

## FEATURES

### High linearity

PSRR: 105dB minimum

CMRR: 105 dB typical

Very low supply current: 20  $\mu$ A/amp maximum

1.8 V to 5.5 V single-supply operation

Rail-to-rail input and output

Low noise 2.9  $\mu$ V p-p from 0.1 Hz to 10 Hz

4 mV offset voltage maximum

Very low input bias current: 1 pA typical

## APPLICATIONS

Pressure and position sensors

Remote security

Medical monitors

Battery-powered consumer equipment

Hazard detectors

## GENERAL DESCRIPTION

The AD8506 is a dual micro-power amplifier featuring rail-to-rail input and output swings while operating from a 1.8 V to 5.5 V single power supply.

Employing a new circuit technology, these low cost amplifiers offer high linearity (excellent PSRR and CMRR performance) and very low bias current, while operating with a supply current of less than 20  $\mu$ A per amplifier.

This combination of features makes the AD8506 amplifier an ideal choice for battery-powered applications since it minimizes errors due to power supply voltage variations over the battery's lifetime and maintains relatively high CMRR for a rail-to-rail op amp.

Remote battery-powered sensors, handheld instrumentation and consumer equipment, hazard detection (for example, smoke, fire, and gas), and patient monitors can benefit from the features of the AD8506 amplifier.

The AD8506 is specified for both the industrial temperature range ( $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ) and the extended industrial temperature range ( $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ). AD8506 dual amplifiers are available in the standard 8-lead MSOP and WLCSP.

## PIN CONFIGURATIONS

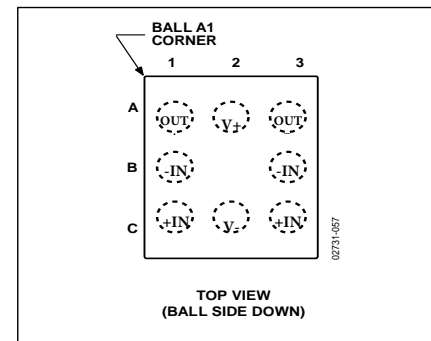


Figure 1. 8-Ball WLCSP

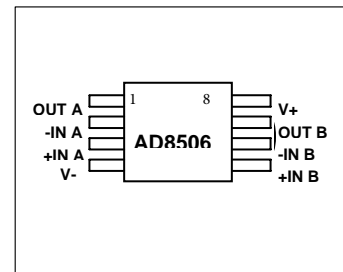


Figure 2. 8-Lead MSOP (RM Suffix)

### Rev. PrA

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**REVISION HISTORY****10/07—Revision 0: Initial Version**

## SPECIFICATIONS

ELECTRICAL CHARACTERISTICS –  $V_S = 5V$ 

$V_S = 5V$ ,  $V_{CM} = V_S/2$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise specified.

Table 1.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	$V_{OS}$	$0V < V_{CM} < 5V$			4	mV
Input Bias Current	$I_B$	$-40^\circ\text{C} < T_A < +85^\circ\text{C}$		1	10	pA
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$			100	pA
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$				600
Input Offset Current	$I_{OS}$	$-40^\circ\text{C} < T_A < +85^\circ\text{C}$		0.5	5	pA
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$			50	pA
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$				100
Input Voltage Range		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$	0		5	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = 0V$ to $5V$	90	105		dB
		$-40^\circ\text{C} < T_A < +85^\circ\text{C}$	90	105		dB
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$	90			dB
Large Signal Voltage Gain	$A_{VO}$	$0.05 < V_{OUT} < 4.95$	110	130		dB
		$-40^\circ\text{C} < T_A < +85^\circ\text{C}$	100			dB
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$	100			dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$-40^\circ\text{C} < T_A < +85^\circ\text{C}$		2.2		$\mu\text{V}/^\circ\text{C}$
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$		2.2		$\mu\text{V}/^\circ\text{C}$
OUTPUT CHARACTERISTICS						
Output Voltage High	$V_{OH}$	$R_L = 100\text{ k}\Omega$ to GND	4.95	4.99		V
		$R_L = 10\text{ k}\Omega$ to GND	4.85	4.9		V
Output Voltage Low	$V_{OL}$	$R_L = 100\text{ k}\Omega$ to $V_S$		2	50	mV
		$R_L = 10\text{ k}\Omega$ to $V_S$		8	150	mV
Short Circuit Limit	$I_{SC}$	$-40^\circ\text{C}$ to $+85^\circ\text{C}$			$\pm 60$	mA
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			$\pm 80$	mA
						TBD
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	$V_S = 1.8V$ to $5V$	105	120		dB
		$-40^\circ\text{C}$ to $+85^\circ\text{C}$	100	120		dB
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	90	120		dB
Supply Current/Amplifier	$I_{SY}$	$V_O = V_S/2$		18	20	$\mu\text{A}$
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$			28	$\mu\text{A}$
DYNAMIC PERFORMANCE						
Slew Rate	SR			12		$\text{mV}/\mu\text{s}$
Gain Bandwidth Product	GBP			150		kHz
NOISE PERFORMANCE						
Peak-to-Peak Noise	$e_{n\text{ p-p}}$	$f = 0.1$ to $10\text{ Hz}$		2.9		$\mu\text{V p-p}$
Voltage Noise Density	$e_n$	$f = 1\text{ kHz}$		48		$\text{nV}/\sqrt{\text{Hz}}$
Current Noise Density	$i_n$	$f = 10\text{ Hz}$		TBD		$\text{fA}/\sqrt{\text{Hz}}$

