

# Precision Amplifiers ( $V_{OS} < 1 \text{ mV}$ , Bandwidth $< 50 \text{ MHz}$ )

## Zero-Drift Amplifiers

### ADA4528-1: Precision, Ultralow Noise, RRIO, Zero-Drift Op Amp

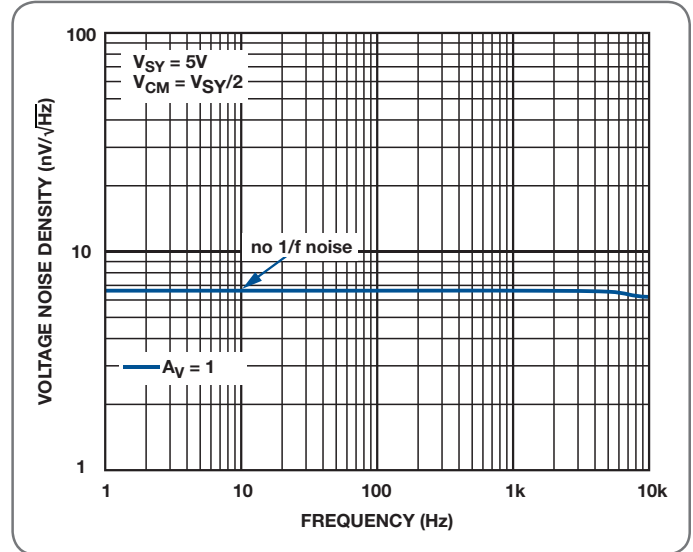
The **ADA4528-1** is an ultralow noise, zero-drift operational amplifier featuring rail-to-rail input and output swing. With an offset voltage of  $2.5 \mu\text{V}$ , offset voltage drift of  $0.015 \mu\text{V}/^\circ\text{C}$ , and noise of  $97 \text{ nV p-p}$  ( $0.1 \text{ Hz}$  to  $10 \text{ Hz}$ ,  $A_V = +100$ ), the device is well suited for applications in which error sources cannot be tolerated. With wide operating supply range of  $2.2 \text{ V}$  to  $5.5 \text{ V}$ , high gain and excellent CMRR and PSRR specifications, the **ADA4528-1** is ideal for precision amplification of low level signals, such as position and pressure sensors, strain gages, and medical instrumentation.

#### Features

- Low offset:  $2.5 \mu\text{V}$  maximum
- Low offset voltage drift:  $0.015 \mu\text{V}/^\circ\text{C}$  maximum
- Low noise
- $5.6 \text{ nV}/\sqrt{\text{Hz}}$  at  $f = 1 \text{ kHz}$ ,  $A_V = +100$
- $97 \text{ nV p-p}$  at  $f = 0.1 \text{ Hz}$  to  $10 \text{ Hz}$ ,  $A_V = +100$
- Open-loop voltage gain:  $130 \text{ dB}$  minimum
- CMRR:  $135 \text{ dB}$  minimum
- PSRR:  $130 \text{ dB}$  minimum
- Gain bandwidth product:  $4 \text{ MHz}$
- Single-supply operation:  $2.2 \text{ V}$  to  $5.5 \text{ V}$
- Dual-supply operation:  $\pm 1.1 \text{ V}$  to  $\pm 2.75 \text{ V}$
- Rail-to-rail input and output
- Unity-gain stable

#### Application

- Thermocouple/thermopile
- Load cell and bridge transducer
- Precision instrumentation
- Electronic scales
- Medical instrumentation
- Handheld test equipment



Voltage noise density vs. frequency.

### Zero Drift Amplifiers

| Process | Part Number | No. of Amps | Supply Voltage (Min/Max) | Rail-to-Rail <sup>1</sup> | BW @ A <sub>OL</sub> Min (MHz) | Slew Rate (V/ $\mu\text{s}$ ) | $V_{OS}$ Max (mV) | $TcV_{OS}$ ( $\mu\text{V}/^\circ\text{C}$ Typ) | CMRR Min (dB) | PSRR Min (dB) | $A_{VO}$ Min (dB) | Noise (nV/ $\sqrt{\text{Hz}}$ ) @ $1 \text{ kHz}$ | $I_S$ /Amp (mA Max) | $I_B$ Max (pA) | Packaging       | Price @ 1k (DEM \$US) |
|---------|-------------|-------------|--------------------------|---------------------------|--------------------------------|-------------------------------|-------------------|------------------------------------------------|---------------|---------------|-------------------|---------------------------------------------------|---------------------|----------------|-----------------|-----------------------|
| CMOS    | AD8628      | 1           | 2.7/6                    | RRIO                      | 2.5                            | 1                             | 0.005             | 0.002                                          | 120           | 115           | 125               | 22                                                | 0.850               | 100            | SOT-23/SOIC     | 0.96                  |
|         | AD8629      | 2           |                          |                           |                                |                               |                   |                                                |               |               |                   |                                                   |                     |                | MSOP/SOIC       | 1.47                  |
|         | AD8630      | 4           |                          |                           |                                |                               |                   |                                                |               |               |                   |                                                   |                     |                | SOIC/TSSOP      | 2.73                  |
| CMOS    | ADA4528-1   | 1           | 2.2/5.5                  | RRIO                      | 4                              | 0.4                           | 0.0025            | 0.015                                          | 115           | 120           | 130               | 5.3                                               | 1.500               | 100            | MSOP/LFCSP      | 1.15                  |
|         | ADA4528-2*  | 2           |                          |                           |                                |                               |                   |                                                |               |               |                   |                                                   |                     |                |                 | 1.90                  |
| CMOS    | ADA4051-1   | 1           | 1.8/5.5                  | RRIO                      | 0.125                          | 0.06                          | 0.015             | 0.02                                           | 110           | 110           | 115               | 95                                                | 0.017               | 70             | SC70/SOT-23     | 0.93                  |
|         | ADA4051-2   | 2           |                          |                           |                                |                               |                   |                                                |               |               |                   |                                                   |                     |                |                 | 1.47                  |
| CMOS    | AD8538      | 1           | 2.7/5.5                  | RRIO                      | 0.43                           | 0.35                          | 0.013             | 0.03                                           | 115           | 105           | 115               | 50                                                | 0.180               | 25             | SOT-23/SOIC     | 0.90                  |
|         | AD8539      | 2           |                          |                           |                                |                               |                   |                                                |               |               |                   |                                                   |                     |                |                 | 1.31                  |
| CMOS    | AD8551      | 1           | 2.7/6                    | RRIO                      | 1.5                            | 0.4                           | 0.005             | 0.005                                          | 120           | 120           | 125               | 42                                                | 0.975               | 50             | MSOP/SOIC       | 1.20                  |
|         | AD8552      | 2           |                          |                           |                                |                               |                   |                                                |               |               |                   |                                                   |                     |                | SOIC/TSSOP      | 1.90                  |
|         | AD8554      | 4           |                          |                           |                                |                               |                   |                                                |               |               |                   |                                                   |                     |                | SOIC/TSSOP      | 3.36                  |
| CMOS    | AD8571      | 1           | 2.7/6                    | RRIO                      | 1.5                            | 0.4                           | 0.005             | 0.005                                          | 120           | 120           | 125               | 51                                                | 0.850               | 50             | MSOP/SOIC       | 1.11                  |
|         | AD8572      | 2           |                          |                           |                                |                               |                   |                                                |               |               |                   |                                                   |                     |                | SOIC/TSSOP      | 1.78                  |
|         | AD8574      | 4           |                          |                           |                                |                               |                   |                                                |               |               |                   |                                                   |                     |                | SOIC/TSSOP      | 3.40                  |
| CMOS    | AD8638      | 1           | 5/16                     | SS                        | 1.5                            | 2                             | 0.009             | 0.03                                           | 127           | 127           | 130               | 60                                                | 1.500               | 75             | SOT-23/SOIC     | 1.27                  |
|         | AD8639      | 2           |                          |                           |                                |                               |                   |                                                |               |               |                   |                                                   |                     |                | MSOP/SOIC/LFCSP | 2.19                  |

\*Prerelease

<sup>1</sup> RRIO: Rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes  $-V_{SY}$ ).

## Precision Amplifiers ( $V_{OS} < 1\text{ mV}$ , Bandwidth $< 50\text{ MHz}$ )

### Zero Input Crossover Distortion (ZCO) Amplifiers

#### ADA4505-2: 10 $\mu\text{A}$ , Rail-to-Rail I/O, Zero Input Crossover Distortion Amplifier

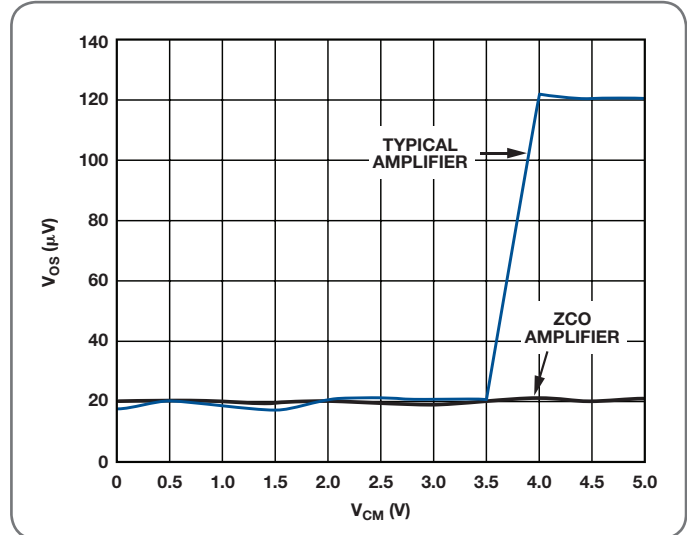
The ADA4505-x family solves the crossover distortion problem by using an on-chip charge pump to power the input differential pair. The charge pump creates a supply voltage higher than the voltage of the battery, allowing the input stage to handle a wide range of input signal voltages without using a second differential pair. With this solution, the input voltage can vary from one supply extreme to the other with no distortion, thereby restoring the full common-mode dynamic range of the op amp.

#### Features

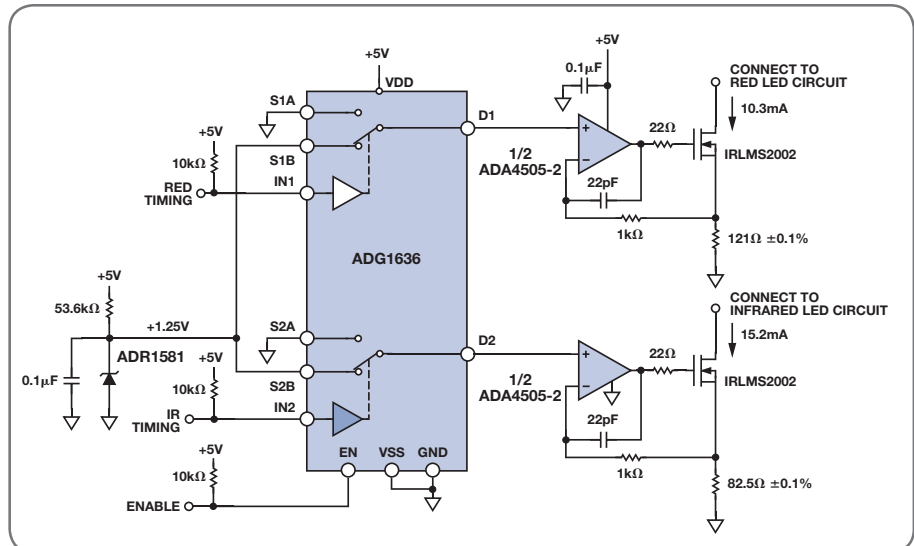
- PSRR: 100 dB minimum
- CMRR: 105 dB typical
- Very low supply current: 10  $\mu\text{A}$  per amplifier maximum
- 1.8 V to 5.5 V single-supply or  $\pm 0.9\text{ V}$  to  $\pm 2.5\text{ V}$  dual-supply operation
- Rail-to-rail input/output
- 3 mV offset voltage maximum
- Very low input bias current: 0.5 pA typical

#### Applications

- Pressure and position sensors
- Remote security
- Medical monitors
- Battery-powered consumer equipment
- Hazard detectors



Input offset voltage vs. common mode voltage.



Circuit Note CN-0125, Precision Pulse Oximeter LED Current Sink Reference Circuit, [www.analog.com/CN0125](http://www.analog.com/CN0125).

### Zero Input Crossover Distortion (ZCO) Amplifiers

| Process | Part Number            | No. of Amps | Supply Voltage (Min/Max) | Rail-to-Rail <sup>1</sup> | BW @ $A_{CL}$ Min (MHz) | Slew Rate (V/ $\mu\text{s}$ ) | $V_{OS}$ Max (mV) | $T_{CV_{OS}}$ ( $\mu\text{V}/^{\circ}\text{C}$ Typ) | CMRR Min (dB) | PSRR Min (dB) | $A_{VO}$ Min (dB) | Noise (nV/ $\sqrt{\text{Hz}}$ ) @ 1 kHz | $I_{S/Amp}$ (mA Max) | $I_B$ Max (pA) | Packaging    | Price @ 1k (OEM \$US) |
|---------|------------------------|-------------|--------------------------|---------------------------|-------------------------|-------------------------------|-------------------|-----------------------------------------------------|---------------|---------------|-------------------|-----------------------------------------|----------------------|----------------|--------------|-----------------------|
| CMOS    | ADA4505-1 <sup>2</sup> | 1           | 1.8/5.5                  | RRIO                      | 0.050                   | 0.006                         | 3                 | 2                                                   | 90            | 100           | 105               | 65                                      | 0.010                | 2              | WLCSP/SOT-23 | 0.55                  |
|         | ADA4505-2              | 2           |                          |                           |                         |                               |                   |                                                     |               |               |                   |                                         |                      |                | WLCSP/MSOP   | 0.67                  |
|         | ADA4505-4              | 4           |                          |                           |                         |                               |                   |                                                     |               |               |                   |                                         |                      |                | WLCSP/TSSOP  | 1.15                  |
| CMOS    | AD8505 <sup>2</sup>    | 1           | 1.8/5.5                  | RRIO                      | 0.095                   | 0.013                         | 2.5               | 2                                                   | 90            | 100           | 105               | 45                                      | 0.020                | 10             | WLCSP/SOT-23 | 0.59                  |
|         | AD8506                 | 2           |                          |                           |                         |                               |                   |                                                     |               |               |                   |                                         |                      |                |              | 0.71                  |
|         | AD8508                 | 4           |                          |                           |                         |                               |                   |                                                     |               |               |                   |                                         |                      |                |              | 1.20                  |

<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes  $-V_{SV}$ ).

<sup>2</sup> Check data sheet for test conditions and actual product specification—may be different for single/dual/quad amplifiers for part numbers with <sup>2</sup> mark.

# Precision Amplifiers ( $V_{OS} < 1\text{ mV}$ , Bandwidth $< 50\text{ MHz}$ )

## Overvoltage Protection (OVP) Amplifiers

### ADA4091-2/ADA4091-4: Micropower, OVP, Rail-to-Rail Input/Output Operational Amplifier

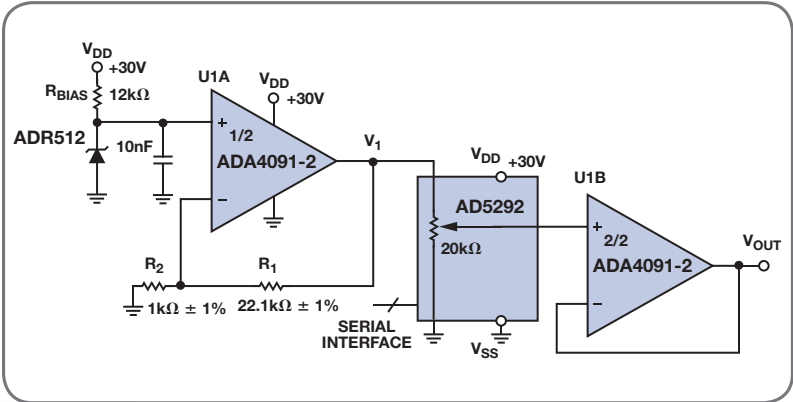
The ADA4091-2 dual and ADA4091-4 quad are micropower, single-supply, 1.2 MHz bandwidth amplifiers featuring rail-to-rail inputs and outputs. They are guaranteed to operate from a +2.7 V to +30 V single supply, as well as from  $\pm 1.35\text{ V}$  to  $\pm 15\text{ V}$  dual supplies. The ADA4091 family features a unique input stage that allows the input voltage to exceed either supply safely without any phase reversal or latch-up; this is called overvoltage protection, or OVP.

#### Features

- Single-supply operation: 2.7 V to 36 V
- Rail-to-rail output swing
- Low supply current: 200  $\mu\text{A}$ /amplifier
- Wide bandwidth: 1.2 MHz
- Low offset voltage: 250  $\mu\text{V}$  maximum
- No phase reversal
- Overvoltage protection (OVP)
- 25 V above/below supply rails at  $\pm 5\text{ V}$
- 12 V above/below supply rails at  $\pm 15\text{ V}$

#### Applications

- Industrial process control
- Battery-powered instrumentation
- Power supply control and protection
- Telecommunications
- Remote sensors
- Low voltage strain gage amplifiers
- DAC output amplifiers



Circuits  
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Reference Circuits

Circuit Note CN-0111, Low Cost, High Voltage, Unipolar DAU Reference Circuit,  
[www.analog.com/CN0111](http://www.analog.com/CN0111).

### Overvoltage Protection (OVP) Amplifiers

| Process | Part Number | No. of Amps | Supply Voltage (Min/Max) | Rail-to-Rail¹ | BW @ A <sub>CL</sub> Min (MHz) | Slew Rate (V/ $\mu\text{s}$ ) | $V_{OS}$ Max (mV) | $TcV_{OS}$ ( $\mu\text{V}/^\circ\text{C}$ Typ) | CMRR Min (dB) | PSRR Min (dB) | $A_{VO}$ Min (dB) | Noise (nV/ $\sqrt{\text{Hz}}$ ) @ 1 kHz | $I_S$ /Amp (mA Max) | OVP Level (V) | Packaging       | Price @ 1k (DEM \$US) |
|---------|-------------|-------------|--------------------------|---------------|--------------------------------|-------------------------------|-------------------|------------------------------------------------|---------------|---------------|-------------------|-----------------------------------------|---------------------|---------------|-----------------|-----------------------|
| Bipolar | OP191       | 1           |                          |               |                                |                               |                   |                                                |               |               |                   |                                         |                     | 10            | SOIC            | 1.69                  |
|         | OP291       | 2           | 2.7/12                   | RRIO          | 1.5                            | 0.5                           | 0.5               | 1.1                                            | 75            | 80            | 88                | 42                                      | 0.420               | 10            | SOIC            | 2.22                  |
|         | OP491       | 4           |                          |               |                                |                               |                   |                                                |               |               |                   |                                         |                     | 25            | SOIC/TSSOP/PDIP | 3.60                  |
| Bipolar | ADA4091-2   | 2           | $\pm 1.35/\pm 18$        | RRIO          | 1.27                           | 0.46                          | 0.25              | 2.5                                            | 104           | 108           | 116               | 25                                      | 0.250               | 12            | SOIC/LFCSP      | 2.22                  |
|         | ADA4091-4   | 4           |                          |               |                                |                               |                   |                                                |               |               |                   |                                         |                     |               | LFCSP/TSSOP     | 3.50                  |
| Bipolar | ADA4092-4   | 4           | $\pm 1.35/\pm 18$        | RRIO          | 1.4                            | 0.4                           | 1.5               | 2.5                                            | 90            | 98            | 116               | 30                                      | 0.250               | 12            | TSSOP           | 2.50                  |

¹ RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes  $-V_{SS}$ ).

## Precision Amplifiers (Bandwidth < 50 MHz)

### Ultralow Offset Voltage ( $V_{OS} \leq 250 \mu\text{V}$ Max) Amplifiers

#### AD8597/AD8599: Ultralow Distortion, Ultralow Noise Operational Amplifier

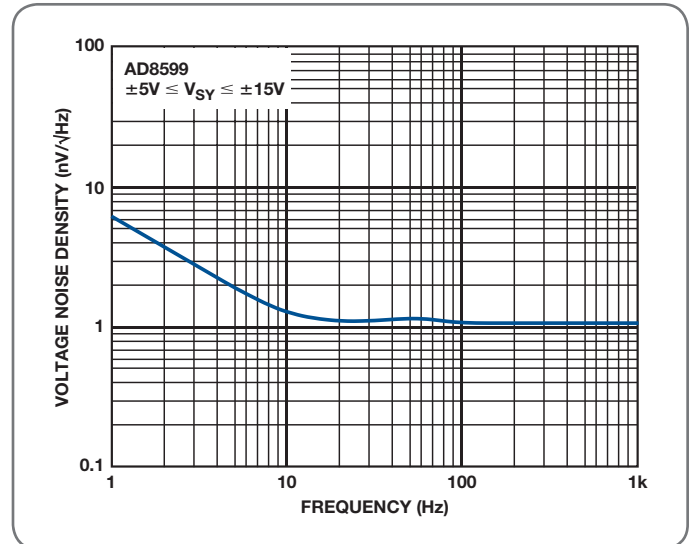
The **AD8597** (single) and **AD8599** (dual) are very low noise, low distortion operational amplifiers ideal for use as preamplifiers. The low noise of  $1.1 \text{ nV}/\sqrt{\text{Hz}}$  and low harmonic distortion of  $-120 \text{ dB}$  (or better) at audio bandwidths give the devices the wide dynamic range necessary for preamplifiers in audio, medical, and instrumentation applications. The excellent slew rate of  $14 \text{ V}/\mu\text{s}$  and  $10 \text{ MHz}$  gain bandwidth make them highly suitable for medical applications. The low distortion and fast settling time make them ideal for buffering of high resolution data converters.

#### Features

- Low noise:  $1.1 \text{ nV}/\sqrt{\text{Hz}}$  at  $1 \text{ kHz}$
- Low distortion:  $-120 \text{ dB THD}$  @  $1 \text{ kHz}$
- Bandwidth:  $10 \text{ MHz}$
- Supply current:  $4.8 \text{ mA/amp}$  typical
- Low offset voltage:  $10 \mu\text{V}$  typical
- CMRR:  $120 \text{ dB}$

#### Applications

- Professional audio preamplifiers
- ATE/precision testers
- Imaging systems
- Medical/physiologic measurements
- Precision data conversion



Voltage noise density vs. frequency.

#### AD8622: Dual, Low Power, Low Noise, Precision Amplifier

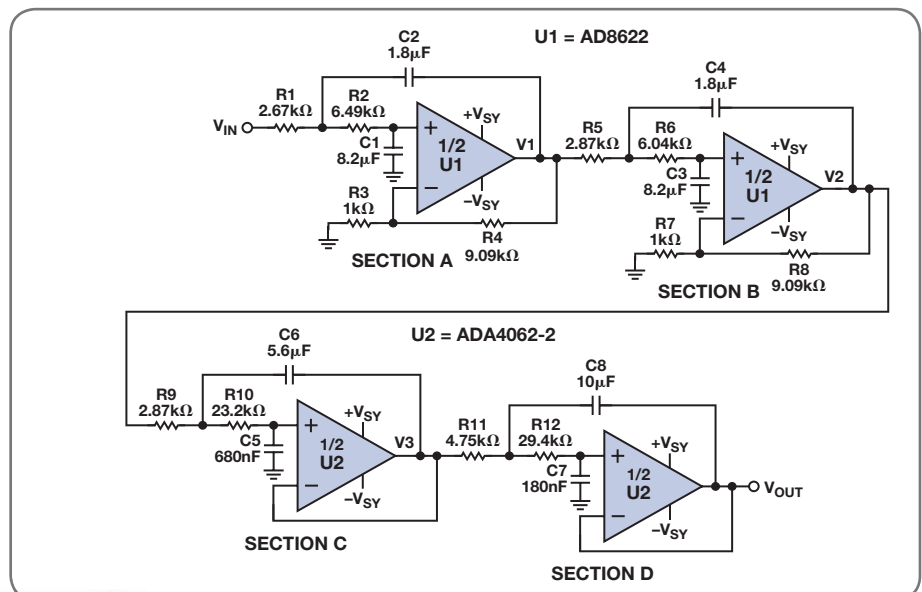
The **AD8622** is a dual, precision, rail-to-rail output operational amplifier with a low supply current of only  $350 \mu\text{A}$  maximum over temperature and supply voltage. It also offers ultralow offset, drift, and voltage noise combined with very low input bias current over the full operating temperature range. It is perfectly suited for applications where large error sources cannot be tolerated.

#### Features

- Very low offset voltage:  $125 \mu\text{A}$  maximum
- Supply current:  $215 \mu\text{A/amp}$  typical
- Input bias current:  $200 \text{ pA}$  maximum
- Low input offset voltage drift:  $1.2 \mu\text{V}/^\circ\text{C}$  maximum
- Very low voltage noise:  $11 \text{ nV}/\sqrt{\text{Hz}}$

#### Applications

- Portable precision instrumentation
- Laser diode control loops
- Medical instrumentation
- Strain gage amplifier
- Thermocouple amplifiers



**Circuits**  
from the **Lab**  
Reference Circuits

Circuit Note CN-0127, 8-Pole Active Low-Pass Filter Optimized for Precision, Low Noise, and High Gain Reference Circuit, [www.analog.com/CN0127](http://www.analog.com/CN0127).

