

## FEATURES

### Superb clamping characteristics

- 3 mV clamp error
- 1.5 ns overdrive recovery
- Minimized nonlinear clamping region
- 240 MHz clamp input bandwidth
- $\pm 3.9$  V clamp input range

### Wide bandwidth

- Small signal: 270 MHz
- Large signal (4 V p-p): 190 MHz

### Good dc characteristics

- 2 mV offset
- 10  $\mu$ V/ $^{\circ}$ C drift

### Ultralow distortion, low noise

- 72 dBc typical at 20 MHz
- 4.5 nV/ $\sqrt{\text{Hz}}$  input voltage noise

### High speed

- Slew rate 1500 V/ $\mu$ s
- Settling 10 ns to 0.1%, 16 ns to 0.01%
- $\pm 3$  V to  $\pm 5$  V supply operation

## ENHANCED PRODUCT FEATURES

Supports defense and aerospace applications (AQEC standard)

Extended industrial temperature range:  $-55^{\circ}\text{C}$  to  $+105^{\circ}\text{C}$

Controlled manufacturing baseline

One assembly/test site

One fabrication site

Product change notification

Qualification data available on request

## APPLICATIONS

ADC buffer

IF/RF signal processing

High quality imaging

Broadcast video systems

Video amplifier

Full wave rectifier

## GENERAL DESCRIPTION

The **AD8037-EP** is a wide bandwidth, low distortion clamping amplifier. The **AD8037-EP** is stable at a gain of two or greater. This device allows the designer to specify a high ( $V_{CH}$ ) and low ( $V_{CL}$ ) output clamp voltage. The output signal clamps at these specified levels. Utilizing a unique patent pending CLAMPING™ input clamp architecture, the **AD8037-EP** offers a 10 $\times$  improvement in clamp performance compared to traditional output clamping devices. In particular, clamp error is typically 3 mV or less and distortion in the clamp region is minimized. This product can be used as a classical op amp or clamp amplifier.

Rev. 0

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## FUNCTIONAL BLOCK DIAGRAM

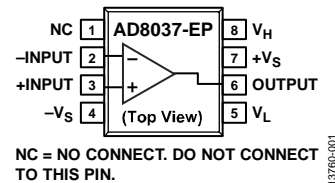


Figure 1.

13760-001

The **AD8037-EP**, which utilizes a voltage feedback architecture, meets the requirement of many applications which previously depended on current feedback amplifiers. The **AD8037-EP** exhibits an exceptionally fast and accurate pulse response (16 ns to 0.01%), extremely wide small-signal and large-signal bandwidths and ultralow distortion. The **AD8037-EP** recovers from 2 $\times$  clamp overdrive within 1.5 ns. These characteristics position the **AD8037-EP** ideally for driving as well as buffering flash and high resolution ADCs.

In addition to traditional output clamp amplifier applications, the input clamp architecture supports the clamp levels as additional input to the amplifier. As such, in addition to static dc clamp levels, signals with speeds up to 240 MHz can be applied to the clamp pins. The clamp values can be set to any value within the output voltage range provided that  $V_H$  is greater than  $V_L$ . Due to these clamp characteristics, the **AD8037-EP** can be used in nontraditional applications such as a full wave rectifier, a pulse generator, or an amplitude modulator. These novel applications are only examples of some of the diverse applications which can be designed with input clamps.

Additional application and technical information can be found in the **AD8037** data sheet.

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**REVISION HISTORY**

6/2016—Revision 0: Initial Version

## SPECIFICATIONS

$V_S = \pm 5\text{ V}$ ,  $R_L = 100\ \Omega$ , gain = +2,  $V_H$ ,  $V_L$  open unless otherwise noted.

Table 1.

