

Precision Converters

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THE ANALOG DEVICES SOLUTIONS BULLETIN

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New 16-Bit SAR ADC Offers Unparalleled Performance and Speed in a Compact Package

While package sizes for 16-bit ADCs have gone from SOICs to MSOPs, sampling rates for these small devices have not gone beyond 250 kSPS. The AD7686 provides a small package (10-lead MSOP), high precision (± 3 LSB max), and more than twice the sampling rate (550 kSPS) of its closest competitor. While the 10-lead MSOP has the same outline as the 8-lead MSOP (3 mm \times 5 mm), the two extra pins of the AD7686 provide a more flexible serial interface than competitor models. Multiple ADCs can be configured using one SDI input (daisy chain). The SDI pin also provides a busy signal indicator.

The AD7686 is just one 16-bit ADC in a group of seven new models that offer small packages, low power, pin-for-pin compatibility, and competitive pricing. Together those features demonstrate that the most significant breakthroughs in SAR ADC technology originate from one source.



APPLICATIONS

- Battery-operated equipment
- Isolated data acquisition
- Medical instruments
- Communications
- Automotive

- Throughput:
 - 550 kSPS (warp mode)
 - 450 kSPS (normal mode)
 - 380 kSPS (impulse mode)
- INL: ± 3 LSB max
- S/(N + D): 89 dB typ @ 10 kHz
- THD: -95 dB typ @ 10 kHz
- Pseudodifferential analog input range: 0 V to V_{REF}
- SPI®/QSPI™/MICROWIRE™/DSP compatible
- -40°C to +85°C operation

Part Number	Sampling Rate (kSPS)	Voltage Supply (V)	Input Range	INL (LSB)	No Missing Codes (Bits)	Package	Price (\$U.S.)
AD7686	550	2.7-5	0 V- V_{REF}	± 3	16	10-Lead MSOP	12.00
AD7688	550	2.7-5	$\pm V_{REF}$	± 1.5	16	10-Lead MSOP	14.95
AD7685	250	2.7-5	0 V- V_{REF}	± 3	16	10-Lead MSOP	8.00
AD7687	250	2.7-5	$\pm V_{REF}$	± 1.5	16	10-Lead MSOP	8.95
AD7680	100	3-5	0 V- V_{REF}	± 4	15	6-Lead SOT-23 8-Lead MSOP	6.00
AD7683	100	2.7-5	0 V- V_{REF}	± 3	16	8-Lead MSOP	6.50
AD7684	100	2.7-5	$\pm V_{REF}$	± 3	16	8-Lead MSOP	6.50

The AD7683 and AD7684 offer a second source upgrade to the ADS8325 and ADS8321.

Visit our website for samples, data sheets, and additional product information.

www.analog.com/bulletins/precision-converters

All prices in this bulletin are in USD in quantities greater than 1,000 (unless otherwise noted), recommended lowest grade resale, FOB U.S.A.



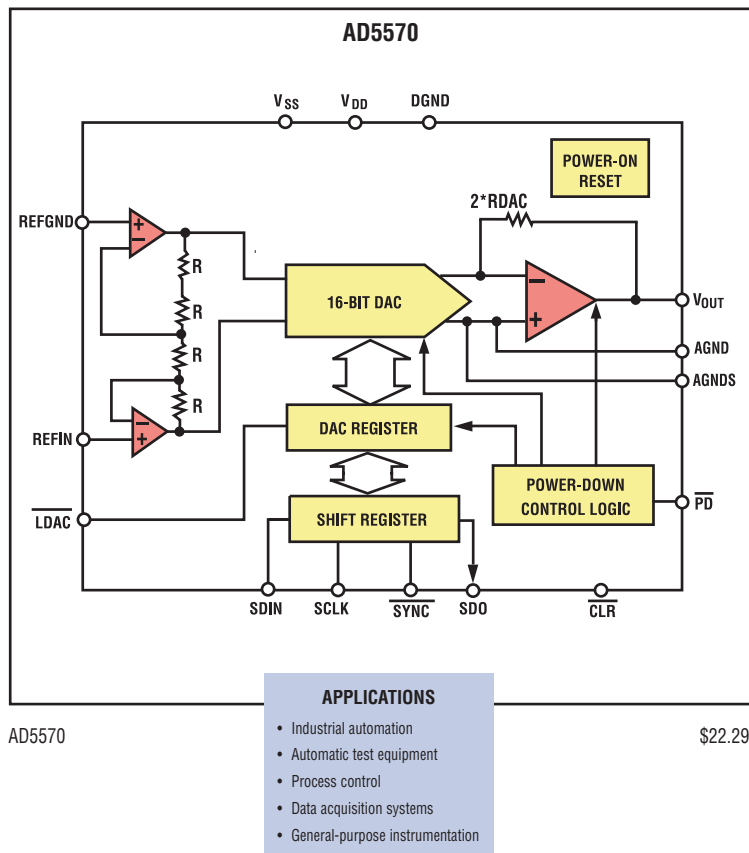
Accurate 16-Bit DAC Delivers ± 13.6 V Output

High accuracy industrial and instrumentation applications need DACs with superior INL and wide voltage range to achieve system performance targets.

Solution

The AD5570 is the most accurate and smallest 16-bit DAC available, with only ± 1 LSB INL and monotonic performance over the full temperature and supply range. It is the only full accuracy 16-bit DAC with a serial (SPI, QSPI, MICROWIRE, and DSP/ μ C compatible) interface. Packaged in a 16-lead SSOP, the AD5570 is 20% smaller than similar but less accurate parts. The reference input is buffered, eliminating the need for external reference buffers or expensive tracking bipolar references.

The 16-bit AD5570 operates with ± 12 V or ± 15 V supplies, and the digital interface is compatible with logic operating at 3 V or 5 V. Featuring power-on-reset to 0 V, data readback and daisy-chaining, CLR to 0 V, LDAC for asynchronous output update, and power-down to less than 20 μ A, these parts operate over the -40°C to $+125^{\circ}\text{C}$ range.



Features	Benefits
± 1 LSB INL (Relative Accuracy)	High System Accuracy, Easier Error Budget Control
± 12 V or ± 15 V Supplies	Compatible with Industrial Signal Levels, Wide Signal Range, Large LSB Size, Better SNR
Power-On-Reset to 0 V	Controlled Power-On
On-Board Reference Buffers	Reduced Cost, Less Board Space, Easier to Design
CLR to 0 V	Calibration, Return to Known Steady State or Benign Value, Reset
16-Lead SSOP	Small Size
Serial Interface	Fewer Tracks, Fewer Leads, Less Board Space, Lower Power, Easier Routing, Suitable for Optocoupler Isolation
3 V/5 V Compatible Digital Interface	Low Voltage, Low Power, DSP/ μ C Compatible, Battery Compatible
Data Readback	Write Verification, Diagnostics
Daisy Chaining (Serial Interface)	Multiple Parts on Same Bus
LDAC	Asynchronous Output Update
Power-Down	Reduced Power Dissipation, Standby Operation, Low Power Battery, or Portable Operation

Single-Supply 40- and 32-Channel DACs Control Large Numbers of Channels in a Small Space

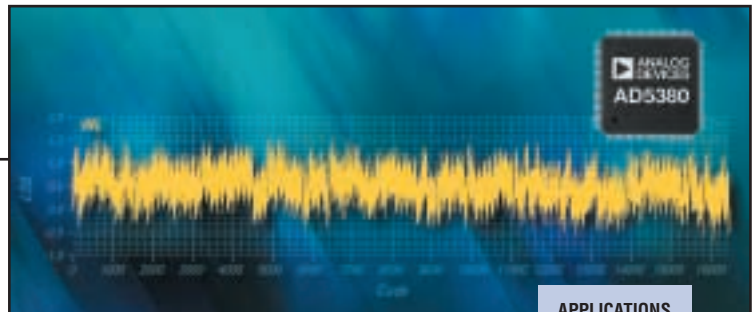
High channel count DACs are critical in optical networking and automatic test equipment (ATE) level-setting applications. Only one supplier, ADI, provides the channel count, high resolution, and programmability demanded by these challenging designs.

