Low Cost Instrumentation Amplifier

AD622

FEATURES

Easy to use
Low cost solution
Higher performance than two or three op amp design
Unity gain with no external resistor
Optional gains with one external resistor
(Gain range: 2 to 1000)
Wide power supply range: ±2.6 V to ±15 V
Available in 8-lead PDIP and 8-lead SOIC_N packages
Low power, 1.5 mA maximum supply current
DC performance
- **0.15% gain accuracy: G = 1**
- **125 µV maximum input offset voltage**
- **1.0 µV/°C maximum input offset drift**
- **5 nA maximum input bias current**
- **66 dB minimum common-mode rejection ratio: G = 1**

Noise
- **12 nV/√Hz @ 1 kHz input voltage noise**
- **0.60 µV p-p noise: 0.1 Hz to 10 Hz, G = 10**

AC characteristics
- **800 kHz bandwidth: G = 10**
- **10 µs settling time to 0.1% @ G = 1 to 100**
- **1.2 V/µs slew rate**

APPLICATIONS

Transducer interface
Low cost thermocouple amplifier
Industrial process controls
Difference amplifier
Low cost data acquisition

PIN CONFIGURATION

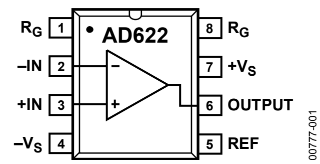


Figure 1. 8-Lead PDIP and 8-Lead SOIC_N (N and R Suffixes)

GENERAL DESCRIPTION

The AD622 is a low cost, moderately accurate instrumentation amplifier that requires only one external resistor to set any gain between 2 and 1000. For a gain of 1, no external resistor is required. The AD622 is a complete difference or subtracter amplifier system that also provides superior linearity and common-mode rejection by incorporating precision laser-trimmed resistors.

The AD622 replaces low cost, discrete, two or three op amp instrumentation amplifier designs and offers good common-mode rejection, superior linearity, temperature stability, reliability, and board area consumption. The low cost of the AD622 eliminates the need to design discrete instrumentation amplifiers to meet stringent cost targets. While providing a lower cost solution, it also provides performance and space improvements.

SPECIFICATIONS

T_A = 25°C, V_S = ±15 V, and R_L = 2 kΩ typical, unless otherwise noted.

Table 1.

Parameter	Conditions	Min	Typ	Max	Unit
GAIN	G = 1 + (50.5 k/R_G)				
Gain Range		1		1000	
Gain Error[1]	V_{OUT} = ±10 V				
G = 1			0.05	0.15	%
G = 10			0.2	0.50	%
G = 100			0.2	0.50	%
G = 1000			0.2	0.50	%
Nonlinearity	V_{OUT} = ±10 V				
G = 1 to 1000	R_L = 10 kΩ		10		ppm
G = 1 to 100	R_L = 2 kΩ		10		ppm
Gain vs. Temperature	Gain = 1			10	ppm/°C
	Gain > 1[1]			−50	ppm/°C
VOLTAGE OFFSET	Total RTI Error = V_{OSI} + V_{OSO}/G				
Input Offset, V_{OSI}	V_S = ±5 V to ±15 V		60	125	µV
Average Temperature Coefficient	V_S = ±5 V to ±15 V			1.0	µV/°C
Output Offset, V_{OSO}	V_S = ±5 V to ±15 V		600	1500	µV
Average Temperature Coefficient	V_S = ±5 V to ±15 V			15	µV/°C
Offset Referred to Input vs. Supply (PSR)	V_S = ±5 V to ±15 V				
G = 1		80	100		dB
G = 10		95	120		dB
G = 100		110	140		dB
G = 1000		110	140		dB
INPUT CURRENT					
Input Bias Current			2.0	5.0	nA
Average Temperature Coefficient			3.0		pA/°C
Input Offset Current			0.7	2.5	nA
Average Temperature Coefficient			2.0		pA/°C
INPUT					
Input Impedance					
Differential			10‖2		G Ω‖pF
Common Mode			10‖2		GΩ‖pF
Input Voltage Range[2]	V_S = ±2.6 V to ±5 V	$-V_S$ + 1.9		$+V_S$ − 1.2	V
Over Temperature		$-V_S$ + 2.1		$+V_S$ − 1.3	V
	V_S = ±5 V to ±18 V	$-V_S$ + 1.9		$+V_S$ − 1.4	V
Over Temperature		$-V_S$ + 2.1		$+V_S$ − 1.4	V
Common-Mode Rejection Ratio	V_{CM} = 0 V to ±10 V				
DC to 60 Hz with 1 kΩ Source Imbalance					
G = 1		66	78		dB
G = 10		86	98		dB
G = 100		103	118		dB
G = 1000		103	118		dB
OUTPUT					
Output Swing	R_L = 10 kΩ				
	V_S = ±2.6 V to ±5 V	$-V_S$ + 1.1		$+V_S$ − 1.2	V
Over Temperature		$-V_S$ + 1.4		$+V_S$ − 1.3	V
	V_S = ±5 V to ±18 V	$-V_S$ + 1.2		$+V_S$ − 1.4	V
Over Temperature		$-V_S$ + 1.6		$+V_S$ − 1.5	V
Short Current Circuit			±18		mA