**Ultralow Offset Voltage ( $V_{os} \leq 250 \mu V$  Max) Amplifiers**

| Process      | Part Number | No. of Amps | Supply Voltage (Min/Max) | Rail-to-Rail <sup>1</sup> | BW @ $A_{CL}$ Min (MHz) | Slew Rate (V/ $\mu s$ ) | $V_{os}$ Max (mV) | $TcV_{os}$ ( $\mu V/^{\circ}C$ Typ) | CMRR Min (dB) | PSRR Min (dB) | $A_{VO}$ Min (dB) | Noise (nV/ $\sqrt{Hz}$ ) @ 1 kHz | $I_s$ /Amp (mA Max) | $I_b$ Max | Packaging                              | Price @ 1k (OEM \$US) |
|--------------|-------------|-------------|--------------------------|---------------------------|-------------------------|-------------------------|-------------------|-------------------------------------|---------------|---------------|-------------------|----------------------------------|---------------------|-----------|----------------------------------------|-----------------------|
| CMOS         | AD8628      | 1           | 2.7/6                    | RRIO                      | 2.5                     | 1                       | 0.005             | 0.002                               | 120           | 115           | 125               | 22                               | 0.850               | 100 pA    | SOT-23/SOIC<br>MSOP/SOIC<br>SOIC/TSSOP | 0.96                  |
|              | AD8629      | 2           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 1.47                  |
|              | AD8630      | 4           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 2.73                  |
| CMOS         | AD8551      | 1           | 2.7/6                    | RRIO                      | 1.5                     | 0.4                     | 0.005             | 0.005                               | 120           | 120           | 125               | 42                               | 0.975               | 50 pA     | MSOP/SOIC<br>SOIC/TSSOP<br>SOIC/TSSOP  | 1.20                  |
|              | AD8552      | 2           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 1.90                  |
|              | AD8554      | 4           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 3.36                  |
| CMOS         | AD8571      | 1           | 2.7/6                    | RRIO                      | 1.5                     | 0.4                     | 0.005             | 0.005                               | 120           | 120           | 125               | 51                               | 0.850               | 50 pA     | MSOP/SOIC<br>SOIC/TSSOP<br>SOIC/TSSOP  | 1.11                  |
|              | AD8572      | 2           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 1.78                  |
|              | AD8574      | 4           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 3.40                  |
| CMOS         | AD8638      | 1           | 5/16                     | SS                        | 1.5                     | 2                       | 0.009             | 0.03                                | 127           | 127           | 130               | 60                               | 1.500               | 75 pA     | SOT-23/SOIC<br>MSOP/SOIC/LFCSP         | 1.18                  |
|              | AD8639      | 2           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 1.86                  |
| CMOS         | ADA4528-1   | 1           | 2.2/5.5                  | RRIO                      | 4                       | 0.4                     | 0.0025            | 0.015                               | 115           | 120           | 130               | 5.3                              | 1.500               | 100 pA    | MSOP/LFCSP                             | 1.15                  |
|              | ADA4528-2*  | 2           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 1.90                  |
| CMOS         | AD8538      | 1           | 2.7/5.5                  | RRIO                      | 0.43                    | 0.35                    | 0.013             | 0.03                                | 115           | 105           | 115               | 50                               | 0.180               | 25 pA     | SOT-23/SOIC<br>MSOP/SOIC               | 0.90                  |
|              | AD8539      | 2           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 1.31                  |
| CMOS         | ADA4051-1   | 1           | 1.8/5.5                  | RRIO                      | 0.125                   | 0.06                    | 0.015             | 0.02                                | 110           | 110           | 115               | 95                               | 0.017               | 70 pA     | SC70/SOT-23<br>MSOP/LFCSP              | 0.93                  |
|              | ADA4051-2   | 2           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 1.47                  |
| Bipolar      | AD8676B     | 2           | $\pm 5/\pm 18$           | RRO                       | 10                      | 2.5                     | 0.05              | 0.2                                 | 111           | 106           | 123               | 2.8                              | 3.400               | 2 nA      | MSOP/SOIC                              | 2.14                  |
| Bipolar      | AD8675      | 1           | $\pm 5/\pm 18$           | RRO                       | 10                      | 2.5                     | 0.075             | 0.2                                 | 114           | 120           | 123               | 2.8                              | 2.900               | 2 nA      | MSOP/SOIC                              | 1.18                  |
| Bipolar      | AD8671      | 1           | $\pm 5/\pm 18$           |                           | 10                      | 4                       | 0.075             | 0.3                                 | 100           | 110           | 120               | 2.8                              | 3.500               | 12 nA     | MSOP/SOIC<br>MSOP/SOIC<br>SOIC/TSSOP   | 1.06                  |
|              | AD8672      | 2           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 1.72                  |
|              | AD8674      | 4           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 3.24                  |
| JFET         | AD8610B     | 1           | $\pm 5/\pm 13$           |                           | 25                      | 60                      | 0.1               | 0.5                                 | 90            | 100           | 100               | 6                                | 3.500               | 10 pA     | MSOP/SOIC<br>SOIC                      | 9.86                  |
|              | AD8620B     | 2           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 16.70                 |
| Bipolar      | AD8676A     | 2           | $\pm 5/\pm 18$           | RRO                       | 10                      | 2.5                     | 0.1               | 0.2                                 | 111           | 106           | 123               | 2.8                              | 3.400               | 2 nA      | MSOP/SOIC                              | 1.66                  |
| Bipolar      | AD8597      | 1           | $\pm 4.5/\pm 18$         |                           | 10                      | 16.8                    | 0.12              | 0.8                                 | 120           | 120           | 110               | 1.07                             | 5.700               | 200 nA    | SOIC/LFCSP<br>SOIC                     | 2.25                  |
|              | AD8599      | 2           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 3.24                  |
| Bipolar      | ADA4004-1   | 1           | $\pm 5/\pm 18$           |                           | 12                      | 2.7                     | 0.125             | 0.7                                 | 110           | 110           | 114               | 1.8                              | 2.200               | 90 nA     | SOT-23/SOIC<br>MSOP/SOIC<br>SOIC/LFCSP | 1.75                  |
|              | ADA4004-2   | 2           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 2.65                  |
|              | ADA4004-4   | 4           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 4.25                  |
| Bipolar      | AD8622      | 2           | $\pm 2.5/\pm 18$         | RRO                       | 0.56                    | 0.48                    | 0.125             | 0.5                                 | 125           | 125           | 125               | 11                               | 0.250               | 200 pA    | MSOP/SOIC<br>LFCSP/TSSOP               | 2.30                  |
|              | AD8624      | 4           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 3.75                  |
| Bipolar      | AD8677      | 1           | $\pm 4/\pm 18$           |                           | 0.6                     | 0.2                     | 0.13              | 0.5                                 | 120           | 115           | 120               | 10                               | 1.300               | 1 nA      | SOT-23/SOIC                            | 0.76                  |
| CMOS         | AD8661      | 1           | 5/16                     | SS                        | 4                       | 3.5                     | 0.16              | 4                                   | 90            | 95            | 106               | 12                               | 1.550               | 1 pA      | SOIC/LFCSP<br>MSOP/SOIC<br>SOIC/TSSOP  | 1.08                  |
|              | AD8662      | 2           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 1.37                  |
|              | AD8664      | 4           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 2.23                  |
| JFET         | ADA4627-1B  | 1           | $\pm 4/\pm 18$           |                           | 19                      | 84                      | 0.2               | 1                                   | 106           | 106           | 112               | 6.1                              | 7.500               | 5 pA      | SOIC/LFCSP                             | 10.75                 |
| CMOS         | AD8655      | 1           | 2.7/5.5                  | RRIO                      | 28                      | 11                      | 0.25              | 0.4                                 | 85            | 88            | 100               | 2.7 <sup>2</sup>                 | 4.500               | 10 pA     | MSOP/SOIC<br>MSOP/SOIC                 | 0.71                  |
|              | AD8656      | 2           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 1.11                  |
| JFET         | AD8610A     | 1           | $\pm 5/\pm 13$           |                           | 25                      | 60                      | 0.25              | 0.8                                 | 90            | 100           | 100               | 6                                | 3.500               | 10 pA     | MSOP/SOIC<br>SOIC                      | 3.75                  |
|              | AD8620A     | 2           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 7.50                  |
| JFET         | AD549K      | 1           | $\pm 2.5/\pm 18$         |                           | 5                       | 3                       | 0.25              | 5                                   | 90            | 90            | 109               | 35                               | 0.700               | 100 fA    | Header                                 | 19.11                 |
| Bipolar      | ADA4091-2   | 2           | $\pm 1.35/\pm 18$        | RRIO                      | 1.27                    | 0.46                    | 0.25              | 2.5                                 | 104           | 108           | 116               | 25                               | 0.250               | 55 nA     | SOIC/LFCSP<br>LFCSP/TSSOP              | 2.22                  |
|              | ADA4091-4   | 4           |                          |                           |                         |                         |                   |                                     |               |               |                   |                                  |                     |           |                                        | 3.50                  |
| Bipolar-JFET | OP285       | 2           | $\pm 4.5/\pm 18$         |                           | 9                       | 22                      | 0.25              | 1                                   | 80            | 85            | 108               | 6                                | 2.500               | 350 nA    | SOIC/PDIP                              | 2.40                  |

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<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes  $-V_{SY}$ ).

Precision Amplifiers ( $V_{OS} < 1\text{ mV}$ , Bandwidth  $< 50\text{ MHz}$ )

Low Offset Voltage ( $V_{OS} \leq 1\text{ mV}$ )

AD8657: Precision, Micropower, 18 V CMOS RRIO Op Amplifier

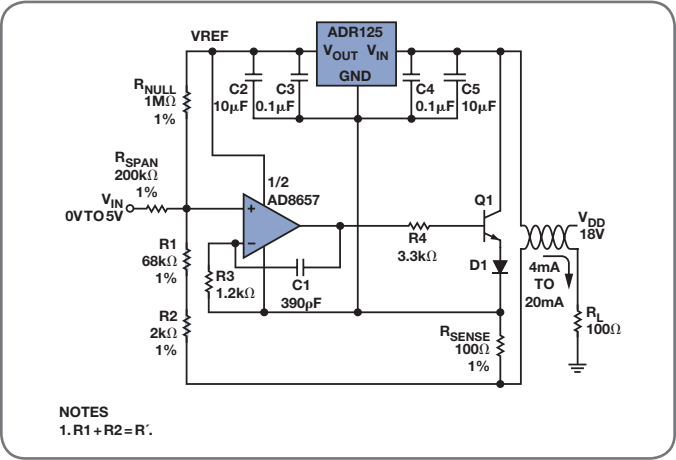
The AD8657 is a dual, precision, micropower, rail-to-rail input/output (RRIO) amplifier optimized for low power and wide operating supply voltage range applications. The device operates from 2.7 V up to 18 V with a typical quiescent supply current of 18  $\mu\text{A}$  and achieves low offset voltage thanks to Analog Devices' patented DigiTrim trimming technique. The AD8657 also has high immunity to electromagnetic interference. The combination of low supply current, low offset voltage, very low input bias current, wide supply range, and rail-to-rail input and output makes the AD8657 ideal for current monitoring and current loops in process and motor control applications. In addition, the precision specifications make this device well suited for dc gain and buffering of sensor front ends or high impedance input sources in wireless or remote sensors or transmitters

Features

- Micropower at high voltage (18 V): 18  $\mu\text{A}$  typical
- Low offset voltage: 350  $\mu\text{V}$  maximum
- Single-supply operation: 2.7 V to 18 V
- Dual-supply operation:  $\pm 1.35\text{ V}$  to  $\pm 9\text{ V}$
- Low input bias current: 20 pA
- Gain bandwidth: 200 kHz
- Unity-gain stable
- Excellent electromagnetic interference immunity

Applications

- Portable operating systems
- Current monitors
- 4 mA to 20 mA loop drivers
- Buffer/level shifting
- Multipole filters
- Remote/wireless sensors
- Low power transimpedance amplifiers



4 mA to 20 mA current loop transmitter.

Low Offset Voltage ( $V_{OS} \leq 1\text{ mV}$ ) Amplifiers

| Process | Part Number | No. of Amps | Supply Voltage (Min/Max) | $V_{OS}$ Max (mV) | $T_C V_{OS}$ ( $\mu\text{V}/^\circ\text{C}$ Typ) | Rail-to-Rail <sup>1</sup> | BW @ $A_{CL}$ Min (MHz) | Slew Rate (V/ $\mu\text{s}$ ) | CMRR Min (dB) | PSRR Min (dB) | $A_{VO}$ Min (dB) | Noise (nV/ $\sqrt{\text{Hz}}$ ) @ 1 kHz | $I_S$ /Amp (mA Max) | $I_O$ Max  | Packaging       | Price @ 1k (OEM \$US) |
|---------|-------------|-------------|--------------------------|-------------------|--------------------------------------------------|---------------------------|-------------------------|-------------------------------|---------------|---------------|-------------------|-----------------------------------------|---------------------|------------|-----------------|-----------------------|
| CMOS    | AD8603      | 1           | 1.8/6                    | 0.3               | 1                                                | RRIO                      | 0.4                     | 0.1                           | 85            | 80            | 112               | 25                                      | 0.040               | 1 pA       | SOT-23          | 0.68                  |
|         | AD8607      | 2           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | MSOP/SOIC       | 1.02                  |
|         | AD8609      | 4           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | SOIC/TSSOP      | 1.85                  |
| CMOS    | AD8605      | 1           | 2.7/6                    | 0.3               | 1                                                | RRIO                      | 10                      | 5                             | 85            | 80            | 109               | 8                                       | 1.200               | 1 pA       | WLCSP/SOT-23    | 0.68                  |
|         | AD8606      | 2           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | WLCSP/MSOP/SOIC | 1.19                  |
|         | AD8608      | 4           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | SOIC/TSSOP      | 1.58                  |
| CMOS    | AD8663      | 1           | 5/16                     | 0.3               | 1.5                                              | SS                        | 0.54                    | 0.6                           | 87            | 95            | 115               | 23                                      | 0.285               | 0.3 pA typ | SOIC/LFCSP      | 1.17                  |
|         | AD8667      | 2           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | MSOP/SOIC       | 1.58                  |
|         | AD8669      | 4           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | SOIC/TSSOP      | 2.70                  |
| CMOS    | AD8657      | 2           | 2.7/18                   | 0.3               | 4                                                | RRIO                      | 0.175                   | 0.3                           | 95            | 105           | 110               | 50                                      | 0.022               | 5 pA       | MSOP/SOIC       | 0.95                  |
|         | AD8659*     | 4           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | SOIC/LFCSP      | 1.35                  |
|         | ADA4627-1A  | 1           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | SOIC/LFCSP      | 6.75                  |
| CMOS    | AD8651      | 1           | 2.7/5.5                  | 0.35              | 4                                                | RRIO                      | 50                      | 41                            | 80            | 76            | 100               | 4.5 <sup>2</sup>                        | 14.000              | 10 pA      | MSOP/SOIC       | 1.13                  |
|         | AD8652      | 2           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | MSOP/SOIC       | 1.99                  |
|         | AD8510B     | 1           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | MSOP/SOIC       | 2.33                  |
| JFET    | AD8512B     | 2           | $\pm 5/\pm 18$           | 0.4               | 1                                                |                           | 8                       | 20                            | 86            | 86            | 101               | 8                                       | 2.500               | 80 pA      | MSOP/SOIC       | 4.76                  |
|         | AD8601A     | 1           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | SOT-23          | 0.62                  |
|         | AD8602A     | 2           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | MSOP/SOIC       | 0.83                  |
| CMOS    | AD8604A     | 4           | 2.7/6                    | 0.5               | 2                                                | RRIO                      | 8.2                     | 5.2                           | 74            | 67            | 89                | 33                                      | 1.200               | 60 pA      | SOIC/TSSOP      | 1.13                  |
|         | AD8615      | 1           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | SOT-23          | 0.76                  |
|         | AD8616      | 2           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | MSOP/SOIC       | 1.29                  |
| CMOS    | AD8618      | 4           | 2.7/6                    | 0.5               | 1.5                                              | RRIO                      | 24                      | 12                            | 80            | 70            | 105               | 10                                      | 1.300               | 1 pA       | SOIC/TSSOP      | 2.29                  |
|         | AD8627      | 1           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | SC70/SOIC       | 1.60                  |
|         | AD8626      | 2           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | MSOP/SOIC       | 2.63                  |
| JFET    | AD8625      | 4           | $\pm 5/\pm 13$           | 0.75              | 2.5                                              | SS                        | 5                       | 5                             | 76            | 80            | 103               | 16                                      | 0.850               | 1 pA       | SOIC/TSSOP      | 4.09                  |
|         | AD8641      | 1           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | SC70/SOIC       | 1.47                  |
|         | AD8642      | 2           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | MSOP/SOIC       | 2.35                  |
| JFET    | AD8643      | 4           | $\pm 2.5/\pm 13$         | 0.75              | 2.5                                              | SS                        | 3.5                     | 3                             | 90            | 90            | 106               | 27.5                                    | 0.290               | 1 pA       | SOIC/LFCSP      | 3.85                  |
|         | Bipolar     | 2           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | SOIC/LFCSP      | 0.75                  |
|         | ADA4075-2   | 2           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | SC70            | 0.71                  |
| CMOS    | AD8500      | 1           | $\pm 1.8/\pm 5.5$        | 1                 | 3                                                | RRIO                      | 0.007                   | 0.004                         | 75            | 90            | 98                | 190                                     | 0.001               | 10 pA      | MSOP/SOIC       | 0.95                  |
|         | AD8510A     | 1           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | MSOP/SOIC       | 1.49                  |
|         | AD8512A     | 2           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | SOIC/TSSOP      | 3.71                  |
| JFET    | AD8513A     | 4           | $\pm 4.5/\pm 18$         | 1                 | 10                                               |                           | 3.5                     | 9                             | 70            | 92            | 86                | 36                                      | 0.250               | 20 pA      | MSOP/SOIC       | 1.66                  |
|         | AD8682      | 2           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | SOIC/TSSOP      | 2.44                  |
|         | AD8684      | 4           |                          |                   |                                                  |                           |                         |                               |               |               |                   |                                         |                     |            | SOIC/TSSOP      | 2.44                  |

\*Prerelease

<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes  $-V_{SS}$ ).

# Precision Amplifiers ( $V_{OS} < 1\text{ mV}$ , Bandwidth $< 50\text{ MHz}$ )

## Low Power ( $I_S/\text{Amp} \leq 1\text{ mA}$ ) Amplifiers

### AD8500: Micropower, Precision CMOS Operational Amplifier

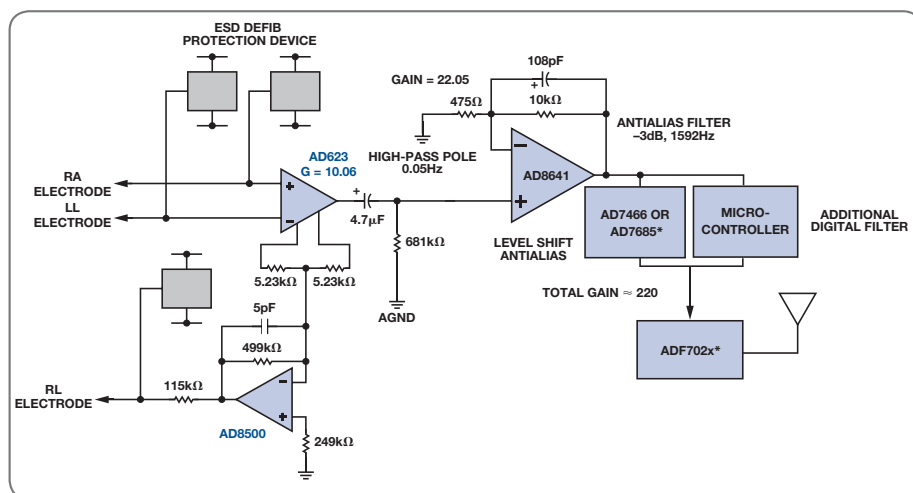
The **AD8500** is a low power, precision CMOS op amp featuring a maximum supply current of  $1\text{ }\mu\text{A}$ . The **AD8500** has a maximum offset voltage of  $1\text{ mV}$  and a typical input bias current of  $1\text{ pA}$ , and it operates rail-to-rail on both the input and output. The **AD8500** can operate from a single-supply voltage of  $+1.8\text{ V}$  to  $+5.5\text{ V}$  or a dual-supply voltage of  $\pm 0.9\text{ V}$  to  $\pm 2.75\text{ V}$ .

#### Features

- Supply current:  $1\text{ }\mu\text{A}$  maximum
- Offset voltage:  $1\text{ mV}$  maximum
- Single-supply or dual-supply operation
- Rail-to-rail input and output
- No phase reversal
- Unity-gain stable

#### Applications

- Portable equipment
- Remote sensors
- Low power filters
- Threshold detectors



ECG signal chain using a micropower precision CMOS op amp.

## Low Power ( $I_S/\text{AMP} \leq 1\text{ mA}$ ) Amplifiers

| Process | Part Number         | No. of Amps | Supply Voltage (Min/Max) | $I_S/\text{Amp}$ (mA Max) | Rail-to-Rail <sup>1</sup> | BW @ $A_{CL}$ Min (MHz) | Slew Rate (V/ $\mu\text{s}$ ) | $V_{OS}$ Max (mV) | $TcV_{OS}$ ( $\mu\text{V}/^\circ\text{C}$ Typ) | CMRR Min (dB) | PSRR Min (dB) | $A_{VO}$ Min (dB) | Noise (nV/ $\sqrt{\text{Hz}}$ ) @ 1 kHz | $I_S$ Max (pA) | Packaging        | Price @ 1k (OEM \$US) |
|---------|---------------------|-------------|--------------------------|---------------------------|---------------------------|-------------------------|-------------------------------|-------------------|------------------------------------------------|---------------|---------------|-------------------|-----------------------------------------|----------------|------------------|-----------------------|
| CMOS    | AD8500              | 1           | 1.8/5.5                  | 0.001                     | RRIO                      | 0.007                   | 0.004                         | 1                 | 3                                              | 75            | 90            | 98                | 190                                     | 10             | SC70             | 0.71                  |
| CMOS    | AD8502              | 2           | 1.8/5.5                  | 0.001                     | RRIO                      | 0.007                   | 0.004                         | 3                 | 5                                              | 67            | 85            | 98                | 190                                     | 10             | SOT-23           | 0.70                  |
|         | AD8504              | 4           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | TSSOP            | 1.00                  |
| CMOS    | ADA4505-1*          | 1           | 1.8/5.5                  | 0.010                     | RRIO                      | 0.050                   | 0.006                         | 3                 | 2                                              | 90            | 100           | 105               | 65                                      | 2              | WLCSP/SOT-23     | 0.55                  |
|         | ADA4505-2           | 2           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | WLCSP/MSOP       | 0.67                  |
|         | ADA4505-4           | 4           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | WLCSP/TSSOP      | 1.15                  |
| CMOS    | ADA4051-1           | 1           | 1.8/5.5                  | 0.017                     | RRIO                      | 0.125                   | 0.06                          | 0.015             | 0.02                                           | 110           | 110           | 115               | 95                                      | 70             | SC70/SOT-23      | 0.93                  |
|         | ADA4051-2           | 2           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | MSOP/LFCSP       | 1.47                  |
| CMOS    | AD8505 <sup>2</sup> | 1           | 1.8/5.5                  | 0.020                     | RRIO                      | 0.095                   | 0.013                         | 2.5               | 2                                              | 90            | 100           | 105               | 45                                      | 10             | WLCSP/SOT-23     | 0.59                  |
|         | AD8506              | 2           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | WLCSP/MSOP       | 0.71                  |
|         | AD8508              | 4           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | WLCSP/TSSOP      | 1.20                  |
| CMOS    | AD8657              | 2           | 2.7/18                   | 0.022                     | RRIO                      | 0.175                   | 0.3                           | 0.3               | 4                                              | 95            | 105           | 110               | 50                                      | 5              | MSOP/SOIC        | 0.95                  |
|         | AD8659*             | 4           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | SOIC/LFCSP       | 1.35                  |
| CMOS    | AD8603              | 1           | 1.8/6                    | 0.040                     | RRIO                      | 0.4                     | 0.1                           | 0.3               | 1                                              | 85            | 80            | 112               | 25                                      | 1              | SOT-23           | 0.68                  |
|         | AD8607              | 2           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | MSOP/SOIC        | 1.02                  |
|         | AD8609              | 4           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | SOIC/TSSOP       | 1.85                  |
| CMOS    | AD8613              | 1           | 1.8/5.5                  | 0.040                     | RRIO                      | 0.4                     | 0.1                           | 2.2               | 1                                              | 68            | 67            | 107               | 25                                      | 1              | SC70/SOT-23      | 0.46                  |
|         | AD8617              | 2           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | MSOP/SOIC        | 0.71                  |
|         | AD8619              | 4           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | SOIC/TSSOP       | 1.11                  |
| CMOS    | AD8541              | 1           | 2.7/6                    | 0.045                     | RRIO                      | 1                       | 0.92                          | 6                 | 4                                              | 40            | 65            | 86                | 40                                      | 60             | SC70/SOT-23/SOIC | 0.27                  |
|         | AD8542              | 2           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | MSOP/SOIC/TSSOP  | 0.38                  |
|         | AD8544              | 4           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | SOIC/TSSOP       | 0.54                  |
| CMOS    | AD8538              | 2           | 2.7/5.5                  | 0.180                     | RRIO                      | 0.43                    | 0.35                          | 0.013             | 0.03                                           | 115           | 105           | 115               | 50                                      | 25             | SOT-23/SOIC      | 0.90                  |
|         | AD8539              | 4           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | MSOP/SOIC        | 1.31                  |
| JFET    | ADA4062-2A          | 2           | $\pm 4/\pm 18$           | 0.220                     |                           | 1.4                     | 3.3                           | 2.5               | 4                                              | 73            | 74            | 76                | 36                                      | 50             | MSOP/SOIC/LFCSP  | 0.75                  |
|         | ADA4062-4A          | 4           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | LFCSP/TSSOP      | 1.21                  |
| JFET    | ADA4062-2B          | 2           | $\pm 4/\pm 18$           | 0.220                     |                           | 1.4                     | 3.3                           | 1.5               | 4                                              | 80            | 80            | 76                | 36                                      | 50             | SOIC             | 1.25                  |
| CMOS    | ADA4692-2           | 2           | 2.7/6                    | 0.225                     | SS                        | 3.6                     | 1.3                           | 2.5               | 1                                              | 75            | 80            | 95                | 16                                      | 5              | SOIC/LFCSP       | 0.55                  |
|         | ADA4692-4           | 4           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | TSSOP            | 0.90                  |
| CMOS    | ADA4691-2SD         | 2           | 2.7/6                    | 0.225                     | SS                        | 3.6                     | 1.3                           | 2.5               | 1                                              | 75            | 80            | 95                | 16                                      | 5              | WLCSP/LFCSP      | 0.57                  |
|         | ADA4691-4SD         | 4           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | LFCSP            | 0.99                  |
| JFET    | OP282               | 2           | $\pm 4.5/\pm 18$         | 0.250                     |                           | 4                       | 9                             | 3                 | 10                                             | 70            | 110           | 86                | 36                                      | 100            | MSOP/SOIC        | 1.31                  |
|         | OP482               | 4           |                          |                           |                           |                         |                               |                   |                                                |               |               |                   |                                         |                | SOIC/PDIP        | 2.06                  |

\*Prerelease



## Low Power ( $I_s/\text{Amp} \leq 1\text{mA}$ ) Amplifiers (continued)

| Process | Part Number                         | No. of Amps | Supply Voltage (Min/Max) | $I_s/\text{Amp}$ (mA Max) | Rail-to-Rail <sup>1</sup> | BW @ $A_{CL}$ Min (MHz) | Slew Rate (V/ $\mu\text{s}$ ) | $V_{OS}$ Max (mV) | $\text{TCV}_{OS}$ ( $\mu\text{V}/^\circ\text{C}$ Typ) | CMRR Min (dB) | PSRR Min (dB) | $A_{VO}$ Min (dB) | Noise ( $\text{nV}/\sqrt{\text{Hz}}$ ) @ 1 kHz | $I_s$ Max  | Packaging                                    | Price @ 1k (OEM \$US) |
|---------|-------------------------------------|-------------|--------------------------|---------------------------|---------------------------|-------------------------|-------------------------------|-------------------|-------------------------------------------------------|---------------|---------------|-------------------|------------------------------------------------|------------|----------------------------------------------|-----------------------|
| JFET    | AD8682<br>AD8684                    | 2<br>4      | $\pm 4.5/\pm 18$         | 0.250                     |                           | 3.5                     | 9                             | 1                 | 10                                                    | 70            | 92            | 86                | 36                                             | 20 pA      | MSOP/SOIC<br>SOIC/TSSOP                      | 1.66<br>2.44          |
| Bipolar | AD8622<br>AD8624                    | 2<br>4      | $\pm 2.5/\pm 18$         | 0.250                     | RRO                       | 0.56                    | 0.48                          | 0.125             | 0.5                                                   | 125           | 125           | 125               | 11                                             | 200 pA     | MSOP/SOIC<br>LFCSP/TSSOP                     | 2.30<br>3.75          |
| Bipolar | ADA4091-2<br>ADA4091-4              | 2<br>4      | $\pm 1.35/\pm 18$        | 0.250                     | RRIO                      | 1.27                    | 0.46                          | 0.25              | 2.5                                                   | 104           | 108           | 116               | 25                                             | 55 nA      | SOIC/LFCSP<br>LFCSP/TSSOP                    | 2.22<br>3.50          |
| Bipolar | ADA4092-2*<br>ADA4092-4             | 2<br>4      | $\pm 1.35/\pm 18$        | 0.250                     | RRIO                      | 1.4                     | 0.4                           | 1.5               | 2.5                                                   | 90            | 98            | 116               | 30                                             | 60 nA      | SOIC/LFCSP<br>TSSOP                          | 1.35<br>2.50          |
| CMOS    | AD8663<br>AD8667<br>AD8669          | 1<br>2<br>4 | 5/16                     | 0.285                     | SS                        | 0.54                    | 0.6                           | 0.3               | 1.5                                                   | 87            | 95            | 115               | 23                                             | 0.3 pA typ | SOIC/LFCSP<br>MSOP/SOIC<br>SOIC/TSSOP        | 1.17<br>1.58<br>2.70  |
| JFET    | AD8641<br>AD8642<br>AD8643          | 1<br>2<br>4 | $\pm 2.5/\pm 13$         | 0.290                     | SS                        | 3.5                     | 3                             | 0.75              | 2.5                                                   | 90            | 90            | 106               | 27.5                                           | 1 pA       | SC70/SOIC<br>MSOP/SOIC<br>SOIC/LFCSP         | 1.47<br>2.35<br>3.85  |
| BP      | AD8631                              | 1           | 1.8/6                    | RRIO                      | SS                        | 3                       | 4                             | 3.5               | 63                                                    | 75            | 100           | 23                | 0.450                                          | 250 nA     | SOT-23                                       | 0.33                  |
| CMOS    | ADA4665-2                           | 2           | 5/16                     | 0.400                     | RRIO                      | 1.2                     | 1                             | 6                 | 3                                                     | 55            | 70            | 85                | 32                                             | 1 pA       | MSOP/SOIC                                    | 0.70                  |
| CMOS    | AD8515                              | 1           | 1.8                      | 0.550                     | RRIO                      | 5                       | 2.7                           | 6                 | 4                                                     | 60            | 65            | 113               | 22                                             | 30 pA      | SC70/SOT-23                                  | 0.28                  |
| JFET    | AD549J                              | 1           | $\pm 2.5/\pm 18$         | 0.700                     |                           | 5                       | 3                             | 1                 | 20                                                    | 80            | 80            | 109               | 35                                             | 250 fA     | TO-99                                        | 13.68                 |
| JFET    | AD549K                              | 1           | $\pm 2.5/\pm 18$         | 0.700                     |                           | 5                       | 3                             | 0.25              | 5                                                     | 90            | 90            | 109               | 35                                             | 100 fA     | TO-99                                        | 19.11                 |
| JFET    | AD549L                              | 1           | $\pm 2.5/\pm 18$         | 0.700                     |                           | 5                       | 3                             | 0.5               | 10                                                    | 90            | 90            | 109               | 35                                             | 60 fA      | TO-99                                        | 23.61                 |
| CMOS    | AD8591 SD<br>AD8592 SD<br>AD8594 SD | 1<br>2<br>4 | 2.7/6                    | 0.700                     | RRIO                      | 3                       | 5                             | 25                | 20                                                    | 38            | 45            | 83                | 45                                             | 50 pA      | SOT-23<br>SOIC<br>SOIC/TSSOP                 | 0.29<br>0.39<br>0.57  |
| CMOS    | AD8531<br>AD8532<br>AD8534          | 1<br>2<br>4 | 2.7/6                    | 0.700                     | RRIO                      | 3                       | 5                             | 25                | 20                                                    | 38            | 45            | 83                | 45                                             | 50 pA      | SC70/SOT-23<br>MSOP/SOIC/TSSOP<br>SOIC/TSSOP | 0.27<br>0.43<br>0.60  |
| CBCMOS  | OP162<br>OP262<br>OP462             | 1<br>2<br>4 | 2.7/12                   | 0.800                     | SS                        | 15                      | 13                            | 0.325             | 1                                                     | 70            | 60            | 97                | 9.5                                            | 500 nA     | MSOP/SOIC/TSSOP<br>SOIC/TSSOP<br>SOIC/TSSOP  | 1.69<br>2.23<br>4.03  |
| Bipolar | AD8565<br>AD8566<br>AD8567          | 1<br>2<br>4 | 4.5/16                   | 0.850                     | RRIO                      | 5                       | 6                             | 10                | 5                                                     | 54            | 70            | 69                | 26                                             | 600 nA     | SC70<br>MSOP<br>LFCSP/TSSOP                  | 0.56<br>0.71<br>0.93  |
| JFET    | AD8627<br>AD8626<br>AD8625          | 1<br>2<br>4 | $\pm 5/\pm 13$           | 0.850                     | SS                        | 5                       | 5                             | 0.75              | 2.5                                                   | 76            | 80            | 103               | 16                                             | 1 pA       | SC-70/SOIC<br>MSOP/SOIC<br>SOIC/TSSOP        | 1.60<br>2.63<br>4.09  |
| CMOS    | AD8628<br>AD8629<br>AD8630          | 1<br>2<br>4 | 2.7/6                    | 0.850                     | RRIO                      | 2.5                     | 1                             | 0.005             | 0.002                                                 | 120           | 115           | 125               | 22                                             | 100 pA     | SOT-23/SOIC<br>MSOP/SOIC<br>SOIC/TSSOP       | 0.96<br>1.47<br>2.73  |
| CMOS    | AD8571<br>AD8572<br>AD8574          | 1<br>2<br>4 | 2.7/6                    | 0.850                     | RRIO                      | 1.5                     | 0.4                           | 0.005             | 0.005                                                 | 120           | 120           | 125               | 51                                             | 50 pA      | MSOP/SOIC<br>SOIC/TSSOP<br>SOIC/TSSOP        | 1.11<br>1.78<br>3.40  |
| JFET    | AD820A<br>AD822A<br>AD824A          | 1<br>2<br>4 | $\pm 2.5/\pm 18$         | 0.900                     | SS                        | 1.9                     | 3                             | 2                 | 2                                                     | 70            | 70            | 114               | 16                                             | 25 pA      | MSOP/SOIC/PDIP<br>MSOP/SOIC/PDIP<br>SOIC     | 1.82<br>2.76<br>4.55  |
| JFET    | AD820B<br>AD822B                    | 1<br>2      | $\pm 2.5/\pm 18$         | 0.900                     | SS                        | 1.9                     | 3                             | 1                 | 2                                                     | 74            | 70            | 114               | 16                                             | 10 pA      | SOIC/PDIP<br>MSOP/SOIC/PDIP                  | 2.66<br>4.11          |
| CMOS    | AD8551<br>AD8552<br>AD8554          | 1<br>2<br>4 | 2.7/6                    | 0.975                     | RRIO                      | 1.5                     | 0.4                           | 0.005             | 0.005                                                 | 120           | 120           | 125               | 42                                             | 50 pA      | MSOP/SOIC<br>SOIC/TSSOP<br>SOIC/TSSOP        | 1.20<br>1.90<br>3.36  |

\*Prerelease

<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes  $-V_{SY}$ ).