**ELECTRICAL CHARACTERISTICS –  $V_S = 1.8\text{V}$** 

$V_S = 1.8\text{V}$ ,  $V_{CM} = V_S/2$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise specified.

Table 2.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit	
<b>INPUT CHARACTERISTICS</b>							
Offset Voltage	$V_{OS}$	$0\text{V} < V_{CM} < 1.8\text{V}$			4	mV	
Input Bias Current	$I_B$	$-40^\circ\text{C} < T_A < +85^\circ\text{C}$		1	10	pA	
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$			100	pA	
Input Offset Current	$I_{OS}$	$-40^\circ\text{C} < T_A < +85^\circ\text{C}$		0.5	5	pA	
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$			600	pA	
		$-40^\circ\text{C} < T_A < +85^\circ\text{C}$				50	pA
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$				100	pA
Input Voltage Range		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$	0		5	V	
Common-Mode Rejection Ratio	CMRR	$V_{CM} = 0\text{V to } 1.8\text{V}$	90	105		dB	
		$-40^\circ\text{C} < T_A < +85^\circ\text{C}$	85	100		dB	
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$	85			dB	
Large Signal Voltage Gain	$A_{VO}$	$0.05 < V_{OUT} < 1.75$	110	130		dB	
		$-40^\circ\text{C} < T_A < +85^\circ\text{C}$	100			dB	
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$	100			dB	
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$-40^\circ\text{C} < T_A < +85^\circ\text{C}$		2.2		$\mu\text{V}/^\circ\text{C}$	
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$		2.2		$\mu\text{V}/^\circ\text{C}$	
<b>OUTPUT CHARACTERISTICS</b>							
Output Voltage High	$V_{OH}$	$R_L = 100\text{ k}\Omega$ to GND	1.75	TBD		V	
		$R_L = 10\text{ k}\Omega$ to GND	1.65	1.7		V	
Output Voltage Low	$V_{OL}$	$R_L = 100\text{ k}\Omega$ to $V_S$		TBD	50	mV	
		$R_L = 10\text{ k}\Omega$ to $V_S$		TBD	150	mV	
Short Circuit Limit	$I_{SC}$	$-40^\circ\text{C}$ to $+85^\circ\text{C}$		$\pm 4$		mA	
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			$\pm 6$	mA	
					TBD	mA	
<b>POWER SUPPLY</b>							
Power Supply Rejection Ratio	PSRR	$V_S = 1.8\text{V to } 5\text{V}$	105	120		dB	
		$-40^\circ\text{C}$ to $+85^\circ\text{C}$	100	120		dB	
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	90	120			
Supply Current/Amplifier	$I_{SY}$	$V_O = V_S/2$		18	20	$\mu\text{A}$	
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$			28	$\mu\text{A}$	
<b>DYNAMIC PERFORMANCE</b>							
Slew Rate	SR			12		mV/ $\mu\text{s}$	
Gain Bandwidth Product	GBP			150		kHz	
<b>NOISE PERFORMANCE</b>							
Peak-to-Peak Noise	$e_{n\text{ p-p}}$	$f = 0.1$ to $10\text{ Hz}$		2.9		$\mu\text{V p-p}$	
Voltage Noise Density	$e_n$	$f = 1\text{ kHz}$		48		nV/ $\sqrt{\text{Hz}}$	
Current Noise Density	$i_n$	$f = 10\text{ Hz}$		TBD		fA/ $\sqrt{\text{Hz}}$	

## ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Supply Voltage	6 V
Input Voltage	$\pm V_s$
Differential Input Voltage <sup>1</sup>	$\pm V_s$
Output Short-Circuit Duration to Gnd	Indefinite
Storage Temperature Range RM, CB Packages	-65°C to +150°C
Operating Temperature Range	-40°C to +125°C
Junction Temperature Range RM, CB Packages	-65°C to +150°C
Lead Temperature (Soldering, 60 sec)	300°C

<sup>1</sup> Differential input voltage is limited to 5 V or the supply voltage, whichever is less.

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 indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## THERMAL RESISTANCE

$\theta_{JA}$  is specified for the worst-case conditions, that is, a device soldered in a circuit board for surface-mount packages.

Table 4. Thermal Resistance

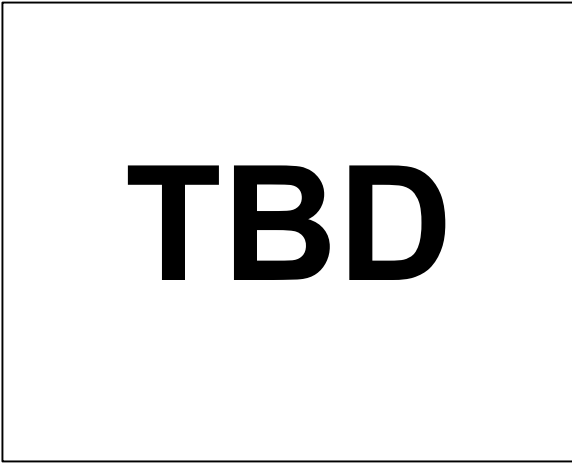
Package Type	$\theta_{JA}$	$\theta_{JC}$	Unit
8-Lead MSOP (RM)	190	44	°C/W
8-Ball WLCSP	TBD	TBD	°C/W

