DC to 20 GHz SPDT Non-Reflective Switch

ADH347S

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/hmc347**.

2.0 Part Number:

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

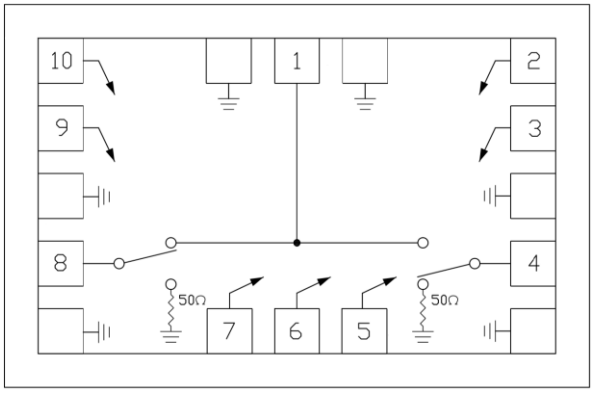
Specific Part Number	Description
ADH347-000C	DC to 20 GHz GaAs MMIC SPDT Non-Reflective Switch

3.0 Die Information

3.1. Die Dimensions

Die Size	Die Thickness	Bond Pad and Backside Metallization
51.2 mils x 33.5 mils	4 mils	Au

3.2. Die Picture



1. RFC
2. A
3. B
4. RF2
5. A
6. B
7. A
8. RF1
9. A
10. B

Die bottom is GND

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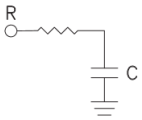
3.3. Pad Descriptions

Pad Number	Function	Description	Interface Schematic
1, 4, 8	RFC, RF2, RF1	These pads are DC coupled and matched to 50 Ω. Blocking capacitors are required if RF line potential is not equal to 0 V.	
2, 5, 7, 9	A	See Truth Table (Table IV) and Control Voltages Table (Table V).	
3, 6, 10	B	See Truth Table (Table IV) and Control Voltages Table (Table V).	
Die Bottom	GND	Die bottom must be connected to RF/DC ground.	

4.0 Specifications

4.1. Absolute Maximum Ratings 1/

RF Input Power (Apply up to T_A = +75 °C)	+27 dBm 2/
RF Input Power (Apply between T_A > +75 °C to T_A = +85 °C only)	+26.4 dBm 2/
Control Voltage Range (A & B)	+0.5 V to -7.5 V
Hot Switch Power Level	+23 dBm 2/
Channel Temperature	150 °C
Thermal Resistance (Channel to die bottom Insertion Loss Path)	338.7 °C/W
Thermal Resistance (Channel to die bottom Terminated Path)	433.6 °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 1A, passed 250 V

4.2 Nominal Operating Performance Characteristics 3/

Insertion Loss (100 MHz)	1.4 dB
Isolation (100 MHz)	64 dB
Return Loss RF1, RF2 & RFC “On State” (100 MHz)	17 dB
Return Loss RF1 & RF2 “Off State” (100 MHz)	11 dB
Input Power for 1 dB Compression (0.5 GHz to 20 GHz)	23 dBm
Input Third Order Intercept Point (0.5 GHz to 20 GHz)	43 dBm 4/

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/ A & B Control Voltage = 0/-5 V.
3/ All specifications apply with T_A = 25 °C unless otherwise noted.
4/ Two-Tone Input Power = +7 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/ Unless otherwise specified	Limits		Unit
			Min	Max	
Insertion Loss	IL			2.2	dB
Isolation	ISO		40		dB
Return Loss RF1, RF2 & RFC "ON State"	RL_{ON}		10		dB
Return Loss RF1, RF2 "OFF State"	RL_{OFF}		8		dB

TABLE I Notes:

1/ Limits apply at T_A = +25 ºC only.
2/ Parameters measured at 1 GHz, 10 GHz & 20 GHz with input power = -15 dBm unless otherwise specified.
3/ A & B Control Voltage Low = 0 V, High = -5 V.

