

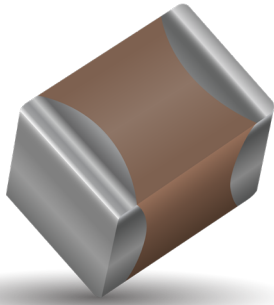


**THE DATASHEET OF
02013A220GAT2A**



COG (NP0) Dielectric

General Specifications



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

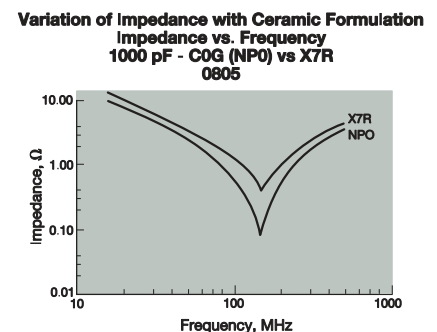
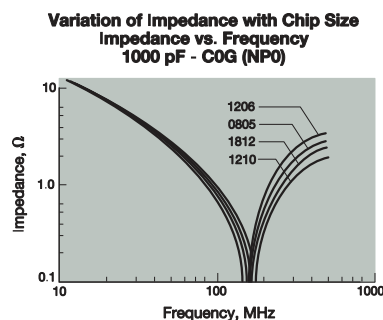
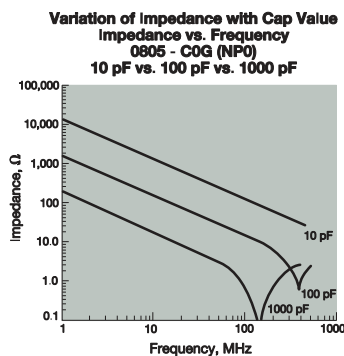
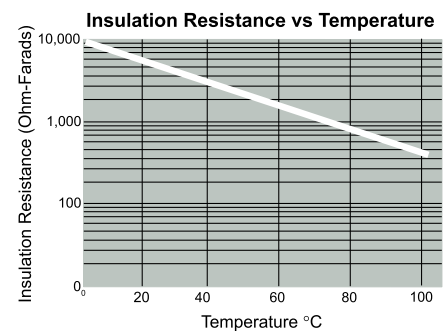
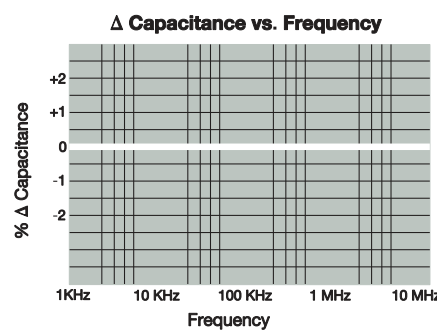
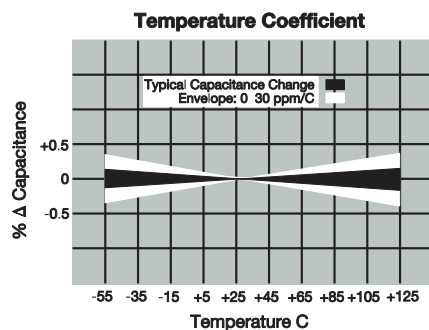
COG (NP0) ceramics offer one of the most stable capacitor dielectrics available. Capacitance change with temperature is $0 \pm 30\text{ppm}/^\circ\text{C}$ which is less than $\pm 0.3\%$ C from -55°C to $+125^\circ\text{C}$. Capacitance drift or hysteresis for COG (NP0) ceramics is negligible at less than $\pm 0.05\%$ versus up to $\pm 2\%$ for films. Typical capacitance change with life is less than $\pm 0.1\%$ for COG (NP0), one-fifth that shown by most other dielectrics.

