2 to 20 GHz Low Noise AGC Amplifier

ADH463S

1.0 SCOPE

This specification documents the detail requirements for space qualified die per MIL-PRF-38534 class K except as modified herein.

The manufacturing flow described in the SPACE DIE BROCHURE is to be considered a part of this specification.

This datasheet specifically details the space grade version of this product. A more detailed operational description and a complete datasheet for commercial product grades can be found at https://www.analog.com/hmc463.

2.0 Part Number:

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

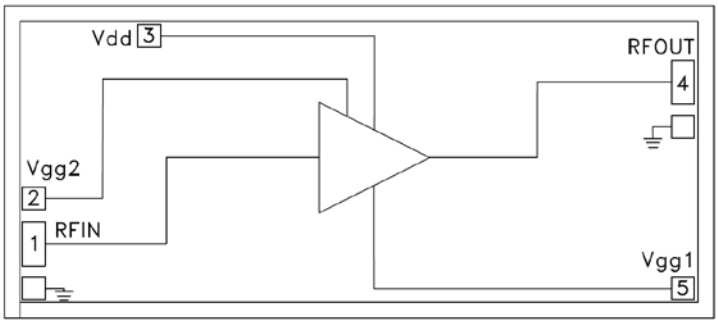
Specific Part Number	Description
ADH463-000C	2 to 20 GHz GaAs PHEMT MMIC Low Noise AGC Amplifier

3.0 Die Information

3.1. Die Dimensions

Die Size	Die Thickness	Bond Pad and Backside Metallization
120 mils x 51 mils	4 mils	Au

3.2. Die Picture



1. RFIN
2. Vgg2
3. Vdd
4. RFOUT
5. Vgg1

Die bottom is GND

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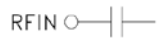
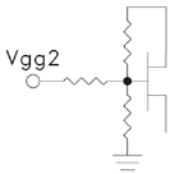
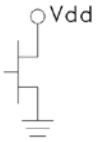
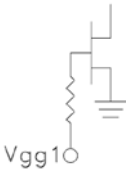
3.3. Pad Descriptions

Pad Number	Function	Description	Interface Schematic
1	RFIN	This pad is AC coupled and matched to 50 Ohms.	
2	Vgg2	Optional gate control if AGC is required. Leave Vgg2 open circuited if AGC is not required.	
3	Vdd	Power supply voltage for the amplifier. External bypass capacitors are required	
4	RFOUT	This pad is AC coupled and matched to 50 Ohms.	
5	Vgg1	Gate control for amplifier. Adjust to achieve Idd= 60 mA.	
Die Bottom	GND	Die bottom must be connected to RF/DC ground.	

4.0 Specifications

4.1. Absolute Maximum Ratings 1/

Drain Bias Voltage (Vdd)	+9 Vdc
Gate Bias Voltage (Vgg1)	-2 Vdc to 0 Vdc
Gate Bias Current (Igg1)	2.5 mA
Gate Bias Voltage (Vgg2)(AGC)	(Vdd -9) Vdc to +2 Vdc
RF Input Power (RFIN) (Vdd = +5V)	+18 dBm
Channel Temperature	175 °C
Continuous Pdiss (T = 85 °C) (derate 20.6 mW/°C above +85 °C)	1.85 W
Thermal Resistance (Channel to die bottom)	48.6 °C/W
Storage Temperature Range	-65 °C to +150 °C
Operating Temperature Range (Performance)	-40 °C to +85 °C
Operating Temperature Range	-55 °C to +85 °C
ESD Sensitivity (HBM)	Class 0B, passed 150 V

4.2 Nominal Operating Performance Characteristics 2/3/

Saturated Output Power (Psat) (2-6 GHz) ..... 21 dBm 4/
Saturated Output Power (Psat) (6-18 GHz) ..... 20 dBm 4/
Saturated Output Power (Psat) (18-20 GHz) ..... 19 dBm 4/
Output Power for 1dB Compression (OP1dB) (2-6 GHz) ..... 19 dBm
Output Power for 1dB Compression (OP1dB) (6-18 GHz) ..... 16 dBm
Output Power for 1dB Compression (OP1dB) (18-20 GHz) ..... 14 dBm
Output Third Order Intercept (OIP3) (2-6 GHz) ..... 29 dBm 5/
Output Third Order Intercept (OIP3) (6-18 GHz)..... 28 dBm 5/
Output Third Order Intercept (OIP3) (18-20 GHz)..... 26 dBm 5/

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 specifications apply with T_A = 25 °C unless otherwise noted.
3/ Tested with Vdd = +5v, Vgg1 set between -1.5 Vdc and -0.5 Vdc to target an Idd of 60mA.
5/ Psat specified as OP5dB.
4/ Two-Tone Output Power = 0 dBm per tone with 1 MHz spacing.

