13 to 24.6 GHz Output x2 Active Frequency Multiplier

ADH814S

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/hmc814-die

2.0 Part Number:

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

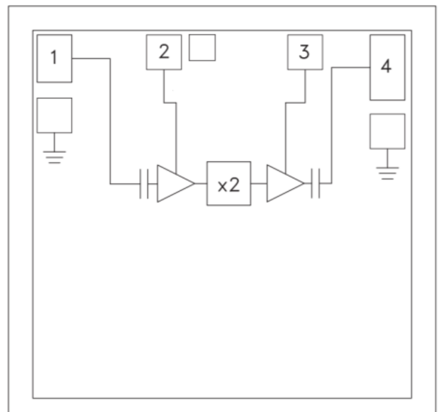
Specific Part Number	Description
ADH814-000C	13 to 24.6 GHz Output GaAs PHEMT MMIC x2 Active Frequency Multiplier

3.0 Die Information

3.1. Die Dimensions

Die Size	Die Thickness	Bond Pad and Backside Metallization
45.6 mils x 44.5 mils	4 mils	Au

3.2. Die Picture



1. RFIN
2. Vdd1
3. Vdd2
4. RFOUT

Die bottom is GND

ASD0016611 Rev. A

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3.3. Pad Descriptions

Pad Number	Function	Description	Interface Schematic
1	RFIN	Pad is AC coupled and matched to 50 Ohms.	RFIN
2, 3	Vdd1, Vdd2	Supply Voltage (+5 V ± 0.5 V) External bypass capacitors of 100 pF, 1,000 pF and 2.2 µF are recommended on each pad.	Vdd1, Vdd2
4	RFOUT	Pad is AC coupled and matched to 50 Ohms.	RFOUT
Die Bottom	GND	Die bottom must be connected to RF/DC ground.	GND

4.0 Specifications

4.1. Absolute Maximum Ratings 1/

RF Input Power (Vdd1 = Vdd2 = +5 V) .... +10 dBm
Supply Voltage (Vdd1, Vdd2) .... +5.5 Vdc
Channel Temperature .... 175 °C
Continuous Pdiss (T = +85 °C) (Derate 8.7 mW/°C above +85 °C) .... 782 mW
Thermal Resistance (Channel to die bottom) .... 115 °C/W
Storage Temperature Range .... -65 °C to +150 °C
Operating Temperature Range (T_A) (Performance) .... -40 °C to +85 °C
Operating Temperature Range (T_A) .... -55 °C to +85 °C
ESD Sensitivity (HBM) .... Class 0

4.2 Recommended Operating Conditions

Supply Voltage (Vdd1 = Vdd2) .... +4.5 Vdc to +5.5 Vdc
Drive Level Range .... +0 dBm to +6 dBm

4.3 Nominal Operating Performance Characteristics 2/

Fo Isolation (with respect to output level) .... 24 dBc
3Fo Isolation (with respect to output level) .... 22 dBc
4Fo Isolation (with respect to output level) .... 23 dBc
Input Return Loss.......... 7 dB
Output Return Loss.......... 7 dB
SSB Phase Noise (100 kHz Offset at Output Frequency = 19 GHz) .... -136 dBc/Hz

4.4 Nominal Isolation Performance Characteristics 3/

Fo Isolation (with respect to output level) .... 24 dBc
3Fo Isolation (with respect to output level) .... 19 dBc
4Fo Isolation (with respect to output level) .... 13 dBc

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, Vdd1 = Vdd2 = +5 Vdc, +4 dBm Drive Level and RFOUT Frequency Range = 13 GHz to 24.6 GHz only, unless otherwise noted.
3/ All specifications apply with T_A = 25 °C, Vdd1 = Vdd2 = +3.5 Vdc, +4 dBm Drive Level and RFOUT Frequency Range = 13 GHz to 24.6 GHz only.

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/ Unless otherwise specified	Limits		Unit
			Min	Max	
Output Power	POUT		14		dBm
Supply Current (Idd1 + Idd2)	Idd	No Drive level applied at RFIN		100	mA

TABLE I Notes:

1/ Limits apply at T_A = +25 °C only with Vdd1 = Vdd2 = +5 Vdc and +4 dBm Drive level.
2/ Parameters measured at FOUT = 14 GHz and 24.6 GHz only.

