8GHz to 14GHz, Low Noise Amplifier

FEATURES

- Single positive supply: 1.5V and I_{DQ} of 35mA nominal
- RBIAS drain current adjustment pin
- Gain: 28.5dB from 8GHz to 10GHz
- Noise figure: 1dB from 8GHz to 10GHz
- Extended operating temperature range: −55°C to +125°C
- Internally matched and AC-coupled
- RoHS-compliant, 2 mm × 2 mm, 8-lead LFCSP

COMMERCIAL SPACE FEATURES

- Support aerospace applications
- Wafer diffusion lot traceability
- Radiation monitors
  - Total ionizing dose (TID)
- Outgassing characterization

APPLICATIONS

- Low Earth orbit (LEO) space payloads
- Satellite communications

GENERAL DESCRIPTION

The ADL8143-CSL is a low noise amplifier (LNA) that operates from 8GHz to 14GHz. The typical gain, noise figure, output power for 1dB compression (OP1dB), and output third-order intercept (OIP3) are 28.5dB, 1dB, 7.5dBm, and 19.5dBm, respectively, from 8GHz to 10GHz. The nominal quiescent current (I_{DQ}), which can be adjusted, is 35mA from a 1.5V supply voltage (V_{DD}). The ADL8143-CSL also features inputs and outputs that are AC-coupled and internally matched to 50Ω.

The ADL8143-CSL is housed in an RoHS-compliant, 2mm × 2mm, 8-lead lead frame chip scale package [LFCSP] and is specified for operation from −55°C to +125°C.

Additional application and technical information can be found in the Commercial Space Products Program brochure and the ADL8143 data sheet.

FUNCTIONAL BLOCK DIAGRAM

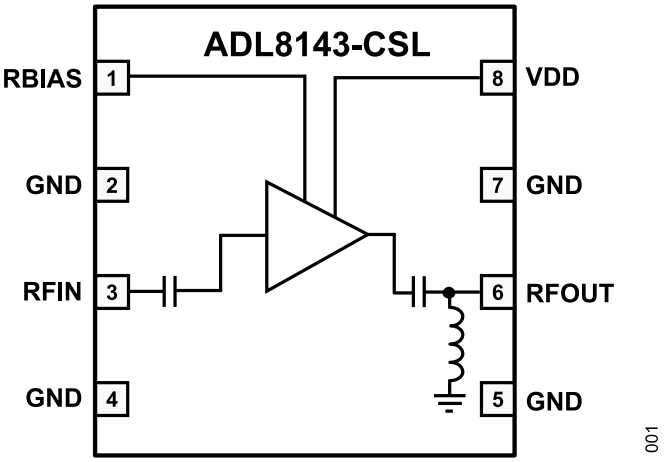

Figure 1. Functional Block Diagram

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REVISION HISTORY

12/2024—Revision 0: Initial Version

SPECIFICATIONS

8GHz TO 10GHz FREQUENCY RANGE

V_{DD} = 1.5V, I_{DQ} = 35mA, bias resistance (R_{BIAS}) = 487Ω, and T_{CASE} = 25°C, unless otherwise noted.

Table 1. 8GHz to 10GHz Frequency Range

Parameter	Min	Typ	Max	Unit	Test Conditions/Comments
FREQUENCY RANGE	8		10	GHz	
GAIN	26.5	28.5		dB	
Gain Variation over Temperature		0.026		dB/°C	
NOISE FIGURE		1		dB	
RETURN LOSS					
Input (S11)		11		dB	
Output (S22)		19		dB	
OUTPUT					
OP1dB	5.5	7.5		dBm	
Saturated Output Power (P_{SAT})		9		dBm	
OIP3		19.5		dBm	Measurement taken at output power (P_{OUT}) per tone = −6dBm
Second-Order Intercept (OIP2)		14		dBm	Measurement taken at P_{OUT} per tone = −6dBm
POWER ADDED EFFICIENCY (PAE)		15.53		%	Measured at P_{SAT}

10GHz TO 14GHz FREQUENCY RANGE

V_{DD} = 1.5V, I_{DQ} = 35mA, R_{BIAS} = 487Ω, and T_{CASE} = 25°C, unless otherwise noted.

Table 2. 10GHz to 14GHz Frequency Range Specifications

Parameter	Min	Typ	Max	Unit	Test Conditions/Comments
FREQUENCY RANGE	10		14	GHz	
GAIN	26.5	28.5		dB	
Gain Variation over Temperature		0.029		dB/°C	
NOISE FIGURE		1.1		dB	
RETURN LOSS					
S11		17		dB	
S22		15		dB	
OUTPUT					
OP1dB	6.5	8.5		dBm	
P_{SAT}		10		dBm	
OIP3		22		dBm	Measurement taken at P_{OUT} per tone = −6dBm
OIP2		22.5		dBm	Measurement taken at P_{OUT} per tone = −6dBm
PAE		19.91		%	

DC SPECIFICATIONS

Table 3. DC Specifications

Parameter	Min	Typ	Max	Unit
SUPPLY CURRENT				
I_{DQ}		35		mA
Amplifier Current (I_{DQ_AMP})		33.2		mA
R_{BIAS} Current (I_{RBIAS})		1.8		mA
SUPPLY VOLTAGE				
V_{DD}	1.2	1.5	3.5	V

SPECIFICATIONS

RADIATION TEST AND LIMIT SPECIFICATIONS

Electrical characteristics at V_{DD} = 1.5V, I_{DQ} = 35mA, R_{BIAS} = 487Ω, and T_{CASE} = 25°C, unless otherwise noted.

