

### FEATURES

Complete multistage logarithmic amplifier  
 92 dB dynamic range:  $-75$  dBm to  $+17$  dBm  
 to  $-90$  dBm using matching network  
 Single supply of  $2.7$  V minimum at  $7.5$  mA typical  
 DC to  $500$  MHz operation,  $\pm 1$  dB linearity  
 Slope of  $25$  mV/dB, intercept of  $-84$  dBm  
 Highly stable scaling over temperature  
 Fully differential dc-coupled signal path  
 $100$  ns power-up time,  $150$   $\mu$ A sleep current

### APPLICATIONS

Conversion of signal level to decibel form  
 Transmitter antenna power measurement  
 Receiver signal strength indication (RSSI)  
 Low cost radar and sonar signal processing  
 Network and spectrum analyzers (to  $120$  dB)  
 Signal level determination down to  $20$  Hz  
 True decibel ac mode for multimeters

### GENERAL DESCRIPTION

The AD8307 is the first logarithmic amplifier made available in an 8-lead (SOIC\_N) package. It is a complete  $500$  MHz monolithic demodulating logarithmic amplifier based on the progressive compression (successive detection) technique, providing a dynamic range of  $92$  dB to  $\pm 3$  dB law-conformance and  $88$  dB to a tight  $\pm 1$  dB error bound at all frequencies up to  $100$  MHz. It is extremely stable and easy to use, requiring no significant external components. A single-supply voltage of  $2.7$  V to  $5.5$  V at  $7.5$  mA is needed, corresponding to an unprecedented power consumption of only  $22.5$  mW at  $3$  V. A fast acting CMOS-compatible control pin can disable the AD8307 to a standby current of less than  $150$   $\mu$ A.

Each of the cascaded amplifier/limiter cells has a small signal gain of  $14.3$  dB, with a  $-3$  dB bandwidth of  $900$  MHz. The input is fully differential and at a moderately high impedance ( $1.1$  k $\Omega$  in parallel with about  $1.4$  pF). The AD8307 provides a basic dynamic range extending from approximately  $-75$  dBm (where dBm refers to a  $50$   $\Omega$  source, that is, a sine amplitude of about  $\pm 56$   $\mu$ V) up to  $+17$  dBm (a sine amplitude of  $\pm 2.2$  V). A simple input matching network can lower this range to  $-88$  dBm to  $+3$  dBm. The logarithmic linearity is typically within  $\pm 0.3$  dB up to  $100$  MHz over the central portion of this range, and degrades

### FUNCTIONAL BLOCK DIAGRAM

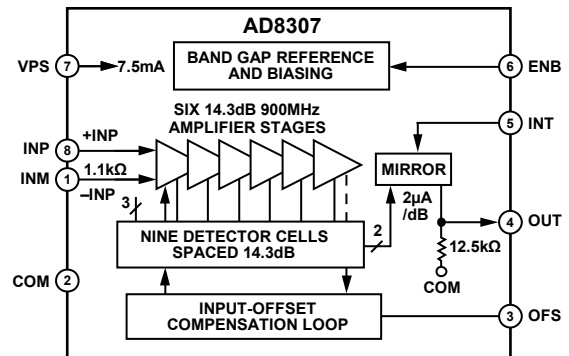


Figure 1.

01082-001

only slightly at  $500$  MHz. There is no minimum frequency limit. The AD8307 can be used at audio frequencies of  $20$  Hz or lower.

The output is a voltage scaled  $25$  mV/dB, generated by a current of nominally  $2$   $\mu$ A/dB through an internal  $12.5$  k $\Omega$  resistor. This voltage varies from  $0.25$  V at an input of  $-74$  dBm (that is, the ac intercept is at  $-84$  dBm, a  $20$   $\mu$ V rms sine input), up to  $2.5$  V for an input of  $+16$  dBm. This slope and intercept can be trimmed using external adjustments. Using a  $2.7$  V supply, the output scaling can be lowered, for example to  $15$  mV/dB, to permit utilization of the full dynamic range.

