

### FEATURES

- 4 to 20dB Gain Range
- 1 dB Step Size  $\pm 0.2$  dB
- Differential input and output
  - 150  $\Omega$  Differential Input
  - Open Collector Differential Output
- 8dB noise figure @ maximum gain
- OIP3 of  $\sim 50$ dBm at 140MHz
- 3 dB bandwidth of 690 MHz
- Parallel 5-bit Control Interface
- Wide input dynamic range
- Power-down feature
- Single 5V Supply Operation
- 24 Lead LFCSP 4 x 4 mm Package

### APPLICATIONS

- Differential ADC drivers
- High IF Sampling Receivers
- High Output Power IF Amplification
- Instrumentation

### GENERAL DESCRIPTION

The AD8375 is a digitally controlled, variable gain wide bandwidth amplifier that provides precise gain control, high IP3 and low noise figure. The excellent distortion performance and high signal bandwidth makes the AD8375 an excellent gain control device for a variety of receiver applications.

For wide input dynamic range applications, the AD8375 provides a broad 24dB gain range with 1 dB resolution. The gain is adjusted through a 5-pin control interface and can be driven using standard TTL levels. The open-collector outputs provide a flexible interface, allowing the overall signal gain to be set by the loading resistance. The AD8375 offers a maximum transconductance gain of  $67 \text{ m}\Omega^{-1}$ 's, resulting in a signal gain of 20dB when driving a 150-Ohm load. The maximum signal gain increases to  $\sim 24$ dB when driving a 250-Ohm differential load.

### FUNCTIONAL BLOCK DIAGRAM

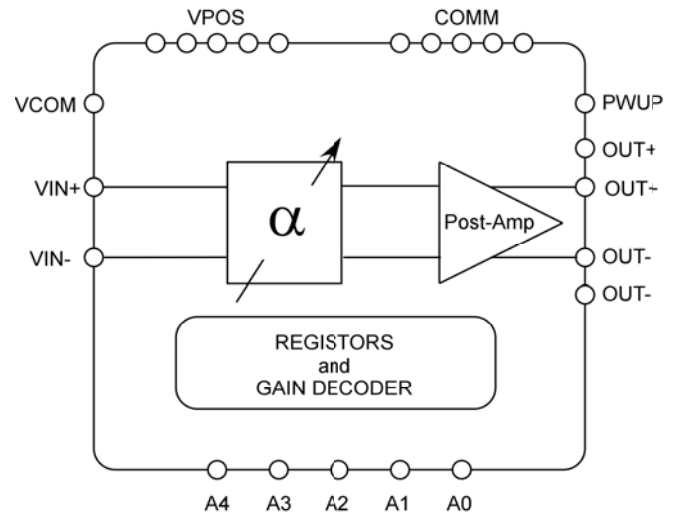


Figure 1.

Using a high speed SiGe process and incorporating proprietary distortion cancellation techniques, the AD8375 achieves 50 dBm output IP3 at 140 MHz.

The AD8375 is powered on by applying the appropriate logic level to the PWUP pin. The quiescent current of the AD8375 is typically 130mA. When powered down, the AD8375 consumes less than 5mA and offers excellent input to output isolation. The gain setting is preserved when powered down.

Fabricated on an ADI's high speed SiGe process, the AD8375 provides precise gain adjustment capabilities with good distortion performance. The AD8375 amplifier comes in a compact, thermally enhanced 4 x 4mm 24-lead LFCSP package and operates over the temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

## SPECIFICATIONS

$V_S = 5\text{ V}$ ,  $T = 25^\circ\text{C}$ ,  $Z_S = Z_L = 150\Omega$  at 100MHz, 2 V p-p differential output unless otherwise noted.

Table 1.