Solution

Analog Devices' new family of high density DACs features the industry's first 40- and 32-channel, 14-bit resolution, voltage-output DACs operating from a single 5 V power supply—the AD5380 and AD5382. Pin compatible 12-bit versions—the AD5381 and AD5383—are also available. All devices in the family contain an on-chip, low drift reference, eliminating the need for an external reference IC, reducing cost and board space. These parts also include user-programmable offset and gain for digital range adjustment and system calibration. They also offer high accuracy and increased functionality, including a boost mode that allows the parts to achieve faster settling times and an LDAC (load DAC) function that allows simultaneous update of all DAC outputs.

The devices provide rail-to-rail outputs that operate up to a maximum of 5 V and contain a parallel interface and both SPI and I²C® serial interfaces. All are available in 100-lead LQFP packages.

For a bipolar output range, see the AD5379 bipolar 40-channel 14-bit DAC at www.analog.com/AD5379.



Part Number	Number of Channels	Number of Bits	Power Supply (V)	Price (\$U.S.)
AD5380	40	14	5	49.50
AD5381	40	12	5	39.50
AD5382	32	14	5	42.50
AD5383	32	12	5	34.50
AD5379	40	14, Bipolar	+5, +12, -12	67.75

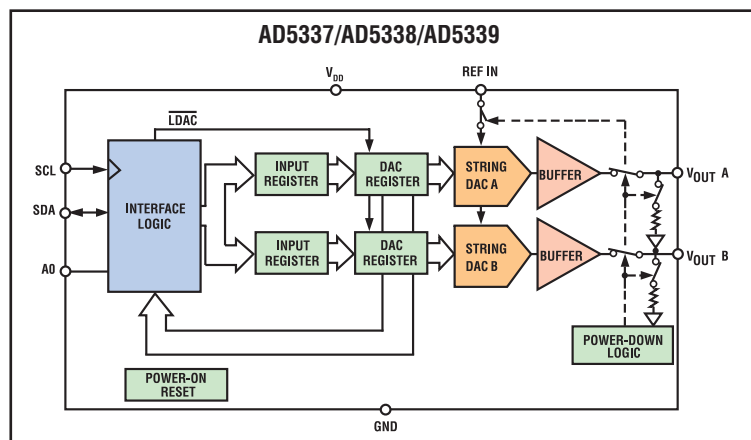
APPLICATIONS

- Optical networking
- VOAs
- MEMS mirrors
- Optical switches
- ATE level settings

New: Dual 12-Bit Low Voltage DAC with I²C Interface in an 8-Lead MSOP

The AD5339 is a dual 12-bit high performance DAC with an I²C interface.

The device operates from 2.5 V to 5.5 V supplies, consumes only 375 μ A max current, and has a relative accuracy of ± 2 LSB typical and ± 8 LSB maximum. The device is completely monotonic, making it ideal for low power control circuits and consumer applications requiring an I²C interface. For less demanding applications, 8-bit and 10-bit pin compatible alternatives (AD5337 and AD5338, respectively) are available. Pricing in 1,000s ranges from \$1.23 to \$4.80, depending on grade and resolution.



World's Smallest Digital Temperature Sensors Offer $\pm 1^\circ\text{C}$ Accuracy

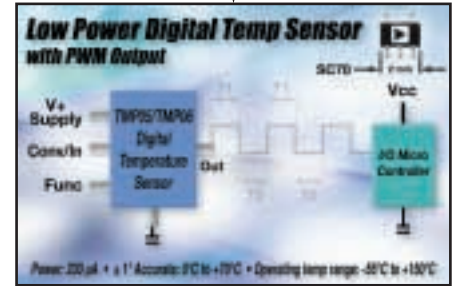
Achieving precise temperature measurement in increasingly smaller packages is not a problem for this family of temperature sensors.

Solution

Two new digital temperature sensors with single-wire, pulsewidth modulation (PWM) outputs offer the industry's most powerful combination of performance, low power consumption, and small package size.

The output of the TMP05 and TMP06 is a square wave; its duty cycle is proportional to the absolute temperature. Both devices offer accuracy to $\pm 1^\circ\text{C}$ max from 0°C to $+70^\circ\text{C}$, an operating temperature range from -55°C to $+150^\circ\text{C}$, and a supply voltage range of 2.7 V to 5.5 V. They are available in space-saving 5-lead SC70 and SOT-23 packages.

Both devices offer three modes of operation: daisy chain (allowing designers to connect any number of TMP05/TMP06 sensors to the same microcontroller), continuously converting, and one-shot mode, which reduces power consumption to $8.25\ \mu\text{W}$.



TMP05
TMP06

\$0.95
\$0.95

Samples are available now, with full production expected in July 2003.

Keeping Temperature in Check Often Is Just One of Many Functions That Require Monitoring

Numerous applications require additional channels to monitor voltage levels, sense overloads in power amplifiers, or turn on fans. Now, devices that perform all these functions, while utilizing minimal board space and power, are available at a competitive price.

Solution

The ADT7x1x family of temperature-to-digital converters offers a combination of multichannel analog-to-digital converters (ADCs) and digital-to-analog converters (DACs) in addition to their core ambient and remote temperature measurement functions. These general-purpose devices, which can address the needs of a broad array of markets/applications, are multifunctional and allow the user to effectively respond to thermal events. Such integrated temperature sensing chips reduce board space, ease system design, and reduce cost by integrating several functions in a single chip.

Part Number	ADC	DAC	Local and Remote Temperature Monitoring	Output	Temperature Error (Typ)	Temperature Range	Supply V/I @ 25°C (V)	Price (\$U.S.)
ADT7516	10-Bit 4-Channel	12-Bit Quad	Yes	SMBus/SPI	$\pm 2^\circ\text{C}$, 0°C to $+85^\circ\text{C}$	-40°C to $+120^\circ\text{C}$	2.7 to 5.5/2.2 mA	6.95
ADT7517	10-Bit 4-Channel	10-Bit Quad	Yes	SMBus/SPI	$\pm 2^\circ\text{C}$, 0°C to $+85^\circ\text{C}$	-40°C to $+120^\circ\text{C}$	2.7 to 5.5/2.2 mA	4.35
ADT7518	10-Bit 4-Channel	8-Bit Quad	Yes	SMBus/SPI	$\pm 2^\circ\text{C}$, 0°C to $+85^\circ\text{C}$	-40°C to $+120^\circ\text{C}$	2.7 to 5.5/2.2 mA	3.20
ADT7411	10-Bit 8-Channel	N/A	Yes	SMBus/SPI	$\pm 2^\circ\text{C}$, 0°C to $+85^\circ\text{C}$	-40°C to $+120^\circ\text{C}$	2.7 to 5.5/2.2 mA	1.99
ADT7316	N/A	12-Bit Quad	Yes	SMBus/SPI	$\pm 2^\circ\text{C}$, 0°C to $+85^\circ\text{C}$	-40°C to $+120^\circ\text{C}$	2.7 to 5.5/2.2 mA	5.80
ADT7317	N/A	10-Bit Quad	Yes	SMBus/SPI	$\pm 2^\circ\text{C}$, 0°C to $+85^\circ\text{C}$	-40°C to $+120^\circ\text{C}$	2.7 to 5.5/2.2 mA	3.15
ADT7318	N/A	8-Bit Quad	Yes	SMBus/SPI	$\pm 2^\circ\text{C}$, 0°C to $+85^\circ\text{C}$	-40°C to $+120^\circ\text{C}$	2.7 to 5.5/2.2 mA	2.00

All are packaged in a 16-lead QSOIP.



Visit our website for samples, data sheets, and additional product information.

