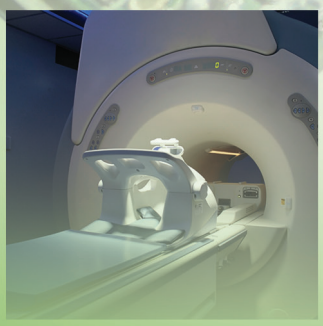
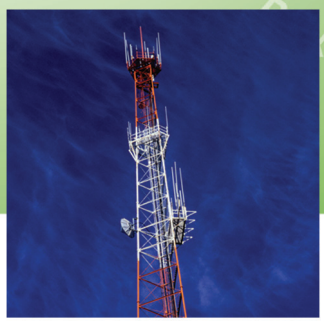
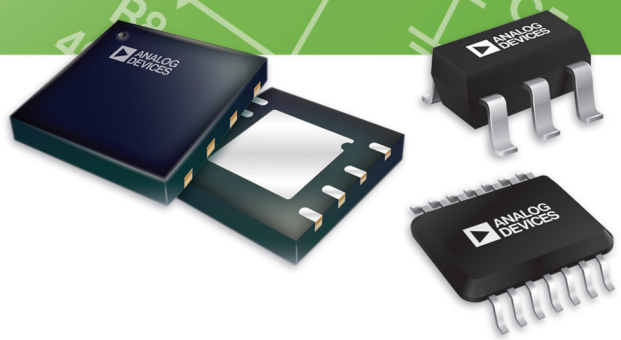
Operational Amplifiers Selection Guide

2011–2012







www.analog.com/opamps

ANALOG DEVICES

Analog Devices Provides Amplifiers for Every Application

Why are there so many different types of operational amplifiers (op amps)? Here at Analog Devices our engineers continue the pursuit of the illusive ideal op amp. And while we're extremely close to its realization, unfortunately it still exists only in textbooks. That is why we are committed to offering such a broad portfolio of op amps to meet the many and varied needs of our customers.

Selecting an op amp is no trivial task: with so many different types of amplifiers, categories, architectures, and parameters to choose from, the process can be difficult. Each customer and application requires slightly different performance. It doesn't matter whether you're designing a coffee maker (yes, op amps can be found in coffee makers) or the next generation medical imaging system, Analog Devices has the right amplifier to meet your needs.

This document will help you quickly and easily identify the right op amp(s) for your application. Inside you'll find a list of op amp terminology and processes used to fabricate the ICs, a variety of selection tables, application guides, design tools, and a handy detachable op amp reference wall chart. We hope you'll refer to this selection guide often and that it provides you with a better understanding and appreciation of op amps and their many applications.

Contents

Op Amp Glossary

Common-Mode Voltage Range (CMVR)

Also known as input voltage range, CMVR is the allowable input voltage range at both inputs before clipping or excessive nonlinearity is seen at the output.

Common-Mode Rejection Ratio (CMRR)

The ratio of the common-mode voltage range (CMVR) to the change in the input offset voltage (ΔVo_{0S}) over this range. The result is expressed in dB. CMRR (dB) = 20log ($CMVR/\Delta V_{0S}$)

Full Power Bandwidth

The maximum frequency measured at unity gain for which the rated output voltage can be obtained for a sinusoidal signal at rated load without distortion due to slew rate limiting.

Gain Bandwidth Product (GBW)

The product of open-loop gain and bandwidth at a specific frequency.

Input Bias Current (I_B)

The current at the input terminals.

Input Bias Current Drift

The proportional change in input bias current vs. temperature over a specified range of temperature.

Input Offset Current

The difference between the two input currents.

Input Offset Current Drift

The ratio of input offset current change over a specified temperature range, with the output held a constant voltage.

Input Offset Voltage Drift (T_CV_{OS})

The ratio of change in input offset voltage to a change in temperature.

Offset Voltage (V_{OS})

The differential voltage needed across the op amp input terminals to obtain zero output voltage. Offset voltage values range varies by process and design technology:

- Auto-Zero Op Amps: <1 μV
- Precision Op Amps: 50 μV to 500 μV
- Best Bipolar Op Amps: 10 μV to 25 μV
- Best JFET Iput Op Amps: 100 μV to 1000 μV
- Best Bipolar High Speed Op Amps: 100 μV to 2000 μV
- Untrimmed CMOS Op Amps: >2 mV
- DigiTrim® CMOS Op Amps: <100 μV to 1000 μV

Open- Loop Gain (A_{VO})

The ratio of the output voltage to the input offset voltage between the two input pins. The result is expressed in dB. Gain is usually specified only at dc (A_0), but for many applications, such as high speed amplifiers for video and RF, the frequency dependence of gain is also important. For this reason the open loop gain and phase response is published for each amplifier.

Operating Supply Voltage Range

The supply voltage range that can be applied to an amplifier for which it operates within specifications. Many applications implement op amp circuits with balanced dual supplies, while other applications for energy conservation or other reasons, use single-supply. For example, battery power in automotive and marine equipment provides only a single polarity. Even line-powered equipment, such as computers, may have only a single-polarity built-in supply, furnishing $+5$ V or $+12$ V dc for the system, or often as low as 1.8 V, with newer applications going even lower.

Power Supply Rejection Ratio (PSRR)

The ratio of the change in power supply voltage to the change in input offset voltage. The result is expressed in dB. PSRR = 20log ($\Delta V_{SY}/\Delta V_{0S}$)

Settling Time

The amount of time required for an amplifier to settle to some predetermined level of accuracy or percentage of output voltage after the application of a step input.

Slew Rate

The maximum rate of change of output voltage under large signal condition. The result is usually expressed in V/μs.

Supply Current

The current required from the supply voltage to operate the amplifier with no load.

Small Signal Unity Gain Frequency

The frequency at which the open-loop gain is unity or 0 dB. This applies only to signals under 200 mV. Due to slew rate limiting, it is not possible to obtain large output voltage swings at high frequencies.

Clamp Amplifiers

Clamp amplifiers allow the designer to specify a high (VCH) and low (VCL) output clamp voltage so the output signal will clamp at the specified levels. Analog Devices' unique CLAMPIN™ input clamp architecture offers significant improvement in clamp performance compared to traditional output clamping devices, minimizing clamp error and distortion in the clamp region.

Common-Mode Linearized Amplifiers

Increasing the linear input range of the input stage optimizes operational amplifier large signal distortion. This can be accomplished through the use of architectures such as degenerated differential structures and class AB input stages, both of which increase noise and lower precision. An alternate method is to linearize using a common-mode structure whose noise is rejected by the inherent differential nature of the input stage while also maintaining such precision metrics as CMRR, PSRR, and V_{OS}. Analog Devices has numerous new amplifiers that now feature this new technology and has patented the common-mode linearized input architecture.

Current Feedback Amplifiers

Current feedback amplifiers are primarily used in applications that require very high speed operation, large slew rates, and low distortion. The fundamental concept is based on the fact that, in bipolar transistor circuits, currents can be switched faster than voltages, all other things being equal. Unlike voltage feedback amplifiers (VFB), CFB amplifiers do not have balanced inputs. Instead, the noninverting input is high impedance, and the inverting input is low impedance. The open-loop gain of the CFB is measured in units of Ω (transimpedance gain) rather than V/V as for VFB amplifiers. Also, the value of the feedback resistor plays a direct role in the CFB's stability. Therefore, adhering to the recommended feedback resistor suggested in the data sheet is highly recommended.

Differential Amplifiers

Differential amplifiers allow the process of single-ended input to complementary differential outputs or differential inputs to differential outputs. These amplifiers feature two separate feedback loops to control the differential and common-mode output voltages. Analog Devices' differential amplifiers are configured with a V_{OCM} pin, which can be easily adjusted for setting output common-mode voltage. This provides a convenient solution when interfacing with analog-to-digital converters (ADCs). ADI also offers a series of differential receiver products that convert differential input signals to single-ended output.

Quad Core (H Bridge)

Analog Devices has patented the quad core architecture, which supplies *current on-demand* to charge and discharge the internal dominant pole capacitor, while allowing the quiescent current to be small. This patented architecture enables amplifiers to provide high slew rates with low distortion at low supply currents.

Overvoltage Protection (OVP) Amplifiers

An OVP amplifier is the most robust solution to protect the amplifier and entire circuitry from outside the rail input voltages due to manufacturing shorts, power supply timing, or human error. OVP is able to protect real estate from various unexpected errors, which in turns save time and money. OVP amplifiers require no external circuitry to provide protection.

Zero-Drift Amplifiers

Zero-drift amplifiers dynamically correct the offset voltage to achieve nanovolt-level offsets and extremely low offset drifts due to time and temperature. The 1/f noise, seen as a dc error, is also removed. Zero-drift amplifiers provide many benefits to designers, as temperature drift and 1/f noise, always nuisances in the system, are otherwise very difficult to eliminate. In addition, zero-drift amplifiers have higher open-loop gain, power supply rejection, and common-mode rejection as compared to standard amplifiers; and their overall output error is less than that obtained by a standard precision amplifier in the same configuration.

Zero Input Crossover Distortion (ZCO) Amplifiers

Traditional rail-to-rail input amplifiers have an input stage that comprises two differential pairs, a p-type and an n-type. During the transition of the input common-mode voltage from the lower to the higher supply voltage, one of the differential pairs turns off and the other turns on. This transition causes crossover distortion. Zero input crossover distortion (ZCO) amplifiers solve this problem by integrating an on-chip charge pump. The charge pump increases the internal supply voltage, thus providing more headroom to the input stage. This allows the input stage to handle a wider range of input voltages (rail to rail) without using a second differential pair. As a result, crossover distortion is avoided.

Amplifier Process and Trimming Technology

Process Technology

Bipolar

Bipolar technology delivers the best overall performance amplifiers. It offers high output current drive, high voltage operation, and low noise.

Extremely Fast Complementary Bipolar (XFCB 1.5)

Analog Device's XFCB 1.5 technology is a suite of advanced bipolar fabrication processes that features dielectric isolation, high speed complementary NPNs and PNPs with 3 GHz to 8 GHz frequency transition, precision capacitors, and low temperature-coefficient thin film resistors that can be trimmed at the wafer level. Dielectric isolation allows much tighter spacing between components and removes the possibility of latch-up. Nonlinear device-to-substrate capacitance that limits device speed and distortion performance is eliminated. XFCB1.5 has supply voltage options from 8 V to 26 V; this allows the selection of the fastest devices possible for the required input and output voltage ranges.

XFCB3

Analog Devices' XFCB3 technology features full dielectric isolation, silicon-germanium hetero-junction NPNs with frequency transition up to 50 GHz and double-poly PNPs with frequency transition up to 18 GHz, precision capacitors, and low temperature coefficient thin film resistors. Minimum feature size is a factor of three less than XFCB1.5. This process family has enabled a new generation of high speed, ultralow distortion differential amplifiers and op amps.

36 V *i*Polar

Analog Devices' *i*Polar™ 36 V precision bipolar process is highly optimized for linear circuits, yielding new levels of performance, size, and value. The *i*Polar process combines the advantages of precision bipolar and JFET with lateral dielectric isolation and modular processing. The transistors on *i*Polar devices have been redesigned from the ground up and are optimized for speed, noise, matching, linearity, and stability at lower power levels. This enables greater signal chain integration without compromising performance.

16 V *i*CMOS Amplifiers

Analog Devices' *i*CMOS® industrial manufacturing process technology combines submicron CMOS with high voltage complementary bipolar technologies. It enables the development of a wide range of high performance analog ICs capable of 30 V operation in a smaller footprint. Unlike analog ICs using conventional CMOS processes, *i*CMOS components can tolerate high supply voltages, while providing increased performance, dramatically lower power consumption, and reduced package size. *i*CMOS components tolerate high voltages (greater than 6 V regular CMOS amps) while employing digital design techniques such as auto-zero and DigiTrim technologies.

JFET Input Amplifiers

JFET input amplifiers have the advantage over bipolar devices by having an extremely high input impedance along with low noise performance, making them very useful in amplifier circuits using very small signals such as high source impedance sensors and photodiodes. A typical JFET has a voltage noise slightly larger than a BJT, but its current noise is significantly lower.

Trimming Technology

Laser Trim

When extremely fine adjustment is required, laser trimming is most effective. By controlling the path and speed of the laser beam, the resistor's value can be adjusted to very precise values. Analog Devices pioneered the use of thin film resistors and laser trimming and uses this technology extensively in precision amplifiers, references, and converters.

Zener Zapping

With each zap removing a predefined resistance value, the nature of the trims is discrete. It is most cost-effective for fairly large geometry processes. Analog Devices pioneered the use of Zener-zap trimming and created the industry standard OP07 precision amplifier.

DigiTrim

Analog Devices' DigiTrim™ is a patented in-package trimming process that delivers guaranteed high accuracy. This in-package process technology eliminates the need for laser trimming during manufacturing and minimizes the input offset of operational amplifiers.

Quick Selection Guide for High Speed Operational Amplifiers (BW > 50 MHz)

High Speed Op Amps

Differential Amplifiers

Single	Dual
ADA4927-1	ADA4927-2
ADA4930-1	ADA4930-2
ADA4932-1	ADA4932-2
ADA4937-1	ADA4937-2
ADA4938-1	ADA4938-2
ADA4939-1	ADA4939-2
ADA4940-1	ADA4940-2
ADA4950-1	ADA4950-2
ADA4922-1	
ADA4941-1	
ADA4960-1	
AD8131	
AD8132	
AD8137	
AD8138	
AD8139	

Differential Amplifier Receivers

Single
AD8129
AD8130

Low Noise, Low Distortion

<1 nV	<2 nV	<3 nV	<6 nV
AD8099	ADA4899-1	ADA4841-1	AD8048
	ADA4898-1	ADA4841-2	AD8047
	ADA4898-2	AD8021	ADA4857-1
	ADA4896-2	AD8022 (Dual)	ADA4857-2
	ADA4897-1	AD8045	
	ADA4897-2		

Rail-To-Rail

Rail-to-Rail In/Out (2.7 V to 10 V)

Single	Dual	Quad
AD8031	AD8032	
AD8027	AD8028	
AD8029	AD8030	AD8040

Rail-to-Rail Out (3 V to 10 V)

Single	Dual	Triple	Quad
ADA4853-1	ADA4853-2	ADA4853-3	
ADA4850-1	ADA4850-2	ADA4855-3	
AD8091	AD8092	ADA4856-3	
AD8051	AD8052		AD8054
AD8041	AD8042		AD8044

Low Cost (<$1/Channel)

Single	Dual	Triple	Quad
ADA4851-1	AD4851-2		ADA4851-4
AD8038	AD8039		
AD8061	AD8062		
AD8063			
AD8055	AD8056		
AD8057	AD8058		
ADA4891-1	ADA4891-2	ADA4891-3	ADA4891-4

FastFET

Single	Dual
ADA4817-1	ADA4817-2
AD8033	AD8034
AD8065	AD8066
AD8067	

Current Feedback (5 V to 10 V)

Low Cost (<$1/Channel)

Single	Dual	Triple
ADA4860-1		ADA4861-3
AD8014		ADA4862-3
	AD8072	AD8073

High Performance

Single	Dual	Triple	Quad
AD8000	AD8002*	AD8003	AD8004
AD8001*	AD8008	AD8013	
AD8005	AD8017	AD8023	
AD8007	ADA4310-1		
AD8009			
AD8011			

*10 V only.

With Charge Pump

Triple
ADA4858-3
ADA4859-3

High Supply Voltage (±15 V)

Single	Dual
ADA4898-1	ADA4898-2
AD818	AD828
AD847	AD827
AD817	AD826
AD829	
AD844*	

*±18 V

High Current Output (>300 mA)

Single	Dual	Quad
AD8390	AD8397	AD8392

Fixed Gain (G = 2)

Single
AD8079

Triple
AD8075
ADA4862-3
ADA4856-3
ADA4859-3
ADA8074*

*G = 1

Adjustable Clamp Amplifiers

Single
AD8036
AD8037

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

Zero-Drift Amplifiers

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

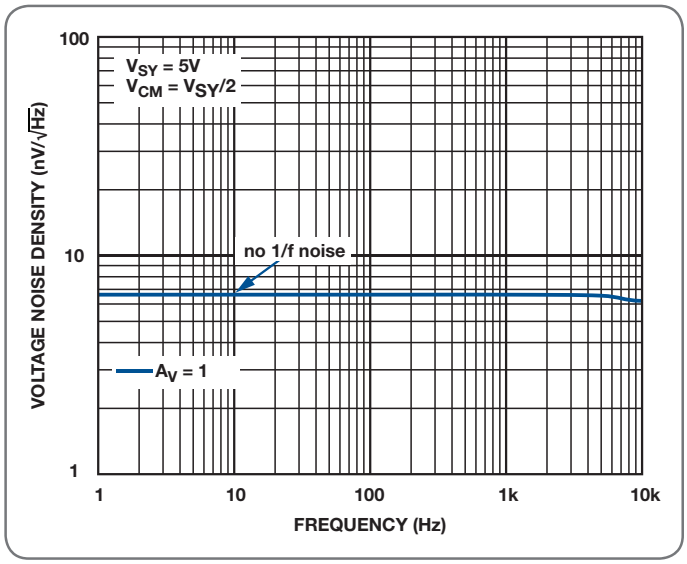
The ADA4528-1 is an ultralow noise, zero-drift operational amplifier featuring rail-to-rail input and output swing. With an offset voltage of 2.5 μV, offset voltage drift of 0.015 μV/°C, and noise of 97 nV p-p (0.1 Hz to 10 Hz, A_V = +100), the device is well suited for applications in which error sources cannot be tolerated. With wide operating supply range of 2.2 V to 5.5 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 μV maximum
- Low offset voltage drift: 0.015 μV/°C maximum
- Low noise
- 5.6 nV/√Hz at f = 1 kHz, A_V = +100
- 97 nV p-p at f = 0.1 Hz to 10 Hz, A_V = +100
- Open-loop voltage gain: 130 dB minimum
- CMRR: 135 dB minimum
- PSRR: 130 dB minimum
- Gain bandwidth product: 4 MHz
- Single-supply operation: 2.2 V to 5.5 V
- Dual-supply operation: ±1.1 V to ±2.75 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[1]	BW @ A_{CL} Min (MHz)	Slew Rate (V/μs)	V_{OS} Max (mV)	TcV_{OS} (μv/°C Typ)	CMRR Min (dB)	PSRR Min (dB)	A_{VO} Min (dB)	Noise (nV/√Hz) @ 1 kHz	I_S/Amp (mA Max)	I_B Max (pA)	Packaging	Price @ 1k (OEM $US)
CMOS	AD8628 AD8629 AD8630	1 2 4	2.7/6	RRIO	2.5	1	0.005	0.002	120	115	125	22	0.850	100	SOT-23/SOIC MSOP/SOIC SOIC/TSSOP	0.96 1.47 2.73
CMOS	ADA4528-1 ADA4528-2*	1 2	2.2/5.5	RRIO	4	0.4	0.0025	0.015	115	120	130	5.3	1.500	100	MSOP/LFCSP	1.15 1.90
CMOS	ADA4051-1 ADA4051-2	1 2	1.8/5.5	RRIO	0.125	0.06	0.015	0.02	110	110	115	95	0.017	70	SC70/SOT-23 MSOP/LFCSP	0.93 1.47
CMOS	AD8538 AD8539	1 2	2.7/5.5	RRIO	0.43	0.35	0.013	0.03	115	105	115	50	0.180	25	SOT-23/SOIC MSOP/SOIC	0.90 1.31
CMOS	AD8551 AD8552 AD8554	1 2 4	2.7/6	RRIO	1.5	0.4	0.005	0.005	120	120	125	42	0.975	50	MSOP/SOIC SOIC/TSSOP SOIC/TSSOP	1.20 1.90 3.36
CMOS	AD8571 AD8572 AD8574	1 2 4	2.7/6	RRIO	1.5	0.4	0.005	0.005	120	120	125	51	0.850	50	MSOP/SOIC SOIC/TSSOP SOIC/TSSOP	1.11 1.78 3.40
CMOS	AD8638 AD8639	1 2	5/16	SS	1.5	2	0.009	0.03	127	127	130	60	1.500	75	SOT-23/SOIC MSOP/SOIC/LFCSP	1.27 2.19

*Prerelease

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

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

Zero Input Crossover Distortion (ZCO) Amplifiers

ADA4505-2: 10 μA, Rail-to-Rail I/O, Zero Input Crossover Distortion Amplifier

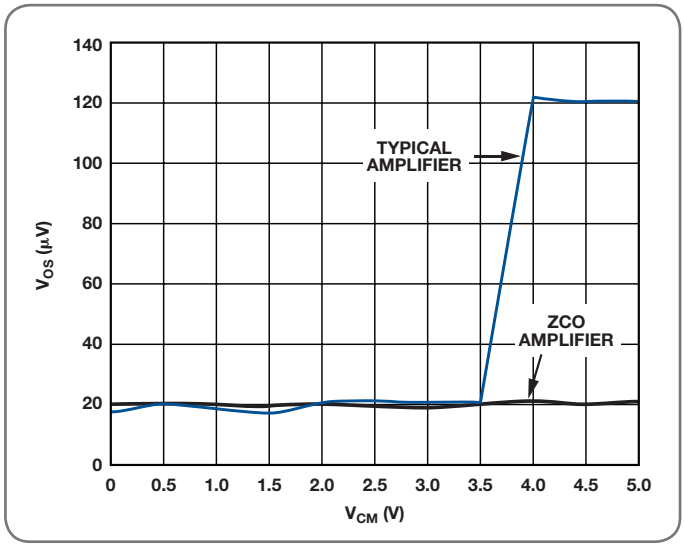
The ADA4505-x family solves the crossover distortion problem by using an on-chip charge pump to power the input differential pair. The charge pump creates a supply voltage higher than the voltage of the battery, allowing the input stage to handle a wide range of input signal voltages without using a 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

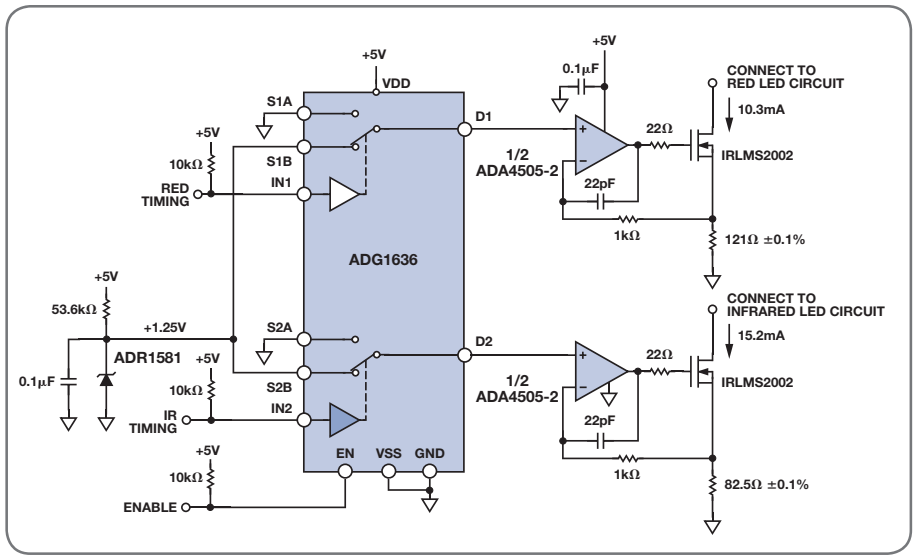
- PSRR: 100 dB minimum
- CMRR: 105 dB typical
- Very low supply current: 10 μA per amplifier maximum
- 1.8 V to 5.5 V single-supply or ±0.9 V to ±2.5 V dual-supply operation
- Rail-to-rail input/output
- 3 mV offset voltage maximum
- Very low input bias current: 0.5 pA typical

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.