Parameter	Conditions	Min	Typ	Max	Unit
<b>DYNAMIC PERFORMANCE</b>					
-3 dB Bandwidth	$V_{OUT} < 2\text{ V p-p}$ (5.2dBm)		690		MHz
Slew Rate			TBD		V/nsec
<b>INPUT STAGE</b>					
Maximum Input Swing	Pins VIN+ and VIN- For linear operation ( $A_v = 0\text{dB}$ )		TBD		V p-p
Differential Input Resistance	Differential		150		$\Omega$
Common-Mode Input Voltage			2		V
CMRR	Gain Code = 00000		TBD		dB
<b>GAIN</b>					
Amplifier Transconductance		0.58	0.067	0.076	$\Omega^{-1}$
Maximum Voltage Gain	Gain Code = 00000		20		dB
Minimum Voltage Gain	Gain Code $\geq 11000$	-5.5	-4	-2.5	dB
Gain Step Size	From Gain Code 00000 to 11000	0.8	1.0	1.2	dB
Gain Flatness	Gain Code = 00000 over 20% fractional bandwidth for $f_c < 200\text{MHz}$		TBD		dB
Gain Temperature Sensitivity	Gain Code = 00000		TBD		mdB/ $^\circ\text{C}$
Gain Step Response	For $V_{IN} = 0.2\text{V}$ , Gain Code 10100 to 00000		TBD		ns
<b>OUTPUT STAGE</b>					
Output Voltage Swing	Pins OUT+ and OUT- At P1dB, Gain Code = 00000		10		V p-p
Output impedance	Differential		5k//1		$\Omega/\text{pF}$
<b>NOISE/HARMONIC PERFORMANCE</b>					
46 MHz					
Noise Figure	Gain Code = 00000		8.5		dB
Second Harmonic	$V_{OUT} = 2\text{ V p-p}$		-94		dBc
Third Harmonic	$V_{OUT} = 2\text{ V p-p}$		-92		dBc
Output IP3	2 MHz spacing, +3 dBm per tone		50		dBm
Output 1 dB Compression Point			19		dBm
70 MHz					
Noise Figure	Gain Code = 00000		8.5		dB
Second Harmonic	$V_{OUT} = 2\text{ V p-p}$		-94		dBc
Third Harmonic	$V_{OUT} = 2\text{ V p-p}$		-92		dBc
Output IP3	2 MHz spacing, +3 dBm per tone		50		dBm
Output 1 dB Compression Point			19		dBm
140 MHz					
Noise Figure	Gain Code = 00000		8.5		dB
Second Harmonic	$V_{OUT} = 2\text{ V p-p}$		-86		dBc
Third Harmonic	$V_{OUT} = 2\text{ V p-p}$		-91		dBc
Output IP3	2 MHz spacing, +3 dBm per tone		50		dBm
Output 1 dB Compression Point			19		dBm

Parameter	Conditions	Min	Typ	Max	Unit
200 MHz	Gain Code = 00000				
Noise Figure			8.5		dB
Second Harmonic	$V_{OUT} = 2\text{ V p-p}$		-85		dBc
Third Harmonic	$V_{OUT} = 2\text{ V p-p}$		-88		dBc
Output IP3	2 MHz spacing, +3 dBm per tone		50		dBm
Output 1 dB Compression Point			18		dBm
<b>POWER-INTERFACE</b>					
Supply Voltage		4.5		5.5	V
Quiescent Current per Channel	thermal connection made to exposed paddle under device		130	140	mA
vs. Temperature	$-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$			165	mA
Power Down Current	PWUP Low		3		mA
vs. Temperature	$-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$			TBD	mA
<b>ENABLE INTERFACE</b>					
Enable Threshold	Pin PWUP			1.6	V
PWUP Input Bias Current	Minimum voltage to enable the device		0.5		nA
<b>GAIN CONTROL INTERFACE</b>					
$V_{IH}$	Pins A0, A1, A2, A3, A4	1.6			V
$V_{IL}$	Minimum voltage for a logic high			0.8	
Maximum Input Bias Current	Maximum voltage for a logic low		900		nA

