10 GHz to 18 GHz Low Noise Amplifier

FEATURES

- Single positive supply: 1.5 V and I_{DQ} of 35 mA nominal
- RBIAS drain current adjustment pin
- Internally matched and AC-coupled
- Frequency range: 10 GHz to 18 GHz
- Noise figure: 1 dB from 12 GHz to 15 GHz
- Gain: 27.5 dB from 12 GHz to 15 GHz
- Extended operating temperature range: −55°C to +125°C
- 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) benchmark characterization
  - Radiation lot acceptance test (RLAT) for production TID assurance
  - Single event latch-up (SEL) benchmark characterization
- Outgassing characterization

APPLICATIONS

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

GENERAL DESCRIPTION

The ADL8140-CSL is a low noise amplifier (LNA) that operates from 10 GHz to 18 GHz.

Typical gain and noise figure are 27.5 dB and 1 dB, respectively, from 12 GHz to 15 GHz. Output power for 1 dB compression (OP1dB) and output third-order intercept (OIP3), are 8 dBm and 23 dBm, respectively, from 12 GHz to 15 GHz. The nominal quiescent current (I_{DQ}), which can be adjusted, is 35 mA from a 1.5 V supply voltage (V_{DD}). The ADL8140-CSL also features inputs and outputs that are AC-coupled and internally matched to 50 Ω.

The ADL8140-CSL is housed in a RoHS-compliant, 2 mm × 2 mm, 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 ADL8140 data sheet.

FUNCTIONAL BLOCK DIAGRAM

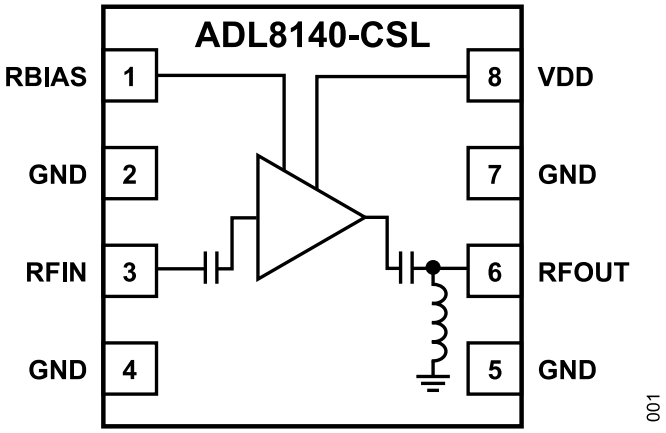

Figure 1. Functional Block Diagram

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REVISION HISTORY

11/2025—Rev. 0 to Rev. A

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Changes to Table 9 ... 5

11/2024—Revision 0: Initial Version

SPECIFICATIONS

10 GHz TO 12 GHz FREQUENCY RANGE

V_{DD} = 1.5 V, I_{DQ} = 35 mA, bias resistance (R_{BIAS}) = 562 Ω, and T_{CASE} = 25°C, unless otherwise noted.

Table 1. 10 GHz to 12 GHz Frequency Range Specifications

Parameter	Min	Typ	Max	Unit	Test Conditions/Comments
FREQUENCY RANGE	10		12	GHz	
GAIN	25	27		dB	
Gain Variation over Temperature		0.039		dB/°C	
NOISE FIGURE		0.95		dB	
RETURN LOSS					
Input (S11)		11		dB	
Output (S22)		12		dB	
OUTPUT					
OP1dB	4.5	6.5		dBm	
Saturated Output Power (P_{SAT})		8		dBm	
OIP3		18		dBm	Measurement taken at output power (P_{OUT}) per tone = −6 dBm
Second-Order Intercept (OIP2)		14		dBm	Measurement taken at P_{OUT} per tone = −6 dBm
POWER ADDED EFFICIENCY (PAE)		10		%	Measured at P_{SAT}

12 GHz TO 15 GHz FREQUENCY RANGE

V_{DD} = 1.5 V, I_{DQ} = 35 mA, R_{BIAS} = 562 Ω, and T_{CASE} = 25°C, unless otherwise noted.

Table 2. 12 GHz to 15 GHz Frequency Range Specifications

Parameter	Min	Typ	Max	Unit	Test Conditions/Comments
FREQUENCY RANGE	12		15	GHz	
GAIN	25.5	27.5		dB	
Gain Variation over Temperature		0.034		dB/°C	
NOISE FIGURE		1		dB	
RETURN LOSS					
S11		14		dB	
S22		14		dB	
OUTPUT					
OP1dB	6	8		dBm	
P_{SAT}		9.5		dBm	
OIP3		23		dBm	Measurement taken at P_{OUT} per tone = −6 dBm
OIP2		22		dBm	Measurement taken at P_{OUT} per tone = −6 dBm
PAE		14.3		%	Measured at P_{SAT}

SPECIFICATIONS

15 GHz TO 18 GHz FREQUENCY RANGE

V_{DD} = 1.5 V, I_{DQ} = 35 mA, R_{BIAS} = 562 Ω, and T_{CASE} = 25°C, unless otherwise noted.