Circuits from the Lab™ Reference Circuits

Zero Input Crossover Distortion (ZCO) Amplifiers

Process	Part Number	No. of Amps	Supply Voltage (Min/Max)	Rail-to-Rail[1]	BW @ A_{CL} Min (MHz)	Slew Rate (V/μs)	V_{OS} Max (mV)	TcV_{OS} (μv/°C Typ)	CMRR Min (dB)	PSRR Min (dB)	A_{VO} Min (dB)	Noise (nV/√Hz) @ 1 kHz	I_S/Amp (mA Max)	I_B Max (pA)	Packaging	Price @ 1k (OEM $US)
CMOS	ADA4505-1[2]	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[2]	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

[1] RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes $-V_{SY}$).
[2] 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 mV, Bandwidth < 50 MHz)

Overvoltage Protection (OVP) Amplifiers

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

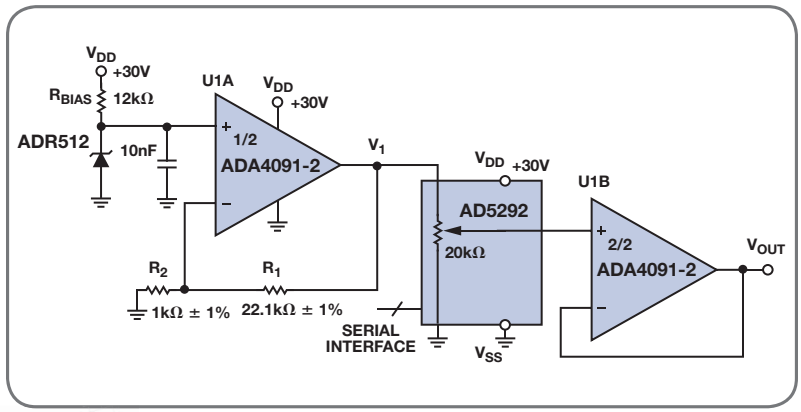
The ADA4091-2 dual and ADA4091-4 quad are micropower, single-supply, 1.2 MHz bandwidth amplifiers featuring rail-to-rail inputs and outputs. They are guaranteed to operate from a +2.7 V to +30 V single supply, as well as from ±1.35 V to ±15 V dual supplies. The ADA4091 family features a unique input 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 µA/amplifier
- Wide bandwidth: 1.2 MHz
- Low offset voltage: 250 µV maximum
- No phase reversal
- Overvoltage protection (OVP)
- 25 V above/below supply rails at ±5 V
- 12 V above/below supply rails at ±15 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 from the Lab™ Reference Circuits

Circuit Note CN-0111, Low Cost, High Voltage, Unipolar DAU Reference Circuit, www.analog.com/CN0111.

Overvoltage Protection (OVP) Amplifiers

Process	Part Number	No. of Amps	Supply Voltage (Min/Max)	Rail-to-Rail[1]	BW @ A_{CL} Min (MHz)	Slew Rate (V/µs)	V_{OS} Max (mV)	TcV_{OS} (µV/°C Typ)	CMRR Min (dB)	PSRR Min (dB)	A_{VO} Min (dB)	Noise (nV/√Hz) @ 1 kHz	I_S/Amp (mA Max)	OVP Level (V)	Packaging	Price @ 1k (OEM $US)
Bipolar	OP191	1	2.7/12	RRIO	1.5	0.5	0.5	1.1	75	80	88	42	0.420	10	SOIC	1.69
	OP291	2												10	SOIC	2.22
	OP491	4												25	SOIC/TSSOP/PDIP	3.60
Bipolar	ADA4091-2	2	±1.35/±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	±1.35/±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 $-V_{SY}$).

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

AD8597/AD8599: Ultralow Distortion, Ultralow Noise Operational Amplifier

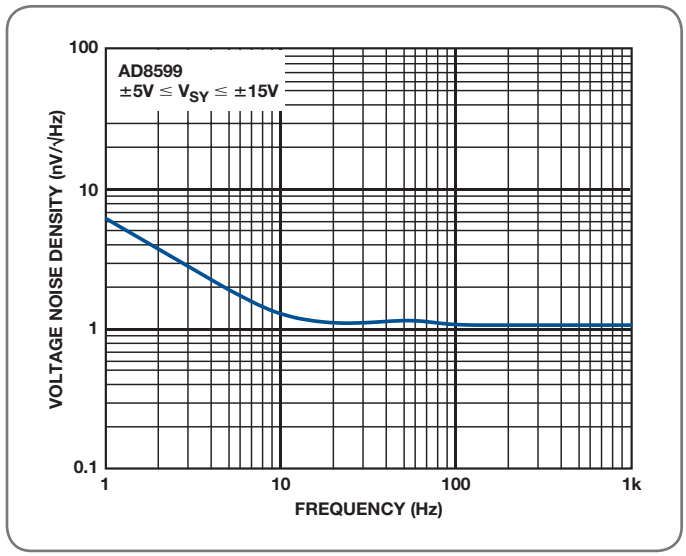
The AD8597 (single) and AD8599 (dual) are very low noise, low distortion operational amplifiers ideal for use as preamplifiers. The low noise of 1.1 nV/√Hz and low harmonic distortion of –120 dB (or better) at audio bandwidths give the devices the wide dynamic range necessary for preamplifiers in audio, medical, and instrumentation applications. The excellent slew rate of 14 V/μs and 10 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 nV/√Hz at 1 kHz
- Low distortion: –120 dB THD @ 1 kHz
- Bandwidth: 10 MHz
- Supply current: 4.8 mA/amp typical
- Low offset voltage: 10 μV typical
- CMRR: 120 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

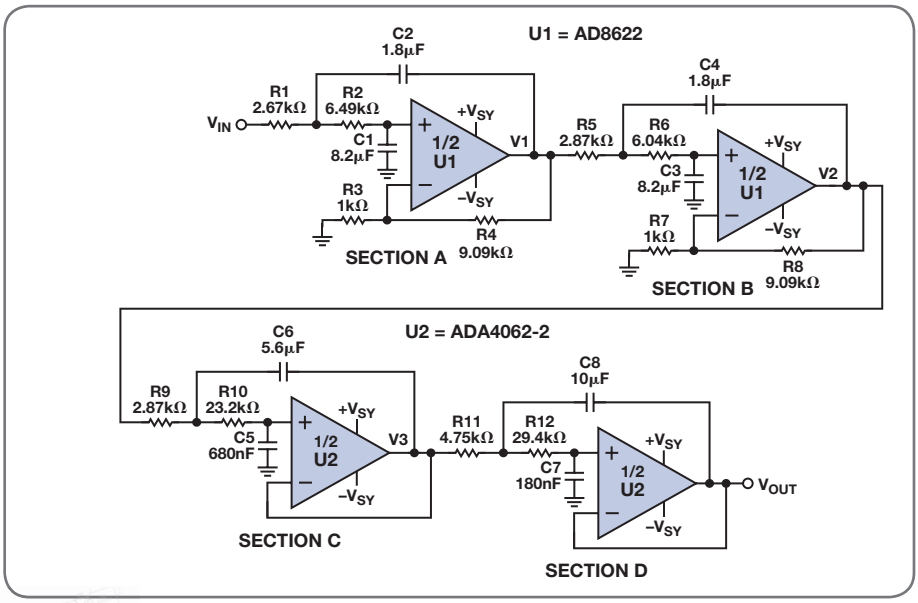
The AD8622 is a dual, precision, rail-to-rail output operational amplifier with a low supply current of only 350 μA maximum over temperature and supply voltage. It also offers ultralow offset, drift, and voltage noise combined with very low input bias current over the full operating temperature range.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

Features

- Very low offset voltage: 125 μA maximum
- Supply current: 215 μA/amp typical
- Input bias current: 200 pA maximum
- Low input offset voltage drift: 1.2 μV/°C maximum
- Very low voltage noise: 11 nV/√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.

Ultralow Offset Voltage ($V_{OS} \leq 250$ µV Max) Amplifiers

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

*Prerelease

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

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

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

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

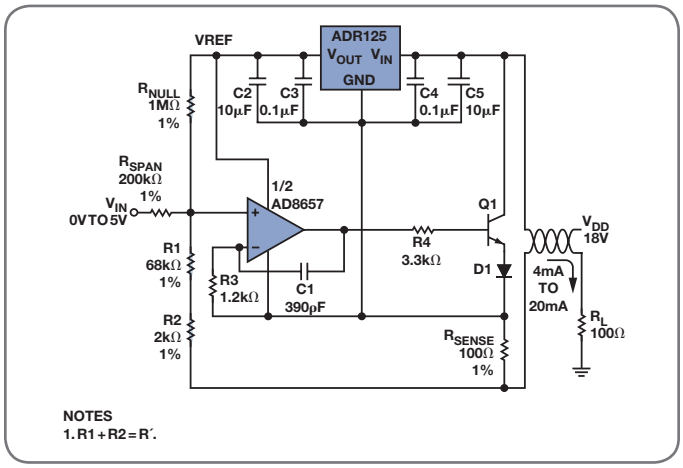
The AD8657 is a dual, precision, micropower, rail-to-rail input/output (RRIO) amplifier optimized for low power and wide operating supply voltage range applications. The device operates from 2.7 V up to 18 V with a typical quiescent supply current of 18 μA and achieves low offset voltage thanks to Analog 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 μA typical
- Low offset voltage: 350 μV maximum
- Single-supply operation: 2.7 V to 18 V
- Dual-supply operation: ±1.35 V to ±9 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 ($V_{OS} \leq$ 1mV) Amplifiers

Process	Part Number	No. of Amps	Supply Voltage (Min/Max)	V_{OS} Max (mV)	TcV_{OS} (μV/°C Typ)	Rail-to-Rail[1]	BW @ A_{CL} Min (MHz)	Slew Rate (V/μs)	CMRR Min (dB)	PSRR Min (dB)	A_{VO} Min (dB)	Noise (nV/√Hz) @ 1 kHz	I_S/Amp (mA Max)	I_B Max	Packaging	Price @ 1k (OEM $US)
	AD8603	1													SOT-23	0.68
CMOS	AD8607	2	1.8/6	0.3	1	RRIO	0.4	0.1	85	80	112	25	0.040	1 pA	MSOP/SOIC	1.02
	AD8609	4													SOIC/TSSOP	1.85
	AD8605	1													WLCSP/SOT-23	0.68
CMOS	AD8606	2	2.7/6	0.3	1	RRIO	10	5	85	80	109	8	1.200	1 pA	WLCSP/MSOP/SOIC	1.19
	AD8608	4													SOIC/TSSOP	1.58
	AD8663	1													SOIC/LFCSP	1.17
CMOS	AD8667	2	5/16	0.3	1.5	SS	0.54	0.6	87	95	115	23	0.285	0.3 pA typ	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
JFET	ADA4627-1A	1	±4/±18	0.3	1		19	84	100	103	106	6.1	7.500	5 pA	SOIC/LFCSP	6.75
CMOS	AD8651	1	2.7/5.5	0.35	4	RRIO	50	41	80	76	100	4.5[2]	14.000	10 pA	MSOP/SOIC	1.13
	AD8652	2													MSOP/SOIC	1.99
JFET	AD8510B	1	±5/±18	0.4	1		8	20	86	86	101	8	2.500	80 pA	MSOP/SOIC	2.33
	AD8512B	2													MSOP/SOIC	4.76
	AD8601A	1													SOT-23	0.62
CMOS	AD8602A	2	2.7/6	0.5	2	RRIO	8.2	5.2	74	67	89	33	1.200	60 pA	MSOP/SOIC	0.83
	AD8604A	4													SOIC/TSSOP	1.13
	AD8615	1													SOT-23	0.76
CMOS	AD8616	2	2.7/6	0.5	1.5	RRIO	24	12	80	70	105	10	1.300	1 pA	MSOP/SOIC	1.29
	AD8618	4													SOIC/TSSOP	2.29
	AD8627	1													SC70/SOIC	1.60
JFET	AD8626	2	±5/±13	0.75	2.5	SS	5	5	76	80	103	16	0.850	1 pA	MSOP/SOIC	2.63
	AD8625	4													SOIC/TSSOP	4.09
	AD8641	1													SC70/SOIC	1.47
JFET	AD8642	2	±2.5/±13	0.75	2.5	SS	3.5	3	90	90	106	27.5	0.290	1 pA	MSOP/SOIC	2.35
	AD8643	4													SOIC/LFCSP	3.85
Bipolar	ADA4075-2	2	±4.5/±18	1	0.3		6.5	12	110	106	114	2.8	2.250	100 nA	SOIC/LFCSP	0.75
CMOS	AD8500	1	±1.8/±5.5	1	3	RRIO	0.007	0.004	75	90	98	190	0.001	10 pA	SC70	0.71
	AD8510A														MSOP/SOIC	0.95
JFET	AD8512A		±5/±18	1	1.7		8	20	86	86	101	8	2.500	80 pA	MSOP/SOIC	1.49
	AD8513A														SOIC/TSSOP	3.71
JFET	AD8682	2	±4.5/±18	1	10		3.5	9	70	92	86	36	0.250	20 pA	MSOP/SOIC	1.66
	AD8684	4													SOIC/TSSOP	2.44

*Prerelease

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

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

Low Power (I_S/Amp ≤ 1 mA) Amplifiers

AD8500: Micorpower, Precision CMOS Operational Amplifier

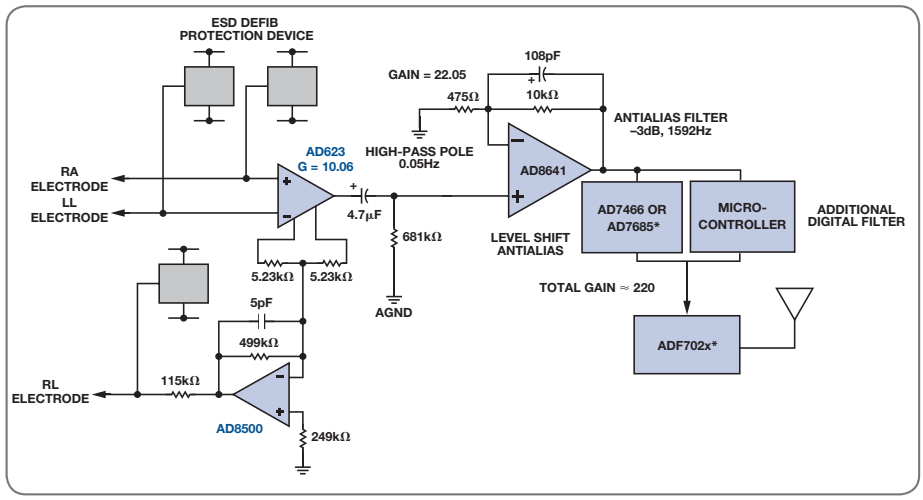
The AD8500 is a low power, precision CMOS op amp featuring a maximum supply current of 1 μA. The AD8500 has a maximum offset voltage of 1 mV and a typical input bias current of 1 pA, and it operates rail-to-rail on both the input and output. The AD8500 can operate from a single-supply voltage of +1.8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

Features

- Supply current: 1 μA maximum
- Offset voltage: 1 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/AMP ≤ 1mA) Amplifiers

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

*Prerelease

Low Power (I_S/Amp ≤ 1mA) Amplifiers (continued)

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

*Prerelease

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

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

Low Noise ($V_n \leq 10$ nV/√Hz) Amplifiers

ADA4075-2: Ultralow Noise Amplifier at Lower Power

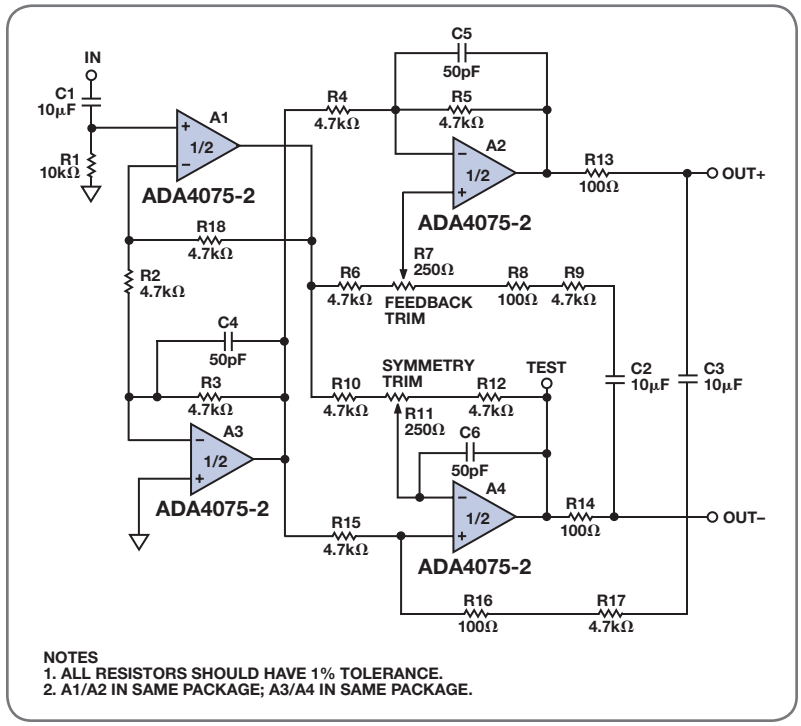
The ADA4075-2 is a dual, high performance, low noise operational amplifier combining excellent dc and ac characteristics on ADI's *i*Polar® process. ADI's proprietary *i*Polar process is an advanced bipolar technology implementing vertical junction isolation with lateral trench isolation, allowing for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

Features

- Ultralow noise: 2.8 nV/√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 V/μs typical
- Unity-gain stable

Applications

- Precision instrumentation
- Professional audio
- Active filters



Balanced line driver design.

ADA4004-1/ADA4004-2/ADA4004-4: Ultraprecision, 1.8 nV/√Hz, 36 V Amplifiers

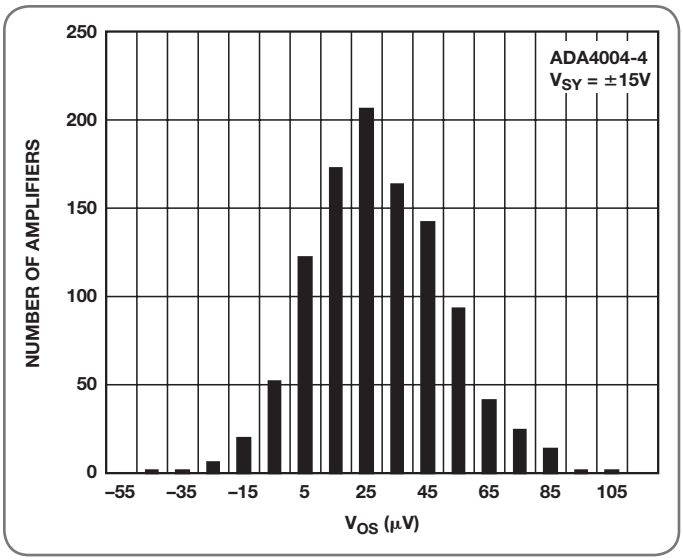
The ADA4004-1/ADA4004-2/ADA4004-4 are designed on the high performance *i*Polar process, enabling improvements such as reduced noise and power consumption, increased speed and stability, and smaller footprint size. Novel design techniques enable the ADA4004-1/ADA4004-2/ADA4004-4 to achieve 1.8 nV/√Hz 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 nV/√Hz
- Low input bias current: 90 nA maximum
- Offset voltage: 125 μV maximum
- High gain: 120 dB
- Wide bandwidth: 12 MHz
- ±5 V to ±15 V operation

Applications

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



Number of amplifiers vs. input offset voltage.

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

Process	Part Number	No. of Amps	Supply Voltage (Min/Max)	Noise ($nV/\sqrt{Hz}$) @ 1khz	Rail-to-Rail[1]	BW @ A_{CL} Min (MHz)	Slew Rate ($V/\mu s$)	V_{OS} Max (mV)	TcV_{OS} ($\mu V/°C$ Typ)	CMRR Min (dB)	PSRR Min (dB)	A_{VO} Min (dB)	Noise ($pA/\sqrt{Hz}$) @ 1 kHz	I_S/Amp (mA Max)	I_B Max	I_{SC} (mA)	Packaging	Price @ 1k (OEM $US)
Bipolar	AD8597 AD8599	1 2	±4.5/±18	1.07		10	16.8	0.12	0.8	120	120	110	1.9	5.700	200 nA	52	SOIC/LFCSP SOIC	2.25 3.24
Bipolar	ADA4004-1 ADA4004-2 ADA4004-4	1 2 4	±5/±18	1.8		12	2.7	0.125	0.7	110	110	114	1.2	2.200	90 nA	25	SOT-23/SOIC MSOP/SOIC SOIC/LFCSP	1.75 2.65 4.25
Bipolar	ADA4075-2	2	±4.5/±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	±5/±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	±5/±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	±5/±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 AD8672 AD8674	1 2 4	±5/±18	2.8		10	4	0.075	0.3	100	110	120	0.3	3.500	12 nA	30	MSOP/SOIC MSOP/SOIC SOIC/TSSOP	1.06 1.72 3.24
JFET	AD8610A AD8620A	1 2	±5/±13	6		25	60	0.25	0.8	90	100	100	0.005	3.500	10 pA	65	MSOP/SOIC SOIC	3.75 7.50
JFET	AD8610B AD8620B	1 2	±5/±13	6		25	60	0.1	0.5	90	100	100	0.005	3.500	10 pA	65	MSOP/SOIC SOIC	9.86 16.70
CMOS	ADA4528-1 ADA4528-2*	1 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 1.90
JFET	ADA4627-1A	1	±4/±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	±4/±18	6.1		19	84	0.2	1	106	106	112	0.0016	7.500	5 pA	55	SOIC/LFCSP	10.75
CMOS	AD8605 AD8606 AD8608	1 2 4	2.7/6	8	RRIO	10	5	0.3	1	85	80	109	0.01	1.200	1 pA	80	WLCSP/SOT-23 WLCSP/MSOP/SOIC SOIC/TSSOP	0.68 1.19 1.58
JFET	AD8510A AD8512A AD8513A	1 2 4	±5/±18	8		8	20	1	1.7	86	86	101		2.500	80 pA	70	MSOP/SOIC MSOP/SOIC SOIC/TSSOP	0.95 1.49 3.71
JFET	AD8510B AD8512B	1 2	±5/±18	8		8	20	0.4	1	86	86	101		2.500	80 pA	70	MSOP/SOIC MSOP/SOIC	2.33 4.76
CMOS	AD8691 AD8692 AD8694	1 2 4	2.7/6	8	SS	10	5	2	1.3	70	80	108	0.05	1.050	1 pA	80	SC70/SOT-23 MSOP/SOIC SOIC/TSSOP	0.51 0.64 0.90
CMOS	AD8646 AD8648	2 4	2.7/6	8	RRIO	24	11	2.5	1.8	67	63	104		1.500	1 pA	120	MSOP/SOIC SOIC/TSSOP	0.61 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 OP262 OP462	1 2 4	2.7/12	9.5	SS	15	13	0.325	1	70	60	97	0.4	0.800	500 nA	30[2]	MSOP/SOIC/TSSOP SOIC/TSSOP SOIC/TSSOP	1.69 2.23 4.03
Bipolar	AD8519 AD8529	1 2	2.7/12	10	SS	8	2.9	1.1	2	70[2]	60	94	0.4	1.200	300 nA	70	SC70/SOT-23/SOIC MSOP/SOIC	0.92 1.22
CMOS	AD8615 AD8616 AD8618	1 2 4	2.7/6	10	RRIO	24	12	0.5	1.5	80	70	105	0.05	1.300	1 pA	150	SOT-23 MSOP/SOIC SOIC/TSSOP	0.76 1.29 2.29
Bipolar	AD8677	1	±4/±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
*i*CMOS	AD8665 AD8666 AD8668	1 2 4	5/16	10	SS	4	3.5	2.5	3	90	98	130	0.1	1.550	1 pA	140	SOT-23/SOIC MSOP/SOIC SOIC/TSSOP	0.83 0.93 1.75

*Prerelease

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

[2] 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 mV, Bandwidth < 50 MHz)

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

Low Input Bias Current ($I_B \leq$ 50 pA) Amplifiers

ADA4627–1: Low Noise, Low Bias Current, JFET Operational Amplifier

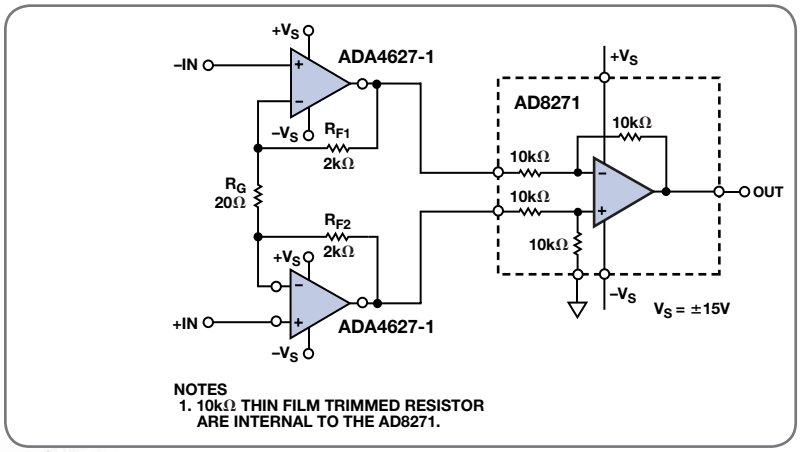
The ADA4627–1 is a wide bandwidth precision amplifier featuring low noise, very low offset, drift, and bias current. Operation is specified from ±5 V to ±15 V dual supply. This amplifier combines the best specifications of precision dc and high speed ac op amps.

