltage-temperature limits | WVDC |
|---|---|---|---|---|
| **AVX Style 1210/CDR33 (BP)** | | | | |
| CDR33BP102B--- | 1,000 | F,J,K | BP | 100 |
| CDR33BP112B--- | 1,100 | F,J,K | BP | 100 |
| CDR33BP122B--- | 1,200 | F,J,K | BP | 100 |
| CDR33BP132B--- | 1,300 | F,J,K | BP | 100 |
| CDR33BP152B--- | 1,500 | F,J,K | BP | 100 |
| CDR33BP162B--- | 1,600 | F,J,K | BP | 100 |
| CDR33BP182B--- | 1,800 | F,J,K | BP | 100 |
| CDR33BP202B--- | 2,000 | F,J,K | BP | 100 |
| CDR33BP222B--- | 2,200 | F,J,K | BP | 100 |
| CDR33BP242A--- | 2,400 | F,J,K | BP | 50 |
| CDR33BP272A--- | 2,700 | F,J,K | BP | 50 |
| CDR33BP302A--- | 3,000 | F,J,K | BP | 50 |
| CDR33BP332A--- | 3,300 | F,J,K | BP | 50 |
| **AVX Style 1210/CDR33 (BX)** | | | | |
| CDR33BX153B--- | 15,000 | K,M | BX | 100 |
| CDR33BX183B--- | 18,000 | K,M | BX | 100 |
| CDR33BX223B--- | 22,000 | K,M | BX | 100 |
| CDR33BX273B--- | 27,000 | K,M | BX | 100 |
| CDR33BX393A--- | 39,000 | K,M | BX | 50 |
| CDR33BX473A--- | 47,000 | K,M | BX | 50 |
| CDR33BX563A--- | 56,000 | K,M | BX | 50 |
| CDR33BX683A--- | 68,000 | K,M | BX | 50 |
| CDR33BX823A--- | 82,000 | K,M | BX | 50 |
| CDR33BX104A--- | 100,000 | K,M | BX | 50 |
| **AVX Style 1812/CDR34 (BP)** | | | | |
| CDR34BP222B--- | 2,200 | F,J,K | BP | 100 |
| CDR34BP242B--- | 2,400 | F,J,K | BP | 100 |
| CDR34BP272B--- | 2,700 | F,J,K | BP | 100 |
| CDR34BP302B--- | 3,000 | F,J,K | BP | 100 |
| CDR34BP332B--- | 3,300 | F,J,K | BP | 100 |
| CDR34BP362B--- | 3,600 | F,J,K | BP | 100 |
| CDR34BP392B--- | 3,900 | F,J,K | BP | 100 |
| CDR34BP432B--- | 4,300 | F,J,K | BP | 100 |
| CDR34BP472B--- | 4,700 | F,J,K | BP | 100 |
| CDR34BP512A--- | 5,100 | F,J,K | BP | 50 |
| CDR34BP562A--- | 5,600 | F,J,K | BP | 50 |
| CDR34BP622A--- | 6,200 | F,J,K | BP | 50 |
| CDR34BP682A--- | 6,800 | F,J,K | BP | 50 |
| CDR34BP752A--- | 7,500 | F,J,K | BP | 50 |
| CDR34BP822A--- | 8,200 | F,J,K | BP | 50 |
| CDR34BP912A--- | 9,100 | F,J,K | BP | 50 |
| CDR34BP103A--- | 10,000 | F,J,K | BP | 50 |

Add appropriate failure rate

Add appropriate termination finish

Capacitance Tolerance

| Military Type Designation 1/ | Capacitance in pF | Capacitance tolerance | Rated temperature and voltage-temperature limits | WVDC |
|---|---|---|---|---|
| **AVX Style 1812/CDR34 (BX)** | | | | |
| CDR34BX273B--- | 27,000 | K,M | BX | 100 |
| CDR34BX333B--- | 33,000 | K,M | BX | 100 |
| CDR34BX393B--- | 39,000 | K,M | BX | 100 |
| CDR34BX473B--- | 47,000 | K,M | BX | 100 |
| CDR34BX563B--- | 56,000 | K,M | BX | 100 |
| CDR34BX104A--- | 100,000 | K,M | BX | 50 |
| CDR34BX124A--- | 120,000 | K,M | BX | 50 |
| CDR34BX154A--- | 150,000 | K,M | BX | 50 |
| CDR34BX184A--- | 180,000 | K,M | BX | 50 |
| **AVX Style 1825/CDR35 (BP)** | | | | |
| CDR35BP472B--- | 4,700 | F,J,K | BP | 100 |
| CDR35BP512B--- | 5,100 | F,J,K | BP | 100 |
| CDR35BP562B--- | 5,600 | F,J,K | BP | 100 |
| CDR35BP622B--- | 6,200 | F,J,K | BP | 100 |
| CDR35BP682B--- | 6,800 | F,J,K | BP | 100 |
| CDR35BP752B--- | 7,500 | F,J,K | BP | 100 |
| CDR35BP822B--- | 8,200 | F,J,K | BP | 100 |
| CDR35BP912B--- | 9,100 | F,J,K | BP | 100 |
| CDR35BP103B--- | 10,000 | F,J,K | BP | 100 |
| CDR35BP113A--- | 11,000 | F,J,K | BP | 50 |
| CDR35BP123A--- | 12,000 | F,J,K | BP | 50 |
| CDR35BP133A--- | 13,000 | F,J,K | BP | 50 |
| CDR35BP153A--- | 15,000 | F,J,K | BP | 50 |
| CDR35BP163A--- | 16,000 | F,J,K | BP | 50 |
| CDR35BP183A--- | 18,000 | F,J,K | BP | 50 |
| CDR35BP203A--- | 20,000 | F,J,K | BP | 50 |
| CDR35BP223A--- | 22,000 | F,J,K | BP | 50 |
| **AVX Style 1825/CDR35 (BX)** | | | | |
| CDR35BX563B--- | 56,000 | K,M | BX | 100 |
| CDR35BX683B--- | 68,000 | K,M | BX | 100 |
| CDR35BX823B--- | 82,000 | K,M | BX | 100 |
| CDR35BX104B--- | 100,000 | K,M | BX | 100 |
| CDR35BX124B--- | 120,000 | K,M | BX | 100 |
| CDR35BX154B--- | 150,000 | K,M | BX | 100 |
| CDR35BX184A--- | 180,000 | K,M | BX | 50 |
| CDR35BX224A--- | 220,000 | K,M | BX | 50 |
| CDR35BX274A--- | 270,000 | K,M | BX | 50 |
| CDR35BX334A--- | 330,000 | K,M | BX | 50 |
| CDR35BX394A--- | 390,000 | K,M | BX | 50 |
| CDR35BX474A--- | 470,000 | K,M | BX | 50 |

Add appropriate failure rate

Add appropriate termination finish

Capacitance Tolerance

1/ The complete part number will include additional symbols to indicate capacitance tolerance, termination and failure rate level.