PART NUMBER (SEE PAGE 4 FOR COMPLETE PART NUMBER EXPLANATION)



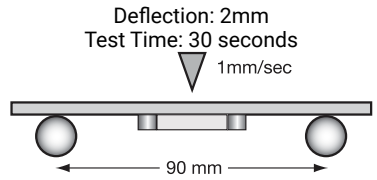
| | | | | | | | | |
|--------------------------|--|------------------------------------|--|--|---|--|---|---|
| 0805 | 5 | A | 101 | J | A | T | 2 | A |
| Size (L" x W") | Voltage 6.3V = 6 10V = Z 16V = Y 25V = 3 50V = 5 100V = 1 200V = 2 250V = V 500V = 7 | Dielectric COG (NP0) = A | Capacitance Code (In pF) 2 Sig. Digits + Number of Zeros | Capacitance Tolerance B = ± 10 pF (<10pF) C = ± 25 pF (<10pF) D = ± 50 pF (<10pF) F = $\pm 1\%$ (≥ 10 pF) G = $\pm 2\%$ (≥ 10 pF) J = $\pm 5\%$ K = $\pm 10\%$ | Failure Rate A = Not Applicable | Terminations T = Plated Ni and Sn | Packaging 2 = 7" Reel 4 = 13" Reel U = 4mm TR (01005) | Special Code A = Std. Product |
| | | | | | | Contact Factory For 1 = Pd/Ag Term 7 = Gold Plated NOT RoHS COMPLIANT | | Contact Factory For Multiples |

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



COG (NP0) Dielectric

Specifications and Test Methods

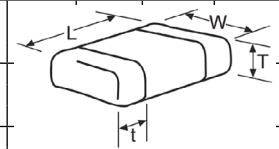
| Parameter/Test | | NP0 Specification Limits | Measuring Conditions | |
|--------------------------------|-----------------------|---|--|--------------------|
| Operating Temperature Range | | -55°C to +125°C | Temperature Cycle Chamber | |
| Capacitance | | Within specified tolerance | Freq.: 1.0 MHz \pm 10% for cap \leq 1000 pF 1.0 kHz \pm 10% for cap $>$ 1000 pF Voltage: 1.0Vrms \pm .2V | |
| Q | | $<$ 30 pF: Q \geq 400+20 x Cap Value \geq 30 pF: Q \geq 1000 | | |
| Insulation Resistance | | 10,000M Ω or 500M Ω - μ F, whichever is less | Charge device with rated voltage for 60 \pm 5 secs @ room temp/humidity | |
| Dielectric Strength | | No breakdown or visual defects | Charge device with 250% of rated voltage for 1-5 seconds, w/charge and discharge current limited to 50 mA (max) Note: Charge device with 150% of rated voltage for 500V devices. | |
| Resistance to Flexure Stresses | Appearance | No defects |  | |
| | Capacitance Variation | \pm 5% or \pm .5 pF, whichever is greater | | |
| | Q | Meets Initial Values (As Above) | | |
| | Insulation Resistance | \geq Initial Value x 0.3 | | |
| Solderability | | \geq 95% of each terminal should be covered with fresh solder | Dip device in eutectic solder at 230 \pm 5°C for 5.0 \pm 0.5 seconds | |
| Resistance to Solder Heat | Appearance | No defects, $<$ 25% leaching of either end terminal | Dip device in eutectic solder at 260°C for 60sec- onds. Store at room temperature for 24 \pm 2 hours before measuring electrical properties. | |
| | Capacitance Variation | \leq \pm 2.5% or \pm .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: -55°C \pm 2° | 30 \pm 3 minutes |
| | Capacitance Variation | \leq \pm 2.5% or \pm .25 pF, whichever is greater | Step 2: Room Temp | \leq 3 minutes |
| | Q | Meets Initial Values (As Above) | Step 3: +125°C \pm 2° | 30 \pm 3 minutes |
| | Insulation Resistance | Meets Initial Values (As Above) | Step 4: Room Temp | \leq 3 minutes |
| | Dielectric Strength | Meets Initial Values (As Above) | Repeat for 5 cycles and measure after 24 hours at room temperature | |
| Load Life | Appearance | No visual defects | Charge device with twice rated voltage in test chamber set at 125°C \pm 2°C for 1000 hours (+48, -0). Remove from test chamber and stabilize at room temperature for 24 hours before measuring. | |
| | Capacitance Variation | \leq \pm 3.0% or \pm .3 pF, whichever is greater | | |
| | Q (C=Nominal Cap) | \geq 30 pF: Q \geq 350 \geq 10 pF, $<$ 30 pF: Q \geq 275 +5C/2 $<$ 10 pF: Q \geq 200 +10C | | |
| | Insulation Resistance | \geq Initial Value x 0.3 (See Above) | | |
| Load Humidity | Appearance | No visual defects | Store in a test chamber set at 85°C \pm 2°C/ 85% \pm 5% relative humidity for 1000 hours (+48, -0) with rated voltage applied. Remove from chamber and stabilize at room temperature for 24 \pm 2 hours before measuring. | |
| | Capacitance Variation | \leq \pm 5.0% or \pm .5 pF, whichever is greater | | |
| | Q | \geq 30 pF: Q \geq 350 \geq 10 pF, $<$ 30 pF: Q \geq 275 +5C/2 $<$ 10 pF: Q \geq 200 +10C | | |
| | Insulation Resistance | \geq Initial Value x 0.3 (See Above) | | |
| | Dielectric Strength | Meets Initial Values (As Above) | | |

