



**THE DATASHEET OF
02013A470GAT2A**



COG (NP0) Dielectric, KGM Series

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.

HOW TO ORDER

KGM	21	A	CG	2J	102	F	L
Series	Size	Thickness	Dielectric	Voltage	Capacitance Code Code (in pF)	Capacitance Tolerance	Packaging
General Purpose Tin/Nickel Finish	02 = 0101 32 = 1210 03 = 0201 43 = 1812 05 = 0402 44 = 1825 15 = 0603 55 = 2220 21 = 0805 56 = 2225 31 = 1206	See Cap Chart	CG = COG	0G = 4.0V 1H = 50V 0J = 6.3V 2A = 100V 1A = 10V 2D = 200V 1C = 16V 2E = 250V 1E = 25V 2H = 500V	2 Significant Digits +Number of zeros eg. $10\mu\text{F} = 106$ $10\text{nF} = 103$ $47\text{pF} = 470$	B = $\pm 10\text{pF}$ ($<10\text{pF}$)* C = $\pm 25\text{pF}$ ($<10\text{pF}$)* D = $\pm 50\text{pF}$ ($<10\text{pF}$)* F = $\pm 1\%$ ($\geq 10\text{pF}$)* G = $\pm 2\%$ ($\geq 10\text{pF}$)* J = $\pm 5\%$ ($\geq 10\text{pF}$) K = $\pm 10\%$ ($\geq 10\text{pF}$) M = $\pm 20\%$	See Table Below



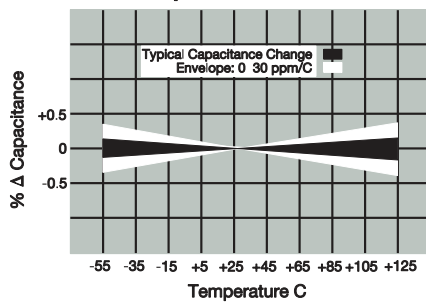
PACKAGING CODES

Code	EIA (inch)	IEC(mm)	7" Paper	7" Embossed	13" Paper	13" Embossed
02	0101	0402	H		n/a	
03	0201	0603	H		N	
05	0402	1005	H		N	
15	0603	1608	T		M	
21	0805	2012	T	U	M	L
31	1206	3216	T	U	M	L
32	1210	3225		U		L
43	1812	4532		V		S
44	1825	4564		V		S
55	2220	5750		V		S
56	2225	5763		V		S

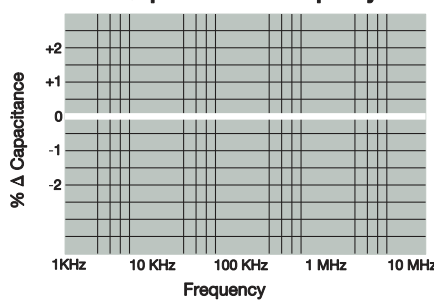
*thickness determines paper or plastic embossed packaging

