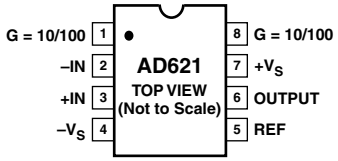
Low Drift, Low Power Instrumentation Amplifier

AD621

FEATURES
EASY TO USE
Pin-Strappable Gains of 10 and 100
All Errors Specified for Total System Performance
Higher Performance than Discrete In Amp Designs
Available in 8-Lead DIP and SOIC
Low Power, 1.3 mA Max Supply Current
Wide Power Supply Range (±2.3 V to ±18 V)
EXCELLENT DC PERFORMANCE
0.15% Max, Total Gain Error
±5 ppm/°C, Total Gain Drift
125 μV Max, Total Offset Voltage
1.0 μV/°C Max, Offset Voltage Drift
LOW NOISE
9 nV/√Hz, @ 1 kHz, Input Voltage Noise
0.28 μV p-p Noise (0.1 Hz to 10 Hz)
EXCELLENT AC SPECIFICATIONS
800 kHz Bandwidth (G = 10), 200 kHz (G = 100)
12 μs Settling Time to 0.01%
APPLICATIONS
Weigh Scales
Transducer Interface and Data Acquisition Systems
Industrial Process Controls
Battery-Powered and Portable Equipment

CONNECTION DIAGRAM
8-Lead Plastic Mini-DIP (N), Cerdip (Q) and SOIC (R) Packages



PRODUCT DESCRIPTION

The AD621 is an easy to use, low cost, low power, high accuracy instrumentation amplifier that is ideally suited for a wide range of applications. Its unique combination of high performance, small size and low power, outperforms discrete in amp implementations. High functionality, low gain errors, and low gain drift errors are achieved by the use of internal gain setting resistors. Fixed gains of 10 and 100 can easily be set via external pin strapping. The AD621 is fully specified as a total system, therefore, simplifying the design process.

For portable or remote applications, where power dissipation, size, and weight are critical, the AD621 features a very low supply current of 1.3 mA max and is packaged in a compact 8-lead SOIC, 8-lead plastic DIP or 8-lead cerdip. The AD621 also excels in applications requiring high total accuracy, such as precision data acquisition systems used in weigh scales and transducer interface circuits. Low maximum error specifications including nonlinearity of 10 ppm, gain drift of 5 ppm/°C, 50 μV offset voltage, and 0.6 μV/°C offset drift ("B" grade), make possible total system performance at a lower cost than has been previously achieved with discrete designs or with other monolithic instrumentation amplifiers.

When operating from high source impedances, as in ECG and blood pressure monitors, the AD621 features the ideal combination of low noise and low input bias currents. Voltage noise is specified as 9 nV/√Hz at 1 kHz and 0.28 μV p-p from 0.1 Hz to 10 Hz. Input current noise is also extremely low at 0.1 pA/√Hz. The AD621 outperforms FET input devices with an input bias current specification of 1.5 nA max over the full industrial temperature range.