# European Detail Specifications CECC 32 101-801/Chips

## Standard European Ceramic Chip Capacitors

### PART NUMBER (example)

| 0805 | 5 | C | 103 | M | T | T | 2 | A |
|---|---|---|---|---|---|---|---|---|
| **Size** (L" x W") | **Voltage** 50V = 5 100V = 1 200V = 2 | **Dielectric** 1B CG = A 2R1 = C 2F4 = G | **Capacitance Code** | **Capacitance Tolerance** See Dielectrics C0G, X7R, Y5V | **Specification** CECC32101-801 | **Terminations** T = Plated Ni and Sn | **Marking Packaging** 2 = 7" Reel 4 = 13" Reel | **Special Code** A = Std. Product |

### RANGE OF APPROVED COMPONENTS

| Case Size | Dielectric Type | Voltage and Capacitance Range | | |
|---|---|---|---|---|
| | | 50V | 100V | 200V |
| **1BCG** | | | | |
| 0603 | 1B CG | 0.47pF - 150pF | 0.47pF - 120pF | 0.47pF - 100pF |
| 0805 | 1B CG | 0.47pF - 560pF | 0.47pF - 560pF | 0.47pF - 330pF |
| 1206 | 1B CG | 0.47pF - 3.3nF | 0.47pF - 3.3nF | 0.47pF - 1.5nF |
| 1210 | 1B CG | 0.47pF - 4.7nF | 0.47pF - 4.7nF | 0.47pF - 2.7nF |
| 1808 | 1B CG | 0.47pF - 6.8nF | 0.47pF - 6.8nF | 0.47pF - 4.7nF |
| 1812 | 1B CG | 0.47pF - 15nF | 0.47pF - 15nF | 0.47pF - 10nF |
| 2220 | 1B CG | 0.47pF - 39nF | 0.47pF - 39nF | 0.47pF - 15nF |
| **2R1** | | | | |
| 0603 | 2R1 | 10pF - 6.8nF | 10pF - 6.8nF | 10pF - 1.2nF |
| 0805 | 2R1 | 10pF - 33nF | 10pF - 18nF | 10pF - 3.3nF |
| 1206 | 2R1 | 10pF - 100nF | 10pF - 68nF | 10pF - 18nF |
| 1210 | 2R1 | 10pF - 150nF | 10pF - 100nF | 10pF - 27nF |
| 1808 | 2R1 | 10pF - 270nF | 10pF - 180nF | 10pF - 47nF |
| 1812 | 2R1 | 10pF - 470nF | 10pF - 330nF | 10pF - 100nF |
| 2220 | 2R1 | 10pF - 1.2µF | 10pF - 680nF | 10pF - 220nF |
| **2F4** | | | | |
| 0805 | 2F4 | 10pF - 100nF | | |
| 1206 | 2F4 | 10pF - 330nF | | |
| 1210 | 2F4 | 10pF - 470nF | | |
| 1808 | 2F4 | 10pF - 560nF | | |
| 1812 | 2F4 | 10pF - 1.8µF | | |
| 2220 | 2F4 | 10pF - 2.2µF | | |

# Packaging of Chip Components

## Automatic Insertion Packaging

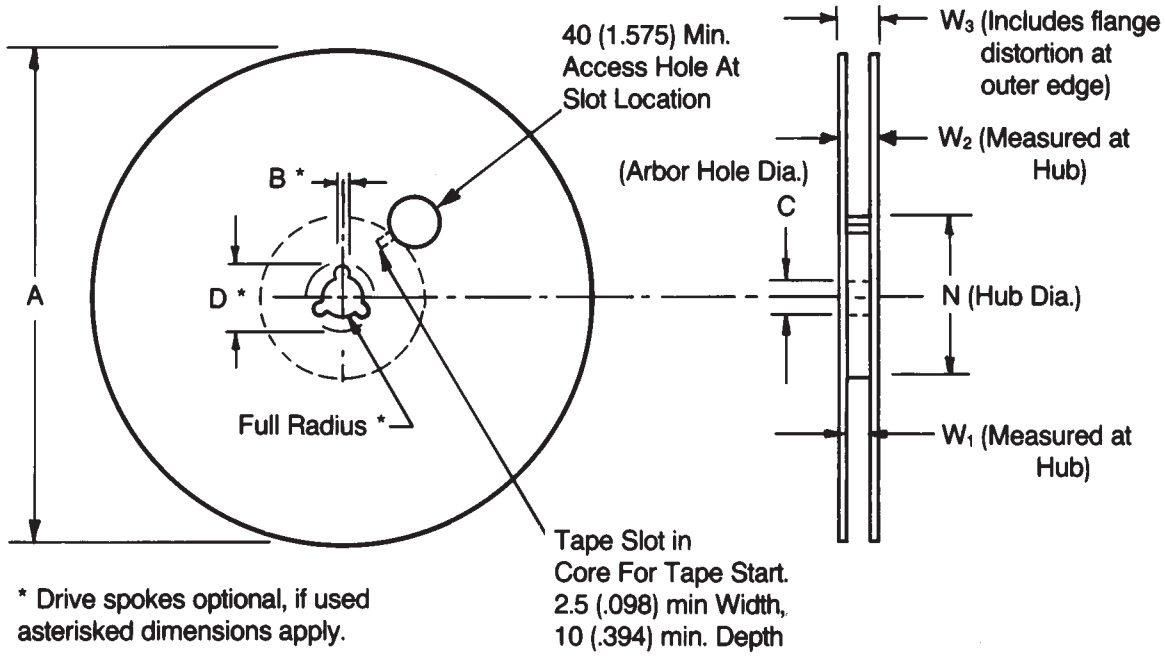
### TAPE & REEL QUANTITIES

All tape and reel specifications are in compliance with RS481.

| | 8mm | 12mm | |
|---|---|---|---|
| Paper or Embossed Carrier | 0805, 1005, 1206, 1210 | | |
| Embossed Only | 0504, 0907 | 1505, 1805, 1808 | 1812, 1825 2220, 2225 |
| Paper Only | 0402, 0603 | | |
| Qty. per Reel/7" Reel | 2,000 or 4,000 (1) | 3,000 | 1,000 |
| Qty. per Reel/13" Reel | 10,000 | 10,000 | 4,000 |

(1) Dependent on chip thickness. Low profile chips shown on page 30 are 5,000 per reel for 7" reel. 0402 size chips are 10,000 per 7" reels and are not available on 13" reels. For 3640 size chip contact factory for quantity per reel.