Parameter	Test Conditions/Comments	Min	Typ	Max	Unit
<b>DYNAMIC PERFORMANCE</b>					
Bandwidth (−3 dB)					
Small Signal	$V_{OUT} \leq 0.4\text{ V p-p}$	200	270		MHz
Large Signal <sup>1</sup>	$V_{OUT} = 3.5\text{ V p-p}$	160	190		MHz
Bandwidth for 0.1 dB Flatness	$V_{OUT} \leq 0.4\text{ V p-p}$ , $R_F = 274\ \Omega$		130		MHz
Slew Rate, Average $\pm$	$V_{OUT} = 4\text{ V step}$ , 10% to 90%	1100	1500		V/ $\mu\text{s}$
Rise/Fall Time	$V_{OUT} = 0.5\text{ V step}$ , 10% to 90%		1.2		ns
	$V_{OUT} = 4\text{ V step}$ , 10% to 90%		2.2		ns
Setting Time					
To 0.1%	$V_{OUT} = 2\text{ V step}$		10		ns
To 0.01%	$V_{OUT} = 2\text{ V step}$		16		ns
<b>NOISE/HARMONIC PERFORMANCE</b>					
Second Harmonic Distortion	2 V p-p, 20 MHz, $R_L = 100\ \Omega$		−52	−45	dBc
	$R_L = 500\ \Omega$		−72	−65	dBc
Third Harmonic Distortion	2 V p-p, 20 MHz, $R_L = 100\ \Omega$		−70	−63	dBc
	$R_L = 500\ \Omega$		−80	−73	dBc
Third-Order Intercept	25 MHz		41		dBm
Noise Figure	$R_S = 50\ \Omega$		14		dB
Input Voltage Noise	1 MHz to 200 MHz		4.5		nV/ $\sqrt{\text{Hz}}$
Input Current Noise	1 MHz to 200 MHz		2.1		pA/ $\sqrt{\text{Hz}}$
Average Equivalent Integrated Input Noise Voltage	0.1 MHz to 200 MHz		60		$\mu\text{V rms}$
Differential Gain Error (3.58 MHz)	$R_L = 150\ \Omega$		0.02	0.04	%
Differential Phase Error (3.58 MHz)	$R_L = 150\ \Omega$		0.02	0.04	Degrees
Phase Nonlinearity	DC to 100 MHz		1.1		Degrees
<b>CLAMP PERFORMANCE</b>					
Clamp Voltage Range <sup>1</sup>	$V_{CH}$ or $V_{CL}$	$\pm 3.3$	$\pm 3.9$		V
Clamp Accuracy	2 $\times$ overdrive, $V_{CH} = 2\text{ V}$ , $V_{CL} = -2\text{ V}$		$\pm 3$	$\pm 10$	mV
	$T_{MIN}$ to $T_{MAX}$			$\pm 20$	mV
Clamp Nonlinearity Range <sup>2</sup>			100		mV
Clamp Input Bias Current ( $V_H$ or $V_L$ )	$V_H$ , $V_L = \pm 0.5\text{ V}$		$\pm 50$	$\pm 70$	$\mu\text{A}$
	$T_{MIN}$ to $T_{MAX}$			$\pm 90$	$\mu\text{A}$
Clamp Input Bandwidth (−3 dB)	$V_{CH}$ or $V_{CL} = 2\text{ V p-p}$	180	270		MHz
Clamp Overshoot	2 $\times$ overdrive, $V_{CH}$ or $V_{CL} = 2\text{ V p-p}$		1	5	%
Overdrive Recovery	2 $\times$ overdrive		1.3		ns
<b>DC PERFORMANCE<sup>3</sup>, <math>R_L = 150\ \Omega</math></b>					
Input Offset Voltage <sup>4</sup>			2	7	mV
	$T_{MIN}$ to $T_{MAX}$			10	mV
Offset Voltage Drift			$\pm 10$		$\mu\text{V}/^\circ\text{C}$
Input Bias Current			3	9	$\mu\text{A}$
	$T_{MIN}$ to $T_{MAX}$			15	$\mu\text{A}$
Input Offset Current			0.1	3	$\mu\text{A}$
	$T_{MIN}$ to $T_{MAX}$			5	$\mu\text{A}$
Common-Mode Rejection Ratio	$V_{CM} = \pm 2\text{ V}$	70	90		dB
Open-Loop Gain	$V_{OUT} = \pm 2.5\text{ V}$	54	60		dB
	$T_{MIN}$ to $T_{MAX}$	46			dB

Parameter	Test Conditions/Comments	Min	Typ	Max	Unit
INPUT CHARACTERISTICS					
Input Resistance			500		k $\Omega$
Input Capacitance			1.2		pF
Input Common-Mode Voltage Range			$\pm 2.5$		V
OUTPUT CHARACTERISTICS					
Output Voltage Range, $R_L = 150 \Omega$		$\pm 3.2$	$\pm 3.9$		V
Output Current			70		mA
Output Resistance			0.3		$\Omega$
Short Circuit Current			240		mA
POWER SUPPLY					
Operating Range		$\pm 3.0$	$\pm 5.0$	$\pm 6.0$	V
Quiescent Current			18.5	19.5	mA
	$T_{MIN}$ to $T_{MAX}$			24	mA
Power Supply Rejection Ratio	$T_{MIN}$ to $T_{MAX}$	56	66		dB

<sup>1</sup> See the Absolute Maximum Ratings section.

<sup>2</sup> Nonlinearity is defined as the voltage delta between the set input clamp voltage ( $V_H$  or  $V_L$ ) and the voltage at which  $V_{OUT}$  starts deviating from  $V_{IN}$ .