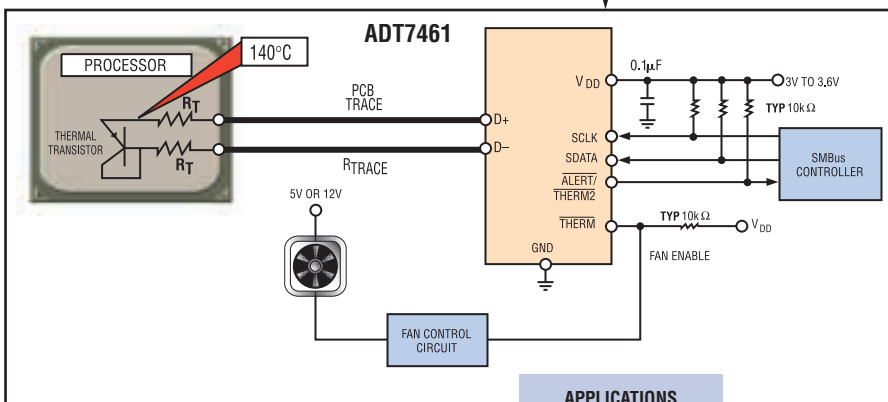
Thermal Monitor Offers $\pm 1^\circ\text{C}$ Accuracy, 150°C Temperature Range, and Automatic Thermal Offset Cancellation

Today's processors, and in particular graphics processors, are manufactured using fine line wafer fabrication processes and have millions of transistors packed closely together. This makes for an environment that gets extremely hot very quickly. Latest generation graphics processors require an extended temperature measurement range up to 150°C , but standard temperature monitors can only measure to 120°C . Thermal offset due to resistance in series with the temperature monitor and the thermal diode gives rise to errors in temperature measurement. The series resistance can be a combination of board trace resistance, package/lead resistance, and resistance between the IC bond pad and the thermal diode device.



The ADT7461 is a $\pm 1^\circ\text{C}$ accurate remote temperature monitor with serial interface, capable of measuring temperatures to $+150^\circ\text{C}$ and beyond on a remote thermal diode. It also has an on-chip temperature sensor for measuring ambient temperature. The ADT7461 has an extended temperature range, giving the user more flexibility to run the processor at higher temperatures while still getting $\pm 1^\circ\text{C}$ accuracy to ensure that any cooling system can be triggered correctly.

The device also can automatically cancel resistances seen in series with the thermal diode. This series resistance cancellation (SRC) feature eliminates offset errors in the temperature measurement with no need for characterization of the resistance by the user. The part typically can cancel $1\text{ k}\Omega$ of series resistance. It also has two interrupt outputs that can be used to implement a cooling system. An $\overline{\text{ALERT}}$ output signals when the on-chip or remote temperature is out of range and can be used as an SMBus $\overline{\text{ALERT}}$. A $\overline{\text{THERM}}$ output is a comparator output, and the interrupt pins can be used for CPU throttling or on-off control of a fan.



ADT7461

APPLICATIONS

- CPU and graphics processor thermal monitoring
- Communications systems
- Notebooks
- Desktop computers
- Consumer

\$1.75

Features

- Extended temperature measurement range up to 150°C
- Cancels temperature-dependent offsets using SRC
- $\pm 1^\circ\text{C}$ accuracy on the external temperature channel
- Configurable $\overline{\text{ALERT}}$ output and $\overline{\text{THERM}}$ output
- Pin compatible with the ADM1032
- SMBus interface
- 8-lead SOIC or MSOP



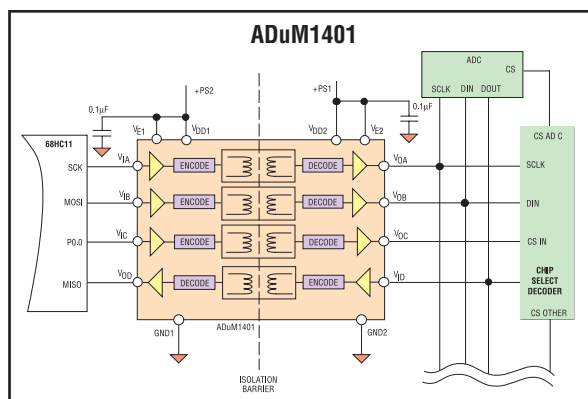
More information on this and other thermal monitoring parts can be found at www.analog.com/temp-sensors.

Multichannel *iCoupler*® Family Brings Size, Cost, and Power Consumption Reductions to Isolated I/O Applications

Analog Devices is pleased to present a new family of 3-channel and 4-channel digital isolators based on our award-winning* *iCoupler* technology. Employing magnetic coupling via chip scale transformers, these devices avoid the many difficulties commonly encountered with optocoupler based designs and allow the mixing of transmit and receive channels within the same 16-lead SOIC package. The 3-channel ADuM130x and 4-channel ADuM140x isolators provide a variety of channel configurations and data rates to suit most applications.



The ADuM130x/ADuM140x family of multichannel isolators eliminates the complexity of optocoupler solutions. One particular area where *iCoupler* technology makes a dramatic impact is in the design of a 4-wire SPI interface for an isolated PLC (programmable logic controller) front end. Replacing multiple optocouplers and their associated support components (18 components total) with a single multichannel isolator and two bypass capacitors (three components total) can cut costs by one-third and reduce board space by two-thirds. Furthermore, power consumption falls to 1/50 to 1/10 the level of the optocoupler solution—consequently, operation within the PLC is also cooler.



Features

- Low power operation:
 - 1.3 mW/channel @ 3 V from dc–2 Mbps
 - 39 mW/channel @ 3 V at 100 Mbps
 - 3 V/5 V level translation feature
- –40°C to +100°C temperature range
- DC–100 Mbps data rate
- 2 ns pulsewidth distortion
- 2 ns max channel-to-channel matching
- UL, CSA, and VDE approval pending

Part Number	Number of Inputs, V _{DD1} Side	Number of Inputs, V _{DD2} Side	Max Data Rate (Mbps)	Max Prop Delay @ 5 V (ns)	Max Pulse-width Distortion (ns)	Price (\$U.S.)
ADuM1300ARW	3	0	1	100	50	2.22
ADuM1300BRW	3	0	10	50	3	2.97
ADuM1300CRW	3	0	100	32	2	3.99
ADuM1301ARW	2	1	1	100	50	2.22
ADuM1301BRW	2	1	10	50	3	2.97
ADuM1301CRW	2	1	100	32	2	3.99
ADuM1400ARW	4	0	1	100	50	2.96
ADuM1400BRW	4	0	10	50	3	3.96
ADuM1400CRW	4	0	100	32	2	4.48
ADuM1401ARW	3	1	1	100	50	2.96
ADuM1401BRW	3	1	10	50	3	3.96
ADuM1401CRW	3	1	100	32	2	4.48
ADuM1402ARW	2	2	1	100	50	2.96
ADuM1402BRW	2	2	10	50	3	3.96
ADuM1402CRW	2	2	100	32	2	4.48

To request a sample for a specific grade shown in this table, and to learn more about *iCoupler* technology, visit www.analog.com/iCoupler.

* The first *iCoupler* device, the ADuM1100, a single-channel digital isolator, won the "Product of the Year" award in 2000 from Electronic Products Magazine.