### REEL DIMENSIONS

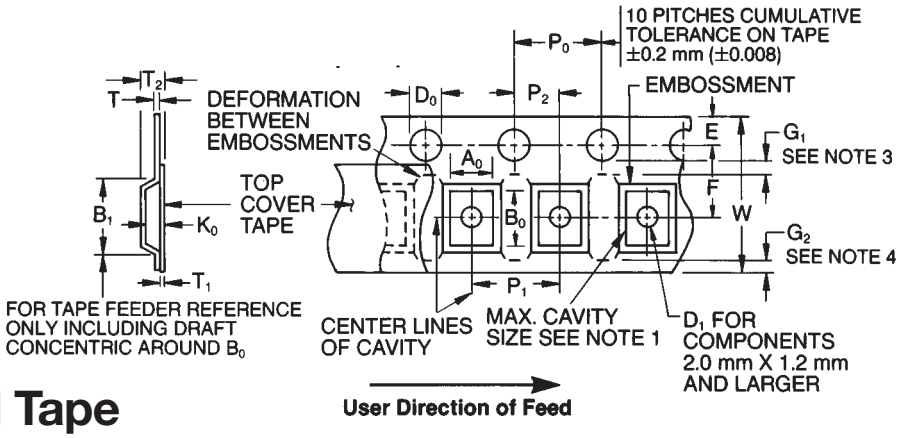



| Tape Size(1) | A Max. | B* Min. | C | D* Min. | N Min. | $W_1$ | $W_2$ Max. | $W_3$ |
|---|---|---|---|---|---|---|---|---|
| 8mm | 330 (12.992) | 1.5 (.059) | 13.0±0.20 (.512±.008) | 20.2 (.795) | 50 (1.969) | $8.4^{+1.0}_{-0.0}$ ($.331^{+.060}_{-0.0}$) | 14.4 (.567) | 7.9 Min. (.311) 10.9 Max. (.429) |
| 12mm | | | | | | $12.4^{+2.0}_{-0.0}$ ($.488^{+.076}_{-0.0}$) | 18.4 (.724) | 11.9 Min. (.469) 15.4 Max. (.607) |

Metric dimensions will govern.
English measurements rounded and for reference only.
(1) For tape sizes 16mm and 24mm (used with chip size 3640) consult EIA RS-481 latest revision.

# Embossed Carrier Configuration

## 8 & 12mm Tape Only




# 8 & 12mm Embossed Tape Metric Dimensions Will Govern

## CONSTANT DIMENSIONS

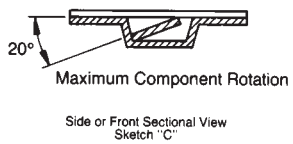
| Tape Size | $D_0$ | E | $P_0$ | $P_2$ | T Max. | $T_1$ | $G_1$ | $G_2$ |
|---|---|---|---|---|---|---|---|---|
| 8mm and 12mm | $8.4^{+0.10}_{-0.0}$ ($.059^{+.004}_{-0.0}$) | 1.75 ± 0.10 (.069 ± .004) | 4.0 ± 0.10 (.157 ± .004) | 2.0 ± 0.05 (.079 ± .002) | 0.600 (.024) | 0.10 (.004) Max. | 0.75 (.030) Min. See Note 3 | 0.75 (.030) Min. See Note 4 |

## VARIABLE DIMENSIONS

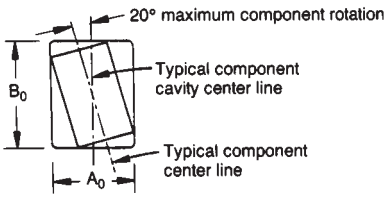
| Tape Size | $B_1$ Max. See Note 6 | $D_1$ Min. See Note 5 | F | $P_1$ | R Min. See Note 2 | $T_2$ | W | $A_0$ $B_0$ $K_0$ |
|---|---|---|---|---|---|---|---|---|
| 8mm | 4.55 (.179) | 1.0 (.039) | 3.5 ± 0.05 (.138 ± .002) | 4.0 ± 0.10 (.157 ± .004) | 25 (.984) | 2.5 Max (.098) | $8.0^{+0.3}_{-0.1}$ ($.315^{+.012}_{-.004}$) | See Note 1 |
| 12mm | 8.2 (.323) | 1.5 (.059) | 5.5 ± 0.05 (.217 ± .002) | 4.0 ± 0.10 (.157 ± .004) | 30 (1.181) | 6.5 Max. (.256) | 12.0 ± .30 (.472 ± .012) | See Note 1 |
| 8mm 1/2 Pitch | 4.55 (.179) | 1.0 (.039) | 3.5 ± 0.05 (.138 ± .002) | 2.0 ± 0.10 0.79 ± .004 | 25 (.984) | 2.5 Max. (.098) | $8.0^{+0.3}_{-0.1}$ ($.315^{+.012}_{-.004}$) | See Note 1 |
| 12mm Double Pitch | 8.2 (.323) | 1.5 (.059) | 5.5 ± 0.05 (.217 ± .002) | 8.0 ± 0.10 (.315 ± .004) | 30 (1.181) | 6.5 Max. (.256) | 12.0 ± .30 (.472 ± .012) | See Note 1 |

**NOTES:**

1. $A_0$, $B_0$, and $K_0$ are determined by the max. dimensions to the ends of the terminals extending from the component body and/or the body dimensions of the component. The clearance between the end of the terminals or body of the component to the sides and depth of the cavity ($A_0$, $B_0$, and $K_0$) must be within 0.05 mm (.002) min. and 0.50 mm (.020) max. The clearance allowed must also prevent rotation of the component within the cavity of not more than 20 degrees (see sketches C & D).
2. Tape with components shall pass around radius "R" without damage. The minimum trailer length (Note 2 Fig. 3) may require additional length to provide R min. for 12 mm embossed tape for reels with hub diameters approaching N min. (Table 4).
3. $G_1$ dimension is the flat area from the edge of the sprocket hole to either the outward deformation of the carrier tape between the embossed cavities or to the edge of the cavity whichever is less.
4. $G_2$ dimension is the flat area from the edge of the carrier tape opposite the sprocket holes to either the outward deformation of the carrier tape between the embossed cavity or to the edge of the cavity whichever is less.
5. The embossment hole location shall be measured from the sprocket hole controlling the location of the embossment. Dimensions of embossment location and hole location shall be applied independent of each other.
6. $B_1$ dimension is a reference dimension for tape feeder clearance only.



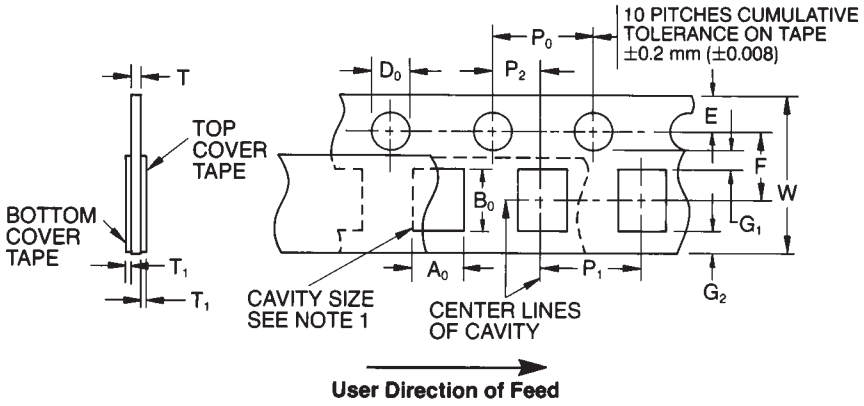

Side or Front Sectional View
Sketch "C"




Top View
Sketch "D"