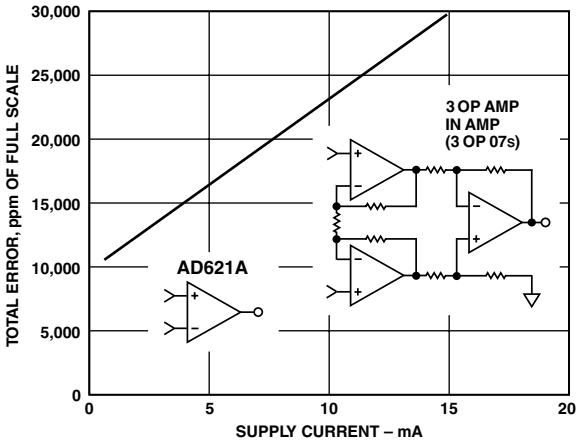


Figure 1. Three Op Amp IA Designs vs. AD621

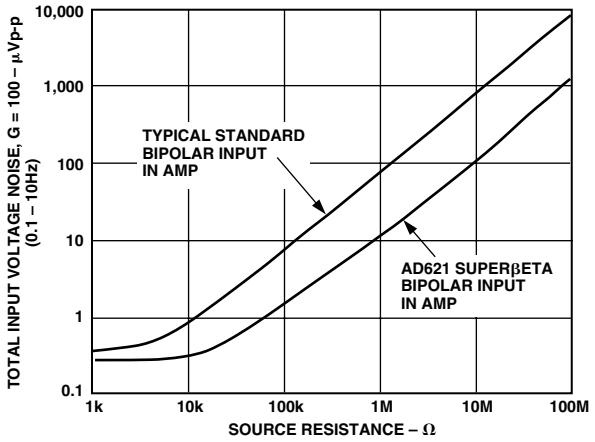


Figure 2. Total Voltage Noise vs. Source Resistance

REV. B

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AD621–SPECIFICATIONS

Gain = 10 (Typical @ 25°C, V_S = ±15 V, and R_L = 2 kΩ, unless otherwise noted.)

