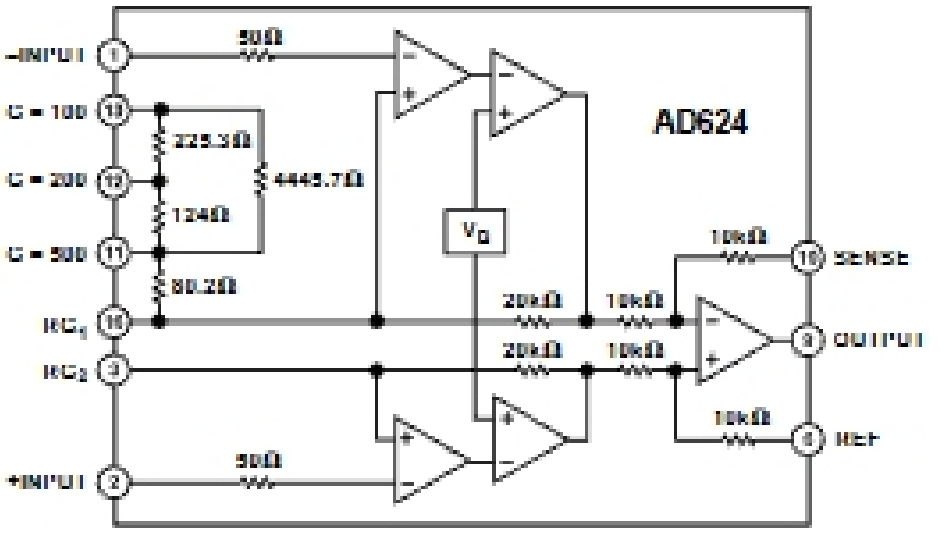
Precision Instrumentation Amplifier

AD624

FEATURES

- Low Noise: 0.2 μV p-p 0.1 Hz to 10 Hz
- Low Gain TC: 5 ppm max (G = 1)
- Low Nonlinearity: 0.001% max (G = 1 to 200)
- High CMRR: 130 dB min (G = 500 to 1000)
- Low Input Offset Voltage: 25 μV, max
- Low Input Offset Voltage Drift: 0.25 μV/°C max
- Gain Bandwidth Product: 25 MHz
- Pin Programmable Gains of 1, 100, 200, 500, 1000
- No External Components Required
- Internally Compensated

FUNCTIONAL BLOCK DIAGRAM



PRODUCT DESCRIPTION

The AD624 is a high precision, low noise, instrumentation amplifier designed primarily for use with low level transducers, including load cells, strain gauges and pressure transducers. An outstanding combination of low noise, high gain accuracy, low gain temperature coefficient and high linearity make the AD624 ideal for use in high resolution data acquisition systems.

The AD624C has an input offset voltage drift of less than 0.25 ∝V/°C, output offset voltage drift of less than 10 ∝V/°C, CMRR above 80 dB at unity gain (130 dB at G = 500) and a maximum nonlinearity of 0.001% at G = 1. In addition to these outstanding dc specifications, the AD624 exhibits superior ac performance as well. A 25 MHz gain bandwidth product, 5 V/∝s slew rate and 15 ∝s settling time permit the use of the AD624 in high speed data acquisition applications.

The AD624 does not need any external components for pretrimmed gains of 1, 100, 200, 500 and 1000. Additional gains such as 250 and 333 can be programmed within one percent accuracy with external jumpers. A single external resistor can also be used to set the 624's gain to any value in the range of 1 to 10,000.

PRODUCT HIGHLIGHTS

1. The AD624 offers outstanding noise performance. Input noise is typically less than 4 nV/$\sqrt{\text{Hz}}$ at 1 kHz.
2. The AD624 is a functionally complete instrumentation amplifier. Pin programmable gains of 1, 100, 200, 500 and 1000 are provided on the chip. Other gains are achieved through the use of a single external resistor.
3. The offset voltage, offset voltage drift, gain accuracy and gain temperature coefficients are guaranteed for all pretrimmed gains.
4. The AD624 provides totally independent input and output offset nulling terminals for high precision applications. This minimizes the effect of offset voltage in gain ranging applications.
5. A sense terminal is provided to enable the user to minimize the errors induced through long leads. A reference terminal is also provided to permit level shifting at the output.