TABLE II – ELECTRICAL CHARACTERISTICS FOR QUALIFICATION SAMPLES

Parameter	Symbol	Conditions 1/2/3/ Unless otherwise specified	Sub-Group 4/	Limits		Unit
				Min	Max	
Output Power	POUT		4	14		dBm
			5, 6	10		dBm
Supply Current (Idd1 + Idd2)	Idd	No Drive level applied at RFIN	1, 2, 3		100	mA

TABLE II Notes:

1/ T_A Nom = +25 ºC, T_A Max = +85 ºC, T_A Min = -40 ºC.
2/ Vdd1 = Vdd2 = +5 Vdc and +5.5 dBm Drive level. Additional drive level needed due to fixure loss.
3/ Parameters measured at FOUT = 14 GHz and 24.6 GHz only.
4/ See ML-PRF-38534 Table C-Xa for Sub-Group parameter definitions.

TABLE III – BURN-IN/LIFE TEST DELTA LIMITS 1/2/3/4/			
Parameter	**Symbol**	**Delta**	**Unit**
Output Power	POUT	± 1	dB
Supply Current (Idd1 + Idd2)	Idd	± 10	%

TABLE III Notes:

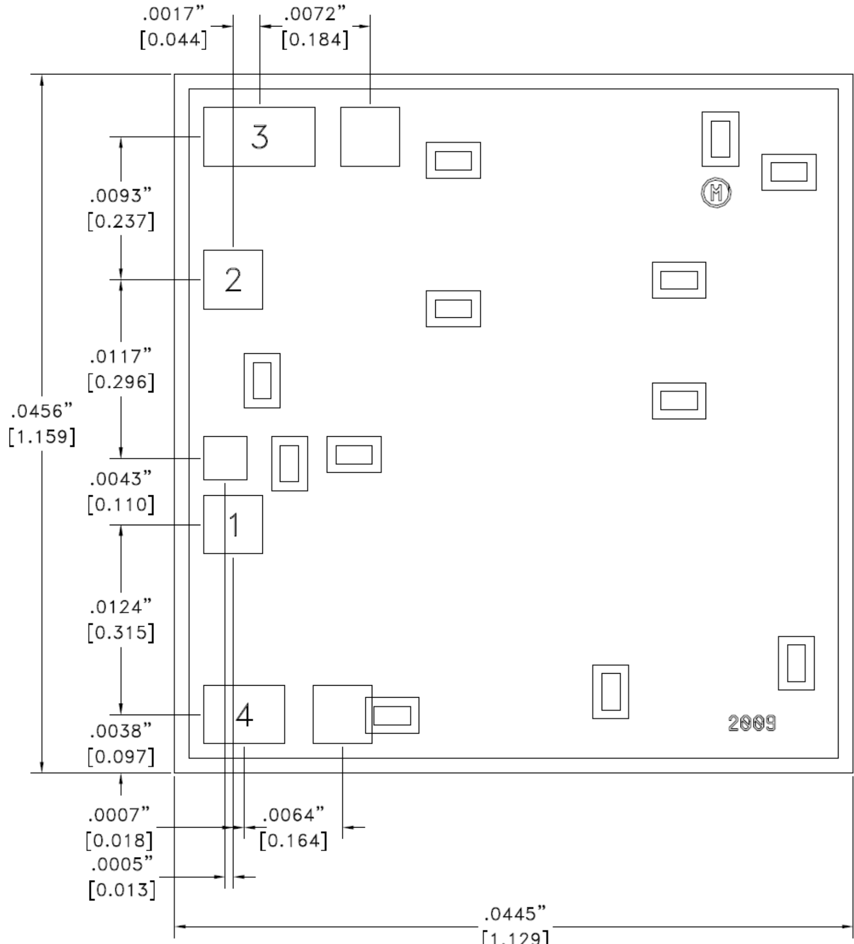
1/ 240 hour burn-in and 1000 hour life test end point electrical parameters.

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.

7.0 Die Outline



PAD	DESCRIPTION	PAD SIZE
1	RFIN	.0054[.136] X .0039[.100]
2	Vdd1	.0039[.100] X .0039[.100]
3	Vdd2	.0039[.100] X .0039[.100]
4	RFOUT	.0074[.188] X .0039[.100]

NOTES:

1. ALL DIMENSIONS ARE IN INCHES [MM]
2. DIE THICKNESS IS .004"
3. TYPICAL BOND PAD IS .004" SQUARE
4. BOND PAD METALIZATION: GOLD
5. BACKSIDE METALIZATION: GOLD
6. BACKSIDE METAL IS GROUND
7. NO CONNECTION REQUIRED FOR UNLABELED BOND PADS
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 mils) thick alumina thin film substrates are recommended for bringing RF to and from the chip (Figure 2). If 0.254 mm (10 mils) thick alumina thin film substrates must be used, the die should be raised 0.15 mm (6 mils) 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 mils) thick die to a 0.150 mm (6 mils) 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 (3 mils). Gold ribbon of 0.075 mm (3 mils) width and minimal length < 0.31 mm (< 12 mils) is recommended to minimize inductance on the RF ports.