Table 3. 15 GHz to 18 GHz Frequency Range Specifications

Parameter	Min	Typ	Max	Unit	Test Conditions/Comments
FREQUENCY RANGE	15		18	GHz	
GAIN	26	28		dB	
Gain Variation over Temperature		0.041		dB/°C	
NOISE FIGURE		1.1		dB	
RETURN LOSS					
S11		13		dB	
S22		10		dB	
OUTPUT					
OP1dB	6.5	8.5		dBm	
P_{SAT}		10.5		dBm	
OIP3		21.5		dBm	Measurement taken at P_{OUT} per tone = −6 dBm
OIP2		27		dBm	Measurement taken at P_{OUT} per tone = −6 dBm
PAE		17.2		%	Measured at P_{SAT}

DC SPECIFICATIONS

Table 4. DC Specifications

Parameter	Min	Typ	Max	Unit
SUPPLY CURRENT				
I_{DQ}		35		mA
Amplifier Current (I_{DQ_AMP})		33.3		mA
R_{BIAS} Current ($I_{R_{BIAS}}$)		1.7		mA
SUPPLY VOLTAGE				
V_{DD}	1.2	1.5	3.5	V

RADIATION TEST AND LIMIT SPECIFICATIONS

Electrical characteristics at V_{DD} = 1.5 V, I_{DQ} = 35 mA, R_{BIAS} = 562 Ω, and T_A = 25°C, unless otherwise noted.

Table 5. Radiation Test and Limit Specifications

Parameter	Min	Typ	Max	Unit
FREQUENCY RANGE	15		18	GHz
GAIN	26	28		dB
OUTPUT				
OP1dB	6.5	8.5		dBm
SUPPLY CURRENT				
I_{DQ}		35		mA
I_{DQ_AMP}		33.3		mA
I_{RBIAS}		1.7		mA
SUPPLY VOLTAGE				
V_{DD}	1.2	1.5	3.5	V

ABSOLUTE MAXIMUM RATINGS

Table 6. Absolute Maximum Ratings

Parameter	Rating
V_{DD}	4 V
RF Input Power (RFIN)	20 dBm
Continuous Power Dissipation (P_{DISS}) and T_{CASE} = 85°C (Derate 12.09 mW/°C Above 85°C)	1.09 W
Temperature	
Storage Range	−65°C to +150°C
Operating Range	−55°C to +125°C
Quiescent Channel (T_{CASE} = 85°C, V_{DD} = 1.5 V, I_{DQ} = 35 mA, and Input Power (P_{IN}) = Off)	89.34°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 7. Thermal Resistance[1]

Package Type	θ_{JC}	Unit
CP-8-30		
Quiescent, T_{CASE} = 25°C	68.4	°C/W
Worst Case[2], T_{CASE} = 85°C	82.7	°C/W

[1] Thermal resistance varies with operating conditions.

[2] 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 8. 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 9. Radiation Features

Specifications	Value	Unit
Maximum Total Dose Available (Dose Rate = 50 rads to 300 rads (Si)/sec)[1]	100	krads (Si)
No SEL Occurs at Effective Linear Energy Transfer (LET)[2]	≤80	MeV-cm^2/mg

[1] Guaranteed by device and process characterization. Contact Analog Devices, Inc, Technical Support for data available up to 100 krads.

[2] Limits are characterized at initial qualification and after any design or process changes that may affect the SEL characteristics but are not production lot tested.

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 ADL8140-CSL

Table 10. ADL8140-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

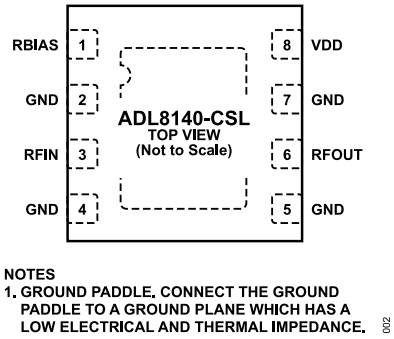

Figure 2. Pin Configuration

Table 11. 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 ADL8140 data sheet for more details.
2, 4, 5, 7	GND	Grounds. Connect these 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.
	GROUND PADDLE	Ground Paddle. Connect the ground paddle to a ground plane which has a low electrical and thermal impedance.

TYPICAL PERFORMANCE CHARACTERISTICS

See the ADL8140 data sheet for the typical performance characteristics plot.

OUTLINE DIMENSIONS

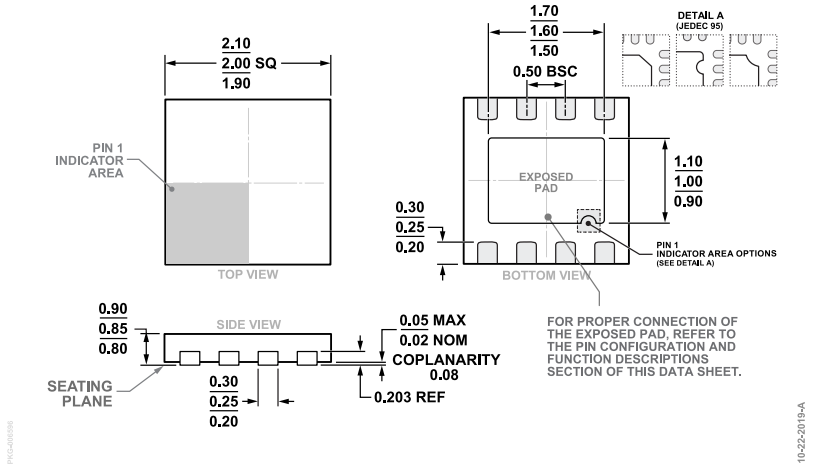

Figure 3. 8-Lead Lead Frame Chip Scale Package [LFCSP]
2 mm × 2 mm Body and 0.85 mm Package Height
(CP-8-30)
Dimensions shown in millimeters

ORDERING GUIDE

Model[1, 2]	Temperature Range	Package Description	Packing Quantity	Package Option
ADL8140ACPZN-CSL	−55°C to +125°C	8-Lead Lead Frame Chip Scale Package [LFCSP]	Tape, 1	CP-8-30
ADL8140ACPZN-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 the ADL8140ACPZN-CSL and ADL8140APCZN-R7-CSL is nickel palladium gold.