>1.5 W (34 dBm), 24 GHz to 34 GHz Power Amplifier

ADH943AS

1.0 SCOPE

This specification documents the detailed requirements for an internally defined equivalent flow per MIL-PRF-38535 Class Q except as modified herein.

The manufacturing flow described in the ADI TRADITIONAL SPACE 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 https://www.analog.com/HMC943A

2.0 Part Number:

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

Specific Part Number	Description
ADH943A-701LSH7	GaAs, pHEMT, 24 GHz to 34 GHz, MMIC, Power Amplifier

3.0 Case Outline

The case outline is as follows:

Outline Letter	Descriptive Designator	Terminals	Lead Finish	Package style
X	EH-18-3	18 Lead	Gold	Ceramic Leadless Hermetic SMT (LSH7)

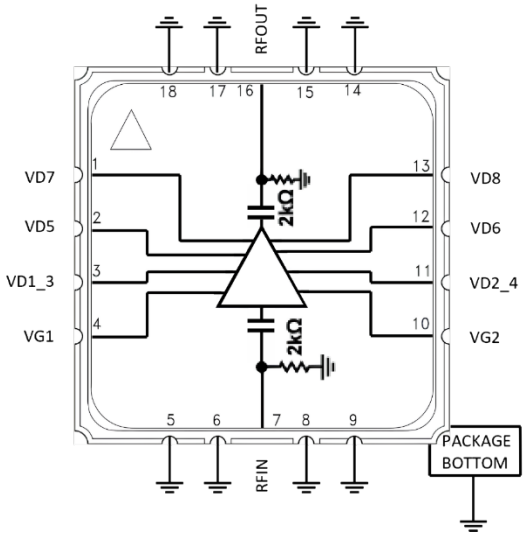

Figure 1 – Functional Block Diagram

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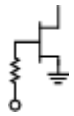
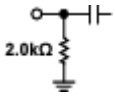
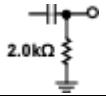
Package: X				
Pin Number	**Terminal Symbol**	**Pin Type**	**Pin Description**	**Interface Schematic**
1, 2, 3, 11, 12, 13	VD7, VD5, VD1_3, VD2_4, VD6, VD8	Power	Drain Bias for the Amplifier. External bypass capacitors of 100 pF, 0.01 µF, and 4.7 µF are required on each pin.	
4, 10	VG1, VG2	Power	Gate Control for the Amplifier. Adjust VG1 or VG2 to achieve the recommended bias current. External bypass capacitors of 100 pF, 10 nF, and 4.7 µF are required. VG1 and VG2 are internally connected. Therefore, external bias can be applied to either VG1 or VG2.	
5, 6, 8, 9, 14, 15, 17, 18	GND	Power	RF/DC ground.	
7	RFIN	RF I/O	RF Input. This pin is dc-coupled and matched to 50 Ω.	
16	RFOUT	RF I/O	RF Output. This pad is dc-coupled and matched to 50 Ω.	
Package Bottom	GND	Power	RF/DC ground 1/	
Package Lid	GND	Power	RF/DC ground 2/	

Figure 2 – Terminal connections

1/ The package bottom has an exposed metal pad that must be connected to RF/DC ground.
2/ The package lid is internally connected to GND.

4.0 Specifications

4.1. Absolute Maximum Ratings 1/

Drain Bias Voltage (VD1_3, VD2_4, VD5, VD6, VD7, VD8)	6.5 V dc
Gate Bias Voltage (VG1, VG2)	-2 V to 0 V dc
Radio Frequency (RF) Input Power (RFIN)	20 dBm
Output Load Standing Wave Ratio (VSWR)	7:1
Maximum Peak Reflow Temperature (MSL3)	260 °C
Continuous Pdiss (T_A = +80 °C) (Derate 120 mV/°C above + 80 °C)	11.45 W
Thermal Resistance (Junction to Package Bottom)	8.3 °C/W
Storage Temperature Range	-65 °C to + 125 °C
Maximum Junction Temperature	+175 °C
ESD Sensitivity (HBM)	Class 0B (passed 150V)