An RF bypass capacitor should be used on each of the Vdd1 and Vdd2 inputs. A 100 pF single layer capacitor (mounted eutectically or by conductive epoxy) placed no further than 0.762 mm (30 mils) from the chip is recommended.

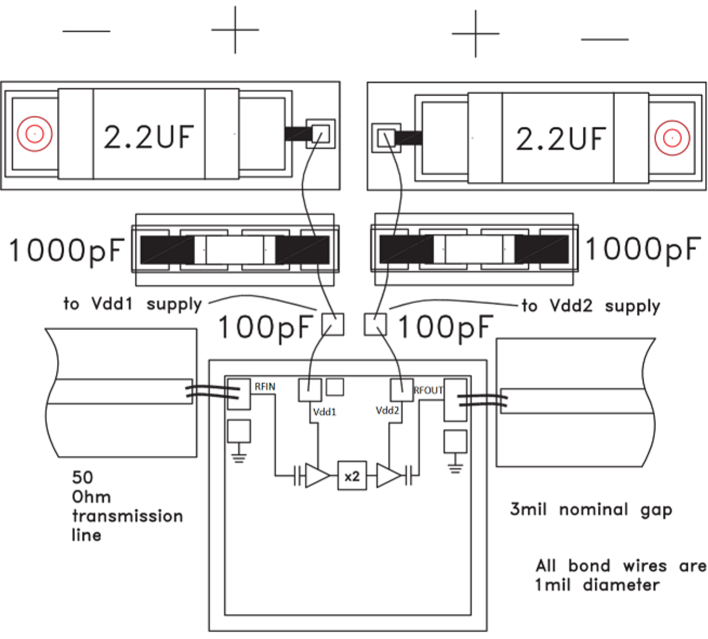


Figure 1. Assembly Diagram

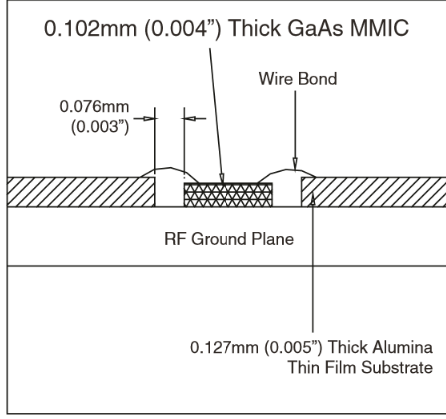


Figure 2. Die without Moly Tab

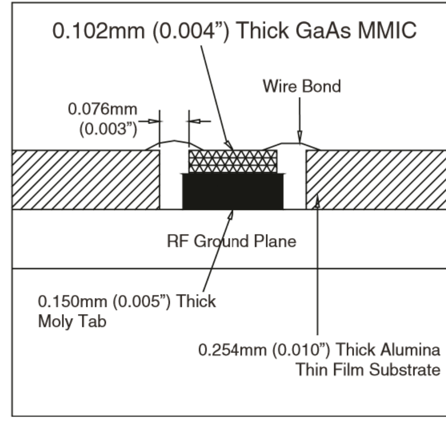


Figure 3. Die with Moly Tab

TYPICAL PERFORMANCE CHARACTERISTICS

All typical performance characteristics apply with Vdd1 = Vdd2 = +5 Vdc, +4 dBm Drive Level and T_A = +25 °C unless otherwise noted.