## Precision Amplifiers ( $V_{OS} < 1 \text{ mV}$ , Bandwidth $< 50 \text{ MHz}$ )

### Low Noise ( $V_n \leq 10 \text{ nV}/\sqrt{\text{Hz}}$ ) Amplifiers

#### ADA4075-2: Ultralow Noise Amplifier at Lower Power

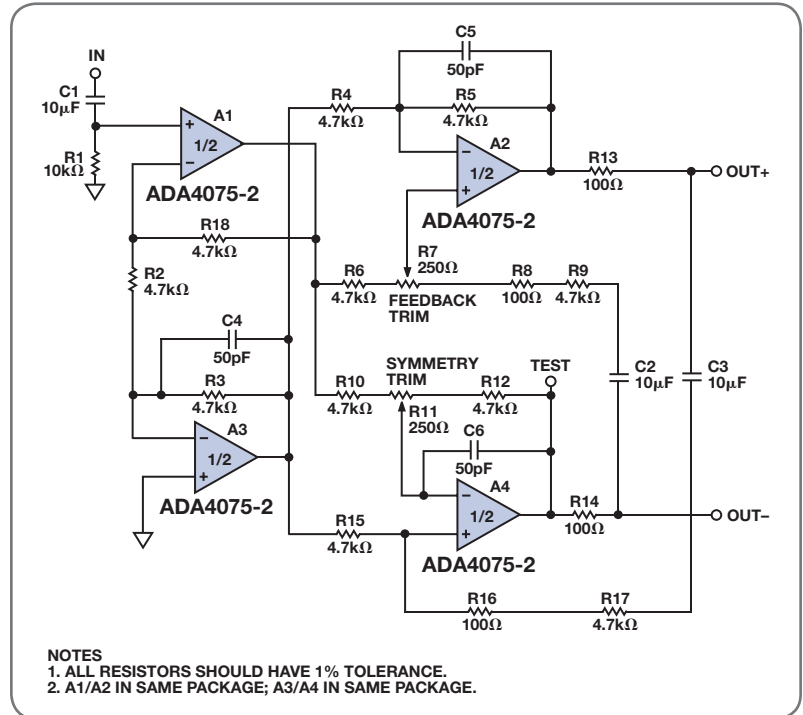
The **ADA4075-2** is a dual, high performance, low noise operational amplifier combining excellent dc and ac characteristics on ADI's *iPolar*® process. ADI's proprietary *iPolar* process is an advanced bipolar technology implementing vertical junction isolation with lateral trench isolation, allowing for low noise performance amplifiers in smaller die size at faster speed and lower power.

##### Features

- Ultralow noise:  $2.8 \text{ nV}/\sqrt{\text{Hz}}$  at 1 kHz typical
- Ultralow distortion: 0.0002% typical
- Low supply current: 1.8 mA per amplifier typical
- Offset voltage: 1 mV maximum
- Bandwidth: 6.5 MHz typical
- Slew rate:  $12 \text{ V}/\mu\text{s}$  typical
- Unity-gain stable

##### Applications

- Precision instrumentation
- Professional audio
- Active filters



Balanced line driver design.

#### ADA4004-1/ADA4004-2/ADA4004-4: Ultraprecision, $1.8 \text{ nV}/\sqrt{\text{Hz}}$ , 36 V Amplifiers

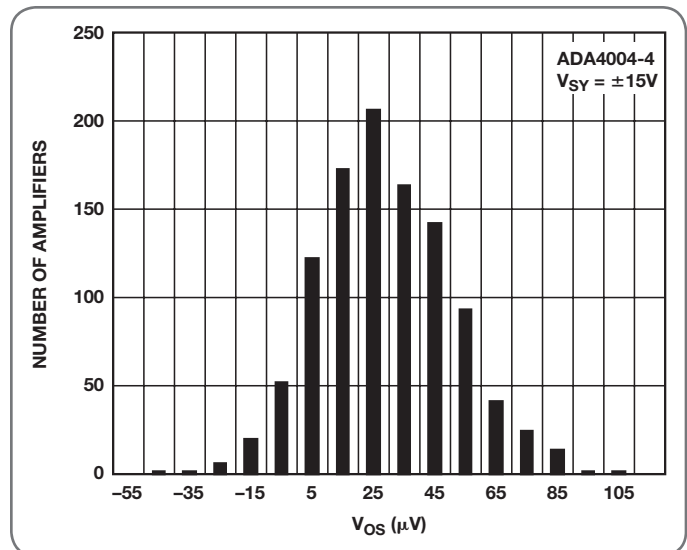
The **ADA4004-1/ADA4004-2/ADA4004-4** are designed on the high performance *iPolar* process, enabling improvements such as reduced noise and power consumption, increased speed and stability, and smaller footprint size. Novel design techniques enable the **ADA4004-1/ADA4004-2/ADA4004-4** to achieve  $1.8 \text{ nV}/\sqrt{\text{Hz}}$  voltage noise density and a low 6 Hz 1/f noise corner frequency while consuming just 1.7 mA per amplifier. The small package saves board space, reduces cost, and improves layout flexibility.

##### Features

- Very low voltage noise:  $1.8 \text{ nV}/\sqrt{\text{Hz}}$
- Low input bias current: 90 nA maximum
- Offset voltage: 125  $\mu\text{V}$  maximum
- High gain: 120 dB
- Wide bandwidth: 12 MHz
- $\pm 5 \text{ V}$  to  $\pm 15 \text{ V}$  operation

##### Applications

- Precision instrumentation
- Filter blocks
- Microphone preamplifiers
- Industrial control
- Thermocouples and RTDs



Number of amplifiers vs. input offset voltage.

## Low noise ( $V_n \leq 10\text{nV}/\sqrt{\text{Hz}}$ ) Amplifiers

| Process    | Part Number                         | No. of Amps | Supply Voltage (Min/Max) | Noise (nV/ $\sqrt{\text{Hz}}$ ) @ 1kHz | Rail-to-Rail <sup>1</sup> | BW @ A <sub>CL</sub> Min (MHz) | Slew Rate (V/ $\mu\text{s}$ ) | V <sub>OS</sub> Max (mV) | TcV <sub>OS</sub> ( $\mu\text{V}/^\circ\text{C}$ Typ) | CMRR Min (dB)   | PSRR Min (dB) | A <sub>VO</sub> Min (dB) | Noise (pA/ $\sqrt{\text{Hz}}$ ) @ 1 kHz | I <sub>O</sub> /Amp (mA Max) | I <sub>S</sub> Max | I <sub>SC</sub> (mA) | Packaging                                     | Price @ 1k (OEM \$US) |
|------------|-------------------------------------|-------------|--------------------------|----------------------------------------|---------------------------|--------------------------------|-------------------------------|--------------------------|-------------------------------------------------------|-----------------|---------------|--------------------------|-----------------------------------------|------------------------------|--------------------|----------------------|-----------------------------------------------|-----------------------|
| Bipolar    | AD8597<br>AD8599                    | 1<br>2      | $\pm 4.5/\pm 18$         | 1.07                                   |                           | 10                             | 16.8                          | 0.12                     | 0.8                                                   | 120             | 120           | 110                      | 1.9                                     | 5.700                        | 200 nA             | 52                   | SOIC/LFCSP<br>SOIC                            | 2.25<br>3.24          |
| Bipolar    | ADA4004-1<br>ADA4004-2<br>ADA4004-4 | 1<br>2<br>4 | $\pm 5/\pm 18$           | 1.8                                    |                           | 12                             | 2.7                           | 0.125                    | 0.7                                                   | 110             | 110           | 114                      | 1.2                                     | 2.200                        | 90 nA              | 25                   | SOT-23/SOIC<br>MSOP/SOIC<br>SOIC/LFCSP        | 1.75<br>2.65<br>4.25  |
| Bipolar    | ADA4075-2                           | 2           | $\pm 4.5/\pm 18$         | 2.8                                    |                           | 6.5                            | 12                            | 1                        | 0.3                                                   | 110             | 106           | 114                      | 1.2                                     | 2.250                        | 100 nA             | 40                   | SOIC/LFCSP                                    | 0.75                  |
| Bipolar    | AD8675                              | 1           | $\pm 5/\pm 18$           | 2.8                                    | RRO                       | 10                             | 2.5                           | 0.075                    | 0.2                                                   | 114             | 120           | 123                      | 0.3                                     | 2.900                        | 2 nA               | 40                   | MSOP/SOIC                                     | 1.18                  |
| Bipolar    | AD8676A                             | 2           | $\pm 5/\pm 18$           | 2.8                                    | RRO                       | 10                             | 2.5                           | 0.1                      | 0.2                                                   | 111             | 106           | 123                      | 0.3                                     | 3.400                        | 2 nA               | 40                   | MSOP/SOIC                                     | 1.66                  |
| Bipolar    | AD8676B                             | 2           | $\pm 5/\pm 18$           | 2.8                                    | RRO                       | 10                             | 2.5                           | 0.05                     | 0.2                                                   | 111             | 106           | 123                      | 0.3                                     | 3.400                        | 2 nA               | 40                   | MSOP/SOIC                                     | 2.14                  |
| Bipolar    | AD8671<br>AD8672<br>AD8674          | 1<br>2<br>4 | $\pm 5/\pm 18$           | 2.8                                    |                           | 10                             | 4                             | 0.075                    | 0.3                                                   | 100             | 110           | 120                      | 0.3                                     | 3.500                        | 12 nA              | 30                   | MSOP/SOIC<br>MSOP/SOIC<br>SOIC/TSSOP          | 1.06<br>1.72<br>3.24  |
| JFET       | AD8610A<br>AD8620A                  | 1<br>2      | $\pm 5/\pm 13$           | 6                                      |                           | 25                             | 60                            | 0.25                     | 0.8                                                   | 90              | 100           | 100                      | 0.005                                   | 3.500                        | 10 pA              | 65                   | MSOP/SOIC<br>SOIC                             | 3.75<br>7.50          |
| JFET       | AD8610B<br>AD8620B                  | 1<br>2      | $\pm 5/\pm 13$           | 6                                      |                           | 25                             | 60                            | 0.1                      | 0.5                                                   | 90              | 100           | 100                      | 0.005                                   | 3.500                        | 10 pA              | 65                   | MSOP/SOIC<br>SOIC                             | 9.86<br>16.70         |
| CMOS       | ADA4528-1<br>ADA4528-2*             | 1<br>2      | 2.2/5.5                  | 5.3                                    | RRIO                      | 4                              | 0.4                           | 0.0025                   | 0.015                                                 | 115             | 120           | 130                      | 0.1                                     | 1.500                        | 100 pA             | 25                   | MSOP/LFCSP                                    | 1.15<br>1.90          |
| JFET       | ADA4627-1A                          | 1           | $\pm 4/\pm 18$           | 6.1                                    |                           | 19                             | 84                            | 0.3                      | 1                                                     | 100             | 103           | 106                      | 0.0025                                  | 7.500                        | 5 pA               | 55                   | SOIC/LFCSP                                    | 6.75                  |
| JFET       | ADA4627-1B                          | 1           | $\pm 4/\pm 18$           | 6.1                                    |                           | 19                             | 84                            | 0.2                      | 1                                                     | 106             | 106           | 112                      | 0.0016                                  | 7.500                        | 5 pA               | 55                   | SOIC/LFCSP                                    | 10.75                 |
| CMOS       | AD8605<br>AD8606<br>AD8608          | 1<br>2<br>4 | 2.7/6                    | 8                                      | RRIO                      | 10                             | 5                             | 0.3                      | 1                                                     | 85              | 80            | 109                      | 0.01                                    | 1.200                        | 1 pA               | 80                   | WLCSP/SOT-23<br>WLCSP/MSOP/SOIC<br>SOIC/TSSOP | 0.68<br>1.19<br>1.58  |
| JFET       | AD8510A<br>AD8512A<br>AD8513A       | 1<br>2<br>4 | $\pm 5/\pm 18$           | 8                                      |                           | 8                              | 20                            | 1                        | 1.7                                                   | 86              | 86            | 101                      |                                         | 2.500                        | 80 pA              | 70                   | MSOP/SOIC<br>MSOP/SOIC<br>SOIC/TSSOP          | 0.95<br>1.49<br>3.71  |
| JFET       | AD8510B<br>AD8512B                  | 1<br>2      | $\pm 5/\pm 18$           | 8                                      |                           | 8                              | 20                            | 0.4                      | 1                                                     | 86              | 86            | 101                      |                                         | 2.500                        | 80 pA              | 70                   | MSOP/SOIC<br>MSOP/SOIC                        | 2.33<br>4.76          |
| CMOS       | AD8691<br>AD8692<br>AD8694          | 1<br>2<br>4 | 2.7/6                    | 8                                      | SS                        | 10                             | 5                             | 2                        | 1.3                                                   | 70              | 80            | 108                      | 0.05                                    | 1.050                        | 1 pA               | 80                   | SC70/SOT-23<br>MSOP/SOIC<br>SOIC/TSSOP        | 0.51<br>0.64<br>0.90  |
| CMOS       | AD8646<br>AD8648                    | 2<br>4      | 2.7/6                    | 8                                      | RRIO                      | 24                             | 11                            | 2.5                      | 1.8                                                   | 67              | 63            | 104                      |                                         | 1.500                        | 1 pA               | 120                  | MSOP/SOIC<br>SOIC/TSSOP                       | 0.61<br>0.88          |
| CMOS       | AD8647                              | 2           | 2.7/6                    | 8                                      | RRIO                      | 24                             | 11                            | 2.5                      | 1.8                                                   | 67              | 63            | 104                      |                                         | 1.500                        | 1 pA               | 120                  | MSOP                                          | 0.71                  |
| Bipolar    | OP162<br>OP262<br>OP462             | 1<br>2<br>4 | 2.7/12                   | 9.5                                    | SS                        | 15                             | 13                            | 0.325                    | 1                                                     | 70              | 60            | 97                       | 0.4                                     | 0.800                        | 500 nA             | 30 <sup>2</sup>      | MSOP/SOIC/TSSOP<br>SOIC/TSSOP<br>SOIC/TSSOP   | 1.69<br>2.23<br>4.03  |
| Bipolar    | AD8519<br>AD8529                    | 1<br>2      | 2.7/12                   | 10                                     | SS                        | 8                              | 2.9                           | 1.1                      | 2                                                     | 70 <sup>2</sup> | 60            | 94                       | 0.4                                     | 1.200                        | 300 nA             | 70                   | SC70/SOT-23/SOIC<br>MSOP/SOIC                 | 0.92<br>1.22          |
| CMOS       | AD8615<br>AD8616<br>AD8618          | 1<br>2<br>4 | 2.7/6                    | 10                                     | RRIO                      | 24                             | 12                            | 0.5                      | 1.5                                                   | 80              | 70            | 105                      | 0.05                                    | 1.300                        | 1 pA               | 150                  | SOT-23<br>MSOP/SOIC<br>SOIC/TSSOP             | 0.76<br>1.29<br>2.29  |
| Bipolar    | AD8677                              | 1           | $\pm 4/\pm 18$           | 10                                     |                           | 0.6                            | 0.2                           | 0.13                     | 0.5                                                   | 120             | 115           | 120                      | 0.074                                   | 1.300                        | 1 nA               | 30                   | SOT-23/SOIC                                   | 0.76                  |
| $\mu$ CMOS | AD8665<br>AD8666<br>AD8668          | 1<br>2<br>4 | 5/16                     | 10                                     | SS                        | 4                              | 3.5                           | 2.5                      | 3                                                     | 90              | 98            | 130                      | 0.1                                     | 1.550                        | 1 pA               | 140                  | SOT-23/SOIC<br>MSOP/SOIC<br>SOIC/TSSOP        | 0.83<br>0.93<br>1.75  |

\*Prerelease

<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes  $-V_{\text{SY}}$ ).

<sup>2</sup> Check data sheet for test conditions and actual product specification—may be different for single/dual/quad amplifiers for part numbers with 2 mark.

# Precision Amplifiers ( $V_{OS} < 1 \text{ mV}$ , Bandwidth $< 50 \text{ MHz}$ )

## Low Input Bias Current ( $I_b \leq 50 \text{ pA}$ ) Amplifiers

Voted as one of the Hot 100 Electronic Products of 2009, EDN Magazine

### ADA4627-1: Low Noise, Low Bias Current, JFET Operational Amplifier

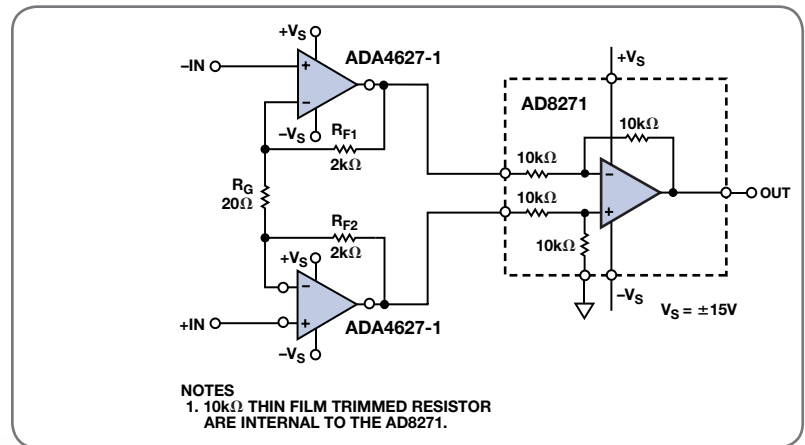
The ADA4627-1 is a wide bandwidth precision amplifier featuring low noise, very low offset, drift, and bias current. Operation is specified from  $\pm 5 \text{ V}$  to  $\pm 15 \text{ V}$  dual supply. This amplifier combines the best specifications of precision dc and high speed ac op amps.

#### Features

- Low offset voltage: 200  $\mu\text{V}$  maximum
- Offset drift: 1  $\mu\text{V}/^\circ\text{C}$  typical
- Very low input bias current: 5 pA maximum
- Extended temperature range:  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$
- $\pm 5 \text{ V}$  to  $\pm 15 \text{ V}$  dual supply
- Guaranteed GBW: 16 MHz
- Voltage noise: 6.1  $\text{nV}/\sqrt{\text{Hz}}$  at 1 kHz
- High slew rate: 60  $\text{V}/\mu\text{s}$

#### Applications

- High impedance sensors
- Photodiode amplifier
- Precision instrumentation
- Phase-locked loop filters
- High end professional audio
- Medical



Circuits from the Lab™  
Reference Circuits

Building an in-amp with gain = 201. Refer to Circuit Note CN-0122 for more information on this reference circuit at [www.analog.com/cn0122](http://www.analog.com/cn0122).

## Low Input Bias Current ( $I_b \leq 50 \text{ pA}$ ) Amplifiers

| Process | Part Number | No. of Amps | Supply Voltage (Min/Max) | Rail-to-Rail* | BW @ $A_{CL}$ Min (MHz) | Slew Rate (V/ $\mu\text{s}$ ) | $V_{OS}$ Max (mV) | $TcV_{OS}$ ( $\mu\text{V}/^\circ\text{C}$ Typ) | CMRR Min (dB) | PSRR Min (dB) | $A_{VO}$ Min (dB) | Noise ( $\text{nV}/\sqrt{\text{Hz}}$ ) @ 1 kHz | Noise ( $\text{pA}/\sqrt{\text{Hz}}$ ) @ 1 kHz | $I_S$ /Amp (mA Max) | $I_b$ Max  | Packaging       | Price @ 1k (OEM \$US) |
|---------|-------------|-------------|--------------------------|---------------|-------------------------|-------------------------------|-------------------|------------------------------------------------|---------------|---------------|-------------------|------------------------------------------------|------------------------------------------------|---------------------|------------|-----------------|-----------------------|
| JFET    | AD549L      | 1           | $\pm 2.5/\pm 18$         |               | 5                       | 3                             | 0.5               | 10                                             | 90            | 90            | 109               | 35                                             | 0.22                                           | 0.700               | 60 fA      | T0-99           | 23.61                 |
| JFET    | AD549K      | 1           | $\pm 2.5/\pm 18$         |               | 5                       | 3                             | 0.25              | 5                                              | 90            | 90            | 109               | 35                                             | 0.22                                           | 0.700               | 100 fA     | T0-99           | 19.11                 |
| JFET    | AD549J      | 1           | $\pm 2.5/\pm 18$         |               | 5                       | 3                             | 1                 | 20                                             | 80            | 80            | 109               | 35                                             | 0.22                                           | 0.700               | 250 fA     | T0-99           | 13.68                 |
| BiJET   | OP285       | 2           | $\pm 4.5/\pm 18$         |               | 9                       | 22                            | 0.25              | 1                                              | 80            | 85            | 108               | 6                                              | 0.9                                            | 2.500               | 350 nA     | SOIC/PDIP       | 2.40                  |
| CMOS    | AD8663      | 1           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SOIC/LFCSP      | 1.17                  |
|         | AD8667      | 2           | 5/16                     | SS            | 0.54                    | 0.6                           | 0.3               | 1.5                                            | 87            | 95            | 115               | 23                                             | 0.05                                           | 0.285               | 0.3 pA typ | MSOP/SOIC       | 1.58                  |
|         | AD8669      | 4           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SOIC/TSSOP      | 2.70                  |
| CMOS    | AD8603      | 1           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SOT-23          | 0.68                  |
|         | AD8607      | 2           | 1.8/6                    | RRIO          | 0.4                     | 0.1                           | 0.3               | 1                                              | 85            | 80            | 112               | 25                                             | 0.05                                           | 0.040               | 1 pA       | MSOP/SOIC       | 1.02                  |
|         | AD8609      | 4           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SOIC/TSSOP      | 1.85                  |
| CMOS    | AD8605      | 1           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | WLCSP/SOT-23    | 0.68                  |
|         | AD8606      | 2           | 2.7/6                    | RRIO          | 10                      | 5                             | 0.3               | 1                                              | 85            | 80            | 109               | 8                                              | 0.01                                           | 1.200               | 1 pA       | WLCSP/MSOP/SOIC | 1.19                  |
|         | AD8608      | 4           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SOIC/TSSOP      | 1.58                  |
| CMOS    | AD8615      | 1           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SOT-23          | 0.76                  |
|         | AD8616      | 2           | 2.7/6                    | RRIO          | 24                      | 12                            | 0.5               | 1.5                                            | 80            | 70            | 105               | 10                                             | 0.05                                           | 1.300               | 1 pA       | MSOP/SOIC       | 1.29                  |
|         | AD8618      | 4           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SOIC/TSSOP      | 2.29                  |
| CMOS    | AD8661      | 1           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SOIC/LFCSP      | 1.08                  |
|         | AD8662      | 2           | 5/16                     | SS            | 4                       | 3.5                           | 0.16              | 4                                              | 90            | 95            | 106               | 12                                             | 0.1                                            | 1.550               | 1 pA       | MSOP/SOIC       | 1.37                  |
|         | AD8664      | 4           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SOIC/TSSOP      | 2.23                  |
| JFET    | AD8627      | 1           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SC70/SOIC       | 1.60                  |
|         | AD8626      | 2           | $\pm 5/\pm 13$           | SS            | 5                       | 5                             | 0.75              | 2.5                                            | 76            | 80            | 103               | 16                                             | 0.5                                            | 0.850               | 1 pA       | MSOP/SOIC       | 2.63                  |
|         | AD8625      | 4           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SOIC/TSSOP      | 4.09                  |
| JFET    | AD8641      | 1           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SC70/SOIC       | 1.47                  |
|         | AD8642      | 2           | $\pm 2.5/\pm 13$         | SS            | 3.5                     | 3                             | 0.75              | 2.5                                            | 90            | 90            | 106               | 27.5                                           | 0.0005                                         | 0.290               | 1 pA       | MSOP/SOIC       | 2.35                  |
|         | AD8643      | 4           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SOIC/LFCSP      | 3.85                  |
| CMOS    | AD8613      | 1           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SC70/SOT-23     | 0.46                  |
|         | AD8617      | 2           | 1.8/5.5                  | RRIO          | 0.4                     | 0.1                           | 2.2               | 1                                              | 68            | 67            | 107               | 25                                             | 0.05                                           | 0.040               | 1 pA       | MSOP/SOIC       | 0.71                  |
|         | AD8619      | 4           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SOIC/TSSOP      | 1.11                  |
| CMOS    | AD8691      | 1           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SC70/SOT-23     | 0.51                  |
|         | AD8692      | 2           | 2.7/6                    | SS            | 10                      | 5                             | 2                 | 1.3                                            | 70            | 80            | 108               | 8                                              | 0.05                                           | 1.050               | 1 pA       | MSOP/SOIC       | 0.64                  |
|         | AD8694      | 4           |                          |               |                         |                               |                   |                                                |               |               |                   |                                                |                                                |                     |            | SOIC/TSSOP      | 0.90                  |