Features

- Low offset voltage: 200 μV maximum
- Offset drift: 1 μV/°C typical
- Very low input bias current: 5 pA maximum
- Extended temperature range: −40°C to +125°C
- ±5 V to ±15 V dual supply
- Guaranteed GBW: 16 MHz
- Voltage noise: 6.1 nV/√Hz at 1 kHz
- High slew rate: 60 V/μs

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.

Low Input Bias Current ($I_B \leq$ 50 pA) Amplifiers

Process	Part Number	No. of Amps	Supply Voltage (Min/Max)	Rail-to-Rail[1]	BW @ A_{CL} Min (MHz)	Slew Rate (V/μs)	V_{OS} Max (mV)	TcV_{OS} (μV/°C Typ)	CMRR Min (dB)	PSRR Min (dB)	A_{VO} Min (dB)	Noise (nV/√Hz) @ 1 kHz	Noise (pA/√Hz) @ 1 kHz	I_S/Amp (mA Max)	I_B Max	Packaging	Price @ 1k (OEM $US)
JFET	AD549L	1	±2.5/±18		5	3	0.5	10	90	90	109	35	0.22	0.700	60 fA	TO-99	23.61
JFET	AD549K	1	±2.5/±18		5	3	0.25	5	90	90	109	35	0.22	0.700	100 fA	TO-99	19.11
JFET	AD549J	1	±2.5/±18		5	3	1	20	80	80	109	35	0.22	0.700	250 fA	TO-99	13.68
BiJET	OP285	2	±4.5/±18		9	22	0.25	1	80	85	108	6	0.9	2.500	350 nA	SOIC/PDIP	2.40
CMOS	AD8663 AD8667 AD8669	1 2 4	5/16	SS	0.54	0.6	0.3	1.5	87	95	115	23	0.05	0.285	0.3 pA typ	SOIC/LFCSP MSOP/SOIC SOIC/TSSOP	1.17 1.58 2.70
CMOS	AD8603 AD8607 AD8609	1 2 4	1.8/6	RRIO	0.4	0.1	0.3	1	85	80	112	25	0.05	0.040	1 pA	SOT-23 MSOP/SOIC SOIC/TSSOP	0.68 1.02 1.85
CMOS	AD8605 AD8606 AD8608	1 2 4	2.7/6	RRIO	10	5	0.3	1	85	80	109	8	0.01	1.200	1 pA	WLCSP/SOT-23 WLCSP/MSOP/SOIC SOIC/TSSOP	0.68 1.19 1.58
CMOS	AD8615 AD8616 AD8618	1 2 4	2.7/6	RRIO	24	12	0.5	1.5	80	70	105	10	0.05	1.300	1 pA	SOT-23 MSOP/SOIC SOIC/TSSOP	0.76 1.29 2.29
CMOS	AD8661 AD8662 AD8664	1 2 4	5/16	SS	4	3.5	0.16	4	90	95	106	12	0.1	1.550	1 pA	SOIC/LFCSP MSOP/SOIC SOIC/TSSOP	1.08 1.37 2.23
JFET	AD8627 AD8626 AD8625	1 2 4	±5/±13	SS	5	5	0.75	2.5	76	80	103	16	0.5	0.850	1 pA	SC70/SOIC MSOP/SOIC SOIC/TSSOP	1.60 2.63 4.09
JFET	AD8641 AD8642 AD8643	1 2 4	±2.5/±13	SS	3.5	3	0.75	2.5	90	90	106	27.5	0.0005	0.290	1 pA	SC70/SOIC MSOP/SOIC SOIC/LFCSP	1.47 2.35 3.85
CMOS	AD8613 AD8617 AD8619	1 2 4	1.8/5.5	RRIO	0.4	0.1	2.2	1	68	67	107	25	0.05	0.040	1 pA	SC70/SOT-23 MSOP/SOIC SOIC/TSSOP	0.46 0.71 1.11
CMOS	AD8691 AD8692 AD8694	1 2 4	2.7/6	SS	10	5	2	1.3	70	80	108	8	0.05	1.050	1 pA	SC70/SOT-23 MSOP/SOIC SOIC/TSSOP	0.51 0.64 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[1]	BW @ A_{CL} Min (MHz)	Slew Rate (V/µs)	V_{OS} Max (mV)	TcV_{OS} (µv/°C Typ)	CMRR Min (dB)	PSRR Min (dB)	A_{VO} Min (dB)	Noise (nV/√Hz) @ 1 kHz	Noise (pA/√Hz) @ 1 kHz	I_S/Amp (mA Max)	I_B Max (pA)	Packaging	Price @ 1k (OEM $US)
CMOS	AD8646 AD8648	2 4	2.7/6	RRIO	24	11	2.5	1.8	67	63	104	8		1.500	1	MSOP/SOIC SOIC/TSSOP	0.61 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
CMOS	AD8665 AD8666 AD8668	1 2 4	5/16	SS	4	3.5	2.5	3	90	98	130	10	0.1	1.550	1	SOT-23/SOIC MSOP/SOIC SOIC/TSSOP	0.83 0.93 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
CMOS	ADA4505-1[2] ADA4505-2 ADA4505-4	1 2 4	1.8/5.5	RRIO	0.050	0.006	3	2	90	100	105	65	0.02	0.010	2	WLCSP/SOT-23 WLCSP/MSOP WLCSP/TSSOP	0.55 0.67 1.15
CMOS	AD8657 AD8659*	2 4	2.7/18	RRIO	0.175	0.3	0.3	4	95	105	110	50		0.022	5	MSOP/SOIC SOIC/LFCSP	0.95 1.35
JFET	ADA4627-1A	1	±4/±18		19	84	0.3	1	100	103	106	6.1	0.0025	7.500	5	SOIC/LFCSP	6.75
JFET	ADA4627-1B	1	±4/±18		19	84	0.2	1	106	106	112	6.1	0.0016	7.500	5	SOIC/LFCSP	10.75
CMOS	ADA4692-2 ADA4692-4	2 4	2.7/6	SS	3.6	1.3	2.5	1	75	80	95	16	0.05	0.225	5	SOIC/LFCSP TSSOP	0.55 0.90
CMOS	ADA4691-2 ADA4691-4	2 4	2.7/6	SS	3.6	1.3	2.5	1	75	80	95	16	0.05	0.225	5	WLCSP/LFCSP LFCSP	0.57 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 AD8656	1 2	2.7/5.5	RRIO	28	11	0.25	0.4	85	88	100	2.7[2]		4.500	10	MSOP/SOIC MSOP/SOIC	0.71 1.11
CMOS	AD8651 AD8652	1 2	2.7/5.5	RRIO	50	41	0.35	4	80	76	100	4.5[2]	0.025	14.000	10	MSOP/SOIC MSOP/SOIC	1.13 1.99
JFET	AD8610A AD8620A	1 2	±5/±13		25	60	0.25	0.8	90	100	100	6	0.005	3.500	10	MSOP/SOIC SOIC	3.75 7.50
JFET	AD8610B AD8620B	1 2	±5/±13		25	60	0.1	0.5	90	100	100	6	0.005	3.500	10	MSOP/SOIC SOIC	9.86 16.70
JFET	AD820B AD822B	1 2	±2.5/±18	SS	1.9	3	1	2	74	70	114	16	0.008	0.900	10	SOIC/PDIP MSOP/SOIC/PDIP	2.66 4.11
CMOS	AD8505[2] AD8506 AD8508	1 2 4	1.8/5.5	RRIO	0.095	0.013	2.5	2	90	100	105	45	0.015	0.020	10	WLCSP/SOT-23 WLCSP/MSOP WLCSP/TSSOP	0.59 0.71 1.20
CMOS	AD8502 AD8504	2 4	1.8/5.5	RRIO	0.007	0.004	3	5	67	85	98	190	0.1	0.001	10	SOT-23 TSSOP	0.70 1.00
JFET	AD8682 AD8684	2 4	±4.5/±18		3.5	9	1	10	70	92	86	36	0.01	0.250	20	MSOP/SOIC SOIC/TSSOP	1.66 2.44
JFET	AD820A AD822A AD824A	1 2 4	±2.5/±18	SS	1.9	3	2	2	70	70	114	16	0.008	0.900	25	MSOP/SOIC/PDIP MSOP/SOIC/PDIP SOIC	1.82 2.76 4.55
CMOS	AD8538 AD8539	1 2	2.7/5.5	RRIO	0.43	0.35	0.013	0.03	115	105	115	50		0.180	25	SOT-23/SOIC MSOP/SOIC	0.90 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
JFET	ADA4000-1 ADA4000-2 ADA4000-4	1 2 4	±4/±18		5	20	1.7	2	80	82	100	16	0.01	1.650	40	SOT-23/SOIC MSOP/SOIC SOIC/TSSOP	0.73 1.31 2.22
JFET	ADA4062-2A ADA4062-4A	2 4	±4/±18		1.4	3.3	2.5	4	73	74	76	36	0.005	0.220	50	MSOP/SOIC/LFCSP LFCSP/TSSOP	0.75 1.21
JFET	ADA4062-2B	2	±4/±18		1.4	3.3	1.5	4	80	80	76	36	0.005	0.220	50	SOIC	1.25
CMOS	AD8551 AD8552 AD8554	1 2 4	2.7/6	RRIO	1.5	0.4	0.005	0.005	120	120	125	42		0.975	50	MSOP/SOIC SOIC/TSSOP SOIC/TSSOP	1.20 1.90 3.36
CMOS	AD8571 AD8572 AD8574	1 2 4	2.7/6	RRIO	1.5	0.4	0.005	0.005	120	120	125	51		0.850	50	MSOP/SOIC SOIC/TSSOP SOIC/TSSOP	1.11 1.78 3.40
CMOS	AD8591 AD8592 AD8594	1 2 4	2.7/6	RRIO	3	5	25	20	38	45	83	45	0.05	0.700	50	SOT-23 SOIC SOIC/TSSOP	0.29 0.39 0.57

*Prerelease

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

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

Amplifiers (Bandwidth < 50 MHz)

Single Supply Amplifiers

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

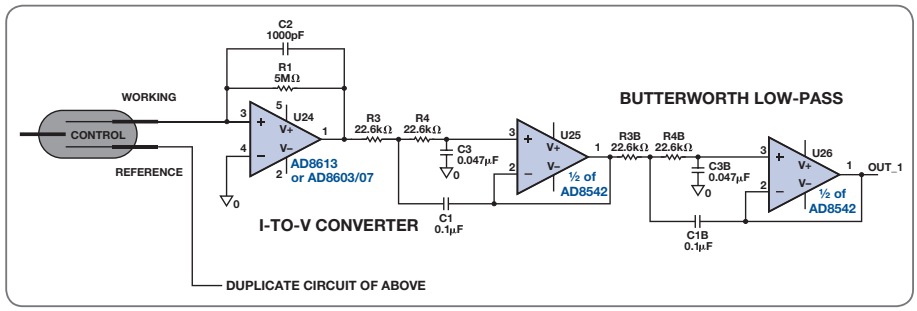
The AD8613/AD8617/AD8619 are single/dual/quad micropower rail-to-rail input and output amplifier that features low offset voltage as well as low input voltage and current noise.

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[1]	BW @ A_{CL} Min (MHz)	Slew Rate (V/μs)	V_{OS} Max (mV)	TcVos (μV/°C Typ)	CMRR Min (dB)	PSRR Min (dB)	A_{VO} Min (dB)	Noise (nV/√Hz) @ 1 kHz	Noise (pA/√Hz) @ 1 kHz	I_S/Amp (mA Max)	I_B Max	I_{SC} (mA)	Packaging	Price @ 1k (OEM $US)
Bipolar	AD8565 AD8566 AD8567	1 2 4	4.5/16	RRIO	5	6	10	5	54	70	69	26	0.8[2]	0.850	600 nA	35[2]	SC70 MSOP LFCSP/TSSOP	0.56 0.71 0.93
CMOS	AD8603 AD8607 AD8609	1 2 4	1.8/6	RRIO	0.4	0.1	0.3	1	85	80	112	25	0.05	0.040	1 pA	80	SOT-23 MSOP/SOIC SOIC/TSSOP	0.68 1.02 1.85
CMOS	AD8601A AD8602A AD8604A	1 2 4	2.7/6	RRIO	8.2	5.2	0.5	2	74	67	89	33	0.05	1.200	60 pA	30	SOT-23 MSOP/SOIC SOIC/TSSOP	0.62 0.83 1.13
CMOS	AD8605 AD8606 AD8608	1 2 4	2.7/6	RRIO	10	5	0.3	1	85	80	109	8	0.01	1.200	1 pA	80	WLCSP/SOT-23 WLCSP/MSOP/SOIC SOIC/TSSOP	0.68 1.19 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 AD8616 AD8618	1 2 4	2.7/6	RRIO	24	12	0.5	1.5	80	70	105	10	0.05	1.300	1 pA	150	SOT-23 MSOP/SOIC SOIC/TSSOP	0.76 1.29 2.29
CMOS	AD8655 AD8656	1 2	2.7/5.5	RRIO	28	11	0.25	0.4	85	88	100	2.7[2]		4.500	10 pA	220	MSOP/SOIC MSOP/SOIC	0.71 1.11
CMOS	AD8651 AD8652	1 2	2.7/5.5	RRIO	50	41	0.35	4	80	76	100	4.5[2]	0.025	14.000	10 pA	80	MSOP/SOIC MSOP/SOIC	1.13 1.99
CMOS	AD8657 AD8659*	2 3	2.7/18	RRIO	0.175	0.3	0.3	4	95	105	110	50		0.022	5 pA	10	MSOP/SOIC SOIC/LFCSP	0.95 1.35
Bipolar	AD4091-2 AD4091-4	2 3	±1.35/±18	RRIO	1.27	0.46	0.25	2.5	104	108	116	25		0.250	55 nA	20	SOIC/LFCSP LFCSP/TSSOP	2.22 3.50
Bipolar	ADA4092-2* ADA4092-4	2 3	±1.35/±18	RRIO	1.4	0.4	1.5	2.5	90	98	116	30		0.250	60 nA	20	SOIC/LFCSP TSSOP	1.35 2.50
CMOS	ADA4505-1[2] ADA4505-2 ADA4505-4	1 2 4	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 WLCSP/MSOP WLCSP/TSSOP	0.55 0.67 1.15
CMOS	AD8505[2] AD8506 AD8508	1 2 4	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 WLCSP/MSOP WLCSP/TSSOP	0.59 0.71 1.20
CMOS	AD8628 AD8629 AD8630	1 2 4	2.7/6	RRIO	2.5	1	0.005	0.002	120	115	125	22		0.850	100 pA	50	SOT-23/SOIC MSOP/SOIC SOIC/TSSOP	0.96 1.47 2.73
CMOS	ADA4528-1 ADA4528-2*	1 2	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 1.90
CMOS	ADA4051-1 ADA4051-2	1 2	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 MSOP/LFCSP	0.93 1.47

Single Supply Amplifiers (continued)

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

*Prerelease

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

[2] 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 mV, Bandwidth < 50 MHz)

Rail-to-Rail Output Amplifiers

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

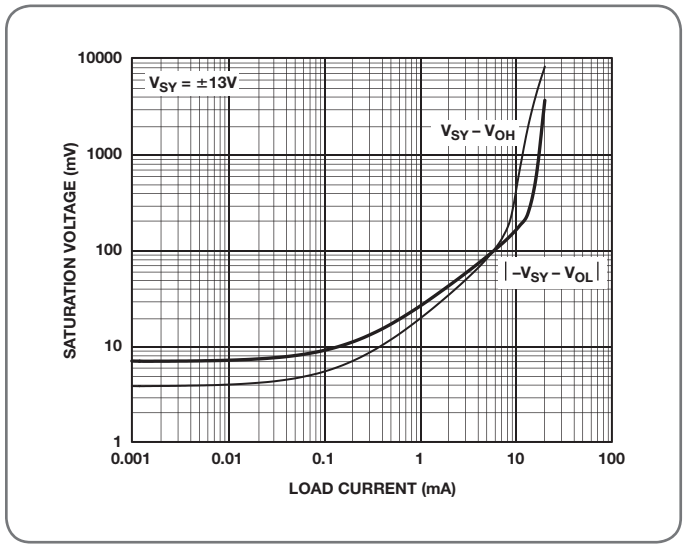
The AD8641/AD8642/AD8643 are low power, precision JFET input amplifiers featuring extremely low input bias current and rail-to-rail output. The ability to swing nearly rail-to-rail at the input and rail-to-rail at the output enables designers to buffer CMOS DACs, ASICs, and other wide output swing devices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

Features

- Low supply current: 250 μA max
- Very low input bias current: 1 pA max
- Low offset voltage: 750 μV max
- Single-supply operation: 5 V to 26 V
- Dual-supply operation: ±2.5 V to ±13 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

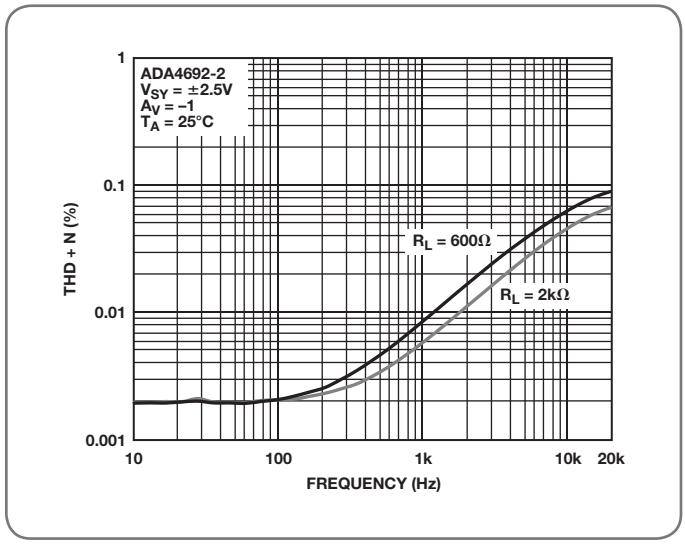
The ADA4691-2 is a dual, rail-to-rail output, single-supply amplifier featuring low power, wide bandwidth, and low noise. The ADA4691-2 has two independent shutdown pins, allowing further reduction in supply current. These amplifiers are ideal for a wide variety of applications. Audio preamps, filters,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

Features

- Low power: 180 μA typical
- Low distortion: 0.003% THD + N
- Low noise: 16 nV/√Hz typical
- 3.6 MHz bandwidth
- Offset voltage: 500 μV 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.

Rail-to-Rail Output Amplifiers

Process	Part Number	No. of Amps	Supply Voltage (Min/Max)	Rail-to-Rail[1]	BW @ A_{CL} Min (MHz)	Slew Rate (V/μs)	V_{OS} Max (mV)	TcV_{OS} (μv/°C Typ)	CMRR Min (dB)	PSRR Min (dB)	A_{VO} Min (dB)	Noise (nV/√Hz) @ 1 kHz	Noise (pA/√Hz) @ 1 kHz	I_S/Amp (mA Max)	I_B 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[2]	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[2]	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[2]	3.400	2 nA	MSOP/SOIC	2.14
CMOS	AD8605 AD8606 AD8608	1 2 4	2.7/6	RRIO	10	5	0.3	1	85	80	109	8	0.01	1.200	1 pA	WLCSP/SOT-23 WLCSP/MSOP/SOIC SOIC/TSSOP	0.68 1.19 1.58
CMOS	AD8691 AD8692 AD8694	1 2 4	2.7/6	SS	10	5	2	1.3	70	80	108	8	0.05	1.050	1 pA	SC70/SOT-23 MSOP/SOIC SOIC/TSSOP	0.51 0.64 0.90
CMOS	AD8646 AD8648	2 4	2.7/6	RRIO	24	11	2.5	1.8	67	63	104	8		1.500	1 pA	MSOP/SOIC SOIC/TSSOP	0.61 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 OP262 OP462	1 2 4	2.7/12	SS	15	13	0.325	1	70	60	97	9.5	0.4	0.800	500 nA	MSOP/SOIC/TSSOP SOIC/TSSOP SOIC/TSSOP	1.69 2.23 4.03
Bipolar	AD8519 AD8529	1 2	2.7/12	SS	8	2.9	1.1	2	70[2]	60	94	10	0.4	1.200	300 nA	SC70/SOT-23/SOIC MSOP/SOIC	0.92 1.22
CMOS	AD8615 AD8616 AD8618	1 2 4	2.7/6	RRIO	24	12	0.5	1.5	80	70	105	10	0.05	1.300	1 pA	SOT-23 MSOP/SOIC SOIC/TSSOP	0.76 1.29 2.29
CMOS	AD8665 AD8666 AD8668	1 2 4	5/16	SS	4	3.5	2.5	3	90	98	130	10	0.1	1.550	1 pA	SOT-23/SOIC MSOP/SOIC SOIC/TSSOP	0.83 0.93 1.75
Bipolar	AD8622 AD8624	2 4	±2.5/±18	RRO	0.56	0.48	0.125	0.5	125	125	125	11	0.15	0.250	200 pA	MSOP/SOIC LFCSP/TSSOP	2.30 3.75
CMOS	AD8661 AD8662 AD8664	1 2 4	5/16	SS	4	3.5	0.16	4	90	95	106	12	0.1	1.550	1 pA	SOIC/LFCSP MSOP/SOIC SOIC/TSSOP	1.08 1.37 2.23
JFET	AD8627 AD8626 AD8625	1 2 4	±5/±13	SS	5	5	0.75	2.5	76	80	103	16	0.5	0.850	1 pA	WLCSP/SOIC MSOP/SOIC SOIC/TSSOP	1.60 2.63 4.09
JFET	AD820A AD822A AD824A	1 2 4	±2.5/±18	SS	1.9	3	2	2	70	70	114	16	0.008	0.900	25 pA	MSOP/SOIC MSOP/SOIC/PDIP SOIC	1.82 2.76 4.55
JFET	AD820B AD822B	1 2	±2.5/±18	SS	1.9	3	1	2	74	70	114	16	0.008	0.900	10 pA	SOIC/PDIP MSOP/SOIC/PDIP	2.66 4.11
CMOS	ADA4692-2 ADA4692-4	2 4	2.7/6	SS	3.6	1.3	2.5	1	75	80	95	16	0.05	0.225	5 pA	SOIC/LFCSP TSSOP	0.55 0.90
CMOS	ADA4691-2 ADA4691-4	2 4	2.7/6	SS	3.6	1.3	2.5	1	75	80	95	16	0.05	0.225	5 pA	WLCSP/LFCSP LFCSP	0.57 0.99
CMOS	AD8628 AD8629 AD8630	1 2 4	2.7/6	RRIO	2.5	1	0.005	0.002	120	115	125	22		0.850	100 pA	SOT-23/SOIC MSOP/SOIC SOIC/TSSOP	0.96 1.47 2.73
CMOS	AD8515	1	1.8/6	RRIO	5	2.7	6	4	60	65	113	22	0.05	0.550	30 pA	SC70/SOT-23	0.28
CMOS	AD8663 AD8667 AD8669	1 2 4	5/16	SS	0.54	0.6	0.3	1.5	87	95	115	23	0.05	0.285	0.3 pA typ	SOIC/LFCSP MSOP/SOIC SOIC/TSSOP	1.17 1.58 2.70
CMOS	AD8603 AD8607 AD8609	1 2 4	1.8/6	RRIO	0.4	0.1	0.3	1	85	80	112	25	0.05	0.040	1 pA	SOT-23 MSOP/SOIC SOIC/TSSOP	0.68 1.02 1.85
Bipolar	ADA4091-2 ADA4091-4	2 4	±1.35/±18	RRIO	1.27	0.46	0.25	2.5	104	108	116	25		0.250	55 nA	SOIC/LFCSP LFCSP/TSSOP	2.22 3.50
CMOS	AD8613 AD8617 AD8619	1 2 4	1.8/5.5	RRIO	0.4	0.1	2.2	1	68	67	107	25	0.05	0.040	1 pA	SC70/SOT-23 MSOP/SOIC SOIC/TSSOP	0.46 0.71 1.11
Bipolar	AD8565 AD8566 AD8567	1 2 4	4.5/16	RRIO	5	6	10	5	54	70	69	26	0.8[2]	0.850	600 nA	SC70 MSOP LFCSP/TSSOP	0.56 0.71 0.93
Bipolar	OP196 OP296 OP496	1 2 4	3/15	RRIO	0.45	0.3	0.3	1.5	65[2]	110	109	26	0.19	0.060	50 nA	SOIC SOIC/TSSOP/PDIP SOIC/TSSOP/PDIP	1.56 1.85 2.66

