

## INTRODUCTION

This low noise amplifier circuit was developed using a CGH40006S GaN HEMT transistor as a means of demonstrating the wide bandwidth low noise performance and ruggedness of the device. This application note describes the typical performance that has been achieved and that which can be expected when evaluating the demonstrators. Details of the circuit are included for further understanding of the topology and all necessary information has been provided to aid reproduction of the amplifier.

## FEATURES

- Demonstrator of performance over 225 MHz - 2.0 GHz
- 17 dB Small Signal Gain
- >50 % Power Added Efficiency
- <3 dB Noise Figure



PN: CGH40006S-LNA-KIT

# CGH40006S, Low Noise Amplifier Demonstrator



AN-0004633

Rev. 9

## BASIC AMPLIFIER SPECIFICATION

MAXIMUM RATINGS FOR EVALUATION OF DEMONSTRATOR AT 25°C

Parameter	Minimum	Maximum	Units	Notes
Gate-to-Source Voltage	-10	+2	Volts	
Frequency	0.225	2	GHz	
Input Power Level	-	39	dBm	CW No Degradation
Input Power Level	-	42	dBm	CW Device Failure
Input Power Level	-	44	dBm	Pulsed 300 $\mu$ s 10% Duty Cycle No Degradation
Input Power Level	-	46	dBm	Pulsed 300 $\mu$ s 10% Duty Cycle Device Failure
Operating Junction Temperature	-	175	°C	
Case Temperature	-40	+150	°C	

## SUMMARY OF TYPICAL LOW NOISE AMPLIFIER DEMONSTRATOR PERFORMANCE

Characteristics	Frequency				Units
	225 MHz	500 MHz	1000 MHz	2000 MHz	
Small Signal Gain	18.5	18.0	17.0	17.5	dB
Input Return Loss	-12.5	-9	-7	-6	dB
Power Gain P <sub>i</sub> =25 dBm	13.7	13.5	13.2	12.8	dB
Power Added Efficiency P <sub>i</sub> =25 dBm	57.5	57.0	50.0	40.0	%
Nose Figure	1.75	2.1	2.5	3.15	dB

Note 1: I<sub>DD</sub> = 50 mA

Note 2: Individual device characteristics are as per CGH40006S data sheet

Note 3: V<sub>GS</sub> has been selected for best noise figure / efficiency tradeoff

## TYPICAL CIRCUIT BIAS CONDITIONS

Circuit Element	Bias Voltage	Quiescent Bias Circuit
Gate Bias	-3.0	50 mA
Drain Voltage	+28	NOTE: GATE BIAS MUST BE APPLIED BEFORE THE DRAIN BIAS IS ACTIVATED.