**Table 2. Gain-Code versus Voltage Gain Look-Up Table**

5-Bit Binary Gain Code	Voltage Gain (dB)	5-Bit Binary Gain Code	Voltage Gain (dB)
00000	20	01101	7
00001	19	01110	6
00010	18	01111	5
00011	17	10000	4
00100	16	10001	3
00101	15	10010	2
00110	14	10011	1
00111	13	10100	0
01000	12	10101	-1
01001	11	10110	-2
01010	10	10111	-3
01011	9	11000	-4
01100	8	>11000	-4

## ABSOLUTE MAXIMUM RATINGS

Parameter	Rating
Supply Voltage, $V_{POS}$	5.5 V
PWUP, A0, A1, A2, A3, A4	-0.6 to ( $V_{POS} + 0.6V$ )
Input Voltage, $V_{IN+}$ , $V_{IN-}$	-0.6 to +3.1V
Internal Power Dissipation	TBD mW
$\theta_{JA}$ (Exposed paddle soldered down)	TBD°C/W
$\theta_{JA}$ (Exposed paddle not soldered down)	TBD°C/W
$\theta_{JC}$ (At exposed paddle)	TBD°C/W
Maximum Junction Temperature	TBD°C
Operating Temperature Range	-40°C to +85°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature Range (Soldering 60 sec)	TBD°C

Stresses above those listed under 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 listed in the operational sections 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