Rail-to-Rail Output Amplifiers (continued)

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

*Prerelease

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

[2] 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 mV, Bandwidth < 50 MHz)

Rail-to-Rail Input/Output Amplifiers

AD8656: Low power, Precision RRIO CMOS Amplifier

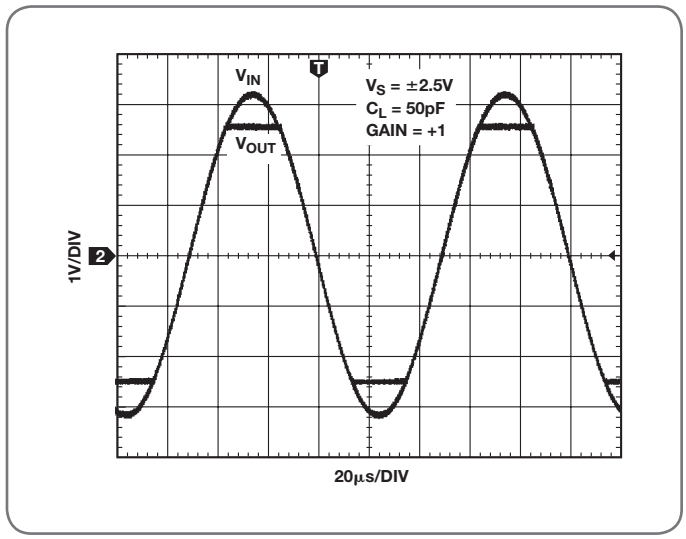
The AD8656 provides low noise (2.7 nV/√Hz @ 10 kHz), low THD + N (0.0007%), and high precision performance (250 µV max over VCM) to low voltage applications. The ability to swing rail-to-rail at the input and output enables designers to buffer analog-to-digital converters (ADCs) and other wide dynamic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

Features

- Low noise: 2.7 nV/√Hz @ f = 10 kHz
- Low offset voltage: 250 µV max over VCM (common-mode voltage)
- Offset voltage drift:; 0.4 µV/°C typ and 2.3 µV/°C max
- Bandwidth: 28 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[1]	BW @ A_{CL} Min (MHz)	Slew Rate (V/µs)	V_{OS} (mV Max)	TcV_{OS} (µV/°C Typ)	BW @ A_{CL} Min (MHz)	Slew Rate (V/µs)	A_{VO} Min (b@)	TcV_{OS} (µV/°C Typ)	I_S/Amp (mA Max)	I_B Max	Packaging	Price @ 1k (OEM $US)
CMOS	ADA4528-1 ADA4528-2*	1 2	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 1.90
CMOS	AD8605 AD8606 AD8608	1 2 4	2.7/6	RRIO	10	5	0.3	1	85	80	109	8	1.200	1 pA	WLCSP/SOT-23 WLCSP/MSOP/SOIC SOIC/TSSOP	0.68 1.19 1.58
CMOS	AD8646 AD8648	2 4	2.7/6	RRIO	24	11	2.5	1.8	67	63	104	8	1.500	1 pA	MSOP/SOIC SOIC/TSSOP	0.61 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 AD8616 AD8618	1 2 4	2.7/6	RRIO	24	12	0.5	1.5	80	70	105	10	1.300	1 pA	SOT-23 MSOP/SOIC SOIC/MSSOP	0.76 1.29 2.29
CMOS	AD8628 AD8629 AD8630	1 2 4	2.7/6	RRIO	2.5	1	0.005	0.002	120	115	125	22	0.850	100 pA	SOT-23/SOIC MSOP/SOIC SOIC/TSSOP	0.96 1.47 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 AD8607 AD8609	1 2 4	1.8/6	RRIO	0.4	0.1	0.3	1	85	80	112	25	0.040	1 pA	SOT-23 MSOP/SOIC SOIC/MSSOP	0.68 1.02 1.85
Bipolar	ADA4091-2 ADA4091-4	2 4	±1.35/±18	RRIO	1.27	0.46	0.25	2.5	104	108	116	25	0.250	55 nA	SOIC/LFCSP LFCSP/TSSOP	2.22 3.50
CMOS	AD8613 AD8617 AD8619	1 2 4	1.8/5.5	RRIO	0.4	0.1	2.2	1	68	67	107	25	0.040	1 pA	SC70/SOT-23 MSOP/SOIC SOIC/TSSOP	0.46 0.71 1.11

*Prerelease

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

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

*Prerelease

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

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

Amplifiers (Bandwidth < 50 MHz)

Low Cost Amplifiers

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

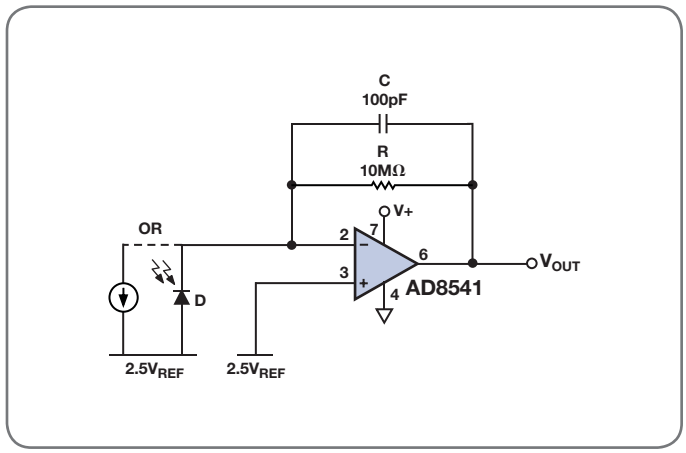
The AD8541/AD8542/AD8544 are single, dual, and quad rail-to-rail input and output single-supply amplifiers featuring very low supply current and 1 MHz bandwidth. All are guaranteed to operate from a 2.7 V single supply, as well as a 5 V supply. These parts provide 1 MHz bandwidth at a low current consumption of 45 μA per amplifier.

Features

- Single-supply operation: 2.7 V to 5.5 V
- Low supply current: 45 μA/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

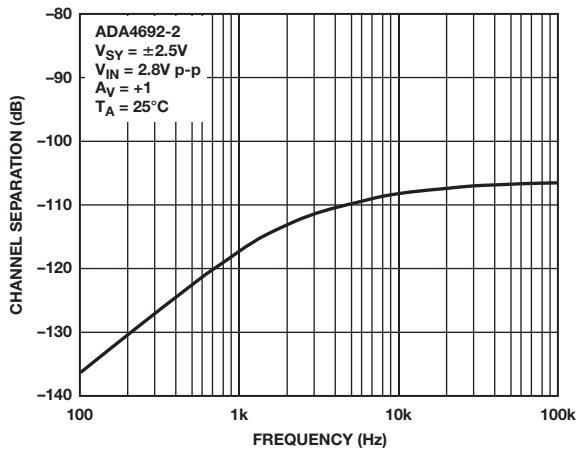
The ADA4692-2 is a dual, rail-to-rail output, single-supply amplifier featuring low power, wide bandwidth, and low noise. The ADA4691-2 has two independent shutdown pins, allowing further reduction in supply current. These amplifiers are ideal for a wide variety of applications. Audio preamps, filters,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

Features

- Low power: 180 μA typical
- Low distortion: 0.003% THD + N
- Low noise: 16 nV/√Hz typical
- 3.6 MHz bandwidth
- Offset voltage: 500 μV 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[1]	BW @ A_{CL} Min (MHz)	Slew Rate (V/µs)	V_{OS} Max (mV)	TcV_{OS} (µv/°C Typ)	CMRR Min (dB)	PSRR Min (dB)	A_{VO} Min (dB)	Noise (nV/√Hz) @ 1kHz	I_S/Amp (mA Max)	I_B 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 AD8542 AD8544	1 2 4	2.7/6	RRIO	1	0.92	6	4	40	65	86	40	0.045	60 pA	SC70/SOT-23 MSOP/SOIC SOIC/TSSOP	0.27 0.38 0.54
CMOS	AD8546 AD8548	2 4	2.7/18	RRIO	0.2	0.07	3	0.025	80	90	88	50	0.022	100 pA	MSOP/SOIC/LFCSP	0.78 1.05
CMOS	AD8531 AD8532 AD8534	1 2 4	2.7/6	RRIO	3	5	25	20	38	45	83	45	0.700	50 pA	SC70/SOT-23 MSOP/SOIC SOIC/TSSOP	0.27 0.43 0.60
CMOS	AD8591 AD8592 AD8594	1 2 4	2.7/6	RRIO	3	5	25	20	38	45	83	45	0.700	50 pA	SOT-23 SOIC SOIC/TSSOP	0.29 0.39 0.57
JFET	ADTL082A ADTL084A	2 4	±4/±18		5	20	5.5	10	80	80	100	16	1.800	100 pA	MSOP/SOIC SOIC/TSSOP	0.42 0.90
CMOS	AD8602 AD8604	2 4	2.7/6	RRIO	8.2	5.2	6	2	56	56	86	33	1.200	200 pA	MSOP/SOIC SOIC/TSSOP	0.44 0.90
CMOS	AD8613 AD8617 AD8619	1 2 4	1.8/5.5	RRIO	0.4	0.1	2.2	1	68	67	107	25	0.040	1 pA	SC70/SOT-23 MSOP/SOIC SOIC/TSSOP	0.46 0.71 1.11
CMOS	AD8691 AD8692 AD8694	1 2 4	2.7/6	SS	10	5	2	1.3	70	80	108	8	1.050	1 pA	SC70/SOT-23 MSOP/SOIC SOIC/TSSOP	0.51 0.64 0.90
CMOS	ADA4505-1[2] ADA4505-2 ADA4505-4	1 2 4	1.8/5.5	RRIO	0.050	0.006	3	2	90	100	105	65	0.010	2 pA	WLCSP/SOT-23 WLCSP/MSOP WLCSP/TSSOP	0.55 0.67 1.15
CMOS	ADA4692-2 ADA4692-4	2 4	2.7/6	SS	3.6	1.3	2.5	1	75	80	95	16	0.225	5 pA	SOIC/LFCSP TSSOP	0.55 0.90
Bipolar	AD8565 AD8566 AD8567	1 2 4	4.5/16	RRIO	5	6	10	5	54	70	69	26	0.850	600 nA	SC70 MSOP LFCSP/TSSOP	0.56 0.71 0.93
CMOS	ADA4691-2 ADA4691-4	2 4	2.7/6	SS	3.6	1.3	2.5	1	75	80	95	16	0.225	5 pA	WLCSP/LFCSP LFCSP	0.57 0.99
CMOS	AD8505[2] AD8506 AD8508	1 2 4	1.8/5.5	RRIO	0.095	0.013	2.5	2	90	100	105	45	0.020	10 pA	WLCSP/SOT-23 WLCSP/MSOP WLCSP/TSSOP	0.59 0.71 1.20
CMOS	AD8646 AD8648	2 4	2.7/6	RRIO	24	11	2.5	1.8	67	63	104	8	1.500	1 pA	MSOP/SOIC SOIC/TSSOP	0.61 0.88
CMOS	AD8601A AD8602A AD8604A	1 2 4	2.7/6	RRIO	8.2	5.2	0.5	2	74	67	89	33	1.200	60 pA	SOT-23 MSOP/SOIC SOIC/TSSOP	0.62 0.83 1.13
CMOS	AD8603 AD8607 AD8609	1 2 4	1.8/6	RRIO	0.4	0.1	0.3	1	85	80	112	25	0.040	1 pA	SOT-23 MSOP/SOIC SOIC/TSSOP	0.68 1.02 1.85
CMOS	AD8605 AD8606 AD8608	1 2 4	2.7/6	RRIO	10	5	0.3	1	85	80	109	8	1.200	1 pA	WLCSP/SOT-23 WLCSP/MSOP/SOIC SOIC/TSSOP	0.68 1.19 1.58
CMOS	AD8502 AD8504	2 4	1.8/5.5	RRIO	0.007	0.004	3	5	67	85	98	190	0.001	10 pA	SOT-23 TSSOP	0.70 1.00

[1] RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes $-V_{SY}$).
[2] Check data sheet for test conditions and actual product specification—may be different for single/dual/quad amplifiers for part numbers with [2] mark.

High Speed Amplifiers (BW > 50 MHz)

Differential Amplifiers

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

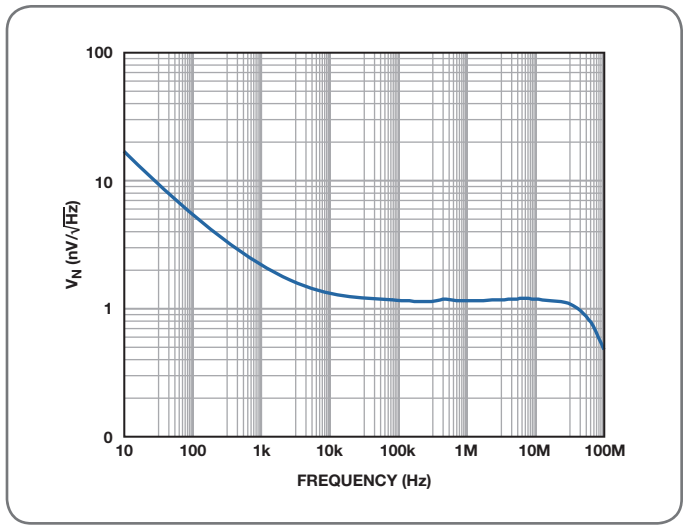
The ADA4930-1 and ADA4930-2 are very low noise, low distortion, high speed differential amplifiers, ideal for driving 1.8 V high performance ADCs with resolutions up to 14 bits from dc to 70 MHz. The devices feature a low 0.9 V output common-mode voltage on single supply, capable of driving dc-coupled,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

Features

- Low input voltage noise: 1.2 nV/√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 V/μs, 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[1]	A_{CL} Min	BW @ A_{CL} Min (MHz)	Slew Rate (V/μs)	Distortion SFDR[1] @ BW (dBc)	Distortion SFDR[1] @ BW (MHz)	Noise (nV/√Hz)	V_{OS} Max (mV)	I_B (μA Max)	I_S/Amp (mA Typ)	I_{OUT} (mA)	Temp Range[2]	Packaging	Price @ 1k (OEM $US)
ADA4927-1	1	•	5, ±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, ±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, ±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, ±5	RRO	1	230	90	103	1	3.9	0.25	1	1.25	45	H	SOIC/LFCSP	1.89
ADA4940-2	2	•	3, 5													LFCSP	2.89
ADA4950-1	1	•	3, 5, ±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, ±5	RRO	1	410	800	–85	5	2.25	0.5	8	24.5	100	H5	SOIC/LFCSP	3.75
AD8131	1		3, 5, ±5		2	400	2000	–68	5	25	7	6	11.5	60	H	SOIC/MSOP	1.82
AD8132	1		3, 5, ±5		1	350	1200	–83	5	8	3.5	7	12	70	H5	SOIC/MSOP	1.67
AD8138	1		3, 5, ±5		1	320	1150	–85	20	5	2.5	7	20	95	I	SOIC/MSOP	3.75
AD8137	1	•	3, 5, ±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, ±5, ±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, ±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

[1] RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes $–V_{SY}$).
[2] 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, 1nV/√Hz, Rail-to-Rail Output Op Amp

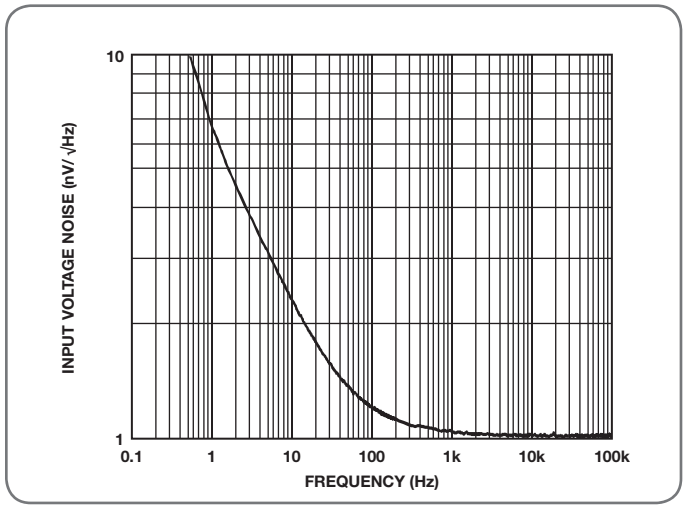
The ADA4896-2/ADA4897-1 are unity gain stable, low noise, rail-to-rail output, high speed voltage feedback amplifiers that have a quiescent current of 3 mA. With the 1/f noise of 2 nV/√Hz @ 10 Hz and a spurious-free dynamic range of –95 dBc @ 2 MHz, the ADA4896-2/ADA4897-1 are an ideal solution in a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

Features

- Unity-gain stable
- Ultralow noise: 1 nV/√Hz, 9 pA/√Hz
- Ultralow distortion: –110 dBc at 100 kHz
- High speed
  - –3 dB bandwidth: 200 MHz (G = +1)
  - Slew rate: 100 V/μs
- Offset voltage: 500 μV
- Low input bias current: 10 μA
- Wide supply voltage range: 2.7 V to 10 V
- Supply current: 3 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[1]	A_{CL} Min	BW @ A_{CL} Min (MHz)	Slew Rate (V/μs)	Distortion SFDR[1] @ BW (dBc)	Distortion SFDR[1] @ BW (MHz)	Noise (nV/√Hz)	V_{OS} Max (mV)	I_B (μA Max)	I_S/Amp (mA Typ)	I_{OUT} (mA)	Temp Range[2]	Packaging	Price @ 1k (OEM $US)
AD8099	1	•	5, ±5		2	700	1350	–92	10	0.95	0.5	1	15	40	H[3]	SOIC/LFCSP	2.00
ADA4899-1	1	•	5, ±5		1	600	310	–123	0.5	1	0.23	1	14.7	40	H[3]	SOIC/LFCSP	1.91
ADA4857-1 ADA4857-2	1 2	• •	5, ±5		1	850	2800	–88	10	4.4	4.5	3.3	5	50	H	SOIC/LFCSP	0.86 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 ADA4897-2	1 2	• •	3 to 10	RRO	1	200	100	110	0.1	1	0.75	10	3	90	H	SOIC/ SOT-23/MSOP	1.89 3.20
ADA4898-1 ADA4898-2	1 2		±5, ±12, ±15		1	65	55	–116	0.1	0.9	0.12	0.4	8.1	40	H	SOIC	2.29 3.21
ADA4841-1 ADA4841-2	1 2	• •	2.7, 5, ±5	RRO	1	80	13	–105	0.1	2.1	0.5	5.3	1.2	60	H[3]	SOT-23/ SOIC MSOP	1.61 2.32
AD8021	1	•	5 , ±5 , ±12		1	560	130	–93	1	2.1	1	11.3	7.8	70	I	SOIC/MSOP	1.31
AD8022	2		5, ±5, ±12		1	130	50	-95	1	2.5	6	5	4	55	I	SOIC/MSOP	2.38
AD8045	1		5, ±5		1	1000	1350	–95	10	3	1	6.3	16	70	H[3]	SOIC/LFCSP	1.41
AD8048	1		5, ±5		2	260	1000	–72	5	3.8	3	3.5	6.6	50	I	SOIC	2.30
AD8047	1		5, ±5		1	250	750	–78	5	5.2	3	3.5	6.6	50	I	SOIC	2.53

[1] RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes $-V_{SY}$).
[2] Temp range: H = extended industrial (–40°C to +125°C), I = industrial (–40°C to +85°C).
[3] Recommended for automotive (from high speed amplifiers selection guide).

High Speed Amplifiers (BW > 50 MHz)

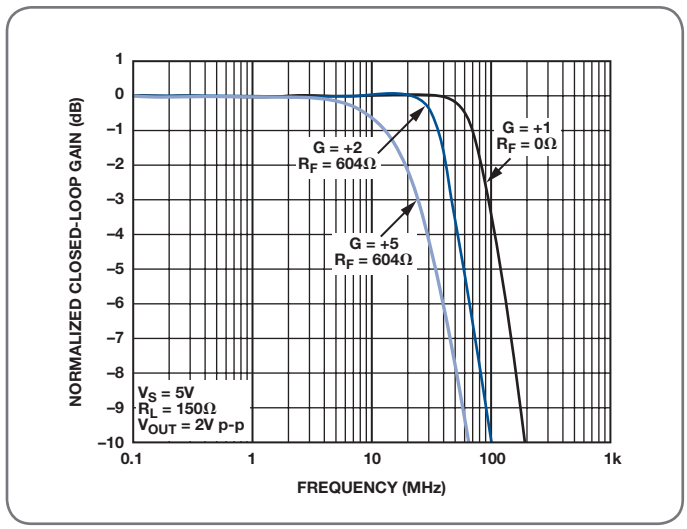
Low Cost Amplifiers

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/μs
  - Settling time to 0.1%: 28 ns
- Video specifications (G = +2, RL = 150 Ω)
  - 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



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

Applications

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

Low Cost Amplifiers

Part Number	No. of Amps	Disable	Supply Voltage (V)	Rail-to-Rail[1]	A_{CL} Min	BW @ A_{CL} Min (MHz)	Slew Rate (V/μs)	Distortion SFDR[1] @ BW (dBc)	Distortion SFDR[1] @ BW (MHz)	Noise (nV/√Hz)	V_{OS} Max (mV)	I_B (μA Max)	I_S/Amp (mA Typ)	I_{OUT} (mA)	Temp Range[2]	Packaging	Price @ 1k (OEM $US)
ADA4851-1	1	•	2.7, 5, ±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, ±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		±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, ±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

[1] RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes $–V_{SY}$).
[2] 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 μA 80 MHz Rail-to-Rail I/O Amplifiers

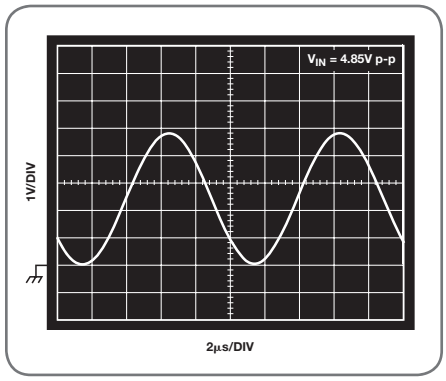
The AD8031 (single) and AD8032 (dual) single-supply, voltage feedback amplifiers feature high speed performance with 80 MHz of small signal bandwidth and 30 V/μs slew rate. This performance is possible while consuming less than 4.0 mW of power from a single 5 V supply. These features increase the operation 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 ±5 V supplies.