No More Tinkering Thanks to This Family of 5 V Programmable Set-and-Forget Digital Trimmers

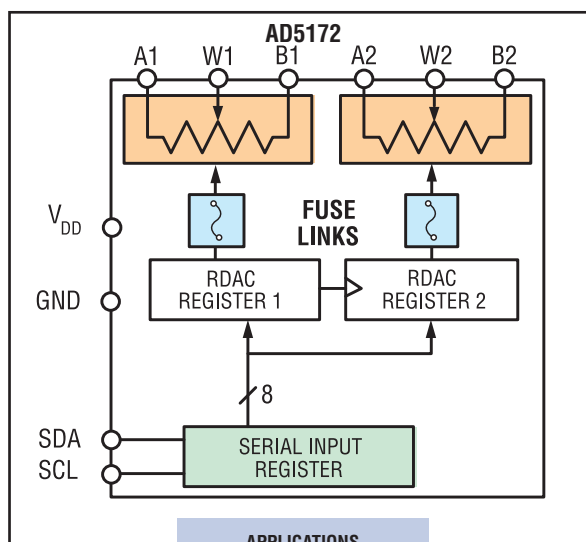
Mechanical potentiometers, a mainstay of electrical circuitry for 100 years, bring a host of problems beyond slowing the manufacturing process and increased labor. Mechanical wear out, sensitivity to vibration, the requirement for periodic manual readjustment, temperature sensitivity, and the lack of processor controlled functionality combine to underscore the mechanical pot as a weak link in modern electronic system design.



Solution

ADI introduces the industry's lowest power, most compact, nonvolatile digital potentiometers. Offered in single-channel and dual-channel, 64-position and 256-position digitally controlled variable resistor (VR) versions, these devices perform the same electronic adjustment function as a potentiometer or variable resistor. Parts are available in a variety of end-to-end resistor options and temperature coefficients. Once the final value is determined, the user asserts a permanent write command, freezing the wiper position at the desired setting (analogous to placing epoxy on a mechanical trimmer). This one-time program sets a validation bit, which can be read back through the I²C interface. Once this acknowledge bit is set, the wiper position will not change, regardless of power supply sequencing, temperature, RF fields, or ESD exposure. Devices consume less than 1 μ A and operate from 2.7 V to 5.5 V supplies. Evaluation boards with device adjustment software are available to simplify programming.

For a complete listing of digital potentiometers, see page 8 of this bulletin.



AD5170
AD5171
AD5172
AD5173
AD5273

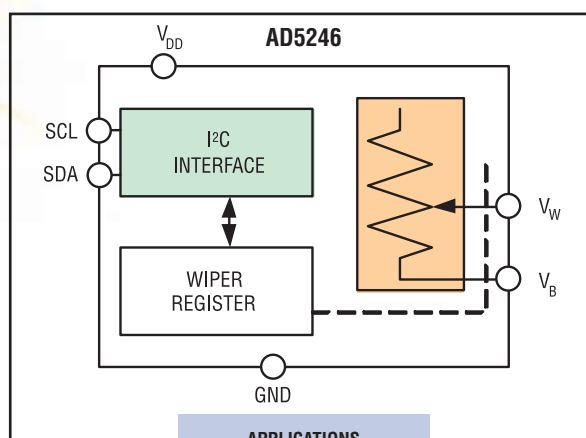
APPLICATIONS

- Transducer circuit zero and gain set
- One-time final system calibration
- Power supply margining
- Trimmer replacement in new designs

\$0.99
\$0.71
\$1.30
\$1.30
\$0.68

Ultracompact 128-Position Digital Potentiometers in 2 mm × 2 mm SC70 Package

Analog Devices introduces the industry's highest resolution digital potentiometers in its smallest IC package. These new devices provide full 2-terminal resistance adjustment over the extended industrial temperature range with 128-position resolution. Offered in two configurations (the rheostat AD5247 and grounded potentiometer-divider AD5246), these parts are ideal for cost-sensitive adjustment applications in portable, battery-operated applications. Operating from single 2.7 V to 5.5 V supplies at less than 1 μ A, these digital potentiometers are ideal for portable applications. Readback of present wiper position and power-on reset to midscale simplify users' adjustment process. The AD5246/AD5247 are ideal for users who need to program resistance, current, or voltage in all types of electronic equipment.



AD5246
AD5247

APPLICATIONS

- Varactor diode adjustment
- System gain and offset CAL
- Trimmer replacement in new designs

\$0.52
\$0.52

DIGITAL POTENTIOMETER SELECTION GUIDE

VOLATILE													
Part Number	Number of Channels	Resolution (Number of Wiper Steps)	Interface Data Control	Nominal Resistance (k Ω)	Terminal Voltage Range (V)	Absolute Tempco (ppm/°C)	Comments	SC70	SOT-23	MSOP	TSSOP	SOIC	PQFP
AD5200	1	256	SPI	10, 50	$\pm 3, 5.5$	500				•			0.98
AD5201	1	33	SPI	10, 50	$\pm 3, 5.5$	500				•			0.54
AD5220	1	128	UP/DOWN	10, 50, 100	5.5	800				•		•	0.99
AD7376	1	128	SPI	10, 50, 100, 1,000	$\pm 15, 28$	300					•	•	2.95
AD8400	1	256	SPI	1, 10, 50, 100	5.5	500						•	1.29
AD5241	1	256	I ² C	10, 100, 1,000	$\pm 3, 5.5$	30					•	•	1.02
AD5260	1	256	SPI	20, 50, 200	$\pm 5, 15$	35					•		1.98
AD5280	1	256	I ² C	20, 50, 200	$\pm 5, 15$	35					•		1.98
AD5245	1	256	I ² C	5, 10, 50, 100	5.5	35		•					0.70
AD5160	1	256	SPI	5, 10, 50, 100	5.5	35		•					0.70
AD5161	1	256	SPI/I ² C	5, 10, 50, 100	5.5	35	SPI/I ² C Selectable			•			0.71
AD5246 ¹	1	128	I ² C	5, 10, 50, 100	5.5	35	Rheostat	•					0.58
AD5247 ¹	1	128	I ² C	5, 10, 50, 100	5.5	35		•					0.58
AD5207	2	256	SPI	10, 50, 100	$\pm 3, 5.5$	500					•		1.17
AD5222	2	128	UP/DOWN	10, 50, 100, 1,000	$\pm 3, 5.5$	35					•	•	1.78
AD8402	2	256	SPI	1, 10, 50, 100	5.5	500					•	•	1.95
AD5242	2	256	I ² C	10, 100, 1,000	$\pm 3, 5.5$	30					•	•	1.39
AD5262	2	256	SPI	20, 50, 200	$\pm 5, 15$	35					•		2.17
AD5282	2	256	I ² C	20, 50, 200	$\pm 5, 15$	35					•		2.17
AD5243 ²	2	256	I ² C	2.5, 10, 50, 100	5.5	35			•				1.10
AD5162 ²	2	256	SPI	2.5, 10, 50, 100	5.5	35	One Rheostat			•			1.10
AD5248 ²	2	256	I ² C	2.5, 10, 50, 100	5.5	35	Two Rheostats			•			1.10
AD5203	4	64	SPI	10, 100	5.5	700					•	•	1.61
AD5204	4	256	SPI	10, 50, 100	$\pm 3, 5.5$	700					•	•	2.23
AD8403	4	256	SPI	1, 10, 50, 100	5.5	500					•	•	2.95
AD5263	4	256	SPI/I ² C	20, 50, 200	$\pm 5, 15$	30	SPI/I ² C Selectable				•		3.50
AD5206	6	256	SPI	10, 50, 100	$\pm 3, 5.5$	700					•	•	2.90
NONVOLATILE MEMORY													
AD5231	1	1024	SPI	10, 50, 100	$\pm 3, 5.5$	600					•		2.20
AD5251 ²	2	64	I ² C	1, 10, 50, 100	$\pm 3, 5.5$	600	Tolerance in NVM				•		2.16
AD5252 ²	2	256	I ² C	1, 10, 50, 100	$\pm 3, +5.5$	600	Tolerance in NVM				•		2.63
AD5232	2	256	SPI	10, 50, 100	$\pm 3, 5.5$	600					•		2.95
AD5235	2	1024	SPI	25, 250	$\pm 3, 5.5$	35	Tolerance in NVM				•		5.63
ADN2850	2	1024	SPI	25, 250	$\pm 3, 5.5$	35	LFCSPP-16						6.50
AD5255 ¹	3	512 \times 2, 128 \times 1	I ² C	25, 250	$\pm 3, 5.5$	35	Tolerance in NVM				•		5.63
ADN2860 ¹	3	512 \times 2, 128 \times 1	I ² C	25, 250	$\pm 3, 5.5$	35	LFCSPP-24						6.22
AD5233	4	64	SPI	10, 50, 100	$\pm 3, 5.5$	600					•		2.74
AD5253 ²	4	64	I ² C	1, 10, 50, 100	$\pm 3, 5.5$	600	Tolerance in NVM				•		2.73
AD5254 ²	4	256	I ² C	1, 10, 50, 100	$\pm 3, 5.5$	600	Tolerance in NVM				•		3.31
ONE-TIME PROGRAMMABLE ³													
AD5273	1	64	I ² C ⁴	1, 10, 50, 100	5.5	300			•				0.75
AD5171 ¹	1	64	I ² C ⁴	5, 10, 50, 100	5.5	35			•				0.83
AD5170 ³	1	256	I ² C ⁴	2.5, 10, 50, 100	5.5	35	Two-Time Programmable			•			1.10
AD5172 ²	2	256	I ² C ⁴	2.5, 10, 50, 100	5.5	35				•			1.44
AD5173 ²	2	256	I ² C ⁴	2.5, 10, 50, 100	5.5	35	Two Rheostats			•			1.44