Model	Conditions	AD621A Min	AD621A Typ	AD621A Max	AD621B Min	AD621B Typ	AD621B Max	AD621S[1] Min	AD621S[1] Typ	AD621S[1] Max	Unit
GAIN											
Gain Error	V_{OUT} = ±10 V			0.15			0.05			0.15	%
Nonlinearity,											
V_{OUT} = –10 V to +10 V	R_L = 2 kΩ		2	10		2	10		2	10	ppm of FS
Gain vs. Temperature			–1.5	±5		–1.5	±5		–1	±5	ppm/°C
TOTAL VOLTAGE OFFSET											
Offset (RTI)	V_S = ±15 V		75	250		50	125		75	250	µV
Over Temperature	V_S = ±5 V to ±15 V			400			215			500	µV
Average TC	V_S = ±5 V to ±15 V		1.0	2.5		0.6	1.5		1.0	2.5	µV/°C
Offset Referred to the											
Input vs. Supply (PSR)[2]	V_S = ±2.3 V to ±18 V	95	120		100	120		95	120		dB
Total NOISE											
Voltage Noise (RTI)	1 kHz		13	17		13	17		13	17	nV/√Hz
RTI	0.1 Hz to 10 Hz		0.55			0.55	0.8		0.55	0.8	µV p-p
Current Noise	f = 1 kHz		100			100			100		fA/√Hz
	0.1 Hz–10 Hz		10			10			10		pA p-p
INPUT CURRENT	V_S = ±15 V										
Input Bias Current			0.5	2.0		0.5	1.0		0.5	2	nA
Over Temperature				2.5			1.5			4	nA
Average TC			3.0			3.0			8.0		pA/°C
Input Offset Current			0.3	1.0		0.3	0.5		0.3	1.0	nA
Over Temperature				1.5			0.75			2.0	nA
Average TC			1.5			1.5			8.0		pA/°C
INPUT											
Input Impedance											
Differential			10‖2			10‖2			10‖2		GΩ‖pF
Common-Mode			10‖2			10‖2			10‖2		GΩ‖pF
Input Voltage Range[3]	V_S = ±2.3 V to ±5 V	$–V_S$ + 1.9		$+V_S$ – 1.2	$–V_S$ + 1.9		$+V_S$ – 1.2	$–V_S$ + 1.9		$+V_S$ – 1.2	V
Over Temperature		$–V_S$ + 2.1		$+V_S$ – 1.3	$–V_S$ + 2.1		$+V_S$ – 1.3	$–V_S$ + 2.1		$+V_S$ – 1.3	V
	V_S = ±5 V to ±18 V	$–V_S$ + 1.9		$+V_S$ – 1.4	$–V_S$ + 1.9		$+V_S$ – 1.4	$–V_S$ + 1.9		$+V_S$ – 1.4	V
Over Temperature		$–V_S$ + 2.1		$+V_S$ – 1.4	$–V_S$ + 2.1		$+V_S$ – 1.4	$–V_S$ + 2.3		$+V_S$ – 1.4	V
Common-Mode Rejection											
Ratio DC to 60 Hz with											
1 kΩ Source Imbalance	V_{CM} = 0 V to ±10 V	93	110		100	110		93	110		dB
OUTPUT											
Output Swing	R_L = 10 kΩ,										
	V_S = ±2.3 V to ±5 V	$–V_S$ + 1.1		$+V_S$ – 1.2	$–V_S$ + 1.1		$+V_S$ – 1.2	$–V_S$ + 1.1		$+V_S$ – 1.2	V
Over Temperature		$–V_S$ + 1.4		$+V_S$ – 1.3	$–V_S$ + 1.4		$+V_S$ – 1.3	$–V_S$ + 1.6		$+V_S$ – 1.3	V
	V_S = ±5 V to ±18 V	$–V_S$ + 1.2		$+V_S$ – 1.4	$–V_S$ + 1.2		$+V_S$ – 1.4	$–V_S$ + 1.2		$+V_S$ – 1.4	V
Over Temperature		$–V_S$ + 1.6		$+V_S$ – 1.5	$–V_S$ + 1.6		$+V_S$ – 1.5	$–V_S$ + 2.3		$+V_S$ – 1.5	V
Short Current Circuit			±18			±18			±18		mA
DYNAMIC RESPONSE											
Small Signal,											
–3 dB Bandwidth			800			800			800		kHz
Slew Rate		0.75	1.2		0.75	1.2		0.75	1.2		V/µs
Settling Time to 0.01%	10 V Step		12			12			12		µs
REFERENCE INPUT											
R_{IN}			20			20			20		kΩ
I_{IN}	V_{IN} +, V_{REF} = 0		50	60		50	60		+50	+60	µA
Voltage Range		$–V_S$ + 1.6		$+V_S$ – 1.6	$–V_S$ + 1.6		$+V_S$ – 1.6	V_S + 1.6		$+V_S$ – 1.6	V
Gain to Output			1 ± 0.0001			1 ± 0.0001			1 ± 0.0001		
POWER SUPPLY											
Operating Range		±2.3		±18	±2.3		±18	±2.3		±18	V
Quiescent Current	V_S = ±2.3 V to ±18 V		0.9	1.3		0.9	1.3		0.9	1.3	mA
Over Temperature			1.1	1.6		1.1	1.6		1.1	1.6	mA
TEMPERATURE RANGE											
For Specified Performance			–40 to +85			–40 to +85			–55 to +125		°C

NOTES

[1]See Analog Devices' military data sheet for 883B tested specifications.

[2]This is defined as the supply range over which PSRR is defined.

[3]Input Voltage Range = CMV + (Gain × V_{DIFF}).

Specifications subject to change without notice.

Gain = 100 (Typical @ 25°C, V_S = ±15 V, and R_L = 2 kΩ, unless otherwise noted.)