# Low Input Bias Current ( $I_b \leq 50$ pA) Amplifiers (continued)

| Process | Part Number            | No. of Amps | Supply Voltage (Min/Max) | Rail-to-Rail <sup>1</sup> | BW @ A <sub>OL</sub> Min (MHz) | Slew Rate (V/ $\mu$ s) | V <sub>OS</sub> Max (mV) | TcV <sub>OS</sub> ( $\mu$ V/ $^{\circ}$ C Typ) | CMRR Min (dB) | PSRR Min (dB) | A <sub>VO</sub> Min (dB) | Noise (nV/ $\sqrt$ Hz) @ 1 kHz | Noise (pA/ $\sqrt$ Hz) @ 1 kHz | I <sub>O</sub> /Amp (mA Max) | I <sub>B</sub> Max (pA) | Packaging       | Price @ 1k (OEM \$US) |
|---------|------------------------|-------------|--------------------------|---------------------------|--------------------------------|------------------------|--------------------------|------------------------------------------------|---------------|---------------|--------------------------|--------------------------------|--------------------------------|------------------------------|-------------------------|-----------------|-----------------------|
| CMOS    | AD8646                 | 2           | 2.7/6                    | RRIO                      | 24                             | 11                     | 2.5                      | 1.8                                            | 67            | 63            | 104                      | 8                              |                                | 1.500                        | 1                       | MSOP/SOIC       | 0.61                  |
|         | AD8648                 | 4           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | SOIC/TSSOP      | 0.88                  |
| CMOS    | AD8647                 | 2           | 2.7/6                    | RRIO                      | 24                             | 11                     | 2.5                      | 1.8                                            | 67            | 63            | 104                      | 8                              |                                | 1.500                        | 1                       | MSOP            | 0.71                  |
|         | AD8665                 | 1           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | SOT-23/SOIC     | 0.83                  |
| CMOS    | AD8666                 | 2           | 5/16                     | SS                        | 4                              | 3.5                    | 2.5                      | 3                                              | 90            | 98            | 130                      | 10                             | 0.1                            | 1.550                        | 1                       | MSOP/SOIC       | 0.93                  |
|         | AD8668                 | 4           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | SOIC/TSSOP      | 1.75                  |
| CMOS    | ADA4665-2              | 2           | 5/16                     | RRIO                      | 1.2                            | 1                      | 6                        | 3                                              | 55            | 70            | 85                       | 32                             |                                | 0.400                        | 1                       | MSOP/SOIC       | 0.70                  |
|         | ADA4505-1 <sup>2</sup> | 1           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | WLCSP/SOT-23    | 0.55                  |
| CMOS    | ADA4505-2              | 2           | 1.8/5.5                  | RRIO                      | 0.050                          | 0.006                  | 3                        | 2                                              | 90            | 100           | 105                      | 65                             | 0.02                           | 0.010                        | 2                       | WLCSP/MSOP      | 0.67                  |
|         | ADA4505-4              | 4           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | WLCSP/TSSOP     | 1.15                  |
| CMOS    | AD8657                 | 2           | 2.7/18                   | RRIO                      | 0.175                          | 0.3                    | 0.3                      | 4                                              | 95            | 105           | 110                      | 50                             |                                | 0.022                        | 5                       | MSOP/SOIC       | 0.95                  |
|         | AD8659*                | 4           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | SOIC/LFCSP      | 1.35                  |
| JFET    | ADA4627-1A             | 1           | $\pm 4/\pm 18$           |                           | 19                             | 84                     | 0.3                      | 1                                              | 100           | 103           | 106                      | 6.1                            | 0.0025                         | 7.500                        | 5                       | SOIC/LFCSP      | 6.75                  |
| JFET    | ADA4627-1B             | 1           | $\pm 4/\pm 18$           |                           | 19                             | 84                     | 0.2                      | 1                                              | 106           | 106           | 112                      | 6.1                            | 0.0016                         | 7.500                        | 5                       | SOIC/LFCSP      | 10.75                 |
| CMOS    | ADA4692-2              | 2           | 2.7/6                    | SS                        | 3.6                            | 1.3                    | 2.5                      | 1                                              | 75            | 80            | 95                       | 16                             | 0.05                           | 0.225                        | 5                       | SOIC/LFCSP      | 0.55                  |
|         | ADA4692-4              | 4           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | TSSOP           | 0.90                  |
| CMOS    | ADA4691-2              | 2           | 2.7/6                    | SS                        | 3.6                            | 1.3                    | 2.5                      | 1                                              | 75            | 80            | 95                       | 16                             | 0.05                           | 0.225                        | 5                       | WLCSP/LFCSP     | 0.57                  |
|         | ADA4691-4              | 4           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | LFCSP           | 0.99                  |
| CMOS    | AD8500                 | 1           | 1.8/5.5                  | RRIO                      | 0.007                          | 0.004                  | 1                        | 3                                              | 75            | 90            | 98                       | 190                            | 0.1                            | 0.001                        | 10                      | SC70            | 0.71                  |
| CMOS    | AD8655                 | 1           | 2.7/5.5                  | RRIO                      | 28                             | 11                     | 0.25                     | 0.4                                            | 85            | 88            | 100                      | 2.7 <sup>2</sup>               |                                | 4.500                        | 10                      | MSOP/SOIC       | 0.71                  |
|         | AD8656                 | 2           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | MSOP/SOIC       | 1.11                  |
| CMOS    | AD8651                 | 1           | 2.7/5.5                  | RRIO                      | 50                             | 41                     | 0.35                     | 4                                              | 80            | 76            | 100                      | 4.5 <sup>2</sup>               | 0.025                          | 14.000                       | 10                      | MSOP/SOIC       | 1.13                  |
|         | AD8652                 | 2           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | MSOP/SOIC       | 1.99                  |
| JFET    | AD8610A                | 1           | $\pm 5/\pm 13$           |                           | 25                             | 60                     | 0.25                     | 0.8                                            | 90            | 100           | 100                      | 6                              | 0.005                          | 3.500                        | 10                      | MSOP/SOIC       | 3.75                  |
|         | AD8620A                | 2           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | SOIC            | 7.50                  |
| JFET    | AD8610B                | 1           | $\pm 5/\pm 13$           |                           | 25                             | 60                     | 0.1                      | 0.5                                            | 90            | 100           | 100                      | 6                              | 0.005                          | 3.500                        | 10                      | MSOP/SOIC       | 9.86                  |
|         | AD8620B                | 2           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | SOIC            | 16.70                 |
| JFET    | AD820B                 | 1           | $\pm 2.5/\pm 18$         | SS                        | 1.9                            | 3                      | 1                        | 2                                              | 74            | 70            | 114                      | 16                             | 0.008                          | 0.900                        | 10                      | SOIC/PDIP       | 2.66                  |
|         | AD822B                 | 2           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | MSOP/SOIC/PDIP  | 4.11                  |
| CMOS    | AD8505 <sup>2</sup>    | 1           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | WLCSP/SOT-23    | 0.59                  |
|         | AD8506                 | 2           | 1.8/5.5                  | RRIO                      | 0.095                          | 0.013                  | 2.5                      | 2                                              | 90            | 100           | 105                      | 45                             | 0.015                          | 0.020                        | 10                      | WLCSP/MSOP      | 0.71                  |
|         | AD8508                 | 4           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | WLCSP/TSSOP     | 1.20                  |
| CMOS    | AD8502                 | 2           | 1.8/5.5                  | RRIO                      | 0.007                          | 0.004                  | 3                        | 5                                              | 67            | 85            | 98                       | 190                            | 0.1                            | 0.001                        | 10                      | SOT-23          | 0.70                  |
|         | AD8504                 | 4           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | TSSOP           | 1.00                  |
| JFET    | AD8682                 | 2           | $\pm 4.5/\pm 18$         |                           | 3.5                            | 9                      | 1                        | 10                                             | 70            | 92            | 86                       | 36                             | 0.01                           | 0.250                        | 20                      | MSOP/SOIC       | 1.66                  |
|         | AD8684                 | 4           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | SOIC/TSSOP      | 2.44                  |
| JFET    | AD820A                 | 1           | $\pm 2.5/\pm 18$         | SS                        | 1.9                            | 3                      | 2                        | 2                                              | 70            | 70            | 114                      | 16                             | 0.008                          | 0.900                        | 25                      | MSOP/SOIC/PDIP  | 1.82                  |
|         | AD822A                 | 2           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | MSOP/SOIC/PDIP  | 2.76                  |
|         | AD824A                 | 4           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | SOIC            | 4.55                  |
| CMOS    | AD8538                 | 1           | 2.7/5.5                  | RRIO                      | 0.43                           | 0.35                   | 0.013                    | 0.03                                           | 115           | 105           | 115                      | 50                             |                                | 0.180                        | 25                      | SOT-23/SOIC     | 0.90                  |
|         | AD8539                 | 2           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | MSOP/SOIC       | 1.31                  |
| CMOS    | AD8515                 | 1           | 1.8/6                    | RRIO                      | 5                              | 2.7                    | 6                        | 4                                              | 60            | 65            | 113                      | 22                             | 0.05                           | 0.550                        | 30                      | SC70/SOT-23     | 0.28                  |
|         | ADA4000-1              | 1           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | SOT-23/SOIC     | 0.73                  |
| JFET    | ADA4000-2              | 2           | $\pm 4/\pm 18$           |                           | 5                              | 20                     | 1.7                      | 2                                              | 80            | 82            | 100                      | 16                             | 0.01                           | 1.650                        | 40                      | MSOP/SOIC       | 1.31                  |
|         | ADA4000-4              | 4           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | SOIC/TSSOP      | 2.22                  |
| JFET    | ADA4062-2A             | 2           | $\pm 4/\pm 18$           |                           | 1.4                            | 3.3                    | 2.5                      | 4                                              | 73            | 74            | 76                       | 36                             | 0.005                          | 0.220                        | 50                      | MSOP/SOIC/LFCSP | 0.75                  |
|         | ADA4062-4A             | 4           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | LFCSP/TSSOP     | 1.21                  |
| JFET    | ADA4062-2B             | 2           | $\pm 4/\pm 18$           |                           | 1.4                            | 3.3                    | 1.5                      | 4                                              | 80            | 80            | 76                       | 36                             | 0.005                          | 0.220                        | 50                      | SOIC            | 1.25                  |
| CMOS    | AD8551                 | 1           | 2.7/6                    | RRIO                      | 1.5                            | 0.4                    | 0.005                    | 0.005                                          | 120           | 120           | 125                      | 42                             |                                | 0.975                        | 50                      | MSOP/SOIC       | 1.20                  |
|         | AD8552                 | 2           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | SOIC/TSSOP      | 1.90                  |
|         | AD8554                 | 4           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | SOIC/TSSOP      | 3.36                  |
| CMOS    | AD8571                 | 1           | 2.7/6                    | RRIO                      | 1.5                            | 0.4                    | 0.005                    | 0.005                                          | 120           | 120           | 125                      | 51                             |                                | 0.850                        | 50                      | MSOP/SOIC       | 1.11                  |
|         | AD8572                 | 2           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | SOIC/TSSOP      | 1.78                  |
|         | AD8574                 | 4           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | SOIC/TSSOP      | 3.40                  |
| CMOS    | AD8591                 | 1           | 2.7/6                    | RRIO                      | 3                              | 5                      | 25                       | 20                                             | 38            | 45            | 83                       | 45                             | 0.05                           | 0.700                        | 50                      | SOT-23          | 0.29                  |
|         | AD8592                 | 2           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | SOIC            | 0.39                  |
|         | AD8594                 | 4           |                          |                           |                                |                        |                          |                                                |               |               |                          |                                |                                |                              |                         | SOIC/TSSOP      | 0.57                  |

\*Prerelease

<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes  $-V_{SV}$ ).

<sup>2</sup> Check data sheet for test conditions and actual product specification—may be different for single/dual/quad amplifiers for part numbers with <sup>2</sup> mark.

# Amplifiers (Bandwidth < 50 MHz)

## Single Supply Amplifiers

### AD8613/AD8617/AD8619: Micropower Low Noise CMOS Rail-to-Rail Input/Output Operational Amplifier

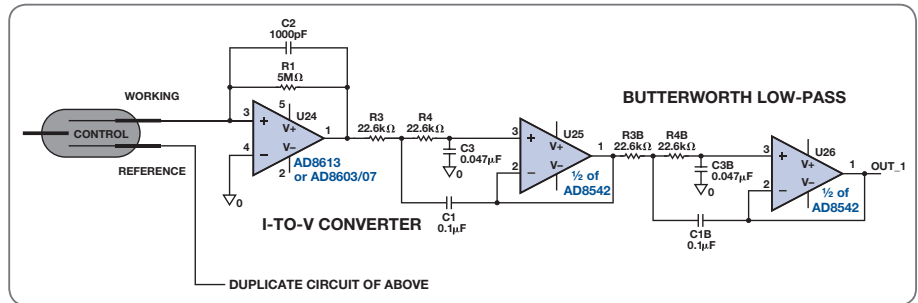
The AD8613/AD8617/AD8619 are single/dual/quad micropower rail-to-rail input and output amplifier that features low offset voltage as well as low input voltage and current noise.

#### Features

- Offset voltage: 2.2 mV maximum
- Low input bias current: 1 pA maximum
- Single-supply operation: 1.8 V to 5 V
- Low noise: 22 nV/√Hz
- Micropower: 50 μA/amplifier maximum over temperature

#### Applications

- Battery-powered instrumentation
- Multipole filters
- ADC predrivers
- DAC drivers/level shifters low power ASIC input or output amplifiers



Micropower, low noise CMOS RRIO amps in home glucose monitoring system.

## Single Supply Amplifiers

| Process | Part Number            | No. of Amps | Supply Voltage (Min/Max) | Rail-to-Rail <sup>1</sup> | BW @ A <sub>CL</sub> Min (MHz) | Slew Rate (V/μs) | V <sub>OS</sub> Max (mV) | TcVos (μV/°C Typ) | CMRR Min (dB) | PSRR Min (dB) | A <sub>vo</sub> Min (dB) | Noise (nV/√Hz) @ 1 kHz | Noise (pA/√Hz) @ 1 kHz | I <sub>G</sub> /Amp (mA Max) | I <sub>B</sub> Max | I <sub>SC</sub> (mA) | Packaging       | Price @ 1k (DEM \$US) |
|---------|------------------------|-------------|--------------------------|---------------------------|--------------------------------|------------------|--------------------------|-------------------|---------------|---------------|--------------------------|------------------------|------------------------|------------------------------|--------------------|----------------------|-----------------|-----------------------|
| Bipolar | AD8565                 | 1           | 4.5/16                   | RRIO                      | 5                              | 6                | 10                       | 5                 | 54            | 70            | 69                       | 26                     | 0.8 <sup>2</sup>       | 0.850                        | 600 nA             | 35 <sup>2</sup>      | SC70            | 0.56                  |
|         | AD8566                 | 2           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | MSOP            | 0.71                  |
|         | AD8567                 | 4           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | LCFSP/TSSOP     | 0.93                  |
| CMOS    | AD8603                 | 1           | 1.8/6                    | RRIO                      | 0.4                            | 0.1              | 0.3                      | 1                 | 85            | 80            | 112                      | 25                     | 0.05                   | 0.040                        | 1 pA               | 80                   | SOT-23          | 0.68                  |
|         | AD8607                 | 2           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | MSOP/SOIC       | 1.02                  |
|         | AD8609                 | 4           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | SOIC/TSSOP      | 1.85                  |
| CMOS    | AD8601A                | 1           | 2.7/6                    | RRIO                      | 8.2                            | 5.2              | 0.5                      | 2                 | 74            | 67            | 89                       | 33                     | 0.05                   | 1.200                        | 60 pA              | 30                   | SOT-23          | 0.62                  |
|         | AD8602A                | 2           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | MSOP/SOIC       | 0.83                  |
|         | AD8604A                | 4           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | SOIC/TSSOP      | 1.13                  |
| CMOS    | AD8605                 | 1           | 2.7/6                    | RRIO                      | 10                             | 5                | 0.3                      | 1                 | 85            | 80            | 109                      | 8                      | 0.01                   | 1.200                        | 1 pA               | 80                   | WLCSP/SOT-23    | 0.68                  |
|         | AD8606                 | 2           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | WLCSP/MSOP/SOIC | 1.19                  |
|         | AD8608                 | 4           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | SOIC/TSSOP      | 1.58                  |
| CMOS    | AD8500                 | 1           | 1.8/5.5                  | RRIO                      | 0.007                          | 0.004            | 1                        | 3                 | 75            | 90            | 98                       | 190                    | 0.1                    | 0.001                        | 10 pA              | 5                    | SC70            | 0.71                  |
| CMOS    | AD8615                 | 1           | 2.7/6                    | RRIO                      | 24                             | 12               | 0.5                      | 1.5               | 80            | 70            | 105                      | 10                     | 0.05                   | 1.300                        | 1 pA               | 150                  | SOT-23          | 0.76                  |
|         | AD8616                 | 2           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | MSOP/SOIC       | 1.29                  |
|         | AD8618                 | 4           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | SOIC/TSSOP      | 2.29                  |
| CMOS    | AD8655                 | 1           | 2.7/5.5                  | RRIO                      | 28                             | 11               | 0.25                     | 0.4               | 85            | 88            | 100                      | 2.7 <sup>2</sup>       |                        | 4.500                        | 10 pA              | 220                  | MSOP/SOIC       | 0.71                  |
|         | AD8656                 | 2           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | MSOP/SOIC       | 1.11                  |
| CMOS    | AD8651                 | 1           | 2.7/5.5                  | RRIO                      | 50                             | 41               | 0.35                     | 4                 | 80            | 76            | 100                      | 4.5 <sup>2</sup>       | 0.025                  | 14.000                       | 10 pA              | 80                   | MSOP/SOIC       | 1.13                  |
|         | AD8652                 | 2           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | MSOP/SOIC       | 1.99                  |
| CMOS    | AD8657                 | 2           | 2.7/18                   | RRIO                      | 0.175                          | 0.3              | 0.3                      | 4                 | 95            | 105           | 110                      | 50                     |                        | 0.022                        | 5 pA               | 10                   | MSOP/SOIC       | 0.95                  |
|         | AD8659*                | 3           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | SOIC/LFCSP      | 1.35                  |
| Bipolar | AD4091-2               | 2           | ±1.35/±18                | RRIO                      | 1.27                           | 0.46             | 0.25                     | 2.5               | 104           | 108           | 116                      | 25                     |                        | 0.250                        | 55 nA              | 20                   | SOIC/LFCSP      | 2.22                  |
|         | AD4091-4               | 3           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | LCFSP/TSSOP     | 3.50                  |
| Bipolar | ADA4092-2*             | 2           | ±1.35/±18                | RRIO                      | 1.4                            | 0.4              | 1.5                      | 2.5               | 90            | 98            | 116                      | 30                     |                        | 0.250                        | 60 nA              | 20                   | SOIC/LFCSP      | 1.35                  |
|         | ADA4092-4              | 3           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | TSSOP           | 2.50                  |
| CMOS    | ADA4505-1 <sup>2</sup> | 1           | 1.8/5.5                  | RRIO                      | 0.050                          | 0.006            | 3                        | 2                 | 90            | 100           | 105                      | 65                     | 0.02                   | 0.010                        | 2 pA               | 40                   | WLCSP/SOT-23    | 0.55                  |
|         | ADA4505-2              | 2           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | WLCSP/MSOP      | 0.67                  |
|         | ADA4505-4              | 4           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | WLCSP/TSSOP     | 1.15                  |
| CMOS    | AD8505 <sup>2</sup>    | 1           | 1.8/5.5                  | RRIO                      | 0.095                          | 0.013            | 2.5                      | 2                 | 90            | 100           | 105                      | 45                     | 0.015                  | 0.020                        | 10 pA              | 45                   | WLCSP/SOT-23    | 0.59                  |
|         | AD8506                 | 2           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | WLCSP/MSOP      | 0.71                  |
|         | AD8508                 | 4           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | WLCSP/TSSOP     | 1.20                  |
| CMOS    | AD8628                 | 1           | 2.7/6                    | RRIO                      | 2.5                            | 1                | 0.005                    | 0.002             | 120           | 115           | 125                      | 22                     |                        | 0.850                        | 100 pA             | 50                   | SOT-23/SOIC     | 0.96                  |
|         | AD8629                 | 2           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | MSOP/SOIC       | 1.47                  |
|         | AD8630                 | 4           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | SOIC/TSSOP      | 2.73                  |
| CMOS    | ADA4528-1              | 1           | 2.2/5.5                  | RRIO                      | 4                              | 0.4              | 0.0025                   | 0.015             | 115           | 120           | 130                      | 5.3                    | 0.1                    | 1.500                        | 100 pA             | 25                   | MSOP/LFCSP      | 1.15                  |
|         | ADA4528-2*             | 2           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      |                 | 1.90                  |
| CMOS    | ADA4051-1              | 1           | 1.8/5.5                  | RRIO                      | 0.125                          | 0.06             | 0.015                    | 0.02              | 110           | 110           | 115                      | 95                     | 0.1                    | 0.017                        | 70 pA              | 15                   | SC70/SOT-23     | 0.93                  |
|         | ADA4051-2              | 2           |                          |                           |                                |                  |                          |                   |               |               |                          |                        |                        |                              |                    |                      | MSOP/LFCSP      | 1.47                  |

## Single Supply Amplifiers (continued)

| Process | Part Number                | No. of Amps | Supply Voltage (Min/Max) | Rail-to-Rail <sup>1</sup> | BW @ A <sub>OL</sub> Min (MHz) | Slew Rate (V/μs) | V <sub>OS</sub> Max (mV) | TcV <sub>OS</sub> (μV/°C Typ) | CMRR Min (dB)   | PSRR Min (dB) | A <sub>VO</sub> Min (dB) | Noise (nV/√Hz) @ 1 kHz | Noise (pA/√Hz) @ 1 kHz | I <sub>S</sub> /Amp (mA Max) | I <sub>B</sub> Max | I <sub>SC</sub> (mA) | Packaging                                         | Price @ 1k (OEM \$US) |
|---------|----------------------------|-------------|--------------------------|---------------------------|--------------------------------|------------------|--------------------------|-------------------------------|-----------------|---------------|--------------------------|------------------------|------------------------|------------------------------|--------------------|----------------------|---------------------------------------------------|-----------------------|
| CMOS    | AD8538<br>AD8539           | 1<br>2      | 2.7/5.5                  | RRIO                      | 0.43                           | 0.35             | 0.013                    | 0.03                          | 115             | 105           | 115                      | 50                     |                        | 0.180                        | 25 pA              | 25                   | SOT-23/SOIC<br>MSOP/SOIC                          | 0.90<br>1.31          |
| CMOS    | AD8551<br>AD8552<br>AD8554 | 1<br>2<br>4 | 2.7/6                    | RRIO                      | 1.5                            | 0.4              | 0.005                    | 0.005                         | 120             | 120           | 125                      | 42                     |                        | 0.975                        | 50 pA              | 50                   | MSOP/SOIC<br>SOIC/TSSOP<br>SOIC/TSSOP             | 1.20<br>1.90<br>3.36  |
| CMOS    | AD8571<br>AD8572<br>AD8574 | 1<br>2<br>4 | 2.7/6                    | RRIO                      | 1.5                            | 0.4              | 0.005                    | 0.005                         | 120             | 120           | 125                      | 51                     |                        | 0.850                        | 50 pA              | 50                   | MSOP/SOIC<br>SOIC/TSSOP<br>SOIC/TSSOP             | 1.11<br>1.78<br>3.40  |
| CMOS    | AD8515                     | 1           | 1.8/6                    | RRIO                      | 5                              | 2.7              | 6                        | 4                             | 60              | 65            | 113                      | 22                     | 0.05                   | 0.550                        | 30 pA              | 20                   | SC70/SOT-23                                       | 0.28                  |
| CMOS    | AD8613<br>AD8617<br>AD8619 | 1<br>2<br>4 | 1.8/5.5                  | RRIO                      | 0.4                            | 0.1              | 2.2                      | 1                             | 68              | 67            | 107                      | 25                     | 0.05                   | 0.040                        | 1 pA               | 80                   | SC70/SOT-23<br>MSOP/SOIC<br>SOIC/TSSOP            | 0.46<br>0.71<br>1.11  |
| CMOS    | AD8602<br>AD8604           | 2<br>4      | 2.7/6                    | RRIO                      | 8.2                            | 5.2              | 6                        | 2                             | 56              | 56            | 86                       | 33                     | 0.05                   | 1.200                        | 200 pA             | 30                   | MSOP/SOIC<br>SOIC/TSSOP                           | 0.44<br>0.90          |
| CMOS    | AD8502<br>AD8504           | 2<br>4      | 1.8/5.5                  | RRIO                      | 0.007                          | 0.004            | 3                        | 5                             | 67              | 85            | 98                       | 190                    | 0.1                    | 0.001                        | 10 pA              | 5                    | SOT-23<br>TSSOP                                   | 0.70<br>1.00          |
| CMOS    | AD8646<br>AD8648           | 2<br>4      | 2.7/6                    | RRIO                      | 24                             | 11               | 2.5                      | 1.8                           | 67              | 63            | 104                      | 8                      |                        | 1.500                        | 1 pA               | 120                  | MSOP/SOIC<br>SOIC/TSSOP                           | 0.61<br>0.88          |
| CMOS    | AD8647                     | 2           | 2.7/6                    | RRIO                      | 24                             | 11               | 2.5                      | 1.8                           | 67              | 63            | 104                      | 8                      |                        | 1.500                        | 1 pA               | 120                  | MSOP                                              | 0.71                  |
| CMOS    | AD8591<br>AD8592<br>AD8594 | 1<br>2<br>4 | 2.7/6                    | RRIO                      | 3                              | 5                | 25                       | 20                            | 38              | 45            | 83                       | 45                     | 0.05                   | 0.700                        | 50 pA              | 250 <sup>2</sup>     | SOT-23<br>SOIC<br>SOIC/TSSOP                      | 0.29<br>0.39<br>0.57  |
| CMOS    | AD8531<br>AD8532<br>AD8534 | 1<br>2<br>4 | 2.7/6                    | RRIO                      | 3                              | 5                | 25                       | 20                            | 38              | 45            | 83                       | 45                     | 0.05                   | 0.700                        | 50 pA              | 250 <sup>2</sup>     | SC70/SOT-23<br>MSOP/SOIC/TSSOP<br>SOIC/TSSOP      | 0.27<br>0.43<br>0.60  |
| CMOS    | AD8541<br>AD8542<br>AD8544 | 1<br>2<br>4 | 2.7/6                    | RRIO                      | 1                              | 0.92             | 6                        | 4                             | 40              | 65            | 86                       | 40                     | 0.1                    | 0.045                        | 60 pA              | 60                   | SC70/SOT-23/SOIC<br>MSOP/SOIC/TSSOP<br>SOIC/TSSOP | 0.27<br>0.38<br>0.54  |
| CMOS    | ADA4665-2                  | 2           | 5/16                     | RRIO                      | 1.2                            | 1                | 6                        | 3                             | 55              | 70            | 85                       | 32                     |                        | 0.400                        | 1 pA               | 10                   | MSOP/SOIC                                         | 0.35<br>0.54          |
| Bipolar | AD8519<br>AD8529           | 1<br>2      | 2.7/12                   | SS                        | 8                              | 2.9              | 1.1                      | 2                             | 70 <sup>2</sup> | 60            | 94                       | 10                     | 0.4                    | 1.200                        | 300 nA             | 70                   | SC70/SOT-23/SOIC<br>MSOP/SOIC                     | 0.92<br>1.22          |
| CMOS    | AD8661<br>AD8664<br>AD8662 | 1<br>2<br>4 | 5/16                     | SS                        | 4                              | 3.5              | 0.16                     | 4                             | 90              | 95            | 106                      | 12                     | 0.1                    | 1.550                        | 1 pA               | 140                  | SOIC/LFCSP<br>MSOP/SOIC<br>SOIC/TSSOP             | 1.08<br>1.37<br>2.23  |
| CMOS    | AD8663<br>AD8667<br>AD8669 | 1<br>2<br>4 | 5/16                     | SS                        | 0.54                           | 0.6              | 0.3                      | 1.5                           | 87              | 95            | 115                      | 23                     | 0.05                   | 0.285                        | 0.3 pA typ         | 50                   | SOIC/LFCSP<br>MSOP/SOIC<br>SOIC/TSSOP             | 1.17<br>1.58<br>2.70  |
| JFET    | AD8627<br>AD8626<br>AD8625 | 1<br>2<br>4 | ±5/±13                   | SS                        | 5                              | 5                | 0.75                     | 2.5                           | 76              | 80            | 103                      | 16                     | 0.5                    | 0.850                        | 1 pA               | 15 <sup>2</sup>      | SC70/SOIC<br>MSOP/SOIC<br>SOIC/TSSOP              | 1.60<br>2.63<br>4.09  |
| JFET    | AD8641<br>AD8642<br>AD8643 | 1<br>2<br>4 | ±2.5/±13                 | SS                        | 3.5                            | 3                | 0.75                     | 2.5                           | 90              | 90            | 106                      | 27.5                   | 0.001                  | 0.290                        | 1 pA               | 12 <sup>2</sup>      | SC70/SOIC<br>MSOP/SOIC<br>SOIC/LFCSP              | 1.47<br>2.35<br>3.85  |
| JFET    | AD820A<br>AD822A<br>AD824A | 1<br>2<br>4 | ±2.5/±18                 | SS                        | 1.9                            | 3                | 2                        | 2                             | 70              | 70            | 114                      | 16                     | 0.008                  | 0.900                        | 25 pA              | 45                   | MSOP/SOIC/PDIP<br>MSOP/SOIC/PDIP<br>SOIC          | 1.82<br>2.76<br>4.55  |
| JFET    | AD820B<br>AD822B           | 1<br>2      | ±2.5/±18                 | SS                        | 1.9                            | 3                | 1                        | 2                             | 74              | 70            | 114                      | 16                     | 0.008                  | 0.900                        | 10 pA              | 45                   | SOIC/PDIP<br>MSOP/SOIC/PDIP                       | 2.66<br>4.11          |
| CMOS    | AD8638<br>AD8639           | 1<br>2      | 5/16                     | SS                        | 1.5                            | 2                | 0.009                    | 0.03                          | 127             | 127           | 130                      | 60                     |                        | 1.500                        | 75 pA              | 37                   | SOT-23/SOIC<br>MSOP/SOIC/LFCSP                    | 1.27<br>2.19          |
| CMOS    | AD8691<br>AD8692<br>AD8694 | 1<br>2<br>4 | 2.7/6                    | SS                        | 10                             | 5                | 2                        | 1.3                           | 70              | 80            | 108                      | 8                      | 0.05                   | 1.050                        | 1 pA               | 80                   | SC70/SOT-23<br>MSOP/SOIC<br>SOIC/TSSOP            | 0.51<br>0.64<br>0.90  |
| CMOS    | ADA4692-2<br>ADA4692-4     | 2<br>4      | 2.7/6                    | SS                        | 3.6                            | 1.3              | 2.5                      | 1                             | 75              | 80            | 95                       | 16                     | 0.05                   | 0.225                        | 5 pA               | 55                   | SOIC/LFCSP<br>TSSOP                               | 0.55<br>0.90          |
| CMOS    | ADA4691-2<br>ADA4691-4     | 2<br>4      | 2.7/6                    | SS                        | 3.6                            | 1.3              | 2.5                      | 1                             | 75              | 80            | 95                       | 16                     | 0.05                   | 0.225                        | 5 pA               | 55                   | LFCSF<br>LFCSF                                    | 0.57<br>0.99          |
| CMOS    | AD8665<br>AD8666<br>AD8668 | 1<br>2<br>4 | 5/16                     | SS                        | 4                              | 3.5              | 2.5                      | 3                             | 90              | 98            | 130                      | 10                     | 0.1                    | 1.550                        | 1 pA               | 140                  | SOT-23/SOIC<br>MSOP/SOIC<br>SOIC/TSSOP            | 0.83<br>0.93<br>1.75  |

\*Prerelease

<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes -V<sub>SY</sub>).

