



# Currents

Your First Look at New High Performance Analog Components from Analog Devices

Winter 2003/2004



## The AD8099: A Low Distortion High Speed Op Amp with Unprecedented Low Noise

A new era for high speed operational amplifiers begins with the introduction of the AD8099, an amplifier that minimizes two fundamental error sources in amplifier design: voltage noise and harmonic distortion. The AD8099 features a patent-pending advanced circuit architecture that addresses fundamental performance trade-offs inherent in traditional differential input stages, which enables the AD8099 to deliver both extremely low voltage noise ( $0.95 \text{ nV}/\sqrt{\text{Hz}}$ ) and very low distortion ( $-90 \text{ dB}$  at  $10 \text{ MHz}$ )—a breakthrough combination of specifications that no other high speed op amp on the market can deliver. In addition, the new device provides a  $1600 \text{ V}/\mu\text{s}$  slew rate and a  $5 \text{ GHz}$  gain bandwidth product at a gain of 10. The AD8099 can slew at rates of  $600 \text{ V}/\mu\text{s}$ , down to a gain of 2.

The AD8099 uses an advanced pinout to provide performance and stability superior to that offered by traditional amplifier pinouts. The AD8099 is the first operational amplifier to use this new pinout to reduce the mutual inductance—and resulting distortion products—caused by the coupling of positive input and negative supply. Additionally, the amplifier provides two output pins to reduce feedback parasitics. This simplifies board layout and increases the stability of the amplifier. The AD8099 is available in a lead frame chip scale package (LFCSP). This tiny package reduces lead inductance, provides better thermal characteristics, and saves board space.

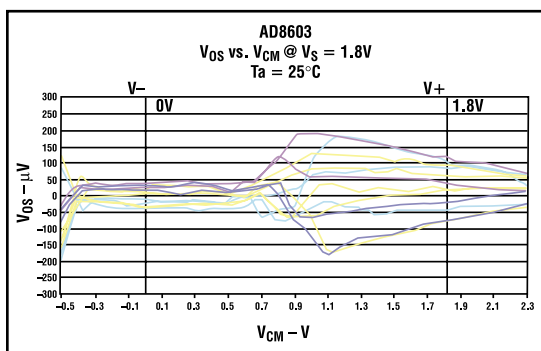
The AD8099 is rated to work over an extended industrial temperature range of  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ . It offers two packaging options: a tiny  $3 \text{ mm} \times 3 \text{ mm}$  LFCSP, which reduces board space requirements and improves thermal characteristics, and the traditional low profile 8-lead SOIC (small outline integrated circuit).



AD8099 \$1.98  
[www.analog.com/AD8099](http://www.analog.com/AD8099)



## The AD8603—The Industry's Most Precise 1.8 V Supply Amplifier



The AD8603 is the latest addition to the growing family of low cost precision DigiTrim® amplifiers from Analog Devices. The AD8603 combines low noise (2.7 nV/√Hz), very low offset (40 μV typ), micropower (50 μA/amp max), and extremely low input bias current (1 pA max). It also features rail-to-rail input and output along with offset trimmed over the full input range, both of which yield maximum flexibility and accuracy at low supply voltages. The AD8603 is fully specified to operate from a +1.8 V to +5.0 V single supply or ±0.9 V and ±2.5 V dual supply.

The combination of low offsets, low noise, very low input bias currents, and low power consumption makes these amplifiers especially useful in portable and loop-powered instrumentation. The ability to swing rail-to-rail at both the input and the output enables designers to buffer CMOS ADCs, DACs, ASICs, and other wide output swing devices in low power single-supply systems.

AD8603 \$0.67  
[www.analog.com/AD8603](http://www.analog.com/AD8603)



## AD8205: A High Performance, Single-Supply Difference Amplifier with a Wide Input Common-Mode Voltage Operational Range of -2 V to +65 V

The AD8205 is a high performance, single-supply difference amplifier with a wide input common-mode voltage (CMV) operational range of -2 V to +65 V, which allows the chip to measure small differential voltages—such as those across a shunt resistor—in the presence of high voltages (large CMV). Additionally, the device can survive over an input CMV range of -5 V to +70 V. The part's ability to reject high common-mode voltages while measuring small differential voltages eliminates error sources commonly associated with current sensing in electromechanical systems.

