10MHz G=1, 2, 4, 8 Programmable Gain iCMOS™ Instrumentation Amplifier

Preliminary Technical Data

AD8251

FEATURES

Easy to Use
Programmable Gains: 1, 2, 4, 8
Digitally Latched or Pin Strapped Gain Setting
Temp Range -40°C to 85°C

EXCELLENT DC PERFORMANCE
High CMRR 100dB G=10
Low Gain Drift: 10ppm/°C
Low Input Offset Drift: 1uV/°C
Low Input Offset: 100uV

EXCELLENT AC PERFORMANCE
Fast Settle Time: 0.5us to 0.01%
High Slew Rate: 30V/µs
High CMRR over Frequency: 80dB to 10kHz
Low Noise: 15nV√Hz, G=8
Low Power: 3mA (typ)
Supply: ±5V t0 ±12V

Applications
Data Acquisition
Bio-Medical Analysis
Test and Measurement
High Performance System Monitoring

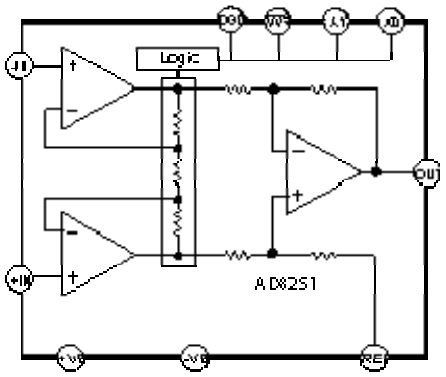

Figure 1. Functional Block Diagram

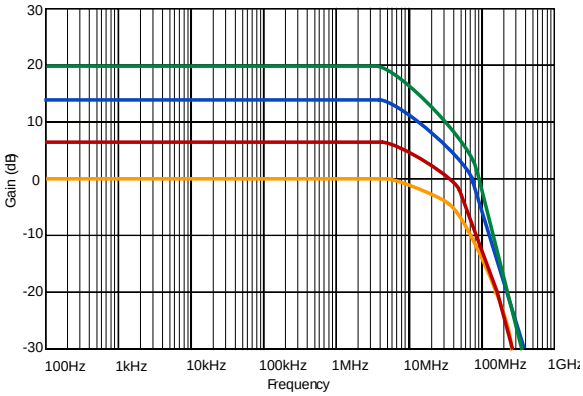

Figure 2. Gain vs Frequency

GENERAL DESCRIPTION

The AD8251 is a digitally gain programmable instrumentation amplifier with high GΩ input impedance and low distortion making it suitable for sensor interfacing and driving high sample rate analog to digital converters. It has a bandwidth of 10MHz, low distortion, and settling time of 0.5us to 0.01%. The offset and gain drift are 1uV/°C and 10ppm/°C respectively. It has a high common-mode rejection of 74dB at G=1 from DC to 100kHz. The combination of precision DC performance coupled with high speed capabilities make the AD8251 an excellent candidate for data acquisition and medical applications. Furthermore, this monolithic solution simplifies design, manufacturing and boosts performance of instrumentation by maintaining tight match of internal resistors and amplifiers.

The AD8251's user interface comprises of a parallel port that allows users to set the gain in one of three different ways. A two bit word sent to A1 and A2, via a bus may be latched using the CLK input. An alternative is to set the gain within 1µs by using the gain port in transparent mode. The last method is to strap A1 and A2 to a high or low voltage potential, permanently setting the gain.

The AD8251 is available in a 10-Lead MSOP package and specified over -40°C to 85°C, making it an excellent solution for applications where size and packing density are important considerations.

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REVISION HISTORY Revision prA: Initial Version

AD8251—SPECIFICATIONS

Table 1. V_S = ±12 V, V_{REF} = 0 V (@T_A = 25ºC, G = +1, R_L = 2 kΩ, unless otherwise noted.)

