1.8 nV/√Hz, 36 V Precision Single and Dual Amplifier

Preliminary Technical Data

ADA4004-1 and ADA4004-2

FEATURES

Very low voltage noise: 1.8 nV/√Hz
Low input bias current: 100 nA maximum
Offset voltage: 100 µV maximum
High gain: 120 dB
Wide bandwidth: 12 MHz
±5 V to ±15 V operation

APPLICATIONS

Precision instrumentation
Filter blocks
Microphone preamplifier
Industrial control
Thermocouples and RTDs
Reference buffers

GENERAL DESCRIPTION

The ADA4004-1 and ADA4004-2 are single and dual precision bipolar op amps that featuring a 1.8 nV/√Hz precision, 40 µV offset, 0.7 µV/°C drift, 12 MHz bandwidth, and low 1.7 mA/amplifier supply current.

The ADA4004 is designed on the high performance *i*Polar™ process, enabling improvements such as reduced noise and power consumption, increased speed and stability, and a smaller footprint size. Novel design techniques enable the ADA4004 to achieve 1.8 nV/√Hz voltage noise density and a low 6 Hz 1/f noise corner frequency while consuming just 1.7 mA/amplifier. The small package saves board space, reduces cost, and improves layout flexibility.

Applications for these amplifiers include high precision controls, PLL filters, high performance precision filters, medical and analytical instrumentation, precision power supply controls, ATE, and data acquisition systems.

The high performance ADA4004 is offered in the very small 5-lead SOT and 8-lead SOIC for the single (ADA4004-1) and the 8-lead MSOP for the dual (ADA4004-2), lead-free, surface-mount packages. Operation is fully specified from ±5 V to ±15 V from −40°C to +125°C.

PIN CONFIGURATIONS

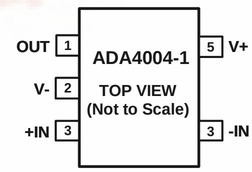


Figure 1. . 5-Lead SOT (RJ-5)

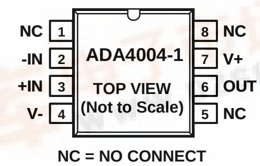
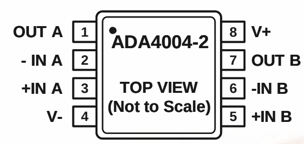


Figure 2. 8-Lead SOIC (R-8)



8-Lead MSOP (RM-8)

Rev. PrA

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SPECIFICATIONS

V_S = ±5.0 V, V_{CM} = 0 V, T_A = +25°C, unless otherwise specified.

Table 1.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			40	140	μV
		−40°C ≤ T_A ≤ +125°C			300	μV
Input Bias Current	I_B			40	85	nA
		−40°C ≤ T_A ≤ +125°C			165	nA
Input Offset Current	I_{OS}			40	85	nA
		−40°C ≤ T_A ≤ +125°C			100	nA
Input Voltage Range			−3.5		+3.5	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = −3.0 V to +3.0 V	105	111		dB
		−40°C ≤ T_A ≤ +125°C	95	110		dB
Open-Loop Gain	A_{VO}	R_L = 2 kΩ, V_O = −2.5 V to +2.5 V	250	400		V/mV
		−40°C ≤ T_A ≤ +125°C	170			V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C ≤ T_A ≤ +125°C		0.7	1	μV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 2 kΩ to ground	3.7	3.9		V
		−40°C ≤ T_A ≤ +125°C	3.4	3.6		V
Output Voltage Low	V_{OL}	R_L = 2 kΩ to ground		−3.6	−3.55	V
		−40°C ≤ T_A ≤ +125°C		−3.6	−3.5	V
Short Circuit Limit	I_{SC}			25		mA
		−40°C ≤ T_A ≤ +125°C				mA
Output Current	I_O	V_{OUT} = ±3.6 V		±10		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = ±5.0 V to ±15.0 V	110	118		dB
		−40°C ≤ T_A ≤ +125°C	110			dB
Supply Current/Amplifier	I_{SY}				1.7	mA
		−40°C ≤ T_A ≤ +125°C			2.0	mA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 2 kΩ to ground		2.7		V/μs
Gain Bandwidth Product	GBP			12		MHz
NOISE PERFORMANCE						
Voltage Noise	$e_{n\,p\text{-}p}$	0.1 Hz to 10 Hz		0.1		μV p-p
Voltage Noise Density	e_n	f = 1 kHz		1.8		nV/√Hz
Current Noise Density	i_n	f = 10 Hz		3.5		pA/√Hz
Current Noise Density	i_n	f = 200 Hz		1.2		pA/√Hz

V_S = ±15 V, V_{CM} = 0 V, T_A = +25°C, unless otherwise specified.

Table 2.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			40	125	µV
		−40°C ≤ T_A ≤ +125°C			270	µV
Input Bias Current	I_B			40	90	nA
		−40°C ≤ T_A ≤ +125°C			165	nA
Input Offset Current	I_{OS}				60	nA
		−40°C ≤ T_A ≤ +125°C			100	nA
Input Voltage Range			−12.5		+12.5	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = −12.5 V to +12.5 V	110	113		dB
		−40°C ≤ T_A ≤ +125°C	100	104		dB
Open-Loop Gain	A_{VO}	R_L = 2 kΩ, V_O = −12.5 V to +12.5 V	500	1200		V/mV
		−40°C ≤ T_A ≤ +125°C	250	500		V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C ≤ T_A ≤ +125°C		0.7	1	µV
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 2 kΩ to ground	13.4	13.6		V
		−40°C ≤ T_A ≤ +125°C	13.1	13.3		V
Output Voltage Low	V_{OL}	R_L = 2 kΩ to ground		−13.3	−13.2	V
		−40°C ≤ T_A ≤ +125°C		−13.25	−13.18	V
Short Circuit Limit	I_{SC}			25		mA
Output Current	I_O	V_{OUT} = ±13.6 V		±10		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = ±5.0 V to ±15.0 V	110	118		dB
		−40°C ≤ T_A ≤ +125°C	110			dB
Supply Current/Amplifier	I_{SY}				1.775	mA
		−40°C ≤ T_A ≤ +125°C			2.10	mA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 2 kΩ to ground		2.7		V/µs
Gain Bandwidth Product	GBP			12		MHz
NOISE PERFORMANCE						
Voltage Noise	$e_{n\ p\text{-}p}$	0.1 Hz to 10 Hz		0.15		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		1.8		nV/√Hz
Current Noise Density	i_n	f = 10 Hz		3.5		pA/√Hz
Current Noise Density	i_n	f = 200 Hz		1.2		pA/√Hz

ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Supply Voltage	±18 V/+36 V
Input Voltage	±V supply
Differential Input Voltage	±V supply
Output Short-Circuit Duration to GND	Indefinite
Storage Temperature Range	−65°C to +150°C
Operating Temperature Range	−40°C to +125°C
Junction Temperature Range	−65°C to +150°C
Lead Temperature (Soldering 60 sec)	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 section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

PR06548–0–12/06(PrA)