The AD8205 is the industry's first difference amplifier appropriate for 42 V automotive systems. It is also well suited for industrial applications that measure small differential voltages in the presence of high CMV. Many industrial current sensing applications, such as hydraulic systems and motor control, already require this extended CMV range. Excellent dc performance over temperature keeps errors in the measurement loop to a minimum. Offset drift is less than 20 μV/°C, and gain drift is below 30 ppm/°C (up to 125°C). The AD8205 also has very high common-mode rejection of 80 dB, which extends from dc to 100 kHz.

The AD8205 comes in an 8-pin SOIC (small outline integrated circuit) package and is specified over the extended temperature range of -40°C to +125°C. The AD8205 is also available in die form, with an extended temperature range of -40°C to +150°C for use in higher temperature applications. The part is priced at \$0.95 per unit in one million piece quantities.



AD8205 \$0.95  
[www.analog.com/AD8205](http://www.analog.com/AD8205)



## Dual and Quad Versions of ADI's High Speed Rail-to-Rail Amplifier Family Released

The AD8030 is the dual version and the AD8040 is a quad version of the AD8029 high speed, rail-to-rail amplifier. Both are low cost, high speed amplifiers with a quiescent current of just 1.5 mA/amp max. With their rail-to-rail input and output, the AD8030 and AD8040 are ideal for low power, low voltage high speed applications such as driving analog-to-digital converters. Both amplifiers are also excellent choices for applications such as battery-powered instrumentation, filters, level shifting, buffering, and high density PC boards. ADI's proprietary XFCEB process also allows for low noise operation (11 nV/√Hz and 1 pA/√Hz) with very low quiescent current (1.3 mA). Both the AD8030 and AD8040 operate with a wide supply range (2.7 V to 12 V) and come in space-saving SO-14 and TSSOP-14 packages. They are rated to work over the extended industrial temperature range of -40°C to +125°C.

AD8029 \$0.85  
AD8030 \$1.20  
AD8040 \$1.60

[www.analog.com/rail2rail](http://www.analog.com/rail2rail)





## Analog Devices Unveils Industry's Fastest 16-Bit DAC for High Frequency Applications

**Leading supplier of data converters breaks new speed threshold with 600 MSPS TxDAC+® converter.**

Analog Devices has introduced the industry's fastest 16-bit digital-to-analog converter (DAC), with a conversion rate exceeding 600 MSPS. This device also features unprecedented noise performance:  $-161$  dBm/Hz for output frequencies between 100 MHz and 300 MHz and  $-169$  dBm/Hz at 20 MHz output. This combination of high speed and low noise is ideal for maximizing signal synthesis performance in multicarrier communication systems, as well as in instrumentation and test applications. The DAC also solves noise and bandwidth challenges by reducing intermodulation distortion (IMD), enabling higher quality signal synthesis and higher speed information processing.

The AD9726 joins the company's industry-leading TxDAC+ portfolio of converters, high speed transmit DACs designed to meet demanding communication system requirements. It is the flagship member of a new AD972x family of 10-bit, 12-bit, 14-bit, and 16-bit TxDAC+ converters that sample at 600 MSPS and provide a fast, low voltage, differential signaling (LVDS) input interface. The LVDS inputs enable high conversion rates and bandwidth, allowing the devices to receive data at a high speed, while maintaining low distortion and noise. The AD972x family also provides a component selection path based on resolution, performance, and cost.



AD9726 \$35.00  
[www.analog.com/AD9726](http://www.analog.com/AD9726)



## Analog Devices Releases UXGA Resolution Dual Interface Solution for Flat Panel Displays



**AD9887A supports UXGA resolution and HDCP for digital content protection.**

Analog Devices' newest data converter, the AD9887A, has dual analog and digital interfaces for high speed, UXGA (ultra extended graphics array) flat panel displays. State-of-the-art flat panel displays must work with analog signals from legacy PCs and be compatible with the high definition digital signals of newer computer and entertainment systems. To help display manufacturers economically bridge the analog/digital divide, the AD9887A combines an analog interface and DVI (digital visual interface) receiver on a single chip to support display resolutions up to  $1600 \times 1200$  at 60 Hz. The digital interface provides full compatibility with the DVI version 1.0 industry standard for liquid crystal displays (LCDs), projectors, and high definition televisions (HDTVs) in a growing market.