5.0 Die Qualification

In accordance with class-K version of MIL-PRF-38534, Appendix C, Table C-II, except as modified herein.
(a) Pre-screen test post assembly required prior to die qualification, to remove all assembly related rejects.
(b) Mechanical Shock or Constant Acceleration not performed.
(c) Interim and post burn-in electrical tests will include tests screened at +25 °C only.

6.0 Dice Electrical Characteristics

TABLE I – DIE ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Conditions 1/2/3/4/5 Unless otherwise specified		Limits		Unit
				Min	Max	
Gain	S21	2 GHz, 18 GHz & 20 GHz	RFIN = -25 dBm	13.5		dB
		6 GHz		12.5		
Input Return Loss	S11	2 GHz		10		dB
		6 GHz		12		
		18 GHz & 20 GHz		11		
Output Return Loss	S22	2 GHz		8		dB
		6 GHz, 18 GHz & 20 GHz		7		
Noise Figure	NF	2 GHz, 18 GHz & 20 GHz			4.0	dB
		6 GHz			3.7	
Supply Current	Idd	No RFIN			80	mA

TABLE I Notes:
1/ Limits apply at T_A = +25 ºC only.
2/ Tested with Vdd = +5 Vdc, Vgg1 set between -1.5 Vdc and -0.5 Vdc to target an Idd of 60 mA.
3/ S-par data measured at 2 GHz, 6 GHz, 18 GHz and 20 GHz
4/ Noise Figure measured at 2 GHz, 6 GHz, 18 GHz and 20 GHz
5/ Performance limits based upon direct to die measurements. Limits differ than that of actual performance in a 50 ohm system with wire bonds.

TABLE II – ELECTRICAL CHARACTERISTICS FOR QUALIFICATION SAMPLES

Parameter	Symbol	Conditions 1/2/3/4/ Unless otherwise specified		Sub-Group 7/	Limits		Unit
					Min	Max	
Gain	S21	2 GHz, 6 GHz, 18 GHz, 20 GHz		4	13		dB
				5,6	12		
Gain Variation Over Temperature	S21/°C	2 GHz, 6 GHz, 18 GHz, 20 GHz		4,5,6		0.025	dB/°C
Input Return Loss	S11	2 GHz		4,5,6	10		dB
		6 GHz & 18 GHz		4,5,6	12		
		20 GHz	RFIN = - 25 dBm	4	12		
				5,6	10		
Output Return Loss	S22	2 GHz, 6 GHz & 18 GHz		4	8		dB
				5,6	7		
		20 GHz		4	7		
				5,6	6		
Noise Figure	NF	2 GHz		4		4	dB
				5,6		5	
		6 GHz & 18 GHz		4		3.7	
				5,6		4.7	
		20 GHz		4		4	
				5,6		5.5	
Output Power for 1dB Compression	OP1dB	2 GHz		4,5,6	16		dBm
		6 GHz		4,5,6	13		
		18 GHz & 20 GHz		4,5,6	11		
Saturated Output Power 5/	PSAT	2 GHz		4	17.5		dBm
				5,6	17		
		6 GHz		4	18		
				5,6	17.5		
		18 GHz & 20 GHz		4,5,6	17		
Output Third Order Intercept 6/	OIP3	2 GHz		4	27		dBm
				5,6	25		
		6 GHz		4	24.5		
				5,6	20		
		18 GHz & 20 GHz		4	23		
				5,6	19		
Supply Current	Idd	No RFIN		1,2,3		80	mA

TABLE II Notes:

1/ T_A Nom = +25 ºC, T_A Max = +85 ºC, T_A Min = -40 ºC.

2/ Tested with Vdd = +5 Vdc, Vgg1 set between -1.5 Vdc and -0.5 Vdc to target an Idd of 60 mA.

