0.1 GHz to 10 GHz Low Noise Amplifier

ADH8410S

1.0 SCOPE

This specification documents the detail requirements for an internally defined equivalent flow per MIL-PRF-38535 Level V except as modified herein.

The manufacturing flow described in the RF & MICROWAVE STANDARD SPACE LEVEL PRODUCTS PROGRAM is to be considered a part of this specification.

This data specifically details the space grade version of this product. A more detailed operational description and a complete data sheet for commercial product grades can be found at http://www.analog.com/HMC8410

2.0 Part Number

The complete part number(s) of this specification follows:

Specific Part Number	Description
ADH8410-701LH5	0.1 GHz to 10 GHz, GaAs pHEMT MMIC, Low Noise Amplifier

3.0 Case Outline

The case outline is as follows:

Outline Letter	Descriptive Designator	Terminals	Lead Finish	Package style
X	E-12-5	12 Lead	Gold	Ceramic Hermetic SMT (LH5)

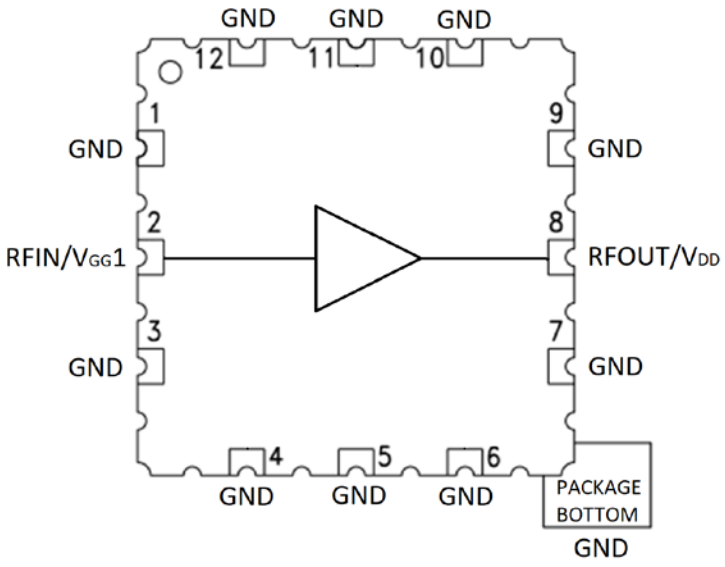


Figure 1 – Functional Block Diagram 1/

1/ Package top view

One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 781.329.4700 www.analog.com
Fax: 781.326.8703

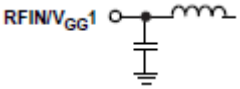
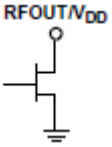
Package: X				
Pin Number	Terminal Symbol	Pin Type	Pin Description	Interface Schematic
1	GND	Power	RF/DC ground	
2	RFIN/V_{GG}1	RF Input	This pin is DC coupled and matched to 50 Ohms. Gate Bias of the amplifier.	
3	GND	Power	RF/DC ground	
4	GND	Power	RF/DC ground	
5	GND	Power	RF/DC ground	
6	GND	Power	RF/DC ground	
7	GND	Power	RF/DC ground	
8	RFOUT/V_{DD}	RF Output	This pin is DC coupled and matched to 50 Ohms. Drain Bias of the amplifier.	
9	GND	Power	RF/DC ground	
10	GND	Power	RF/DC ground	
11	GND	Power	RF/DC ground	
12	GND	Power	RF/DC ground	
Package Bottom	GND	Power	RF/DC ground 1/	
Package Lid	GND	Power	RF/DC ground 2/	

Figure 2 – Terminal Connections

1/ Package bottom must be connected to RF/DC ground.
2/ Package lid is internally connected to GND.