¹Now sampling.²Future product, email Digital.Pots@analog.com for latest status.³Computer software provided for factory programming applications.⁴Price per 100.

View our new 4-page
Digital Potentiometer Brochure online at
www.analog.com/DigitalPots.



Industry-Leading Switch Portfolio

Whatever the need—industry's lowest R_{ON} , largest multiplexer, smallest package, smallest switch capacitance—ADI's portfolio has a product to match it. Recent advances include the introduction of the highest bandwidth CMOS switch, the lowest R_{ON} switch, the highest channel multiplexer, and a new range of digital switches and level translators.

Industry's First Wideband CMOS Switches Exceeding 1 GHz

The ADG918/ADG919 are the industry's first wideband switches using a CMOS process to provide high isolation (37 dB) and low insertion loss (0.7 dB) up to and exceeding 1 GHz. This revolutionary switch family is proving a cost-effective alternative to gallium arsenide (GaAs) switches in low power (18 dBm max) GHz-range applications in wireless systems and for general-purpose high frequency switching. The parts are available in MSOP and chip scale packaging.

Family of Digital/Bus Switches Addresses Need For Speed and Power

ADI's first digital/bus switching products round out the company's portfolio with sub-nanosecond propagation delay and fast switching. These parts exhibit an enhanced 3.3 V to 1.8 V level translation capability, removing the need for additional external circuitry. Current products offer the user advantages in several areas.

High Speed

The ADG3257 is a high speed, 5 V/3.3 V quad 2:1 mux/demux that combines resistance of $2\ \Omega$ with a propagation delay of 100 ps at data rates of 933 Mbps. The device is ideal for switching in LANs, routers, remote access equipment, as well as PC memory modules.

Low Power

The ADG3245/ADG3246/ADG3247 are low power switches that, when not switching, typically consume 1 nA (1 μ A max)—making them excellent for use in low power applications such as notebook PCs.

Extended Level Translation

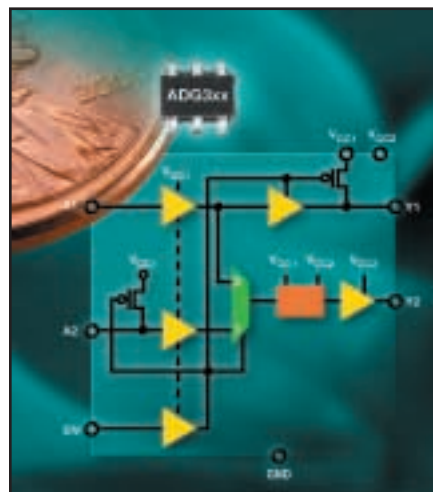
The ADG3231/ADG3232/ADG3233 are low voltage level translator, mux, and bypass switches, respectively. Packaged in a 6-lead, SOT-23 package, they are available in one of the smallest footprints available for their pin counts.

Highest-Channel-Count Multiplexer, Lowest R_{ON} Switch, Smallest Package

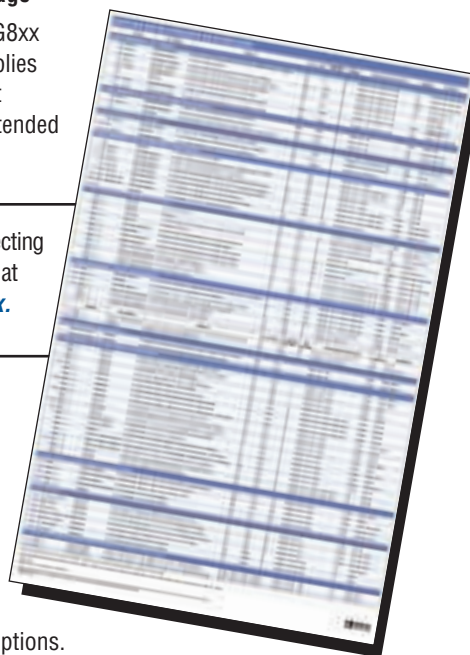
Developments in the traditional analog switch segment include the new ADG8xx series switches, which have the lowest available R_{ON} for 1.8 V to 5.5 V supplies in a tiny SOT-23 package. With R_{ON} as low as $0.25\ \Omega$ and a 400 mA current capability, these parts are ideally suited to portable applications. With an extended temperature range of -40°C to $+125^\circ\text{C}$, they meet the requirements of the harshest environments.

For customers requiring very high channel multiplexing capabilities, the ADG731 (SPI compatible) and ADG732 (parallel interface) provide 32:1 multiplex capability in a space-saving $7\text{ mm} \times 7\text{ mm}$ chip scale package. Dual 16:1 versions of each product are also available. See the *Switches and Multiplexers Selection Guide*.

The very highest density applications are addressed by Analog Devices' increasing range of switch and multiplexer products in space-saving CSP and wafer-level packages. For customers requiring a 0.8 mm or greater pitch, the tiny SC70 and SOT-23 packages are excellent alternatives. Mobile handsets and PDAs are two typical applications that require such package options.



Download a complete guide to selecting ADI's Switches and Multiplexers at www.analog.com/switch-mux.



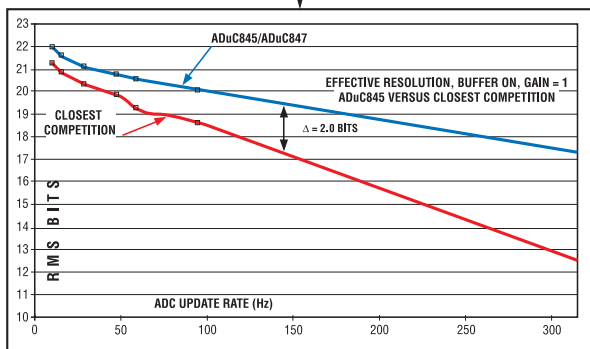
ADI MicroConverters—Precision Converters with Embedded Flash MCU

With processing capabilities 12 times faster than those of previous offerings, the ADuC84x family integrates high precision data conversion technologies with a single-cycle 8052 flash MCU core to produce user-programmable, system-on-chip ICs ideal for today's leading edge industrial applications.