<sup>2</sup> Check data sheet for test conditions and actual product specification—may be different for single/dual/quad amplifiers for part numbers with <sup>2</sup> mark.

## Precision Amplifiers ( $V_{OS} < 1\text{ mV}$ , Bandwidth $< 50\text{ MHz}$ )

### Rail-to-Rail Output Amplifiers

#### AD8641: Low Power, Rail-to-Rail Output Precision JFET Amplifier

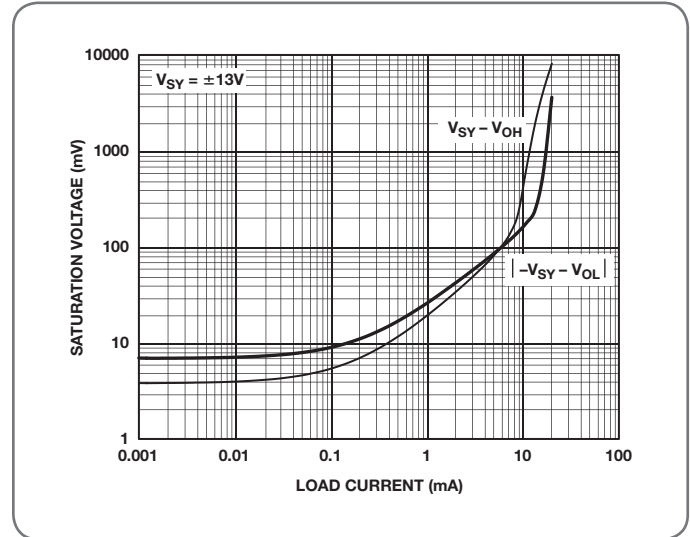
The AD8641/AD8642/AD8643 are low power, precision JFET input amplifiers featuring extremely low input bias current and rail-to-rail output. The ability to swing nearly rail-to-rail at the input and rail-to-rail at the output enables designers to buffer CMOS DACs, ASICs, and other wide output swing devices in single-supply systems. The outputs remain stable with capacitive loads of more than 500 pF.

##### Features

- Low supply current: 250  $\mu\text{A}$  max
- Very low input bias current: 1 pA max
- Low offset voltage: 750  $\mu\text{V}$  max
- Single-supply operation: 5 V to 26 V
- Dual-supply operation:  $\pm 2.5\text{ V}$  to  $\pm 13\text{ V}$
- Rail-to-rail output
- Unity-gain stable

##### Applications

- Line-/battery-powered instruments
- Precision current sensing
- Medical instrumentation
- Industrial controls
- Precision filters
- Portable audio
- ATE



Output saturation voltage vs. load current.

#### ADA4691-2 Dual, Low Power, Wideband, Low Noise, Rail-to-Rail Output Amplifier

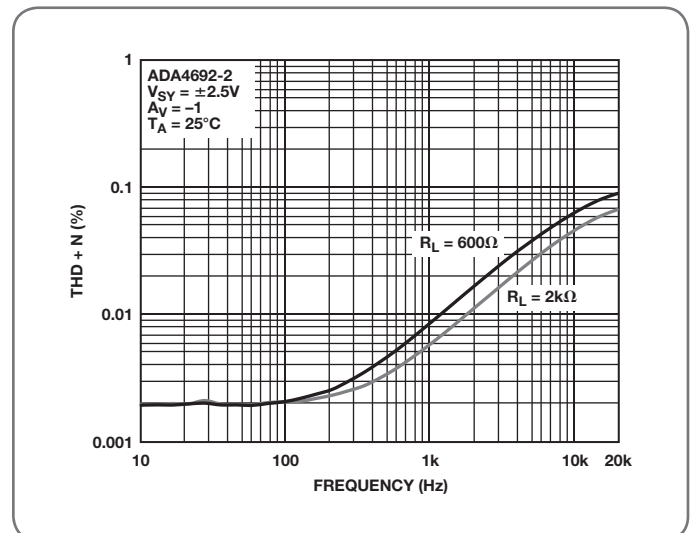
The ADA4691-2 is a dual, rail-to-rail output, single-supply amplifier featuring low power, wide bandwidth, and low noise. The ADA4691-2 has two independent shutdown pins, allowing further reduction in supply current. These amplifiers are ideal for a wide variety of applications. Audio preamps, filters, IR/photodiode amplifiers, charge amps, and high impedance sensors all benefit from this combination of performance features.

##### Features

- Low power: 180  $\mu\text{A}$  typical
- Low distortion: 0.003% THD + N
- Low noise: 16  $\text{nV}/\sqrt{\text{Hz}}$  typical
- 3.6 MHz bandwidth
- Offset voltage: 500  $\mu\text{V}$  typical

##### Applications

- Portable audio
- Portable instrumentation and medical devices
- Photodiode amplifiers
- Sensor amplifiers
- Low-side current sense
- ADC drivers
- Active filters
- Sample-and-hold
- Automotive sensors



Noise vs. frequency.



| Process   | Part Number | No. of Amps     | Supply Voltage (Min/Max) | Rail-to-Rail <sup>1</sup> | BW @ A <sub>CL</sub> Min (MHz) | Slew Rate (V/μs) | V <sub>OS</sub> Max (mV) | TcV <sub>OS</sub> (μV/°C Typ) | CMRR Min (dB)   | PSRR Min (dB) | A <sub>v0</sub> Min (dB) | Noise (nV/√Hz) @ 1 kHz | Noise (pA/√Hz) @ 1 kHz | I <sub>s</sub> /Amp (mA Max) | I <sub>b</sub> Max | Packaging        | Price @ 1k (OEM \$US) |
|-----------|-------------|-----------------|--------------------------|---------------------------|--------------------------------|------------------|--------------------------|-------------------------------|-----------------|---------------|--------------------------|------------------------|------------------------|------------------------------|--------------------|------------------|-----------------------|
| Bipolar   | AD8675      | 1               | ±5/±18                   | RRO                       | 10                             | 2.5              | 0.075                    | 0.2                           | 114             | 120           | 123                      | 2.8                    | 0.3 <sup>2</sup>       | 2.900                        | 2 nA               | MSOP/SOIC        | 1.18                  |
| Bipolar   | AD8676A     | 2               | ±5/±18                   | RRO                       | 10                             | 2.5              | 0.1                      | 0.2                           | 111             | 106           | 123                      | 2.8                    | 0.3 <sup>2</sup>       | 3.400                        | 2 nA               | MSOP/SOIC        | 1.66                  |
| Bipolar   | AD8676B     | 2               | ±5/±18                   | RRO                       | 10                             | 2.5              | 0.05                     | 0.2                           | 111             | 106           | 123                      | 2.8                    | 0.3 <sup>2</sup>       | 3.400                        | 2 nA               | MSOP/SOIC        | 2.14                  |
| CMOS      | AD8605      | 1               | 2.7/6                    | RRIO                      | 10                             | 5                | 0.3                      | 1                             | 85              | 80            | 109                      | 8                      | 0.01                   | 1.200                        | 1 pA               | WLCSOP/SOT-23    | 0.68                  |
|           | AD8606      | WLCSP/MSOP/SOIC |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 1.19             |                       |
|           | AD8608      | SOIC/TSSOP      |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 1.58             |                       |
| CMOS      | AD8691      | 1               | 2.7/6                    | SS                        | 10                             | 5                | 2                        | 1.3                           | 70              | 80            | 108                      | 8                      | 0.05                   | 1.050                        | 1 pA               | SC70/SOT-23      | 0.51                  |
|           | AD8692      | MSOP/SOIC       |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 0.64             |                       |
|           | AD8694      | SOIC/TSSOP      |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 0.90             |                       |
| CMOS      | AD8646      | 2               | 2.7/6                    | RRIO                      | 24                             | 11               | 2.5                      | 1.8                           | 67              | 63            | 104                      | 8                      |                        | 1.500                        | 1 pA               | MSOP/SOIC        | 0.61                  |
|           | AD8648      | SOIC/TSSOP      |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 0.88             |                       |
| CMOS      | AD8647      | 2               | 2.7/6                    | RRIO                      | 24                             | 11               | 2.5                      | 1.8                           | 67              | 63            | 104                      | 8                      |                        | 1.500                        | 1 pA               | MSOP             | 0.71                  |
| Bipolar   | OP162       | 1               | 2.7/12                   | SS                        | 15                             | 13               | 0.325                    | 1                             | 70              | 60            | 97                       | 9.5                    | 0.4                    | 0.800                        | 500 nA             | MSOP/SOIC/TSSOP  | 1.69                  |
|           | OP262       | SOIC/TSSOP      |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 2.23             |                       |
|           | OP462       | SOIC/TSSOP      |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 4.03             |                       |
| Bipolar   | AD8519      | 1               | 2.7/12                   | SS                        | 8                              | 2.9              | 1.1                      | 2                             | 70 <sup>2</sup> | 60            | 94                       | 10                     | 0.4                    | 1.200                        | 300 nA             | SC70/SOT-23/SOIC | 0.92                  |
| AD8529    | MSOP/SOIC   | 1.22            |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    |                  |                       |
| CMOS      | AD8615      | 1               | 2.7/6                    | RRIO                      | 24                             | 12               | 0.5                      | 1.5                           | 80              | 70            | 105                      | 10                     | 0.05                   | 1.300                        | 1 pA               | SOT-23           | 0.76                  |
|           | AD8616      | MSOP/SOIC       |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 1.29             |                       |
|           | AD8618      | SOIC/TSSOP      |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 2.29             |                       |
| CMOS      | AD8665      | 1               | 5/16                     | SS                        | 4                              | 3.5              | 2.5                      | 3                             | 90              | 98            | 130                      | 10                     | 0.1                    | 1.550                        | 1 pA               | SOT-23/SOIC      | 0.83                  |
|           | AD8666      | MSOP/SOIC       |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 0.93             |                       |
|           | AD8668      | SOIC/TSSOP      |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 1.75             |                       |
| Bipolar   | AD8622      | 2               | ±2.5/±18                 | RRO                       | 0.56                           | 0.48             | 0.125                    | 0.5                           | 125             | 125           | 125                      | 11                     | 0.15                   | 0.250                        | 200 pA             | MSOP/SOIC        | 2.30                  |
|           | AD8624      | LFCSP/TSSOP     |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 3.75             |                       |
| CMOS      | AD8661      | 1               | 5/16                     | SS                        | 4                              | 3.5              | 0.16                     | 4                             | 90              | 95            | 106                      | 12                     | 0.1                    | 1.550                        | 1 pA               | SOIC/LFCSP       | 1.08                  |
|           | AD8662      | MSOP/SOIC       |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 1.37             |                       |
|           | AD8664      | SOIC/TSSOP      |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 2.23             |                       |
| JFET      | AD8627      | 1               | ±5/±13                   | SS                        | 5                              | 5                | 0.75                     | 2.5                           | 76              | 80            | 103                      | 16                     | 0.5                    | 0.850                        | 1 pA               | WLCSP/SOIC       | 1.60                  |
|           | AD8626      | MSOP/SOIC       |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 2.63             |                       |
|           | AD8625      | SOIC/TSSOP      |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 4.09             |                       |
| JFET      | AD820A      | 1               | ±2.5/±18                 | SS                        | 1.9                            | 3                | 2                        | 2                             | 70              | 70            | 114                      | 16                     | 0.008                  | 0.900                        | 25 pA              | MSOP/SOIC        | 1.82                  |
|           | AD822A      | MSOP/SOIC/PDIP  |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 2.76             |                       |
|           | AD824A      | SOIC            |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    | 4.55             |                       |
| JFET      | AD820B      | 1               | ±2.5/±18                 | SS                        | 1.9                            | 3                | 1                        | 2                             | 74              | 70            | 114                      | 16                     | 0.008                  | 0.900                        | 10 pA              | SOIC/PDIP        | 2.66                  |
| CMOS      | ADA4692-2   | 2               | 2.7/6                    | SS                        | 3.6                            | 1.3              | 2.5                      | 1                             | 75              | 80            | 95                       | 16                     | 0.05                   | 0.225                        | 5 pA               | SOIC/LFCSP       | 0.55                  |
| ADA4692-4 | TSSOP       | 0.90            |                          |                           |                                |                  |                          |                               |                 |               |                          |                        |                        |                              |                    |                  |                       |
| CMOS      | ADA4691-2   | 2               | 2.7/6                    | SS                        | 3.6                            | 1.3              | 2.5                      | 1                             | 75              | 80            | 95                       | 16</                   |                        |                              |                    |                  |                       |

# Rail-to-Rail Output Amplifiers (continued)

| Process | Part Number            | No. of Amps | Supply Voltage (Min/Max) | Rail-to-Rail <sup>1</sup> | BW @ A <sub>CL</sub> Min (MHz) | Slew Rate (V/μs) | V <sub>OS</sub> Max (mV) | TcV <sub>OS</sub> (μV/°C Typ) | CMRR Min (dB) | PSRR Min (dB) | A <sub>vo</sub> Min (dB) | Noise (nV/√Hz) @ 1 kHz | Noise (pA/√Hz) @ 1 kHz | I <sub>s</sub> /Amp (mA Max) | I <sub>b</sub> Max | Packaging        | Price @ 1k (OEM \$US) |
|---------|------------------------|-------------|--------------------------|---------------------------|--------------------------------|------------------|--------------------------|-------------------------------|---------------|---------------|--------------------------|------------------------|------------------------|------------------------------|--------------------|------------------|-----------------------|
| JFET    | AD8641                 | 1           | ±2.5/±13                 | SS                        | 3.5                            | 3                | 0.75                     | 2.5                           | 90            | 90            | 106                      | 27.5                   | 0.0005                 | 0.290                        | 1 pA               | SC70/SOIC        | 1.47                  |
|         | AD8642                 | 2           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | MSOP/SOIC        | 2.35                  |
|         | AD8643                 | 4           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | SOIC/LFCSP       | 3.85                  |
| CMOS    | ADA4665-2              | 2           | 5/16                     | RRIO                      | 1.2                            | 1                | 6                        | 3                             | 55            | 70            | 85                       | 32                     |                        | 0.400                        | 1 pA               | MSOP/SOIC        | 0.70                  |
| CMOS    | AD8601A                | 1           | 2.7/6                    | RRIO                      | 8.2                            | 5.2              | 0.5                      | 2                             | 74            | 67            | 89                       | 33                     | 0.05                   | 1.200                        | 60 pA              | SOT-23           | 0.62                  |
|         | AD8602A                | 2           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | MSOP/SOIC        | 0.83                  |
|         | AD8604A                | 4           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | SOIC/TSSOP       | 1.13                  |
| CMOS    | AD8602                 | 2           | 2.7/6                    | RRIO                      | 8.2                            | 5.2              | 6                        | 2                             | 56            | 56            | 86                       | 33                     | 0.05                   | 1.200                        | 200 pA             | MSOP/SOIC        | 0.44                  |
|         | AD8604                 | 4           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | SOIC/TSSOP       | 0.90                  |
| CMOS    | AD8541                 | 1           | 2.7/6                    | RRIO                      | 1                              | 0.92             | 6                        | 4                             | 40            | 65            | 86                       | 40                     | 0.1                    | 0.045                        | 60 pA              | SC70/SOT-23/SOIC | 0.27                  |
|         | AD8542                 | 2           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | MSOP/SOIC/TSSOP  | 0.38                  |
|         | AD8544                 | 4           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | SOIC/TSSOP       | 0.54                  |
| Bipolar | OP191                  | 1           | 2.7/12                   | RRIO                      | 1.5                            | 0.5              | 0.5                      | 1.1                           | 75            | 80            | 88                       | 42                     | 0.8                    | 0.420                        | 65 nA              | SOIC             | 1.69                  |
|         | OP291                  | 2           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | SOIC             | 2.22                  |
|         | OP491                  | 4           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | SOIC/TSSOP/PDIP  | 3.60                  |
| CMOS    | AD8551                 | 1           | 2.7/6                    | RRIO                      | 1.5                            | 0.4              | 0.005                    | 0.005                         | 120           | 120           | 125                      | 42                     |                        | 0.975                        | 50 pA              | MSOP/SOIC        | 1.20                  |
|         | AD8552                 | 2           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | SOIC/TSSOP       | 1.90                  |
|         | AD8554                 | 4           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | SOIC/TSSOP       | 3.36                  |
| CMOS    | AD8657                 | 2           | 2.7/18                   | RRIO                      | 0.175                          | 0.3              | 0.3                      | 4                             | 95            | 105           | 110                      | 50                     |                        | 0.022                        | 5 pA               | MSOP/SOIC        | 0.95                  |
|         | AD8659*                | 4           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | SOIC/LFCSP       | 1.35                  |
| CMOS    | AD8505 <sup>2</sup>    | 1           | 1.8/5.5                  | RRIO                      | 0.095                          | 0.013            | 2.5                      | 2                             | 90            | 100           | 105                      | 45                     | 0.015                  | 0.020                        | 10 pA              | SOT-23           | 0.59                  |
|         | AD8506                 | 2           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | MSOP             | 0.71                  |
|         | AD8508                 | 4           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | TSSOP            | 1.20                  |
| CMOS    | AD8591                 | 1           | 2.7/6                    | RRIO                      | 3                              | 5                | 25                       | 20                            | 38            | 45            | 83                       | 45                     | 0.05                   | 0.700                        | 50 pA              | SOT-23           | 0.29                  |
|         | AD8592                 | 2           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | SOIC             | 0.39                  |
|         | AD8594                 | 4           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | SOIC/TSSOP       | 0.57                  |
| CMOS    | AD8531                 | 1           | 2.7/6                    | RRIO                      | 3                              | 5                | 25                       | 20                            | 38            | 45            | 83                       | 45                     | 0.05                   | 0.700                        | 50 pA              | SC70/SOT-23      | 0.27                  |
|         | AD8532                 | 2           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | MSOP/SOIC/TSSOP  | 0.43                  |
|         | AD8534                 | 4           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | SOIC/TSSOP       | 0.60                  |
| CMOS    | AD8538                 | 1           | 2.7/5.5                  | RRIO                      | 0.43                           | 0.35             | 0.013                    | 0.03                          | 115           | 105           | 115                      | 50                     |                        | 0.180                        | 25 pA              | SOT-23/SOIC      | 0.90                  |
|         | AD8539                 | 2           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | MSOP/SOIC        | 1.31                  |
| CMOS    | AD8571                 | 1           | 2.7/6                    | RRIO                      | 1.5                            | 0.4              | 0.005                    | 0.005                         | 120           | 120           | 125                      | 51                     |                        | 0.850                        | 50 pA              | MSOP/SOIC        | 1.11                  |
|         | AD8572                 | 2           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | SOIC/TSSOP       | 1.78                  |
|         | AD8574                 | 4           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | SOIC/TSSOP       | 3.40                  |
| CMOS    | AD8638                 | 1           | 5/16                     | SS                        | 1.5                            | 2                | 0.009                    | 0.03                          | 127           | 127           | 130                      | 60                     |                        | 1.500                        | 75 pA              | SOT-23/SOIC      | 1.27                  |
|         | AD8639                 | 2           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | MSOP/SOIC/LFCSP  | 2.19                  |
| CMOS    | ADA4505-1 <sup>2</sup> | 1           | 1.8/5.5                  | RRIO                      | 0.050                          | 0.006            | 3                        | 2                             | 90            | 100           | 105                      | 65                     | 0.02                   | 0.010                        | 2 pA               | WLCSP/SOT-23     | 0.55                  |
|         | ADA4505-2              | 2           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | WLCSP/MSOP       | 0.67                  |
|         | ADA4505-4              | 4           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | WLCSP/TSSOP      | 1.15                  |
| Bipolar | OP281                  | 2           | 2.7/12                   | SS                        | 0.105                          | 0.028            | 1.5                      | 10                            | 65            | 76            | 74                       | 85                     | 1                      | 0.005                        | 10 nA              | SOIC/TSSOP       | 2.74                  |
|         | OP481                  | 4           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | SOIC/TSSOP       | 3.58                  |
| CMOS    | ADA4051-1              | 1           | 1.8/5.5                  | RRIO                      | 0.125                          | 0.06             | 0.015                    | 0.02                          | 110           | 110           | 115                      | 95                     | 0.1                    | 0.017                        | 70 pA              | SC70/SOT-23      | 0.93                  |
|         | ADA4051-2              | 2           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | MSOP/LFCSP       | 1.47                  |
| CMOS    | AD8500                 | 1           | 1.8/5.5                  | RRIO                      | 0.007                          | 0.004            | 1                        | 3                             | 75            | 90            | 98                       | 190                    | 0.1                    | 0.001                        | 10 pA              | SC70             | 0.71                  |
| CMOS    | AD8502                 | 2           | 1.8/5.5                  | RRIO                      | 0.007                          | 0.004            | 3                        | 5                             | 67            | 85            | 98                       | 190                    | 0.1                    | 0.001                        | 10 pA              | SOT-23           | 0.70                  |
|         | AD8504                 | 4           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | TSSOP            | 1.00                  |
| CMOS    | AD8655                 | 1           | 2.7/5.5                  | RRIO                      | 28                             | 11               | 0.25                     | 0.4                           | 85            | 88            | 100                      | 2.7 <sup>2</sup>       |                        | 4.500                        | 10 pA              | MSOP/SOIC        | 0.71                  |
|         | AD8656                 | 2           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | MSOP/SOIC        | 1.11                  |
| CMOS    | AD8651                 | 1           | 2.7/5.5                  | RRIO                      | 50                             | 41               | 0.35                     | 4                             | 80            | 76            | 100                      | 4.5 <sup>2</sup>       | 0.025                  | 14.000                       | 10 pA              | MSOP/SOIC        | 1.13                  |
|         | AD8652                 | 2           |                          |                           |                                |                  |                          |                               |               |               |                          |                        |                        |                              |                    | MSOP/SOIC        | 1.99                  |

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<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes -V<sub>SV</sub>).

<sup>2</sup> Check data sheet for test conditions and actual product specification—may be different for single/dual/quad amplifiers for part numbers with <sup>2</sup> mark.

# Precision Amplifiers ( $V_{OS} < 1 \text{ mV}$ , Bandwidth $< 50 \text{ MHz}$ )

## Rail-to-Rail Input/Output Amplifiers

### AD8656: Low power, Precision RRIO CMOS Amplifier

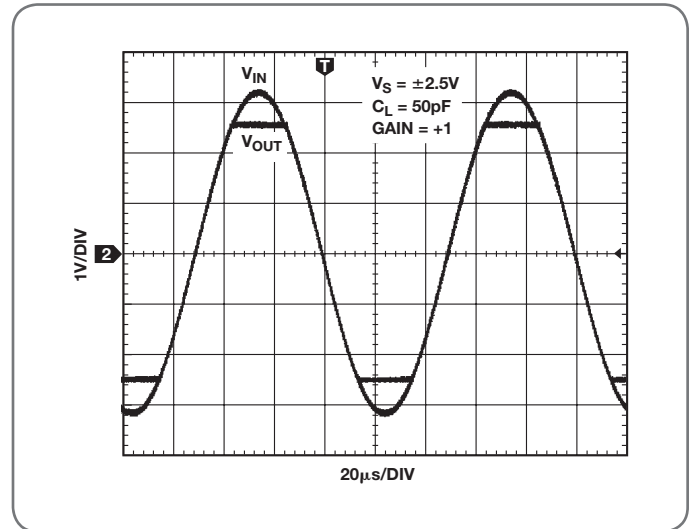
The AD8656 provides low noise ( $2.7 \text{ nV}/\sqrt{\text{Hz}}$  @  $10 \text{ kHz}$ ), low THD + N ( $0.0007\%$ ), and high precision performance ( $250 \text{ } \mu\text{V}$  max over VCM) to low voltage applications. The ability to swing rail-to-rail at the input and output enables designers to buffer analog-to-digital converters (ADCs) and other wide dynamic range devices in single-supply systems.

#### Features

- Low noise:  $2.7 \text{ nV}/\sqrt{\text{Hz}}$  @  $f = 10 \text{ kHz}$
- Low offset voltage:  $250 \text{ } \mu\text{V}$  max over VCM (common-mode voltage)
- Offset voltage drift:  $0.4 \text{ } \mu\text{V}/^\circ\text{C}$  typ and  $2.3 \text{ } \mu\text{V}/^\circ\text{C}$  max
- Bandwidth:  $28 \text{ MHz}$
- Rail-to-rail input/output
- Unity-gain stable

#### Applications

- ADC and DAC buffers
- Audio
- Industrial controls
- Precision filters
- Digital scales
- Strain gages
- PLL filters



No phase reversal.

