Commercial Space Product

GaAs, pHEMT, MMIC, Low Noise Amplifier, 23 GHz to 31 GHz

FEATURES

- Low noise figure: 1.6 dB typical at 27 GHz to 31 GHz
- Single positive supply (self biased)
- High gain: 27 dB typical at 27 GHz to 31 GHz
- High OIP3: 21.5 dBm typical at 27 GHz to 31 GHz
- RoHS-compliant, 2 mm × 2 mm, 8-lead LFCSP

COMMERCIAL SPACE FEATURES

- Wafer diffusion lot traceability
- Radiation lot acceptance test (RLAT)
  - Total ionizing dose (TID)
- Radiation benchmark
  - Single event latch-up (SEL)

APPLICATIONS

- Geosynchronous high throughput satellite (GEO HTS)
- Low Earth orbit (LEO) space payloads
- Satellite communication

GENERAL DESCRIPTION

The ADL8142S-CSL is a gallium arsenide (GaAs), monolithic microwave integrated circuit (MMIC), pseudomorphic high electron mobility transistor (pHEMT), low noise wideband amplifier that operates from 23 GHz to 31 GHz. The ADL8142S-CSL provides a typical gain of 27 dB, a 1.6 dB typical noise figure, and a typical output third-order intercept (OIP3) of 21.5 dBm at 27 GHz to 31 GHz, requiring only 25 mA from a 2 V supply voltage. Note that the OIP3 can be improved with larger drain currents. The ADL8142S-CSL also features inputs and outputs that are ac-coupled and internally matched to 50 Ω, making it ideal for high capacity microwave radio applications.

The ADL8142S-CSL is housed in a RoHS-compliant, 2 mm × 2 mm, 8-lead LFCSP. Additional application and technical information can be found in the Commercial Space Products Program brochure and the ADL8142 data sheet.

FUNCTIONAL BLOCK DIAGRAM

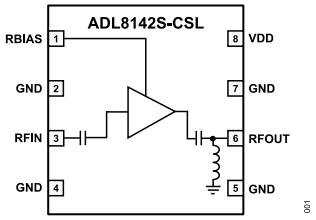

Figure 1. Functional Block Diagram

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REVISION HISTORY

6/2022—Revision 0: Initial Version

SPECIFICATIONS

23 GHZ TO 27 GHZ FREQUENCY RANGE

Supply voltage (V_{DD}) = 2 V, quiescent current (I_{DQ}) = 25 mA, bias resistance (R_{BIAS}) = 634 Ω, and T_C = 25°C, unless otherwise noted.

Table 1.

Parameter	Min	Typ	Max	Unit	Test Conditions/Comments
FREQUENCY RANGE	23		27	GHz	
GAIN		29		dB	
Gain Variation over Temperature		0.073		dB/°C	
NOISE FIGURE		1.8		dB	
RETURN LOSS					
Input (S11)		10.5		dB	
Output (S22)		16		dB	
OUTPUT					
Power for 1 dB Compression (P1dB)		8.5		dBm	
Saturated Power (P_{SAT})		10		dBm	
IP3		17.5		dBm	Measurement taken at output power (P_{OUT}) per tone = −4 dBm
Second-Order Intercept (IP2)		25		dBm	Measurement taken at P_{OUT} per tone = −4 dBm
POWER ADDED EFFICIENCY (PAE)		18		%	Measured at P_{SAT}

27 GHZ TO 31 GHZ FREQUENCY RANGE

V_{DD} = 2 V, I_{DQ} = 25 mA, R_{BIAS} = 634 Ω, and T_C = 25°C, unless otherwise noted.

Table 2.

Parameter	Min	Typ	Max	Unit	Test Conditions/Comments
FREQUENCY RANGE	27		31	GHz	
GAIN	24.5	27		dB	
Gain Variation over Temperature		0.037		dB/°C	
NOISE FIGURE		1.6		dB	
RETURN LOSS					
S11		13		dB	
S22		15		dB	
OUTPUT					
P1dB	7.5	10		dBm	
P_{SAT}		11		dBm	
IP3		21.5		dBm	Measurement taken at P_{OUT} per tone = −4 dBm
IP2		35		dBm	Measurement taken at P_{OUT} per tone = −4 dBm
PAE		21		%	Measured at P_{SAT}

DC SPECIFICATIONS

Table 3.