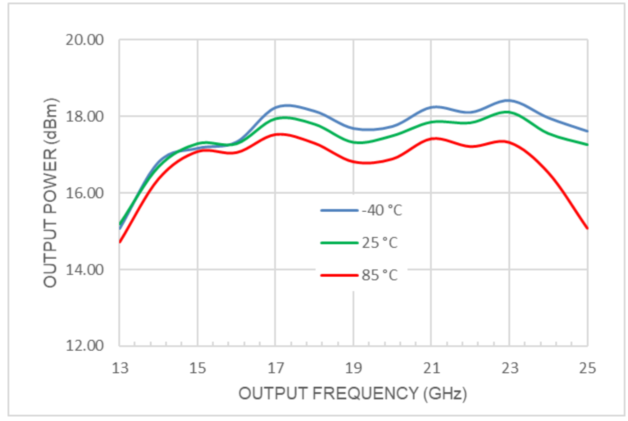


Figure 4. Output Power vs. Temperature

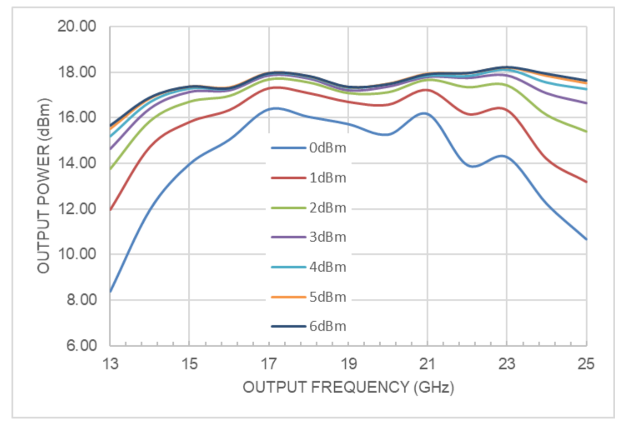


Figure 7. Output Power vs. Drive Level

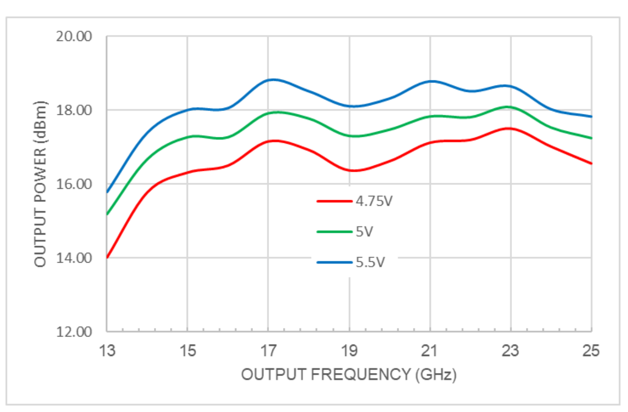


Figure 5. Output Power vs. Supply Voltage

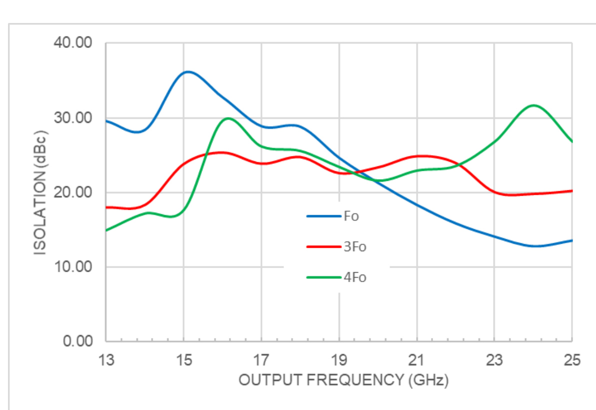


Figure 8. Isolation (with respect to output level) vs. Output Frequency

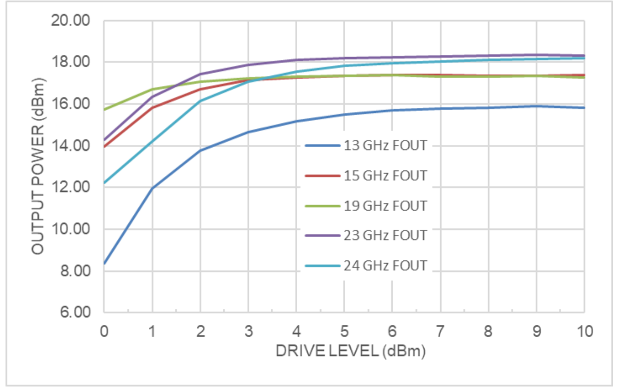


Figure 6. Output Power vs. Drive Level

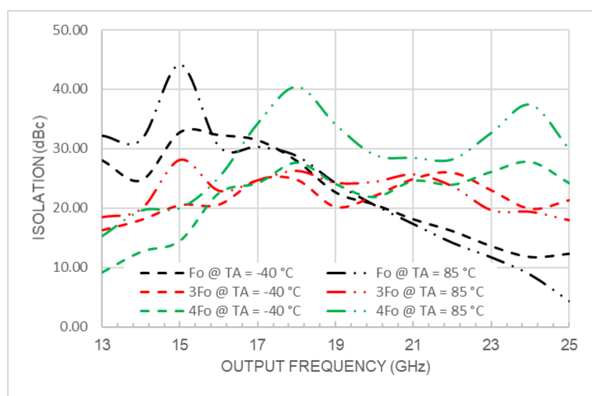


Figure 9. Isolation (with respect to output level) vs. Temperature

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-Jan-2023

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