3/ S-par data measured at 2 GHz, 6 GHz, 18 GHz and 20 GHz

4/ Noise Figure measured at 2 GHz, 6 GHz, 18 GHz and 20 GHz

5/ Psat specified as OP5dB.

6/ Two-Tone Output Power = 0 dBm per tone with 1 MHz spacing.

7/ See ML-PRF-38534 Table C-Xa for Sub-Group parameter definitions.

TABLE III – BURN-IN/LIFE TEST DELTA LIMITS 1/ 2/ 3/ 4/ 5/

Parameter	Symbol	Delta	Units
Gain	S21	± 1	dB
Supply Current	Idd	± 10	%

TABLE III Notes:

1/ 240 hour burn-in and 1000 hour life test end point electrical parameters.

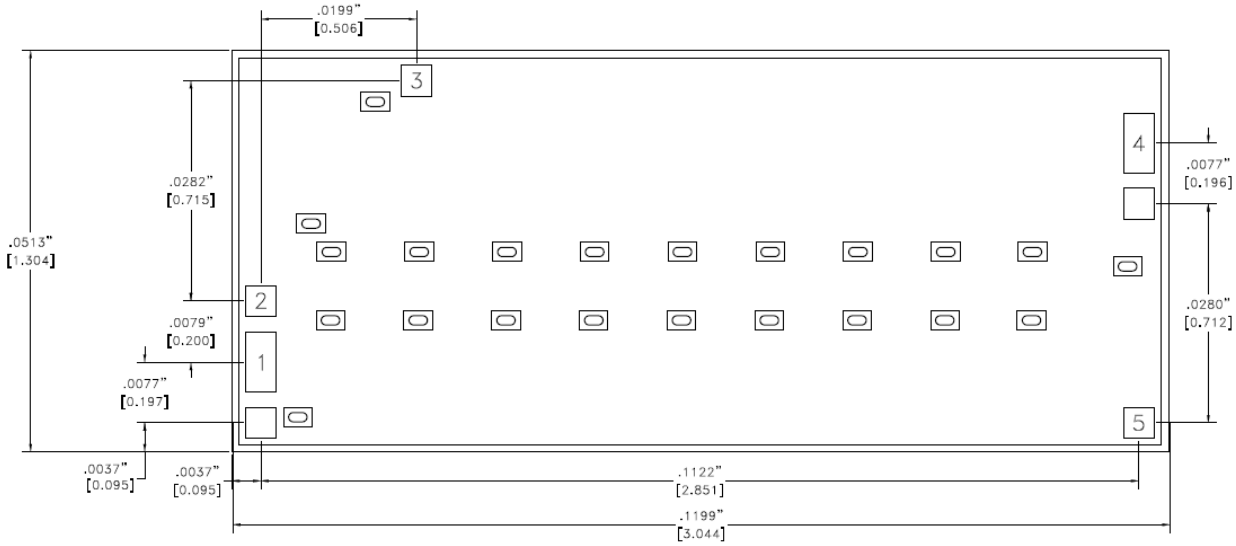
2/ Deltas are performed at T_A = +25 °C only.

3/ Product is tested in accordance with conditions in Table II.

4/ Table II limits shall not be exceeded.

5/ Gain deltas are measured at 2 GHz, 6 GHz, 18 GHz and 20 GHz.

7.0 Die Outline



NOTES:
1. ALL DIMENSIONS IN INCHES [MILLIMETERS]
2. NO CONNECTION REQUIRED FOR UNLABELED BOND PADS
3. DIE THICKNESS IS 0.004 (0.100)
4. TYPICAL BOND PAD IS 0.004 (0.100) SQUARE
5. BACKSIDE METALLIZATION: GOLD
6. BACKSIDE METAL IS GROUND
7. BOND PAD METALIZATION: GOLD
8. OVERALL DIE SIZE ±.002"

8.0 Application Notes

Figure 1 shows the assembly diagram. The die should be attached directly to the ground plane using an eutectic mixture or with conductive epoxy. The 50 Ω microstrip transmission lines on 0.127 mm (5 mil) thick alumina thin film substrates are recommended for bringing RF to and from the chip (Figure 2). If 0.254 mm (10 mil) thick alumina thin film substrates must be used, the die should be raised 0.15 mm (6 mil) so that the surface of the die is coplanar with the surface of the substrate. This can be accomplished by attaching the 0.102 mm (4 mil) thick die to a 0.150 mm (6 mil) thick molybdenum heat spreader (moly-tab) which is then attached to the ground plane (Figure 3). Microstrip substrates should be brought as close to the die as possible in order to minimize wire bond length. Typical die-to-substrate spacing is 0.076 mm to 0.152 mm (3 to 6 mils).