The AD8307 exhibits excellent supply insensitivity and temperature stability of the scaling parameters. The unique combination of low cost, small size, low power consumption, high accuracy and stability, very high dynamic range, and a frequency range encompassing audio through IF to UHF makes this product useful in numerous applications requiring the reduction of a signal to its decibel equivalent.

The AD8307 operates over the industrial temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , and is available in 8-lead SOIC and 8-lead PDIP packages.

### Rev. D

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

## SPECIFICATIONS

$V_S = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ ,  $R_L \geq 1\text{ M}\Omega$ , unless otherwise noted.

Table 1.

Parameter	Conditions	Min	Typ	Max	Unit
<b>GENERAL CHARACTERISTICS</b>					
Input Range ( $\pm 3\text{ dB}$ Error)	From noise floor to maximum input		92		dB
Input Range ( $\pm 1\text{ dB}$ Error)	From noise floor to maximum input		88		dB
Logarithmic Conformance	$f \leq 100\text{ MHz}$ , central 80 dB		$\pm 0.3$	$\pm 1$	dB
	$f = 500\text{ MHz}$ , central 75 dB		$\pm 0.5$		dB
Logarithmic Slope vs. Temperature	Unadjusted <sup>1</sup>	23	25	27	mV/dB
Logarithmic Intercept	Sine amplitude, unadjusted <sup>2</sup>	23		27	mV/dB
	Equivalent sine power in $50\ \Omega$		20		$\mu\text{V}$
		-87	-84	-77	dBm
vs. Temperature		-88		-76	dBm
Input Noise Spectral Density	Inputs shorted		1.5		nV/ $\sqrt{\text{Hz}}$
Operating Noise Floor	$R_{\text{SOURCE}} = 50\ \Omega/2$		-78		dBm
Output Resistance	Pin 4 to ground	10	12.5	15	k $\Omega$
Internal Load Capacitance			3.5		pF
Response Time	Small signal, 10% to 90%, 0 mV to 100 mV, $C_L = 2\text{ pF}$		400		ns
	Large signal, 10% to 90%, 0 V to 2.4 V, $C_L = 2\text{ pF}$		500		ns
Upper Usable Frequency			500		MHz
Lower Usable Frequency	AC-coupled input		10		Hz
<b>AMPLIFIER CELL CHARACTERISTICS</b>					
Cell Bandwidth	-3 dB		900		MHz
Cell Gain			14.3		dB
<b>INPUT CHARACTERISTICS</b>					
DC Common-Mode Voltage	AC-coupled input		3.2		V
Common-Mode Range	Either input (small signal)	-0.3	+1.6	$V_S - 1$	V
DC Input Offset Voltage <sup>3</sup>	$R_{\text{SOURCE}} \leq 50\ \Omega$		50	500	$\mu\text{V}$
	Drift		0.8		$\mu\text{V}/^\circ\text{C}$
Incremental Input Resistance	Differential		1.1		k $\Omega$
Input Capacitance	Either pin to ground		1.4		pF
Bias Current	Either input		10	25	$\mu\text{A}$
<b>POWER INTERFACES</b>					
Supply Voltage		2.7		5.5	V
Supply Current	$V_{\text{ENB}} \geq 2\text{ V}$		8	10	mA
Disabled	$V_{\text{ENB}} \leq 1\text{ V}$		150	750	$\mu\text{A}$

<sup>1</sup> This can be adjusted downward by adding a shunt resistor from the output to ground. A 50 k $\Omega$  resistor reduces the nominal slope to 20 mV/dB.

<sup>2</sup> This can be adjusted in either direction by a voltage applied to Pin 5, with a scale factor of 8 dB/V.

<sup>3</sup> Normally nulled automatically by internal offset correction loop and can be manually nulled by a voltage applied between Pin 3 and ground; see the Applications Information section.

## ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Ratings
Supply	7.5 V
Input Voltage (Pin 1 and Pin 8)	$V_{\text{SUPPLY}}$
Storage Temperature Range (N, R)	-65°C to +125°C
Ambient Temperature Range, Rated Performance Industrial, AD8307AN, AD8307AR	-40°C to +85°C
Lead Temperature Range (Soldering, 10 sec)	300°C

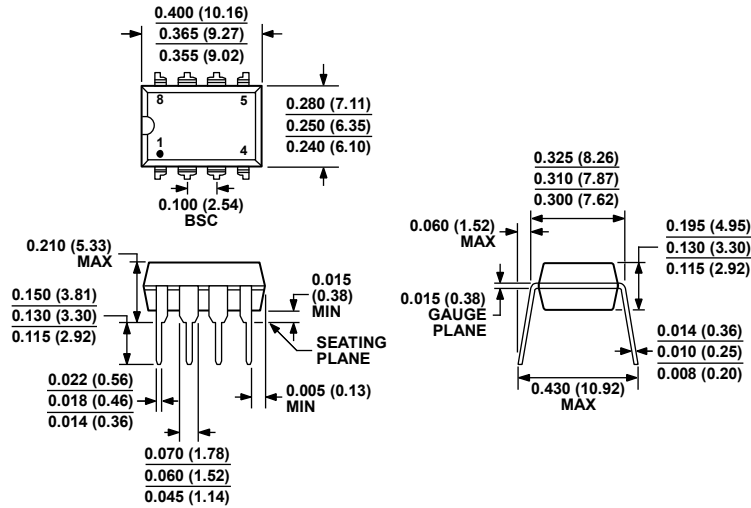
Stresses above those listed under Absolute Maximum Ratings can cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute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

### 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.

OUTLINE DIMENSIONS

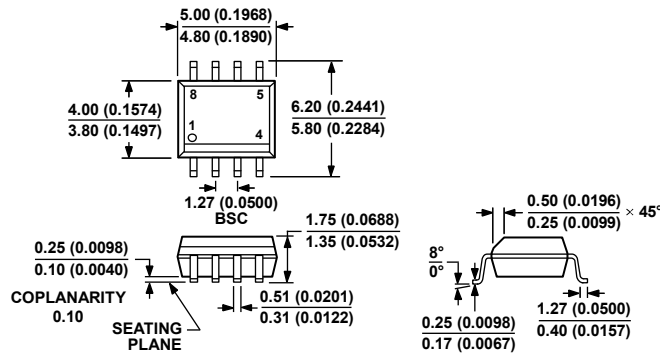


COMPLIANT TO JEDEC STANDARDS MS-001  
 CONTROLLING DIMENSIONS ARE IN INCHES; MILLIMETER DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF INCH EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN. CORNER LEADS MAY BE CONFIGURED AS WHOLE OR HALF LEADS.

Figure 45. 8-Lead Plastic Dual In-Line Package [PDIP] (N-8)

Dimensions shown in inches and (millimeters)

070606-A



COMPLIANT TO JEDEC STANDARDS MS-012-AA  
 CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN.

Figure 46. 8-Lead Standard Small Outline Package [SOIC\_N] Narrow Body (R-8)

Dimensions shown in millimeters and (inches)

012407-A

# AD8307

## ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
AD8307AN	-40°C to +85°C	8-Lead PDIP	N-8
AD8307ANZ <sup>1</sup>	-40°C to +85°C	8-Lead PDIP	N-8
AD8307AR	-40°C to +85°C	8-Lead SOIC_N	R-8
AD8307AR-REEL	-40°C to +85°C	8-Lead SOIC_N 13" Tape and Reel	R-8
AD8307AR-REEL7	-40°C to +85°C	8-Lead SOIC_N 7" Tape and Reel	R-8
AD8307ARZ <sup>1</sup>	-40°C to +85°C	8-Lead SOIC_N	R-8
AD8307ARZ-REEL <sup>1</sup>	-40°C to +85°C	8-Lead SOIC_N 13" Tape and Reel	R-8
AD8307ARZ-RL7 <sup>1</sup>	-40°C to +85°C	8-Lead SOIC_N 7" Tape and Reel	R-8

<sup>1</sup> Z = RoHS Compliant Part.

