



2nV/ $\sqrt{\text{Hz}}$, 36V Precision Quad Amplifier

Preliminary Technical Data

ADA4004-4

FEATURES

- Very Low Voltage Noise 2.0 nV/ $\sqrt{\text{Hz}}$
- Low Input Bias Current: 100 nA Max
- Offset Voltage: 100 μV Max
- High Gain: 120 dB
- Wide Bandwidth: 12MHz
- $\pm 5\text{V}$ to $\pm 15\text{V}$ Operation

APPLICATIONS

- Precision Instrumentation
- Filter Blocks
- Microphone Preamplifier
- Industrial Control
- Thermocouples and RTDs
- Reference Buffers

GENERAL DESCRIPTION

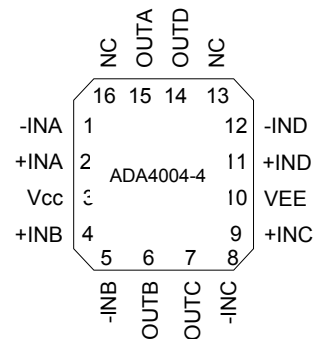
The ADA4004-4 is a 2nV/ $\sqrt{\text{Hz}}$ precision quad amplifier in a 16mm² LFCSP package featuring 40 μV offset, 0.7 $\mu\text{V}/^\circ\text{C}$ drift, 12MHz bandwidth and low 1.7mA/amp supply current.

The ADA4004-4 is designed on the high performance iPolar™ process, enabling improvements such as reduced noise and power consumption, increased speed and stability, and smaller footprint size. Novel design techniques enable the ADA4004-4 to achieve 2nV/ $\sqrt{\text{Hz}}$ voltage noise density, and a low 6Hz 1/f noise corner frequency while consuming just 1.7mA/amp. The small package saves board space, reduces cost and improves layout flexibility.

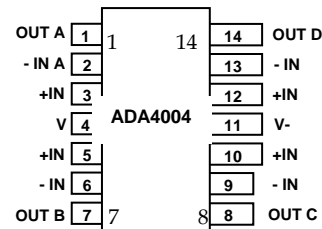
Applications for these amplifiers include high precision controls, PLL filters, high performance precision filters, medical and analytical instrumentation, precision power supply controls, ATE and data acquisition systems.

The high performance ADA4004-4 is offered in the very small 16-lead, 4mm X 4mm LFCSP and 14-lead narrow SOIC lead-free, surface mount packages. Operation is fully specified from $\pm 5\text{V}$ to $\pm 15\text{V}$ from -40°C to $+125^\circ\text{C}$.

16-lead LFCSP
(CP-16 Suffix)



14- Lead
SOIC



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ELECTRICAL SPECIFICATIONS

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

| Parameter | Symbol | Conditions | Min | Typ | Max | Units |
|-------------------------------|----------------------|---|------|------|------|-------------------|
| INPUT CHARACTERISTICS | | | | | | |
| Offset Voltage | V _{OS} | | | 40 | 100 | μV |
| Input Bias Current | I _B | | | 40 | 100 | nA |
| | | -40°C ≤ T _A ≤ +125°C | | | TBD | nA |
| Input Offset Current | I _{OS} | | | TBD | TBD | nA |
| | | -40°C ≤ T _A ≤ +125°C | | | 2 | nA |
| Input Voltage Range | | | -3.5 | | 3.5 | V |
| Common-Mode Rejection Ratio | CMRR | V _{CM} = -3.0V to 3.0V | | 100 | | dB |
| | | -40°C ≤ T _A ≤ +125°C | | TBD | | dB |
| Open Loop Gain (Note 1) | A _{VO} | R _L = 2 kΩ, V _o = -3.5V to 3.5V | 120 | 126 | | dB |
| | | -40°C ≤ T _A ≤ +125°C | TBD | | | V/mV |
| Offset Voltage Drift | ΔV _{OS} /ΔT | -40°C ≤ T _A ≤ +125°C | | 0.7 | TBD | μV/°C |
| OUTPUT CHARACTERISTICS | | | | | | |
| Output Voltage High | V _{OH} | R _L = 2kΩ to Ground | 3.8 | 3.9 | | V |
| | | -40°C ≤ T _A ≤ +125°C | 3.7 | TBD | | V |
| Output Voltage Low | V _{OL} | R _L = 2kΩ to Ground | | -3.5 | -3.4 | V |
| | | -40°C ≤ T _A ≤ +125°C | | TBD | -3.7 | V |
| Short Circuit Limit | I _{SC} | | | 25 | | mA |
| | | -40°C ≤ T _A ≤ +125°C | | | | mA |
| Output Current | I _O | V _{OUT} = ±3.6V | | ± 10 | | mA |
| | | -40°C ≤ T _A ≤ +125°C | | | | mA |
| POWER SUPPLY | | | | | | |
| Power Supply Rejection Ratio | PSRR | V _S = ±4.0V to ±18.0V | 120 | 125 | | dB |
| | | -40°C ≤ T _A ≤ +125°C | | | | dB |
| Supply Current/Amplifier | I _{SY} | | | 1.7 | | mA |
| | | -40°C ≤ T _A ≤ +125°C | | | | 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-p} | 0.1 to 10 Hz | | 0.1 | | μV _{p-p} |
| Voltage Noise Density | e _n | f = 1 kHz | | 2.0 | | nV/√Hz |
| Current Noise Density | i _n | f = 10 Hz | | 3.5 | | pA/√Hz |

