

FEATURES
High accuracy dc performance

 90 dB CMRR ($G = 1$), typ

4pA typ input bias current

1 nA max input bias current over temperature

 2 $\mu\text{V}/^\circ\text{C}$ typ input offset voltage drift

Excellent ac specifications

 80 dB min CMRR to 10 kHz ($G = 1$), typ

 1.75 MHz -3dB bandwidth ($G=1$)

Low Settling Time
Versatile

Rail-to-rail output

 700 μA quiescent supply current (typ)

Available in space-saving MSOP package

Gain set with one resistor (gain range 1 to 1000)

 $\pm 2.3\text{ V}$ to $\pm 18\text{ V}$ dual supplies

 $+4.6\text{ V}$ to $+36\text{ V}$ single supply

 Specified over -40°C to $+85^\circ\text{C}$
APPLICATIONS

Medical instrumentation

Precision data acquisition systems

Transducer interfaces

GENERAL DESCRIPTION

The AD8220 is a gain programmable, high performance instrumentation amplifier that draws a typical input bias current of 4pA and rejects high frequency common mode signals. The CMRR of instrumentation amplifiers on the market today falls off at 200 Hz. In contrast, the AD8220 maintains a CMRR of 80 dB over an extended frequency at $G = 1$. The combination of extremely high input impedance and high CMRR over frequency makes the AD8220 useful in applications such as patient monitoring where input impedance is high and high frequency disturbances must be rejected.

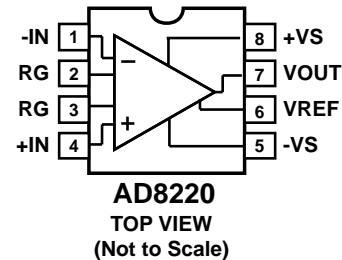
CONNECTION DIAGRAM


Figure 1. MSOP Connection Diagram

The rail to rail output, low power consumption and small MSOP package make this precision instrumentation amplifier attractive for use in multi-channel applications.

Programmable gain affords the user design flexibility. A single resistor sets the gain from 1 to 1000. The AD8220 operates on both single and dual supplies and is well suited for situations where $\pm 10\text{ V}$ input voltages are encountered. In addition its rail to rail output stage allows for maximum dynamic range when constrained by low single supply voltages.

Performance is specified over the entire industrial temperature range of -40°C to $+85^\circ\text{C}$.

Rev. PrA

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TABLE OF CONTENTS

Features	1	Specifications	3
Applications.....	1	Absolute Maximum Ratings	6
Connection Diagram	1	Thermal Characteristics	6
General Description	1	ESD Caution.....	6
Revision History	2	Outline Dimesions	7

REVISION HISTORY

8/05—Revision PrA: Preliminary Version

SPECIFICATIONS

$V_S = \pm 5, \pm 15$ V, $V_{REF} = 0$ V, $T_A = +25^\circ\text{C}$, $G = 1$, $R_L = 2$ k Ω , unless otherwise noted.

Table 1.

Parameter	ARM Grade			Unit	Conditions
	Min	Typ	Max		
COMMON-MODE REJECTION RATIO (CMRR)					
CMRR DC to 60 Hz with 1 k Ω Source Imbalance					$V_{CM} = -10$ V to $+10$ V
G = 1		90		dB	
G = 10		110		dB	
G = 100		116		dB	
G = 1000		116		dB	
CMRR at 10 kHz					$V_{CM} = -10$ V to $+10$ V
G = 1		80		dB	
G = 10		100		dB	
G = 100		116		dB	
G = 1000		116		dB	
NOISE					
Voltage Noise, 1 kHz					$RTI\ noise = \sqrt{e_{NI}^2 + (e_{NO}/G)^2}$
Input Voltage Noise, e_{NI}		15		nV/ $\sqrt{\text{Hz}}$	$V_{IN+}, V_{IN-}, V_{REF} = 0$
Output Voltage Noise, e_{NO}		100		nV/ $\sqrt{\text{Hz}}$	
RTI					$f = 0.1$ Hz to 10 Hz
G = 1				$\mu\text{V p-p}$	
G = 10				$\mu\text{V p-p}$	
G = 100 to 1000				$\mu\text{V p-p}$	
Current Noise		1		fA/ $\sqrt{\text{Hz}}$	$f = 1$ kHz
		6		pA p-p	$f = 0.1$ Hz to 10 Hz
VOLTAGE OFFSET¹					
Input Offset, V_{OSI}		0.2	1	mV	$V_S = \pm 15$ V
Over Temperature			1.6	mV	$V_S = \pm 15$ V; $T = -40^\circ\text{C}$ to $+85^\circ\text{C}$
Average TC		2	10	$\mu\text{V}/^\circ\text{C}$	$V_S = \pm 15$ V
Output Offset, V_{OSO}			1	mV	$V_S = \pm 5$ V to ± 15 V
Over Temperature			1.6	mV	$T = -40^\circ\text{C}$ to $+85^\circ\text{C}$
Average TC			10	$\mu\text{V}/^\circ\text{C}$	
Offset RTI vs. Supply (PSR)					$V_S = \pm 2.5$ V to ± 15 V
G = 1	80	90		dB	
G = 10	95	110		dB	
G = 100	110	130		dB	
G = 1000	110	130		dB	
INPUT CURRENT					
Input Bias Current		4	20	pA	
Over Temperature			1	nA	$T = -40^\circ\text{C}$ to $+85^\circ\text{C}$
Average TC				pA/ $^\circ\text{C}$	
Input Offset Current			5	pA	
Over Temperature			1	nA	$T = -40^\circ\text{C}$ to $+85^\circ\text{C}$
Average TC		1		pA/ $^\circ\text{C}$	
REFERENCE INPUT					
R_{IN}		40		k Ω	
I_{IN}		50		μA	$V_{IN+}, V_{IN-}, V_{REF} = 0$
Voltage Range	$-V_S$		$+V_S$	V	
Gain to Output		1 ± 0.0001		V/V	