## Rail-to-Rail Input/Output Amplifiers

| Process | Part Number | No. of Amps | Supply Voltage (Min/Max) | Rail-to-Rail <sup>1</sup> | BW @ A <sub>CL</sub> Min (MHz) | Slew Rate (V/ $\mu$ s) | $V_{OS}$ (mV Max) | $TcV_{OS}$ ( $\mu$ V/ $^\circ\text{C}$ Typ) | BW @ A <sub>CL</sub> Min (MHz) | Slew Rate (V/ $\mu$ s) | A <sub>VO</sub> Min (b $\odot$ ) | $TcV_{OS}$ ( $\mu$ V/ $^\circ\text{C}$ Typ) | I <sub>O</sub> /Amp (mA Max) | I <sub>B</sub> Max | Packaging                                       | Price @ 1k (DEM \$US) |
|---------|-------------|-------------|--------------------------|---------------------------|--------------------------------|------------------------|-------------------|---------------------------------------------|--------------------------------|------------------------|----------------------------------|---------------------------------------------|------------------------------|--------------------|-------------------------------------------------|-----------------------|
| CMOS    | ADA4528-1   | 1           | 2.2/5.5                  | RRIO                      | 4                              | 0.4                    | 0.0025            | 0.015                                       | 115                            | 120                    | 130                              | 5.3                                         | 1.500                        | 100 pA             | MSOP/LFCSP                                      | 1.15                  |
|         | ADA4528-2*  | 2           |                          |                           |                                |                        |                   |                                             |                                |                        |                                  |                                             |                              |                    |                                                 | 1.90                  |
| CMOS    | AD8605      | 1           | 2.7/6                    | RRIO                      | 10                             | 5                      | 0.3               | 1                                           | 85                             | 80                     | 109                              | 8                                           | 1.200                        | 1 pA               | WLCSOP/SOT-23<br>WLCSOP/MSOP/SOIC<br>SOIC/TSSOP | 0.68                  |
|         | AD8606      | 2           |                          |                           |                                |                        |                   |                                             |                                |                        |                                  |                                             |                              |                    |                                                 | 1.19                  |
|         | AD8608      | 4           |                          |                           |                                |                        |                   |                                             |                                |                        |                                  |                                             |                              |                    |                                                 | 1.58                  |
| CMOS    | AD8646      | 2           | 2.7/6                    | RRIO                      | 24                             | 11                     | 2.5               | 1.8                                         | 67                             | 63                     | 104                              | 8                                           | 1.500                        | 1 pA               | MSOP/SOIC<br>SOIC/TSSOP                         | 0.61                  |
|         | AD8648      | 4           |                          |                           |                                |                        |                   |                                             |                                |                        |                                  |                                             |                              |                    |                                                 | 0.88                  |
| CMOS    | AD8647 SD   | 2           | 2.7/6                    | RRIO                      | 24                             | 11                     | 2.5               | 1.8                                         | 67                             | 63                     | 104                              | 8                                           | 1.500                        | 1 pA               | MSOP                                            | 0.71                  |
| CMOS    | AD8615      | 1           | 2.7/6                    | RRIO                      | 24                             | 12                     | 0.5               | 1.5                                         | 80                             | 70                     | 105                              | 10                                          | 1.300                        | 1 pA               | SOT-23<br>MSOP/SOIC<br>SOIC/MSSOP               | 0.76                  |
|         | AD8616      | 2           |                          |                           |                                |                        |                   |                                             |                                |                        |                                  |                                             |                              |                    |                                                 | 1.29                  |
|         | AD8618      | 4           |                          |                           |                                |                        |                   |                                             |                                |                        |                                  |                                             |                              |                    |                                                 | 2.29                  |
| CMOS    | AD8628      | 1           | 2.7/6                    | RRIO                      | 2.5                            | 1                      | 0.005             | 0.002                                       | 120                            | 115                    | 125                              | 22                                          | 0.850                        | 100 pA             | SOT-23/SOIC<br>MSOP/SOIC<br>SOIC/TSSOP          | 0.96                  |
|         | AD8629      | 2           |                          |                           |                                |                        |                   |                                             |                                |                        |                                  |                                             |                              |                    |                                                 | 1.47                  |
|         | AD8630      | 4           |                          |                           |                                |                        |                   |                                             |                                |                        |                                  |                                             |                              |                    |                                                 | 2.73                  |
| CMOS    | AD8515      | 1           | 1.8/6                    | RRIO                      | 5                              | 2.7                    | 6                 | 4                                           | 60                             | 65                     | 113                              | 22                                          | 0.550                        | 30 pA              | SC70/SOT-23                                     | 0.28                  |
| CMOS    | AD8603      | 1           | 1.8/6                    | RRIO                      | 0.4                            | 0.1                    | 0.3               | 1                                           | 85                             | 80                     | 112                              | 25                                          | 0.040                        | 1 pA               | SOT-23<br>MSOP/SOIC<br>SOIC/MSSOP               | 0.68                  |
|         | AD8607      | 2           |                          |                           |                                |                        |                   |                                             |                                |                        |                                  |                                             |                              |                    |                                                 | 1.02                  |
|         | AD8609      | 4           |                          |                           |                                |                        |                   |                                             |                                |                        |                                  |                                             |                              |                    |                                                 | 1.85                  |
| Bipolar | ADA4091-2   | 2           | $\pm 1.35/\pm 18$        | RRIO                      | 1.27                           | 0.46                   | 0.25              | 2.5                                         | 104                            | 108                    | 116                              | 25                                          | 0.250                        | 55 nA              | SOIC/LFCSP<br>LFCSP/TSSOP                       | 2.22                  |
|         | ADA4091-4   | 4           |                          |                           |                                |                        |                   |                                             |                                |                        |                                  |                                             |                              |                    |                                                 | 3.50                  |
| CMOS    | AD8613      | 1           | 1.8/5.5                  | RRIO                      | 0.4                            | 0.1                    | 2.2               | 1                                           | 68                             | 67                     | 107                              | 25                                          | 0.040                        | 1 pA               | SC70/SOT-23<br>MSOP/SOIC<br>SOIC/TSSOP          | 0.46                  |
|         | AD8617      | 2           |                          |                           |                                |                        |                   |                                             |                                |                        |                                  |                                             |                              |                    |                                                 | 0.71                  |
|         | AD8619      | 4           |                          |                           |                                |                        |                   |                                             |                                |                        |                                  |                                             |                              |                    |                                                 | 1.11                  |

\*Prerelease

# Rail-to-Rail Input/Output Amplifiers (continued)

| Process | Part Number            | No. of Amps | Supply Voltage (Min/Max) | Rail-to-Rail <sup>1</sup> | BW @ A <sub>OL</sub> Min (MHz) | Slew Rate (V/μs) | V <sub>OS</sub> (mV Max) | TcV <sub>OS</sub> (μV/°C Typ) | BW @ A <sub>OL</sub> Min (MHz) | Slew Rate (V/μs) | A <sub>VO</sub> Min (dB) | TcV <sub>OS</sub> (μV/°C Typ) | I <sub>S</sub> /Amp (mA Max) | I <sub>B</sub> Max | Packaging        | Price @ 1k (OEM \$US) |
|---------|------------------------|-------------|--------------------------|---------------------------|--------------------------------|------------------|--------------------------|-------------------------------|--------------------------------|------------------|--------------------------|-------------------------------|------------------------------|--------------------|------------------|-----------------------|
| Bipolar | AD8565                 | 1           | 4.5/16                   | RRIO                      | 5                              | 6                | 10                       | 5                             | 54                             | 70               | 69                       | 26                            | 0.850                        | 600 nA             | SC70             | 0.56                  |
|         | AD8566                 | 2           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | MSOP             | 0.71                  |
|         | AD8567                 | 4           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | LFCSP/TSSOP      | 0.93                  |
| CBCMOS  | OP196                  | 1           | 3/15                     | RRIO                      | 0.45                           | 0.3              | 0.3                      | 1.5                           | 65 <sup>2</sup>                | 110              | 109                      | 26                            | 0.060                        | 50 nA              | SOIC             | 1.56                  |
|         | OP296                  | 2           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | SOIC/TSSOP/PDIP  | 1.85                  |
|         | OP496                  | 4           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | SOIC/TSSOP/PDIP  | 2.66                  |
| BiPolar | ADA4092-2*             | 2           | ±1.35/±18                | RRIO                      | 1.4                            | 0.4              | 1.5                      | 2.5                           | 90                             | 98               | 116                      | 30                            | 0.250                        | 60 nA              | SOIC/LFCSP       | 1.35                  |
|         | ADA4092-4              | 4           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | TSSOP            | 2.50                  |
| CMOS    | ADA4665-2              | 2           | 5/16                     | RRIO                      | 1.2                            | 1                | 6                        | 3                             | 55                             | 70               | 85                       | 32                            | 0.400                        | 1 pA               | MSOP/SOIC        | 0.70                  |
| CMOS    | AD8601A                | 1           | 2.7/6                    | RRIO                      | 8.2                            | 5.2              | 0.5                      | 2                             | 74                             | 67               | 89                       | 33                            | 1.200                        | 60 pA              | SOT-23           | 0.62                  |
|         | AD8602A                | 2           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | MSOP/SOIC        | 0.83                  |
|         | AD8604A                | 4           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | SOIC/TSSOP       | 1.13                  |
| CMOS    | AD8602                 | 2           | 2.7/6                    | RRIO                      | 8.2                            | 5.2              | 6                        | 2                             | 56                             | 56               | 86                       | 33                            | 1.200                        | 200 pA             | MSOP/SOIC        | 0.44                  |
|         | AD8604                 | 4           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | SOIC/TSSOP       | 0.90                  |
| CMOS    | AD8541                 | 1           | 2.7/6                    | RRIO                      | 1                              | 0.92             | 6                        | 4                             | 40                             | 65               | 86                       | 40                            | 0.045                        | 60 pA              | SC70/SOT-23/SOIC | 0.27                  |
|         | AD8542                 | 2           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | MSOP/SOIC/TSSOP  | 0.38                  |
|         | AD8544                 | 4           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | SOIC/TSSOP       | 0.54                  |
| CMOS    | OP191                  | 1           | 2.7/12                   | RRIO                      | 1.5                            | 0.5              | 0.5                      | 1.1                           | 75                             | 80               | 88                       | 42                            | 0.420                        | 65 nA              | SOIC             | 1.69                  |
|         | OP291                  | 2           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | SOIC             | 2.22                  |
|         | OP491                  | 4           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | SOIC/TSSOP/PDIP  | 3.60                  |
| CMOS    | AD8551                 | 1           | 2.7/6                    | RRIO                      | 1.5                            | 0.4              | 0.005                    | 0.005                         | 120                            | 120              | 125                      | 42                            | 0.975                        | 50 pA              | MSOP/SOIC        | 1.20                  |
|         | AD8552                 | 2           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | SOIC/TSSOP       | 1.90                  |
|         | AD8554                 | 4           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | SOIC/TSSOP       | 3.36                  |
| CMOS    | AD8657                 | 2           | 2.7/18                   | RRIO                      | 0.175                          | 0.3              | 0.3                      | 4                             | 95                             | 105              | 110                      | 50                            | 0.022                        | 5 pA               | MSOP/SOIC        | 0.95                  |
|         | AD8659*                | 4           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | SOIC/LFCSP       | 1.35                  |
| CMOS    | AD8505 <sup>2</sup>    | 1           | 1.8/5.5                  | RRIO                      | 0.095                          | 0.013            | 2.5                      | 2                             | 90                             | 100              | 105                      | 45                            | 0.020                        | 10 pA              | WLCSP/SOT-23     | 0.59                  |
|         | AD8506                 | 2           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | WLCSP/MSOP       | 0.71                  |
|         | AD8508                 | 4           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | WLCSP/TSSOP      | 1.20                  |
| CMOS    | AD8591                 | 1           | 2.7/6                    | RRIO                      | 3                              | 5                | 25                       | 20                            | 38                             | 45               | 83                       | 45                            | 0.700                        | 50 pA              | SOT-23           | 0.29                  |
|         | AD8592                 | 2           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | SOIC             | 0.39                  |
|         | AD8594                 | 4           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | SOIC/TSSOP       | 0.57                  |
| CMOS    | AD8531                 | 1           | 2.7/6                    | RRIO                      | 3                              | 5                | 25                       | 20                            | 38                             | 45               | 83                       | 45                            | 0.700                        | 50 pA              | SC70/SOT-23      | 0.27                  |
|         | AD8532                 | 2           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | MSOP/SOIC        | 0.43                  |
|         | AD8534                 | 4           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | SOIC/TSSOP       | 0.60                  |
| CMOS    | AD8538                 | 1           | 2.7/5.5                  | RRIO                      | 0.43                           | 0.35             | 0.013                    | 0.03                          | 115                            | 105              | 115                      | 50                            | 0.180                        | 25 pA              | SOT-23/SOIC      | 0.90                  |
|         | AD8539                 | 2           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | MSOP/SOIC        | 1.31                  |
| CMOS    | AD8571                 | 1           | 2.7/6                    | RRIO                      | 1.5                            | 0.4              | 0.005                    | 0.005                         | 120                            | 120              | 125                      | 51                            | 0.850                        | 50 pA              | MSOP/SOIC        | 1.11                  |
|         | AD8672                 | 2           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | SOIC/TSSOP       | 1.78                  |
|         | AD8574                 | 4           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | SOIC/TSSOP       | 3.40                  |
| CMOS    | ADA4505-1 <sup>2</sup> | 1           | 1.8/5.5                  | RRIO                      | 0.050                          | 0.006            | 3                        | 2                             | 90                             | 100              | 105                      | 65                            | 0.010                        | 2 pA               | WLCSP/SOT-23     | 0.55                  |
|         | ADA4505-2              | 2           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | WLCSP/MSOP       | 0.67                  |
|         | ADA4505-4              | 4           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | WLCSP/TSSOP      | 1.15                  |
| CMOS    | ADA4051-1              | 1           | 1.8/5.5                  | RRIO                      | 0.125                          | 0.06             | 0.015                    | 0.02                          | 110                            | 110              | 115                      | 95                            | 0.017                        | 70 pA              | SC70/SOT-23      | 0.93                  |
|         | ADA4051-2              | 2           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | MSOP/LFCSP       | 1.47                  |
| CMOS    | AD8500                 | 1           | 1.8/5.5                  | RRIO                      | 0.007                          | 0.004            | 1                        | 3                             | 75                             | 90               | 98                       | 190                           | 0.001                        | 10 pA              | SC70             | 0.71                  |
| CMOS    | AD8502                 | 2           | 1.8/5.5                  | RRIO                      | 0.007                          | 0.004            | 3                        | 5                             | 67                             | 85               | 98                       | 190                           | 0.001                        | 10 pA              | SOT-23           | 0.70                  |
|         | AD8504                 | 4           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | TSSOP            | 1.00                  |
| CMOS    | AD8655                 | 1           | 2.7/5.5                  | RRIO                      | 28                             | 11               | 0.25                     | 0.4                           | 85                             | 88               | 100                      | 2.7 <sup>2</sup>              | 4.500                        | 10 pA              | MSOP/SOIC        | 0.71                  |
|         | AD8656                 | 2           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | MSOP/SOIC        | 1.11                  |
| CMOS    | AD8651                 | 1           | 2.7/5.5                  | RRIO                      | 50                             | 41               | 0.35                     | 4                             | 80                             | 76               | 100                      | 4.5 <sup>2</sup>              | 14.000                       | 10 pA              | MSOP/SOIC        | 1.13                  |
|         | AD8652                 | 2           |                          |                           |                                |                  |                          |                               |                                |                  |                          |                               |                              |                    | MSOP/SOIC        | 1.99                  |

\*Prerelease

<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes -V<sub>SY</sub>).

<sup>2</sup> Check data sheet for test conditions and actual product specification—may be different for single/dual/quad amplifiers for part numbers with <sup>2</sup> mark.

## Amplifiers (Bandwidth < 50 MHz)

### Low Cost Amplifiers

#### AD8541: General-Purpose CMOS Rail-to-Rail Amplifier

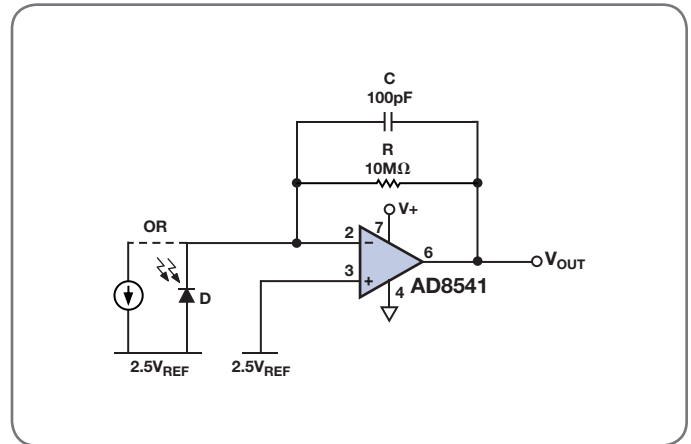
The [AD8541/AD8542/AD8544](#) are single, dual, and quad rail-to-rail input and output single-supply amplifiers featuring very low supply current and 1 MHz bandwidth. All are guaranteed to operate from a 2.7 V single supply, as well as a 5 V supply. These parts provide 1 MHz bandwidth at a low current consumption of 45  $\mu\text{A}$  per amplifier.

##### Features

- Single-supply operation: 2.7 V to 5.5 V
- Low supply current: 45  $\mu\text{A}$ /amplifier
- Wide bandwidth: 1 MHz
- No phase reversal
- Low input currents: 4 pA
- Unity-gain stable
- Rail-to-rail Input/Output

##### Applications

- Sensor interfaces
- Piezoelectric transducer amplifiers
- Medical instrumentation
- Mobile communications
- Audio outputs
- Portable systems



High input impedance application—photodiode amplifier.

#### ADA4692-2: Dual, Low Power, Wideband, Low Noise, Rail-to-Rail Output Amplifier

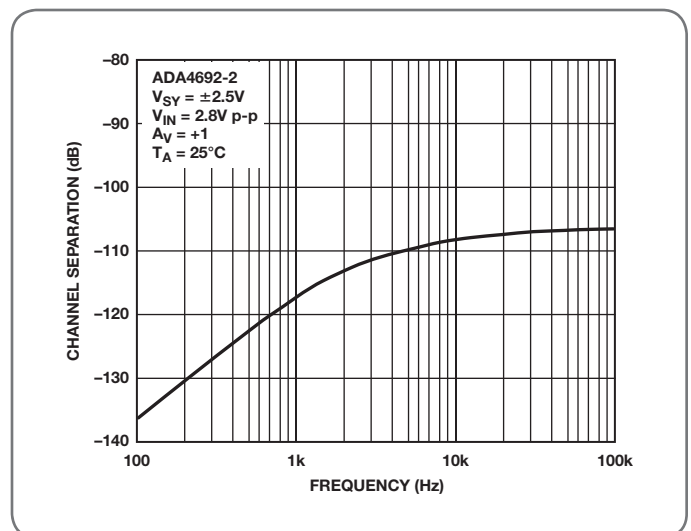
The [ADA4692-2](#) is a dual, rail-to-rail output, single-supply amplifier featuring low power, wide bandwidth, and low noise. The [ADA4691-2](#) has two independent shutdown pins, allowing further reduction in supply current. These amplifiers are ideal for a wide variety of applications. Audio preamps, filters, IR/photodiode amplifiers, charge amps, and high impedance sensors all benefit from this combination of performance features.

##### Features

- Low power: 180  $\mu\text{A}$  typical
- Low distortion: 0.003% THD + N
- Low noise: 16 nV/ $\sqrt{\text{Hz}}$  typical
- 3.6 MHz bandwidth
- Offset voltage: 500  $\mu\text{V}$  typical

##### Applications

- Portable audio
- Portable instrumentation and medical devices
- Photodiode amplifiers
- Sensor amplifiers
- Low-side current sense
- ADC drivers
- Active filters
- Sample-and-hold
- Automotive sensors



Channel separation vs. frequency.

## Low Cost Amplifiers

| Process | Part Number            | No. of Amps | Supply Voltage (Min/Max) | Rail-to-Rail <sup>1</sup> | BW @ A <sub>v</sub> Min (MHz) | Slew Rate (V/μs) | V <sub>os</sub> Max (mV) | TcV <sub>os</sub> (μV/°C Typ) | CMRR Min (dB) | PSRR Min (dB) | A <sub>v0</sub> Min (dB) | Noise (nV/√Hz) @ 1 kHz | I <sub>n</sub> /Amp (mA Max) | I <sub>b</sub> Max | Packaging       | Price @ 1k (OEM \$US) |
|---------|------------------------|-------------|--------------------------|---------------------------|-------------------------------|------------------|--------------------------|-------------------------------|---------------|---------------|--------------------------|------------------------|------------------------------|--------------------|-----------------|-----------------------|
| CMOS    | AD8515                 | 1           | 1.8/6                    | RRIO                      | 5                             | 2.7              | 6                        | 4                             | 60            | 65            | 113                      | 22                     | 0.550                        | 30 pA              | SC70/SOT-23     | 0.28                  |
| CMOS    | ADA4665-2              | 2           | 5/16                     | RRIO                      | 1.2                           | 1                | 6                        | 3                             | 55            | 70            | 85                       | 32                     | 0.400                        | 1 pA               | MSOP/SOIC       | 0.70                  |
| CMOS    | AD8541                 | 1           | 2.7/6                    | RRIO                      | 1                             | 0.92             | 6                        | 4                             | 40            | 65            | 86                       | 40                     | 0.045                        | 60 pA              | SC70/SOT-23     | 0.27                  |
|         | AD8542                 | 2           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | MSOP/SOIC       | 0.38                  |
|         | AD8544                 | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | SOIC/TSSOP      | 0.54                  |
| CMOS    | AD8546                 | 2           | 2.7/18                   | RRIO                      | 0.2                           | 0.07             | 3                        | 0.025                         | 80            | 90            | 88                       | 50                     | 0.022                        | 100 pA             | MSOP/SOIC/LFCSP | 0.78                  |
|         | AD8548                 | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    |                 | 1.05                  |
| CMOS    | AD8531                 | 1           | 2.7/6                    | RRIO                      | 3                             | 5                | 25                       | 20                            | 38            | 45            | 83                       | 45                     | 0.700                        | 50 pA              | SC70/SOT-23     | 0.27                  |
|         | AD8532                 | 2           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | MSOP/SOIC       | 0.43                  |
|         | AD8534                 | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | SOIC/TSSOP      | 0.60                  |
| CMOS    | AD8591                 | 1           | 2.7/6                    | RRIO                      | 3                             | 5                | 25                       | 20                            | 38            | 45            | 83                       | 45                     | 0.700                        | 50 pA              | SOT-23          | 0.29                  |
|         | AD8592                 | 2           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | SOIC            | 0.39                  |
|         | AD8594                 | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | SOIC/TSSOP      | 0.57                  |
| JFET    | ADTL082A               | 2           | ±4/±18                   |                           | 5                             | 20               | 5.5                      | 10                            | 80            | 80            | 100                      | 16                     | 1.800                        | 100 pA             | MSOP/SOIC       | 0.42                  |
|         | ADTL084A               | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | SOIC/TSSOP      | 0.90                  |
| CMOS    | AD8602                 | 2           | 2.7/6                    | RRIO                      | 8.2                           | 5.2              | 6                        | 2                             | 56            | 56            | 86                       | 33                     | 1.200                        | 200 pA             | MSOP/SOIC       | 0.44                  |
|         | AD8604                 | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | SOIC/TSSOP      | 0.90                  |
| CMOS    | AD8613                 | 1           | 1.8/5.5                  | RRIO                      | 0.4                           | 0.1              | 2.2                      | 1                             | 68            | 67            | 107                      | 25                     | 0.040                        | 1 pA               | SC70/SOT-23     | 0.46                  |
|         | AD8617                 | 2           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | MSOP/SOIC       | 0.71                  |
|         | AD8619                 | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | SOIC/TSSOP      | 1.11                  |
| CMOS    | AD8691                 | 1           | 2.7/6                    | SS                        | 10                            | 5                | 2                        | 1.3                           | 70            | 80            | 108                      | 8                      | 1.050                        | 1 pA               | SC70/SOT-23     | 0.51                  |
|         | AD8692                 | 2           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | MSOP/SOIC       | 0.64                  |
|         | AD8694                 | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | SOIC/TSSOP      | 0.90                  |
| CMOS    | ADA4505-1 <sup>2</sup> | 1           | 1.8/5.5                  | RRIO                      | 0.050                         | 0.006            | 3                        | 2                             | 90            | 100           | 105                      | 65                     | 0.010                        | 2 pA               | WLCSP/SOT-23    | 0.55                  |
|         | ADA4505-2              | 2           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | WLCSP/MSOP      | 0.67                  |
|         | ADA4505-4              | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | WLCSP/TSSOP     | 1.15                  |
| CMOS    | ADA4692-2              | 2           | 2.7/6                    | SS                        | 3.6                           | 1.3              | 2.5                      | 1                             | 75            | 80            | 95                       | 16                     | 0.225                        | 5 pA               | SOIC/LFCSP      | 0.55                  |
|         | ADA4692-4              | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | TSSOP           | 0.90                  |
| Bipolar | AD8565                 | 1           | 4.5/16                   | RRIO                      | 5                             | 6                | 10                       | 5                             | 54            | 70            | 69                       | 26                     | 0.850                        | 600 nA             | SC70            | 0.56                  |
|         | AD8566                 | 2           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | MSOP            | 0.71                  |
|         | AD8567                 | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | LFCSP/TSSOP     | 0.93                  |
| CMOS    | ADA4691-2              | 2           | 2.7/6                    | SS                        | 3.6                           | 1.3              | 2.5                      | 1                             | 75            | 80            | 95                       | 16                     | 0.225                        | 5 pA               | WLCSP/LFCSP     | 0.57                  |
|         | ADA4691-4              | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | LFCSP           | 0.99                  |
| CMOS    | AD8505 <sup>2</sup>    | 1           | 1.8/5.5                  | RRIO                      | 0.095                         | 0.013            | 2.5                      | 2                             | 90            | 100           | 105                      | 45                     | 0.020                        | 10 pA              | WLCSP/SOT-23    | 0.59                  |
|         | AD8506                 | 2           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | WLCSP/MSOP      | 0.71                  |
|         | AD8508                 | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | WLCSP/TSSOP     | 1.20                  |
| CMOS    | AD8646                 | 2           | 2.7/6                    | RRIO                      | 24                            | 11               | 2.5                      | 1.8                           | 67            | 63            | 104                      | 8                      | 1.500                        | 1 pA               | MSOP/SOIC       | 0.61                  |
|         | AD8648                 | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | SOIC/TSSOP      | 0.88                  |
| CMOS    | AD8601A                | 1           | 2.7/6                    | RRIO                      | 8.2                           | 5.2              | 0.5                      | 2                             | 74            | 67            | 89                       | 33                     | 1.200                        | 60 pA              | SOT-23          | 0.62                  |
|         | AD8602A                | 2           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | MSOP/SOIC       | 0.83                  |
|         | AD8604A                | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | SOIC/TSSOP      | 1.13                  |
| CMOS    | AD8603                 | 1           | 1.8/6                    | RRIO                      | 0.4                           | 0.1              | 0.3                      | 1                             | 85            | 80            | 112                      | 25                     | 0.040                        | 1 pA               | SOT-23          | 0.68                  |
|         | AD8607                 | 2           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | MSOP/SOIC       | 1.02                  |
|         | AD8609                 | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | SOIC/TSSOP      | 1.85                  |
| CMOS    | AD8605                 | 1           | 2.7/6                    | RRIO                      | 10                            | 5                | 0.3                      | 1                             | 85            | 80            | 109                      | 8                      | 1.200                        | 1 pA               | WLCSP/SOT-23    | 0.68                  |
|         | AD8606                 | 2           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | WLCSP/MSOP/SOIC | 1.19                  |
|         | AD8608                 | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | SOIC/TSSOP      | 1.58                  |
| CMOS    | AD8502                 | 2           | 1.8/5.5                  | RRIO                      | 0.007                         | 0.004            | 3                        | 5                             | 67            | 85            | 98                       | 190                    | 0.001                        | 10 pA              | SOT-23          | 0.70                  |
|         | AD8504                 | 4           |                          |                           |                               |                  |                          |                               |               |               |                          |                        |                              |                    | TSSOP           | 1.00                  |

<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes -V<sub>SS</sub>).

<sup>2</sup> Check data sheet for test conditions and actual product specification—may be different for single/dual/quad amplifiers for part numbers with <sup>2</sup> mark.

# High Speed Amplifiers (BW > 50 MHz)

## Differential Amplifiers

### ADA4930-1/ADA4930-2: Low Power, Ultralow Noise Differential ADC Driver for Low Voltage ADCs

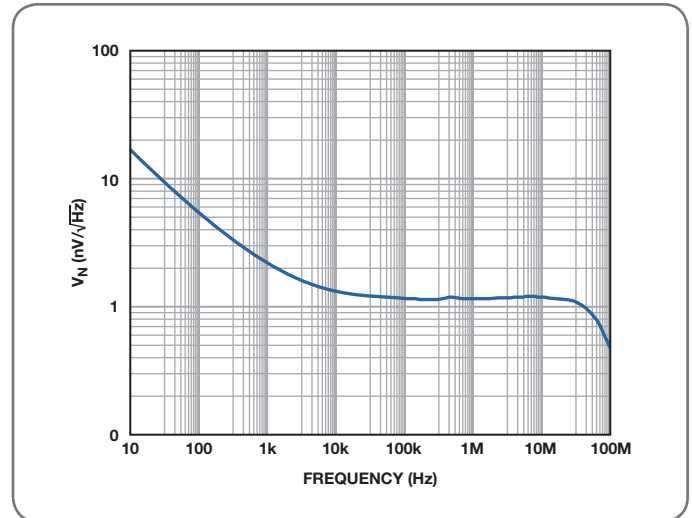
The ADA4930-1 and ADA4930-2 are very low noise, low distortion, high speed differential amplifiers, ideal for driving 1.8 V high performance ADCs with resolutions up to 14 bits from dc to 70 MHz. The devices feature a low 0.9 V output common-mode voltage on single supply, capable of driving dc-coupled, 1.8 V ADCs all the way to ground.

#### Features

- Low input voltage noise:  $1.2 \text{ nV}/\sqrt{\text{Hz}}$
- Low common-mode output: 0.9 V on single supply
- Extremely low harmonic distortion
  - -104 dBc HD2 at 10 MHz
  - -79 dBc HD2 at 70 MHz
  - -73 dBc HD2 at 100 MHz
- High speed
  - -3 dB bandwidth of 1.35 GHz,  $G = 1$
  - Slew rate:  $3400 \text{ V}/\mu\text{s}$ , 25% to 75%
  - 0.1 dB gain flatness to 380 MHz
- 0.5 mV typical offset voltage
- Externally adjustable gain
- Single-supply operation: 3.3 V or 5 V

#### Applications

- ADC drivers
- Single-ended-to-differential converters
- IF and baseband gain blocks
- Differential buffers
- Line drivers



Voltage noise spectral density.

