

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 ADI 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/HMC519LC4>

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

| <u>Specific Part Number</u> | <u>Description</u> |
|-----------------------------|---|
| ADH519R701LSH6 | GaAs pHEMT Low Noise Amplifier, 17.5 GHz – 31.5 GHz |

3.0 Case Outline

The case outline is as follows:

| <u>Outline Letter</u> | <u>Descriptive Designator</u> | <u>Terminals</u> | <u>Lead Finish</u> | <u>Package style</u> |
|-----------------------|-------------------------------|------------------|--------------------|-----------------------------|
| X | EH-16-2 | 16 Lead | Gold | Ceramic Hermetic SMT (LSH6) |

FUNCTIONAL BLOCK DIAGRAM

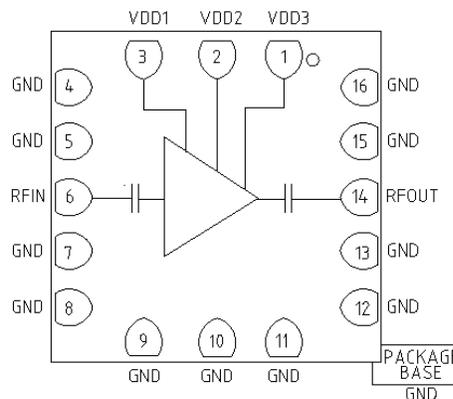


Figure 1 – Functional Block Diagram

ASD0016589B

Rev. B

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective companies.

| Package: X <u>1</u> / | | | |
|-----------------------|------------------|----------|--|
| Pin Number | Terminal Symbol | Pin Type | Pin Description |
| 1 | V _{DD3} | Power | Supply Voltage |
| 2 | V _{DD2} | Power | Supply Voltage |
| 3 | V _{DD1} | Power | Supply Voltage |
| 4 | GND | Power | Ground |
| 5 | GND | Power | Ground |
| 6 | RF IN | RF I/O | RF IN <u>2</u> / |
| 7 | GND | Power | Ground |
| 8 | GND | Power | Ground |
| 9 | GND | Power | Ground |
| 10 | GND | Power | Ground |
| 11 | GND | Power | Ground |
| 12 | GND | Power | Ground |
| 13 | GND | Power | Ground |
| 14 | RF OUT | RF I/O | RF OUT <u>2</u> / |
| 15 | GND | Power | Ground |
| 16 | GND | Power | Ground |
| Package Base | GND | Power | Ground |
| Package Lid | GND | Power | Package lid is connected to RF/DC ground |

Figure 2 – Terminal Connections

1/ The package base has an exposed metal pad that must connect the printed circuit board (PCB) RF/DC ground.

2/ This pin is DC blocked and internally matched to 50 ohms.

4.0 Specifications

4.1. Absolute Maximum Ratings 1/

| | |
|---|----------------|
| Drain Bias Voltage (V_{DD1} , V_{DD2} , V_{DD3}) | +3.5 Vdc |
| RF Input Power (RFIN) ($V_{DD1} = V_{DD2} = V_{DD3} = +3.0$ Vdc) | +20 dBm 2/ |
| Channel Temperature | 175°C |
| Continuous P_{diss} ($T=85^{\circ}\text{C}$) | 1.71 W |
| (derate 19 mW/°C above 85 °C) | |
| Thermal Resistance (Channel to package bottom) θ_{JC} | 52.63 °C/W |
| Storage temperature | -65°C to 150°C |
| ESD Sensitivity (HBM) | Class 1A |

4.2. Recommended Operating Conditions

| | |
|--|------------------|
| Positive Supply voltage (V_{DD}) | +2.5 V to +3.5 V |
| Ambient Operating Temperature Range (T_A)..... | -40°C to +85°C |