Table 4. Radiation Test and Limit Specifications

Parameter	Min	Typ	Max	Unit
FREQUENCY RANGE	10		14	GHz
GAIN	26.5	28.5		dB
OUTPUT				
OP1dB	6.5	8.5		dBm
SUPPLY CURRENT				
I_{DQ}		35		mA
I_{DQ_AMP}		33.2		mA
I_{RBIAS}		1.8		mA
SUPPLY CURRENT				
V_{DD}	1.2	1.5	3.5	V

ABSOLUTE MAXIMUM RATINGS

Table 5. Absolute Maximum Ratings

Parameter	Rating
V_{DD}	4V
RF Input Power (RF_{IN})	20dBm
Continuous Power Dissipation (P_{DISS}), T_{CASE} = 85°C (Derate 10.6mW/°C Above 85°C)	0.95W
Temperature	
Storage Range	−65°C to +150°C
Operating Range	−55°C to +125°C
Quiescent Channel (T_{CASE} = 85°C, V_{DD} = 1.5V, I_{DQ} = 35mA, Input Power (P_{IN}) = Off)	89.95°C
Maximum Channel	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. Careful attention to PCB thermal design is required.

θ_{JC} is the channel-to-case thermal resistance.

Table 6. Thermal Resistance

Package Type	θ_{JC}	Unit
CP-8-30		
Quiescent, T_{CASE} = 25°C	80.4	°C/W
Worst Case,[1] T_{CASE} = 85°C	94.3	°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	%

RADIATION FEATURES

Table 8. Radiation Features

Specifications	Value	Unit
Maximum Total Dose Available (Dose Rate = 50rads to 300rads (Si)/sec)[1]	100	krads (Si)

[1] Guaranteed by device and process characterization.

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 ADL8143-CSL

Table 9. ADL8143-CSL, 8-Lead LFCSP

ESD Model	Withstand Threshold (V)	Class
HBM	±300	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

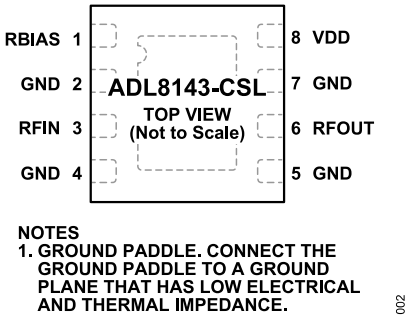

Figure 2. Pin Configuration

Table 10. 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 various I_{DQ} values, V_{DD} = 1.5 V table in the ADL8143 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 50Ω.
6	RFOUT	RF Output. The RFOUT pin is AC-coupled and matched to 50Ω.
8	VDD	Drain Bias. Connect the VDD pin to the supply voltage.
	GROUND PADDLE	Ground Paddle. Connect the ground paddle to a ground plane that has low electrical and thermal impedance.

TYPICAL PERFORMANCE CHARACTERISTICS

See the ADL8143 data sheet for the typical performance characteristics plot.

OUTLINE DIMENSIONS

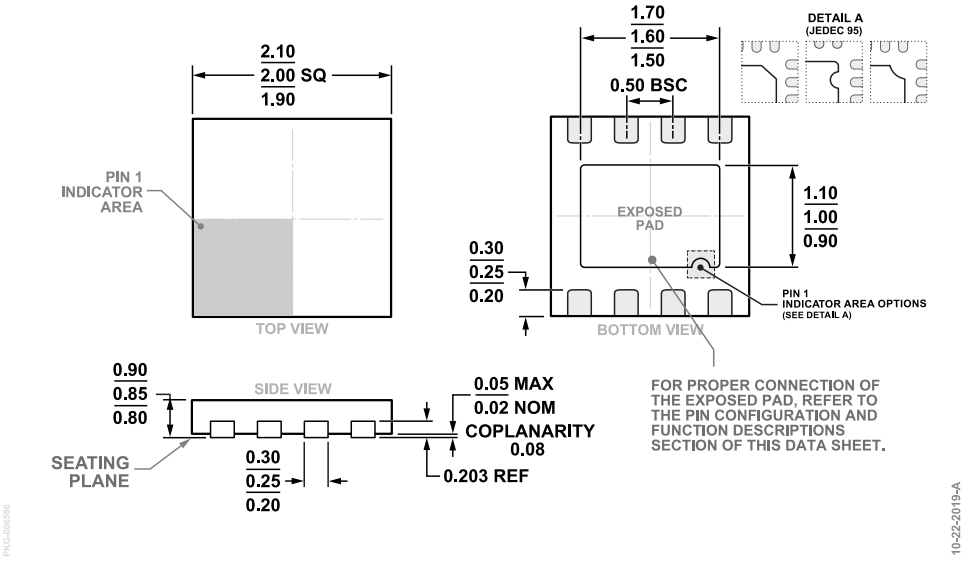

Figure 3. 8-Lead Lead Frame Chip Scale Package [LFCSP]
2mm × 2mm Body and 0.85mm Package Height
(CP-8-30)
Dimensions shown in millimeters

ORDERING GUIDE

Model[1, 2]	Temperature Range	Package Description	Packing Quantity	Package Option
ADL8143ACPZN-CSL	−55°C to +125°C	8-Lead Lead Frame Chip Scale Package [LFCSP]	Tape, 1	CP-8-30
ADL8143ACPZN-R7-CSL	−55°C to +125°C	8-Lead Lead Frame Chip Scale Package [LFCSP]	Reel, 3000	CP-8-30

[1] Z = RoHS Compliant Part.

[2] The lead finish of ADL8143ACPZN-CSL and ADL8143ACPZN-R7-CSL is nickel palladium gold.