## Differential Amplifiers

| Part Number | No. of Amps | Disable | Supply Voltage (V)   | Rail-to-Rail <sup>1</sup> | A <sub>CL</sub> Min | BW @ A <sub>CL</sub> Min (MHz) | Slew Rate (V/ $\mu$ s) | Distortion SFDR <sup>1</sup> @ BW |       | Noise (nV/ $\sqrt{\text{Hz}}$ ) | V <sub>OS</sub> Max (mV) | I <sub>b</sub> ( $\mu$ A Max) | I <sub>s</sub> /Amp (mA Typ) | I <sub>out</sub> (mA) | Temp Range <sup>2</sup> | Packaging  | Price @ 1k (OEM \$US) |
|-------------|-------------|---------|----------------------|---------------------------|---------------------|--------------------------------|------------------------|-----------------------------------|-------|---------------------------------|--------------------------|-------------------------------|------------------------------|-----------------------|-------------------------|------------|-----------------------|
|             |             |         |                      |                           |                     |                                |                        | (dBc)                             | (MHz) |                                 |                          |                               |                              |                       |                         |            |                       |
| ADA4927-1   | 1           | •       | 5, $\pm$ 5           |                           | 1                   | 2300                           | 5000                   | -91                               | 70    | 1.4                             | 1.3                      | 15                            | 20 mA                        | 65                    | H                       | LFCSP      | 3.79                  |
| ADA4927-2   | 2           | •       |                      |                           |                     |                                |                        |                                   |       |                                 |                          |                               |                              |                       |                         |            | 6.29                  |
| ADA4930-1   | 1           | •       | 3 to 5.25            |                           | 1                   | 1350                           | 3400                   | -88                               | 30    | 1.15                            | 3.1                      | 24                            | 34                           | 30                    |                         | LFCSP      | 3.79                  |
| ADA4930-2   | 2           | •       |                      |                           |                     |                                |                        |                                   |       |                                 |                          |                               |                              |                       |                         |            | 6.29                  |
| ADA4932-1   | 1           | •       | 3, 5, $\pm$ 5        |                           | 1                   | 560                            | 2800                   | -90                               | 20    | 3.6                             | 2.2                      | 5.2                           | 9.6                          | 80                    | H                       | LFCSP      | 2.95                  |
| ADA4932-2   | 2           | •       |                      |                           |                     |                                |                        |                                   |       |                                 |                          |                               |                              |                       |                         |            | 5.29                  |
| ADA4937-1   | 1           | •       | 3, 5                 |                           | 1                   | 1900                           | 6000                   | -84                               | 70    | 2.2                             | 2.5                      | 30                            | 39.5                         | 100                   | I                       | LFCSP      | 3.79                  |
| ADA4937-2   | 2           | •       |                      |                           |                     |                                |                        |                                   |       |                                 |                          |                               |                              |                       |                         |            | 5.69                  |
| ADA4938-1   | 1           | •       | 5, $\pm$ 5           |                           | 1                   | 1000                           | 4700                   | 82                                | 50    | 2.6                             | 1                        | 18                            | 37                           | 75                    | I                       | LFCSP      | 3.79                  |
| ADA4938-2   | 2           | •       |                      |                           |                     |                                |                        |                                   |       |                                 |                          |                               |                              |                       |                         |            | 5.69                  |
| ADA4939-1   | 1           | •       | 3, 5                 |                           | 2                   | 1400                           | 6800                   | -77                               | 100   | 2.3                             | 3.4                      | 26                            | 36.5                         | 100                   | H                       | LFCSP      | 3.79                  |
| ADA4939-2   | 2           | •       |                      |                           |                     |                                |                        |                                   |       |                                 |                          |                               |                              |                       |                         |            | 5.69                  |
| ADA4940-1   | 1           | •       | 3, 5, $\pm$ 5        | RRO                       | 1                   | 230                            | 90                     | 103                               | 1     | 3.9                             | 0.25                     | 1                             | 1.25                         | 45                    | H                       | SOIC/LFCSP | 1.89                  |
| ADA4940-2   | 2           | •       |                      |                           |                     |                                |                        |                                   |       |                                 |                          |                               |                              |                       |                         |            | 2.89                  |
| ADA4950-1   | 1           | •       | 3, 5, $\pm$ 5        |                           | 1                   | 750                            | 2900                   | -98                               | 20    | 9.2 RTO                         | 2.5                      | N/A                           | 9.5                          | 114                   | H                       | LFCSP      | 2.99                  |
| ADA4950-2   | 2           | •       |                      |                           |                     |                                |                        |                                   |       |                                 |                          |                               |                              |                       |                         |            | 5.29                  |
| AD8139      | 1           |         | 3, 5, $\pm$ 5        | RRO                       | 1                   | 410                            | 800                    | -85                               | 5     | 2.25                            | 0.5                      | 8                             | 24.5                         | 100                   | H5                      | SOIC/LFCSP | 3.75                  |
| AD8131      | 1           |         | 3, 5, $\pm$ 5        |                           | 2                   | 400                            | 2000                   | -68                               | 5     | 25                              | 7                        | 6                             | 11.5                         | 60                    | H                       | SOIC/MSOP  | 1.82                  |
| AD8132      | 1           |         | 3, 5, $\pm$ 5        |                           | 1                   | 350                            | 1200                   | -83                               | 5     | 8                               | 3.5                      | 7                             | 12                           | 70                    | H5                      | SOIC/MSOP  | 1.67                  |
| AD8138      | 1           |         | 3, 5, $\pm$ 5        |                           | 1                   | 320                            | 1150                   | -85                               | 20    | 5                               | 2.5                      | 7                             | 20                           | 95                    | I                       | SOIC/MSOP  | 3.75                  |
| AD8137      | 1           | •       | 3, 5, $\pm$ 5        | RRO                       | 1                   | 110                            | 450                    | -90                               | 0.5   | 8.25                            | 2.6                      | 1                             | 3.2                          | 20                    | H5                      | SOIC/LFCSP | 1.10                  |
| ADA4922-1   | 1           | •       | 5, $\pm$ 5, $\pm$ 12 |                           | 2                   | 38                             | 260                    | -99                               | 0.1   | 12 RTO                          | 1.1                      | 3.5                           | 9.4                          | 40                    | I                       | SOIC/LFCSP | 3.63                  |
| ADA4941-1   | 1           | •       | 3, 5, $\pm$ 5        | RRO                       | 2                   | 31                             | 24.5                   | -110                              | 0.1   | 10.2 RTO                        | 0.8                      | 3                             | 2.3                          | 25                    | I                       | SOIC/LFCSP | 2.42                  |
| ADA4960-1   | 1           | •       | 5                    |                           | 2                   | 5000                           | 8700                   | -73                               | 1000  | 4.8                             | 20                       | 20                            | 60                           | 17.5                  | I                       | LFCSP      | 6.95                  |

<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes -V<sub>SS</sub>).

<sup>2</sup> Temp range: H = extended industrial (-40°C to +125°C), I = industrial (-40°C to +85°C).

RTO: Referred to output.



# High Speed Amplifiers (BW > 50 MHz)

## Low Noise/Low Distortion Amplifiers

### ADA4896-2/ADA4897-1: Gain Stable, Low Power, $1\text{nV}/\sqrt{\text{Hz}}$ , Rail-to-Rail Output Op Amp

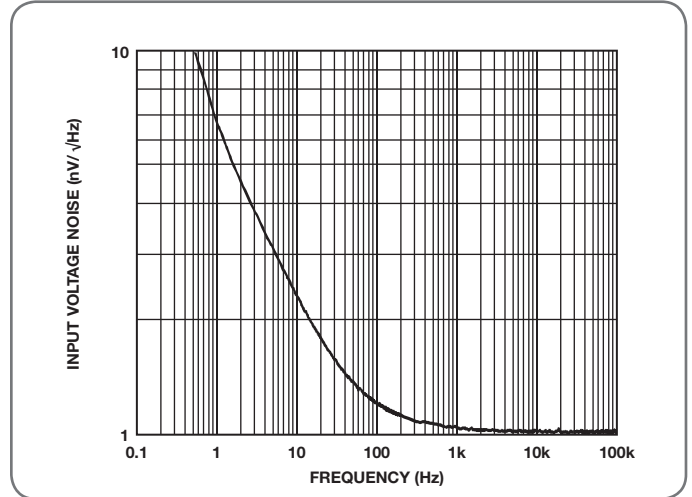
The ADA4896-2/ADA4897-1 are unity gain stable, low noise, rail-to-rail output, high speed voltage feedback amplifiers that have a quiescent current of 3 mA. With the  $1/f$  noise of  $2\text{ nV}/\sqrt{\text{Hz}}$  @ 10 Hz and a spurious-free dynamic range of  $-95\text{ dBc}$  @ 2 MHz, the ADA4896-2/ADA4897-1 are an ideal solution in a variety of applications, including ultrasound, automatic test equipment (ATE), active filters, and 16-bit PuISAR ADC drivers.

#### Features

- Unity-gain stable
- Ultralow noise:  $1\text{ nV}/\sqrt{\text{Hz}}$ ,  $9\text{ pA}/\sqrt{\text{Hz}}$
- Ultralow distortion:  $-110\text{ dBc}$  at 100 kHz
- High speed
  - $-3\text{ dB}$  bandwidth: 200 MHz ( $G = +1$ )
  - Slew rate:  $100\text{ V}/\mu\text{s}$
- Offset voltage:  $500\text{ }\mu\text{V}$
- Low input bias current:  $10\text{ }\mu\text{A}$
- Wide supply voltage range:  $2.7\text{ V}$  to  $10\text{ V}$
- Supply current:  $3\text{ mA}$

#### Applications

- Analog-to-digital drivers
- Instrumentation
- Active filters
- IF and baseband amplifiers
- DAC buffers
- Optical electronics
- Ultrasound



Voltage noise vs. frequency.

### Low Noise/Low Distortion Amplifiers

| Part Number | No. of Amps | Disable | Supply Voltage (V)               | Rail-to-Rail <sup>1</sup> | A <sub>OL</sub> Min | BW @ A <sub>OL</sub> Min (MHz) | Slew Rate (V/ $\mu\text{s}$ ) | Distortion SFDR <sup>1</sup> @ BW |       | Noise (nV/ $\sqrt{\text{Hz}}$ ) | V <sub>OS</sub> Max (mV) | I <sub>b</sub> ( $\mu\text{A}$ Max) | I <sub>e</sub> /Amp (mA Typ) | I <sub>OUT</sub> (mA) | Temp Range <sup>2</sup> | Packaging            | Price @ 1k (OEM \$US) |
|-------------|-------------|---------|----------------------------------|---------------------------|---------------------|--------------------------------|-------------------------------|-----------------------------------|-------|---------------------------------|--------------------------|-------------------------------------|------------------------------|-----------------------|-------------------------|----------------------|-----------------------|
|             |             |         |                                  |                           |                     |                                |                               | (dBc)                             | (MHz) |                                 |                          |                                     |                              |                       |                         |                      |                       |
| AD8099      | 1           | •       | 5, $\pm 5$                       |                           | 2                   | 700                            | 1350                          | -92                               | 10    | 0.95                            | 0.5                      | 1                                   | 15                           | 40                    | H <sup>3</sup>          | SOIC/LFCSP           | 2.00                  |
| ADA4899-1   | 1           | •       | 5, $\pm 5$                       |                           | 1                   | 600                            | 310                           | -123                              | 0.5   | 1                               | 0.23                     | 1                                   | 14.7                         | 40                    | H <sup>3</sup>          | SOIC/LFCSP           | 1.91                  |
| ADA4857-1   | 1           | •       | 5, $\pm 5$                       |                           | 1                   | 850                            | 2800                          | -88                               | 10    | 4.4                             | 4.5                      | 3.3                                 | 5                            | 50                    | H                       | SOIC/LFCSP           | 0.86                  |
| ADA4857-2   | 2           | •       |                                  |                           |                     |                                |                               |                                   |       |                                 |                          |                                     |                              |                       |                         |                      | 1.41                  |
| ADA4896-2   | 2           |         | 3 to 10                          | RRIO                      | 1                   | 200                            | 100                           | 110                               | 0.1   | 1                               | 0.5                      | 10                                  | 3                            | 90                    | H                       | LFCSP/MSOP           | 3.20                  |
| ADA4897-1   | 1           | •       | 3 to 10                          | RRO                       | 1                   | 200                            | 100                           | 110                               | 0.1   | 1                               | 0.75                     | 10                                  | 3                            | 90                    | H                       | SOIC/<br>SOT-23/MSOP | 1.89                  |
| ADA4897-2   | 2           | •       |                                  |                           |                     |                                |                               |                                   |       |                                 |                          |                                     |                              |                       |                         |                      | 3.20                  |
| ADA4898-1   | 1           |         | $\pm 5$ , $\pm 12$ ,<br>$\pm 15$ |                           | 1                   | 65                             | 55                            | -116                              | 0.1   | 0.9                             | 0.12                     | 0.4                                 | 8.1                          | 40                    | H                       | SOIC                 | 2.29                  |
| ADA4898-2   | 2           |         |                                  |                           |                     |                                |                               |                                   |       |                                 |                          |                                     |                              |                       |                         |                      | 3.21                  |
| ADA4841-1   | 1           | •       | 2.7, 5, $\pm 5$                  | RRO                       | 1                   | 80                             | 13                            | -105                              | 0.1   | 2.1                             | 0.5                      | 5.3                                 | 1.2                          | 60                    | H <sup>3</sup>          | SOT-23/<br>SOIC MSOP | 1.61                  |
| ADA4841-2   | 2           | •       |                                  |                           |                     |                                |                               |                                   |       |                                 |                          |                                     |                              |                       |                         |                      | 2.32                  |
| AD8021      | 1           | •       | 5, $\pm 5$ , $\pm 12$            |                           | 1                   | 560                            | 130                           | -93                               | 1     | 2.1                             | 1                        | 11.3                                | 7.8                          | 70                    | I                       | SOIC/MSOP            | 1.31                  |
| AD8022      | 2           |         | 5, $\pm 5$ , $\pm 12$            |                           | 1                   | 130                            | 50                            | -95                               | 1     | 2.5                             | 6                        | 5                                   | 4                            | 55                    | I                       | SOIC/MSOP            | 2.38                  |
| AD8045      | 1           |         | 5, $\pm 5$                       |                           | 1                   | 1000                           | 1350                          | -95                               | 10    | 3                               | 1                        | 6.3                                 | 16                           | 70                    | H <sup>3</sup>          | SOIC/LFCSP           | 1.41                  |
| AD8048      | 1           |         | 5, $\pm 5$                       |                           | 2                   | 260                            | 1000                          | -72                               | 5     | 3.8                             | 3                        | 3.5                                 | 6.6                          | 50                    | I                       | SOIC                 | 2.30                  |
| AD8047      | 1           |         | 5, $\pm 5$                       |                           | 1                   | 250                            | 750                           | -78                               | 5     | 5.2                             | 3                        | 3.5                                 | 6.6                          | 50                    | I                       | SOIC                 | 2.53                  |

<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes  $-V_{SS}$ ).

<sup>2</sup> Temp range: H = extended industrial ( $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ), I = industrial ( $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ).

<sup>3</sup> Recommended for automotive (from high speed amplifiers selection guide).

# High Speed Amplifiers (BW > 50 MHz)

## Low Cost Amplifiers

### ADA4891: Low Cost CMOS, High Speed, Rail-to-Rail Amplifiers

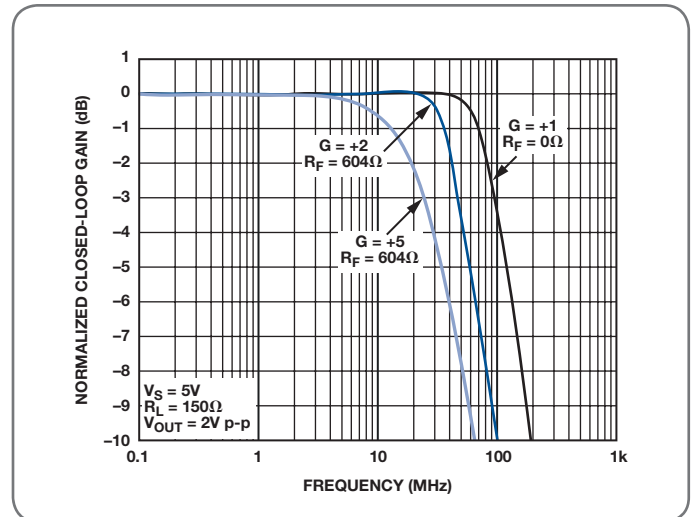
The [ADA4891-1](#) (single), [ADA4891-2](#) (dual), [ADA4891-3](#) (triple), and [ADA4891-4](#) (quad) are CMOS high speed amplifiers that offer high performance at a low cost. The amplifiers feature true single-supply capability, with an input voltage range that extends 300 mV below the negative rail. The rail-to-rail output stage enables the output to swing within 50 mV of each rail, enabling maximum dynamic range. The [ADA4891](#) family of amplifiers is ideal for imaging applications, such as consumer video, CCD buffers, and contact image sensor buffers. Low distortion and fast settling time also make them ideal for active filter applications.

#### Features

- High speed and fast settling
  - -3 dB bandwidth: 240 MHz ( $G = +1$ )
  - Slew rate: 170 V/ $\mu$ s
  - Settling time to 0.1%: 28 ns
- Video specifications ( $G = +2$ ,  $R_L = 150 \Omega$ )
  - 0.1 dB gain flatness: 25 MHz
  - Differential gain error: 0.05%
  - Differential phase error: 0.25°
- Single-supply operation
- Wide supply range: 2.7 V to 5.5 V
  - Output swings to within 50 mV of supply rails
- Low distortion: 79 dBc SFDR @ 1 MHz
- Linear output current: 150 mA @ -50 dBc
- Low power of 4.4 mA per amplifier

#### Applications

- Imaging
- Consumer video
- Active filters
- Coaxial cable drivers
- Clock buffers
- Photodiode preamp
- Contact image sensor and buffers



Large signal frequency response vs. gain,  $V_S = 5V$ , ADA4891-1/ADA4891-2.

### Low Cost Amplifiers

| Part Number | No. of Amps | Disable | Supply Voltage (V) | Rail-to-Rail <sup>1</sup> | $A_{CL}$ Min | BW @ $A_{CL}$ Min (MHz) | Slew Rate (V/ $\mu$ s) | Distortion SFDR <sup>1</sup> @ BW |       | Noise (nV/ $\sqrt{Hz}$ ) | $V_{OS}$ Max (mV) | $I_b$ ( $\mu$ A Max) | $I_S$ /Amp (mA Typ) | $I_{OUT}$ (mA) | Temp Range <sup>2</sup> | Packaging               | Price @ 1k (DEM \$US) |
|-------------|-------------|---------|--------------------|---------------------------|--------------|-------------------------|------------------------|-----------------------------------|-------|--------------------------|-------------------|----------------------|---------------------|----------------|-------------------------|-------------------------|-----------------------|
|             |             |         |                    |                           |              |                         |                        | (dBc)                             | (MHz) |                          |                   |                      |                     |                |                         |                         |                       |
| ADA4851-1   | 1           | •       | 2.7, 5, $\pm 5$    | RRO                       | 1            | 105                     | 375                    | -83                               | 1     | 10                       | 3.5               | 4                    | 2.9                 | 90             | H5                      | SOT-23/ TSSOP/MSOP      | 0.56                  |
| ADA4851-2   | 2           | •       |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                         | 0.70                  |
| ADA4851-4   | 4           | •       |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                         | 1.10                  |
| AD8038      | 1           | •       | 3, 5, $\pm 5$      |                           | 1            | 350                     | 425                    | -90                               | 1     | 8                        | 3                 | 0.75                 | 1                   | 20             | I                       | SC70/ SOT-23/ SOIC      | 0.86                  |
| AD8039      | 2           | •       |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                         | 1.21                  |
| AD8061      | 1           | •       | 2.7, 8             | RRO                       | 1            | 320                     | 650                    | -62                               | 5     | 8.5                      | 6                 | 9                    | 6.8                 | 50             | I                       | SOT-23/ SOIC/ MSOP      | 0.86                  |
| AD8063      | 1           | •       |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                         | 1.62                  |
| AD8062      | 2           | •       |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                         | 0.86                  |
| AD8055      | 1           | •       | $\pm 5$            |                           | 1            | 300                     | 1400                   | -72                               | 10    | 6                        | 5                 | 1.2                  | 5.4                 | 60             | H5                      | SOT-23/ SOIC/ MSOP      | 0.86                  |
| AD8056      | 2           | •       |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                         | 1.62                  |
| AD8057      | 1           | •       | 3, 5, $\pm 5$      |                           | 1            | 325                     | 1150                   | -68                               | 5     | 7                        | 5                 | 2.5                  | 6                   | 30             | I5                      | SOT-23/ SOIC/MSOP       | 0.86                  |
| AD8058      | 2           | •       |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                         | 1.62                  |
| ADA4891-1   | 1           | •       | 3, 5               | RRO                       | 1            | 270                     | 166                    | -80                               | 1     | 8.8                      | 10                | 0.002                | 5                   | 100            | H                       | SOT-23/SOIC/ TSSOP/MSOP | 0.49                  |
| ADA4891-2   | 2           | •       |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                         | 0.69                  |
| ADA4891-3   | 3           | •       |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                         | 0.89                  |
| ADA4891-4   | 4           | •       |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                         | 1.09                  |

<sup>1</sup> RRO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (I<sub>VR</sub> includes -V<sub>SS</sub>).

<sup>2</sup> Temp range: H = extended industrial (-40°C to +125°C), I = industrial (-40°C to +85°C).

# High Speed Amplifiers (BW > 50 MHz)

## Rail-to-Rail Input/Output Amplifiers

### ADA8031/ADA8032: 2.7 V, 800 $\mu$ A, 80 MHz Rail-to-Rail I/O Amplifiers

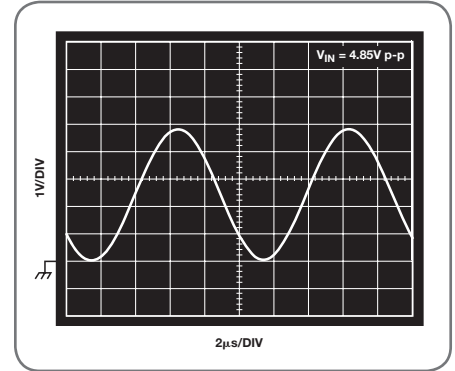
The **AD8031** (single) and **AD8032** (dual) single-supply, voltage feedback amplifiers feature high speed performance with 80 MHz of small signal bandwidth and 30 V/ $\mu$ s slew rate. This performance is possible while consuming less than 4.0 mW of power from a single 5 V supply. These features increase the operation time of high speed, battery-powered systems without compromising dynamic performance. The products have true single-supply capability with rail-to-rail input and output characteristics and are specified for +2.7 V, +5 V, and  $\pm 5$  V supplies.

#### Features

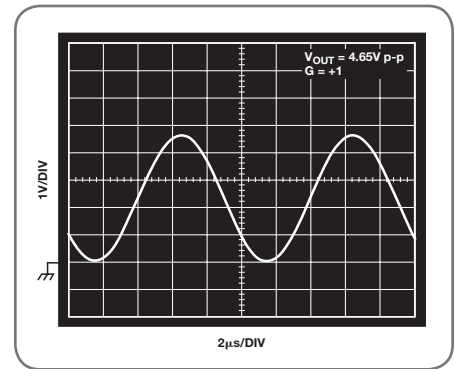
- Low power
  - Supply current: 800  $\mu$ A/amplifier
  - Fully specified at +2.7 V, +5 V, and  $\pm 5$  V supplies
- High speed and fast settling on 5 V
  - 80 MHz,  $-3$  dB bandwidth ( $G = +1$ )
  - 30 V/ $\mu$ s slew rate
  - 125 ns settling time to 0.1%
- Rail-to-rail input and output
  - No phase reversal with input 0.5 V beyond supplies
  - Input CMVR extends beyond rails by 200 mV
  - Output swing to within 20 mV of either rail
- Low distortion
  - $-62$  dB @ 1 MHz,  $V_o = 2$  V p-p
  - $-86$  dB @ 100 kHz,  $V_o = 4.6$  V p-p
- Output current: 15 mA

#### Applications

- High speed, battery-operated systems
- High component density systems
- Portable test instruments
- Analog-to-Digital buffers
- Active filters
- High speed, set-and-demand amplifiers



Input  $V_{IN}$ .



Output:  $V_{OUT}$ .

### Rail-to-Rail Input/Output Amplifiers

| Part Number | No. of Amps | Disable | Supply Voltage (V) | Rail-to-Rail <sup>1</sup> | $A_{CL}$ Min | BW @ $A_{CL}$ Min (MHz) | Slew Rate (V/ $\mu$ s) | Distortion SFDR <sup>1</sup> @ BW |       | Noise (nV/ $\sqrt{Hz}$ ) | $V_{OS}$ Max (mV) | $I_b$ ( $\mu$ A Max) | $I_S$ /Amp (mA Typ) | $I_{OUT}$ (mA) | Temp Range <sup>2</sup> | Packaging              | Price @ 1k (OEM \$US) |
|-------------|-------------|---------|--------------------|---------------------------|--------------|-------------------------|------------------------|-----------------------------------|-------|--------------------------|-------------------|----------------------|---------------------|----------------|-------------------------|------------------------|-----------------------|
|             |             |         |                    |                           |              |                         |                        | (dBc)                             | (MHz) |                          |                   |                      |                     |                |                         |                        |                       |
| AD8031      | 1           |         | 2.7, 5, $\pm 5$    | RRIO                      | 1            | 80                      | 35                     | -77                               | 0.5   | 15                       | 1.5               | 1.2                  | 0.9                 | 15             | 1                       | SOT-23/MSOP            | 1.32                  |
| AD8032      | 2           |         |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                        | 1.97                  |
| ADA4853-1   | 1           | •       | 3, 5               | RRO                       | 1            | 100                     | 120                    | -90                               | 1     | 22                       | 4                 | 1.6                  | 1.4                 | 120            | H5                      | SC70/LFCSP/TSSOP       | 0.56                  |
| ADA4853-2   | 2           | •       |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                        | 0.70                  |
| ADA4853-3   | 3           | •       |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                        | 0.86                  |
| ADA4855-3   | 3           | •       | 3, 5               | RRO                       | 1            | 410                     | 870                    | -84                               | 5     | 6.8                      | 3                 | 3.8                  | 7.8                 | 40             | H                       | LFCSP                  | 1.39                  |
| ADA4856-3   | 3           | •       | 3, 5               | RRO                       | 2            | 225                     | 800                    | -92                               | 5     | 14                       | 3.4               | 3.8                  | 7.8                 | 7.5            | H                       | LFCSP                  | 1.39                  |
| AD8091      | 1           |         | 3, 5, $\pm 5$      | RRO                       | 1            | 110                     | 145                    | -71                               | 5     | 16                       | 10                | 2.5                  | 4.4                 | 45             | I                       | SOT-23/SOIC/MSOP       | 0.70                  |
| AD8092      | 2           |         |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                        | 0.90                  |
| AD8051      | 1           |         | 3, 5, $\pm 5$      | RRO                       | 1            | 110                     | 170                    | -72                               | 5     | 16                       | 11                | 2.5                  | 4.8                 | 45             | H5                      | SOT-23/SOIC/TSSOP/MSOP | 0.86                  |
| AD8052      | 2           |         |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                        | 1.62                  |
| AD8054      | 4           |         |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                        | 2.88                  |
| AD8029      | 1           | •       | 2.7, 5, $\pm 5$    | RRIO                      | 1            | 125                     | 62                     | -74                               | 1     | 16.5                     | 5                 | 1.3                  | 1.3                 | 20             | H                       | SC70/SOIC/TSSOP/MSOP   | 0.86                  |
| AD8030      | 2           | •       |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                        | 1.21                  |
| AD8040      | 4           |         |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                        | 1.62                  |
| AD8041      | 1           |         | 3, 5, $\pm 5$      | RRO                       | 1            | 170                     | 225                    | -78                               | 5     | 15                       | 9.8               | 3.2                  | 6                   | 50             | I                       | SOIC                   | 1.95                  |
| AD8042      | 2           |         |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                        | 2.28                  |
| AD8044      | 4           |         |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                        | 4.00                  |
| ADA4850-1   | 1           | •       | 2.7, 5             | RRO                       | 1            | 175                     | 220                    | -81                               | 1     | 10                       | 4.2               | 4.2                  | 2.5                 | 90             | H                       | LFCSP                  | 0.56                  |
| ADA4850-2   | 2           | •       |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                        | 0.70                  |
| AD8027      | 1           | •       | 3, 5, $\pm 5$      | RRIO                      | 1            | 190                     | 100                    | -120                              | 1     | 4.3                      | 0.9               | 6                    | 6.5                 | 25             | H5                      | SOT-23/SOIC/MSOP       | 1.20                  |
| AD8028      | 2           | •       |                    |                           |              |                         |                        |                                   |       |                          |                   |                      |                     |                |                         |                        | 1.91                  |

<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes  $-V_{SV}$ ).

<sup>2</sup> Temp range: H = extended industrial ( $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ), I = industrial ( $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ).

# High Speed Amplifiers (BW > 50 MHz)

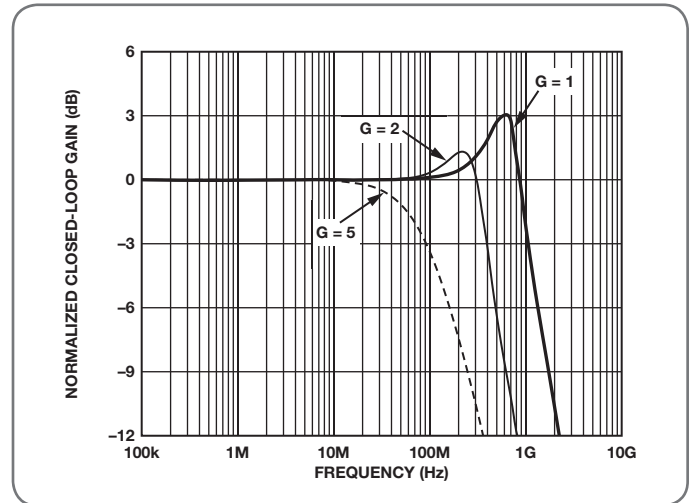
## FastFET Amplifiers

### ADA4817-1/ADA4817-2: Low Noise, 1GHz FastFET

The [ADA4817-1](#) (single) and [ADA4817-2](#) (dual) FastFET™ amplifiers are unity-gain stable, ultrahigh speed voltage feedback amplifiers with FET inputs. These amplifiers were developed with Analog Devices proprietary eXtra Fast Complementary Bipolar (XFCB) process, which allows the amplifiers to achieve ultralow noise ( $4 \text{ nV}/\sqrt{\text{Hz}}$ ;  $2.5 \text{ fA}/\sqrt{\text{Hz}}$ ), as well as very high input impedances.

#### Features

- High speed
  - $-3 \text{ dB}$  bandwidth ( $G = 1$ ,  $R_L = 100 \Omega$ ): 1050 MHz
  - Slew rate:  $870 \text{ V}/\mu\text{s}$
  - 0.1% settling time: 9 ns
- Low input bias current: 2 pA
- Low input capacitance
  - Common-mode capacitance: 1.3 pF
  - Differential-mode capacitance: 0.1 pF
- Low noise
  - $4 \text{ nV}/\sqrt{\text{Hz}}$  @ 100 kHz
  - $2.5 \text{ fA}/\sqrt{\text{Hz}}$  @ 100 kHz
- Low distortion
  - $-90 \text{ dBc}$  @ 10 MHz ( $G = 1$ ,  $R_L = 1 \text{ k}\Omega$ )
  - Offset voltage: 2 mV maximum
- High output current: 40 mA
- Supply current per amplifier: 19 mA
- Power-down supply current per amplifier: 1.5 mA



Wideband photodiode preamplifier.