## ESD CAUTION

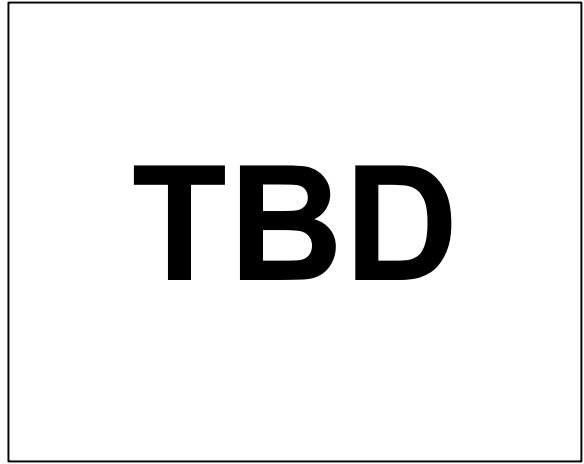


**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

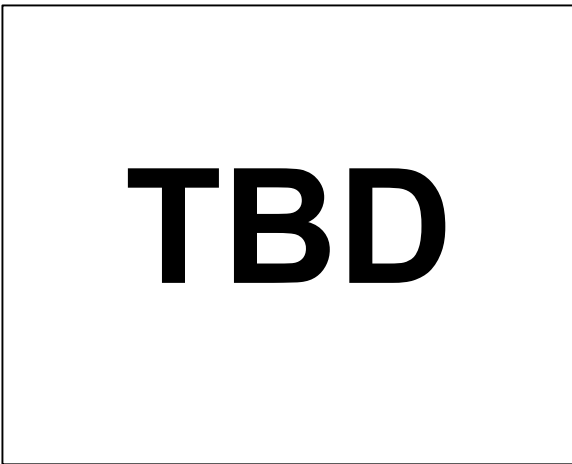
**TYPICAL PERFORMANCE CHARACTERISTICS**



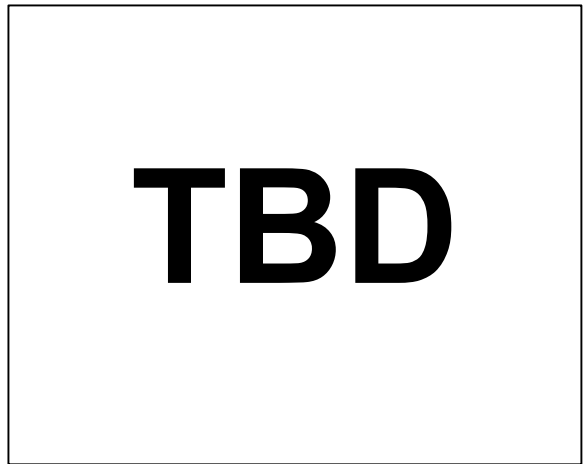
*Figure 3*



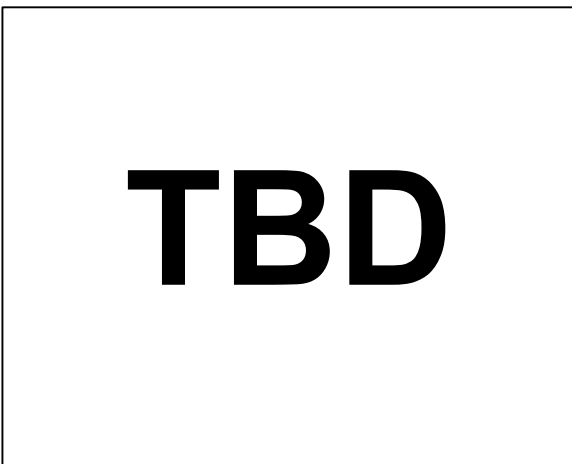
*Figure 6*



*Figure 4*



*Figure 7*



*Figure 5*

## TERMINOLOGY

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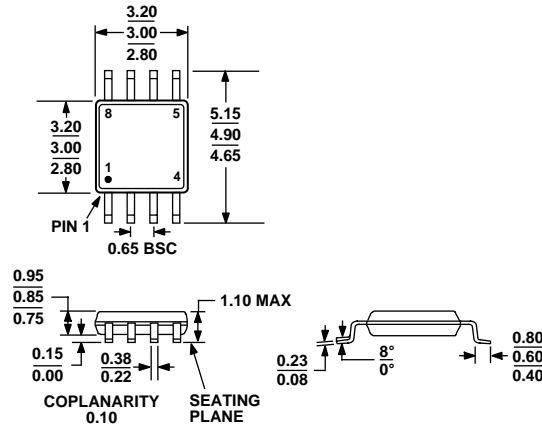
Definition

**THEORY OF OPERATION**



## APPLICATIONS INFORMATION

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-187-AA

Figure 8. 8-Lead Mini Small Outline Package [MSOP] (RM-8)

Dimensions shown in millimeters

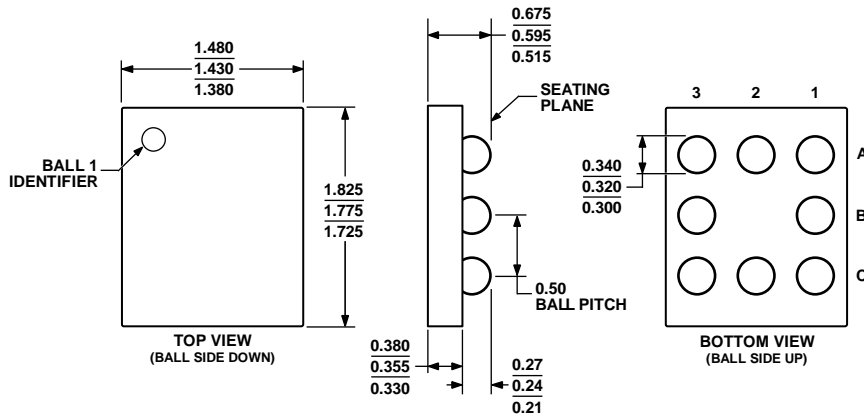


Figure 9. 8-Ball Wafer Level Chip Scale Package [WLCSP] (CB-8-1)

Dimensions shown in millimeters

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
AD8506ARMZ <sup>1</sup>	-40°C to +125°C	8-Lead Mini Small Outline Package [MSOP]	RM-8
AD8506ACBZ <sup>1</sup>	-40°C to +125°C	8-Ball Wafer Level Chip Scale Package [WLCSP]	CB-8-1

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