*COG only

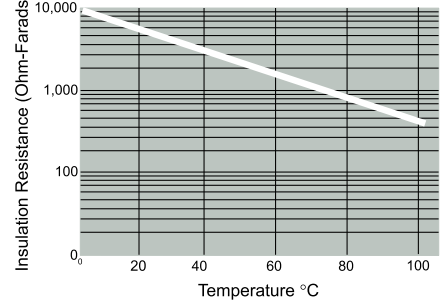
Temperature Coefficient



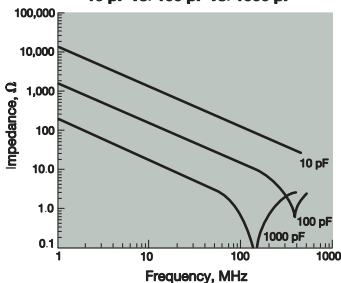
Δ Capacitance vs. Frequency



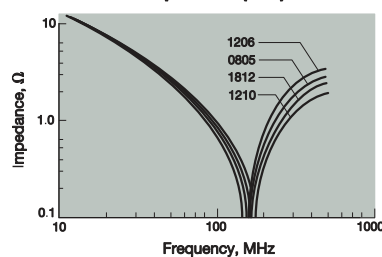
Insulation Resistance vs. Temperature



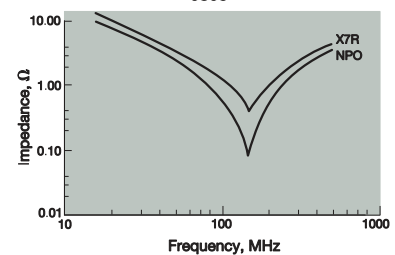
Variation of Impedance with Cap Value Impedance vs. Frequency 0805 - COG (NP0) 10 pF vs. 100 pF vs. 1000 pF



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

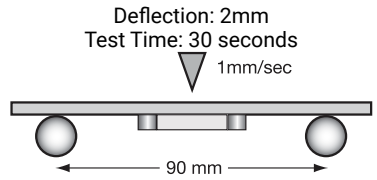


Variation of Impedance with Ceramic Formulation Impedance vs. Frequency 1000 pF - COG (NP0) vs X7R 0805



COG (NP0) Dielectric, KGM Series

Specifications and Test Methods

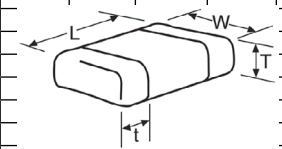
Parameter/Test		NP0 Specification Limits	Measuring Conditions	
Operating Temperature Range		-55°C to +125°C	Temperature Cycle Chamber	
Capacitance		Within specified tolerance	Freq.: 1.0 MHz \pm 10% for cap \leq 1000 pF 1.0 kHz \pm 10% for cap $>$ 1000 pF Voltage: 1.0Vrms \pm .2V	
Q		$<$ 30 pF: Q \geq 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)		