C0G (NP0) Dielectric Capacitance Range



PREFERRED SIZES ARE SHADED

| SIZE | 1210 | | | | | 1812 | | | | | 1825 | | | 2220 | | | 2225 | | |
|--------------|--------------------------------|----|-----|-----|-----|--------------------------------|----|-----|-----|-----|--------------------------------|-----|-----|--------------------------------|-----|-----|--------------------------------|-----|-----|
| Soldering | Reflow Only | | | | | Reflow Only | | | | | Reflow Only | | | Reflow Only | | | Reflow Only | | |
| Packaging | Paper/Embossed | | | | | All Embossed | | | | | All Embossed | | | All Embossed | | | All Embossed | | |
| (L) Length | 3.20 ± 0.20 (0.126 ± 0.008) | | | | | 4.50 ± 0.30 (0.177 ± 0.012) | | | | | 4.50 ± 0.30 (0.177 ± 0.012) | | | 5.70 ± 0.40 (0.225 ± 0.016) | | | 5.72 ± 0.25 (0.225 ± 0.010) | | |
| (W) Width | 2.50 ± 0.20 (0.098 ± 0.008) | | | | | 3.20 ± 0.20 (0.126 ± 0.008) | | | | | 6.40 ± 0.40 (0.252 ± 0.016) | | | 5.00 ± 0.40 (0.197 ± 0.016) | | | 6.35 ± 0.25 (0.250 ± 0.010) | | |
| (t) Terminal | 0.50 ± 0.25 (0.020 ± 0.010) | | | | | 0.61 ± 0.36 (0.024 ± 0.014) | | | | | 0.61 ± 0.36 (0.024 ± 0.014) | | | 0.64 ± 0.39 (0.025 ± 0.015) | | | 0.64 ± 0.39 (0.025 ± 0.015) | | |
| WVDC | 25 | 50 | 100 | 200 | 500 | 25 | 50 | 100 | 200 | 500 | 50 | 100 | 200 | 50 | 100 | 200 | 50 | 100 | 200 |
| Cap (pF) | 3.9 | | | | | | | | | | | | | | | | | | |
| | 4.7 | | | | | | | | | | | | | | | | | | |
| | 5.6 | | | | | | | | | | | | | | | | | | |
| | 6.8 | | | | | | | | | | | | | | | | | | |
| | 8.2 | | | | | | | | | | | | | | | | | | |
| | 10 | M | M | M | M | M | P | P | P | P | | | | | | | | | |
| | 12 | M | M | M | M | M | P | P | P | P | | | | | | | | | |
| | 15 | M | M | M | M | M | P | P | P | P | | | | | | | | | |
| | 18 | M | M | M | M | M | P | P | P | P | | | | | | | | | |
| | 22 | M | M | M | M | M | P | P | P | P | | | | | | | | | |
| | 27 | M | M | M | M | M | P | P | P | P | | | | | | | | | |
| | 33 | M | M | M | M | M | P | P | P | P | | | | | | | | | |
| | 39 | M | M | M | M | M | P | P | P | P | | | | | | | | | |
| | 47 | P | P | P | P | P | P | P | P | P | | | | | | | | | |
| | 56 | P | P | P | P | P | P | P | P | P | | | | | | | | | |
| | 68 | P | P | P | P | P | P | P | P | P | | | | | | | | | |
| | 82 | P | P | P | P | P | P | P | P | P | | | | | | | | | |
| | 100 | P | P | P | P | P | P | P | P | P | | | | | | | | | |
| | 120 | P | P | P | P | P | P | P | P | P | | | | | | | | | |
| | 150 | P | P | P | P | P | P | P | P | P | | | | | | | | | |
| | 180 | P | P | P | P | P | P | P | P | P | | | | | | | | | |
| | 220 | P | P | P | P | P | P | P | P | P | | | | | | | | | |
| | 270 | P | P | P | P | P | P | P | P | P | | | | | | | | | |
| | 330 | P | P | P | P | P | P | P | P | P | | | | | | | | | |