4.0 Specifications

4.1. Absolute Maximum Ratings 1/

Drain Bias Voltage (V_{DD})	7.0 V dc
RF Input Power (RFIN)	+20 dBm
Channel Temperature	+175 °C
Continuous Pdiss (T_A = +85 °C) (Derate 6.7 mW/°C above +85 °C)	0.602 W
Thermal resistance (Channel-to-ground paddle)	149.4 °C/W
Storage temperature range	-65 °C to +150 °C
ESD Sensitivity (HBM)	Class 1B passed 500 V

4.2. Recommended Operating Conditions

Ambient operating temperature range (T_A)	-40 °C to +85 °C
Supply Voltage (V_{DD})	2 V to 6 V

4.3. Nominal Operating Performance Characteristics 2/

Gain Variation Over Temperature (0.1 GHz to 10 GHz) 3/	0.01 dB/°C
Input Return Loss (IRL) (0.1 GHz to 3 GHz) 3/	16 dB
Input Return Loss (IRL) (3 GHz to 8 GHz) 3/	14 dB
Input Return Loss (IRL) (8 GHz to 10 GHz) 3/	7 dB
Output Return Loss (ORL) (0.1 GHz to 3 GHz) 3/	28 dB
Output Return Loss (ORL) (3 GHz to 8 GHz) 3/	27 dB
Output Return Loss (ORL) (8 GHz to 10 GHz) 3/	12 dB
Output Power for 1dB Compression (OP1dB) (0.1 GHz to 3 GHz)	22 dBm
Output Power for 1dB Compression (OP1dB) (3 GHz to 8 GHz)	21.5 dBm
Output Power for 1dB Compression (OP1dB) (8 GHz to 10 GHz)	20 dBm
Saturated Output Power (Psat) (0.1 GHz to 3 GHz) 4/	23.5 dBm
Saturated Output Power (Psat) (3 GHz to 8 GHz) 4/	23 dBm
Saturated Output Power (Psat) (8 GHz to 10 GHz) 4/	22 dBm
Output Third Order Intercept (OIP3) (0.1 GHz to 3 GHz) 5/	34.5 dBm
Output Third Order Intercept (OIP3) (3 GHz to 8 GHz) 5/	32 dBm
Output Third Order Intercept (OIP3) (8 GHz to 10 GHz) 5/	31 dBm

1/ Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions outside of those indicated in the operation sections of this specification is not implied. Exposure to absolute maximum ratings for extended periods may affect device reliability.

2/ All typical specifications are at T_A = 25 °C, V_{DD} = 5 V, I_{DQ} = 65 mA unless otherwise noted.

3/ RF Input power = -25 dBm.

4/ Saturated Output Power measured at 5 dB compression.

5/ Two-Tone Output Power = +5 dBm per output tone with 1 MHz spacing.

TABLE I – ELECTRICAL PERFORMANCE CHARACTERISTICS

Parameter See notes at end of table	Symbol	Conditions 1/2/ Unless otherwise specified		Group A Subgroups	Limits		Unit
					Min	Max	
Quiescent Supply Current	I_{DQ}	No RF in		1, 2, 3		70	mA
Gain	S21	0.3 GHz & 3 GHz	RF In = -25 dBm	4, 5, 6	17.5		dB
		5 GHz & 8 GHz			15.5		
		10 GHz			13		
Noise Figure	NF	0.3 GHz		4, 5, 6		2.5	dB
		3 GHz				1.6	
		5 GHz				1.9	
		8 GHz		4, 6		1.9	
				5		2.4	
		10 GHz		4, 6		2.2	
				5		2.7	

TABLE I Notes:

1/ T_A Nom = +25 ºC, T_A Max = +85 ºC, T_A Min = -40 ºC and V_{DD} = 5 V nom.

2/ Adjust $V_{GG}1$ to achieve I_{DQ} = 65 mA typical. Each device shall use the individual $V_{GG}1$ voltage established at pre burn-in throughout all screening and qualification testing.

TABLE IIA – ELECTRICAL TEST REQUIREMENTS

Test Requirements	Subgroups (in accordance with MIL-PRF-38535, Table III)
Interim Electrical Parameters	1, 4
Final Electrical Parameters	1, 4 1/ 2/
Group A Test Requirements	1, 2, 3, 4, 5, 6
Group C end-point electrical parameters	1, 4 2/
Group D end-point electrical parameters	1, 4

TABLE IIA Notes:

1/ PDA applies to Table I subgroup 1 and Table IIB delta parameters.

