

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 brochure 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/HMC424>.

2.0 Part Number

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

<u>Specific Part Number</u>	<u>Description</u>
ADH424-701LH5	DC – 13 GHz, GaAs MMIC Hermetic 0.5 dB LSB 6-Bit Digital Attenuator

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	E-12-5	12 Lead	Gold	Ceramic Hermetic SMT (LH5)

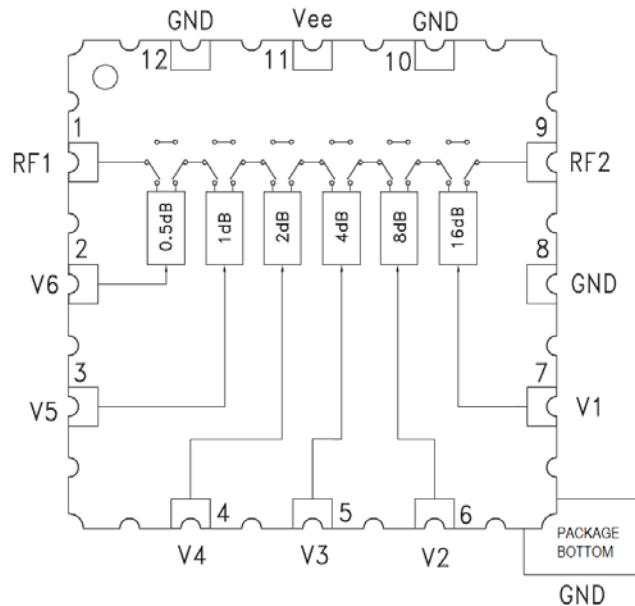


Figure 1 – Functional Block Diagram ^{1/}

^{1/} Package top view

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Rev. B

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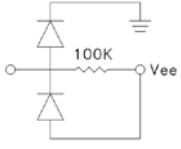



Package: X				
Pin Number	Terminal Symbol	Pin Type	Pin Description	Interface Schematic
1	RF1	RF I/O	This pin is DC coupled and matched to 50 Ω. Blocking capacitors are required if RF line potential is not equal to 0 V.	
2 - 7	V6 - V1	Digital Inputs	See Truth Table (Table III) and Control Voltages Table (Table IV)	
8, 10, 12	GND	Power	Ground	
9	RF2	RF I/O	This pin is DC coupled and matched to 50 Ω. Blocking capacitors are required if RF line potential is not equal to 0 V.	
11	Vee	Power	Supply Voltage	
Package Bottom	GND	Power	Ground <u>1</u>	
Package Lid	GND	Power	Ground <u>2</u>	

Figure 2 – Terminal Connections

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

4.0 Specifications

4.1. Absolute Maximum Ratings ^{1/}

Control Voltage (VCTL on V1 to V6)	V _{ee} – 0.5 Vdc
Bias Voltage (V _{ee})	-7 Vdc
RF Input Power (0.5 – 13 GHz).....	+25 dBm
Storage Temperature Range	-65 °C to +150 °C
Junction Temperature Maximum (T _J)	150 °C
Thermal Resistance, Junction-to-Case (θ _{JC})	344 °C/W
ESD Sensitivity (HBM)	Class 0, passed 50V

4.2. Recommended Operating Conditions

Supply Voltage Range (V _{ee})	-5 Vdc ± 10 %
Ambient Operating Temperature Range (T _A).....	-40 °C to +85 °C

4.3. Nominal Operating Performance

Characteristics ^{2/}

Return Loss (RF1 & RF2, All Attenuation States, DC – 13 GHz)	12 dBm
Input Power 0.1 dB Compression (1 – 13 GHz)	22 dBm
Input Third Order Intercept Point (1 – 13 GHz) ^{3/}	
REF State.....	46 dBm
All Other States	32 dBm

Switching Characteristics

Rise/Fall (10 % / 90 % RF).....	30 ns
On/Off (50 % VCTL to 10 % / 90 % RF).....	50 ns

^{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, unless otherwise noted.

^{3/} f₁ power = f₂ power = 0 dBm, Fixed Delta F = 1 MHz

TABLE I – ELECTRICAL PERFORMANCE CHARACTERISTICS

Parameter See notes at end of table	Symbol	Conditions <u>1/ 2/</u> Unless otherwise specified	Group A Subgroups	Limits		Units
				Min	Max	
Insertion Loss <u>3/</u>	IL	4 GHz	4, 5, 6		3.2	dB
		8 GHz	4, 5, 6		3.8	dB
		12 GHz	4		4.7	dB
			5, 6		4.8	dB
Attenuation Accuracy: 0.5–16.5 dB States <u>3/</u>	AA	4 GHz, 8 GHz, 12 GHz	4	± (0.4 + 4% of Atten. Setting) Max		dB
			5, 6	± (0.5 + 4% of Atten. Setting) Max		
Attenuation Accuracy: 17.0 – 31.5 dB States <u>3/</u>			4	± (0.5 + 5% of Atten. Setting) Max		
			5, 6	± (0.6 + 5% of Atten. Setting) Max		
Bias Current	lee		1, 2, 3		5	mA

TABLE I Notes:

1/ T_A nom = 25 °C, T_A max = 85 °C and T_A min = -40 °C, 50 ohm system, unless otherwise noted.

2/ V_{ee} = -5 V, VCTL Low = 0 V, VCTL High = -5 V.

3/ RF Input Power = -15 dBm.

TABLE IIA – ELECTRICAL TEST REQUIREMENTS:

Test Requirements	Subgroups (in accordance with MIL-PRF-38535, Table III)
Interim Electrical Parameters	1
Final Electrical Parameters	1, 4 <u>1/ 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

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

Parameter	Test Conditions	Symbol	Delta	Units
Bias Current	Per Table I	lee	± 10	%
Insertion Loss		IL	± 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.

TABLE III – TRUTH TABLE

Control Voltage Input						Attenuation State RF1 – RF2
V1 16 dB	V2 8 dB	V3 4 dB	V4 2 dB	V5 1 dB	V6 0.5 dB	
Low	Low	Low	Low	Low	Low	Reference IL
Low	Low	Low	Low	Low	High	0.5 dB
Low	Low	Low	Low	High	Low	1 dB
Low	Low	Low	High	Low	Low	2 dB
Low	Low	High	Low	Low	Low	4 dB
Low	High	Low	Low	Low	Low	8 dB
High	Low	Low	Low	Low	Low	16 dB
High	High	High	High	High	High	31.5 dB

Table III Note:

1/ Any combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.

TABLE IV – CONTROL VOLTAGES

State	Bias Condition
Low	0 V to -3 V @ 35 μ A Typical
High	Vee to Vee + 0.8 V @ 5 μ A Typical

5.0 **Burn-In Life Test, and Radiation**

5.1. Burn-In Test Circuit, Life Test Circuit

HTRB is not applicable for this drawing.

5.2. Test Conditions and Circuit

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.

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 testing is not performed.

7.0 **Application Notes**

The circuit board used in the final application should be generated with proper RF circuit design techniques. Signal lines at the RF ports should have 50 Ohm impedance. Also, the package ground leads, and package bottom should be connected directly to the ground plane. The recommended circuit board material is Rogers 4350.

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
ADH424-701LH5	-40 °C to +85 °C	12 Lead Ceramic Hermetic SMT	LH5 (E-12-5)

Revision History		
Rev	Description of Change	Date
A	Initial Release	4/20/2021
B	Update internal description	9/22/2021