# Paper Carrier Configuration

## 8 & 12mm Tape Only




## 8 & 12mm Paper Tape Metric Dimensions Will Govern

### CONSTANT DIMENSIONS

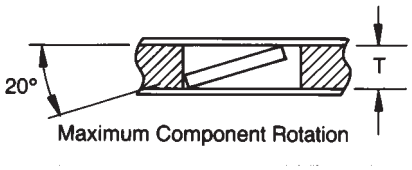
| Tape Size | $D_0$ | E | $P_0$ | $P_2$ | $T_1$ | $G_1$ | $G_2$ | R MIN. |
|---|---|---|---|---|---|---|---|---|
| 8mm and 12mm | $1.5^{+0.1}_{-0.0}$ ($.059^{+.004}_{-.000}$) | 1.75 ± 0.10 (.069 ± .004) | 4.0 ± 0.10 (.157 ± .004) | 2.0 ± 0.05 (.079 ± .002) | 0.10 (.004) Max. | 0.75 (.030) Min. | 0.75 (.030) Min. | 25 (.984) See Note 2 |

### VARIABLE DIMENSIONS

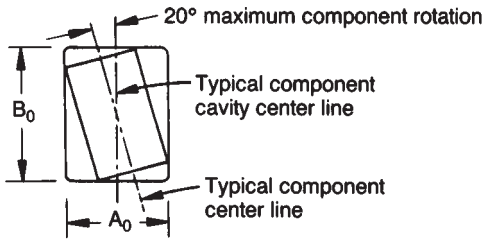
| Tape Size | $P_1$ | F | W | $A_0$ $B_0$ | T |
|---|---|---|---|---|---|
| 8mm | 4.0 ± 0.10 (.157 ± .004) | 3.5 ± 0.05 (.138 ± .002) | $8.0^{+0.3}_{-0.1}$ ($.315^{+.012}_{-.004}$) | See Note 1 | See Note 3 |
| 12mm | 4.0 ± .010 (.157 ± .004) | 5.5 ± 0.05 (.217 ± .002) | 12.0 ± 0.3 (.472 ± .012) | | |
| 8mm 1/2 Pitch | 2.0 ± 0.10 (.079 ± .004) | 3.5 ± 0.05 (.138 ± .002) | $8.0^{+0.3}_{-0.1}$ ($.315^{+.012}_{-.004}$) | | |
| 12mm Double Pitch | 8.0 ± 0.10 (.315 ± .004) | 5.5 ± 0.05 (.217 ± .002) | 12.0 ± 0.3 (.472 ± .012) | | |

**NOTES:**

1. $A_0$, $B_0$, and T are determined by the max. dimensions to the ends of the terminals extending from the component body and/or the body dimensions of the component. The clearance between the ends of the terminals or body of the component to the sides and depth of the cavity ($A_0$, $B_0$, and T) must be within 0.05 mm (.002) min. and 0.50 mm (.020) max. The clearance allowed must also prevent rotation of the component within the cavity of not more than 20 degrees (see sketches A & B).
2. Tape with components shall pass around radius "R" without damage.
3. 1.1 mm (.043) Base Tape and 1.6 mm (.063) Max. for Non-Paper Base Compositions.




Side or Front Sectional View
Sketch "A"




Top View
Sketch "B"

## Bar Code Labeling Standard

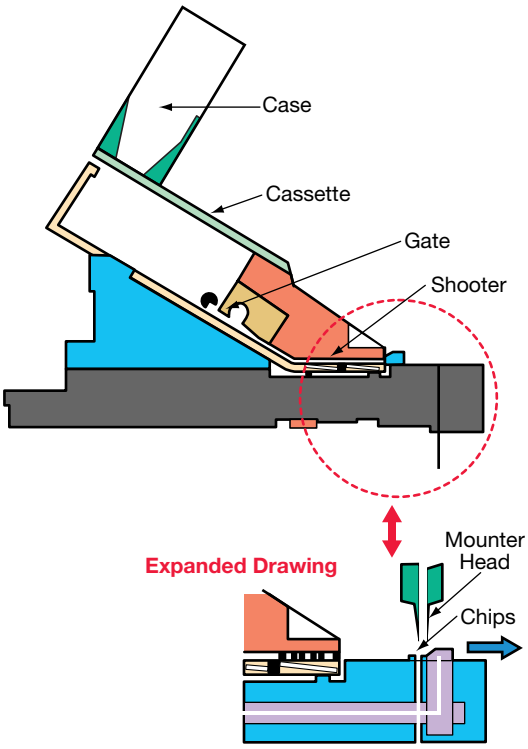
AVX bar code labeling is available and follows latest version of EIA-556-A.

# Bulk Case Packaging

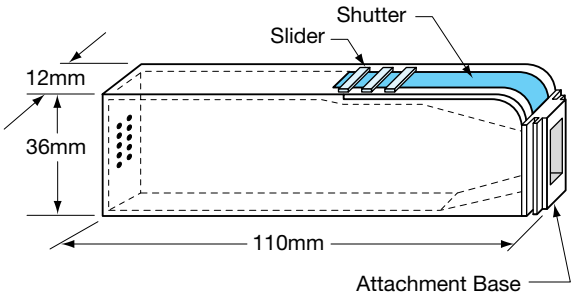
## BENEFITS

- Easier handling
- Smaller packaging volume
  (1/20 of T/R packaging)
- Easier inventory control
- Flexibility
- Recyclable

