General Purpose 70 MHz, DC Coupled VGA

Preliminary Technical Data

AD8336

FEATURES

Low Noise
- **Voltage noise = 3.2 nV/√Hz**
- **Current noise = 3 pA/√Hz**

Wide Bandwidth (-3 dB) = 100 MHz
Large Signal BW (2V p-p) = 70 MHz
Slew Rate 450V/µs, 2Vp-p
Gain Ranges (specified)
- **-14 to +46 dB, 0 to 60 dB**

Gain Scaling
- **50 dB/V**

DC Coupled
Single Ended Input and Output
Supplies: ±3V to ±12V
Low power: 150 mW @ ±3V

APPLICATIONS

Industrial Process Controls
High performance AGC systems
I/Q signal processing
Video
Industrial and Medical Ultrasound
Radar Receivers

FUNCTIONAL BLOCK DIAGRAM

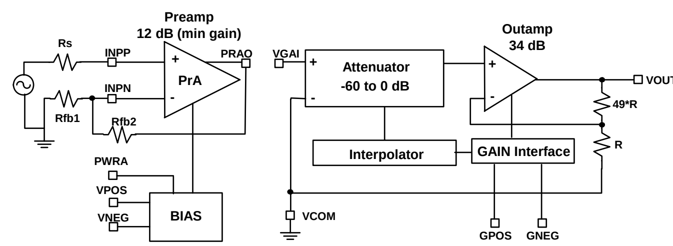

Figure 1. AD8336 Functional Block Diagram and Pinout

GENERAL DESCRIPTION

The AD8336 is a low noise single ended linear-in-dB, general purpose variable gain amplifier usable as a low noise variable gain element over a large supply voltage range. For example, at ±5V supplies, the part can be used for frequencies up to 70 MHz (2Vpp); the –3 dB bandwidth is 100 MHz; these values are for the lowest gain range (-14 to +46 dB).

The VGA has 60 dB of gain range and is intended for a broad spectrum of applications. Excellent bandwidth uniformity is maintained across the entire range. The gain control interface provides precise linear-in-dB scaling of 50 dB/V. Since the gain control input is differential it is easy to interface the gain control voltage to a variety of external circuits as long as they are within the devices' common voltage range.

The large voltage range makes the AD8336 particularly suited for industrial, medical, and for video applications. Dual supply operation enables gain control of negative-going pulses such as generated by photodiodes or photo-multiplier tubes. The AD8336 has an op-amp at its input which allows both inverting and non-inverting topologies and thereby a dual polarity VGA. The part can be used within the specified gain range of -14 to +46 dB by selecting the appropriate preamp gain from a minimum of 12 dB to a maximum of 26 dB. This is accomplished by simply choosing the correct feedback resistors.

The part also contains a power adjust pin, PWRA, with which the quiescent power of the part can be reduced by a factor of roughly two. This is especially useful for the highest supply voltage of ±12 V and at high temperatures, plus if the highest speed operation is not required.

The operating temperature range is –40°C to +125°C. The AD8336 is available in a 16 lead LFCSP (4x4 mm).

Rev. PrA

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REVISION HISTORY

Rev. PrA

AD8336—SPECIFICATIONS

Table 1. V_S = ±5 V, T_A = -55 to +125°C, Gain Range = -14 to +46 dB, PrA Gain = +12 dB, f = 5 MHz, C_L = 5 pF, R_L = 500 Ω, PWRA = GND unless otherwise specified.