Features

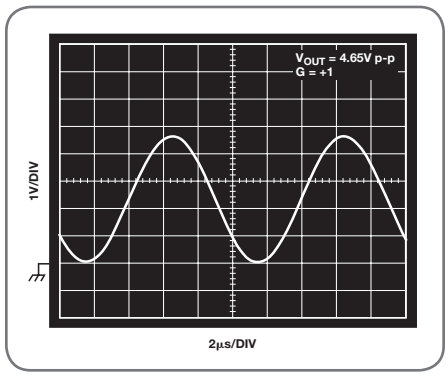
- Low power
  - Supply current: 800 μA/amplifier
  - Fully specified at +2.7 V, +5 V, and ±5 V supplies
- High speed and fast settling on 5 V
  - 80 MHz, –3 dB bandwidth (G = +1)
  - 30 V/μs slew rate
  - 125 ns settling time to 0.1%
- Rail-to-rail input and output
  - No phase reversal with input 0.5 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[1]	A_{CL} Min	BW @ A_{CL} Min (MHz)	Slew Rate (V/μs)	Distortion SFDR[1] @ BW (dBc)	Distortion SFDR[1] @ BW (MHz)	Noise (nV/√Hz)	V_{OS} Max (mV)	I_B (μA Max)	I_S/Amp (mA Typ)	I_{OUT} (mA)	Temp Range[2]	Packaging	Price @ 1k (OEM $US)
AD8031 AD8032	1 2		2.7, 5, ±5	RRIO	1	80	35	–77	0.5	15	1.5	1.2	0.9	15	1	SOT-23/MSOP	1.32 1.97
ADA4853-1 ADA4853-2 ADA4853-3	1 2 3	• • •	3, 5	RRO	1	100	120	–90	1	22	4	1.6	1.4	120	H5	SC70/LFCSP/ TSSOP	0.56 0.70 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 AD8092	1 2		3, 5, ±5	RRO	1	110	145	–71	5	16	10	2.5	4.4	45	I	SOT-23/SOIC/ MSOP	0.70 0.90
AD8051 AD8052 AD8054	1 2 4		3, 5, ±5	RRO	1	110	170	–72	5	16	11	2.5	4.8	45	H5	SOT-23/SOIC/ TSSOP/MSOP	0.86 1.62 2.88
AD8029 AD8030 AD8040	1 2 4	• •	2.7, 5, ±5	RRIO	1	125	62	–74	1	16.5	5	1.3	1.3	20	H	SC70/SOIC/ TSSOP/MSOP	0.86 1.21 1.62
AD8041 AD8042 AD8044	1 2 4		3, 5, ±5	RRO	1	170	225	–78	5	15	9.8	3.2	6	50	I	SOIC	1.95 2.28 4.00
ADA4850-1 ADA4850-2	1 2	• •	2.7, 5	RRO	1	175	220	–81	1	10	4.2	4.2	2.5	90	H	LFCSP	0.56 0.70
AD8027 AD8028	1 2	• •	3, 5, ±5	RRIO	1	190	100	–120	1	4.3	0.9	6	6.5	25	H5	SOT-23/SOIC/ MSOP	1.20 1.91

[1] RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes $–V_{SY}$).
[2] Temp range: H = extended industrial (–40°C to +125°C), I = industrial (–40°C to +85°C).

High Speed Amplifiers (BW > 50 MHz)

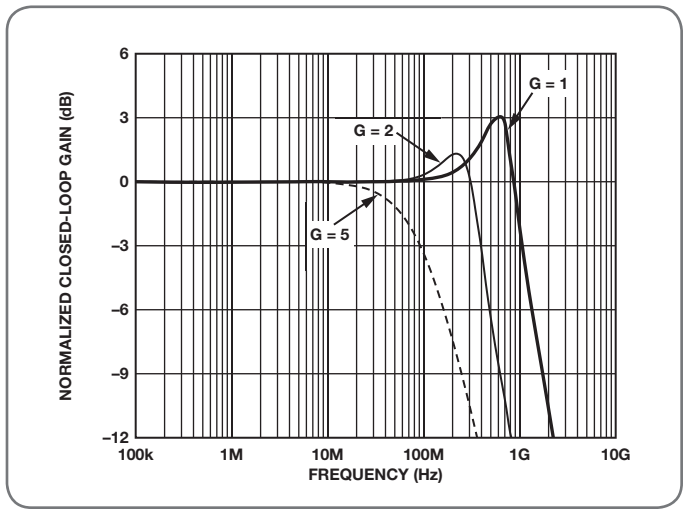
FastFET Amplifiers

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 nV/√Hz; 2.5 fA/√Hz), as well as very high input impedances.

Features

- High speed
  - –3 dB bandwidth (G = 1, RL = 100 Ω): 1050 MHz
  - Slew rate: 870 V/μs
  - 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 nV/√Hz @ 100 kHz
  - 2.5 fA/√Hz @ 100 kHz
- Low distortion
  - –90 dBc @ 10 MHz (G = 1, RL = 1 kΩ)
  - 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[1]	A_{CL} Min	BW @ A_{CL} Min (MHz)	Slew Rate (V/μs)	Distortion SFDR[1] @ BW (dBc)	Distortion SFDR[1] @ BW (MHz)	Noise (nV/√Hz)	V_{OS} Max (mV)	I_B (μA Max)	I_S/Amp (mA Typ)	I_{OUT} (mA)	Temp Range[2]	Packaging	Price @ 1k (OEM $US)
ADA4817-1 ADA4817-2	1 2	• •	5, ±5		1	1050	870	–90	10	4	2	20 pA	19	40	H	SOIC/LFCSP	2.95 4.98
AD8067	1		5, ±5, ±12	RRO	8	54	500	–95	1	6.6	1	5 pA	6.6	30	I	SOT-23	2.32
AD8065 AD8066	1 2		5, ±5, ±12	RRO	1	145	180	–88	1	7	1.5	7 pA	6.4	35	I5	SOT-23/MSOP	1.62 2.32
AD8033 AD8034	1 2		5, ±5, ±12	RRO	1	80	80	–82[3]	1	11	2	11 pA	3.3	25	I	SC70/SOT-23	1.08 1.61

[1] RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes $–V_{SY}$).
[2] Temp range: H = extended industrial (–40°C to +125°C), I = industrial (–40°C to +85°C).
[3] THD: total harmonic distortion.

High Speed Amplifiers (BW > 50 MHz)

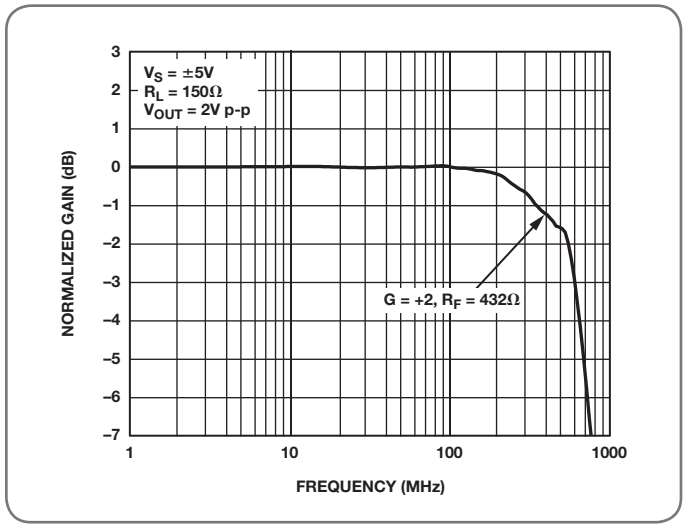
Current Feedback Amplifiers

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/μs.

Features

- High speed
  - 1.5 GHz, –3 dB bandwidth (G = +1)
  - 650 MHz, full power bandwidth (G = +2, V_0 = 2 V p-p)
  - Slew rate: 4100 V/μs
  - 0.1% settling time: 12 ns
  - 0.1 dB flatness: 170 MHz
- Low noise: 1.6 nV/√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



Large signal frequency response.

Applications

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

Current Feedback Amplifiers

Part Number	No. of Amps	Disable	Supply Voltage (V)	Rail-to-Rail[1]	A_{CL} MIN	BW @ A_{CL} MIN (MHz)	Slew Rate (V/μs)	Distortion SFDR[1] @ BW (dBc)	Distortion SFDR[1] @ BW (MHz)	Noise (nV/√Hz)	Noise[3] (pa/√Hz)	V_{OS} Max (mV)	I_B (μA Max)	I_S/Amp (mA Typ)	I_{OUT} (mA)	Temp Range[2]	Packaging	Price @ 1k (OEM $US)
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 (RTO)	1.4	25 (RTO)	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 AD8073	2 3		5, ± 5		1	100	500	–64	5	3	6	6	12	3.5	30	I	SOIC/MSOP	1.65 2.15
High Performance																		
AD8000 AD8003	1 3	• •	5, ± 5		1	1500	4100	–75	20	1.6	3.4/26 3/36	10	45	13.5	100	H5	SOIC/LFCSP	1.68
AD8009	1		5, ± 5		1	1000	5500	–38	20	1.9	46/41	5	150	14	175	I	SOT-23/SOIC	1.75
AD8001 AD8002	1 2		± 5		1	880	1000	–66	5	2	2/18	5.5	25	5	70	I	SOT-23/SOIC	1.49
AD8007 AD8008	1 2		5, ± 5		1	650	1000	–83	20	2.7	2/23	4	8	9	30	I	SC70/SOT-23/ SOIC/MSOP	1.31 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 (RTO)	2	25 (RTO)	2	17	19	H	LFCSP	1.69

[1] RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes $–V_{SY}$).
[2] Temp range: H = extended industrial (–40°C to +125°C), I = industrial (–40°C to +85°C).
[3] Noise first entry is noninverting input, second entry is inverting input.

High Speed Amplifiers (BW > 50 MHz)

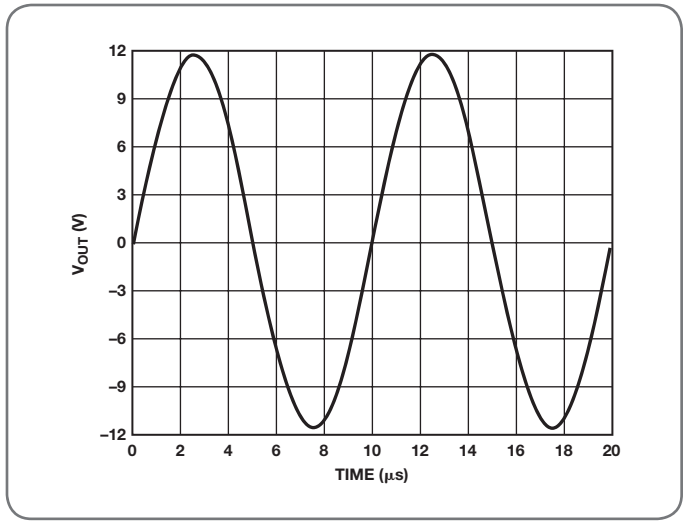
High Output Current Amplifiers

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 Ω 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 Ω on ±12 V supplies while maintaining –80 dBc SFDR
- Low noise
  - 4.5 nV/√Hz voltage noise density @ 100 kHz
  - 1.5 pA/√Hz current noise density @ 100 kHz
- High speed
  - 69 MHz bandwidth (G = 1, –3 dB)
  - 53 V/µs slew rate (R_{LOAD} = 25 Ω)



Output swing, V_S = ±12 V, R_L = 100 Ω.

Applications

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

High Output Current Amplifiers

Part Number	No. of Amps	Disable	Supply Voltage (V)	Rail-to-Rail[1]	A_{CL} Min	BW @ A_{CL} Min (MHz)	Slew Rate (V/µs)	Distortion SFDR[1] @ BW		Noise (nV/√Hz)	V_{OS} Max (mV)	I_B (µA Max)	I_S/Amp (mA Typ)	I_{OUT} (mA)	Temp Range[2]	Packaging	Price @ 1k (OEM $US)
								(dBc)	(MHz)								
AD8397	2		3, 5, ±5, ±12	RRO	1	69	53	-87	0.1	4.5	1	2	5.5	310	I	SOIC	$2.32
AD8390	1	•	±5, ±12		5	60	300	–82[3]	1	8	3	7	3.8	400	I	LFCSP	$2.92
AD8392	4	•	±5, ±12		1	40	900	–72[3]	1	4.3	5	15	3.6	400	I	LFCSP/ TSSOP	Last Time Buy

[1] RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes $–V_{SY}$).
[2] Temp range: H = extended industrial (–40°C to +125°C), I = industrial (–40°C to +85°C).
[3] THD: total harmonic distortion.

High Speed Amplifiers (BW > 50 MHz)

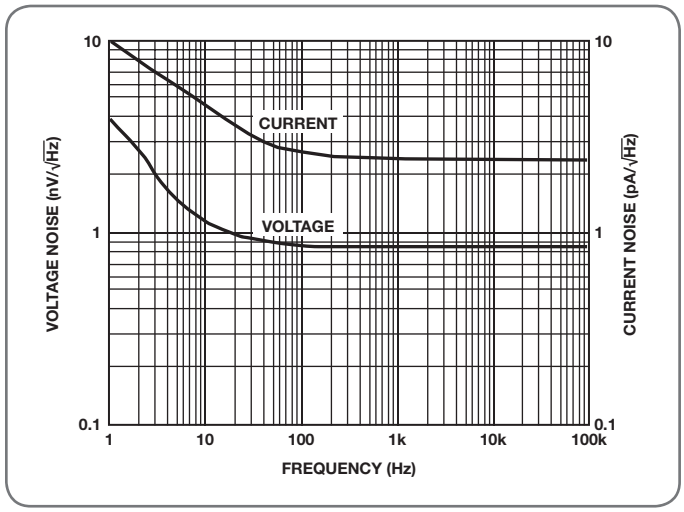
High Supply Voltage Amplifiers

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 μ5 V to μ16 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 nV/√Hz
  - 2.4 pA/√Hz
  - 1.2 nV/√Hz at 10 Hz
- Ultralow distortion: –93 dBc at 500 kHz
- Wide supply voltage range: ±5 V to ±16 V
- High speed
  - –3 dB bandwidth: 65 MHz (G = +1)
  - Slew rate: 55 V/μs
- Unity-gain stable
- Low input offset voltage: 160 μV maximum
- Low input offset voltage drift: 1 μV/°C
- Low input bias current: –0.1 μA
- Low input bias current drift: 2 nA/°C
- Supply current: 8 mA



Input voltage noise and current noise frequency.

Applications

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

High Supply Voltage Amplifiers

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

[1] RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes $–V_{SY}$).
[2] Temp range: H = extended industrial (–40°C to +125°C), I = industrial (–40°C to +85°C).
[3] THD: total harmonic distortion.

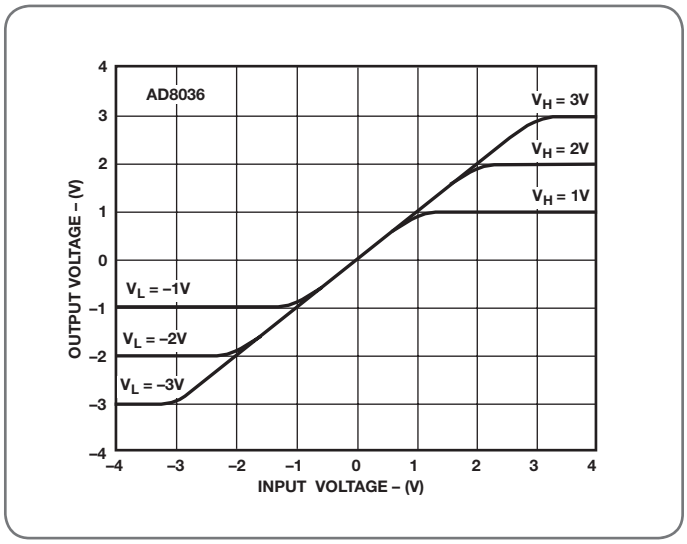
Clamp Amplifiers

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 (VCH) and low (VCL) 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
  - 10μV/°C drift
- Settling 10 ns to 0.1%, 16 ns to 0.01%
  - ±3 V to ±5 V supply operation



Clamp dc cccuracy vs. input voltage.

Applications

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

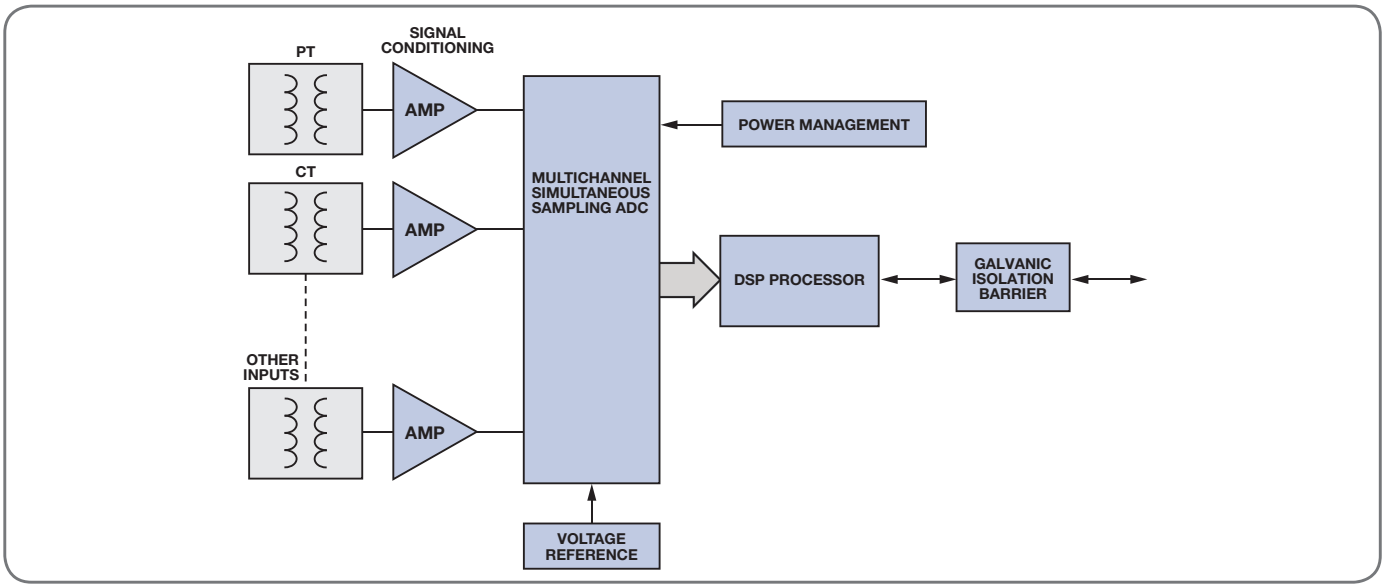
Clamp Amplifiers

Part Number	No. of Amps	Disable	Supply Voltage (V)	Rail-to-Rail[1]	A_{CL} Min	BW @ A_{CL} Min (MHz)	Slew Rate (V/μs)	Distortion SFDR[1] @ BW (dBc)	Distortion SFDR[1] @ BW (MHz)	Noise (nV/√Hz)	V_{OS} Max (mV)	I_B (μA Max)	I_S/Amp (mA Typ)	I_{OUT} (mA)	Temp Range[2]	Packaging	Price @ 1k (OEM $US)
AD8037	1		65		2	270	1500	–77[3]	10	4.5	7	9	18.5	70	I	SOIC	4.12
AD8036	1		65		1	240	1200	–8[13]	10	6.7	7	10	20.5	70	H/I	SOIC	4.28

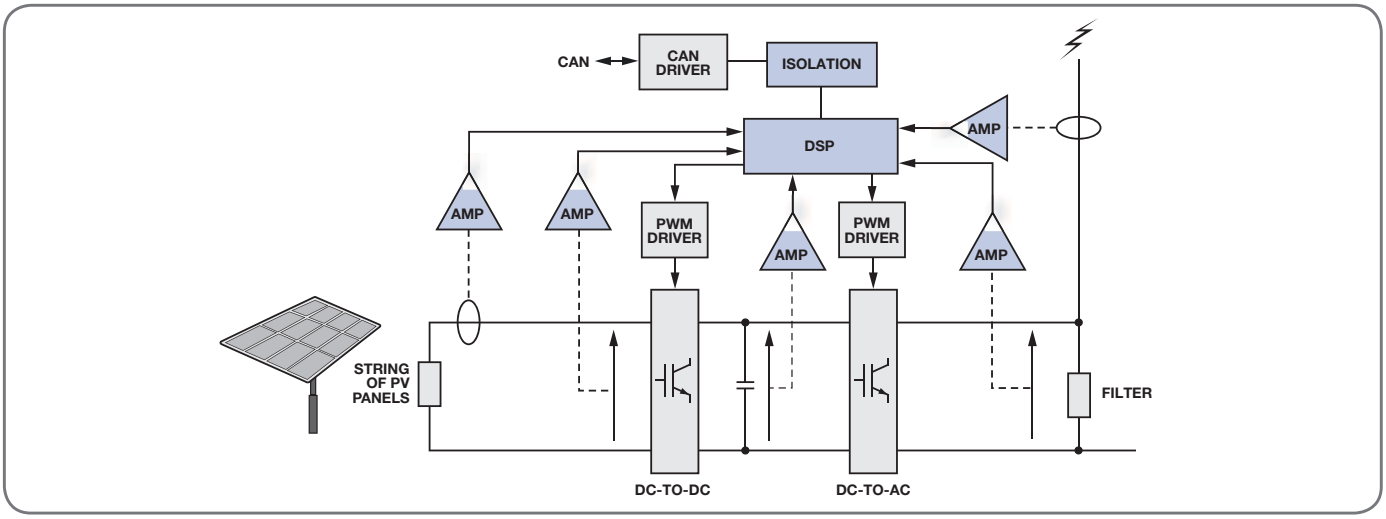
[1] RRIO: rail-to-rail input/output, RRO: rail-to-rail output, SS: single supply (IVR includes $-_{VS}$Y).
[2] Temp range: H = extended industrial (–40°C to +125°C), I = industrial (–40°C to +85°C).
[3] THD: total harmonic distortion.

Amplifiers for Energy Applications

Analog Devices has been developing innovative energy solutions for over a decade. Our portfolio of high performance amplifiers plays a key role in advancing power quality monitoring in substation equipment and, more recently, enables breakthrough solutions in renewable energy systems.



Typical substation automation system diagram.