As the market for flat panel displays grows, so does consumer demand for high definition content. The AD9887A fully supports the HDCP (high bandwidth digital content protection) standard for transmitting and receiving digital entertainment content between DVI compliant devices. The HDCP for DVI specifications will enable film studios to release premium digital content without fear of unauthorized reproduction and distribution.

The AD9887A's analog and digital interfaces are optimized to support resolutions up to  $1600 \times 1200$  at 60 Hz, as well as all HDTV formats. To achieve this, the analog interface combines a 170 MHz triple ADC (analog-to-digital converter) with a low jitter PLL (phase-locked loop).

AD9887A (170 MHz) \$17.75  
AD9887A (140 MHz) \$10.90  
AD9887A (100 MHz) \$ 9.54  
[www.analog.com/AD9887A](http://www.analog.com/AD9887A)



## JPEG2000 Video Codec

The ADV202 is a single-chip JPEG2000 codec targeted at video and high bandwidth image compression applications that will benefit from the enhanced quality and feature set provided by the JPEG2000 (J2K) image compression standard. It implements the computationally intensive operations of the JPEG2000 image compression standard and provides fully compliant code stream generation for most applications. The ADV202's dedicated video port provides glueless connection to common digital video standards such as CCIR656, SMPTE125M, SMPTE293M [525p], and ITU-R-BT1358 [625p]. A variety of other high speed synchronous pixel and video formats can also be supported using the programmable framing and validation signals.

The ADV202 can process images at a rate of  $>36$  M components/s in reversible mode and at higher rates when used in irreversible mode. The ADV202 contains a dedicated wavelet transform engine, three entropy codecs, an on-board memory system, and an embedded RISC processor, which provides a complete JPEG2000 compression/decompression solution.



ADV202 \$29.90  
[www.analog.com/ADV202](http://www.analog.com/ADV202)



## Analog Devices Integrates Four 65 MSPS Analog-to-Digital Converters on a Single Chip



### Industry's first 4-in-1 ADC family features serial LVDS output.

Analog has unveiled the industry's first quad analog-to-digital converters (ADCs). Four ADCs are integrated onto one chip to meet the needs of high density, space constrained systems, such as medical imaging systems—which can require more than 100 converters per system—or space constrained, multichannel applications, such as wireless communications base stations. Using serial low voltage differential signaling (LVDS) data outputs, Analog Devices is able to integrate four ADCs onto a single chip, creating a solution that is compact, fast, cost competitive, and power efficient. The LVDS outputs dramatically reduce pin count, package size, number of board traces, and substrate noise.

The first members of the new AD92x9 quad ADC family are the 12-bit 50 MSPS (mega samples per second) and 60 MSPS AD9229 and the 8-bit 65 MSPS AD9289. Both parts are general-purpose converters for high channel density applications.

Both the AD9229 and AD9289 quad ADCs feature best-in-class dynamic specifications, with the highest signal-to-noise ratio (SNR) and spurious-free dynamic range (SFDR) of any converter that provides comparable resolution.

AD9229 \$35.00  
[www.analog.com/AD9229](http://www.analog.com/AD9229)  
AD9289 \$10.52  
[www.analog.com/AD9289](http://www.analog.com/AD9289)



## Power Efficient Charge Pump Regulator Delivers High Performance for Color TFT Displays

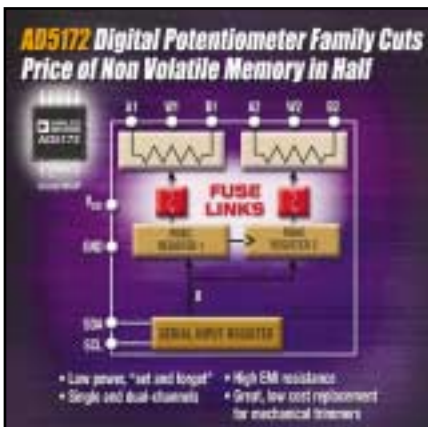
### The ADM8839 provides maximum power efficiency with minimal power drain.