Parameter	Conditions	Min	Typ	Max	Unit
GENERAL PARAMETERS					
–3 dB Small Signal Bandwidth	V_{OUT} = 10 mV p-p		100		MHz
–3 dB Large Signal Bandwidth	V_{OUT} = 2 V p-p		70		MHz
Slew Rate	V_{OUT} = 2 V p-p		450		V/µs
Input Voltage Noise			3.0		nV/√Hz
Input Current Noise			TBD		pA/√Hz
Output-Referred Noise	V_{GAIN} = 0.7 V (Gain = +46 dB)		600		nV/√Hz
	V_{GAIN} = -0.7 V (Gain = -14 dB)		190		nV/√Hz
Output Impedance	DC to 10 MHz		1		Ω
Output Signal Range	R_L ≥ 500 Ω (for $\|V_{SUPPLY}\|$ < 5V); R_L ≥ 1 kΩ above that		$\|V_{SUPPLY}\|$ - 2		V
Output Offset Voltage	V_{GAIN} = 0.7 V (Gain = +46 dB)	Min	±50	Max	mV
DYNAMIC PERFORMANCE					
Harmonic Distortion	V_{GAIN} = 0V, V_{OUT} = 1 Vpp				
HD2	f = 1 MHz		TBD		dBc
HD3			TBD		dBc
HD2	f = 10 MHz		TBD		dBc
HD3			TBD		dBc
Output 1 dB Compression Point	V_{GAIN} = -0.7 V, f = 10 MHz		TBD		dBm[1]
	V_{GAIN} = +0.7 V, f = 10 MHz		TBD		dBm
Two-Tone Intermodulation Distortion (IMD3)	V_{GAIN} = 0 V, V_{OUT} = 1 Vpp, f_1 = 1 MHz, f_2 = 1.1 MHz		TBD		dBc
	V_{GAIN} = 0, V_{OUT} = 1 Vpp, f_1 = 10 MHz, f_2 = 11 MHz		TBD		dBc
	V_{GAIN} = 0, V_{OUT} = 2 Vpp, f_1 = 1 MHz, f_2 = 1.1 MHz		TBD		dBc
	V_{GAIN} = 0, V_{OUT} = 2 Vpp, f_1 = 10 MHz, f_2 = 11 MHz		TBD		dBc
Output Third Order Intercept	V_{GAIN} = 0, V_{OUT} = 1 Vpp, f = 1 MHz		TBD		dBm
	V_{GAIN} = 0, V_{OUT} = 1 Vpp, f = 10 MHz		TBD		dBm
	V_{GAIN} = 0, V_{OUT} = 2 Vpp, f = 1 MHz		TBD		dBm
	V_{GAIN} = 0, V_{OUT} = 2 Vpp, f = 10 MHz		TBD		dBm
Overload Recovery	V_{GAIN} = 0.7 V, V_{IN} = TBD mV p-p		TBD		ns
Group Delay Variation	1 MHz < f < 10 MHz, Full Gain Range		±3		ns
ACCURACY					
Absolute Gain Error[2]	-0.7 V < V_{GAIN} < -0.6V	Min	TBD	Max	dB
	-0.6 V < V_{GAIN} < 0.6 V	Min	±0.3	Max	dB
	0.6 V < V_{GAIN} < 0.7V	Min	TBD	Max	dB
Gain Law Conformance[3]	-0.6 V < V_{GAIN} < 0.6 V, over temperature	N/A	N/A	N/A	dB
GAIN CONTROL INTERFACE					
Gain Scaling Factor			50		dB/V
Gain Range		Min	60	Max	dB
Input Voltage (V_{GAIN}) Range	No foldover	$-V_S$		$+V_S$	V
Input Impedance			TBD		MΩ
Response Time	60 dB Gain Change		TBD		ns
POWER SUPPLY					
Supply Voltage Operating Range		±3		±12	V
Quiescent Current	Vsupply between ± 3 V and ± 5 V	Min	25	Max	mA
Power Dissipation	Vsupply = ± 3 V		150		mW
PSRR	V_{GAIN} = 0.7 V, f = 10 MHz		TBD		dB

[1] All dBm values are calculated with 50 Ω reference, unless otherwise noted.
[2] Conformance to theoretical gain expression (see Equation 1).
[3] Conformance to best fit dB linear curve.

Parameter	Conditions	Min	Typ	Max	Unit
Quiescent Current	Vsupply = ± 12 V		28		mA
Power Dissipation	Vsupply = ± 12 V		670		mW
PSRR	V_{GAIN} = 0.7 V, f = 10 MHz		TBD		dB