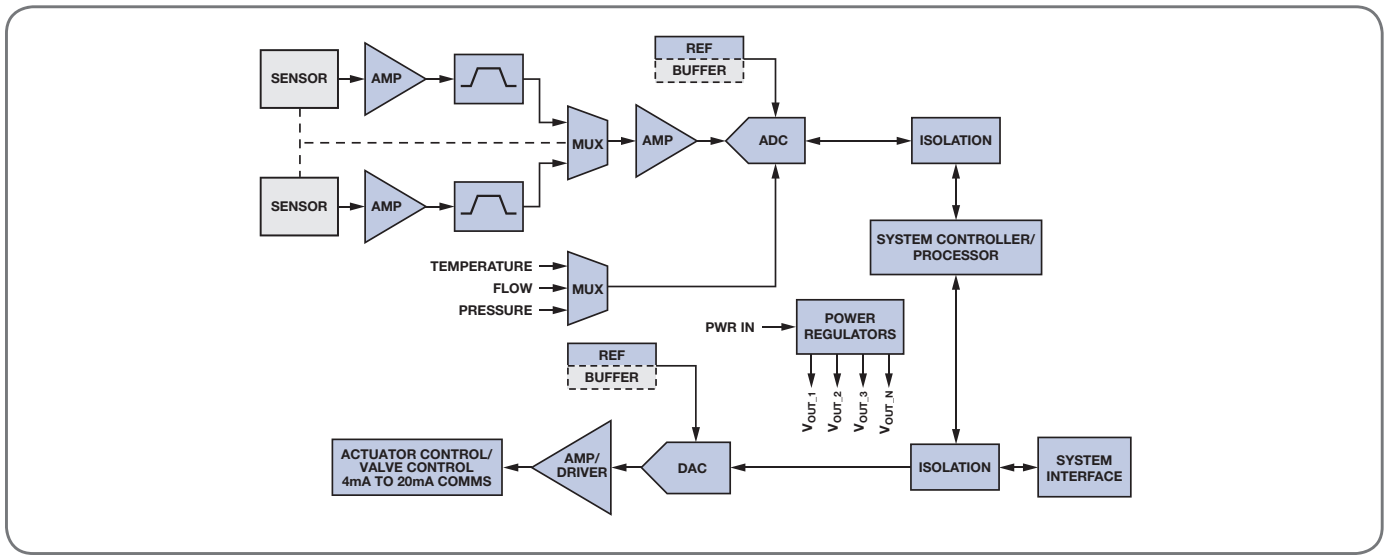
Typical solar cell system diagram.

Application	Recommended Amplifiers	Key Amplifier Characteristics
Renewable energy generation—wind turbines	Precision: OP282, AD820, AD822, AD824, OP4177, OP2177, AD8622, AD8624	Low noise, high load drive
Renewable energy generation—solar inverters	Precision: AD8512, AD824, ADA4610-2 High speed: AD8039, AD8092	Low noise, low input bias current low power, low cost
Substation automation—transmission and distribution	Precision: AD8510, AD8512, AD8513, OP4177, AD8622, AD8624	Low noise, low input bias current

For more information in energy applications, visit *energy.analog.com.*

Amplifiers for Applications in Process Control and Industrial Automation

For over 40 years, designers of industrial process control systems and Analog Devices have worked together to define, develop, and deploy complete signal chain solutions, optimized for a wide array of applications. We bring reliability and innovation to this process with precision control and monitoring solutions based on our industry-leading technologies and systems-level expertise.

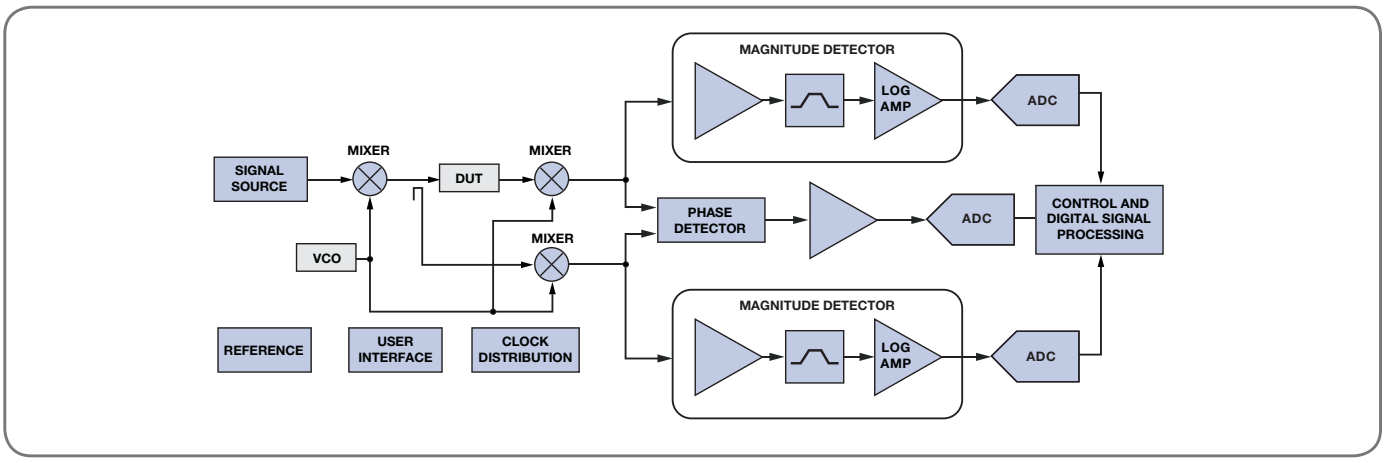


Application	Recommended Amplifiers for Input Stage	Recommended Amplifiers for Output Stage	Key Amplifier Characteristics
Programmable logic controllers (PLC)/ distribution contol systems (DCS)	Precision: OP2177, OP177, OP07, ADA4091-2, AD8677, OP213, OP295, OP284, AD822, ADA4091, ADA4092, ADA4051-2, AD8629, AD8639, AD8572, AD8539, AD8607, AD8606, AD8542, ADA4692, AD8617, AD8657	Precision: AD8622, AD822, OP297, ADTL082, AD8607, AD8606, AD8542, ADA4692, AD8617, AD8657, OP2177, OP177, OP07, ADA4091, AD8677, ADA4062, ADA4692	Precision, low power, overvoltage protection, high voltage
	High speed: AD8021, AD8051, AD8032, AD8029, AD8062, AD8099, AD8045, ADA4899-1, ADA4899-2, ADA4898-1, AD4898-2, AD8139, ADA4927, ADA4940	High speed: AD8397, ADA4891-1, ADA4891-2, ADA4891-3, ADA4891-4, AD8017	High speed, low noise, high output current
Field instrumentation and smart transmitters	Precision: AD8538, AD8628, OP4177	Precision: AD8655, AD8656, AD8615, AD8616, AD8618	Precision, low power

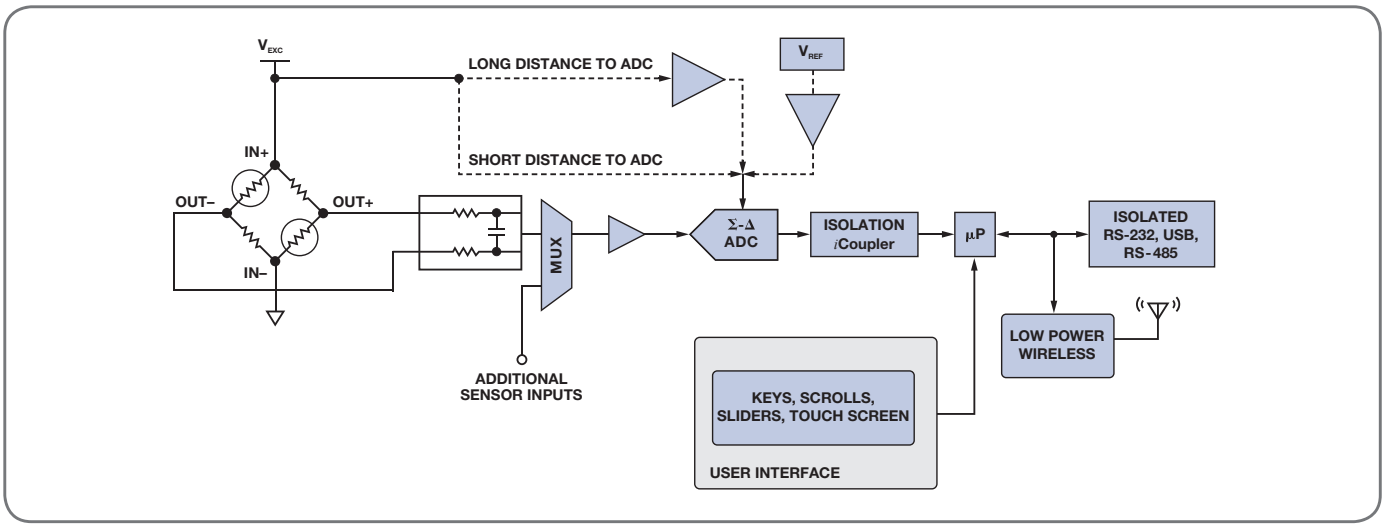
For more information in process control and industrial automation applications, visit *processcontrol.analog.com.*

Amplifiers for Instrumentation and Measurement Applications

ADI offers high performance analog solutions that detect, measure, and control a variety of sensors. Our technology enables a wide range of innovative equipment used to identify and characterize liquids, powders, solids, and gases. Our portfolio of leading-edge amplifiers can help you optimize the performance of your quantitative and qualitative instruments.



Network analyzer block diagram.



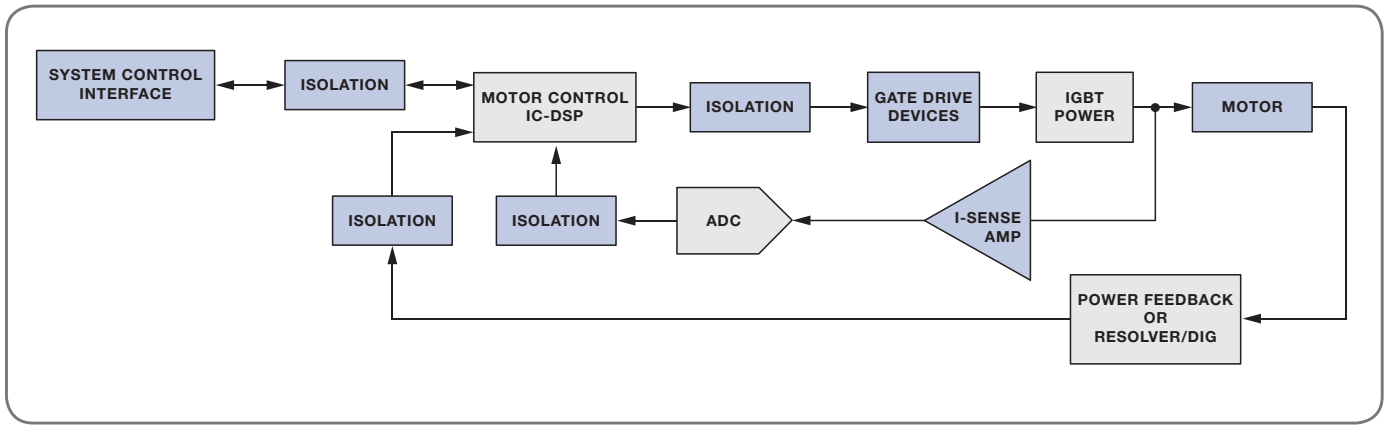
Weight scales block diagram.

Application	Recommended Amplifiers	Key Amplifier Characteristics
Electronic test and measurement	Precision: ADA4051, AD8655, AD8656, AD8615, AD8605, ADA4528	High input impedance, low noise, low drift
	High speed: ADA4899, ADA4927, ADA4937, ADA4938, ADA4939, ADA4960, ADA4932, ADA4817	Low noise, wide bandwidth, high input impedance, differential input and output
Chemical analysis	Precision: AD8616, AD8603, AD8607, AD8609	Low power
	High speed: ADA4930, ADA4940, ADA4932-1, ADA4932-2	Low voltage, low power
Weigh scales	Precision: ADA4051, AD8628, AD8638, AD8639, AD8571, AD8677, AD8675, AD8676, ADA4528, AD8671, AD8672, AD8674	Low offset; low offset drift, high CMRR/PSRR
Environmental monitors	Precision: AD8657, AD8655, AD8615, AD8622, ADA4528, ADA4610-2	Low bias current, low current noise, low drift

For more information in instrumentation and measurement applications, *visit instrumentation.analog.com.*

Amplifiers for Motor and Power Control Applications

Analog Devices offers a complete product portfolio to optimize system-level and applications-oriented designs for motor and power control solutions. ADI's amplifier products provide many advantages in current sensing and voltage sensing applications.

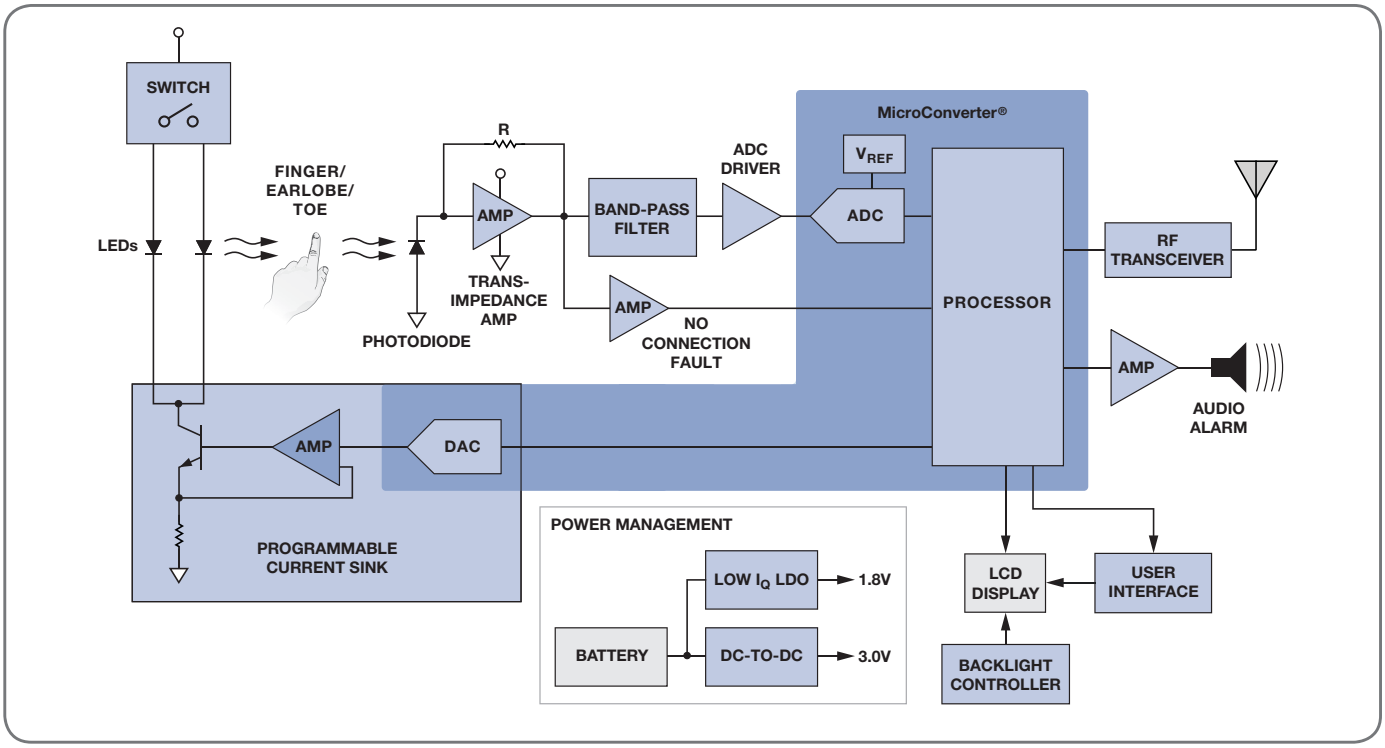


Application	Recommended Amplifiers	Key Amplifier Characteristics
Motor control	ADA4051, AD8657, AD8512, AD8620, AD8622, AD8624, OP1177, OP2177, OP4177, AD8510, AD8513, AD8602, AD8604, ADA4000, ADA4096, ADA4528	Low noise, low offset voltage, low offset drift

For more information in motor and power control applications, visit *motorcontrol.analog.com.*

Amplifiers for Healthcare Applications

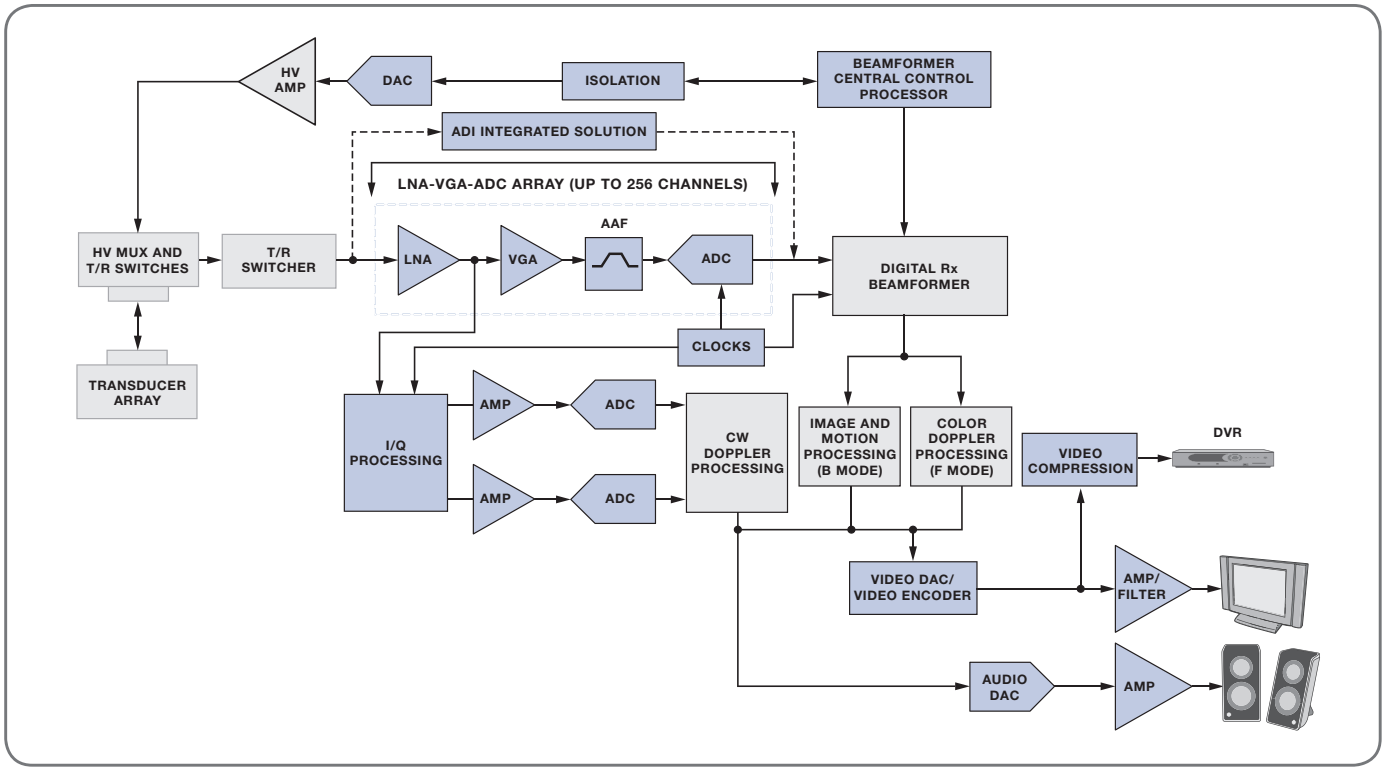
ADI's portfolio of high performance op amps and signal processing expertise enable innovative solutions to healthcare designs—helping shape the future of diagnostics and monitoring equipment, as well as health and wellness devices.



Pulse oximetry functional diagram.

Application	Recommended Amplifiers		Key Amplifier Characteristics
Pulse oximetry	Transimpedance amp	Precision: AD8603, AD8607, AD8609, AD8663, AD8667, AD8669, AD8622, AD549	Low input bias current
	Band-pass filter	Precision: AD8605, AD8606, AD8608, AD8603, AD8607, AD8609, AD8597, AD8599, AD8641, AD8642, AD8643	Low noise, wide bandwidth
	ADC driver	Precision: AD8605, AD8606, AD8608, AD8661, AD8662, AD8664, AD8597, AD8599, AD820, AD822, AD824, ADA4505-2, ADA4505-4	Low noise, low offset, high slew rate
		High speed: AD8132, ADA4841-1, ADA4932-1, ADA4941-1	High speed differential drivers
	Programmable current sink/DAC buffer	Precision: AD8661, AD8662, AD8664, ADA4075-2 Precision: AD8663, AD8605, AD8603, AD8613, ADA4004-1, ADA4004-2	Wide bandwidth, high output drive, unity-gain stable
		High speed: AD8017, AD8022, AD817 High speed: AD8065, AD8066, ADA4817-1, ADA4817-2, AD843	Wide bandwidth, FET input, rail-to-rail output
	No connection fault amplifiers	Precision: AD8605, AD8601, AD8541, AD8505	Low power

Amplifiers for Healthcare Applications (continued)



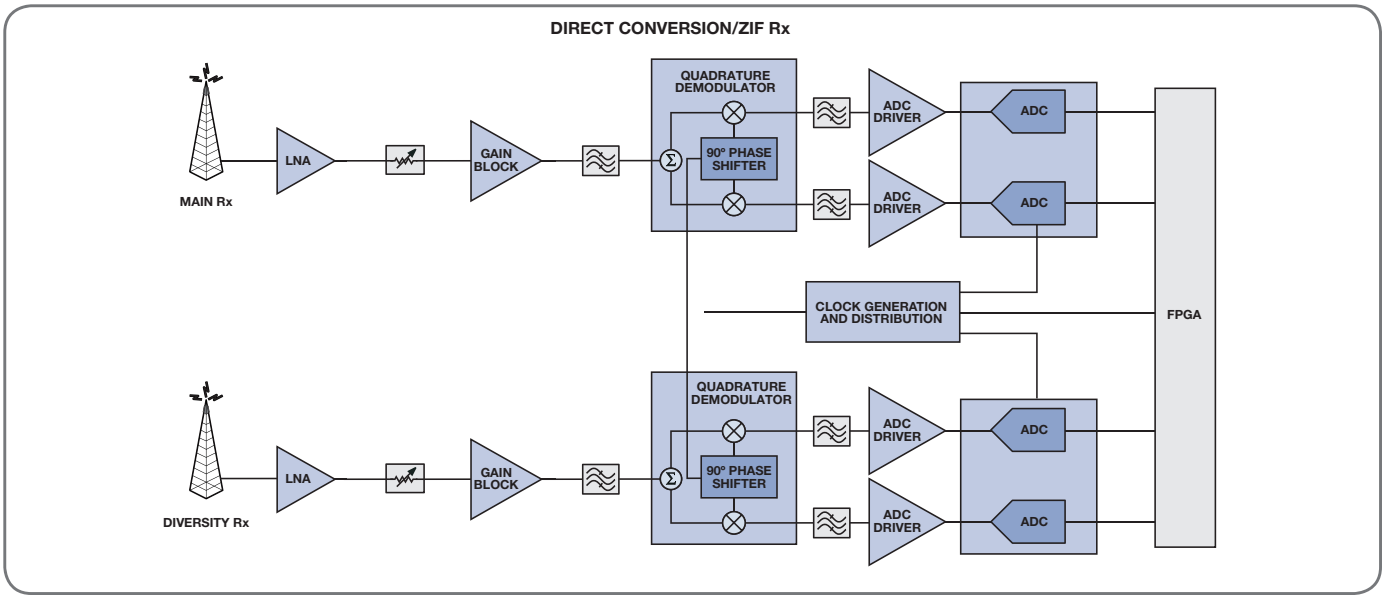
Ultrasound functional diagram.