ELECTRICAL SPECIFICATIONS ($V_S = \pm 15V$, $V_{CM} = 0V$, $T_A = +25^\circ C$ unless otherwise specified.)

| Parameter | Symbol | Conditions | Min | Typ | Max | Units |
|-------------------------------|--------------------------|--|--------------|-------------------|----------------|------------------|
| INPUT CHARACTERISTICS | | | | | | |
| Offset Voltage | V_{OS} | | | 40 | 100 | μV |
| Input Bias Current | I_B | | | 40 | 100 | nA |
| | | $-40^\circ C \leq T_A \leq +125^\circ C$ | | | TBD | nA |
| Input Offset Current | I_{OS} | | | | TBD | nA |
| | | $-40^\circ C \leq T_A \leq +125^\circ C$ | | | 2 | nA |
| Input Voltage Range | | | -13.5 | | 13.5 | V |
| Common-Mode Rejection Ratio | CMRR | $V_{CM} = -12.5V$ to $12.5V$ $-40^\circ C \leq T_A \leq +125^\circ C$ | | 100 | | dB |
| Open Loop Gain | A_{VO} | $R_L = 2k\Omega$, $V_o = -12.5V$ to $12.5V$ $-40^\circ C \leq T_A \leq +125^\circ C$ | 120 | 130 | | dB |
| | | $-40^\circ C \leq T_A \leq +125^\circ C$ | | TBD | | dB |
| Offset Voltage Drift | $\Delta V_{OS}/\Delta T$ | $-40^\circ C \leq T_A \leq +125^\circ C$ | | 0.7 | TBD | $\mu V/^\circ C$ |
| OUTPUT CHARACTERISTICS | | | | | | |
| Output Voltage High | V_{OH} | $R_L = 2k\Omega$ to Ground $-40^\circ C \leq T_A \leq +125^\circ C$ | 13.6 13.5 | 13.9 TBD | | V V |
| Output Voltage Low | V_{OL} | $R_L = 2k\Omega$ to Ground $-40^\circ C \leq T_A \leq +125^\circ C$ | | -13.5 TBD | -13.4 -13.5 | V V |
| Short Circuit Limit | I_{SC} | | | 25 | | mA |
| | | $-40^\circ C \leq T_A \leq +125^\circ C$ | | | | mA |
| Output Current | I_O | $V_{OUT} = \pm 13.6V$ $-40^\circ C \leq T_A \leq +125^\circ C$ | | ± 10 \pm | | mA mA |
| POWER SUPPLY | | | | | | |
| Power Supply Rejection Ratio | PSRR | $V_S = \pm 4.0V$ to $\pm 18.0V$ $-40^\circ C \leq T_A \leq +125^\circ C$ | 120 | 125 | | dB dB |
| Supply Current/Amplifier | I_{SY} | | | 1.7 | TBD | mA mA |
| | | $-40^\circ C \leq T_A \leq +125^\circ C$ | | | | mA |
| DYNAMIC PERFORMANCE | | | | | | |
| Slew Rate | SR | $R_L = 2k\Omega$ to ground | | 2.7 | | V/ μs |
| Gain Bandwidth Product | GBP | | | 12 | | MHz |
| NOISE PERFORMANCE | | | | | | |
| Voltage Noise | $e_{n\ p-p}$ | 0.1 to 10 Hz | | 0.15 | | μV_{p-p} |
| Voltage Noise Density | e_n | $f = 1\ kHz$ | | 2.0 | | nV/ \sqrt{Hz} |
| Current Noise Density | i_n | $f = 10\ Hz$ | | 3.5 | | pA/ \sqrt{Hz} |
| Current Noise Density | i_n | $f = 200Hz$ | | 1.2 | | pA/ \sqrt{Hz} |

ABSOLUTE MAXIMUM RATINGS

| | |
|--|----------------------|
| Supply Voltage | ±18V/+36V |
| Input Voltage | ±V _{supply} |
| Differential Input Voltage | ±V _{supply} |
| Output Short-Circuit Duration to Gnd | Indefinite |
| Storage Temperature Range | |
| R-14, CP-16 Packages | -65°C to +150°C |
| Operating Temperature Range | |
| ADA4004-4 | -40°C to +125°C |
| Junction Temperature Range | |
| R-14, CP-16 Packages | -65°C to +150°C |
| Lead Temperature Range (Soldering, 60 sec) | +300°C |

| Package Type | θ_{JA} ¹ | θ_{JC} | Units |
|---------------------|----------------------------|---------------|-------|
| 14-Lead SOIC (RZ) | 120 | 36 | °C/W |
| 16-Lead LFCSP (CPZ) | 44 | 31.5 | °C/W |

NOTES

¹ θ_{JA} is specified for the worst case conditions, i.e., θ_{JA} is specified for device in socket for P-DIP packages; θ_{JA} is specified for device soldered in circuit board for SOIC and TSSOP packages.

ORDERING GUIDE

| Model | Temperature Range | Package Description | Package Option |
|---------------|-------------------|---------------------|----------------|
| ADA4004-4ARZ | -40°C to +125°C | 14-lead SOIC_N | R-14 |
| ADA4004-4ACPZ | -40°C to +125°C | 16-lead LFCSP | CP-16-4 |