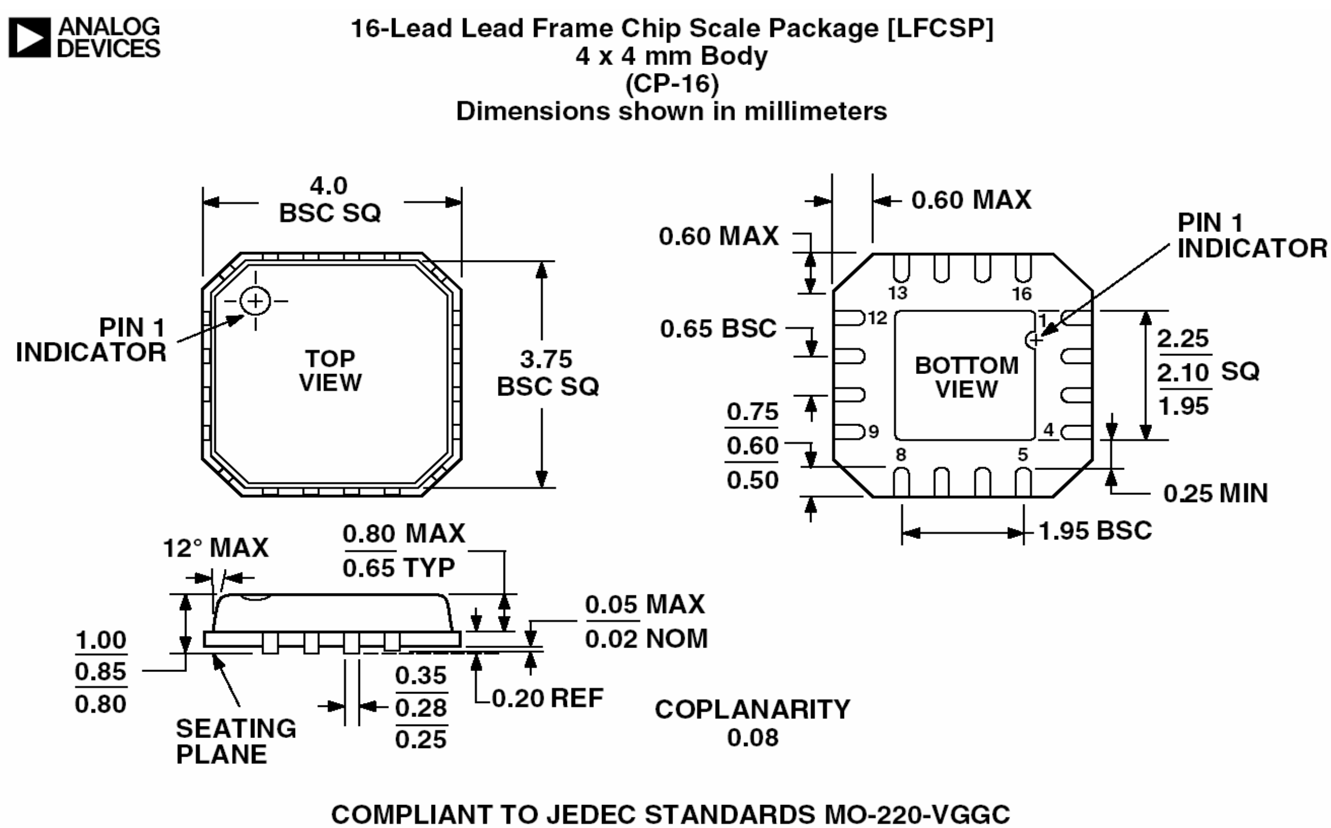
ABSOLUTE MAXIMUM RATINGS

Table 2. Absolute Maximum Ratings

Parameter	Rating
Voltage	
Supply Voltage (VPOS, VNEG)	±13V
Input Voltage (INPx)	TBD V
GAIN Voltage	VPOS, VNEG
Power Dissipation	TBD W
Temperature	
Operating Temperature	–40°C to +125°C
Storage Temperature	–65°C to +150°C
Lead Temperature (Soldering 60 sec)	300°C
θ_{JA}	
16-LFCSP (4 x 4 mm) Package[4]	58°C/W

[4] Four-Layer JEDEC Board (2S2P).

Stresses above those listed under the Absolute Maximum Ratings may 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 may affect device reliability.



ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTIONAL DESCRIPTIONS

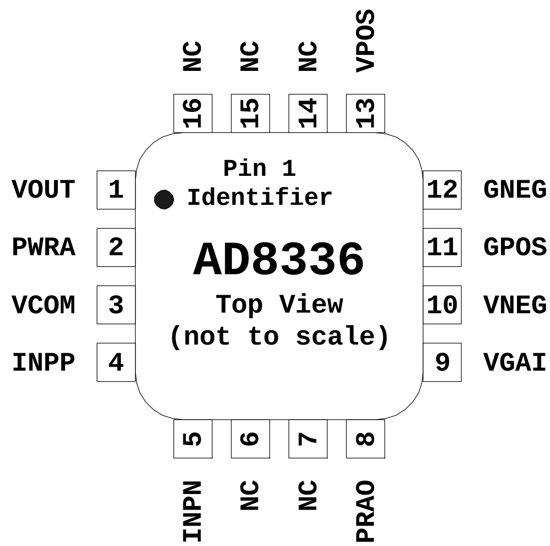


Figure 1. 16 LFCSP

Table 3. Pin Function Descriptions

Pin No.	Mnemonic	Function
1	**VOUT**	Output Voltage
2	**PWRA**	Power Control, allows quiescent power to be reduced by a factor-of-two
3	**VCOM**	Commom-Mode Voltage (Normally GND when using a dual supply)
4	**INPP**	Positive Input to Preamp
5	**INPN**	Negative Input to Preamp
6	**NC**	No Connect
7	**NC**	No Connect
8	**PRAO**	Preamp Output
9	**VGAI**	VGA Input
10	**VNEG**	Negative Supply
11	**GPOS**	Positive Gain Control Input
12	**GNEG**	Negative Gain Control Input
13	**VPOS**	Positive Supply
14	**NC**	No Connect
15	**NC**	No Connect
16	**NC**	No Connect