REV. C

One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 781/329-4700 World Wide Web Site: http://www.analog.com
Fax: 781/326-8703

AD624—SPECIFICATIONS (@ V_S = ±15 V, R_L = 2 kΩ and T_A = +25°C, unless otherwise noted)

Model	AD624A			AD624B			AD624C			AD624S			Units
	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
GAIN													
Gain Equation (External Resistor Gain Programming)	$\left[\frac{40,000}{R_G}+1\right]$ ± 20%			$\left[\frac{40,000}{R_G}+1\right]$ ± 20%			$\left[\frac{40,000}{R_G}+1\right]$ ± 20%			$\left[\frac{40,000}{R_G}+1\right]$ ± 20%			
Gain Range (Pin Programmable)	1 to 1000			1 to 1000			1 to 1000			1 to 1000			
Gain Error													
G = 1			±0.05			±0.03			±0.02			±0.05	%
G = 100			±0.25			±0.15			±0.1			±0.25	%
G = 200, 500			±0.5			±0.35			±0.25			±0.5	%
Nonlinearity													
G = 1			±0.005			±0.003			±0.001			±0.005	%
G = 100, 200			±0.005			±0.003			±0.001			±0.005	%
G = 500			±0.005			±0.005			±0.005			±0.005	%
Gain vs. Temperature													
G = 1			5			5			5			5	ppm/°C
G = 100, 200			10			10			10			10	ppm/°C
G = 500			25			15			15			15	ppm/°C
VOLTAGE OFFSET (May be Nulled)													
Input Offset Voltage			200			75			25			75	µV
vs. Temperature			2			0.5			0.25			2.0	µV/°C
Output Offset Voltage			5			3			2			3	mV
vs. Temperature			50			25			10			50	µV/°C
Offset Referred to the Input vs. Supply (PSR)													
G = 1	70			75			80			75			dB
G = 100, 200	95			105			110			105			dB
G = 500	100			110			115			110			dB
INPUT CURRENT													
Input Bias Current			±50			±25			±15			±50	nA
vs. Temperature		±50			±50			±50			±50		pA/°C
Input Offset Current			±35			±15			±10			±35	nA
vs. Temperature		±20			±20			±20			±20		pA/°C
INPUT													
Input Impedance													
Differential Resistance		10^9			10^9			10^9			10^9		Ω
Differential Capacitance		10			10			10			10		pF
Common-Mode Resistance		10^9			10^9			10^9			10^9		Ω
Common-Mode Capacitance		10			10			10			10		pF
Input Voltage Range[1]													
Max Differ. Input Linear (V_{DL})	±10			±10			±10			±10			V
Max Common-Mode Linear (V_{CM})	$12\ V - \left(\frac{G}{2} \cdot V_D\right)$			$12\ V - \left(\frac{G}{2} \cdot V_D\right)$			$12\ V - \left(\frac{G}{2} \cdot V_D\right)$			$12\ V - \left(\frac{G}{2} \cdot V_D\right)$			V
Common-Mode Rejection dc to 60 Hz with 1 kΩ Source Imbalance													
G = 1	70			75			80			70			dB
G = 100, 200	100			105			110			100			dB
G = 500	110			120			130			110			dB
OUTPUT RATING													
V_O, R_L = 2 kΩ	±10			±10			±10			±10			V
DYNAMIC RESPONSE													
Small Signal –3 dB													
G = 1		1			1			1			1		MHz
G = 100		150			150			150			150		kHz
G = 200		100			100			100			100		kHz
G = 500		50			50			50			50		kHz
G = 1000		25			25			25			25		kHz
Slew Rate		5.0			5.0			5.0			5.0		V/µs
Settling Time to 0.01%, 20 V Step													
G = 1 to 200		15			15			15			15		µs
G = 500		35			35			35			35		µs
G = 1000		75			75			75			75		µs
NOISE													
Voltage Noise, 1 kHz													
R.T.I.		4			4			4			4		$nV/\sqrt{Hz}$
R.T.O.		75			75			75			75		$nV/\sqrt{Hz}$
R.T.I., 0.1 Hz to 10 Hz													
G = 1		10			10			10			10		µV p-p
G = 100		0.3			0.3			0.3			0.3		µV p-p
G = 200, 500, 1000		0.2			0.2			0.2			0.2		µV p-p
Current Noise													
0.1 Hz to 10 Hz		60			60			60			60		pA p-p
SENSE INPUT													
R_{IN}	8	10	12	8	10	12	8	10	12	8	10	12	kΩ
I_{IN}		30			30			30			30		µA
Voltage Range	±10			±10			±10			±10			V
Gain to Output		1			1			1			1		%

Model	AD624A			AD624B			AD624C			AD624S			
	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Units
REFERENCE INPUT													
R_{IN}	16	20	24	16	20	24	16	20	24	16	20	24	kΩ
I_{IN}		30			30			30			30		nA
Voltage Range	±10			±10			±10			±10			V
Gain to Output		1			1			1			1		%
TEMPERATURE RANGE													
Specified Performance	–25		+85	–25		+85	–25		+85	–55		+125	°C
Storage	–65		+150	–65		+150	–65		+150	–65		+150	°C
POWER SUPPLY													
Power Supply Range	±6	±15	±18	±6	±15	±18	±6	±15	±18	±6	±15	±18	V
Quiescent Current		3.5	5		3.5	5		3.5	5		3.5	5	mA

NOTES

[1]V_{IN} is the maximum differential input voltage at G = 1 for specified nonlinearity, V_{IN} at other gains = 10 V/G. V_D = actual differential input voltage.
Example: G = 10, V_D = 0.50. V_{CM} = 12 V – (10/2 · 0.50 V) = 9.5 V.