Parameter	ARM Grade			Unit	Conditions
	Min	Typ	Max		
POWER SUPPLY					
Operating Range	±2.3		±18	V	$V_S = \pm 2.3 \text{ V to } \pm 18 \text{ V}$
Quiescent Current		700		μA	
Over Temperature			1,000	μA	$T = -40^\circ\text{C to } +85^\circ\text{C}$
DYNAMIC RESPONSE					
Small Signal –3 dB Bandwidth					
G = 1		1,800		kHz	
G = 10		1,000		kHz	
G = 100		120		kHz	
G = 1000		12		kHz	
Settling Time 0.01%					
G = 1 to 10		5		μs	10 V step
G = 100		12		μs	
G = 1000		100			
Settling Time 0.001%					
G = 1 to 100				μs	10 V step
G = 1000				μs	
Slew Rate					
	1.7	2		V/μs	G = 1
	2	2.5		V/μs	G = 5 to 100
GAIN					
Gain Range	1		1,000	V/V	$G = 1 + 49.4 \text{ k}\Omega/\text{RG}$
Gain Error					
G = 1		0.10	0.30	%	$V_{\text{OUT}} \pm 10 \text{ V}$
G = 10		0.10	0.30	%	
G = 100		0.10	0.30	%	
G = 1000		0.10	0.30	%	
Gain Nonlinearity					
G = 1		5	10	ppm	$V_{\text{OUT}} = -10 \text{ V to } +10 \text{ V}$
G = 10				ppm	$R_L = 10 \text{ k}\Omega$
G = 100				ppm	$R_L = 10 \text{ k}\Omega$
G = 1 to 100				ppm	$R_L = 2 \text{ k}$
Gain vs. Temperature					
G = 1		3	10	ppm/°C	
G > 1 ²			-50	ppm/°C	
INPUT					
Input Impedance					
Differential		1000 6			$G\Omega \text{pF}$
Common Mode		1000 12			$G\Omega \text{pF}$
Input Operating Voltage Range ³					
Over Temperature	-V _S		+V _S - 2.5	V	$V_S = \pm 2.3 \text{ V to } \pm 5 \text{ V}$
Input Operating Voltage Range					
Over Temperature	-V _S + 0.2		+V _S - 2.5	V	$V_S = \pm 5 \text{ V to } \pm 18 \text{ V}$
Overload Recovery					
				V	$T = -40^\circ\text{C to } +85^\circ\text{C}$
				μs	
OUTPUT					
Output Swing					
Over Temperature	-V _S + 0.1		-V _S - 0.1	V	$V_S = \pm 2.3 \text{ V to } \pm 5 \text{ V}$
	-V _S + 0.1		-V _S - 0.1	V	$T = -40^\circ\text{C to } +85^\circ\text{C}$

Parameter	ARM Grade			Unit	Conditions
	Min	Typ	Max		
Output Swing	$-V_S + 0.1$		$-V_S - 0.1$	V	$V_S = \pm 5\text{ V to } \pm 18\text{ V}$ $T = -40^\circ\text{C to } +85^\circ\text{C}$
Over Temperature	$-V_S + 0.1$		$-V_S - 0.1$	V	
Capacitance Load Drive		300		pF	
Short-Circuit Current		20		mA	
TEMPERATURE RANGE					
Specified Performance	-40		+85	°C	
TBD Specified Performance	-40		+125	°C	

¹ Total RTI $V_{OS} = (V_{OS1}) + (V_{OS0}/G)$.

² Does not include the effects of External Resistor R_G .

³ One input grounded. $G = 1$.

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Supply Voltage	± 18 V
Internal Power Dissipation	
Output Short Circuit Current	
Input Voltage (Common-Mode)	$\pm V_S$
Differential Input Voltage	$\pm V_S$
Storage Temperature	-65°C to $+150^\circ\text{C}$

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 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 CHARACTERISTICS

Specification is for device in free air.

Table 3.

Package Type	θ_{JA} ¹	Unit
MSOP	135	$^\circ\text{C}/\text{W}$

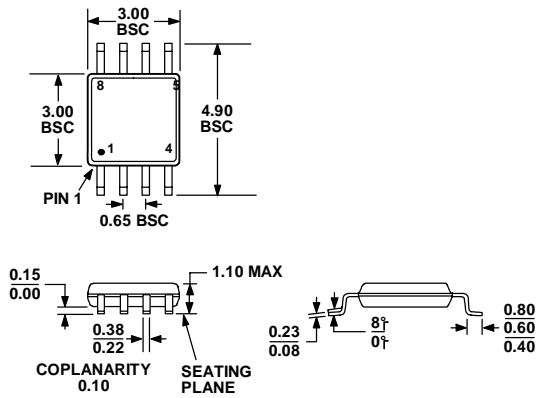
¹ 4-layer JEDEC board.

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.



OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-187AA

Figure 2. 8-Lead Mini Small Outline Package [MSOP] (RM-8)

Dimensions shown in millimeters

NOTES