Parameter	Conditions	Min	Typ	Max	Unit
DYNAMIC RESPONSE					
Small Signal −3 dB Bandwidth					
G = 1			1000		kHz
G = 10			800		kHz
G = 100			120		kHz
G = 1000			12		kHz
Slew Rate			1.2		V/µs
Settling Time to 0.1%	10 V step				
G = 1 to 100			10		µs
NOISE					
Voltage Noise, 1 kHz	Total RTI Noise = $\sqrt{(e^2_{ni}) + (e_{no}/G)2}$				
Input Voltage Noise, e_{ni}			12		nV/√Hz
Output Voltage Noise, e_{no}			72		nV/√Hz
RTI, 0.1 Hz to 10 Hz					
G = 1			4.0		µV p-p
G = 10			0.6		µV p-p
G = 100			0.3		µV p-p
Current Noise	f = 1 kHz		100		fA/√Hz
0.1 Hz to 10 Hz			10		pA p-p
REFERENCE INPUT					
R_{IN}			20		kΩ
I_{IN}	V_{IN+}, V_{REF} = 0		50	60	µA
Voltage Range		$-V_S + 1.6$		$+V_S - 1.6$	V
Gain to Output			1 ± 0.0015		
POWER SUPPLY					
Operating Range[3]		±2.6		±18	V
Quiescent Current	V_S = ±2.6 V to ±18 V		0.9	1.3	mA
Over Temperature			1.1	1.5	mA
TEMPERATURE RANGE					
For Specified Performance			−40 to +85		°C

[1] Does not include effects of External Resistor R_G.
[2] One input grounded, G = 1.
[3] Defined as the same supply range that is used to specify PSR.

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Supply Voltage	±18 V
Internal Power Dissipation[1]	650 mW
Input Voltage (Common Mode)	$\pm V_S$
Differential Input Voltage[2]	±25 V
Output Short Circuit Duration	Indefinite
Storage Temperature Range	−65°C to +125°C
Operating Temperature Range	−40°C to +85°C
Lead Temperature (Soldering, 10 sec)	300°C

[1] Specification is for device in free air; see Table 3.
[2] May be further restricted for gains greater than 14. See the Input Protection section for more information.

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.

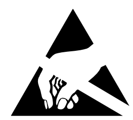
THERMAL RESISTANCE

θ_{JA} is specified for the device in free air.

Table 3. Thermal Resistance

Package Type	θ_{JA}	Unit
8-Lead PDIP (N-8)	95	°C/W
8-Lead SOIC_N (R-8)	155	°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.