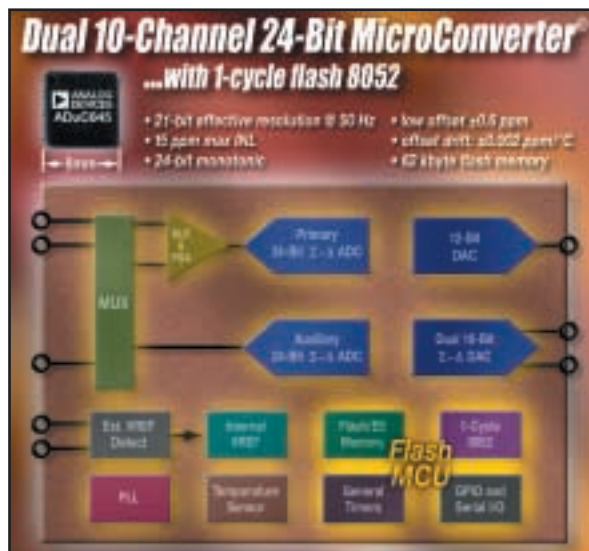
Solution

The ADuC844/ADuC845/ADuC846/ADuC847 are complete, smart-transducer front ends, each with two ADCs, a temperature sensor, and a PGA facilitating measurement of low level signals. The ADCs, with on-chip digital filtering and programmable output data rates, are ideal for measuring wide dynamic range, low frequency signals in a range of applications, including smart transmitters, weigh scales, pressure transducers, chromatography, patient monitoring, energy metering, precision temperature monitors, and many more. The ADuC844/ADuC846 and ADuC845/ADuC847 differ, with the latter providing additional analog inputs. The ADuC846 is identical to the ADuC844, except the primary ADC is specified at 16 bits. All ADuC84x family devices are in 8 mm × 8 mm chip scale packaging or a Quad Flat Pack, specified to 125°C.

The ADuC844/ADuC846 are pin compatible with earlier versions from ADI's MicroConverter® family, providing a convenient upgrade path in terms of memory size and/or MCU core speed.



Even with the higher level of integration, these parts still outperform competitive models.



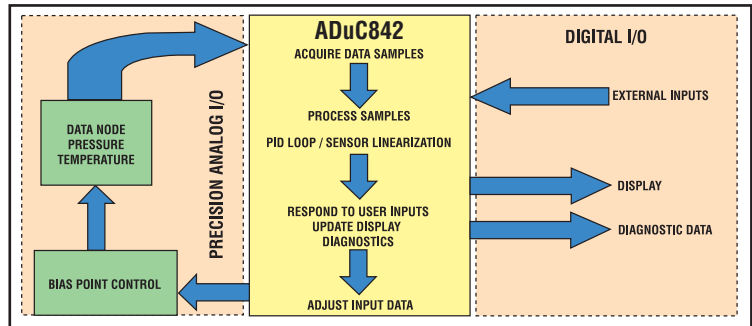
Part Number	A/D	D/A and PWM	MCU	Flash (Bytes)	RAM	Features	Price (\$U.S.)
ADuC844	Dual 24-/16-Bit, Σ - Δ , 100 Hz	12-Bit Single V_{OUT} + Dual PWM	12.6 MIPS 1-Cycle 8051	62k Code 4k Data ¹	256 Byte +2 Kbyte	21-Bit Effective Resolution @ 60 Hz on Σ - Δ ADC	11.35 ²
ADuC845	10-Channel, Dual 24-Bit, Σ - Δ , 1.3 kHz Max	12-Bit Single V_{OUT} + Dual PWM	12.6 MIPS 1-Cycle 8051	62k Code 4k Data ¹	256 Byte +2 Kbyte	Effective Resolution Same as ADuC844. 10 Single-Ended, Five Fully Differential AINs	13.16 ²
ADuC846	Dual 16-Bit, Σ - Δ , 100 Hz	12-Bit Single V_{OUT} + Dual PWM	12.6 MIPS 1-Cycle 8051	62k Code 4k Data ¹	256 Byte +2 Kbyte	Pin Compatible 16-Bit Version of ADuC844	9.94 ²
ADuC847	10-Channel, 24-Bit, Σ - Δ , 1.3 kHz Max	Dual PWM (No DAC)	12.6 MIPS 1-Cycle 8051	62k Code 4k Data ¹	256 Byte +2 Kbyte	Effective Resolution Same as ADuC844. 10 Single-Ended, Five Fully Differential AINs	9.42 ²

¹Three flash memory size options are available: 62k, 32k, and 8k. ²Price is for smallest memory (8k) version.

The ADuC842 MicroConverter Combines Fast 12-Bit ADC and DACs with 1-Cycle 8052 Flash MCU

An ADuC842 is an ideal solution for the classic measurement and control loop shown. Typically, an input parameter is required to lie within a defined range. Data samples acquired via the ADC are processed by the microcontroller core. The core may implement an algorithm such as a sensor linearization routine or a PID control loop. Depending on the acquired data, the DACs are used to ensure that the input data lies within the required range. The fast MCU core on the ADuC842 combined with the 400 kSPS multichannel 12-bit ADC facilitates analysis and processing of several channels in a short space of time and allows for additional free processing time during a fixed loop for diagnostic/user control.

Other features of the ADuC842 include dual PWMs in addition to the dual 12-bit V_{OUT} DACs, a 20 ppm/°C voltage reference, operation from a 32 kHz crystal or internal oscillator, and UART, SPI, and I²C serial ports.



Part Number	MCU Speed (MIPS)	Flash/EE (Kbytes)	Package	Price (\$U.S.)
ADuC814	1.3	8	28-TSSOP	4.52
ADuC841 ¹	16	62	8 mm × 8 mm CSP	6.56–9.64
ADuC842 ²	16	62	8 mm × 8 mm CSP	6.56–9.64
ADuC843 ³	16	62	8 mm × 8 mm CSP	5.15–6.95

¹Pin compatible upgrade for ADuC812 and ADuC831

²Pin compatible upgrade for ADuC832 (on-chip PLL)

³Same as ADuC842 without the DACs

MicroConverters Expand Development Tools Options

All MicroConverter products are supported by a suite of comprehensive software development tools, which are shipped along with supporting hardware in one of two inexpensive QuickStart™ Development System options.



Developers can choose between the entry-level QuickStart Development System available directly from Analog Devices, or the enhanced QuickStart Plus system, a more feature-rich, advanced development kit available directly from one of our third-party suppliers. For more information or to place your order, visit www.analog.com/microconverters.

Development Tools	QuickStart	QuickStart Plus
Evaluation Board	✓	✓
Power Supply and Serial Cable	✓	✓
Windows® Serial Downloader	✓	✓
Code Examples	✓	✓
Documentation	✓	✓
Integrated Development Environment	✓	✓
• Product Manager	✓	✓
• Source Code Editor	✓	✓
• Integrated Assembler	✓	✓
• Simulator	✓	✓
• Code Download and Debug	✓	✓
• Entry Level C Compiler		✓
• C-Source Debug Capabilities		✓
Single-Pin Emulation POD		✓
Price (\$U.S.)	75.00	299.00

Measuring AC Energy Just Got Easier

Designing circuitry for measuring power consumption in households, office buildings, laboratory equipment, or other applications can be a challenge. Many hours and expertise are needed to put together a robust design using discrete components. In addition to time required to design circuit hardware consisting of amplifiers, voltage references, ADCs, and a microprocessor, designers also need to invest time to develop microprocessor algorithms to perform calculations and achieve high performance.



With over 75 million Energy IC (ADE) units deployed in the field, Analog Devices continues to grow its family of standard products designed for low cost energy measurement. These solutions have enabled new, low cost approaches to ac energy measurement and provide innovative ways to monitor energy. The products in the ADE portfolio share a core architecture of proprietary $\Sigma\Delta$ ADCs and superior fixed-function DSPs to guarantee performance with an error rate of less than 0.1% over an extended current dynamic range. In addition, an on-chip PGA allows direct sensor interface, and an accurate on-chip voltage reference further simplifies design. Bipolar analog inputs are supported with a unipolar 5 V power supply. Although the primary application of the IC is energy measurement, it may also be used in any application that requires the digitization and multiplication of two signals. ADE products are designed to operate over the industrial temperature range (-40°C to $+85^{\circ}\text{C}$). Designers can now choose from a variety of products in the ADE family, depending on the level of functionality and energy parameters required in their system. Refer to the selection guide below to identify key features for your design. To shorten design time, complete documentation, local technical support, and reference designs are also provided. For more information, visit www.analog.com/energymeter.