#### Applications

- Photodiode amplifiers
- Data acquisition front ends
- Instrumentation
- Filters
- ADC drivers
- CCD output buffers

### FastFET Amplifiers

| Part Number | No. of Amps | Disable | Supply Voltage (V)    | Rail-to-Rail <sup>1</sup> | A <sub>CL</sub> Min | BW @ A <sub>CL</sub> Min (MHz) | Slew Rate (V/ $\mu$ s) | Distortion SFDR <sup>1</sup> @ BW |       | Noise (nV/ $\sqrt{\text{Hz}}$ ) | V <sub>OS</sub> Max (mV) | I <sub>B</sub> ( $\mu$ A Max) | I <sub>f</sub> /Amp (mA Typ) | I <sub>OUT</sub> (mA) | Temp Range <sup>2</sup> | Packaging   | Price @ 1k (OEM \$US) |
|-------------|-------------|---------|-----------------------|---------------------------|---------------------|--------------------------------|------------------------|-----------------------------------|-------|---------------------------------|--------------------------|-------------------------------|------------------------------|-----------------------|-------------------------|-------------|-----------------------|
|             |             |         |                       |                           |                     |                                |                        | (dBc)                             | (MHz) |                                 |                          |                               |                              |                       |                         |             |                       |
| ADA4817-1   | 1           | •       | 5, $\pm 5$            |                           | 1                   | 1050                           | 870                    | -90                               | 10    | 4                               | 2                        | 20 pA                         | 19                           | 40                    | H                       | SOIC/LFCSP  | 2.95                  |
| ADA4817-2   | 2           | •       |                       |                           |                     |                                |                        |                                   |       |                                 |                          |                               |                              |                       |                         |             | 4.98                  |
| AD8067      | 1           |         | 5, $\pm 5$ , $\pm 12$ | RRIO                      | 8                   | 54                             | 500                    | -95                               | 1     | 6.6                             | 1                        | 5 pA                          | 6.6                          | 30                    | I                       | SOT-23      | 2.32                  |
| AD8065      | 1           |         | 5, $\pm 5$ , $\pm 12$ | RRIO                      | 1                   | 145                            | 180                    | -88                               | 1     | 7                               | 1.5                      | 7 pA                          | 6.4                          | 35                    | I5                      | SOT-23/MSOP | 1.62                  |
| AD8066      | 2           |         |                       |                           |                     |                                |                        |                                   |       |                                 |                          |                               |                              |                       |                         |             | 2.32                  |
| AD8033      | 1           |         | 5, $\pm 5$ , $\pm 12$ | RRIO                      | 1                   | 80                             | 80                     | -82 <sup>3</sup>                  | 1     | 11                              | 2                        | 11 pA                         | 3.3                          | 25                    | I                       | SC70/SOT-23 | 1.08                  |
| AD8034      | 2           |         |                       |                           |                     |                                |                        |                                   |       |                                 |                          |                               |                              |                       |                         |             | 1.61                  |

<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes  $-V_{SY}$ ).

<sup>2</sup> Temp range: H = extended industrial ( $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ ), I = industrial ( $-40^\circ\text{C}$  to  $+85^\circ\text{C}$ ).

<sup>3</sup> THD: total harmonic distortion.

# High Speed Amplifiers (BW > 50 MHz)

## Current Feedback Amplifiers

### AD8000: 1.5 GHz Ultrahigh Speed Op Amp

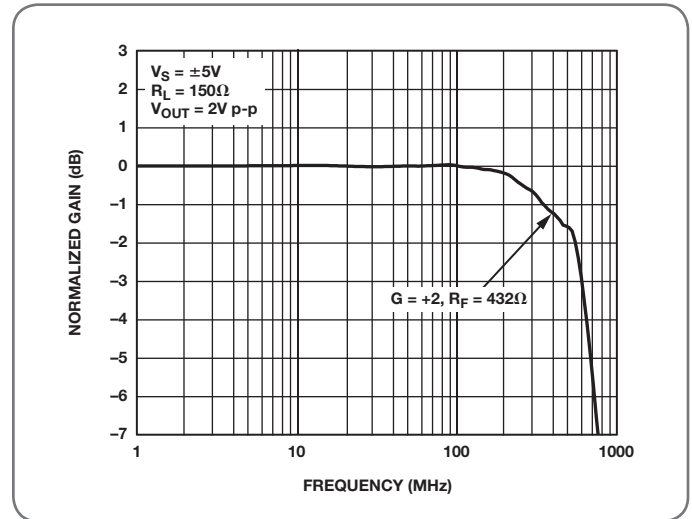
The **AD8000** is an ultrahigh speed, high performance, current feedback amplifier. Using ADI's proprietary eXtra Fast Complementary Bipolar (XFCB) process, the amplifier can achieve a small signal bandwidth of 1.5 GHz and a slew rate of 4100 V/ $\mu$ s.

#### Features

- High speed
  - 1.5 GHz,  $-3$  dB bandwidth ( $G = +1$ )
  - 650 MHz, full power bandwidth ( $G = +2$ ,  $V_o = 2$  V p-p)
  - Slew rate: 4100 V/ $\mu$ s
  - 0.1% settling time: 12 ns
  - 0.1 dB flatness: 170 MHz
- Low noise: 1.6 nV/ $\sqrt{\text{Hz}}$  input voltage noise
- Low distortion over wide bandwidth
  - 75 dBc SFDR @ 20 MHz
  - 62 dBc SFDR @ 50 MHz
- Input offset voltage: 1 mV typ
- High output current: 100 mA
- Wide supply voltage range: 4.5 V to 12 V
- Supply current: 13.5 mA

#### Applications

- Professional video
- High speed instrumentation
- Video switching
- IF/RF gain stage
- CCD imaging



Large signal frequency response.

### Current Feedback Amplifiers

| Part Number      | No. of Amps | Disable | Supply Voltage (V) | Rail-to-Rail <sup>1</sup> | A <sub>CL</sub> MIN | BW @ A <sub>CL</sub> MIN (MHz) | Slew Rate (V/μs) | Distortion SFDR <sup>1</sup> @ BW |       | Noise (nV/√Hz) | Noise <sup>2</sup> (pa/√Hz) | V <sub>OS</sub> Max (mV) | I <sub>B</sub> (μA Max) | I <sub>S</sub> /Amp (mA Typ) | I <sub>OUT</sub> (mA) | Temp Range <sup>2</sup> | Packaging                 | Price @ 1k (OEM \$US) |
|------------------|-------------|---------|--------------------|---------------------------|---------------------|--------------------------------|------------------|-----------------------------------|-------|----------------|-----------------------------|--------------------------|-------------------------|------------------------------|-----------------------|-------------------------|---------------------------|-----------------------|
|                  |             |         |                    |                           |                     |                                |                  | (dBc)                             | (MHz) |                |                             |                          |                         |                              |                       |                         |                           |                       |
| Value            |             |         |                    |                           |                     |                                |                  |                                   |       |                |                             |                          |                         |                              |                       |                         |                           |                       |
| ADA4860-1        | 1           | •       | 5, ± 5             |                           | 1                   | 800                            | 790              | −75                               | 10    | 4              | 1.5/7.7                     | 13                       | 10                      | 6                            | 85                    | I                       | SOT-23                    | 0.55                  |
| ADA4861-3        | 3           | •       | 5, ± 5             |                           | 1                   | 730                            | 680              | −68                               | 10    | 3.8            | 1.7/5.5                     | 13                       | 13                      | 6                            | 100                   | I                       | SOIC                      | 0.95                  |
| ADA4862-3        | 3           | •       | 5, ± 5             |                           | 2                   | 500                            | 1050             | −68                               | 10    | 10.6 (RT0)     | 1.4                         | 25 (RT0)                 | 1                       | 5.5                          | 75                    | I                       | SOIC                      | 0.95                  |
| AD8014           | 1           |         | 5, ± 5             |                           | 1                   | 480                            | 4000             | −70                               | 5     | 3.5            | 5                           | 5                        | 15                      | 1.1                          | 50                    | I                       | SOT-23/SOIC               | 1.19                  |
| AD8072           | 2           |         | 5, ± 5             |                           | 1                   | 100                            | 500              | −64                               | 5     | 3              | 6                           | 6                        | 12                      | 3.5                          | 30                    | I                       | SOIC/MSOP                 | 1.65                  |
| AD8073           | 3           |         |                    | 2.15                      |                     |                                |                  |                                   |       |                |                             |                          |                         |                              |                       |                         |                           |                       |
| High Performance |             |         |                    |                           |                     |                                |                  |                                   |       |                |                             |                          |                         |                              |                       |                         |                           |                       |
| AD8000           | 1           | •       | 5, ± 5             |                           | 1                   | 1500                           | 4100             | −75                               | 20    | 1.6            | 3.4/26<br>3/36              | 10                       | 45                      | 13.5                         | 100                   | H5                      | SOIC/LFCSP                | 1.68                  |
| AD8003           | 3           | •       |                    |                           |                     |                                |                  |                                   |       |                |                             |                          |                         |                              |                       |                         |                           |                       |
| AD8009           | 1           |         | 5, ± 5             |                           | 1                   | 1000                           | 5500             | −38                               | 20    | 1.9            | 46/41                       | 5                        | 150                     | 14                           | 175                   | I                       | SOT-23/SOIC               | 1.75                  |
| AD8001           | 1           |         | ± 5                |                           | 1                   | 880                            | 1000             | −66                               | 5     | 2              | 2/18                        | 5.5                      | 25                      | 5                            | 70                    | I                       | SOT-23/SOIC               | 1.49                  |
| AD8002           | 2           |         |                    |                           |                     |                                |                  |                                   |       |                |                             |                          |                         |                              |                       |                         |                           |                       |
| AD8007           | 1           |         | 5, ± 5             |                           | 1                   | 650                            | 1000             | −83                               | 20    | 2.7            | 2/23                        | 4                        | 8                       | 9                            | 30                    | I                       | SC70/SOT-23/<br>SOIC/MSOP | 1.31                  |
| AD8008           | 2           |         |                    | 2.19                      |                     |                                |                  |                                   |       |                |                             |                          |                         |                              |                       |                         |                           |                       |
| AD8011           | 1           |         | 5, ± 5             |                           | 1                   | 400                            | 3500             | −75                               | 5     | 2              | 5                           | 5                        | 15                      | 1                            | 30                    | I                       | SOIC                      | 2.27                  |
| AD8023           | 3           | •       | 5, ± 5             |                           | 1                   | 400                            | 1200             | −78                               | 5     | 2              | 14                          | 5                        | 45                      | 6.2                          | 70                    | I                       | SOIC                      | 5.14                  |
| AD8005           | 1           |         | 5, ± 5             |                           | 1                   | 270                            | 1500             | −53                               | 5     | 4              | 1.1/.9.1                    | 30                       | 10                      | 0.4                          | 10                    | I                       | SOT-23                    | 1.63                  |
| AD8004           | 4           |         | 5, ± 5             |                           | 1                   | 250                            | 3000             | −78                               | 5     | 1.5            | 38                          | 3.5                      | 90                      | 3.5                          | 50                    | I                       | SOIC                      | 4.35                  |
| ADA4310-1        | 2           | •       | 5, ± 5             |                           | 2                   | 190                            | 820              | −95                               | 1     | 2.9            | 22                          | 1                        | 6                       | 7.6                          | 250                   | I                       | LFCSP/MSOP                | 1.43                  |
| AD8017           | 2           |         | 5, ± 5             |                           | 1                   | 160                            | 1600             | −78                               | 0.5   | 1.9            | 23/21                       | 3                        | 67                      | 7                            | 270                   | I                       | SOIC                      | 2.36                  |
| AD8013           | 3           | •       | 5, ± 5             |                           | 1                   | 140                            | 1000             | −76                               | 5     | 3.5            | 12                          | 5                        | 15                      | 4                            | 30                    | I                       | SOIC                      | 4.82                  |
| With Charge Pump |             |         |                    |                           |                     |                                |                  |                                   |       |                |                             |                          |                         |                              |                       |                         |                           |                       |
| ADA4858-3        | 3           | •       | 3, 5               |                           | 1                   | 600                            | 600              | −71                               | 5     | 4              | 2/9                         | 14                       | 13                      | 19                           | 21                    | H                       | LFCSP                     | 1.69                  |
| ADA4859-3        | 3           | •       | 3, 5               |                           | 2                   | 195                            | 740              | −70                               | 5     | 17 (RT0)       | 2                           | 25 (RT0)                 | 2                       | 17                           | 19                    | H                       | LFCSP                     | 1.69                  |

<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes  $-V_{SS}$ ).

<sup>2</sup> Temp range: H = extended industrial ( $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ), I = industrial ( $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ).

<sup>3</sup> Noise first entry is noninverting input, second entry is inverting input.

# High Speed Amplifiers (BW > 50 MHz)

## High Output Current Amplifiers

### AD8397: Rail-to-Rail, High Output Current Amplifier

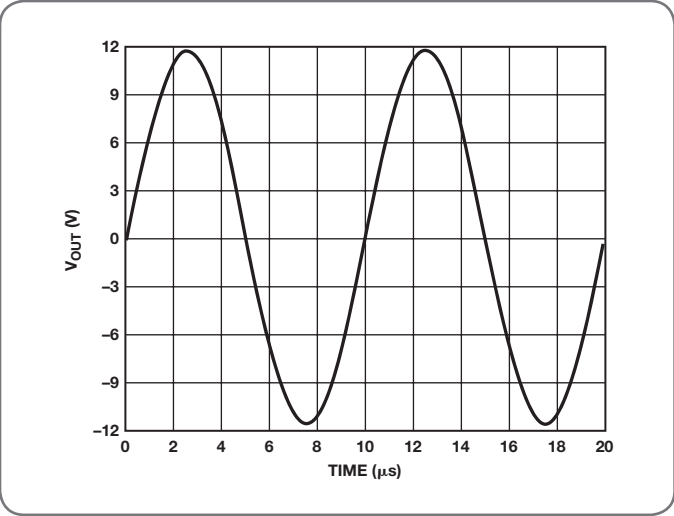
The AD8397 has two voltage feedback operational amplifiers capable of driving heavy loads with excellent linearity. The common-emitter, rail-to-rail output stage surpasses the output voltage capability of typical emitter-follower output stages and can swing to within 0.5 V of either rail while driving a 25  $\Omega$  load. The low distortion, high output current, and wide output dynamic range make the AD8397 ideal for applications that require a large signal swing into a heavy load.

#### Features

- Dual operational amplifier
- Voltage feedback
- Wide supply range: from 3 V to 24 V
- Rail-to-rail output
- Output swing to within 0.5 V of supply rails
- High linear output current
  - 310 mA peak into 32  $\Omega$  on  $\pm 12$  V supplies while maintaining  $-80$  dBc SFDR
- Low noise
  - 4.5 nV/ $\sqrt{\text{Hz}}$  voltage noise density @ 100 kHz
  - 1.5 pA/ $\sqrt{\text{Hz}}$  current noise density @ 100 kHz
- High speed
  - 69 MHz bandwidth (G = 1,  $-3$  dB)
  - 53 V/ $\mu\text{s}$  slew rate ( $R_{\text{LOAD}} = 25 \Omega$ )

#### Applications

- Twisted-pair line drivers
- Audio applications
- General-purpose high current amplifiers



Output swing,  $V_s = \pm 12$  V,  $R_L = 100 \Omega$ .

### High Output Current Amplifiers

| Part Number | No. of Amps | Disable | Supply Voltage (V)       | Rail-to-Rail <sup>1</sup> | A <sub>CL</sub> Min | BW @ A <sub>CL</sub> Min (MHz) | Slew Rate (V/ $\mu\text{s}$ ) | Distortion SFDR <sup>1</sup> @ BW |       | Noise (nV/ $\sqrt{\text{Hz}}$ ) | V <sub>OS</sub> Max (mV) | I <sub>B</sub> ( $\mu\text{A}$ Max) | I <sub>S</sub> /Amp (mA Typ) | I <sub>OUT</sub> (mA) | Temp Range <sup>2</sup> | Packaging   | Price @ 1k (OEM \$US) |
|-------------|-------------|---------|--------------------------|---------------------------|---------------------|--------------------------------|-------------------------------|-----------------------------------|-------|---------------------------------|--------------------------|-------------------------------------|------------------------------|-----------------------|-------------------------|-------------|-----------------------|
|             |             |         |                          |                           |                     |                                |                               | (dBc)                             | (MHz) |                                 |                          |                                     |                              |                       |                         |             |                       |
| AD8397      | 2           |         | 3, 5, $\pm 5$ , $\pm 12$ | RRO                       | 1                   | 69                             | 53                            | -87                               | 0.1   | 4.5                             | 1                        | 2                                   | 5.5                          | 310                   | I                       | SOIC        | \$2.32                |
| AD8390      | 1           | •       | $\pm 5$ , $\pm 12$       |                           | 5                   | 60                             | 300                           | -82 <sup>3</sup>                  | 1     | 8                               | 3                        | 7                                   | 3.8                          | 400                   | I                       | LFCSP       | \$2.92                |
| AD8392      | 4           | •       | $\pm 5$ , $\pm 12$       |                           | 1                   | 40                             | 900                           | -72 <sup>3</sup>                  | 1     | 4.3                             | 5                        | 15                                  | 3.6                          | 400                   | I                       | LFCSP/TSSOP | Last Time Buy         |

<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes  $-V_{\text{SY}}$ ).

<sup>2</sup> Temp range: H = extended industrial ( $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ ), I = industrial ( $-40^\circ\text{C}$  to  $+85^\circ\text{C}$ ).

<sup>3</sup> THD: total harmonic distortion.

# High Speed Amplifiers (BW > 50 MHz)

## High Supply Voltage Amplifiers

### ADA4898-1/ADA4898-2: High Voltage, Low Noise, Low Distortion, Unity-Gain Stable, High Speed Op Amp

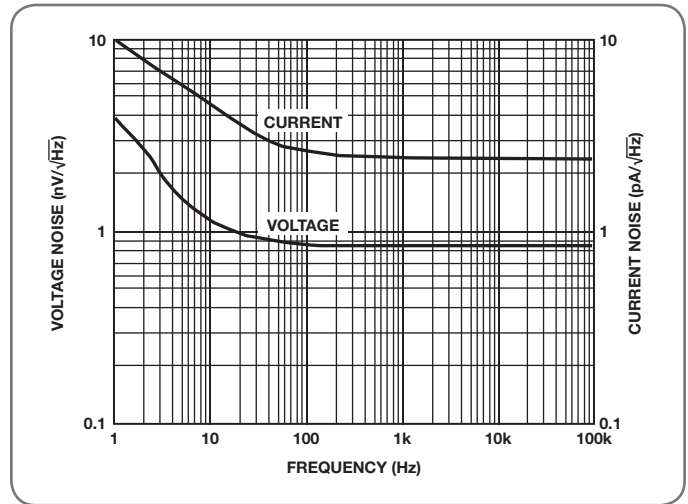
The [ADA4898](#) is an ultralow noise and distortion, unity gain stable, voltage feedback op amp that is ideal for use in 16-bit and 18-bit systems with power supplies from  $\mu 5$  V to  $\mu 16$  V. The [ADA4898](#) features a linear, low noise input stage and internal compensation that achieves high slew rates and low noise.

#### Features

- Ultralow noise
  - $0.9 \text{ nV}/\sqrt{\text{Hz}}$
  - $2.4 \text{ pA}/\sqrt{\text{Hz}}$
  - $1.2 \text{ nV}/\sqrt{\text{Hz}}$  at 10 Hz
- Ultralow distortion:  $-93 \text{ dBc}$  at 500 kHz
- Wide supply voltage range:  $\pm 5 \text{ V}$  to  $\pm 16 \text{ V}$
- High speed
  - $-3 \text{ dB}$  bandwidth: 65 MHz ( $G = +1$ )
  - Slew rate:  $55 \text{ V}/\mu\text{s}$
- Unity-gain stable
- Low input offset voltage: 160  $\mu\text{V}$  maximum
- Low input offset voltage drift:  $1 \mu\text{V}/^\circ\text{C}$
- Low input bias current:  $-0.1 \mu\text{A}$
- Low input bias current drift:  $2 \text{ nA}/^\circ\text{C}$
- Supply current: 8 mA

#### Applications

- Instrumentation
- Active filters
- DAC buffers
- SAR ADC drivers
- Optoelectronics



Input voltage noise and current noise frequency.

### High Supply Voltage Amplifiers

| Part Number | No. of Amps | Disable | Supply Voltage (V)         | Rail-to-Rail <sup>1</sup> | A <sub>CL</sub> Min | BW @ A <sub>CL</sub> Min (MHz) | Slew Rate (V/ $\mu$ s) | Distortion SFDR <sup>1</sup> @ BW |       | Noise (nV/ $\sqrt{\text{Hz}}$ ) | V <sub>OS</sub> Max (mV) | I <sub>S</sub> ( $\mu$ A Max) | I <sub>S</sub> /Amp (mA Typ) | I <sub>OUT</sub> (mA) | Temp Range <sup>2</sup> | Packaging | Price @ 1k (OEM \$US) |
|-------------|-------------|---------|----------------------------|---------------------------|---------------------|--------------------------------|------------------------|-----------------------------------|-------|---------------------------------|--------------------------|-------------------------------|------------------------------|-----------------------|-------------------------|-----------|-----------------------|
|             |             |         |                            |                           |                     |                                |                        | (dBc)                             | (MHz) |                                 |                          |                               |                              |                       |                         |           |                       |
| ADA4898-1   | 1           |         | $\pm 5, \pm 12, \pm 15$    |                           | 1                   | 65                             | 55                     | -116                              | 0.1   | 0.9                             | 0.12                     | 0.4                           | 8.1                          | 40                    | H                       | SOIC      | 2.29                  |
| ADA4898-2   | 2           |         | $\pm 5, \pm 12, \pm 15$    |                           | 1                   | 65                             | 55                     | -116                              | 0.1   | 0.9                             | 0.12                     | 0.4                           | 8.1                          | 40                    | H                       | SOIC      | 3.21                  |
| AD829       | 1           |         | $\pm 5, \pm 12, \pm 15$    |                           | 1                   | 120                            | 150                    | -55 <sup>3</sup>                  | 1     | 1.7                             | 1                        | 7                             | 5                            | 32                    | H                       | SOIC      | 2.75                  |
| AD818       | 1           |         | $5, \pm 5, \pm 12, \pm 15$ |                           | 2                   | 130                            | 450                    | -78 <sup>3</sup>                  | 1     | 10                              | 2                        | 6.6                           | 7                            | 50                    | I                       | SOIC      | 1.94                  |
| AD828       | 2           |         | $\pm 5, \pm 12, \pm 15$    |                           | 2                   | 130                            | 450                    | -78 <sup>3</sup>                  | 1     | 10                              | 2                        | 6.6                           | 7                            | 50                    | I                       | SOIC      | 2.40                  |
| AD844       | 1           |         | $\pm 5, \pm 12, \pm 18$    |                           | 2                   | 60                             | 2000                   | -86 <sup>3</sup>                  | 0.1   | 2                               | 0.3                      | 0.45                          | 6.5                          | 50                    | H                       | SOIC      | 2.78                  |
| AD847       | 1           |         | $\pm 5, \pm 12, \pm 15$    |                           | 1                   | 50                             | 300                    | -92 <sup>3</sup>                  | 0.1   | 15                              | 2                        | 7                             | 4.8                          | 32                    | H/I                     | SOIC      | 2.86                  |
| AD827       | 2           |         | $\pm 5, \pm 12, \pm 15$    |                           | 1                   | 50                             | 300                    | -92 <sup>3</sup>                  | 0.1   | 15                              | 2                        | 7                             | 4.8                          | 32                    | H/I                     | SOIC      | 5.82                  |
| AD817       | 1           |         | $5, \pm 5, \pm 12, \pm 15$ |                           | 1                   | 50                             | 350                    | -78 <sup>3</sup>                  | 1     | 15                              | 2                        | 6.6                           | 7                            | 50                    | I                       | SOIC      | 1.74                  |
| AD826       | 2           |         | $\pm 5, \pm 12, \pm 15$    |                           | 1                   | 50                             | 350                    | -78 <sup>3</sup>                  | 1     | 15                              | 2                        | 6.6                           | 7                            | 50                    | I                       | SOIC      | 2.40                  |

<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (I<sub>VR</sub> includes  $-V_{SS}$ ).

<sup>2</sup> Temp range: H = extended industrial ( $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ ), I = industrial ( $-40^\circ\text{C}$  to  $+85^\circ\text{C}$ ).

<sup>3</sup> THD: total harmonic distortion.



## High Speed Amplifiers (BW > 50 MHz)

### Clamp Amplifiers

#### AD8036: Low Distortion, Wide Bandwidth Voltage Feedback Clamp Amps

The [AD8036](#) and [AD8037](#) are wide bandwidth, low distortion clamping amplifiers. The [AD8036](#) is unity-gain stable. The [AD8037](#) is stable at a gain of two or greater. These devices allow the designer to specify a high (V<sub>H</sub>) and low (V<sub>L</sub>) output clamp voltage. The output signal will clamp at these specified levels. Utilizing a unique CLAMPIN™ input clamp architecture, the [AD8036](#) and [AD8037](#) offer a 10× improvement in clamp performance compared to traditional output clamping devices. In particular, clamp error is typically 3 mV or less and distortion in the clamp region is minimized. This product can be used as a classical op amp or a clamp amplifier where a high and low output voltage are specified.

#### Features

- Clamping characteristics
  - 3 mV clamp error
  - 1.5 ns overdrive recovery
  - Minimized nonlinear clamping region
  - 240 MHz clamp input bandwidth
  - ±3.9 V clamp input range
- Wide bandwidth
  - Small signal: 240 MHz ([AD8036](#)), 270 MHz ([AD8037](#))
  - Large signal (4 V p-p): 195 MHz ([AD8036](#)), 190 MHz ([AD8037](#))
  - Slew rate: 1500 V/μs
- Ultralow distortion, low noise
  - −72 dBc typ @ 20 MHz
  - 4.5 nV/√Hz input voltage noise
- DC characteristics
  - 2 mV offset
  - 10 μV/°C drift
- Settling 10 ns to 0.1%, 16 ns to 0.01%
  - ±3 V to ±5 V supply operation

#### Applications

- ADC buffer
- IF/RF signal processing
- High quality imaging
- Broadcast video systems
- Video amplifier
- Full wave rectifier

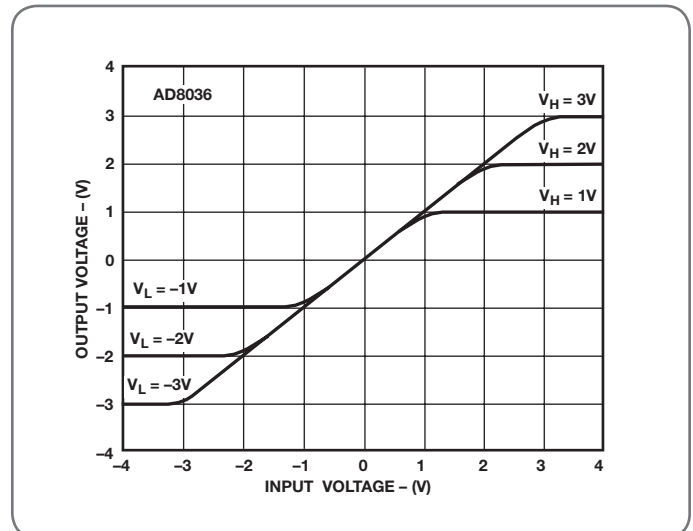
#### Clamp Amplifiers

| Part Number            | No. of Amps | Disable | Supply Voltage (V) | Rail-to-Rail <sup>1</sup> | A <sub>CL</sub> Min | BW @ A <sub>CL</sub> Min (MHz) | Slew Rate (V/μs) | Distortion SFDR <sup>1</sup> @ BW |       | Noise (nV/√Hz) | V <sub>OS</sub> Max (mV) | I <sub>b</sub> (μA Max) | I <sub>s</sub> /Amp (mA Typ) | I <sub>OUT</sub> (mA) | Temp Range <sup>2</sup> | Packaging | Price @ 1k (OEM \$US) |
|------------------------|-------------|---------|--------------------|---------------------------|---------------------|--------------------------------|------------------|-----------------------------------|-------|----------------|--------------------------|-------------------------|------------------------------|-----------------------|-------------------------|-----------|-----------------------|
|                        |             |         |                    |                           |                     |                                |                  | (dBc)                             | (MHz) |                |                          |                         |                              |                       |                         |           |                       |
| <a href="#">AD8037</a> | 1           |         | 65                 |                           | 2                   | 270                            | 1500             | −77 <sup>3</sup>                  | 10    | 4.5            | 7                        | 9                       | 18.5                         | 70                    | I                       | SOIC      | 4.12                  |
| <a href="#">AD8036</a> | 1           |         | 65                 |                           | 1                   | 240                            | 1200             | −8 <sup>13</sup>                  | 10    | 6.7            | 7                        | 10                      | 20.5                         | 70                    | H/I                     | SOIC      | 4.28                  |

<sup>1</sup> RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes −V<sub>S</sub>Y).

<sup>2</sup> Temp range: H = extended industrial (−40°C to +125°C), I = industrial (−40°C to +85°C).

<sup>3</sup> THD: total harmonic distortion.



Clamp dc accuracy vs. input voltage.