OUTLINE DIMENSIONS

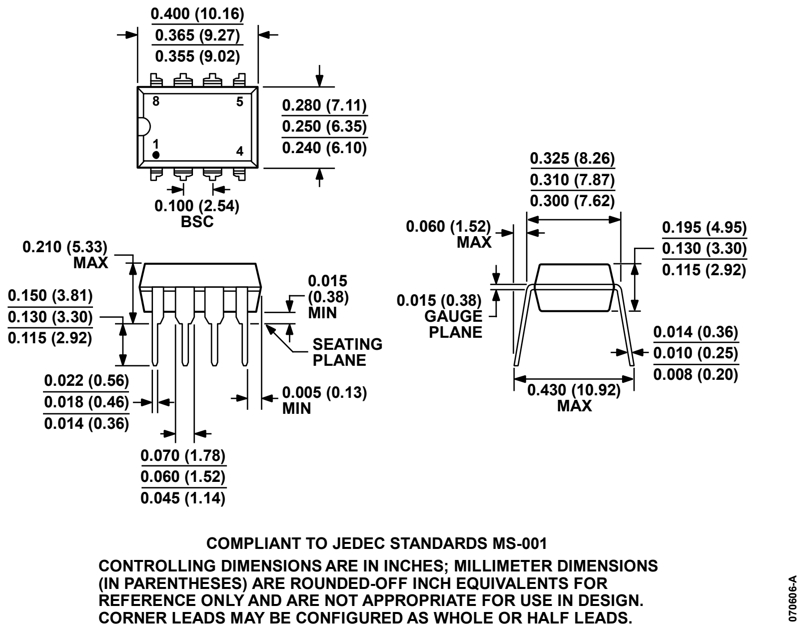


Figure 22. 8-Lead Plastic Dual In-Line Package [PDIP]
Narrow Body
(N-8)
Dimensions shown in inches and (millimeters)

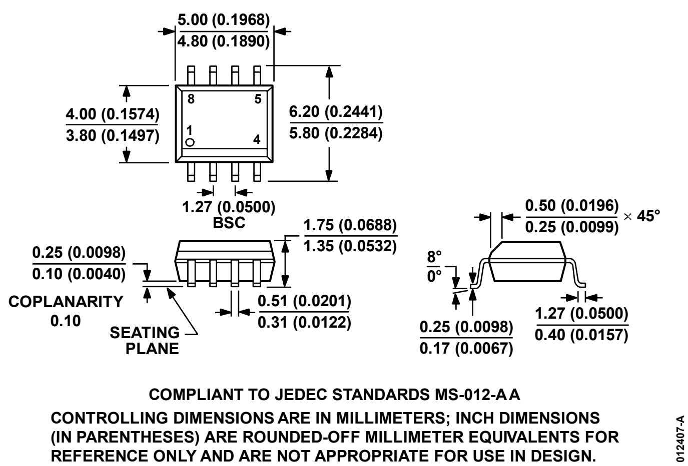


Figure 23. 8-Lead Standard Small Outline Package [SOIC_N]
Narrow Body
(R-8)
Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
AD622AN	−40°C to +85°C	8-Lead PDIP	N-8
AD622ANZ[1]	−40°C to +85°C	8-Lead PDIP	N-8
AD622AR	−40°C to +85°C	8-Lead SOIC_N	R-8
AD622AR-REEL	−40°C to +85°C	8-Lead SOIC_N	R-8
AD622AR-REEL7	−40°C to +85°C	8-Lead SOIC_N	R-8
AD622ARZ[1]	−40°C to +85°C	8-Lead SOIC_N	R-8
AD622ARZ-RL[1]	−40°C to +85°C	8-Lead SOIC_N	R-8
AD622ARZ-RL7[1]	−40°C to +85°C	8-Lead SOIC_N	R-8

[1] Z = RoHS Compliant Part.