## BULK FEEDER




## CASE DIMENSIONS

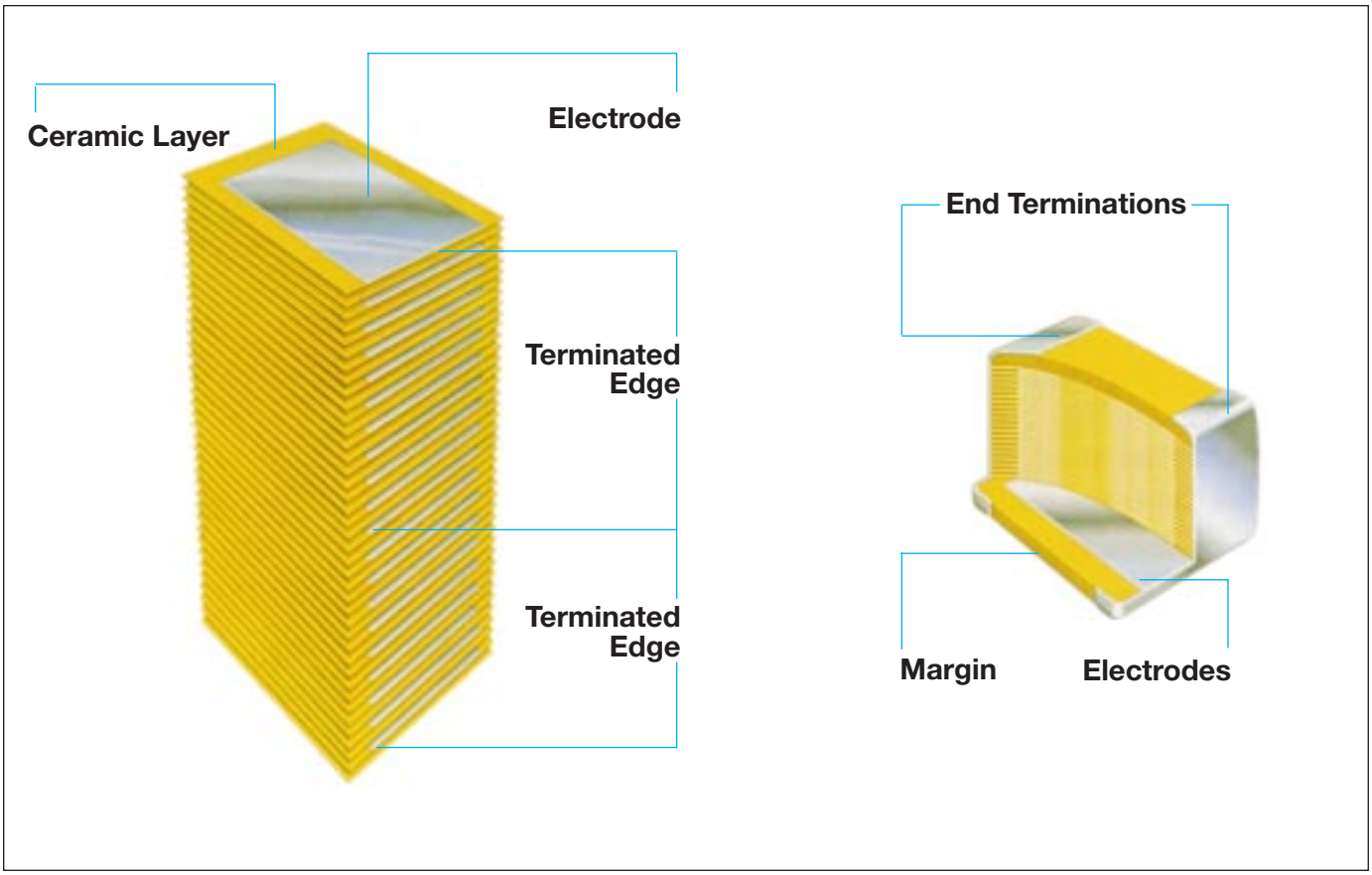



## CASE QUANTITIES

| Part Size | 0402 | 0603 | 0805 |
|---|---|---|---|
| Qty.<br>(pcs / cassette) | 80,000 | 15,000 | 10,000 (T=0.6mm)<br>5,000 (T≥0.6mm) |

# General Description

**Basic Construction –** A multilayer ceramic (MLC) capacitor is a monolithic block of ceramic containing two sets of offset, interleaved planar electrodes that extend to two opposite surfaces of the ceramic dielectric. This simple structure requires a considerable amount of sophistication, both in material and manufacture, to produce it in the quality and quantities needed in today's electronic equipment.




**Formulations –** Multilayer ceramic capacitors are available in both Class 1 and Class 2 formulations. Temperature compensating formulation are Class 1 and temperature stable and general application formulations are classified as Class 2.

**Class 1 –** Class 1 capacitors or temperature compensating capacitors are usually made from mixtures of titanates where barium titanate is normally not a major part of the mix. They have predictable temperature coefficients and in general, do not have an aging characteristic. Thus they are the most stable capacitor available. The most popular Class 1 multilayer ceramic capacitors are C0G (NP0) temperature compensating capacitors (negative-positive 0 ppm/°C).

**Class 2 –** EIA Class 2 capacitors typically are based on the chemistry of barium titanate and provide a wide range of capacitance values and temperature stability. The most commonly used Class 2 dielectrics are X7R and Y5V. The X7R provides intermediate capacitance values which vary only ±15% over the temperature range of -55°C to 125°C. It finds applications where stability over a wide temperature range is required.

The Y5V provides the highest capacitance values and is used in applications where limited temperature changes are expected. The capacitance value for Y5V can vary from 22% to -82% over the -30°C to 85°C temperature range. The Z5U dielectric is between X7R and Y5V in both stability and capacitance range.

All Class 2 capacitors vary in capacitance value under the influence of temperature, operating voltage (both AC and DC), and frequency. For additional information on performance changes with operating conditions, consult AVX's software, SpiCap.

**Effects of Voltage –** Variations in voltage have little effect on Class 1 dielectric but does affect the capacitance and dissipation factor of Class 2 dielectrics. The application of DC voltage reduces both the capacitance and dissipation factor while the application of an AC voltage within a reasonable range tends to increase both capacitance and dissipation factor readings. If a high enough AC voltage is applied, eventually it will reduce capacitance just as a DC voltage will. Figure 2 shows the effects of AC voltage.

**Cap. Change vs. A.C. Volts**
**AVX X7R T.C.**

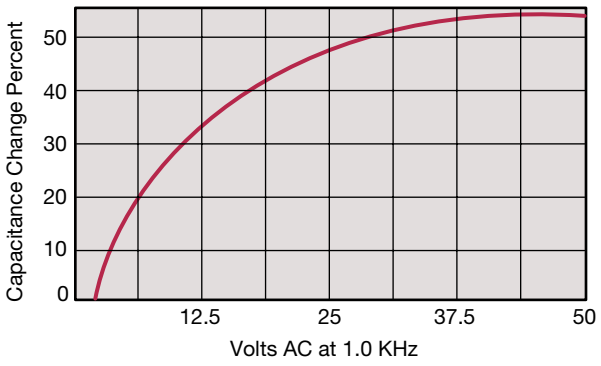



*Figure 2*

Capacitor specifications specify the AC voltage at which to measure (normally 0.5 or 1 VAC) and application of the wrong voltage can cause spurious readings. Figure 3 gives the voltage coefficient of dissipation factor for various AC voltages at 1 kilohertz. Applications of different frequencies will affect the percentage changes versus voltages.

**D.F. vs. A.C. Measurement Volts**
**AVX X7R T.C.**

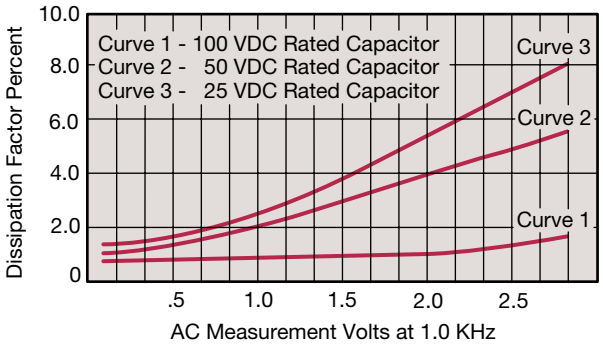



*Figure 3*

The effect of the application of DC voltage is shown in Figure 4. The voltage coefficient is more pronounced for higher K dielectrics. These figures are shown for room temperature conditions. The combination characteristic known as voltage temperature limits which shows the effects of rated voltage over the operating temperature range is shown in Figure 5 for the military BX characteristic.