| | 390 | P | P | P | P | P | P | P | P | P | | | | | | | | | |
| | 470 | P | P | P | P | P | P | P | P | P | | | | | | | | | |
| | 560 | P | P | P | P | P | P | P | P | P | | | | | | | | | |
| | 680 | P | P | P | P | P | P | P | P | P | | | | | | | | | |
| | 820 | P | P | P | P | P | P | P | P | P | | | | | | | | | |
| | 1000 | P | P | P | P | P | P | P | P | P | M | M | M | | | | M | M | P |
| | 1200 | P | P | P | P | P | P | P | P | P | M | M | M | | | | M | M | P |
| | 1500 | P | P | P | P | P | P | P | P | P | M | M | M | | | | M | M | P |
| | 1800 | P | P | P | P | P | P | P | P | P | M | M | M | | | | M | M | P |
| | 2200 | P | P | P | P | P | P | P | P | P | X | X | M | | | | M | M | P |
| | 2700 | P | P | P | P | P | P | P | P | Q | X | X | M | | | | M | M | P |
| | 3300 | P | P | P | P | P | P | P | P | Q | X | X | X | | | X | M | M | P |
| | 3900 | P | P | P | P | P | P | P | P | Q | X | X | X | | | X | M | M | P |
| | 4700 | P | P | P | P | P | P | P | P | Y | X | X | X | | X | X | M | M | P |
| | 5600 | P | P | P | P | P | P | P | P | Y | X | X | X | | X | X | M | M | P |
| | 6800 | P | P | P | X | X | P | P | Q | Q | Y | X | X | | X | X | M | M | P |
| | 8200 | P | P | P | X | X | P | P | Q | Q | Y | X | X | | X | X | M | M | P |
| Cap (µF) | 0.010 | P | P | X | X | X | P | P | Q | Q | Y | X | X | | X | X | M | M | P |
| | 0.012 | X | X | X | X | X | P | P | Q | X | Y | X | X | | X | X | M | M | P |
| | 0.015 | X | X | X | Z | Z | P | P | Q | X | Y | X | X | | X | X | M | M | Y |
| | 0.018 | X | X | Z | Z | | P | P | X | X | Y | X | X | | X | X | M | M | Y |
| | 0.022 | X | X | Z | Z | | P | P | X | X | | X | X | | X | X | M | Y | Y |
| | 0.027 | X | Z | Z | Z | | Q | X | X | Z | | X | X | | Y | | P | Y | Y |
| | 0.033 | X | Z | Z | Z | | Q | X | X | Z | | X | X | | X | X | X | Y | Y |
| | 0.039 | Z | Z | Z | | | X | X | Z | Z | | X | | | Y | | X | Y | Y |
| | 0.047 | Z | Z | Z | | | X | X | Z | Z | | X | | | Y | | X | Z | |
| | 0.068 | | | | | | Z | Z | Z | | | | | | Z | | X | Z | |
| | 0.082 | | | | | | Z | Z | Z | | | | | | Z | | X | Z | |
| | 0.1 | | | | | | Z | Z | Z | | | | | | Z | | Z | Z | |
| WVDC | 25 | 50 | 100 | 200 | 500 | 25 | 50 | 100 | 200 | 500 | 50 | 100 | 200 | 50 | 100 | 200 | 50 | 100 | 200 |
| SIZE | 1210 | | | | | 1812 | | | | | 1825 | | | 2220 | | | 2225 | | |



| Letter | A | B | C | E | G | J | K | M | N | P | Q | X | Y | Z |
|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Max. Thickness | 0.33 (0.013) | 0.22 (0.009) | 0.56 (0.022) | 0.71 (0.028) | 0.90 (0.035) | 0.94 (0.037) | 1.02 (0.040) | 1.27 (0.050) | 1.40 (0.055) | 1.52 (0.060) | 1.78 (0.070) | 2.29 (0.090) | 2.54 (0.100) | 2.79 (0.110) |
| | PAPER | | | | | | EMBOSSSED | | | | | | | |

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