



**THE DATASHEET OF  
02013A6R8BAT2A**



# 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.

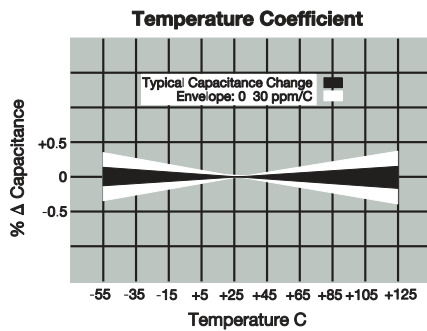
COG (NP0) ceramics offer one of the most stable capacitor dielectrics available. Capacitance change with temperature is  $0 \pm 30\text{ppm}/^\circ\text{C}$  which is less than  $\pm 0.3\%$  C from  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$ . Capacitance drift or hysteresis for COG (NP0) ceramics 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)



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

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



# 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 $\Omega$ or 500M $\Omega$ - $\mu$ 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)		

# COG (NP0) Dielectric Capacitance Range



## PREFERRED SIZES ARE SHADED

SIZE	0101*	0201			0402			0603				0805					1206								
Soldering	Reflow Only	Reflow Only			Reflow/Wave			Reflow/Wave				Reflow/Wave					Reflow/Wave								
Packaging	All Paper	All Paper			All Paper			All Paper				Paper/Embossed					Paper/Embossed								
(L) Length	mm (in.)	0.40 ± 0.02 (0.016 ± 0.0008)		0.60 ± 0.03 (0.024 ± 0.001)		1.00 ± 0.10 (0.040 ± 0.004)		1.60 ± 0.15 (0.063 ± 0.006)				2.01 ± 0.20 (0.079 ± 0.008)					3.20 ± 0.20 (0.126 ± 0.008)								
(W) Width	mm (in.)	0.20 ± 0.02 (0.008 ± 0.0008)		0.30 ± 0.03 (0.011 ± 0.001)		0.50 ± 0.10 (0.020 ± 0.004)		0.81 ± 0.15 (0.032 ± 0.006)				1.25 ± 0.20 (0.049 ± 0.008)					1.60 ± 0.20 (0.063 ± 0.008)								
(t) Terminal	mm (in.)	0.10 ± 0.04 (0.004 ± 0.0016)		0.15 ± 0.05 (0.006 ± 0.002)		0.25 ± 0.15 (0.010 ± 0.006)		0.35 ± 0.15 (0.014 ± 0.006)				0.50 ± 0.25 (0.020 ± 0.010)					0.50 ± 0.25 (0.020 ± 0.010)								
WVDC		16	25	50	16	25	50	16	25	50	100	200	16	25	50	100	200	250	16	25	50	100	200	250	500
Cap (pF)	0.5	A	A	C	C	C	G	G	G	G			J	J	J	J	J	J	J	J	J	J	J	J	J
	1.0	B	A	A	C	C	C	G	G	G	G		J	J	J	J	J	J	J	J	J	J	J	J	J
	1.2	B	A	A	C	C	C	G	G	G	G		J	J	J	J	J	J	J	J	J	J	J	J	J
	1.5	B	A	A	C	C	C	G	G	G	G		J	J	J	J	J	J	J	J	J	J	J	J	J
	1.8	B	A	A	C	C	C	G	G	G	G		J	J	J	J	J	J	J	J	J	J	J	J	J
	2.2	B	A	A	C	C	C	G	G	G	G		J	J	J	J	J	J	J	J	J	J	J	J	J
	2.7	B	A	A	C	C	C	G	G	G	G		J	J	J	J	J	J	J	J	J	J	J	J	J
	3.3	B	A	A	C	C	C	G	G	G	G		J	J	J	J	J	J	J	J	J	J	J	J	J
	3.9	B	A	A	C	C	C	G	G	G	G		J	J	J	J	J	J	J	J	J	J	J	J	J
	4.7	B	A	A	C	C	C	G	G	G	G		J	J	J	J	J	J	J	J	J	J	J	J	J
	5.6	B	A	A	C	C	C	G	G	G	G		J	J	J	J	J	J	J	J	J	J	J	J	J
	6.8	B	A	A	C	C	C	G	G	G	G		J	J	J	J	J	J	J	J	J	J	J	J	J
	8.2	B	A	A	C	C	C	G	G	G	G		J	J	J	J	J	J	J	J	J	J	J	J	J
	10	B	A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	12	B	A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	15	B	A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	18	B	A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	22	B	A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	27	B	A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	33	B	A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	39	B	A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	47	B	A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	56	B	A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	68	B	A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	82	B	A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	100	B	A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	120		A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	150		A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	180		A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	220		A	A	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	270				C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	330				C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	390				C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	470				C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	560				C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	680				C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	750				C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	820				C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	1000				C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	1200							G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	1500							G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	1800							G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J
	2200							G	G	G	G	G	P	P	P	P	P	P	J	J	M	P	Q	P	P
	2700							G	G	G	G	G	P	P	P	P	P	P	J	J	M	P	Q	P	P
	3300							G	G	G	G	G	P	P	P	P	P	P	J	J	M	P	Q	X	P
	3900							G	G	G	G	G	P	P	P	P	P	P	J	J	M	P	X	X	X
	4700							G	G	G	G	G	P	P	P	P	P	P	J	J	M	P	X	X	X
	5600												P	P	P				J	J	M	P	X	X	X
	6800												P	P	P				M	M	M	P	X	X	X
	8200												P	P	P				P	P	P	P	X	X	
Cap (µF)	0.010												P	P	P				P	P	P	P	X	X	
	0.012												P	P	P				X	X	X	X			
	0.015																		X	X	X	X			
	0.018																		X	X	X	X			
	0.022																		X	X	X	X			
	0.027																		X	X	X	X			
	0.033																		X	X	X	X			
	0.039																		X	X	X	X			
	0.047																		X	X	X	X			
	0.068																		X	X	X	X			
	0.082																		X	X	X	X			
	0.1																		X	X	X	X			
WVDC		16	25	50	16	25	50	16	25	50	100	200	16	25	50	100	200	250	16	25	50	100	200	250	500
SIZE		0101*	0201			0402			0603				0805					1206							



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						EMBOSSED							

# 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		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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