<sup>3</sup> Measured at  $A_v = 50$ .

<sup>4</sup> Measured with respect to the inverting input

## ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Supply Voltage	12.6 V
Power Dissipation	See Figure 2
Voltage Swing $\times$ Bandwidth Product	350 V-MHz
Common-Mode Input Voltage	$\pm V_S$
$ V_H - V_{IN} $	$\leq 6.3$ V
$ V_L - V_{IN} $	$\leq 6.3$ V
Differential Input Voltage	$\pm 1.2$ V
Storage Temperature Range	$-65^\circ\text{C}$ to $+125^\circ\text{C}$
Operating Temperature Range	$-55^\circ\text{C}$ to $+105^\circ\text{C}$
Lead Temperature (Soldering, 10 sec)	$300^\circ\text{C}$

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.

Table 3. Thermal Resistance

Package Type	$\theta_{JA}$	Unit
R-8	155	$^\circ\text{C}/\text{W}$

### MAXIMUM POWER DISSIPATION

The maximum power that can be safely dissipated by these devices is limited by the associated rise in junction temperature. The maximum safe junction temperature for plastic encapsulated devices is determined by the glass transition temperature of the plastic, approximately  $150^\circ\text{C}$ . Exceeding this limit temporarily may cause a shift in parametric performance due to a change in the stresses exerted on the die by the package. Exceeding a junction temperature of  $175^\circ\text{C}$  for an extended period can result in device failure.

Although the AD8037-EP is internally short-circuit protected, this may not be sufficient to guarantee that the maximum junction temperature ( $150^\circ\text{C}$ ) is not exceeded under all conditions. To ensure proper operation, it is necessary to observe the maximum power derating curves.

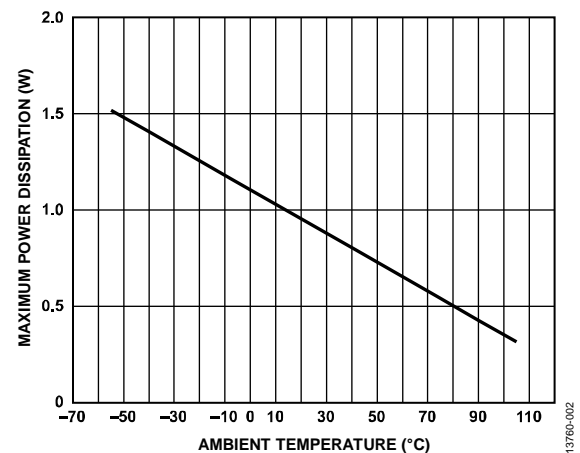


Figure 2. Maximum Power Dissipation vs. Ambient Temperature

### 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 CONFIGURATIONS AND FUNCTION DESCRIPTIONS

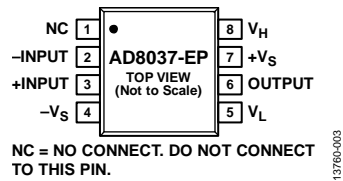


Figure 3. Pin Configuration

Table 4. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	NC	No Connect
2	-INPUT	Inverting Input
3	+INPUT	Noninverting Input
4	-Vs	Negative Supply
5	VL	Low Clamping Voltage
6	OUTPUT	Output
7	+Vs	Positive Supply
8	VH	High Clamping Voltage

# TYPICAL PERFORMANCE CHARACTERISTICS

$V_S = \pm 5\text{ V}$ ,  $R_L = 150\ \Omega$ ,  $T_A = -55^\circ\text{C}$  to  $+105^\circ\text{C}$ , unless otherwise noted.