The ADM8839 charge pump regulator is designed specifically for micro-color TFT (thin film transistor) LCDs used in cell phones with color displays, PDAs, pocket PCs, and other portable devices. Using high performance charge pump technology, the ADM8839 generates the three voltages needed for the LCD controller and panel transistors' gate drivers, +5 V, +15 V, and -15 V, all from a single +3 V supply. The supply voltage is doubled and then regulated by the ADM8839's LDO (low dropout regulator) to provide a low ripple 5 V output. This 5 V output drives the charge pump section, which generates the +15 V and -15 V outputs. The LDO can be shut down, and an external LDO can be used in its place. The ADM8839 ensures proper power sequencing for TFT panels by ramping the -15 V supply before the +15 V supply.

ADM8839 \$1.50  
[www.analog.com/ADM8839](http://www.analog.com/ADM8839)



## Digital Potentiometers Cut Price Of Nonvolatile Memory In Half



### "Set and forget" family includes a second-chance option, single and dual channel, multiplexed output.

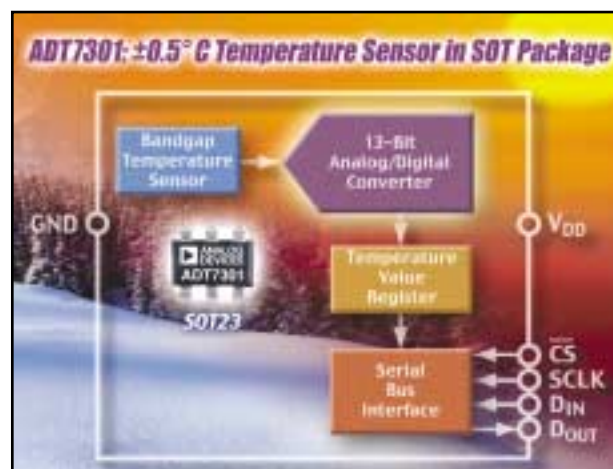
AD517x family devices replace mechanical trimmers with set and forget factory adjustments, saving both time and labor. Their one-time programmable feature permanently sets the wiper position. These devices feature an I<sup>2</sup>C compatible interface for reading/writing the wiper position, and for initiating the "fuse blow" command that permanently sets the resistance value. The set and forget technology delivers nonvolatile functions for half the price of other flash memory nonvolatile devices on the market. AD517x potentiometers are available in 2.5 kW, 5 kW, 10 kW, 50 kW, and 100 kW end-to-end resistances. Rated for operation from -40°C to +125°C, they feature a low 35 ppm/°C temperature coefficient. Drawing no more than 5  $\mu$ A on 2.7 V to 5.5 V power supplies, they are useful in high stability battery-operated applications. They meet the high EMI (electromagnetic interference) resistance standards of the automobile industry, and eliminate the expense of manual trimmer adjustment, as well as the need to design boards with external access to make those adjustments possible. The AD5170, AD5172, and AD5173 potentiometers come in 10-lead MSOPs, and the AD5171 comes in an 8-lead SOT-23 package.

AD5170 \$0.99  
AD5171 \$0.71  
AD5172 \$1.30  
AD5173 \$1.30  
[www.analog.com/digitalpots](http://www.analog.com/digitalpots)

## Industry's Most Accurate SPI Compatible Temperature Sensor in a Compact SOT Package

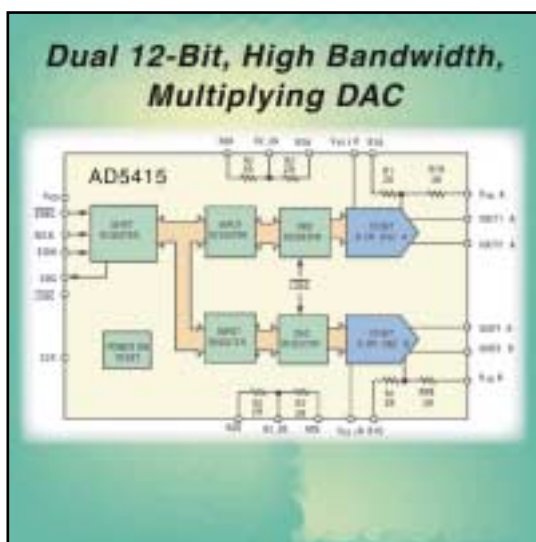
The 13-bit ADT7301 provides  $\pm 0.5^{\circ}\text{C}$  measurement accuracy.