4.3. Nominal Operating Performance Characteristics 3/

| | |
|--|----------|
| Saturated Output Power (P_{sat}) (17.5-28.5 GHz) | 10.5 dBm |
| Saturated Output Power (P_{sat}) (28.5-31.5 GHz) | 14 dBm |
| Input Return Loss (S_{11}) (17.5-28.5 GHz)..... | 3.2 dB |
| Input Return Loss (S_{11}) (28.5-31.5 GHz)..... | 4 dB |
| Output Return Loss (S_{22}) (17.5-28.5 GHz) | 3.5 dB |
| Output Return Loss (S_{22}) (28.5-31.5 GHz) | 9 dB |
| Reverse Isolation (S_{12}) (17.5-28.5 GHz) | 27 dB |
| Reverse Isolation (S_{12}) (28.5-31.5 GHz)..... | 31 dB |
| Dynamic I_{DD} at P_{sat} | 95 mA |

4.4. Radiation Features

Maximum Total Dose Available (dose rate = 50 – 300 rads (Si)/s).... 100K rads (Si)

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/ Frequency = 17.5 GHz - 31.5 GHz

3/ All typical specifications are at $T_A = 25^{\circ}\text{C}$, $V_{DD1} = V_{DD2} = V_{DD3} = 3\text{V}$, unless otherwise noted.

TABLE I – ELECTRICAL PERFORMANCE CHARACTERISTICS

| Parameter See notes at end of table | Symbol | Conditions 1/ Unless otherwise specified | Group A Subgroups | Limits | | Units |
|--|-----------------|--|----------------------|--------|-------|-------|
| | | | | Min | Max | |
| RF CHARACTERISTICS | | | | | | |
| Gain | S21 | 17.5 GHz | 4 | 11.8 | | dB |
| | | | 5,6 | 10.5 | | |
| | | | M,D,P,L,R | 4 | 11.8 | |
| | | 28.5 GHz | 4 | 11 | | |
| | | | 5,6 | 10 | | |
| | | | M,D,P,L,R | 4 | 11 | |
| | | 31.5 GHz | 4 | 10.5 | | |
| | | | 5,6 | 9.5 | | |
| | | | M,D,P,L,R | 4 | 10.5 | |
| Gain Variation Over Temp 2/ 3/ | S21 / °C | 17.5 GHz | 4,5,6 | | 0.026 | dB/°C |
| | | 28.5 GHz | 4,5,6 | | 0.026 | |
| | | 31.5 GHz | 4,5,6 | | 0.026 | |
| Noise Figure | NF | 17.5 GHz | 4 | | 4 | dB |
| | | | 5,6 | | 4.5 | |
| | | | M,D,P,L,R | 4 | | |
| | | 28.5 GHz | 4 | | 4 | |
| | | | 5,6 | | 4.5 | |
| | | | M,D,P,L,R | 4 | | |
| | | 31.5 GHz | 4 | | 4.5 | |
| | | | 5,6 | | 5 | |
| | | | M,D,P,L,R | 4 | | |
| Output Power for 1dB Compression 2/ 3/ 5/ | OP1dB | 17.5 GHz | 4 | 7.2 | | dBm |
| | | | 5 | 6.5 | | |
| | | | 6 | 8.5 | | |
| | | 28.5 GHz | 4 | 7.2 | | |
| | | | 5 | 6.5 | | |
| | | | 6 | 8.5 | | |
| | | 31.5 GHz | 4 | 8.5 | | |
| | | | 5 | 8 | | |
| | | | 6 | 9.5 | | |
| Output Third Order Intercept 2/ 3/ 6/ | OIP3 | 17.5 GHz | 4 | 17.2 | | dBm |
| | | | 5 | 16 | | |
| | | | 6 | 19 | | |
| | | 28.5 GHz | 4 | 17.2 | | |
| | | | 5 | 16 | | |
| | | | 6 | 19 | | |
| | | 31.5 GHz | 4 | 19.2 | | |
| | | | 5 | 17.5 | | |
| | | | 6 | 20.5 | | |
| BIAS AND SUPPLY CURRENT | | | | | | |
| Supply Current 4/ | I _{DD} | M,D,P,L,R | 1,2,3 | | 95 | mA |
| | | | 1 | | 95 | mA |

TABLE I NOTES:

1/ T_A nom = 25°C, T_A max = 85°C, and T_A min = -40°C unless otherwise noted, V_{DD1} = V_{DD2}, = V_{DD3} = +3V

2/ Parameter is part of device initial characterization which is only repeated after design and process changes or with subsequent wafer lots.