Model	Conditions	AD621A Min	AD621A Typ	AD621A Max	AD621B Min	AD621B Typ	AD621B Max	AD621S[1] Min	AD621S[1] Typ	AD621S[1] Max	Unit
GAIN											
Gain Error	V_{OUT} = ±10 V			0.15			0.05			0.15	%
Nonlinearity,											
V_{OUT} = –10 V to +10 V	R_L = 2 kΩ		2	10		2	10		2	10	ppm of FS
Gain vs. Temperature			–1	±5		–1	±5		–1	±5	ppm/°C
TOTAL VOLTAGE OFFSET											
Offset (RTI)	V_S = ±15 V		35	125		25	50		35	125	µV
Over Temperature	V_S = ±5 V to ±15 V			185			215			225	µV
Average TC	V_S = ±5 V to ±15 V		0.3	1.0		0.1	0.6		0.3	1.0	µV/°C
Offset Referred to the											
Input vs. Supply (PSR)[2]	V_S = ±2.3 V to ±18 V	110	140		120	140		110	140		dB
Total NOISE											
Voltage Noise (RTI)	1 kHz		9	13		9	13		9	13	nV/√Hz
RTI	0.1 Hz to 10 Hz		0.28			0.28	0.4		0.28	0.4	µV p-p
Current Noise	f = 1 kHz		100			100			100		fA/√Hz
	0.1 Hz–10 Hz		10			10			10		pA p-p
INPUT CURRENT	V_S = ±15 V										
Input Bias Current			0.5	2.0		0.5	1.0		0.5	2	nA
Over Temperature				2.5			1.5			4	nA
Average TC			3.0			3.0			8.0		pA/°C
Input Offset Current			0.3	1.0		0.3	0.5		0.3	1.0	nA
Over Temperature				1.5			0.75			2.0	nA
Average TC			1.5			1.5			8.0		pA/°C
INPUT											
Input Impedance											
Differential			10‖2			10‖2			10‖2		GΩ‖pF
Common-Mode			10‖2			10‖2			10‖2		GΩ‖pF
Input Voltage Range[3]	V_S = ±2.3 V to ±5 V	$–V_S$ + 1.9		$+V_S$ – 1.2	$–V_S$ + 1.9		$+V_S$ – 1.2	$–V_S$ + 1.9		$+V_S$ – 1.2	V
Over Temperature		$–V_S$ + 2.1		$+V_S$ – 1.3	$–V_S$ + 2.1		$+V_S$ – 1.3	$–V_S$ + 2.1		$+V_S$ – 1.3	V
	V_S = ±5 V to ±18 V	$–V_S$ + 1.9		$+V_S$ – 1.4	$–V_S$ + 1.9		$+V_S$ – 1.4	$–V_S$ + 1.9		$+V_S$ – 1.4	V
Over Temperature		$–V_S$ + 2.1		$+V_S$ – 1.4	$–V_S$ + 2.1		$+V_S$ – 1.4	$–V_S$ + 2.3		$+V_S$ – 1.4	V
Common-Mode Rejection											
Ratio DC to 60 Hz with											
1 kΩ Source Imbalance	V_{CM} = 0 V to ±10 V	110	130		120	130		110	130		dB
OUTPUT											
Output Swing	R_L = 10 kΩ,										
	V_S = ±2.3 V to ±5 V	$–V_S$ + 1.1		$+V_S$ – 1.2	$–V_S$ + 1.1		$+V_S$ – 1.2	$–V_S$ + 1.1		$+V_S$ – 1.2	V
Over Temperature		$–V_S$ + 1.4		$+V_S$ – 1.3	$–V_S$ + 1.4		$+V_S$ – 1.3	$–V_S$ + 1.6		$+V_S$ – 1.3	V
	V_S = ±5 V to ±18 V	$–V_S$ + 1.2		$+V_S$ – 1.4	$–V_S$ + 1.2		$+V_S$ – 1.4	$–V_S$ + 1.2		$+V_S$ – 1.4	V
Over Temperature		$–V_S$ + 1.6		$+V_S$ – 1.5	$–V_S$ + 1.6		$+V_S$ – 1.5	$–V_S$ + 2.3		$+V_S$ – 1.5	V
Short Current Circuit			±18			±18			±18		mA
DYNAMIC RESPONSE											
Small Signal,											
–3 dB Bandwidth			200			200			200		kHz
Slew Rate		0.75	1.2		0.75	1.2		0.75	1.2		V/µs
Settling Time to 0.01%	10 V Step		12			12			12		µs
REFERENCE INPUT											
R_{IN}			20			20			20		kΩ
I_{IN}	V_{IN} +, V_{REF} = 0		50	60		50	60		50	60	µA
Voltage Range		$–V_S$ + 1.6		$+V_S$ – 1.6	$–V_S$ + 1.6		$+V_S$ – 1.6	V_S + 1.6		$+V_S$ – 1.6	V
Gain to Output			1 ± 0.0001			1 ± 0.0001			1 ± 0.0001		
POWER SUPPLY											
Operating Range		±2.3		±18	±2.3		±18	±2.3		±18	V
Quiescent Current	V_S = ±2.3 V to ±18 V		0.9	1.3		0.9	1.3		0.9	1.3	mA
Over Temperature			1.1	1.6		1.1	1.6		1.1	1.6	mA
TEMPERATURE RANGE											
For Specified Performance			–40 to +85			–40 to +85			–55 to +125		°C