**Cap. Change vs. D.C. Volts**
**AVX X7R T.C.**

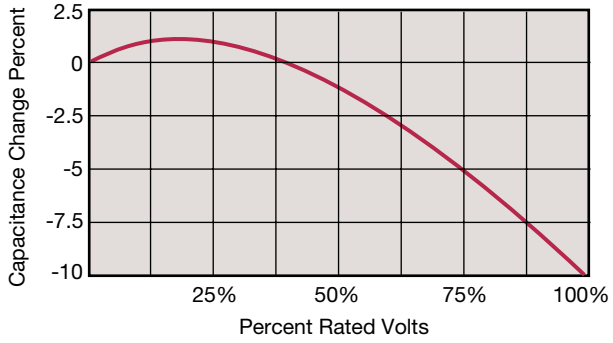



*Figure 4*

**Typical Cap. Change vs. Temperature**
**AVX X7R T.C.**

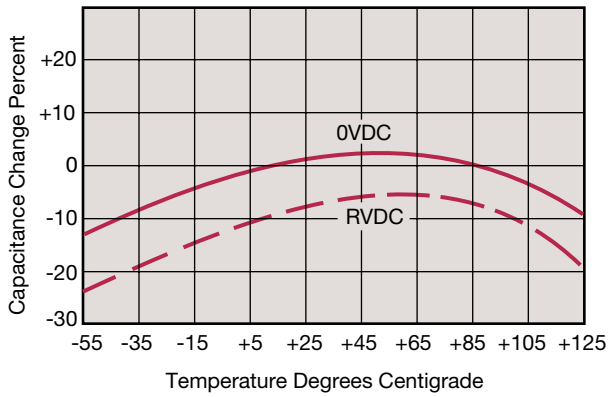


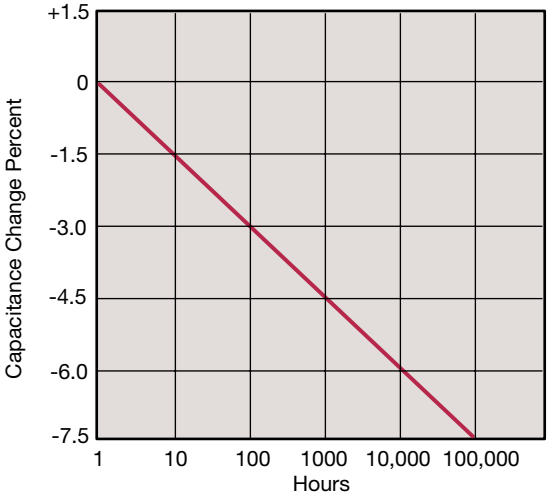

*Figure 5*

**Effects of Time –** Class 2 ceramic capacitors change capacitance and dissipation factor with time as well as temperature, voltage and frequency. This change with time is known as aging. Aging is caused by a gradual re-alignment of the crystalline structure of the ceramic and produces an exponential loss in capacitance and decrease in dissipation factor versus time. A typical curve of aging rate for semi-stable ceramics is shown in Figure 6.

If a Class 2 ceramic capacitor that has been sitting on the shelf for a period of time, is heated above its curie point, (125°C for 4 hours or 150°C for ½ hour will suffice) the part will de-age and return to its initial capacitance and dissipation factor readings. Because the capacitance changes rapidly, immediately after de-aging, the basic capacitance measurements are normally referred to a time period sometime after the de-aging process. Various manufacturers use different time bases but the most popular one is one day or twenty-four hours after "last heat." Change in the aging curve can be caused by the application of voltage and other stresses. The possible changes in capacitance due to de-aging by heating the unit explain why capacitance changes are allowed after test, such as temperature cycling, moisture resistance, etc., in MIL specs. The application of high voltages such as dielectric withstanding voltages also

tends to de-age capacitors and is why re-reading of capacitance after 12 or 24 hours is allowed in military specifications after dielectric strength tests have been performed.

**Typical Curve of Aging Rate**
**X7R Dielectric**




| Characteristic | Max. Aging Rate %/Decade |
|---|---|
| C0G (NP0) | None |
| X7R | 2 |
| Z5U | 3 |
| Y5V | 5 |

*Figure 6*

**Effects of Frequency –** Frequency affects capacitance and impedance characteristics of capacitors. This effect is much more pronounced in high dielectric constant ceramic formulation that is low K formulations. AVX's SpiCap software generates impedance, ESR, series inductance, series resonant frequency and capacitance all as functions of frequency, temperature and DC bias for standard chip sizes and styles. It is available free from AVX.


**Effects of Mechanical Stress –** High "K" dielectric ceramic capacitors exhibit some low level piezoelectric reactions under mechanical stress. As a general statement, the piezoelectric output is higher, the higher the dielectric constant of the ceramic. It is desirable to investigate this effect before using high "K" dielectrics as coupling capacitors in extremely low level applications.

**Reliability –** Historically ceramic capacitors have been one of the most reliable types of capacitors in use today. The approximate formula for the reliability of a ceramic capacitor is:

$$\frac{L_o}{L_t} = \left(\frac{V_t}{V_o}\right)^X \left(\frac{T_t}{T_o}\right)^Y$$

where

$L_o$ = operating life
$L_t$ = test life
$V_t$ = test voltage
$V_o$ = operating voltage
$T_t$ = test temperature and
$T_o$ = operating temperature in °C
**X,Y** = see text

Historically for ceramic capacitors exponent X has been considered as 3. The exponent Y for temperature effects typically tends to run about 8.

A capacitor is a component which is capable of storing electrical energy. It consists of two conductive plates (electrodes) separated by insulating material which is called the dielectric. A typical formula for determining capacitance is:

$$C = \frac{.224\ KA}{t}$$

**C** = capacitance (picofarads)
**K** = dielectric constant (Vacuum = 1)
**A** = area in square inches
**t** = separation between the plates in inches (thickness of dielectric)
**.224** = conversion constant (.0884 for metric system in cm)

**Capacitance –** The standard unit of capacitance is the farad. A capacitor has a capacitance of 1 farad when 1 coulomb charges it to 1 volt. One farad is a very large unit and most capacitors have values in the micro ($10^{-6}$), nano ($10^{-9}$) or pico ($10^{-12}$) farad level.

**Dielectric Constant –** In the formula for capacitance given above the dielectric constant of a vacuum is arbitrarily chosen as the number 1. Dielectric constants of other materials are then compared to the dielectric constant of a vacuum.

**Dielectric Thickness –** Capacitance is indirectly proportional to the separation between electrodes. Lower voltage requirements mean thinner dielectrics and greater capacitance per volume.

**Area –** Capacitance is directly proportional to the area of the electrodes. Since the other variables in the equation are usually set by the performance desired, area is the easiest parameter to modify to obtain a specific capacitance within a material group.

**Energy Stored –** The energy which can be stored in a capacitor is given by the formula:

$$E = \tfrac{1}{2}CV^2$$

**E** = energy in joules (watts-sec)
**V** = applied voltage
**C** = capacitance in farads

**Potential Change –** A capacitor is a reactive component which reacts against a change in potential across it. This is shown by the equation for the linear charge of a capacitor:

$$I_{ideal} = C\frac{dV}{dt}$$

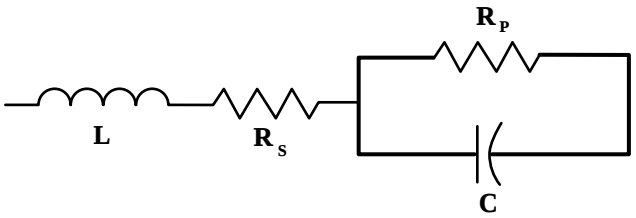
where

**I** = Current
**C** = Capacitance
**dV/dt** = Slope of voltage transition across capacitor

Thus an infinite current would be required to instantly change the potential across a capacitor. The amount of current a capacitor can "sink" is determined by the above equation.