TABLE II – ELECTRICAL CHARACTERISTICS FOR QUALIFICATION SAMPLES

Parameter	Symbol	Conditions 1/2/3/ Unless otherwise specified	Sub-Group 4/	Limits		Unit
				Min	Max	
Insertion Loss	IL	1 GHz & 10 GHz	4, 5, 6		2.2	dB
		20 GHz	4, 6		2.2	
			5		2.4	
Isolation	ISO		4, 5, 6	40		dB
Return Loss RF1, RF2 & RFC "ON State"	RL_{ON}		4, 5, 6	10		dB
Return Loss RF1 & RF2 "OFF State"	RL_{OFF}		4, 5, 6	8		dB

TABLE II Notes:

1/ T_A Nom = +25 ºC, T_A Max = +85 ºC, T_A Min = -40 ºC.
2/ Parameters measured at 1 GHz, 10 GHz & 20 GHz with input power = -15 dBm unless otherwise specified.
3/ A & B Control Voltage Low = 0 V, High = -5 V.
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	Units
Insertion Loss	IL	± 1	dB

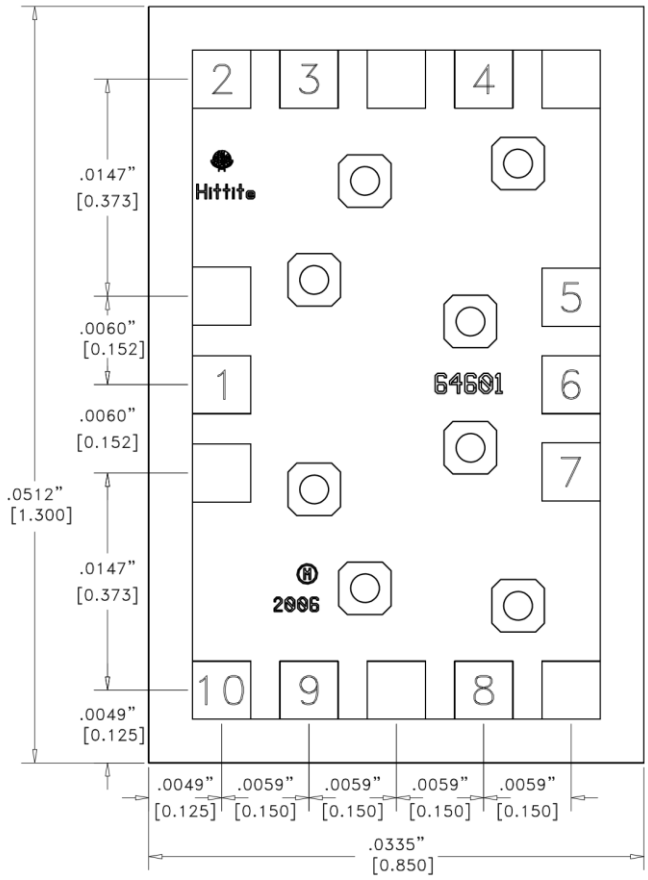
TABLE III Notes:

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.

TABLE IV – TRUTH TABLE			
Control Input		Signal Path State	
A	B	RFC to RF1	RFC to RF2
High	Low	ON	OFF
Low	High	OFF	ON

TABLE V – CONTROL VOLTAGES	
State	Bias Condition
Low	0 V to -0.2 V @ 10 µA Max.
High	-5 V @ 10 µA Typ. to -7 V @ 40 µA Max.

7.0 Die Outline



PAD	DESCRIPTION	PAD SIZE
1	RFC	.0040[.102] X .0040[.102]
2	A	.0040[.102] X .0040[.102]
3	B	.0040[.102] X .0040[.102]
4	RF2	.0040[.102] X .0040[.102]
5	A	.0040[.102] X .0040[.102]
6	B	.0040[.102] X .0040[.102]
7	A	.0040[.102] X .0040[.102]
8	RF1	.0040[.102] X .0040[.102]
9	A	.0040[.102] X .0040[.102]
10	B	.0040[.102] X .0040[.102]

NOTES:

1. ALL DIMENSIONS ARE IN INCHES [MM]
2. DIE THICKNESS IS .004"
3. OVERALL DIE SIZE ±.002"
4. BACKSIDE METALIZATION: GOLD
5. BACKSIDE METAL IS GROUND
6. BOND PAD METALIZATION: GOLD
7. NO CONNECTION REQUIRED FOR UNLABLED BOND PADS.