Specifications subject to change without notice.

Specifications shown in **boldface** are tested on all production unit at final electrical test. Results from those tests are used to calculate outgoing quality levels. All min and max specifications are guaranteed, although only those shown in boldface are tested on all production units.

ABSOLUTE MAXIMUM RATINGS*

Supply Voltage ..... ±18 V
Internal Power Dissipation ..... 420 mW
Input Voltage ..... $\pm V_S$
Differential Input Voltage ..... $\pm V_S$
Output Short Circuit Duration ..... Indefinite
Storage Temperature Range ..... –65°C to +150°C
Operating Temperature Range
AD624A/B/C ..... –25°C to +85°C
AD624S ..... –55°C to +125°C
Lead Temperature (Soldering, 60 secs) ..... +300°C

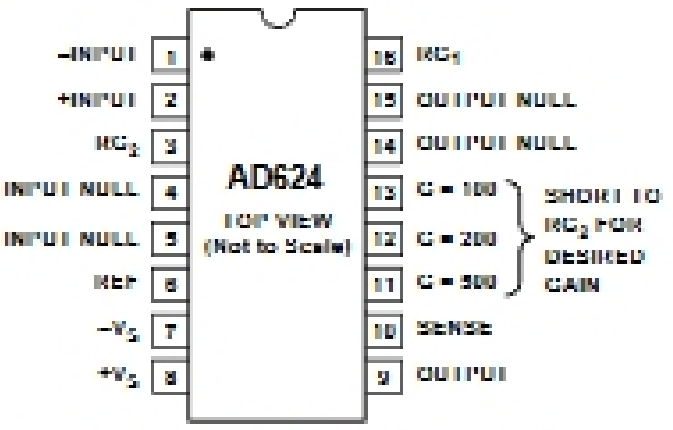
*Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
AD624AD	–25°C to +85°C	16-Lead Ceramic DIP	D-16
AD624BD	–25°C to +85°C	16-Lead Ceramic DIP	D-16
AD624CD	–25°C to +85°C	16-Lead Ceramic DIP	D-16
AD624SD	–55°C to +125°C	16-Lead Ceramic DIP	D-16
AD624SD/883B*	–55°C to +125°C	16-Lead Ceramic DIP	D-16
AD624AChips	–25°C to +85°C	Die	
AD624SChips	–25°C to +85°C	Die	

*See Analog Devices' military data sheet for 883B specifications.

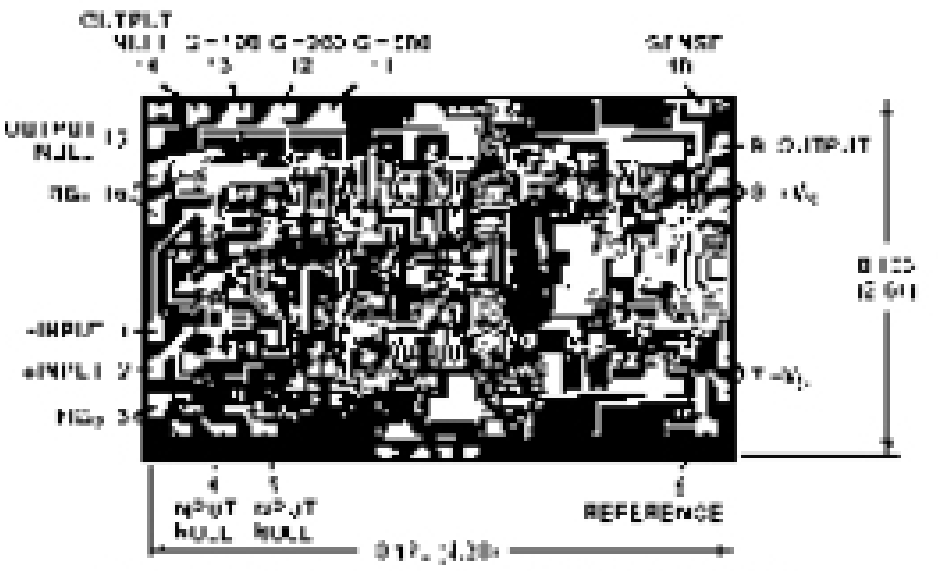
CONNECTION DIAGRAM



FOR GAINS OF 1000 SHORT RG_1 TO PIN 12 AND PINS 11 AND 13 TO RG_2

METALIZATION PHOTOGRAPHY

Contact factory for latest dimensions
Dimensions shown in inches and (mm).



PAD NUMBERS CORRESPOND TO PIN NUMBERS FOR THE D-16 16-LEAD CERAMIC PACKAGE