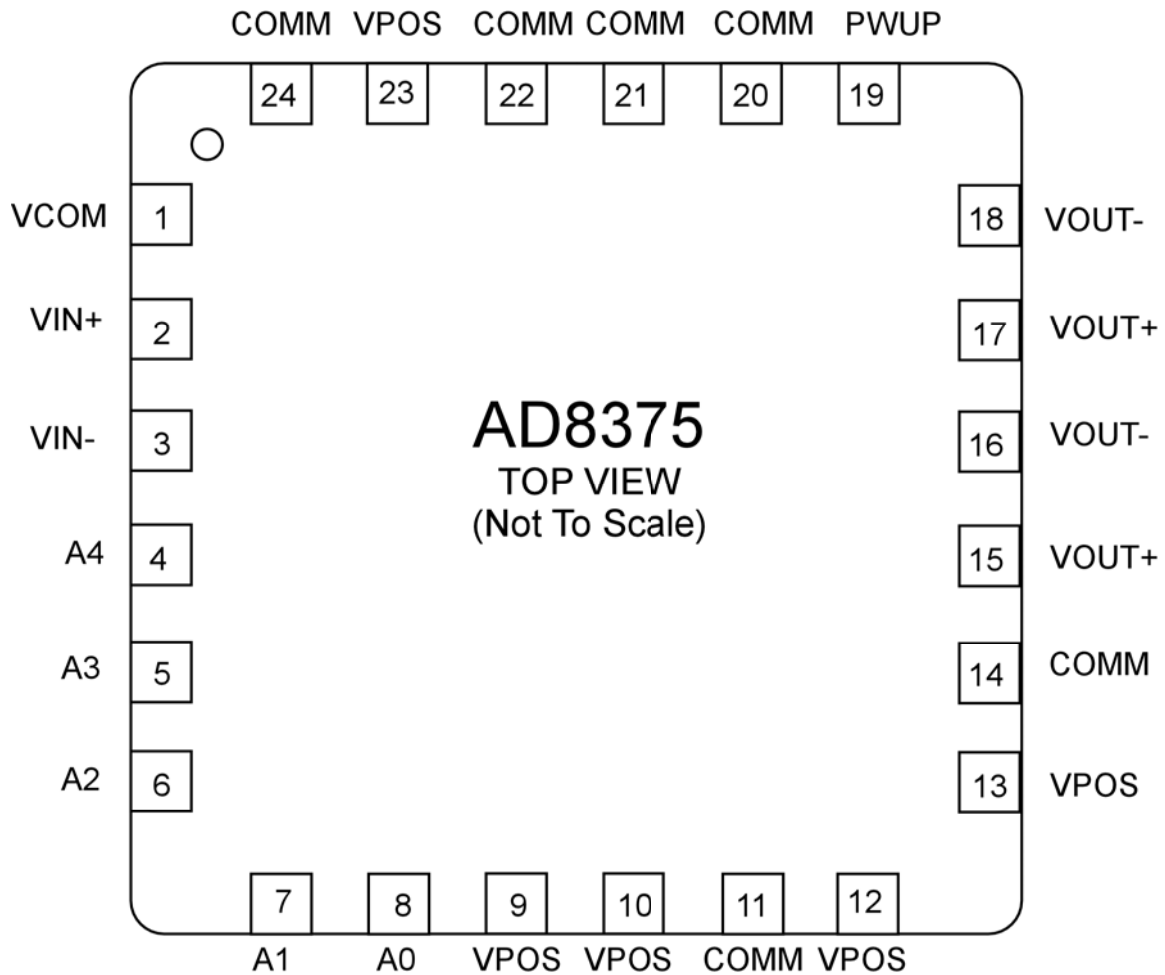


Figure 2. 24 Lead LFCSP

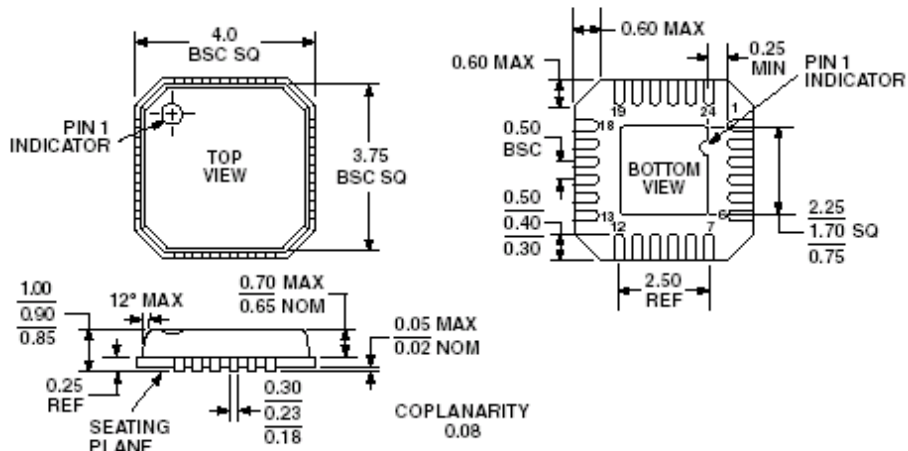
Table 3. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	VCOM	Common Mode Pin. Typically bypassed to ground using external capacitor.
2	VIN+	Voltage Input Positive.
3	VIN-	Voltage Input Negative.
4	A4	The Most Significant Bit (MSB) for the 5-bit Gain Control Interface.
5	A3	MSB-1 for the Gain Control Interface.
6	A2	MSB-2 for the Gain Control Interface.
7	A1	LSB+1 for the Gain Control Interface.
8	A0	The Least Significant Bit (LSB) for the 5-bit Gain Control Interface.
9, 10, 12, 13, 23	VPOS	Positive Supply Pins. Should be bypassed to Ground using suitable bypass capacitor.
11, 14, 20, 21, 22, 24	COMM	Device Common (DC Ground).
15, 17	VOUT+	Positive Ouptut Pins (Open Collector). Require DC bias of +5V nominal.
16, 18	VOUT-	Negative Ouptut Pins (Open Collector). Require DC bias of +5V nominal.
19	PWUP	Chip Enable Pin.

OUTLINE DIMENSIONS

24-Lead Frame Chip Scale Package [LFCSP]  
 4 mm x 4 mm Body  
 (CP-24)

Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-220-VGGD-2

Figure 2. 24-Lead LFCSP

ORDERING GUIDE

Model	Temperature	Package Description	Package Option
AD8375ACPZ-WP	-40°C to +85°C	Waffle Pack, 24 Lead Frame Chip Scale Package	CP-24
AD8375ACPZ-REEL7	-40°C to +85°C	7" Reel, 24 Lead Frame Chip Scale Package	CP-24
AD8375-EVALZ		Evaluation Board	