4.2. Recommended Operating Conditions

Drain Bias Voltage (VD1_3, VD2_4, VD5, VD6, VD7, VD8)	+4 V dc to +6 V dc
Quiescent Supply Current (IDDQ)	1300 mA 2/
Frequency Range	24 GHz to 34 GHz
Ambient Operating Temperature Range (Performance) (T_A)	0 °C to + 80 °C
Ambient Operating Temperature Range (T_A)	-40 °C to + 85 °C

4.3. Nominal Operating Performance Characteristics at T_A = +25 °C 3/

Gain Variation over Temperature (S21/°C) (24 GHz to 34 GHz)	0.04 dB/°C 4/
Input Return Loss (S11) (24 GHz to 29 GHz)	12 dB
Input Return Loss (S11) (29 GHz to 34 GHz)	10 dB
Output Return Loss (S22) (24 GHz to 29 GHz)	12 dB
Output Return Loss (S22) (29 GHz to 34 GHz)	13 dB
Output Third Order Intercept (OIP3) (24 GHz to 29 GHz)	39 dBm 5/
Output Third Order Intercept (OIP3) (29 GHz to 34 GHz)	37.5 dBm 5/

4.4. Nominal Operating Performance Characteristics at T_A = 0 °C 6/

Input Return Loss (S11) (24 GHz to 29 GHz)	12 dB
Input Return Loss (S11) (29 GHz to 34 GHz)	10 dB
Output Return Loss (S22) (24 GHz to 29 GHz)	12 dB
Output Return Loss (S22) (29 GHz to 34 GHz)	13 dB
Output Third Order Intercept (OIP3) (24 GHz to 29 GHz)	38 dBm 5/
Output Third Order Intercept (OIP3) (29 GHz to 34 GHz)	36.5 dBm 5/

4.5. Nominal Operating Performance Characteristics at T_A = -40 °C 7/

Input Return Loss (S11) (24 GHz to 29 GHz)	12 dB
Input Return Loss (S11) (29 GHz to 34 GHz)	9 dB
Output Return Loss (S22) (24 GHz to 29 GHz)	12 dB
Output Return Loss (S22) (29 GHz to 34 GHz)	13 dB
Gain (S21) (24 GHz to 29 GHz)	25 dB
Gain (S21) (29 GHz to 34 GHz)	25 dB
Output Power 1dB Compression (OP1dB) (24 GHz to 29 GHz)	33.5 dBm
Output Power 1dB Compression (OP1dB) (29 GHz to 34 GHz)	33.5 dBm
Output Third Order Intercept (OIP3) (24 GHz to 29 GHz)	37 dBm 5/
Output Third Order Intercept (OIP3) (29 GHz to 34 GHz)	37 dBm 5/

4.6. Nominal Operating Performance Characteristics at T_A = +80 °C 8/

Input Return Loss (S11) (24 GHz to 29 GHz)	12 dB
Input Return Loss (S11) (29 GHz to 34 GHz)	11 dB
Output Return Loss (S22) (24 GHz to 29 GHz)	12 dB
Output Return Loss (S22) (29 GHz to 34 GHz)	13 dB
Output Third Order Intercept (OIP3) (24 GHz to 29 GHz)	40 dBm 5/
Output Third Order Intercept (OIP3) (29 GHz to 34 GHz)	38.5 dBm 5/

4.7. Nominal Operating Performance Characteristics at T_A = +85 °C 9/

Input Return Loss (S11) (24 GHz to 29 GHz)	12 dB
Input Return Loss (S11) (29 GHz to 34 GHz)	11 dB
Output Return Loss (S22) (24 GHz to 29 GHz)	12 dB
Output Return Loss (S22) (29 GHz to 34 GHz)	13 dB
Gain (S21) (24 GHz to 29 GHz)	21 dB
Gain (S21) (29 GHz to 34 GHz)	21 dB
Output Power 1dB Compression (OP1dB) (24 GHz to 29 GHz)	32.5 dBm
Output Power 1dB Compression (OP1dB) (29 GHz to 34 GHz)	32 dBm
Output Third Order Intercept (OIP3) (24 GHz to 29 GHz)	40 dBm 5/
Output Third Order Intercept (OIP3) (29 GHz to 34 GHz)	38.5 dBm 5/