**Equivalent Circuit –** A capacitor, as a practical device, exhibits not only capacitance but also resistance and inductance. A simplified schematic for the equivalent circuit is:

**C** = Capacitance
**L** = Inductance
**$R_S$** = Series Resistance
**$R_P$** = Parallel Resistance



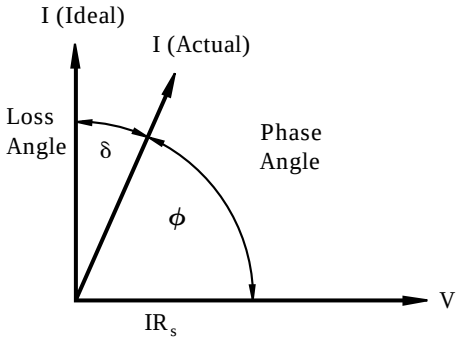

**Reactance –** Since the insulation resistance ($R_P$) is normally very high, the total impedance of a capacitor is:

where $Z = \sqrt{R_S^2 + (X_C - X_L)^2}$

**Z** = Total Impedance
**$R_s$** = Series Resistance
**$X_C$** = Capacitive Reactance = $\frac{1}{2\pi fC}$
**$X_L$** = Inductive Reactance = $2\pi fL$

The variation of a capacitor's impedance with frequency determines its effectiveness in many applications.

**Phase Angle –** Power Factor and Dissipation Factor are often confused since they are both measures of the loss in a capacitor under AC application and are often almost identical in value. In a "perfect" capacitor the current in the capacitor will lead the voltage by 90°.

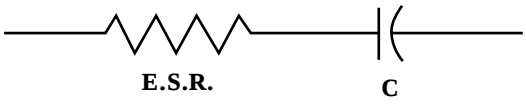



In practice the current leads the voltage by some other phase angle due to the series resistance $R_S$. The complement of this angle is called the loss angle and:

Power Factor (P.F.) = Cos $\phi$ or Sine $\delta$
Dissipation Factor (D.F.) = tan $\delta$

for small values of $\delta$ the tan and sine are essentially equal which has led to the common interchangeability of the two terms in the industry.

**Equivalent Series Resistance –** The term E.S.R. or Equivalent Series Resistance combines all losses both series and parallel in a capacitor at a given frequency so that the equivalent circuit is reduced to a simple R-C series connection.




**Dissipation Factor –** The DF/PF of a capacitor tells what percent of the apparent power input will turn to heat in the capacitor.

$$\textbf{Dissipation Factor} = \frac{\textbf{E.S.R.}}{\textbf{X}_C} = (2\pi fC)(\text{E.S.R.})$$

The watts loss are:

**Watts loss = $(2\pi fCV^2)$ (D.F.)**

Very low values of dissipation factor are expressed as their reciprocal for convenience. These are called the "Q" or Quality factor of capacitors.

**Parasitic Inductance –** The parasitic inductance of capacitors is becoming more and more important in the decoupling of today's high speed digital systems. The relationship between the inductance and the ripple voltage induced on the DC voltage line can be seen from the simple inductance equation:

$$V = L\frac{di}{dt}$$

The $\frac{di}{dt}$ seen in current microprocessors can be as high as 0.3 A/ns, and up to 10A/ns. At 0.3 A/ns, 100pH of parasitic inductance can cause a voltage spike of 30mV. While this does not sound very drastic, with the Vcc for microprocessors decreasing at the current rate, this can be a fairly large percentage.

Another important, often overlooked, reason for knowing the parasitic inductance is the calculation of the resonant frequency. This can be important for high frequency, bypass capacitors, as the resonant point will give the most signal attenuation. The resonant frequency is calculated from the simple equation:

$$f_{res} = \frac{1}{2\pi\sqrt{LC}}$$

**Insulation Resistance –** Insulation Resistance is the resistance measured across the terminals of a capacitor and consists principally of the parallel resistance $R_P$ shown in the equivalent circuit. As capacitance values and hence the area of dielectric increases, the I.R. decreases and hence the product (C x IR or RC) is often specified in ohm farads or more commonly megohm-microfarads. Leakage current is determined by dividing the rated voltage by IR (Ohm's Law).

**Dielectric Strength –** Dielectric Strength is an expression of the ability of a material to withstand an electrical stress. Although dielectric strength is ordinarily expressed in volts, it is actually dependent on the thickness of the dielectric and thus is also more generically a function of volts/mil.

**Dielectric Absorption –** A capacitor does not discharge instantaneously upon application of a short circuit, but drains gradually after the capacitance proper has been discharged. It is common practice to measure the dielectric absorption by determining the "reappearing voltage" which appears across a capacitor at some point in time after it has been fully discharged under short circuit conditions.

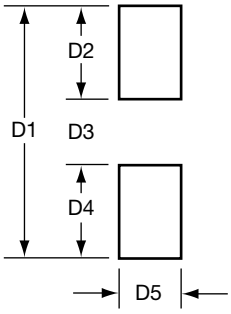
**Corona –** Corona is the ionization of air or other vapors which causes them to conduct current. It is especially prevalent in high voltage units but can occur with low voltages as well where high voltage gradients occur. The energy discharged degrades the performance of the capacitor and can in time cause catastrophic failures.

**Component Pad Design**

Component pads should be designed to achieve good solder filets and minimize component movement during reflow soldering. Pad designs are given below for the most common sizes of multilayer ceramic capacitors for both wave and reflow soldering. The basis of these designs is:

- Pad width equal to component width. It is permissible to decrease this to as low as 85% of component width but it is not advisable to go below this.
- Pad overlap 0.5mm beneath component.
- Pad extension 0.5mm beyond components for reflow and 1.0mm for wave soldering.

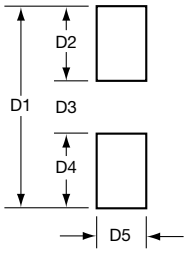
## REFLOW SOLDERING




Dimensions in millimeters (inches)

| Case Size | D1 | D2 | D3 | D4 | D5 |
|---|---|---|---|---|---|
| **0402** | 1.70 (0.07) | 0.60 (0.02) | 0.50 (0.02) | 0.60 (0.02) | 0.50 (0.02) |
| **0603** | 2.30 (0.09) | 0.80 (0.03) | 0.70 (0.03) | 0.80 (0.03) | 0.75 (0.03) |
| **0805** | 3.00 (0.12) | 1.00 (0.04) | 1.00 (0.04) | 1.00 (0.04) | 1.25 (0.05) |
| **1206** | 4.00 (0.16) | 1.00 (0.04) | 2.00 (0.09) | 1.00 (0.04) | 1.60 (0.06) |
| **1210** | 4.00 (0.16) | 1.00 (0.04) | 2.00 (0.09) | 1.00 (0.04) | 2.50 (0.10) |
| **1808** | 5.60 (0.22) | 1.00 (0.04) | 3.60 (0.14) | 1.00 (0.04) | 2.00 (0.08) |
| **1812** | 5.60 (0.22) | 1.00 (0.04)) | 3.60 (0.14) | 1.00 (0.04) | 3.00 (0.12) |
| **1825** | 5.60 (0.22) | 1.00 (0.04) | 3.60 (0.14) | 1.00 (0.04) | 6.35 (0.25) |
| **2220** | 6.60 (0.26) | 1.00 (0.04) | 4.60 (0.18) | 1.00 (0.04) | 5.00 (0.20) |
| **2225** | 6.60 (0.26) | 1.00 (0.04) | 4.60 (0.18) | 1.00 (0.04) | 6.35 (0.25) |