DETAILS OF THE CGH40006S DEMONSTRATOR CIRCUIT

CGH40006S LNA Circuit Typical S Parameters  
 Vdd = 28 V, Idq = 50 mA

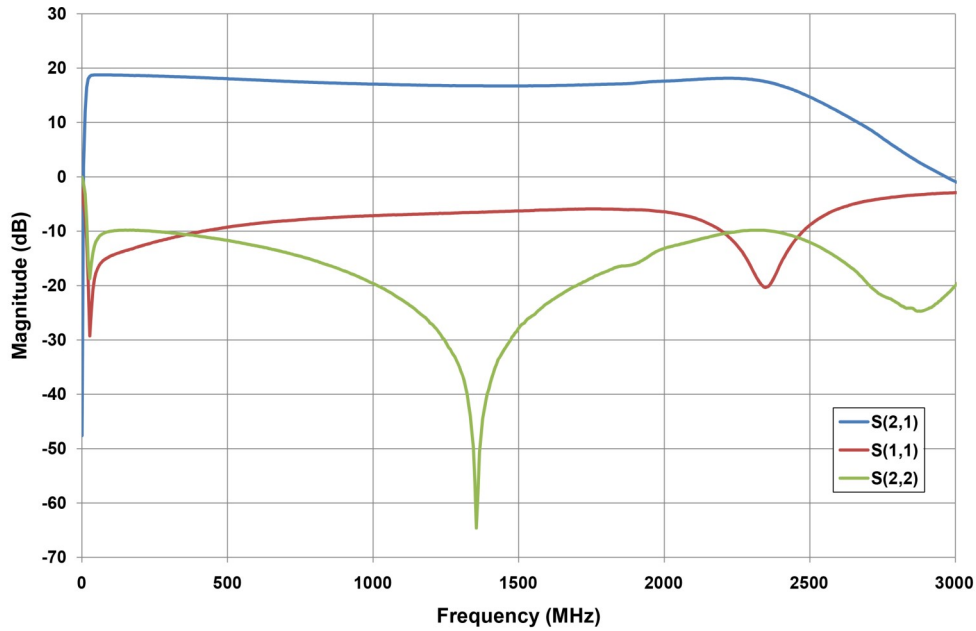


Figure 1 -CGH40006S LNA Circuit Typical S-parameters

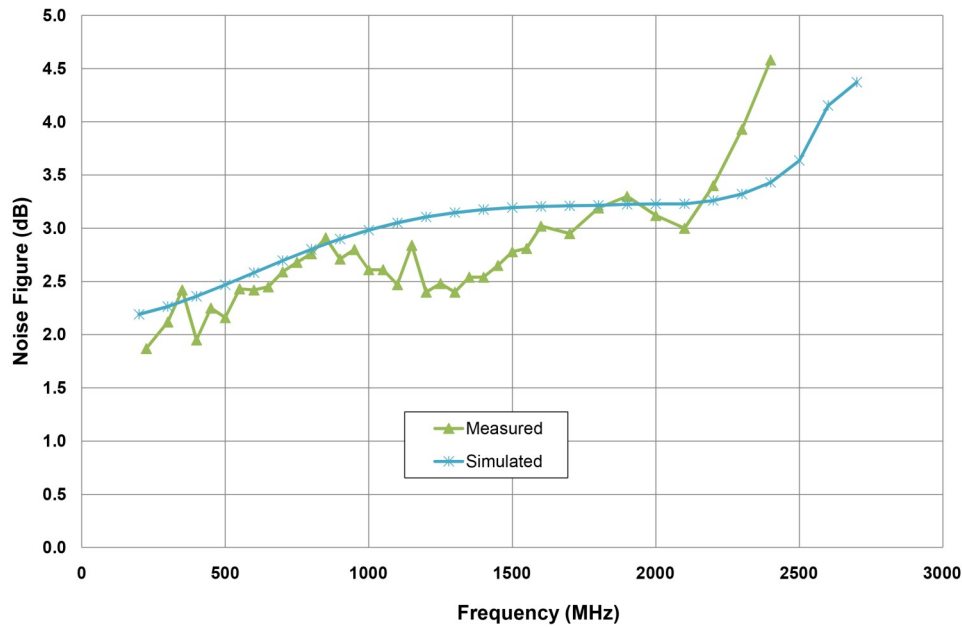


Figure 2 -CGH40006S LNA Noise Figure vs. Frequency

DETAILS OF THE CGH40006S DEMONSTRATOR CIRCUIT

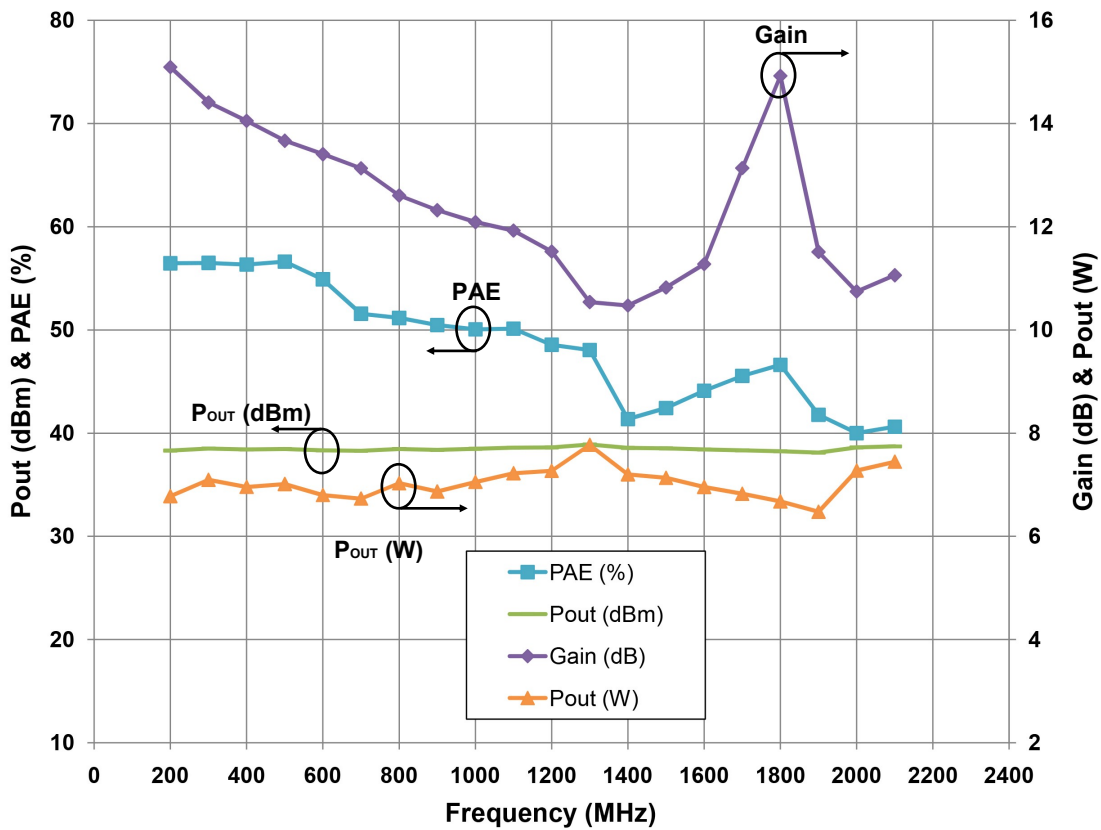


Figure 3 -CGH40006S LNA Circuit  
PSAT, PAE and Power Gain vs. Frequency

**DETAILS OF THE CGH40006S-LNA-KIT DEMONSTRATOR CIRCUIT**

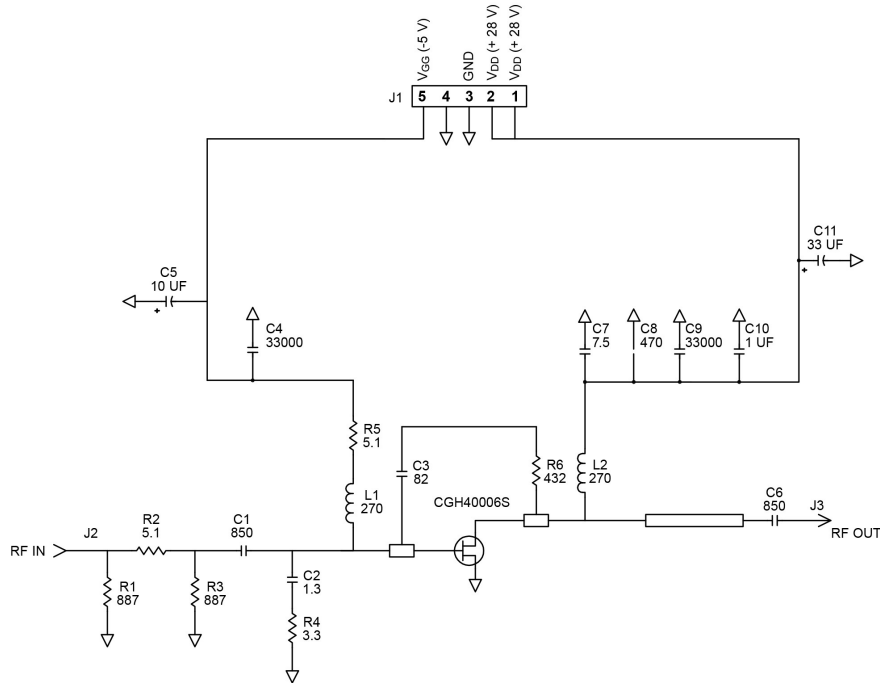


Figure 4 - Schematic of CGH40006S-LNA-KIT Demonstrator Circuit

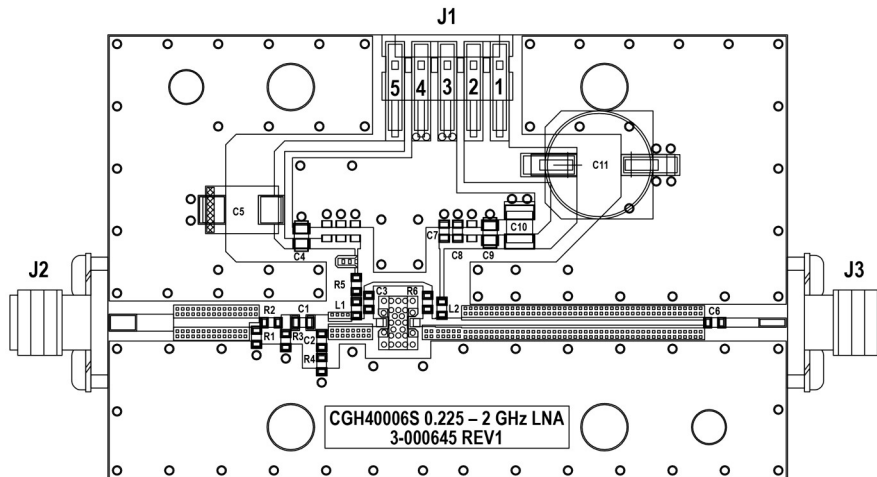


Figure 5 - CGH40006S-LNA-KIT Demonstrator Printed Circuit Board Assembly

Application Note