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Capacitance Range



SIZE		1210					1812					1825			2220			2225		
Soldering		Reflow Only					Reflow Only					Reflow Only			Reflow Only			Reflow Only		
Packaging		All Embossed					All Embossed					All Embossed			All Embossed			All Embossed		
(L) Length	mm	3.20 ± 0.20					4.50 ± 0.30					4.50 ± 0.30			5.70 ± 0.40			5.72 ± 0.25		
	(in.)	(0.126 ± 0.008)					(0.177 ± 0.012)					(0.177 ± 0.012)			(0.225 ± 0.016)			(0.225 ± 0.010)		
(W) Width	mm	2.50 ± 0.20					3.20 ± 0.20					6.40 ± 0.40			5.00 ± 0.40			6.35 ± 0.25		
	(in.)	(0.098 ± 0.008)					(0.126 ± 0.008)					(0.252 ± 0.016)			(0.197 ± 0.016)			(0.250 ± 0.010)		
Terminal (t)	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	WVDC	25	50	100	200	500	25	50	100	200	500	50	100	200	50	100	200	50	100	200
Cap 3.9																				
(pF) 4.7																				
5.6																				
6.8																				
8.2																				
10		E	E	E	E	E	B	B	B	B	B									
12		E	E	E	E	E	B	B	B	B	B									
15		E	E	E	E	E	B	B	B	B	B									
18		E	E	E	E	E	B	B	B	B	B									
22		E	E	E	E	E	B	B	B	B	B									
27		E	E	E	E	E	B	B	B	B	B									
33		E	E	E	E	E	B	B	B	B	B									
39		E	E	E	E	E	B	B	B	B	B									
47		E	E	E	E	E	B	B	B	B	B									
56		E	E	E	E	E	B	B	B	B	B									
68		E	E	E	E	E	B	B	B	B	B									
82		E	E	E	E	E	B	B	B	B	B									
100		E	E	E	E	E	B	B	B	B	B									
120		E	E	E	E	E	B	B	B	B	B									
150		E	E	E	E	E	B	B	B	B	B									
180		E	E	E	E	E	B	B	B	B	B									
220		E	E	E	E	E	B	B	B	B	B									
270		E	E	E	E	E	B	B	B	B	B									
330		E	E	E	E	E	B	B	B	B	B									
390		E	E	E	E	E	B	B	B	B	B									
470		E	E	E	E	E	B	B	B	B	B									
560		E	E	E	E	E	B	B	B	B	B									
680		E	E	E	E	E	B	B	B	B	B									
820		E	E	E	E	E	B	B	B	B	B									
1,000		E	E	E	E	E	B	B	B	B	B	C	C	C	Z	Z	Z	D	D	D
1200		E	E	E	E	E	B	B	B	B	B	C	C	C	Z	Z	Z	D	D	D
1500		E	E	E	E	E	B	B	B	B	B	C	C	C	Z	Z	Z	D	D	D
1800		E	E	E	E	E	B	B	B	B	B	C	C	C	Z	Z	Z	D	D	D
2200		E	E	E	E	E	B	B	B	B	B	C	C	C	Z	Z	Z	D	D	D
2700		E	E	E	E	E	B	B	B	B	B	C	C	C	Z	Z	Z	D	D	D
3300		E	E	E	E	E	B	B	B	B	B	C	C	C	Z	Z	Z	D	D	D
3900		E	E	E	E	E	B	B	B	B	B	C	C	C	Z	Z	Z	D	D	D
4700		E	E	E	H	H	B	B	B	B	B	C	C	C	Z	Z	Z	D	D	D
5600		E	E	E	H	H	B	B	B	B	B	C	C	C	Z	Z	Z	D	D	D
6800		E	E	E	H	H	B	B	B	B	B	C	C	C	Z	Z	Z	D	D	D
8200		E	E	E	H	H	B	B	B	B	B	C	C	C	Z	Z	Z	D	D	D
Cap 0.010		E	E	H	J	J	B	B	B	B	B	C	C	C	Z	Z	Z	D	D	D
(µF) 0.012		H	H	H	J	J	B	B	B	E	E	C	C	C	Z	Z	Z	D	D	D
0.015		H	H	J	L	L	B	B	B	E	E	C	C	C	Z	Z	Z	D	D	D
0.018		J	J	L	L		B	B	E	F	F	C	C	C	Z	Z	Z	D	D	D
0.022		J	J	L	L		B	B	E	F	F	C	C	C	Z	Z	Z	D	D	D
0.027		L	L	L	L		E	E	F	J		C	C	C	Z	Z	Z	D	D	D
0.033		L	L	L	L		E	E	F			C	C	C	Z	Z	Z	D	D	D
0.039		L	L	L			J	J	J			C	C	C	Z	Z	Z	D	D	D
0.047		L	L	L			J	J	J			C	C	C	Z	Z	C	D	D	D
0.068							J	J	J			C	C	F	Z	Z	C	D	D	G
0.082							J	J	J			C	F		Z	C		D	D	G
0.100							J	J	J			F	F		C	C		D	G	G
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		



Case Size	1210 (KGM 32)					1812 (KGM 43)					1825 (KGM 44)		2220 (KGM 55)			2225 (KGM56)	
Thickness Letter	E	H	J	L		B	E	F	J	C	F	Z	C	D	G	E	G
Max Thickness (mm)	1.45	1.8	2.21	2.80		1.45	1.8	2.21	2.80	2.21	2.80	2.21	2.80	2.21	2.80	2.29	2.80
Carrier Tape	EMB	EMB	EMB	EMB		EMB	EMB	EMB	EMB	EMB	EMB	EMB	EMB	EMB	EMB	EMB	EMB
Packaging Code 7" reel	U	U	U	U		V	V	V	V	V	V	V	V	V	V	V	V
Packaging Code 13" reel	L	L	L	L		S	S	S	S	S	S	S	S	S	S	S	S

EMBOSS (EMB)

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