NOTES

[1]See Analog Devices' military data sheet for 883B tested specifications.

[2]This is defined as the supply range over which PSEE is defined.

[3]Input Voltage Range = CMV + (Gain × V_{DIFF}).

Specifications subject to change without notice.

ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage . . . . . ±18 V
Internal Power Dissipation[2] . . . . . 650 mW
Input Voltage (Common Mode) . . . . . $\pm V_S$
Differential Input Voltage . . . . . ±25 V
Output Short Circuit Duration . . . . . Indefinite
Storage Temperature Range (Q) . . . . . –65°C to +150°C
Storage Temperature Range (N, R) . . . . . –65°C to +125°C
Operating Temperature Range
AD621 (A, B) . . . . . –40°C to +85°C
AD621 (S) . . . . . –55°C to +125°C
Lead Temperature Range
(Soldering 10 seconds) . . . . . 300°C

NOTES
[1]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.
[2]Specification is for device in free air:
8-Lead Plastic Package: θ_{JA} = 95°C/W
8-Lead Cerdip Package: θ_{JA} = 110°C/W
8-Lead SOIC Package: θ_{JA} = 155°C/W

ESD SUSCEPTIBILITY

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 volts, which readily accumulate on the human body and on test equipment, can discharge without detection. Although the AD621 features proprietary ESD protection circuitry, permanent damage may still occur on these devices if they are subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid any performance degradation or loss of functionality.

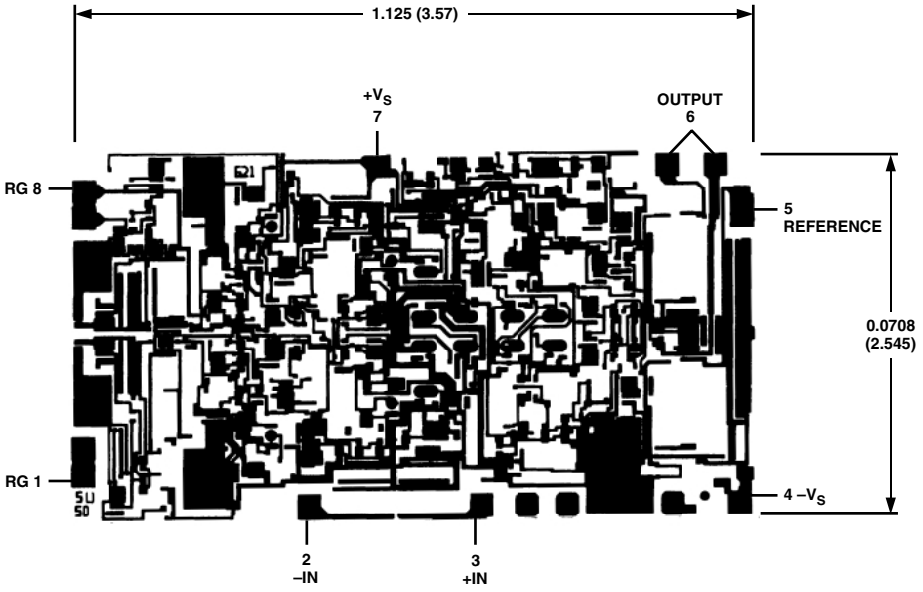
ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option[1]
AD621AN	–40°C to +85°C	8-Lead Plastic DIP	N-8
AD621BN	–40°C to +85°C	8-Lead Plastic DIP	N-8
AD621AR	–40°C to +85°C	8-Lead Plastic SOIC	R-8
AD621BR	–40°C to +85°C	8-Lead Plastic SOIC	R-8
AD621SQ/883B[2]	–55°C to +125°C	8-Lead Cerdip	Q-8
AD621ACHIPS	–40°C to +85°C	Die	