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).

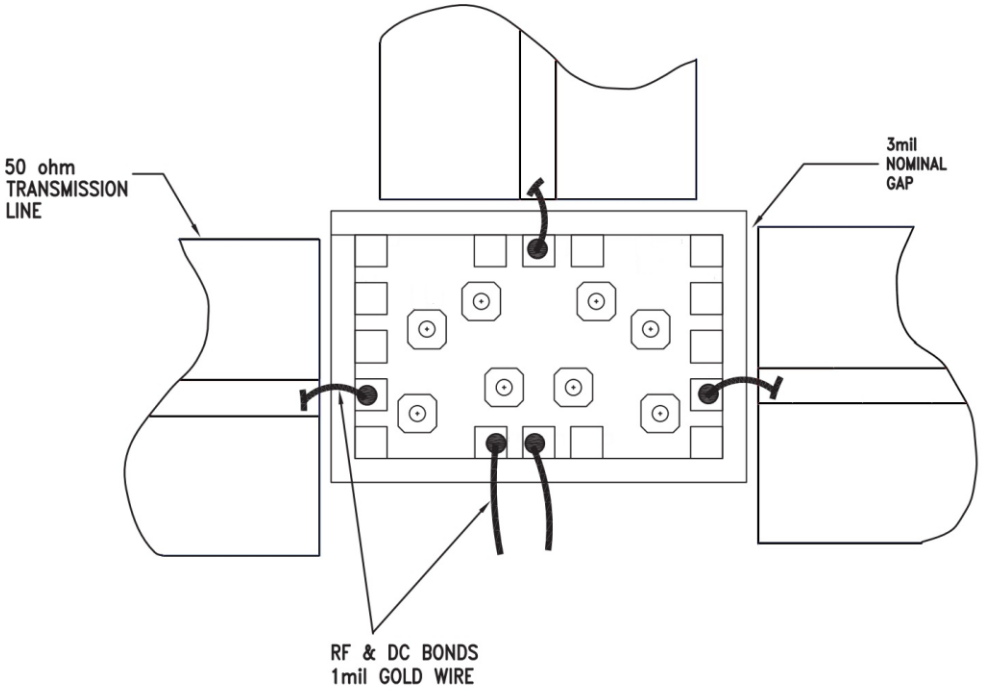


Figure 1. Assembly Diagram

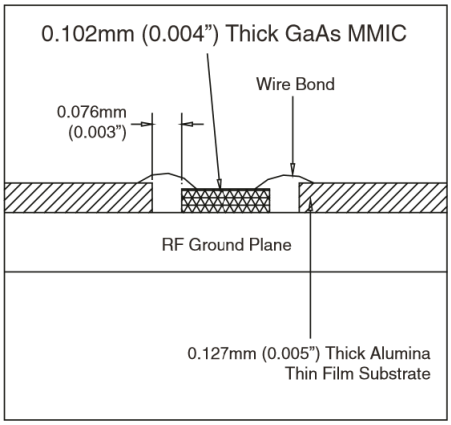


Figure 2. Die without Moly Tab

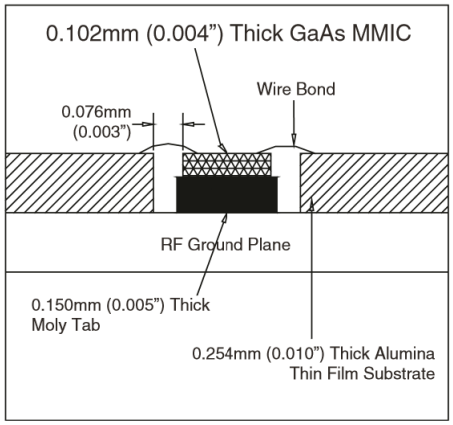


Figure 3. Die with Moly Tab

Die Packaging Information

Standard	Alternate
GP-5 (Gel Pack)	1/

Note:

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

Revision History		
Rev	**Description of Change**	**Date**
A	Initial Production Release	6/28/2022