APPLICATIONS

AC energy measurement

- Networked revenue energy meter
 - Intelligent home appliances (load shedding)
 - Motor protection
 - Manufacturing equipment power monitor
 - Utility automation
- Analog-to-digital converter
- Weigh scales

	SINGLE-PHASE						POLYPHASE	
Part Number	ADE7751	ADE7753	ADE7755	ADE7756	ADE7757	ADE7759	ADE7752	ADE7754
INTERFACE								
$\mu\Omega$ Shunts and Current Transformers	•	•	•	•	•	•	•	•
Rogowski Coil (di/dt Input)		•				•		
KEY FEATURES								
Active Energy	•	•	•	•	•	•	•	•
Apparent Energy, RMS Voltage, RMS Current		•						•
Reactive Energy		•						
High Frequency Pulse Output	•	•	•	•	•	•	•	•
Low Frequency Complementary Pulse Output	•		•		•		•	
Hardware Calibration	•	•	•	•	•	•	•	•
Software Calibration		•		•		•		•
Serial Port and Interrupts		•		•		•		•
Fault Tolerant Billing	•						•	•
Integrated Oscillator					•			
Power Quality Supervisory*		•		•		•		•
STATUS AND PRICE								
Status	Released	Sampling	Released	Released	Released	Released	Released	Released
Price (\$U.S.)	2.83	3.19	1.89	2.31	1.89	3.11	4.02	5.12

* May include some or all of the following: SAG and peak detections, peak level recording, line period measurement, and zero crossing detection.

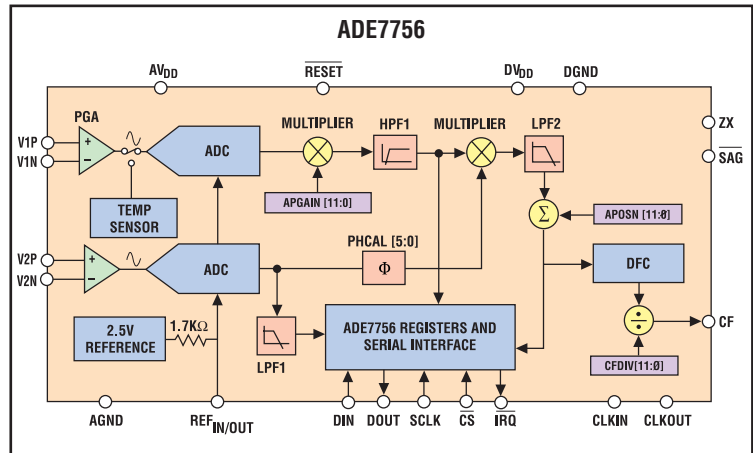


Visit our website for samples, data sheets, and additional product information.

Solution for Single-Phase Energy Measurement: ADE7756—Active Energy with Serial Port Interface

In addition to providing accurate active energy measurement readings, the ADE7756 enables SAG detection for power supply monitoring, zero-crossing detection for cycle-to-cycle fast calibration, and waveform samples for power quality related information. The ADE7756 interfaces directly to current sensors such as shunt and current transformers (CT). Featuring bidirectional communication on a serial port, the ADE7756 device is a flexible platform, designed to support different system architectures with channel-offset correction, phase calibration, and power calibration.

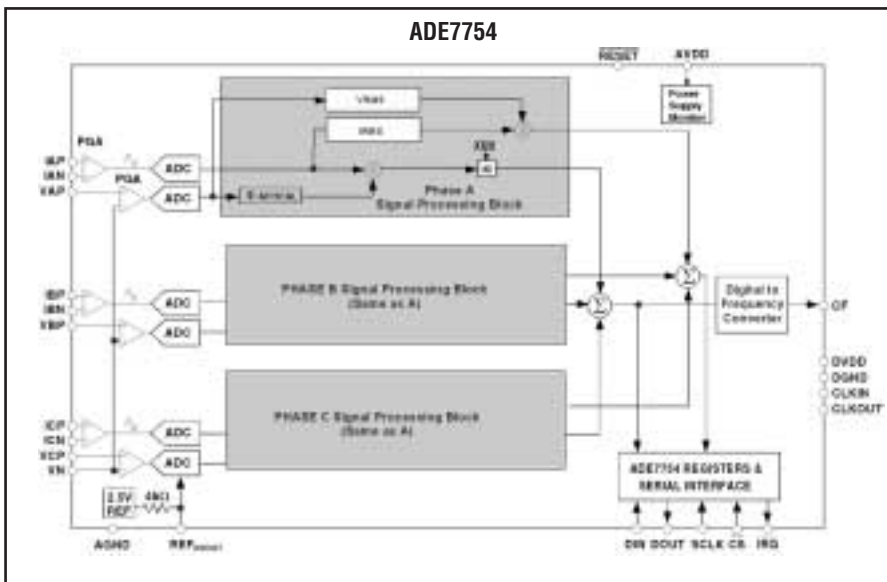
Also available in high volume is an enhanced version of the ADE7756 that incorporates a digital integrator in the current channel to allow direct interface with a di/dt (change-in-current over change-in-time) sensor such as the Rogowski coil. Disabling the digital integrator in the ADE7759 allows the use of conventional current sensors such as shunt and CT types. For additional system compensation, line period and temperature sensor measurements can be used. Currently sampling is the ADE7753, a derivative of the ADE7759, which provides advanced multifunction features as described in the selection guide table. Available in a 20-lead SSOP, the ADE7756 is pin compatible with the ADE7759 and ADE7753.



For more information, visit
www.analog.com/ADE7756.

Solution for Polyphase Energy Measurement: ADE7754—Active Energy, Apparent Energy, RMS Voltage, and RMS Current (Serial Port Interface)

This new product is the electricity industry's first single-chip, multifunctional, 3-phase energy measurement IC with digital calibration. Features include active and apparent energy registers, voltage and current RMS, peak voltage and current detection, voltage sag detection, calibration frequency pulse output, period measurement, and temperature sensor. The ADE7754 is compatible with 3-wire and 4-wire distribution systems. Power supervisory features are similar to those of other ADE serial port interface products. The ADE7754 is available in a 24-lead SOIC.



For more detailed information, visit
www.analog.com/ADE7754.

Combining Performance and Functionality Creates the Industry's Best Σ - Δ Converters

When designers are looking for a Σ - Δ architecture that enables higher resolutions and accuracy, greater flexibility and functionality, and lower overall system costs, there's only one company to turn to—Analog Devices.

Solution

Low Noise, Low Power Σ - Δ ADCs

The AD779x family of Σ - Δ ADCs features low noise (1.5 μ V), low power (65 μ A), and high functionality. Features such as on-chip internal clocks and buffers and 10-lead MSOP packaging create new design possibilities in applications that demand precise ADC performance.