NOTES
[1]N = Plastic DIP; Q = Cerdip; R = SOIC.
[2]See Analog Devices' military data sheet for 883B specifications.

METALIZATION PHOTOGRAPH

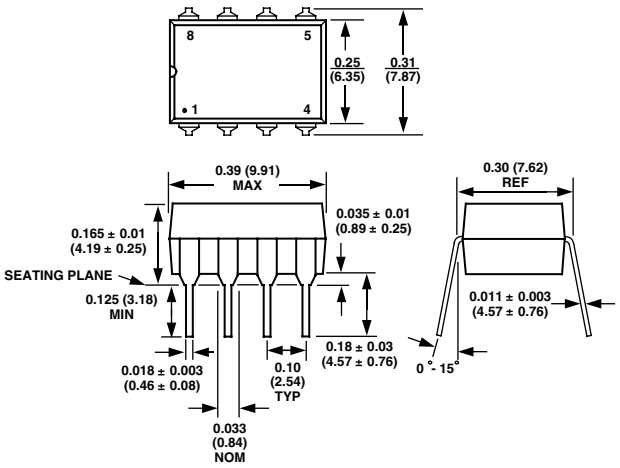
Dimensions shown in inches and (mm).
Contact factory for latest dimensions.



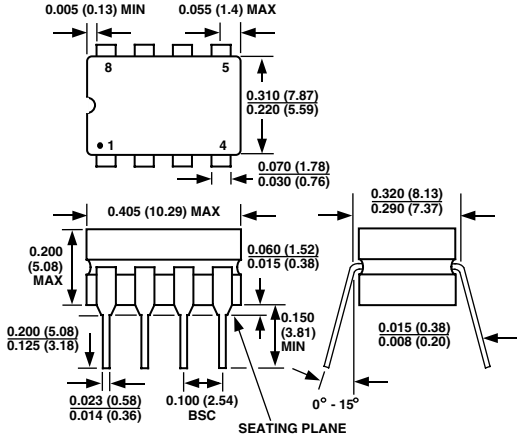
OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).

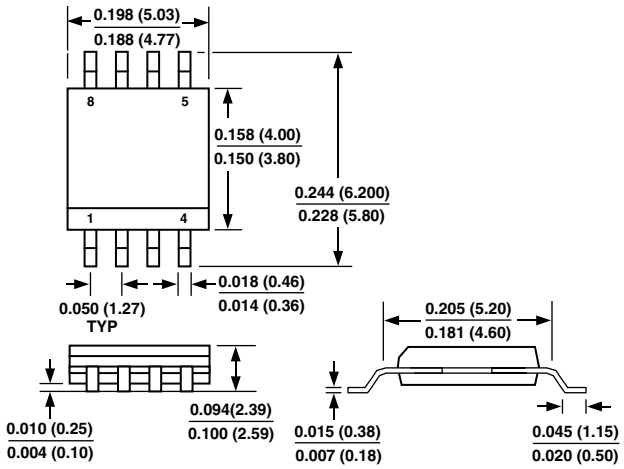
Plastic DIP (N-8) Package



Cerdip (Q-8) Package



SOIC (R-8) Package



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