Parameter	Conditions	AD8251ARM Min	Typ	Max	Unit
COMMON-MODE REJECTION RATIO (CMRR)					
CMRR to 60 Hz with 1 kΩ Source Imbalance	VCM = -10 V to +10 V				
	G = 1		80		dB
	G = 2		86		dB
	G = 4		94		dB
	G = 8		100		dB
CMRR to 100kHz	V_{CM} = -10 V to +10 V				
	G = 1		74		dB
	G = 2				dB
	G = 4				dB
	G = 8				dB
NOISE					
Voltage Noise, 1kHz	G=1				nV/√Hz
	G=2				nV/√Hz
	G=4				nV/√Hz
	G=8		15		nV/√Hz
RTI, 0.1 Hz to 10 Hz	G=1				µV p-p
	G=2				µV p-p
	G=4				µV p-p
	G=8				µV p-p
Current Noise	f = 1kHz				fA/√Hz
VOLTAGE OFFSET					
Input Offset, V_{OS}	G=1, V_S = ±5 V to ±12 V			100	µV
Over Temperature	T = -40°C to +85°C				µV
Average TC	T = -40°C to +85°C			1	µV/°C
Input Offset, V_{OS}	G=2, V_S = ±5 V to ±12 V			100	µV
Over Temperature	T = -40°C to +85°C				µV
Average TC	T = -40°C to +85°C			1	µV/°C
Input Offset, V_{OS}	G=5, V_S = ±5 V to ±12 V			100	µV
Over Temperature	T = -40°C to +85°C				µV
Average TC	T = -40°C to +85°C			1	µV/°C
Input Offset, V_{OS}	G=10, V_S = ±5 V to ±12 V			100	µV
Over Temperature	T = -40°C to +85°C				µV
Average TC	T = -40°C to +85°C			1	µV/°C
Offset Referred to the Input vs. Supply (PSR)	V_S = ±2.5 V to ±8 V				
G = 1		76			dB
G = 2					dB
G = 4					dB
G = 8		96			dB
INPUT CURRENT					
Input Bias Current			10	15	nA
Over Temperature	T = -40°C to +85°C			25	nA

Parameter	Conditions	AD8251ARM Min	Typ	Max	Unit
Average TC					pA/°C
Input Offset Current			5	10	nA
Over Temperature	T = -40°C to +85°C				nA
Average TC			1.5		pA/°C
DYNAMIC RESPONSE					
Small Signal -3dB Bandwidth					
,	G=1		17		MHz
	G=2		15		MHz
	G=4		10		MHz
	G=8		3.5		MHz
Settling Time 0.01%	10 V Step				
	G=1		0.5		µS
	G=2				µS
	G=4				µS
	G=8				µS
Settling Time 0.001%	10 V Step				
	G=1				µS
	G=2				µS
	G=4				µS
	G=8				µS
Slew Rate	G=1	20		35	V/µS
	G=2				V/µS
	G=4				V/µS
	G=8				V/µS
Gain Switching and Settle Time	Gain 1 to Gain 8 1V signal. 0.01% (if this is just the sum of gain time + settle, then remove)				µS
	Gain 1 to Gain 8, 1V signal. 0.001%				µS
Total Harmonic Distortion + Noise	RL = 100kOhms, G=1				%
	RL = 2kOhms (try 600Ohms?), G=1				%
GAIN					
Gain Range: 1, 2, 4, 8		1		8	V/V
Gain Error	V_{OUT}= ±10 V				
	G=1			0.10	%
	G=2				
	G=5				
	G=10				
Gain Nonlinearity	V_{OUT} = –10 V to +10 V				
	G=1, R_L = 10 kΩ		10	40	ppm
	G=2, R_L = 10 kΩ				Ppm
	G=4, R_L = 10 kΩ				Ppm
	G=8, R_L = 10 kΩ				Ppm
Gain Nonlinearity	G=1-8, R_L = 2 kΩ				Ppm
Gain vs. Temperature	All Gains			10	ppm/°C
			3		
INPUT					
Input Impedance					
Differential			1|| 2		GΩ|| pF
Common Mode			1|| 2		GΩ|| pF
Input Operating Voltage Range	V_S = ±5 V to ±15 V				V