Application	Recommended Amplifiers		Key Amplifier Characteristics
Ultrasound			Dual channel, low noise
	High speed: AD810, AD812, AD813, AD815, AD817, AD825, AD826, AD818, AD827, AD828, AD829, AD847, AD4898-1, AD4898-2, OP467		High voltage, wide bandwidth
	High speed: ADA4841-1, ADA4898-1, ADA4899-1, AD8012, AD8021, AD8022, AD8099		Low noise, high speed
Instrumentation/blood analysis using flow cytometry	Transimpedance amp	Precision: AD8603, AD8607, AD8609, AD8610, AD8620, AD8663, AD8667, AD8669, AD8622, AD549 , ADA4051, ADA4627, ADA4610	Low input bias current
	DAC buffer	Precision: AD8605, AD8606, AD8608, AD8661, AD8662, AD8664, ADA4075-2	High bandwidth, high output drive
	Photodiode pre-amp	High speed: AD8033, AD8034, AD8065, AD8066, AD8067, AD8610, AD8615, AD8618, AD8620, ADA4817-1, ADA4817-2	High speed, FET input
		High speed: AD8022, AD8029, AD8041, AD812, AD818, ADA4851-1, ADA4851-2	Wide bandwidth, low noise, rail-to-rail, low power
	ADC driver	High speed: ADA4941-1, ADA4932-1, ADA4932-2, ADA4940-1, ADA4940-2, ADA4950-1, ADA4950-2, AD8138, AD8137	Low noise, low offset, high slew rate
HRM (heart rate monitoring devices)/ blood pressure monitor	Band-pass filter	Precision: AD8500, ADA4051-1, ADA4051-2, AD8603, AD8607, AD8609, AD8508, AD8541, AD8538, AD8539, AD8642, ADA4505, AD8655, AD8656, ADA4505-4	Low noise, low power, wide bandwidth
	Audio amp	Precision: AD8691, AD8692, AD8694, AD8665, ADA4665-2, AD8668, ADA4075-2	Low noise, high output drive
	ADC driver	High speed: ADA4941, ADA4940	Low noise, low offset, high slew rate

For more information in healthcare applications, visit *healthcare.analog.com.*

Amplifiers for Communications Applications

Whether transmitting critical information, reporting breaking news, or linking people with family and friends, communications systems connect the world. And designers of these broadband systems have come to rely on Analog Devices to make a difference in their designs. Our broad op amp portfolio enables low power, high capacity, and cost-effective results demanded in the network of point-to-point communications systems, private mobile radios, and wireless infrastructure equipment.



Direct conversion block diagram.

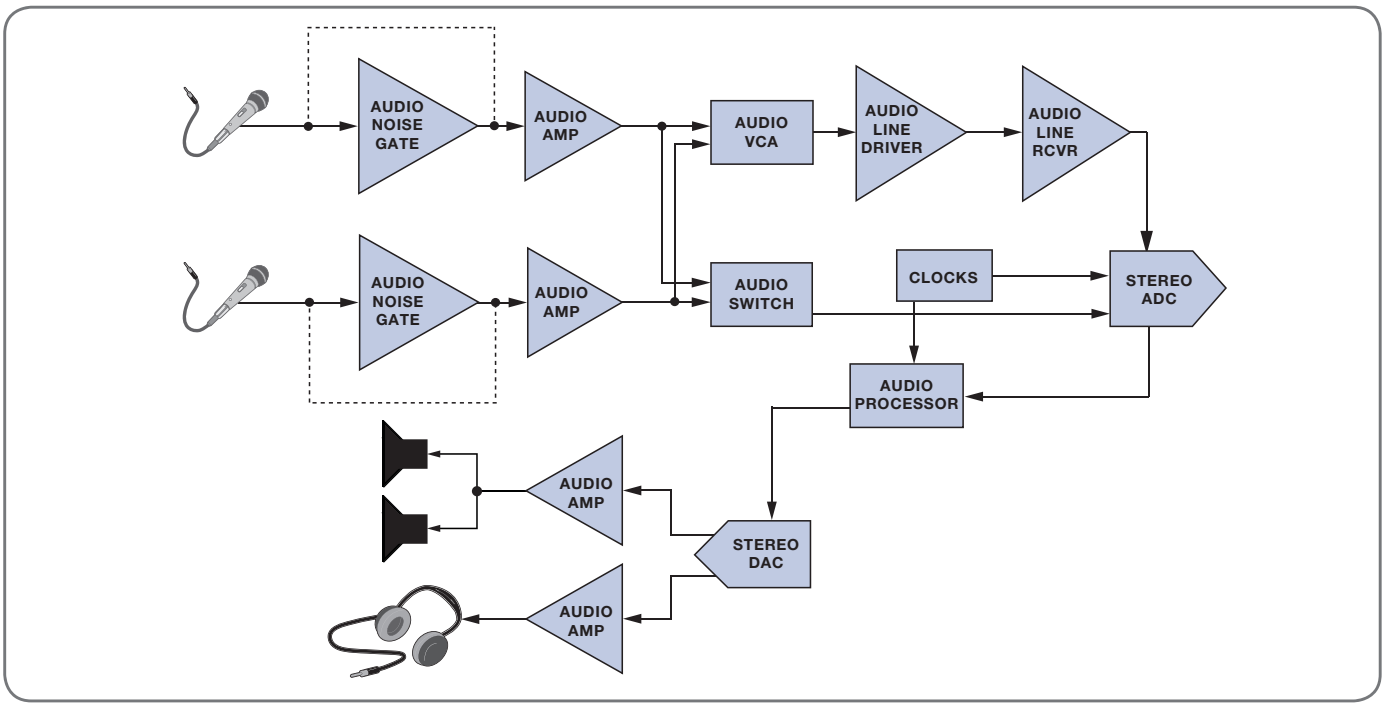
Communications

Category	Recommended Components	Key Parameters
ADC drivers	ADA4927-1/ADA4927-2	Current feedback, wide bandwidth, high slew rate
	ADA4930-1/ADA4930-2	1.8 V ADC driver
	ADA4932-1/ADA4932-2	Low power, wide bandwidth
	ADA4937-1/ADA4937-2	Low voltage, wide bandwidth
	ADA4938-1/ADA4938-2	+ 5 V, ± 5 V supply, wide bandwidth
	ADA4939-1/ADA4939-2	+ 5 V, ± 5 V supply, wide bandwidth, G > 2
	ADA4950-1/ADA4950-2	Wide bandwidth, low power, fixed G = 1, 2, 3
	ADA4960-1	5 GHz bandwidth, slew rate = 8 kV
High speed amplifiers	ADA4891-1/ADA4891-2/ADA4891-3/ADA4891-4	CMOS, high speed low cost
	ADA4857-1/ADA4857-2	High slew rate, wide bandwidth, low power
	ADA4817-1/ADA4817-2	FET input, wide bandwidth
	ADA4896-1/ADA4896-2*	Low noise, low power, high speed
	ADA4897-1/ADA4897-2*	Low noise, low power, high speed, power down
	AD8045	Low noise low distortion, high slew rate
	AD8009	Current feedback, super high slew rate, ultrawide bandwidth
	AD8003	Triple current feedback, super high slew rate, ultrawide bandwidth
	AD8000	Current feedback, super high slew rate, ultrawide bandwidth, power down

*Prerelease

For more information in communications applications, visit *communications.analog.com.*

Amplifiers for Consumer Audio Applications



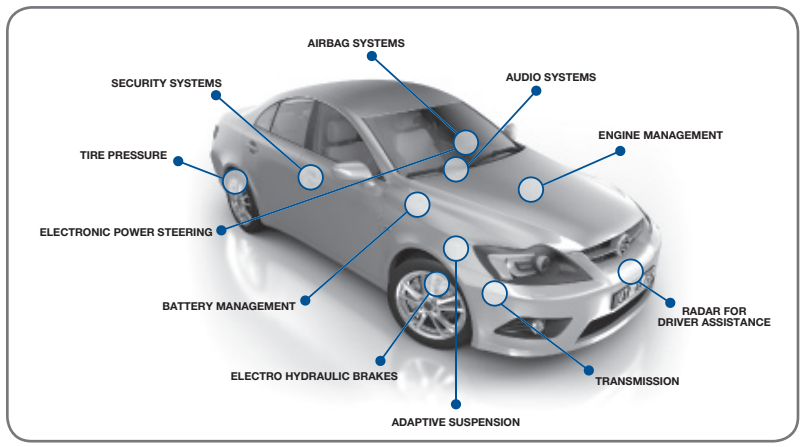
Application	Recommended Amplifiers	Key Amplifier Characteristics
Audio pre-amps	AD8597, AD8599, AD797	Low noise
Microphone pre-amps	ADA4004	Low distortion
	AD8510, AD8512, AD8513	Low power
	AD8627, AD8646, AD8647, AD8648, AD8691, AD8692, AD8694, ADA4075, ADA4692	Low cost

For more information in consumer applications, visit *consumer.analog.com.*

Amplifiers for Automotive Applications

With over 45 years of experience in signal processing and the industry's leading portfolio, ADI provides design engineers with the robust amplifier products and technical support to build any automotive applications. ADI's technologies are used to address the most challenging signal chain requirements in advanced safety, infotainment, power-train, and body/chassis electronics systems for electric, hybrid, and fossil fuel powered vehicles worldwide.

ADI's automotive grade amplifiers are identified by the "W" suffix immediately after the part number. These products are qualified for automotive applications and meet or exceed the rigorous requirements of the automotive industry.

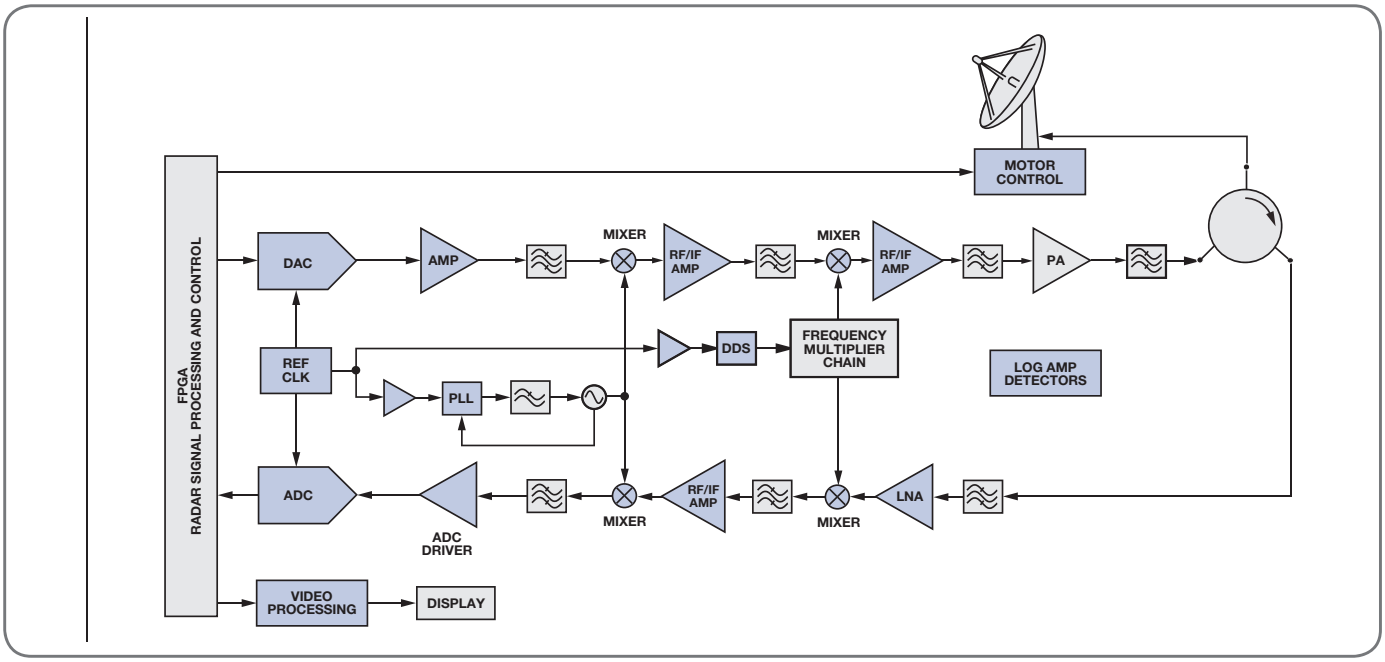


Application	Recommended Amplifiers	Part Description	Key Amplifier Characteristics
Automotive sensing	Precision: AD8601WARTZ-R7, AD8601WARTZ-RL, AD8601WDRTZ-REEL	DigiTrim rail-to-rail input and output single amplifier with very low offset voltage	Auto-zero, low offset voltage and low offset voltage
	Precision: AD8617WARMZ-REEL, AD8617WARZ-R7, AD8617WARZ-RL	Low cost, micropower, low noise, CMOS, rail-to-rail input/output op amp	
	Precision: AD8628WARTZ-R7, AD8628WARTZ-RL, AD8628WARZ-R7, AD8628WARZ-RL, AD8628WAUJZ-R7, AD8628WAUJZ-RL	Zero drift, single-supply, rail-to-rail input/output operational amplifier	
	Precision: AD8629WARZ-R7, AD8629WARZ-RL	Zero drift, single-supply, rail-to-rail, input/output operational amplifier	
	Precision: AD8630WARZ-R7, AD8630WARZ-RL	Quad, zero drift, single-supply, rail-to-rail operational amplifier	
	Precision: AD8646WARMZ-R7, AD8646WARMZ-RL, AD8646WARZ-R7, AD8646WARZ-RL	24 MHz, rail-to-rail, dual amplifier	
	Precision: AD8648WARUZ, AD8648WARUZ-RL	24 MHz, rail-to-rail, quad amplifier	
	Precision: AD8656WARMZ-REEL	Low noise, precision CMOS dual amplifier	
Infortainment and vision ADAS	High speed: ADA4851-1WYRJZ-R7, ADA4851-2WYRMZ-R7, ADA4851-4WYRUZ-R7	Low cost, rail-to-rail output op amp	Video amplifiers
	High speed: ADA4853-3WYRUZ-R7	Ultralow power, rail-to-rail output op amp	
	High speed: ADA4891-1WARJZ-R7, ADA4891-2WARMZ-R7, ADA4891-4WARUZ-R7	Low cost, CMOS, rail-to-rail op amp	
		Low cost	
Advanced driver assistance (ADAS)	High speed: AD8040WARUZ-R7, AD8028WARMZ-R7, AD8065WARTZ-R7	Rail-to-rail, FET input	Wide bandwidth, low power
	High speed: AD8132WARMZ-R7, AD8137WYCPZ-R7	Single ended input or differential input, differential output	Differential amps
Pressure sensing In antilock braking systems (ABS)	Precision: AD8628WARTZ-R7, AD8628WARTZ-RL, AD8628WARZ-R7, AD8628WARZ-RL, AD8628WAUJZ-R7, AD8628WAUJZ-RL	Zero-drift, single-supply, rail-to-rail input/output operational amplifier	Low offset, low noise
	Precision: AD8629WARZ-R7, AD8629WARZ-RL	Zero-drift, single-supply, rail-to-rail, input/output operational amplifier	
	Precision: AD8630WARZ-R7, AD8630WARZ-RL	Quad, zero-drift, single-supply, rail-to-rail operational amplifier	
	Precision: AD8601WARTZ-R7, AD8601WARTZ-RL, AD8601WDRTZ-REEL	DigiTrim rail-to-rail input and output single amplifier with very low offset voltage	
	Precision: AD8692WARMZ-REEL	Dual, low cost, low noise, CMOS rail-to-rail output operational amplifier	
	Precision: AD8694WARUZ, AD8694WARUZ-REEL	Quad, low cost, low noise, CMOS rail-to-rail output operational amplifier	

For more information in automotive applications, visit *automotive.analog.com.*

Amplifiers for Applications in Defense and Aerospace

For over 45 years Analog Devices has been at the forefront of innovation in signal processing for aerospace and defense applications. ADI's commitment to performance and reliability has made ADI a preferred supplier to the Department of Defense and other U.S. and foreign defense agencies around the world. Today's advanced defense systems in radar, communications, avionics, defense electronics, and much more demand the best in system level performance. ADI's superior products and system level knowledge will help you overcome the most difficult of design challenges.



Defense Qualified Products

Precision			High Speed		
Part Number	**Model Number**	**Description**	**Part Number**	**Model Number**	**Description**
OP11	5962-89801012A 5962-8980101CA	Quad matched 741-Type op amp	AD830	5962-9313001MPA	Video difference amp
OP27	OP27AJ/883C OP27AZ/883C	Low noise, Precision op amp	AD713	5962-9063301MCA	Quad precision, low cost, BiFET op amp
OP77	5962-87738012A 5962-8773802GA 5962-8773802PA	Ultralow offset voltage op amp	AD8001	5962-9459301MPA	800 MHz, 50 mW current feedback amplifier
OP400	5962-8777101M3A 5962-8777101MCA	Quad low offset, low power op amp	AD8004	AD8004SQ	Quad 3000 V/μs, 35 mW current feedback amplifier
AD712	AD712SQ/883B	Precision, low cost, high speed, BiFET dual op amp	AD8036	5962-9559701MPA	Unity gain stable, low distortion, wide bandwidth voltage feedback clamp amps
OP470	5962-88565012A 5962-8856501CA	Very low noise, quad op amp	AD8041	5962-9683901MPA	160 MHz rail-to-rail amplifier with disable
OP270	5962-8872101PA	Very low noise dual op amp	AD810	5962-9313201MPA	Low power video op amp with disable
OP471	5962-88565022A 5962-88565023A 5962-8856502CA	High speed, low noise quad op amp	AD811	5962-9313101M2A 5962-9313101MPA AD811SCHIPS AD811SE/883B AD811SQ/883B	High performance video op amp
AD549	AD549SH/883B	Ultralow input-bias current op amp	AD813	5962-9559601M2A	Single supply, low power triple video amplifier
OP200	5962-8859301MPA 5962-8859301M2A	Dual low offset, low power operational amplifier	AD827	5962-9211701M2A 5962-9313101MPA AD827SCHIPS AD827SE/883B AD827SQ AD827SQ/883B	High performance video op amp

Defense Qualified Products (Continued)

Precision			High Speed		
Part Number	Model Number	Description	Part Number	Model Number	Description
OP97	5962-8954401PA	Low power, high precision op amp	AD829	5962-9312901M2A 5962-9312901MPA AD829SCHIPS AD829SE/883B AD829SQ AD829SQ/883B	Low noise video op amp
AD713	5962-9063301MCA	Precision, high speed, BiFET quad op amp	AD830	5962-9313001MPA	Video difference amplifier
AD708	AD708SQ/883B	Ultralow offset voltage dual op amp	AD843	5962-9098001M2A 5962-9098001MPA 5962-9098001MXA AD843SCHIPS AD843SH/883B AD843SQ AD843SQ/883B	34 MHz, CBFET fast settling op amp
OP249	5962-9151901M2A 5962-9151901MPA	Dual, precision JFET high speed operational amplifier	AD844	5962-8964401PA AD844SCHIPS AD844SQ AD844SQ/883B	60 MHz, 2000 V/µms monolithic op amp
AD704	AD704SE/883B	Picoampere input current quad bipolar op amp	AD845	5962-8964501PA AD845SQ AD845SQ/883B	Precision, 16 MHz CBFET op amp
OP497	5962-9452101M2A	Precision picoampere input current quad operational amplifier	OP249	5962-9151901M2A 5962-9151901MPA OP249AZ	Dual, precision JFET high speed operational amplifier

For more information in defense and aerospace applications, visit *mil-aero.analog.com.*

Space Qualified Products

Analog Devices is committed to serving the needs of the world space community by providing the highest quality linear and mixed-signal products. In addition to the comprehensive offering of amplifier products indentified below, ADI offers a broad range of other linear and data conversion device types for space applications. Analog Devices processes its space products to the highest quality levels of MIL-PRF-38535 QML Level V, including radiation hardness assurance (RHA) testing.

Precision Op Amps

Part Number	Model Number	Package	Description
Low Offset			
AD8629S	AD8629D703L	10-lead FP	Zero-drift, single-supply, rail-to-rail input/output op amp
AD8671S	5962L0922301VHA	10-lead FP	Single, very low noise, low input bias current op amp
OP07S	5962R9863901VGA 5962R9863901VHA 5962R9863901VPA OP07000C OP07R000C	8-lead can 10-lead FP 8-lead DIP Class K die Class K die	Ultralow offset voltage op amp
OP22S	OP220903J	8-lead can	Programmable micropower op amp
OP27S	5962R9468002VGA 5962R9468002VHA 5962R9468002V2A 5962R9468002VPA OP484-000C OP484R000C	8-lead can 10-lead FP 20-lead LCC 8-lead DIP Class K die Class K die	Low noise precision op amp
OP37S	5962-8853701VGA 5962-8853701VPA	8-lead can 8-lead DIP	Low noise precision high speed op amp
OP77S	5962-8773802VGA 5962-8773802VHA 5962-8773802V2A 5962-8773802VPA	8-lead can 10-lead FP 20-lead LCC 8-lead DIP	Ultralow offset voltage operational amplifier
OP200S	5962-8859301V2A 5962-8859301VPA	20-lead LCC 8-lead DIP	Dual low offset, low power op amp
OP207S	5962R0821401VCA	14-lead DIP	Dual ultralow V_{OS} matched op amp
OP227S	OP227R903Y OP227R903M	14-lead DIP 14-lead FP	Dual low noise low offset instrumentation op amp
OP270S	5962-8872101VPA 5962-8872101VDA 5962-8872101V2A 5962R8872101VPA 5962R8872101VDA 5962R8872101V2A OP2700000C OP270R000C	8-lead DIP 14-lead FP 20-lead LCC 8-lead DIP 14-lead FP 20-lead LCC Class K die Class K die	Dual very low noise precision op amp
OP400S	5962-8777101VKA 5962-8777101V3A 5962-8777101VCA OP400-000C	24-lead FP 28-lead LCC 14-lead DIP Class K die	Quad low offset, low power op amp
OP484S	5962-0051701VCA 5962-0051701VDA 5962R0051701VCA 5962R0051701VDA OP484-000C OP484R000C	14-lead DIP 14-lead FP 14-lead DIP 14-lead FP Class K die Class K die	Rail-to-rail input and output op amp
Low Input Bias			
AD648S	5962-9753501VGA 5962-9753501VPA 5962-9753502VGA 5962-9753502VPA	6-lead can 8-lead DIP 6-lead can 8-lead DIP	Dual low power BiFET op amp
OP12S	OP120903J OP120000C	8-lead can Class K die	Precision low input current operational amplifier
OP15S	5962R8954203VGA 5962R8954203VHA 5962R8954203VPA	6-lead can 10-lead FP 8-lead DIP	Precision JFET input op amp
OP16S	5962R8954304VGA 5962R8954304VPA	6-lead can 8-lead DIP	Precision JFET input op amp
OP42S	5962-8851301VGA 5962-8851301VPA	6-lead can 8-lead DIP	
OP215S	5962-8853801VGA 5962-8853801VPA 5962R8853801VGA 5962R8853801VPA 5962R8853804V2A OP215-000C OP215R000C	6-lead can 8-lead DIP 6-lead can 8-lead DIP 20-lead LCC Class K die Class K die	Dual precision JFET input op amp

Part Number	Model	Package	Description
Low Input Bias (Continued)			
PM108S	5962R9863701VGA 5962R9863701VHA 5962R9863701VPA PM1080000C PM108R000C	6-lead can 10-lead FP 8-lead DIP Class K die Class K die	Low input current operational amplifier
PM155S	5962R9863601VGA 5962R9863601VPA	6-lead can 8-lead DIP	Monolithic JFET input operational amplifier
PM156S	5962R9863602VGA 5962R9863602VPA	6-lead can 8-lead DIP	Monolithic JFET input operational amplifier

High Speed Op Amps

Part Number	Model	Package	Description
Low Noise			
OP467S	5962-9325801VCA 5962-9325801V2A 5962R9325801VDA 5962R9325801VCA	14-lead FP 20-lead LCC 14-lead FP 14-lead DIP	Quad, high speed, precision op amp
OP470S	5962-8856501V2A 5962-8856501VCA 5962R8856501V2A 5962R8856501VKA 5962R8856501VCA OP470-000C OP470R000C	20-lead LCC 14-lead FP 20-lead LCC 24-lead FP 14-lead DIP Class K die Class K die	Very low noise, quad op amp
OP471S	5962-8856502VCA 5962R8856502VDA 5962R8856502VKA 5962R8856502VCA	14-lead DIP 14-lead FP 24-lead FP 14-lead FP	High speed, low noise, quad op amp
Wide Bandwidth			
AD8001S	5962-9459301VPA 5962-9459301VHA 5962R9459301VPA 5962R9459301VHA	8-lead DIP 10-lead FP 8-lead DIP 10-lead FP	800 MHz, 50 mW current feedback amplifier
AD8041S	5962R9683902VPA 5962R9683902VHA AD8041-000C	8-lead DIP 10-lead FP Class K die	160 MHz rail-to-rail amplifier with disable
Differential			
AD8138S	5962R092001VHA	10-lead FP	320 MHz, low distortion differential amplifier