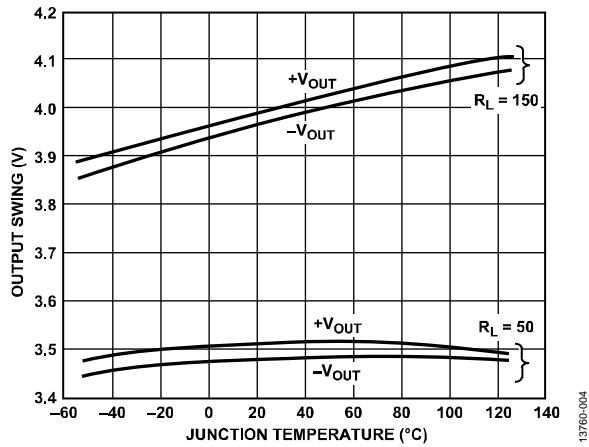


Figure 4. Output Swing vs. Junction Temperature

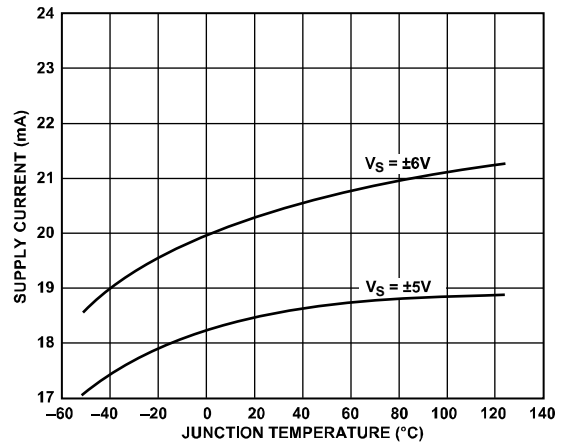


Figure 7. Supply Current vs. Junction Temperature

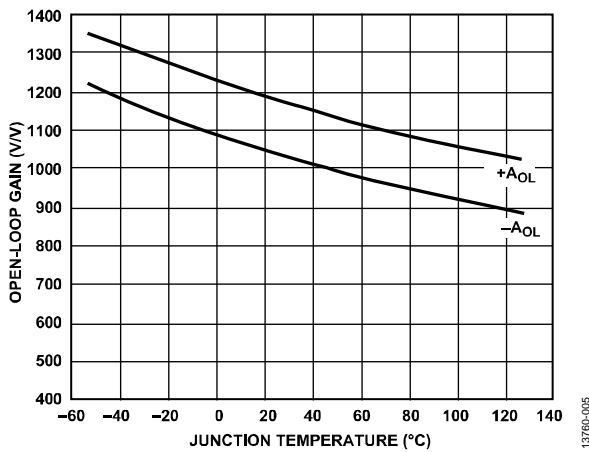


Figure 5. Open-Loop Gain vs. Junction Temperature

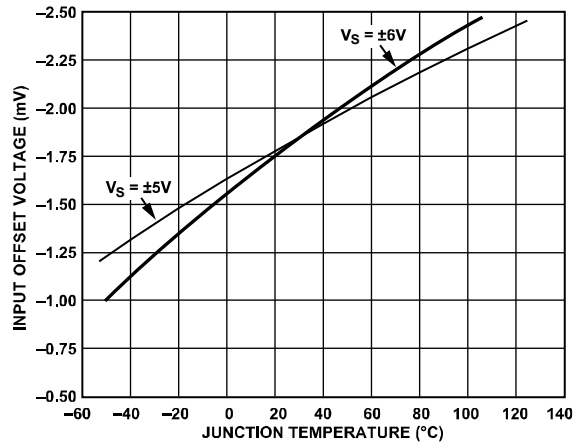


Figure 8. Input Offset Voltage vs. Junction Temperature

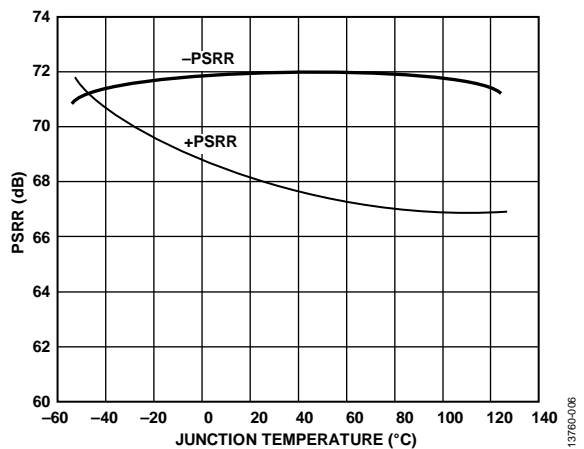
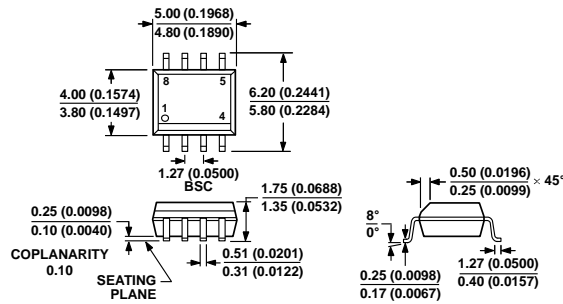


Figure 6. PSRR vs. Junction Temperature

OUTLINE DIMENSIONS



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 9. 8-Lead Standard Small Outline Package [SOIC\_N]  
 Narrow Body  
 (R-8)  
 Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Model <sup>1</sup>	Temperature Range	Package Description	Package Option
AD8037SRZ-EP	-55°C to +105°C	8-Lead Standard Small Outline Package [SOIC_N]	R-8
AD8037SRZ-EP-R7	-55°C to +105°C	8-Lead Standard Small Outline Package [SOIC_N]	R-8

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



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