Parameter	Conditions	AD8251ARM Min	Typ	Max	Unit
Over Temperature	T = -40°C to +85°C				V
OUTPUT	R_L = 10 kΩ,				
Output Swing	V_S = ±5 V to ±15 V	–Vs + 1.5		+Vs – 2	V
Over Temperature	T = -40°C to +85°C				V
Short Circuit Current					mA
REFERENCE INPUT					
R_{IN}			20		kΩ
I_{IN}	V_{IN}+, V_{IN}–, V_{REF} = 0				µA
Voltage Range		–Vs		+Vs	V
Gain to Output					V/V
Digital Logic Inputs					V
Digital Ground Voltage, DGND					V
Digital Input Voltage Low					V
Digital Input Voltage High					V
Digital Input Leakage Current					pA
Gain Switching Time					Ns
T_{SU}					Ns
T_{HD}					ns
T_{WR_LO}					Ns
T_{WR_HI}					Ns
POWER SUPPLY					
Operating Range[3]		±5		±15	
Quiescent Current			3		mA
Over Temperature	T = -40°C to +85°C				mA
TEMPERATURE RANGE					
Specified Performance		–40		+85	°C

ABSOLUTE MAXIMUM RATINGS

Table 2. AD8251 Absolute Maximim Ratings

Parameter	**Rating**
Supply Voltage	+/-14V
Power Dissipation	See Figure 2
Output Short Circuit Current	
Common-Mode Input Voltage	VEE – 0.5 V to VCC + 0.5 V
Differential Input Voltage	V
Storage Temperature	–65°C to +125°C
Operating Temperature Range	–40°C to +85°C
Lead Temperature Range (Soldering 10 sec)	°C
Junction Temperature	°C
Θ_{JA} (4 layer JEDEC Standard Board)	°C/W
Package Glass Transition Temperature	°C
ESD (Human Body Model)	kV
ESD (Charge Device Model)	kV
ESD (Machine Model)	kV

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other condition s 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.

PIN CONFIGURATIONS AND FUNCTIONAL DESCRIPTIONS

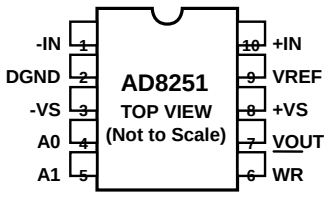

Figure 3. 10-Lead MSOP

Table 3. Pin Function Descriptions—
10-Lead MSOP(ARM PACKAGE)

Pin No.	Name	Description
1	-IN	Inverting Input Terminal (True differential input)
2	DGND	Digital Ground.
3	-Vs	Negative Supply Terminal
4	A0	Gain Setting Pin (LSB)
5	A1	Gain Setting Pin (MSB)
6	$\overline{WR}$	Write Enable
7	VOUT	Output Terminal
8	+Vs	Positive Supply Terminal
9	VREF	Reference Voltage Terminal (drive this pin with a low impedance voltage source to level shift the output signal)
10	+IN	Non-inverting Input Terminal (True differential input)

OUTLINE DIMENSIONS

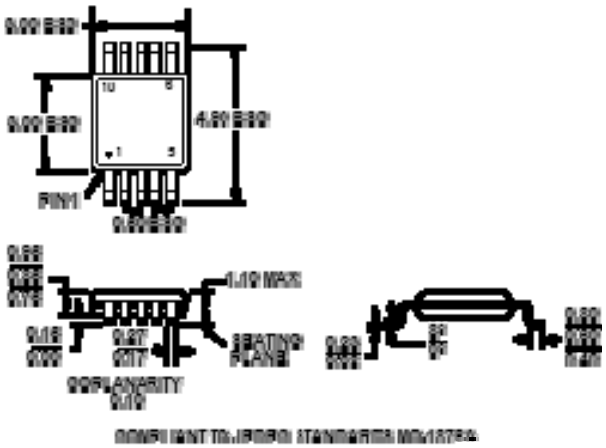

Figure 4. 10 Lead MSOP (RM) – Dimensions shown in millimeters

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.

Table 4. Ordering Guide

AD8251 Products	Temperature Package	Package Description	Package Option	Branding
AD8251ARMZ	–40°C to +85°C	10-Lead MSOP	RM-10	
AD8251ARMZ-RL	–40°C to +85°C	10-Lead MSOP	RM-10	
AD8251ARMZ-R7	–40°C to +85°C	10-Lead MSOP	RM-10	
AD8251-EVAL		Evaluation Board		

NOTES