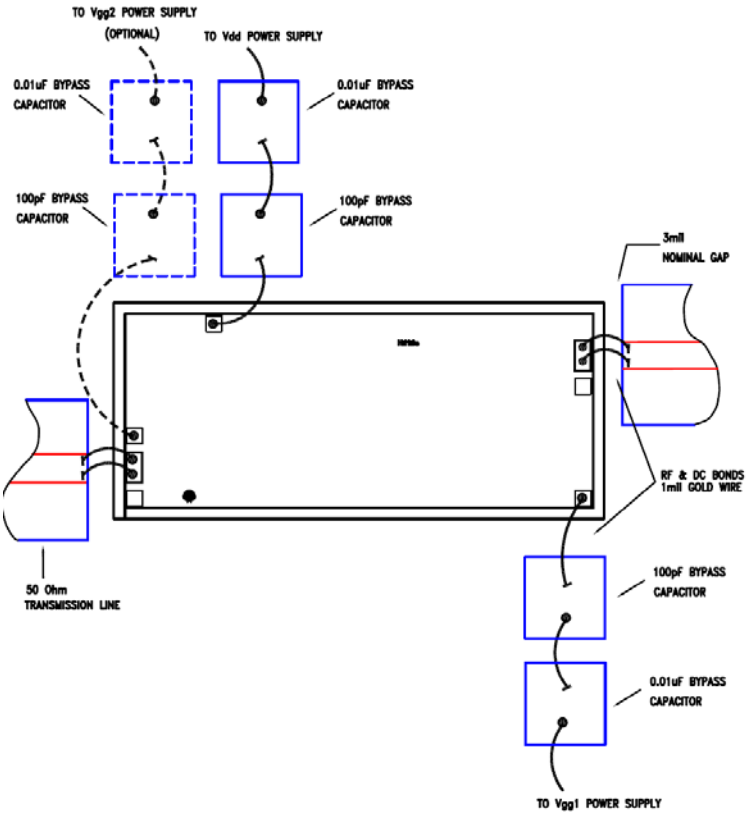


Figure 1. Assembly Diagram

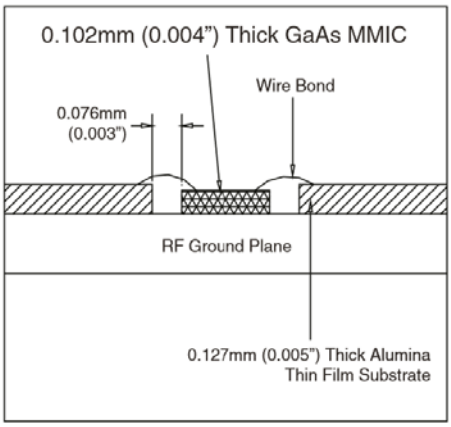


Figure 2. Die without Moly Tab

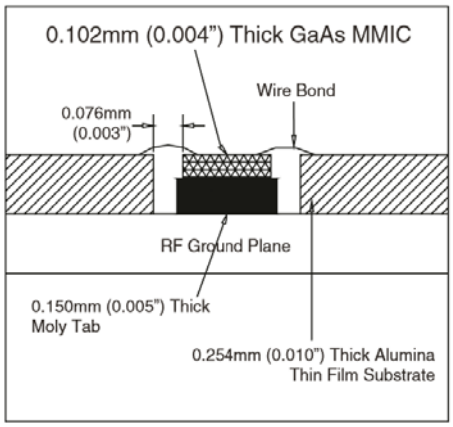


Figure 3. Die with Moly Tab

Die Packaging Information

Standard	Alternate
GP-2 (Gel Pack)	1/

Note:

1/ For alternate packaging information, contact Analog Devices Inc.

Revision History		
Rev	**Description of Change**	**Date**
A	Initial Production Release	4/18/23

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