2/ See Table IIB for delta parameters

TABLE IIB – BURN-IN/LIFE TEST DELTA LIMITS 1/2/

Parameter	Test Conditions	Symbol	Delta	Units
Quiescent Supply Current	Per Table I	I_{DQ}	± 12	%
Gain		S21	± 1	dB

TABLE IIB Notes:
1/ 240 hour burn in and 1000 hour life test (Group C) end point electrical parameters.
2/ Deltas are performed at T_A = +25 °C only

5.0 Burn-In Life Test, and Radiation

5.1. Burn-In Test Circuit, Life Test Circuit

5.1.1. The test conditions and circuit shall be maintained by the manufacturer under document revision level control and shall be made available to the preparing or acquiring activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in method 1015 test condition B of MIL –STD-883.

5.1.2. HTRB is not applicable for this drawing.

6.0 MIL-PRF-38535 QMLV Exceptions

The manufacturing flow described in the RF & MICROWAVE STANDARD SPACE LEVEL PRODUCTS PROGRAM is to be considered a part of this specification. The brochure describes standard QMLV exceptions for Aerospace products run at the ADI Chelmsford, MA facility.

6.1. Wafer Fabrication

Foundry information is available upon request.

6.2. Group D

Group D-5 Salt Atmosphere is not performed.

7.0 Application Notes

Figure 3 shows the basic connections for operating the ADH8410S. To not damage the amplifier, follow the recommended bias sequencing:

During Power-Up

The recommended bias sequence during power-up is as follows:

1. Connect to GND.
2. Set $V_{GG}1$ to -2 V.
3. Set V_{DD} to 5 V.
4. Increase $V_{GG}1$ to achieve a typical supply current (I_{DQ}) = 65 mA.
5. Apply the RF signal.

During Power-Down

The recommended bias sequence during power-down is as follows:

1. Turn off the RF signal.
2. Decrease $V_{GG}1$ to -2 V to achieve typical supply current (I_{DQ}) = 0 mA.
3. Decrease V_{DD} to 0 V.
4. Increase $V_{GG}1$ to 0 V.

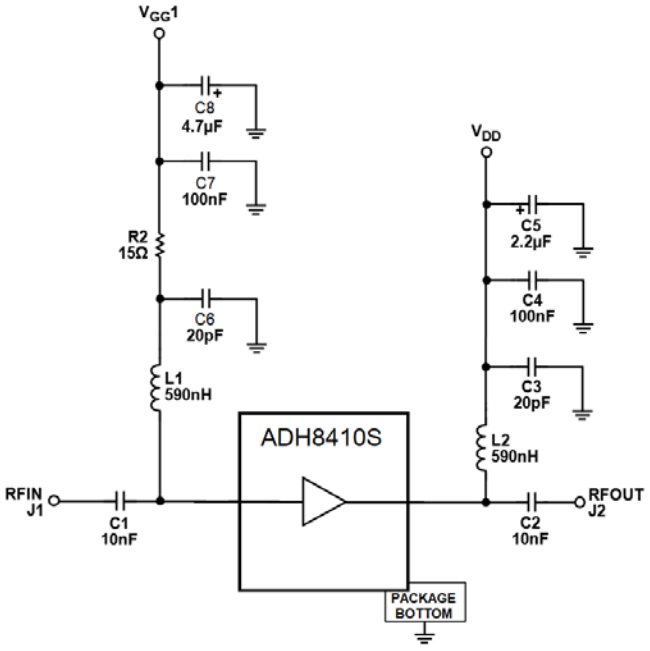


Figure 3 – Typical application Circuit

8.0 Package Outline Dimensions

The LH5 package and outline dimensions can be found at http://www.analog.com or upon request.

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
ADH8410-701LH5	–40 °C to +85 °C	12 Lead Ceramic Hermetic SMT	LH5 (E-12-5)

Revision History		
Rev	**Description of Change**	**Date**
A	Initial Release	9/8/2021

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