APPLICATIONS

- 4 to 20 mA transmitters
- Battery applications
- Hand-held instrumentation
- Sensor measurement
- Temperature measurement
- Pressure measurement
- Weigh scales (kitchen/bathroom)

Features

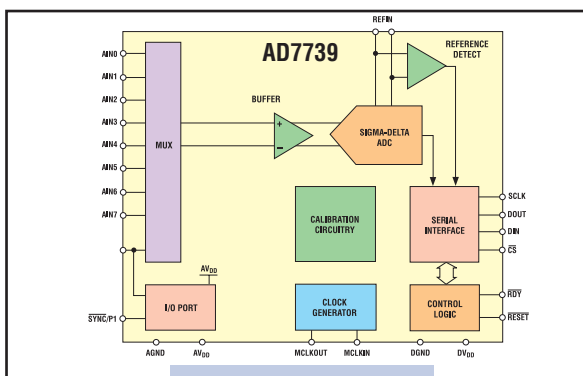
- Low RMS noise: 1.5 μ V
- 65 μ A I_{DD}
- On-chip clock
- On-chip buffer and PG
- Simultaneous 50 Hz/60 Hz rejection
- Offset drift: 10 nV/°C
- Battery monitor
- Power-save mode: 25 μ A
- Power-down mode: 1 μ A max

Part Number	ADC Resolution (Bits)	Normal I_{DD} (Max) (μ A)	On-Chip Buffer	PGA	Price (\$U.S.)
AD7790	16	160	Yes	Yes	2.95
AD7791	24	160	Yes	No	3.83
AD7788	16	90	No	No	1.99
AD7789	24	90	No	No	2.95

Solution

Low Bandwidth, Low Noise Σ - Δ ADCs

Precision and high speed are no longer mutually exclusive in multichannel applications. Analog Devices' family of 24-bit Σ - Δ ADCs raises the industry's performance standard with fast throughput, superior accuracy, and the lowest noise. These parts offer 24 bits with no missing codes, programmable conversion rates up to 15.4 kHz, system on-chip functionality, and an extended industrial temperature range of -40°C to $+105^{\circ}\text{C}$.



APPLICATIONS

- Programmable logic controllers
- Distributed control systems
- Process control
- Medical and industrial instrumentation

Part Number	Min/Max Input Range (V)	Input Channels	Switching Rate for 16-Bit Performance (kHz)	Price (\$U.S.)
AD7732	$\pm 5/\pm 10$	2 Fully Diff	2	8.50
AD7734	$\pm 5/\pm 10$	4 Single-Ended	2	8.50
AD7738	0.625/2.5	4 Fully Diff, 8 Single-Ended	8.5	7.77
AD7739	0.625/2.5	4 Fully Diff, 8 Single-Ended	4	7.65



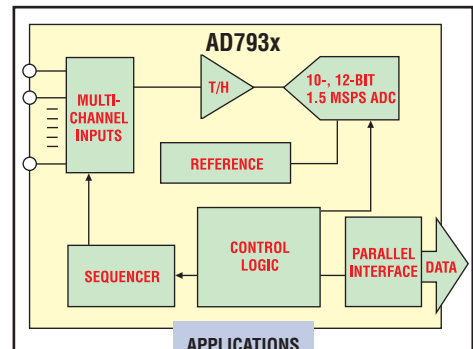
Visit our website for samples, data sheets, and additional product information.

World's Fastest, Multiplexed SAR Converters

The AD793x is a family of multichannel, 12- and 10-bit ADCs with throughput rates up to 1.5 MSPS. Data transfers occur over a parallel bus, and the parts operate from a single 2.7 V to 5.25 V power supply. The family has both four and eight analog input channel options with a channel sequencer to allow a preprogrammed selection of channels to be converted sequentially. These parts can operate with single-ended, fully differential, or pseudodifferential analog inputs. The analog input configuration is chosen by setting the relevant bits in the on-chip control register. The conversion process and data acquisition are controlled using standard control inputs, allowing easy interfacing to microprocessors and DSPs. The input signal is sampled on the falling edge of CONVST; the conversion is also initiated at this point. The AD7938/AD7939 have an accurate on-chip 2.5 V reference that can be used as the reference source for the analog-to-digital conversion. Alternatively, this pin can be overdriven to provide an external reference in the 100 mV to 3.5 V range.

Features

- Fast throughput rate: 1.5 MSPS
- Specified for V_{DD} of 2.7 V to 5.25 V
- 8 analog input channels with a sequencer
- Accurate on-chip 2.5 V reference
- High speed parallel interface—word/byte modes



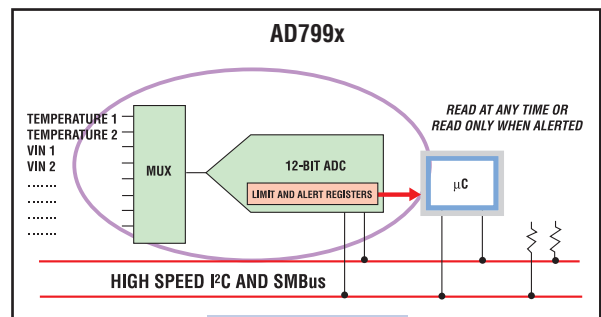
APPLICATIONS

- Data acquisition
- Industrial
- Instrumentation
- Communications

Part Number	Resolution (Bits)	Throughput	Channels	Price (\$U.S.)
AD7938	12	1.5 MSPS	8	7.35
AD7938-6	12	600 kSPS	8	4.85
AD7934	12	1.5 MSPS	4	7.10
AD7934-6	12	600 kSPS	4	4.60
AD7939	10	1.5 MSPS	8	3.75
AD7933	10	1.5 MSPS	4	3.50

Smart Multichannel, 12-Bit I²C ADCs

For cycle, limit, alert registers, for controlling the conversion process, and for transmission of data, there's the AD799x family of multichannel 12- and 10-bit successive approximation ADCs with a full I²C and SMBus compatible interface. The parts operate from a single 2.7 V to 5.5 V power supply and feature a conversion time of 2 μ s. The family includes 2-, 4-, and 8-channel versions in a 10-lead MSOP, 16-lead TSSOP, and 20-lead TSSOP.



APPLICATIONS

- Any I²C data acquisition
- Instrumentation and control
- Medical instruments
- Voltage monitoring

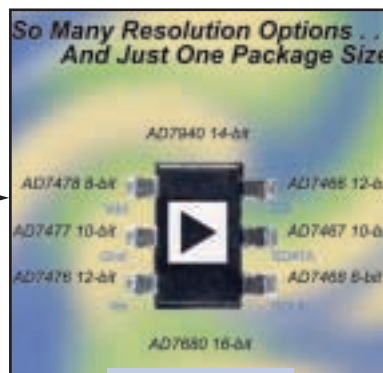
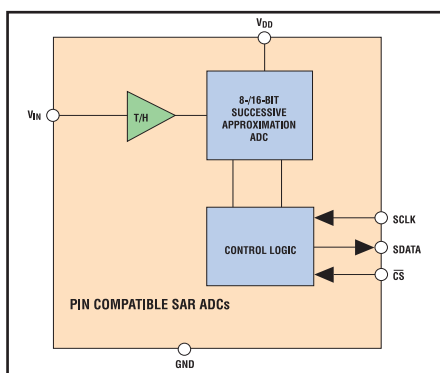
Part Number	Resolution (Bits)	Throughput (kSPS)	Channels	Price (\$U.S.)
AD7992	12	188	2	3.50
AD7994	12	188	4	3.50
AD7993	10	188	4	2.75
AD7998	12	188	8	3.75
AD7997	10	188	8	3.00

Many Resolution Options and Just One Small Package

With pressure to deliver products to market faster, design engineers find their design cycle times shrinking. When an application's design demands an upgrade for higher accuracy, there's no faster and better solution than pin-for-pin compatible ICs.



Analog Devices' SAR ADCs provide several upgrade paths to allow designers to accomplish a performance jump in the shortest time. Our family of AD747x and AD746x, 8-, 10-, and 12-bit ADCs are not only pin compatible with each other, they include the smallest 14- and 16-bit ADCs on the market—ADI's own AD7940 and AD7680. These high performance ADCs combine the smallest package size (SOT-23-6) with the lowest power dissipation—the 8-bit AD746x dissipates just 0.15 mW of power at 100 kSPS.



Part Number	Resolution (Bits)	Sampling Rate (kSPS)	Power Supply (V)	Price (\$U.S.)
AD7478/AD7468	8	1000/100	1.8–5.25	0.95/1.05
AD7477/AD7467	10	1000/100	1.8–5.25	2.50/1.25
AD7476/AD7466	12	1000/100	1.8–5.25	4.00/2.05
AD7940	14	100	2.5–5.25	4.25
AD7680	16	100	2.5–5.25	6.00

APPLICATIONS

- Battery-powered systems
- Portable equipment
- Medical instruments
- Remote data acquisition

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