## WAVE SOLDERING

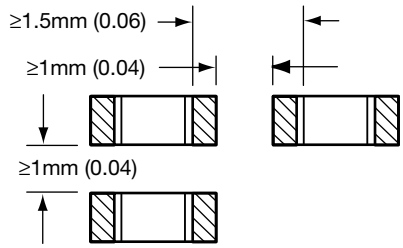



| Case Size | D1 | D2 | D3 | D4 | D5 |
|---|---|---|---|---|---|
| **0603** | 3.10 (0.12) | 1.20 (0.05) | 0.70 (0.03) | 1.20 (0.05) | 0.75 (0.03) |
| **0805** | 4.00 (0.15) | 1.50 (0.06) | 1.00 (0.04) | 1.50 (0.06) | 1.25 (0.05) |
| **1206** | 5.00 (0.19) | 1.50 (0.06) | 2.00 (0.09) | 1.50 (0.06) | 1.60 (0.06) |
| **1210** | 5.00 (0.19) | 1.50 (0.06) | 2.00 (0.09) | 1.50 (0.06) | 2.50 (0.10) |

Dimensions in millimeters (inches)

### Component Spacing

For wave soldering components, must be spaced sufficiently far apart to avoid bridging or shadowing (inability of solder to penetrate properly into small spaces). This is less important for reflow soldering but sufficient space must be allowed to enable rework should it be required.




### Preheat & Soldering

The rate of preheat should not exceed 4°C/second to prevent thermal shock. A better maximum figure is about 2°C/second.

For capacitors size 1206 and below, with a maximum thickness of 1.25mm, it is generally permissible to allow a temperature differential from preheat to soldering of 150°C. In all other cases this differential should not exceed 100°C.

For further specific application or process advice, please consult AVX.

### Cleaning

Care should be taken to ensure that the capacitors are thoroughly cleaned of flux residues especially the space beneath the capacitor. Such residues may otherwise become conductive and effectively offer a low resistance bypass to the capacitor.

Ultrasonic cleaning is permissible, the recommended conditions being 8 Watts/litre at 20-45 kHz, with a process cycle of 2 minutes vapor rinse, 2 minutes immersion in the ultrasonic solvent bath and finally 2 minutes vapor rinse.

## APPLICATION NOTES

### Storage
Good solderability is maintained for at least twelve months, provided the components are stored in their "as received" packaging at less than 40°C and 70% RH.

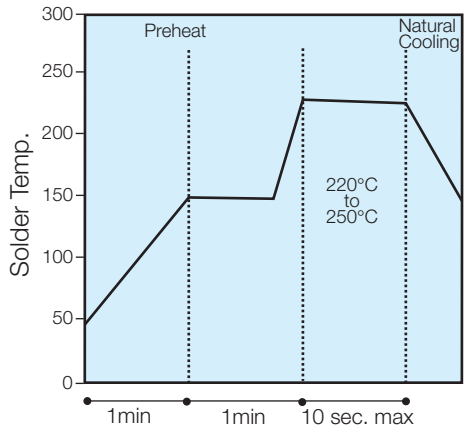
### Solderability
Terminations to be well soldered after immersion in a 60/40 tin/lead solder bath at 235 ±5°C for 2±1 seconds.

### Leaching
Terminations will resist leaching for at least the immersion times and conditions shown below.

| Termination Type | Solder Tin/Lead/Silver | Solder Temp. °C | Immersion Time Seconds |
|---|---|---|---|
| Nickel Barrier | 60/40/0 | 260±5 | 30±1 |

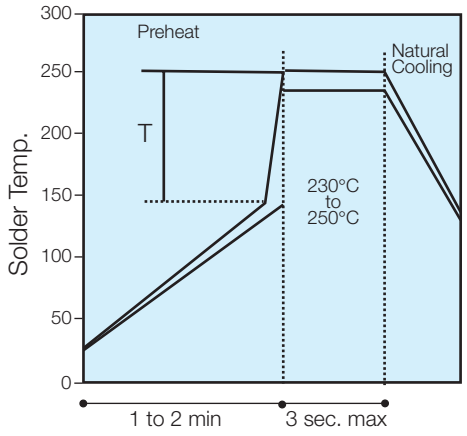
### Recommended Soldering Profiles

**Reflow**




(Minimize soldering time)

**Wave**




(Preheat chips before soldering)
T/maximum 150°C

### General
Surface mounting chip multilayer ceramic capacitors are designed for soldering to printed circuit boards or other substrates. The construction of the components is such that they will withstand the time/temperature profiles used in both wave and reflow soldering methods.

### Handling
Chip multilayer ceramic capacitors should be handled with care to avoid damage or contamination from perspiration and skin oils. The use of tweezers or vacuum pick ups is strongly recommended for individual components. Bulk handling should ensure that abrasion and mechanical shock are minimized. Taped and reeled components provides the ideal medium for direct presentation to the placement machine. Any mechanical shock should be minimized during handling chip multilayer ceramic capacitors.

### Preheat
It is important to avoid the possibility of thermal shock during soldering and carefully controlled preheat is therefore required. The rate of preheat should not exceed 4°C/second and a target figure 2°C/second is recommended. Although an 80°C to 120°C temperature differential is preferred, recent developments allow a temperature differential between the component surface and the soldering temperature of 150°C (Maximum) for capacitors of 1210 size and below with a maximum thickness of 1.25mm. The user is cautioned that the risk of thermal shock increases as chip size or temperature differential increases.

### Soldering
Mildly activated rosin fluxes are preferred. The minimum amount of solder to give a good joint should be used. Excessive solder can lead to damage from the stresses caused by the difference in coefficients of expansion between solder, chip and substrate. AVX terminations are suitable for all wave and reflow soldering systems. If hand soldering cannot be avoided, the preferred technique is the utilization of hot air soldering tools.

### Cooling
Natural cooling in air is preferred, as this minimizes stresses within the soldered joint. When forced air cooling is used, cooling rate should not exceed 4°C/second. Quenching is not recommended but if used, maximum temperature differentials should be observed according to the preheat conditions above.

### Cleaning
Flux residues may be hygroscopic or acidic and must be removed. AVX MLC capacitors are acceptable for use with all of the solvents described in the specifications MIL-STD-202 and EIA-RS-198. Alcohol based solvents are acceptable and properly controlled water cleaning systems are also acceptable. Many other solvents have been proven successful, and most solvents that are acceptable to other components on circuit assemblies are equally acceptable for use with ceramic capacitors.

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Comprehensive capacitor application software library which includes:

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