30kHz to 20GHz, Ultra-Wideband, Low Noise Amplifier

FEATURES

- Wideband operation: 30kHz to 20GHz
- Single positive supply (self biased): 3.3V and I_{DQ} = 55mA
- RBIAS drain current adjustment pin
- 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)
- Outgassing characterization

APPLICATIONS

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

GENERAL DESCRIPTION

The ADL8120-CSL is an ultra-wideband low noise amplifier (LNA) that operates from 30kHz to 20GHz. Typical gain and noise figure are 14dB and 1.9dB, respectively, from 30kHz to 14GHz. Output power for 1dB compression (OP1dB), output third-order intercept (OIP3), and output second-order intercept (OIP2) are 16dBm, 29.5dBm and 33dBm, respectively, from 30kHz to 14GHz. The nominal quiescent current (I_{DQ}), which can be adjusted, is 55mA from a 3.3V supply voltage (V_{DD}). The internally matched, DC-coupled RF input and output pins require external AC coupling capacitors along with a bias inductor on RFOUT. In addition, the RF input is biased through an external inductor connected between the VBIAS pin and the RFIN pin.

The ADL8120-CSL is fabricated on a pseudomorphic high electron mobility transistor (pHEMT) process. It is housed in a RoHS-compliant, 2 mm × 2 mm, 8-lead 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 ADL8120 data sheet.

FUNCTIONAL BLOCK DIAGRAM

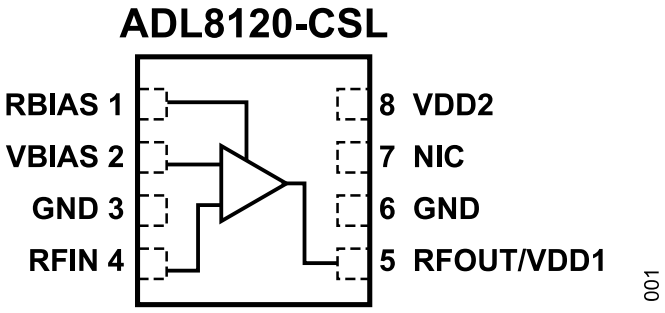

Figure 1. Functional Block Diagram

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REVISION HISTORY

1/2025—Revision 0: Initial Version

SPECIFICATIONS

30kHz TO 14GHz FREQUENCY RANGE

V_{DD} = 3.3V, I_{DQ} = 55mA, bias resistance (R_{BIAS}) = 542Ω, and T_{CASE} = 25°C, unless otherwise noted.

Table 1. 30kHz to 14GHz Frequency Range

Parameter	Min	Typ	Max	Unit	Test Conditions/Comments
FREQUENCY RANGE	0.00003		14	GHz	Refer to the Low Frequency Bias Tee section in the ADL8120 data sheet for the parameter coverage and operation down to the 30kHz range
GAIN	12	14		dB	
Gain Variation over Temperature		0.0213		dB/°C	
NOISE FIGURE		1.9		dB	
RETURN LOSS					
Input (S11)		14		dB	
Output (S22)		15		dB	
OUTPUT					
OP1dB	13.5	16		dBm	
Saturated Power (P_{SAT})		17.5		dBm	
OIP3		29.5		dBm	Measurement taken at output power (P_{OUT}) per tone = 0dBm
OIP2		33		dBm	Measurement taken at P_{OUT} per tone = 0dBm
POWER ADDED EFFICIENCY (PAE)		20.5		%	Measured at P_{SAT}

14GHz TO 20GHz FREQUENCY RANGE

V_{DD} = 3.3V, I_{DQ} = 55mA, R_{BIAS} = 542Ω, and T_{CASE} = 25°C, unless otherwise noted.

Table 2. 14GHz to 20GHz Frequency Range

Parameter	Min	Typ	Max	Unit	Test Conditions/Comments
FREQUENCY RANGE	14		20	GHz	
GAIN	13	15		dB	
Gain Variation over Temperature		0.022		dB/°C	
NOISE FIGURE		2.3		dB	
RETURN LOSS					
S11		8		dB	
S22		15		dB	
OUTPUT					
OP1dB	11	13.5		dBm	
P_{SAT}		16		dBm	
OIP3		26.5		dBm	Measurement taken at P_{OUT} per tone = 0dBm
OIP2		33		dBm	Measurement taken at P_{OUT} per tone = 0dBm
PAE		16		%	Measured at P_{SAT}

SPECIFICATIONS

DC SPECIFICATIONS

Table 3. DC Specifications

Parameter	Min	Typ	Max	Unit
SUPPLY CURRENT				
I_{DQ}		55		mA
Amplifier Current (I_{DQ_AMP})		51		mA
RBIAS Current (I_{RBIAS})		4		mA
SUPPLY VOLTAGE				
V_{DD}	3	3.3	3.6	V

RADIATION TEST AND LIMIT SPECIFICATIONS

Electrical characteristics at V_{DD} = 3.3V, I_{DQ} = 55mA, R_{BIAS} = 542Ω, and T_A = 25°C, unless otherwise noted.

