Rail-to-Rail Output JFET Input Instrumentation

Preliminary Technical Data

AD8220

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 uV/°C typ input offset voltage drift**

Excellent ac specificatons
- **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 quiscent supply current (typ)**
- **Available in space-saving MSOP package**
- **Gain set with one resistor (gain range 1 to 1000)**
- **±2.3 V to ±18 V dual supplies**
- **+4.6 V to +36 V single supply**
- **Specified over –40°C to +85°C**

CONNECTION DIAGRAM

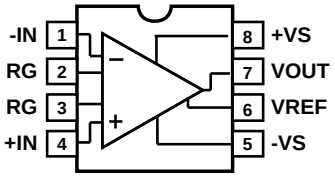

Figure 1. MSOP Connection Diagram

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.

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 ±10 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°C.

Rev. PrA

One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 781.329.4700 **www.analog.com**
Fax: 781.461.3113

TABLE OF CONTENTS

REVISION HISTORY

8/05—Revision PrA: Preliminary Version

SPECIFICATIONS

V_S = ±5, ±15 V, V_{REF} = 0 V, T_A = +25°C, G = 1, R_L = 2 kΩ, unless otherwise noted.

Table 1.

		ARM Grade			
Parameter	**Min**	**Typ**	**Max**	**Unit**	**Conditions**
COMMON-MODE REJECTION RATIO (CMRR)					
CMRR DC to 60 Hz with 1 kΩ 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					*RTI noise* = $\sqrt{e_{NI}^2 + (e_{NO}/G)^2}$
Voltage Noise, 1 kHz					
Input Voltage Noise, e_{NI}		15		nV/√Hz	V_{IN+}, V_{IN-}, V_{REF} = 0
Output Voltage Noise, e_{NO}		100		nV/√Hz	
RTI					f = 0.1 Hz to 10 Hz
G = 1				μV p-p	
G = 10				μV p-p	
G = 100 to 1000				μV p-p	
Current Noise		1		fA/√Hz	f = 1 kHz
		6		pA p-p	f = 0.1 Hz to 10 Hz
VOLTAGE OFFSET[1]					
Input Offset, V_{OSI}		0.2	1	mV	V_S = ±15 V
Over Temperature			1.6	mV	V_S = ±15 V ; T = –40°C to +85°C
Average TC		2	10	μV/°C	V_S = ±15 V
Output Offset, V_{OSO}			1	mV	V_S = ±5 V to ±15 V
Over Temperature			1.6	mV	T = –40°C to +85°C
Average TC			10	μV/°C	
Offset RTI vs. Supply (PSR)					V_S = ±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°C to +85°C
Average TC				pA/°C	
Input Offset Current			5	pA	
Over Temperature			1	nA	T = –40°C to +85°C
Average TC		1		pA/°C	
REFERENCE INPUT					
R_{IN}		40		kΩ	
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 Min	Typ	Max	Unit	Conditions
POWER SUPPLY					
Operating Range	±2.3		±18	V	V_S = ±2.3 V to ±18 V
Quiescent Current		700		µA	
Over Temperature			1,000	µA	T = –40°C to +85°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%					10 V step
G = 1 to 10		5		µs	
G = 100		12		µs	
G = 1000		100			
Settling Time 0.001%					10 V step
G = 1 to 100				µs	
G = 1000				µs	
Slew Rate	1.7	2		V/µs	G = 1
	2	2.5		V/µs	G = 5 to 100
GAIN					G = 1 + 49.4 kΩ/RG
Gain Range	1		1,000	V/V	
Gain Error					V_{OUT} ±10 V
G = 1		0.10	0.30	%	
G = 10		0.10	0.30	%	
G = 100		0.10	0.30	%	
G = 1000		0.10	0.30	%	
Gain Nonlinearity					V_{OUT} = –10 V to +10 V
G = 1		5	10	ppm	R_L = 10 kΩ
G = 10				ppm	R_L = 10 kΩ
G = 100				ppm	R_L = 10 kΩ
G = 1 to 100				ppm	R_L = 2 k
Gain vs. Temperature					
G = 1		3	10	ppm/°C	
G > 1[2]			–50	ppm/°C	
INPUT					
Input Impedance					
Differential		1000‖6			GΩ‖pF
Common Mode		1000‖12			GΩ‖pF
Input Operating	$–V_S$		$+V_S$ – 2.5	V	V_S = ±2.3 V to ±5 V
Voltage Range[3]					
Over Temperature				V	T = –40°C to +85°C
Input Operating	$–V_S$ + 0.2		$+V_S$ – 2.5	V	V_S = ±5 V to ±18 V
Voltage Range					
Over Temperature				V	T = –40°C to +85°C
Overload Recovery				µs	
OUTPUT					R_L = 10 kΩ
Output Swing	$–V_S$ + 0.1		$–V_S$ – 0.1	V	V_S = ±2.3 V to ±5 V
Over Temperature	$–V_S$ + 0.1		$–V_S$ – 0.1	V	T = –40°C to +85°C

Parameter	ARM Grade Min	Typ	Max	Unit	Conditions
Output Swing	$-V_S + 0.1$		$-V_S - 0.1$	V	$V_S = \pm 5$ V to ± 18 V
Over Temperature	$-V_S + 0.1$		$-V_S - 0.1$	V	T = −40°C to +85°C
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 $V_{OS} = (V_{OSI}) + (V_{OSO}/G)$.
[2] Does not include the effects of External Resister 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°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	°C/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 DIMESIONS

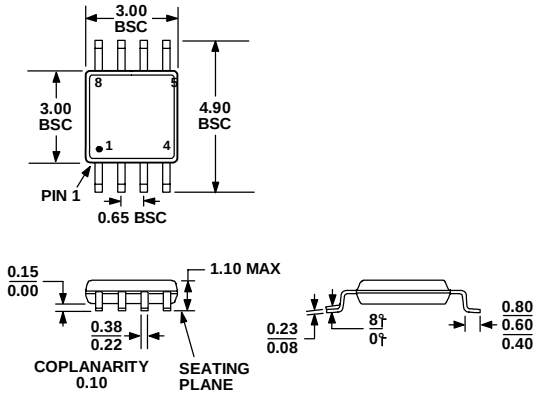

Figure 2. 8-Lead Mini Small Outline Package [MSOP]
(RM-8)
Dimensions shown in millimeters

NOTES