Parameter	Min	Typ	Max	Unit
SUPPLY CURRENT				
I_{DQ}		25		mA
Amplifier Current (I_{DQ_AMP})		23		mA
RBIAS Current (I_{RBIAS})		2		mA
SUPPLY VOLTAGE				
V_{DD}	1.5	2	3.5	V

SPECIFICATIONS

RADIATION TEST AND LIMIT SPECIFICATIONS

Electrical characteristics at V_{DD} = 2 V, I_{DQ} = 25 mA, R_{BIAS} = 634 Ω, and T_C = 25°C, unless otherwise noted. Total ionizing dose (TID) testing characterized to 30 krads.

Table 4.

Parameter	Min	Typ	Max	Unit
FREQUENCY RANGE	27		31	GHz
GAIN	24.5	27		GHz
OUTPUT				
P1dB	7	10		dBm
SUPPLY CURRENT				
I_{DQ}		25		mA
SUPPLY VOLTAGE				
V_{DD}	1.5	2	3.5	V

ABSOLUTE MAXIMUM RATINGS

Table 5.

Parameter	Rating
V_{DD}	4.5 V
RF Input Power (RFIN)	20 dBm
Pulsed RFIN (Duty Cycle = 10%, Pulse Width = 100 µs)	22 dBm
Continuous Power Dissipation (P_{DISS}), T_{CASE} = 85°C (Derate 5.99 mW/°C Above 85°C)	0.54 W
Temperature	
Storage Range	−65°C to +150°C
Operating Range	−40°C to +85°C
Nominal Junction (T_A = 85°C, V_{DD} = 2 V, I_{DQ} = 25 mA, Input Power (P_{IN}) = Off)	93.4°C
Maximum Junction	175°C

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

THERMAL RESISTANCE

Thermal performance is directly linked to printed circuit board (PCB) design and operating environment. Close attention to PCB thermal design is required.

θ_{JC} is the junction to case thermal resistance.

Table 6. Thermal Resistance

Package Type	θ_{JC}	Unit
CP-8-30		
Quiescent, T_{BASE} = 25°C	134.3	°C/W
Worst Case[1], T_{BASE} = 85°C	167	°C/W

[1] Worst case across all specified operating conditions

OUTGAS TESTING

The criteria used for the acceptance and rejection of materials must be determined by the user and based upon specific component and system requirements. Historically, a total mass loss (TML) of 1.00% and collected volatile condensable material (CVCM) of 0.10% have been used as screening levels for rejection of spacecraft materials.

Table 7. Outgas Testing

Specification (Tested per ASTM E595 -15)	Value	Unit
Total Mass Lost	0.14	%
Collected Volatile Condensable Material	0.01	%
Water Vapor Recovered	0.03	%

ELECTROSTATIC DISCHARGE (ESD) RATINGS

The following ESD information is provided for handling of ESD-sensitive devices in an ESD protected area only.

Human body model (HBM) per ANSI/ESDA/JEDEC JS-001.

ESD Ratings for ADL8142S-CSL

Table 8. ADL8142S-CSL, 8-Lead LFCSP

ESD Model	Withstand Threshold (V)	Class
HBM	±250	1A

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

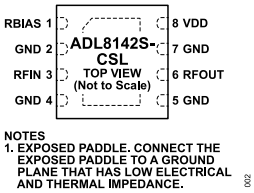

Figure 2. Pin Configuration

Table 9. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	RBIAS	Bias Setting Resistor. Connect a resistor between RBIAS and VDD to set the I_{DQ}. See the typical application circuit and the recommended bias resistor values for V_{DD} = 2 V table in the ADL8142 data sheet for more details.
2, 4, 5, 7	GND	Ground. Connect the GND pins to a ground plane that has low electrical and thermal impedance.
3	RFIN	RF Input. The RFIN pin is ac-coupled and matched to 50 Ω.
6	RFOUT	RF Output. The RFOUT pin is ac-coupled and matched to 50 Ω.
8	VDD	Drain Bias. Connect the VDD pin to the supply voltage.
	EXPOSED PADDLE	Exposed Paddle. Connect the exposed paddle to a ground plane that has low electrical and thermal impedance.

TYPICAL PERFORMANCE CHARACTERISTICS

See the ADL8142 data sheet for the typical performance characteristics plots.