Table 4. Radiation Test and Limit Specifications

Parameter	Min	Typ	Max	Unit
FREQUENCY RANGE	14		20	GHz
GAIN	13	15		dB
OUTPUT				
OP1dB	11	13.5		dBm
SUPPLY CURRENT				
I_{DQ}		55		mA
I_{DQ_AMP}		51		mA
I_{RBIAS}		4		mA
SUPPLY VOLTAGE				
V_{DD}	3	3.3	3.6	V

ABSOLUTE MAXIMUM RATINGS

Table 5. Absolute Maximum Ratings

Parameter	Rating
V_{DD}	5.5V
RF Input Power (RFIN)	28dBm
Continuous Power Dissipation (P_{DISS}), T_{CASE} = 85°C (Derate 10mW/°C Above 85°C)	0.9W
Temperature	
Storage Range	−65°C to +150°C
Operating Range	−55°C to +125°C
Quiescent Channel (T_{CASE} = 85°C, V_{DD} = 3.3V, I_{DQ} = 55mA, Input Power (P_{IN}) = Off)	103.15°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[1]

Package Type	θ_{JC}	Unit
CP-8-30		
Quiescent, T_{CASE} = 25°C	98	°C/W
Worst Case[2], T_{CASE} = 85°C	100	°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 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. Contact Analog Devices, Inc, Technical Support for data available up to 100krads.

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 ADL8120-CSL

Table 9. ADL8120-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

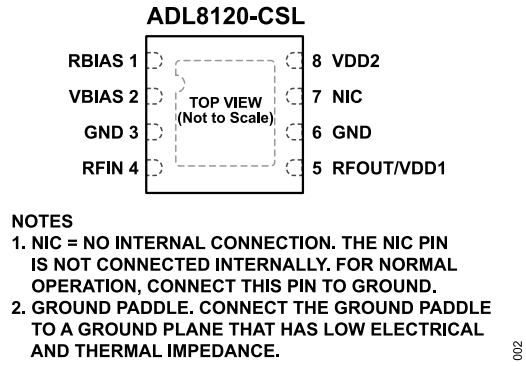

Figure 2. Pin Configuration

Table 10. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	RBIAS	Bias Setting Resistor. Connect a resistor between RBIAS and VDDx to set I_{DQ}. See the Typical Application Circuit and the Recommended Bias Values for V_{DD} = 3.3V table in the ADL8120 data sheet for more details.
2	VBIAS	Bias Setting Voltage Output. VBIAS sets the bias voltage for the RFIN pin. Connect VBIAS to RFIN using an inductor or ferrite bead as shown in Typical Application Circuit in the ADL8120 data sheet.
3, 6	GND	Ground. Connect to a ground plane that has low electrical and thermal impedance.
4	RFIN	RF Input. The RFIN pin is DC-coupled and matched to 50Ω.
5	RFOUT/VDD1	RF Output and Drain Bias Voltage. The RF output is DC-coupled and also serves as the drain biasing node. For the drain bias voltage, connect a DC bias network to provide the drain current and AC-couple the RF output path.
7	NIC	No Internal Connection. The NIC pin is not connected internally. For normal operation, connect this pin to ground.
8	VDD2	Drain Bias. Connect the VDD2 pin to a common supply with VDD1.
	GROUND PADDLE	Ground Paddle. Connect the ground paddle to a ground plane that has low electrical and thermal impedance.

TYPICAL PERFORMANCE CHARACTERISTICS

See the ADL8120 data sheet for the typical performance characteristics plot.

OUTLINE DIMENSIONS

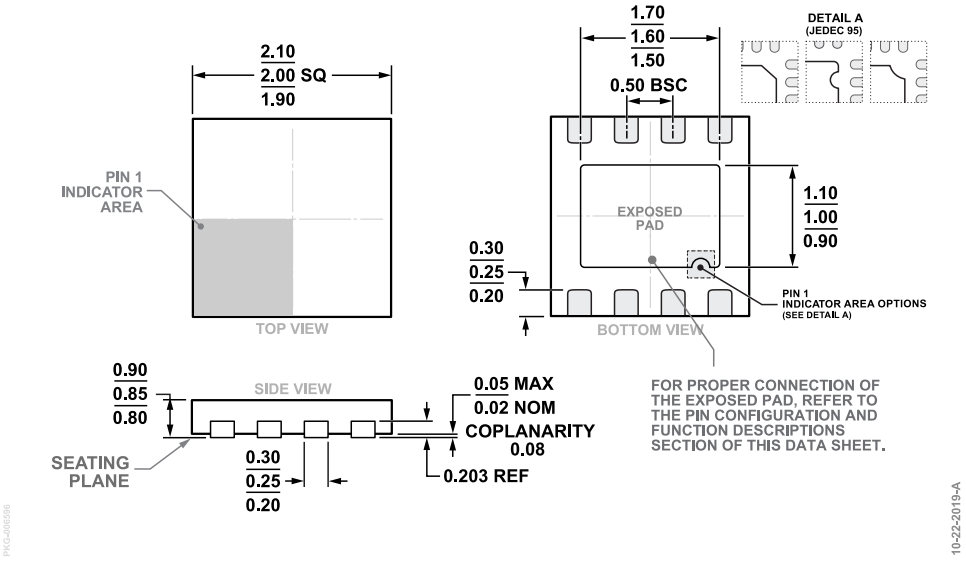

Figure 3. 8-Lead Lead Frame Chip Scale Package [LFCSP]
2 mm × 2 mm Body and 0.85 mm Package Height
(CP-8-30)
Dimensions shown in millimeters

Updated: April 02, 2024

ORDERING GUIDE

Model[1, 2]	Temperature Range	Package Description	Packing Quantity	Package Option
ADL8120ACPZN-CSL	−55°C to +125°C	8-lead LFCSP, 2 mm × 2 mm × 0.85 mm	Tape, 1	CP-8-30
ADL8120ACPZN-R7-CSL	−55°C to +125°C	8-lead LFCSP, 2 mm × 2 mm × 0.85 mm	Reel, 3000	CP-8-30

[1] Z = RoHS Compliant Part.

[2] The lead finish of the ADL8120ACPZN-CSL and the ADL8120ACPZN-R7-CSL is nickel palladium gold.