1/ Stresses at or 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 above those indicated in the operational section of this specification is not implied. Operating beyond the maximum operating conditions for extended periods may affect device reliability.
2/ Adjust VG1 or VG2 between -2 Vdc and 0 V dc to achieve 1300 mA typical.
3/ All typical specifications are at T_A = +25 °C, VD1_3 = VD2_4 = VD5 = VD6 = VD7 = VD8 = +5.5 Vdc, and IDDQ = 1300 mA.
4/ Calculated between T_A = -40 °C and T_A = +85 °C.
5/ RFOUT = +22 dBm per tone, 1 MHz spacing.
6/ Specifications apply at T_A = 0 °C with VD1_3 = VD2_4 = VD5 = VD6 = VD7 = VD8 = +5.5 Vdc, and IDDQ = 1300 mA.
7/ Specifications apply at T_A = -40 °C with VD1_3 = VD2_4 = VD5 = VD6 = VD7 = VD8 = +5.5 Vdc, and IDDQ = 1300 mA.
8/ Specifications apply at T_A = +80 °C with VD1_3 = VD2_4 = VD5 = VD6 = VD7 = VD8 = +5.5 Vdc, and IDDQ = 1300 mA.
9/ Specifications apply at T_A = +85 °C with VD1_3 = VD2_4 = VD5 = VD6 = VD7 = VD8 = +5.5 Vdc, and IDDQ = 1300 mA.

TABLE I – ELECTRICAL PERFORMANCE CHARACTERISTICS

Parameter See notes at end of table	Symbol	Conditions 1/ 2/ 3/ Unless otherwise specified	Group A Subgroups	Limits		Units
				Min	Max	
RF CHARACTERISTICS						
Gain 4/	S21	P_{IN} = -20 dBm	4	18.5		dB
			5, 6	16		dB
Gain Variation Over Temperature 4/	S21 / °C		4, 5, 6		0.05	dB/°C
Output Power 1dB Compression 4/ 5/	OP1dB		7	27.5		dBm
			8A, 8B	25.5		dBm
DC CHARACTERISTICS						
Quiescent Supply Current	IDDQ	No Signal at RFIN	1, 2, 3		1375	mA

TABLE I Notes:
1/ T_A nom = +25 °C, T_A max = +80 °C, T_A min = 0 °C.
2/ VD1_3 = VD2_4 = VD5 = VD6 = VD7 = VD8 = +5.5 V dc.
3/ Adjust VG1 or VG2 between -2 V dc and 0 V dc to achieve IDQQ = 1300 mA typical at T_A nom, T_A max, and T_A min.
Each device shall use the individual VG1 or VG2 voltage established at pre burn-in throughout all T_A nom qualification testing.
4/ Data tabulated at 24 GHz, 25.5 GHz, 26 GHz, 27 GHz, 29 GHz, 31 GHz, and 34 GHz.
5/ OP1dB testing is go-no-go confirming minimum requirements are met.

TABLE IIA – ELECTRICAL TEST REQUIREMENTS

Test Requirements	Subgroups (in accordance with MIL-PRF-38535, Table III)
Interim Electrical Parameters	1, 4, 7
Final Electrical Parameters	1, 4, 7 1/ 2/
Group A Test Requirements	1, 2, 3, 4, 5, 6, 7, 8A, 8B
Group C end-point electrical parameters	1, 4, 7 2/
Group D end-point electrical parameters	1, 4, 7

Table IIA Notes:
1/ PDA applies to Table I subgroup 1 only and Table IIB delta parameters.
2/ See Table IIB for delta parameters

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

Parameter	Test Conditions	Symbol	Delta	Units
Gain	Per Table I	S21	± 1	dB
Quiescent Supply Current		IDDQ	± 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 T_A = +25 °C only.