The ADT7301 13-bit temperature-to-digital converter provides  $\pm 0.5^{\circ}\text{C}$  measurement accuracy from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$  and is fully specified for operation from  $-40^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$ . In addition to its small footprint, the device's low shutdown current ( $\mu\text{A}$ ) and wide supply range (2.7 V to 5.5 V) make it ideal for many low power applications requiring precise thermal measurement. The ADT7301 contains a flexible serial interface, which allows easy interfacing to most microcontrollers. The part is compatible with SPI, QSPI, and MICROWIRE protocols, as well as DSPs (digital signal processors). The ADT7301 also offers a standby mode for added power savings. In addition to the SOT-23 package, the ADT7301 is available in an 8-lead MSOP (micro small outline package).



ADT7301 \$1.20  
[www.analog.com/ADT7301](http://www.analog.com/ADT7301)

## Feature-Rich 12-Bit Multiplying DAC Offers Dual Output, High Bandwidth



AD5415 \$5.76  
[www.analog.com/AD5415](http://www.analog.com/AD5415)

AD5415 joins family of extremely versatile current out DACs.

New to ADI's portfolio of current out digital-to-analog converters (DACs) is the AD5415. This device is a 12-bit dual channel current output that operates from a 2.5 V to 5.5 V power supply, making it suitable for battery-powered applications and many other applications. The current outputs can be used for dc as well as ac applications, and can be paralleled or injected into a circuit node. Operating bandwidth is 10 MHz and the part can process signals as high as  $\pm 10$  V even with a low supply voltage. The high speed serial interface allows fast output updates for waveform generation. The applied external reference input voltage ( $V_{\text{REF}}$ ) determines the full-scale output current. An integrated feedback resistor ( $R_{\text{FB}}$ ) provides temperature tracking and full-scale voltage output when combined with an external current to voltage precision amplifier. In addition, this device contains all the 4-quadrant resistors necessary for bipolar operation and other configuration modes. It utilizes a double buffered 3-wire serial interface that is compatible with SPI, QSPI, MICROWIRE, and most DSP interface standards. In addition, a serial data out pin (SDO) allows for daisy chaining when multiple packages are used.

All members of ADI's family of current out DACs are pin and software compatible and have serial and parallel interfaces, and single and dual outputs, allowing designers to traverse the price/performance curve with just one board design.

For a complete list of products released this quarter and to order samples, please visit our Web site at [www.analog.com/currents](http://www.analog.com/currents).



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## 16-Bit SAR Converter Delivers Highest Speed and Accuracy in the Industry

**New PulSAR® device offers 50 percent more speed and more than three times the accuracy of competing products.**

Establishing another speed and accuracy benchmark for SAR ADCs, Analog Devices introduces a new 16-bit SAR (successive-approximation register) ADC. The AD7621 operates at 3 MSPS while providing  $\pm 1$  LSB INL and DNL, and no missing codes. The AD7621 delivers the highest combination of speed and accuracy, while consuming low power ( $<100$  mW at 3 MSPS). The AD7621 also reduces the price per channel by allowing engineers to design systems that multiplex to a greater number of channels. A general-purpose ADC, the AD7621 is suitable for applications in which resolution is a critical performance requirement, such as high end data acquisition, CT scanners, spectrum analyzers, ATE, and general-purpose test equipment.

The AD7621 joins Analog Devices' industry leading PulSAR family of SAR converters, which is based on an ADC architecture that provides the added advantage of zero data latency, a critical factor in data acquisition systems. SAR converters represent the majority of ADCs on the market and are often the most cost-effective technology for applications that require very precise digital modeling of analog signals. Other PulSAR family converters include the AD7677, a 16-bit, 1 MSPS ADC, and the AD7674, an 18-bit, 800 kSPS ADC.

The AD7621 is available in both 7 mm  $\times$  7 mm 48-lead LQFP (low profile quad flat pack) and 48-lead LFCSP (lead frame chip scale) packaging. True 16-bit accuracy provides clear imaging for scanner applications. The device features three different conversion rate modes to optimize performance for individual applications. Samples of the AD7621 are available by visiting the Web site.



AD7621 \$29.95  
[www.analog.com/AD7621](http://www.analog.com/AD7621)

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Printed in the U.S.A. N04554-70-12/03(0)



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