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## DETAILS OF THE CGH40006S LNA DEMONSTRATOR CIRCUIT CONTINUED

### CGH40006S DEMONSTRATOR BILL OF MATERIALS

Reference Designator	Description	Quantity
R1, R3	RES, 1/16W, 0603, 1%, 887 Ohms	2
R2, R5	RES, 1/16W, 0603, 1%, 5.1 Ohms	2
R4	RES, 1/16W, 0603, 1%, 3.3 Ohms	1
R6	RES, 1/16W, 0603, 1%, 432 Ohms	1
C1, C6	CAP, DC BLOCK, MULTI-LAYER, 0603, 850pF	2
C2	CAP, 1.3pF, +/-0.1pF, 0603, ATC	1
C3	CAP, 82.0pF, +/-5%, 0603, ATC	1
C5	CAP 10uF, 16V, TANTALUM	1
C7	CAP, 7.5pF, +/-0.1pF, 0603, ATC	1
C8	CAP, 470pF, 5%, 100V, 0603	1
C9	CAP, 33000pF, 0805, 100V, X7R	1
C10	CAP, 1.0uF, 100V, 10%, X7R, 1210	1
C11	CAP, 33 uF, 20%, G CASE	1
L1, L2	INDUCTOR, SMT, 0603, 270nH, 5%, RoHS COMPLIANT	2
J1	HEADER RT>PLZ .1CEN LK 5POS	1
J2, J3	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST	2
	PCB, RO4350B, 20 MIL THK, CGH40006S 225 MHz - 2 GHz LNA APPLICATION CIRCUIT	1
	2-56 SOC HD SCREW 1/4 SS	4
	#2 SPLIT LOCKWASHER SS	4

Application Note

## CONCLUSION

This application note has shown the performance advantages of using discrete GaN HEMT transistors for low noise amplifiers. The reference design here shows that it is possible to achieve wide bandwidths, high power and efficiency whilst maintaining low noise and is able to withstand CW input power of 5 W with no degradation. As this transistor is unmatched performance can be replicated at other frequency bands. This reference design was generated with first pass success using large signal models, which are available on request.

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