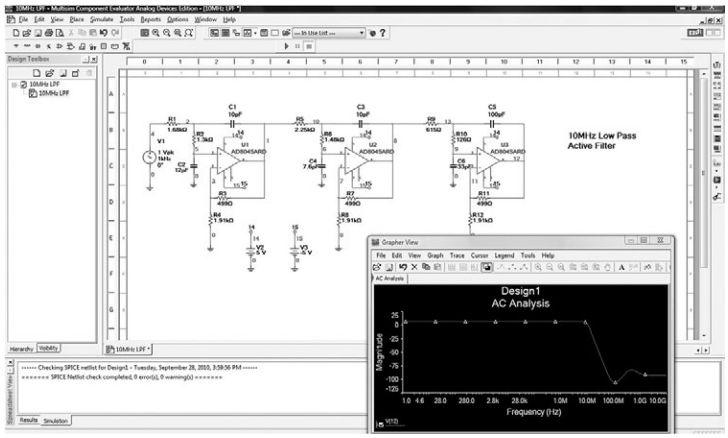
Tools

Multisim

NI Multisim™ Component Evaluator Analog Devices Edition is a free, downloadable version of National Instruments Multisim 11 circuit simulation software, tailored for evaluating ADI components. The software abstracts away the complexities of traditional SPICE simulation through intuitive analysis instruments and interactive circuit components for a highly graphical approach to design. It also combines a powerful mixed-mode simulation parser and an extensive collection of analyses. It offers a holistic approach to component evaluation. SPICE models, online example circuits, and data sheets are all connected through a single evaluation environment. Visit *www.analog.com/multisim.*

Features and Benefits

- Build simulated circuits with a library of Analog Devices operational amplifiers, switches, and voltage references
- Simulate better with SPICE parser improvements, updated BSIM models, support for advanced parameters, and enhanced digital simulation accuracy
- Improved design communication with on-page connectors and a new WYSIWYG net naming system

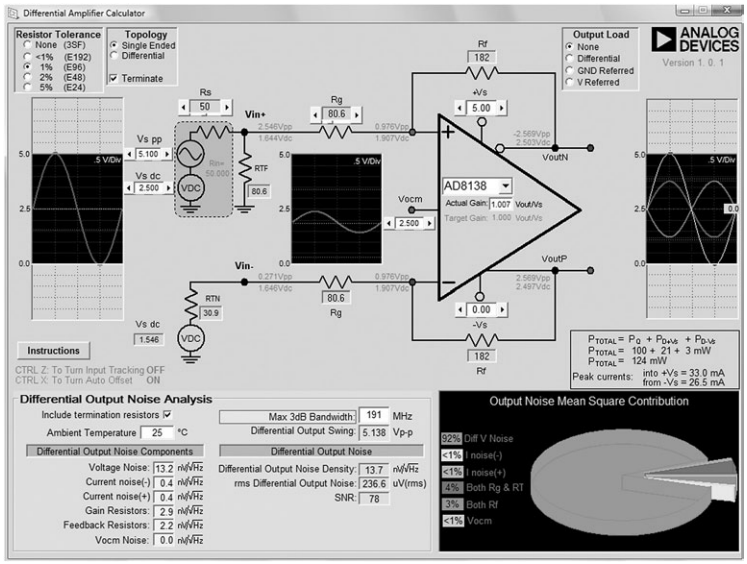


ADI DiffAmpCalc

ADI DiffAmpCalc™ performs all the required differential amplifier calculations, which reduces design risks and further speeds time to market. In addition, designers can quickly and easily calculate gain and component values of a differential amplifier circuit for terminated or unterminated loads, determine the input/output and VOCM voltage range, as well as calculate noise and power dissipation. The tool also prevents you from making mistakes by alerting you when a device parameter has been exceeded. Visit *www.analog.com/diffampcalc.*

Features and Benefits

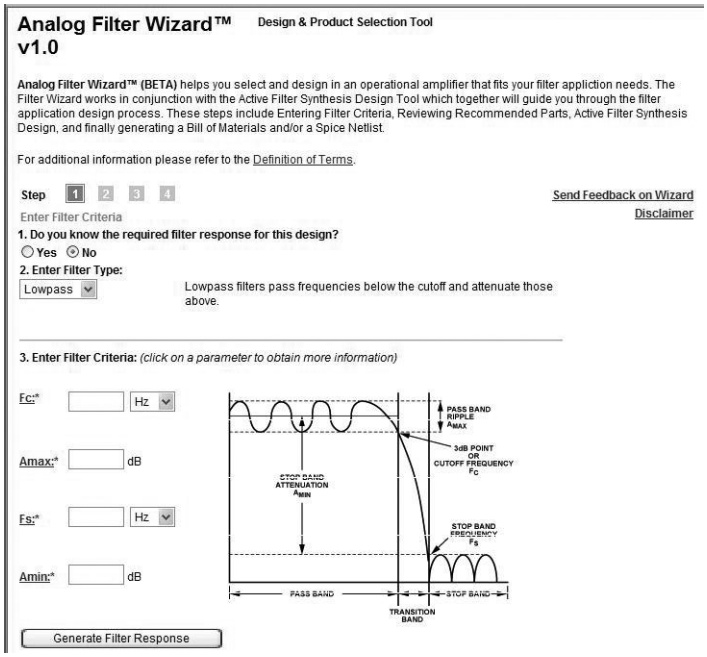
- Automate time-consuming calculations required to determine optimal levels for gain, termination resistors, power dissipation, noise output and input common-mode voltage range
- Create unlimited “what if” scenarios as data changes appear in real-time
- Intuitive GUI features an interactive dashboard.
- Use a “point and click” method for quickly and easily adding and changing data
- Supports ADI’s differential amplifier products including ADA4927, ADA4932, ADA4937, ADA4938, ADA4939, AD8132, AD8137, AD8138, AD8139, and ADA4930



Analog Filter Wizard

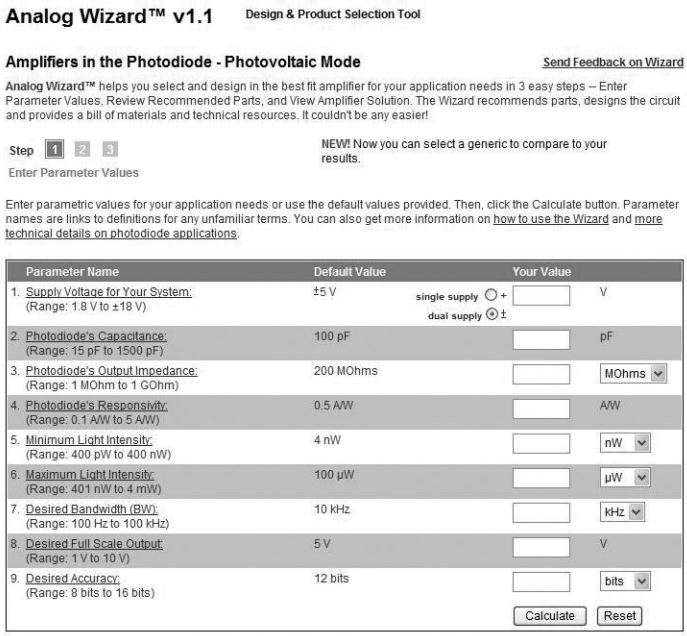
This tool helps you select and design in an operational amplifier that fits your filter appliction needs. The Filter Wizard works in conjunction with the Active Filter Synthesis Design Tool—together they will guide you through the filter application design process. The steps include entering filter criteria, reviewing recommended parts, active filter synthesis design, and finally generating a bill of materials and/or a SPICE netlist. Visit *www.analog.com/filteruserentry.*

Order active filter evaluation board for easy hardware implementation: *www.analog.com/eval-fltr.*



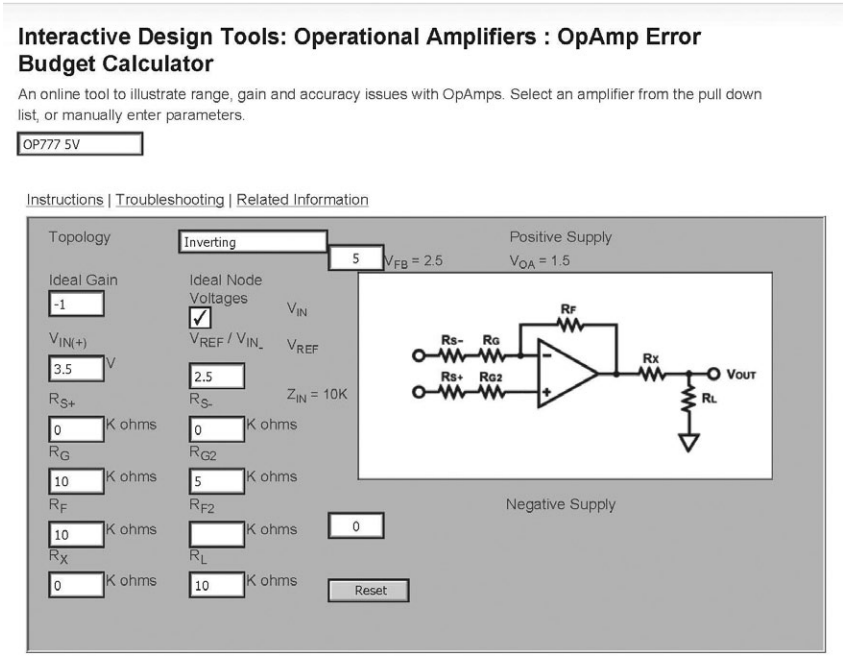
Analog Photodiode-Photovoltaic Wizard

This tool helps you select and design in the best fit amplifier for your application needs in three easy steps—enter parameter values, review recommended parts, and view amplifier solutions. The wizard recommends parts, designs the circuit, and provides a bill of materials and technical resources.



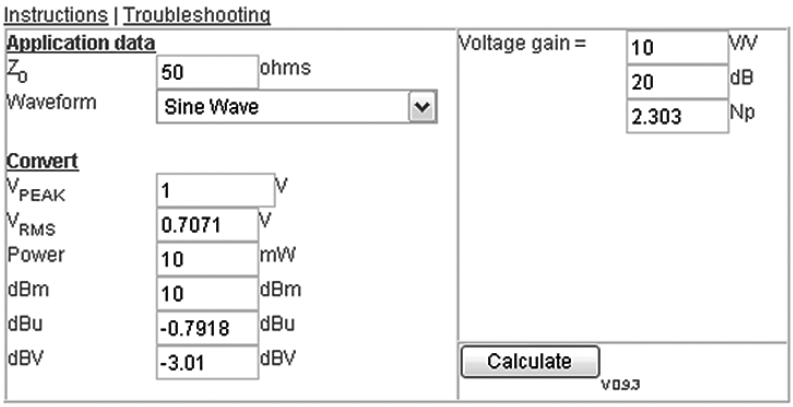
Op Amp Stability for Capacitive Loads

Driving capacitive loads can be challenging for op amps. Stability, bandwidth, and settling time are all concerns when capacitive loads are involved. This tool helps prevent and remedy any potential issues that might arise when driving capacitive loads. This tool is Web based.
Visit *www.analog.com/opamp_stability.*



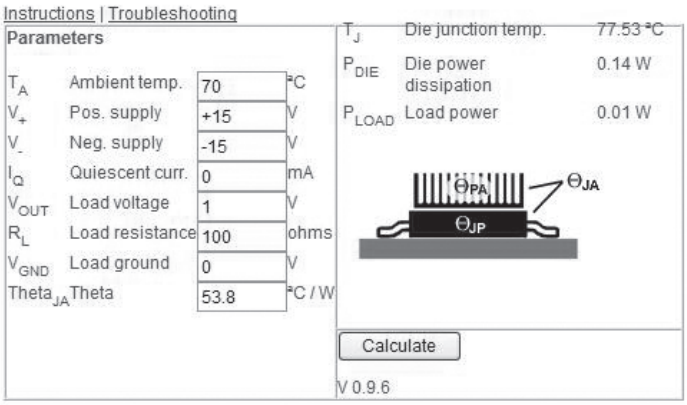
Vrms/dBm/dBu/dBV Calculator

A utility to convert between standard units of power measurement and signal strength, this calculator converts between dBm, dBu, dBV, Vpeak, and Vrms (ANSI T1.523-2001 definitions). dBm is a power ratio relative to 1 mW, dBu and dBV are voltage ratios, relative to 0.775 V and 1 V, respectively.
Visit *www.analog.com/vrms_dbm_dbu_dbv_calculator*.



Power Dissipation vs. Die Temperature Calculator

This is a calculator for estimating junction temperature from power dissipation and packaging/heatsink characteristics. It computes die power dissipation and temperature for a linearly regulated output from quantities specified under “Parameters.” It also computes power dissipated in an external load. Visit *www.analog.com/powerdis_vs_dietempcalculator.*



Evaluation Boards

Analog Devices provides a variety of amplifier evaluation boards for both high speed and precision amplifiers.

High speed evaluation boards: follow the ordering guide on each product page to order high speed op amps evaluation boards. All evaluation boards are “bare,” therefore, it is necessary to order the amplifier and the evaluation board.

Precision evaluation boards: unpopulated precision op amp evaluation boards are available to the user to evaluate precision amplifiers in multiple circuit configurations and application circuits. Op amps, resistors, capacitors, or any other components can be easily mounted on these blank boards.

For more information regarding layouts and schematics for board-specific packages, please refer to the following application notes:

- AN-692, *Application Note Universal Precision Op Amp Evaluation Board, www.analog.com/AN-692*
- AN-763, *Application Note Dual Universal Precision Op Amp Evaluation Board, www.analog.com/AN-763*
- AN-734, *Application Note Universal Precision Op Amp Evaluation Board in SC70 Package, www.analog.com/AN-734*
- AN-733, *Application Note Universal Precision Op Amp Evaluation Board in MSOP Package, www.analog.com/AN-733*
- AN-732, *Application Note Universal Precision Op Amp Evaluation Board in SOIC package, www.analog.com/AN-732*

SPICE Models

Analog Devices supplies SPICE models that closely duplicate data sheet test measurements. Each SPICE model can be found on the amplifier product page under “Tools, Software & Simulation Models.” SPICE models can also be found in the Analog Devices version and the full version of National Instruments Multisim, as well as many other circuit simulators.

Design Resources

Circuits from the Lab™ Reference Circuits

Analog Devices’ Circuits from the Lab™ reference circuits are engineered and tested for quick and easy system integration to help solve today’s analog, mixed-signal, and RF design challenges. These circuits represent easy-to-understand subsystem level building blocks intended for time-saving evaluation and easy integration.

All of our reference circuits have been thoroughly documented, and new circuits provide test data, design/layout guidelines, schematics, PCB layout files, a bill of materials, and a device driver (when applicable). Evaluation hardware is also available for most new circuits. Find operational amplifier circuits at *www.analog.com/circuits.*

ENGINEER ZONE®

EngineerZone is an online support community for engineers who are using Analog Devices amplifier products to ask questions, share knowledge and search for answers to their design questions. Collaborate with Analog Devices engineers and other designers in this open forum at *ez.analog.com.*

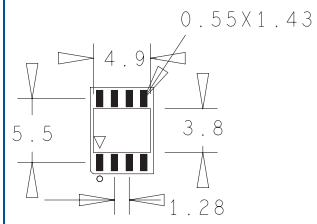
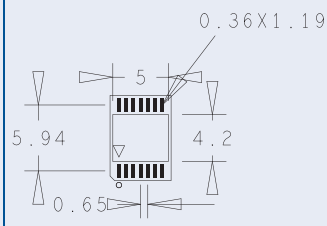
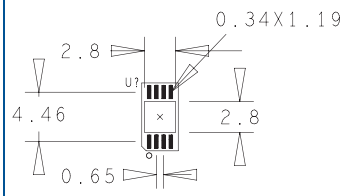
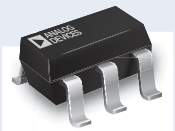
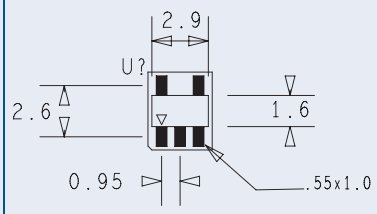
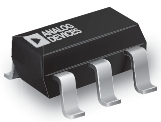
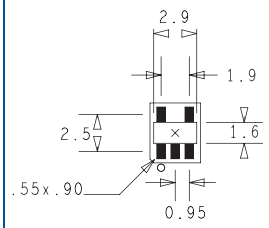
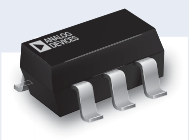
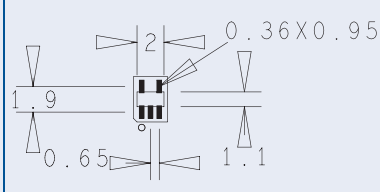
Amplifier Packaging

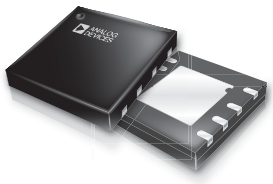
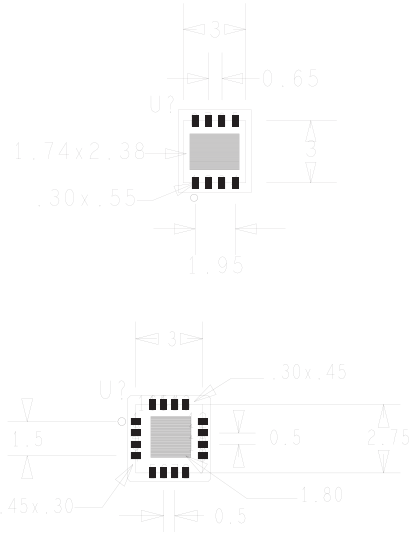
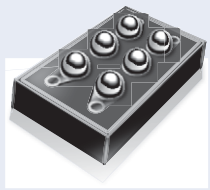
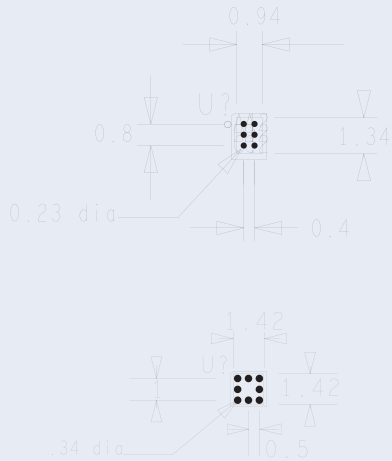
ADI offers a wide variety of plastic packages from through-hole to surface-mount applications. Many of these plastic packages provide cost-effective solutions to achieving greater board density (surface-mount packages) and high performance. Plastic packages are extensively used in many of today's applications.

Analog Devices offers molded plastic packages and the primary materials are a leadframe, die attach material, bond wire, mold compound, and a Pb-free finish. In order to provide plastic package solutions that do not sacrifice reliability or functionality, Analog Devices continues to improve on the materials used, whether focusing on leadframe composition for increased thermal conductivity, low stress mold compound used for large die applications, or low moisture absorption mold compounds for improved reliability.

Improvements in the small surface-mount packages include the introduction of the devices offered in small body size packages. The following table provides information on smaller plastic packages offered by Analog Devices.

For more information about ADI's packaging, please refer to: *www.analog.com/pcb_design_resources.*

Package Type	Package Dimensions	Package Characteristics	Package Footprint
Small outline integrated circuit (SOIC)	8-lead: 4.0 mm × 6.0 mm × 1.55 mm 14-lead: 8.65 mm × 6.0 mm × 1.55 mm 	• Surface-mount package • Solder plate Pb-free finish • Molded package • Package suffix—"R"	
Thin shrink small outline package (TSSOP)	8-lead: 3.0 mm × 6.4 mm × 1.2 mm 14-lead: 5.0 mm × 6.4 mm × 1.2 mm 	• Surface-mount package • Solder plate Pb-free finish • Molded package • Package suffix—"RU"	
Microsmall outline package (MSOP)	8-lead: 3.0 mm × 4.9 mm × 1.1 mm 10-lead: 3.0 mm × 4.9 mm × 1.1 mm 	• Surface-mount package • Solder plate Pb-free finish • Molded package • Package suffix—"RM"	
Small outline transistor package (SOT-23)	5-lead: 2.9 mm × 2.8 mm × 1.45 mm 6-lead: 2.9 mm × 2.8 mm × 1.45 mm 	• Surface-mount package • Solder plate Pb-free finish • Molded package • Package suffix—"RJ"	
Thin small outline transistor package (TSOT-23)	5-lead: 2.9 mm × 2.8 mm × 1.1 mm 	• Surface-mount package • Solder plate Pb-free finish • Molded package • Package suffix—"UJ"	
Thin shrink small outline transistor package (SC70)	5-lead: 2 mm × 2.1 mm × 1.1 mm 	• Surface-mount package • Solder plate Pb-free finish • Molded package • Package suffix—"KS"	

Package Type	Package Dimensions	Package Characteristics	Package Footprint
Lead frame chip scale package (LFCSP)	8-lead: 2 mm × 2 mm × 0.55 mm; 0.5 mm pitch 8-lead: 3 mm × 3 mm × 0.75 mm; 0.5 mm pitch 8-lead: 3 mm × 3 mm × 0.85 mm; 0.5 mm pitch 10-lead: 1.3 mm × 1.6 mm × 0.55 mm; 0.4 mm pitch 10-lead: 2 mm × 2 mm × 0.55 mm; 0.5 mm pitch 16-lead: 3 mm × 3 mm × 0.75 mm; 0.5 mm pitch 16-lead: 4 mm × 4 mm × 0.75 mm; 0.65 mm pitch 	• Surface-mount package • Leadless package • Solder plate Pb-free finish • Molded package • Exposed pad for thermal performance • Package suffix – “CP”	
Wafer level chip scale package (WLCSP)	6-ball: 0.905 mm × 1.385 mm × 0.6 mm; 0.4 mm pitch 8-ball: 1.42 mm × 1.42 mm × 0.595 mm; 0.5 mm pitch 9-ball: 1.21 mm × 1.22 mm × 0.6 mm; 0.4 mm pitch 14-ball: 1.46 mm × 2.96 mm × 0.595 mm; 0.5 mm pitch 	• Surface-mount package • Ball array • Solder ball Pb-free finish • Package suffix – “CB”	

Analog Devices, Inc.
Worldwide Headquarters
Analog Devices, Inc.
One Technology Way
P.O. Box 9106
Norwood, MA 02062-9106
U.S.A.
Tel: 781.329.4700
(800.262.5643,
U.S.A. only)
Fax: 781.461.3113

Analog Devices, Inc.
Europe Headquarters
Analog Devices, Inc.
Wilhelm-Wagenfeld-Str. 6
80807 Munich
Germany
Tel: 49.89.76903.0
Fax: 49.89.76903.157

Analog Devices, Inc.
Japan Headquarters
Analog Devices, KK
New Pier Takeshiba
South Tower Building
1-16-1 Kaigan, Minato-ku,
Tokyo, 105-6891
Japan
Tel: 813.5402.8200
Fax: 813.5402.1064

Analog Devices, Inc.
Southeast Asia
Headquarters
Analog Devices
22/F One Corporate Avenue
222 Hu Bin Road
Shanghai, 200021
China
Tel: 86.21.2320.8000
Fax: 86.21.2320.8222

Printed in the U.S.A. SG10060-1.5-8/11

www.analog.com/opamps

ANALOG DEVICES