5.0 Burn-In Life Test, and Radiation

5.1. Burn-In Test Circuit, Life Test Circuit

5.1.1. The test conditions and circuits 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.

6.0 MIL-PRF-38535 QMLV Exceptions

The manufacturing flow described in the ADI TRADITIONAL SPACE PRODUCTS PROGRAM brochure 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.

7.0 Application Notes

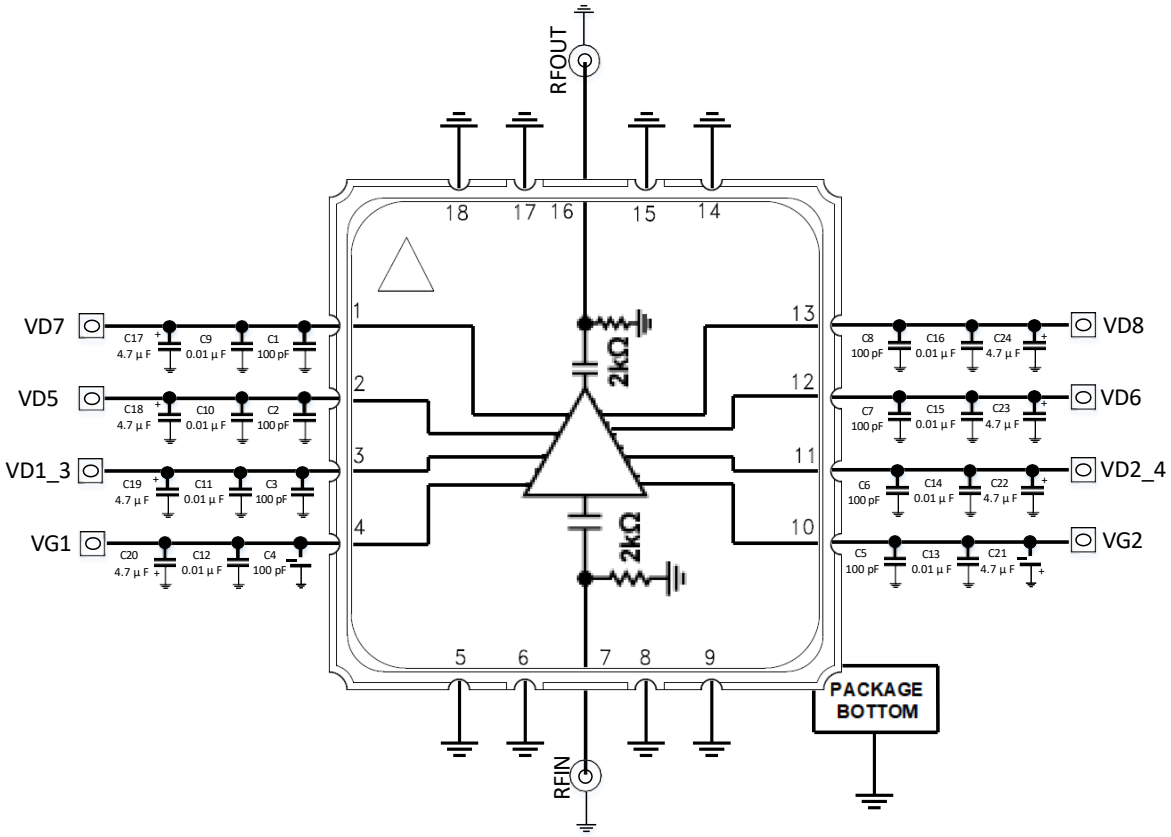


Figure 3 – Application Circuit

8.0 Package Outline Dimensions

The LSH7 package and outline dimensions can be found at http://www.analog.com or upon request.

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
ADH943A-701LSH7	0 °C to +80 °C	18 Lead Ceramic Leadless Hermetic SMT	LSH7 (EH-18-3)

Revision History		
Rev	**Description of Change**	**Date**
A	Initial Release	07/20/2026