3/ Parameter is not tested post irradiation

4/ Supply current measured with no signal at RF IN.

5/ Input power sweep -5 dBm to 10 dBm

6/ f₁ power = f₂ power = -5 dBm, Fixed Delta F = 1 MHz

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 <u>1</u> / <u>2</u> / |
| Group A Test Requirements | 1, 2, 3, 4, 5, 6 |
| Group C end-point electrical parameters | 1, 4 <u>2</u> / |
| Group D end-point electrical parameters | 1, 4 |
| Group E end-point electrical parameters | 1, 4 <u>3</u> / |

Table IIA Notes:

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

2/ See Table IIB for delta parameters

3/ Parameters noted in Table I are not tested post irradiation.

TABLE IIB – BURN-IN / LIFE TEST DELTA LIMITS 1/2/3/

| Parameter | Symbol | Delta | Units |
|------------------|-----------------|-------|-------|
| Gain at 17.5 GHz | S21 | ±1.0 | dB |
| Gain at 28.5 GHz | S21 | ±1.5 | dB |
| Gain at 31.5 GHz | S21 | ±1.5 | dB |
| Supply Current | I _{DD} | ±10 | % |

Table IIB Notes:

1/ 240 hour burn in and 1000 hour life test (group C) end point electrical parameters.

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

3/ Deltas apply with V_{DD1} = V_{DD2} = V_{DD3} = 3.0V unless otherwise noted

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.

5.2. Radiation Exposure Circuit

5.2.1. The radiation exposure circuit shall be maintained by the manufacturer under document revision level control and shall be made available to the preparing and acquiring activity upon request. Total dose irradiation testing shall be performed in accordance with MIL-STD-883 method 1019, condition A.

5.2.2. ADH519S have been characterized through all levels M, D, P, L, R of irradiation. However, ADH519S is only tested at the “R” level. Pre and Post irradiation values are identical unless otherwise specified in Table IA.

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 on request.

6.2. Group D

Group D-5 Salt Atmosphere testing is not being performed.

7.0 Application Circuit

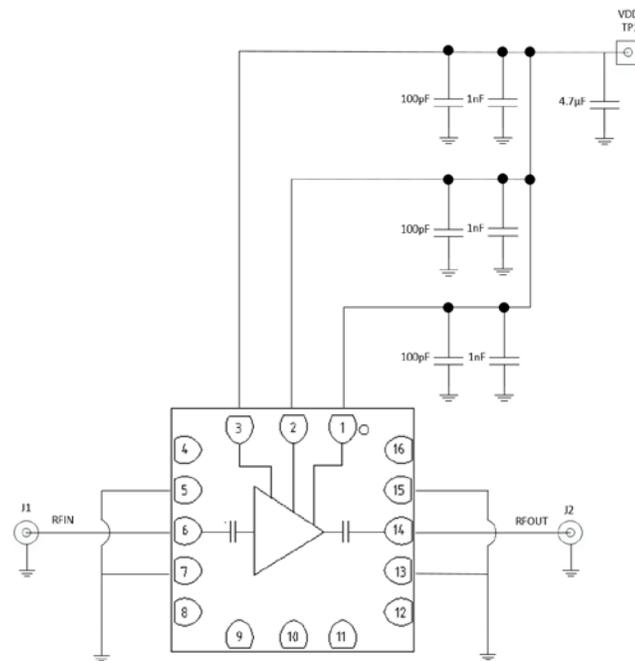


Figure 3 – Application Circuit

8.0 Package Outline Dimensions

The LSH6 package and outline dimensions can be found at <http://www.analog.com> or upon request.

ORDERING GUIDE

| Model | Temperature Range | Package Description | Package Option |
|----------------|-------------------|------------------------------|----------------|
| ADH519R701LSH6 | -40°C to +85°C | 16 Lead Ceramic Leadless SMT | LSH6 (EH-16-2) |

| Revision History | | |
|------------------|------------------------------------|-----------|
| Rev | Description of Change | Date |
| A | Initial Release | 2/14/2020 |
| B | Update table IIB and Section 5.1.1 | 5/23/2022 |