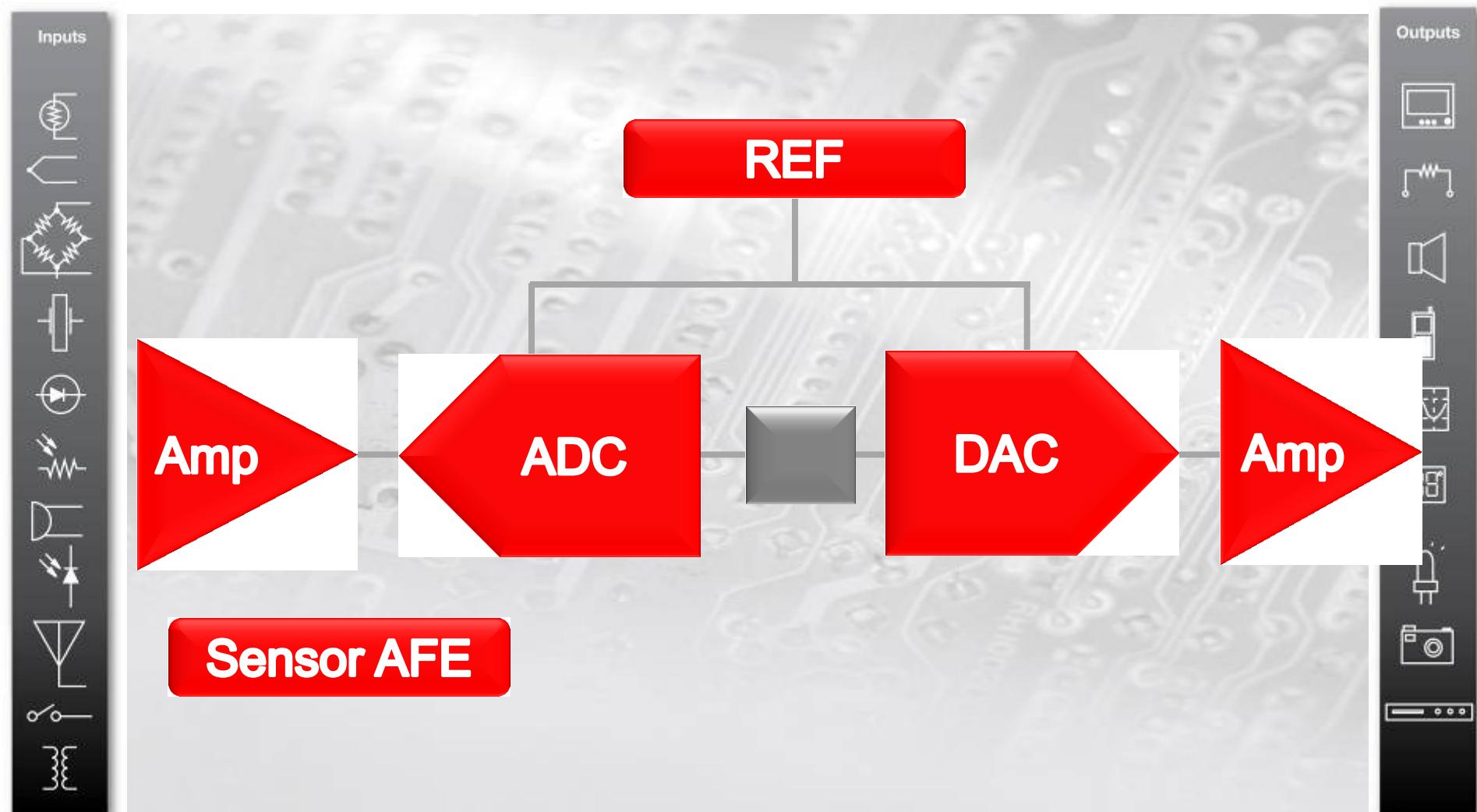


# Texas Instruments – Precision Analog Product Portfolio



# Amplifiers

## Value Line



## Integrated Function

### Instrumentation Amps



### Difference Amps



### 4-20mA Conditioning



### Comparators



### Programmable Gain Amps



## Low Voltage ( $V_s \leq 5.5V$ )

### Low Power ( $<100\mu A$ )



### Low Input Bias Current ( $\leq 100pA$ )



### Low Noise ( $\leq 25nV / \sqrt{Hz}$ )



### Wide Bandwidth (Up to 115MHz)



### Low Offset Voltage ( $\leq 500\mu V$ )



## Wide Supply ( $V_s > 5.5V$ )

### Low Input Bias Current ( $\leq 10pA$ )



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



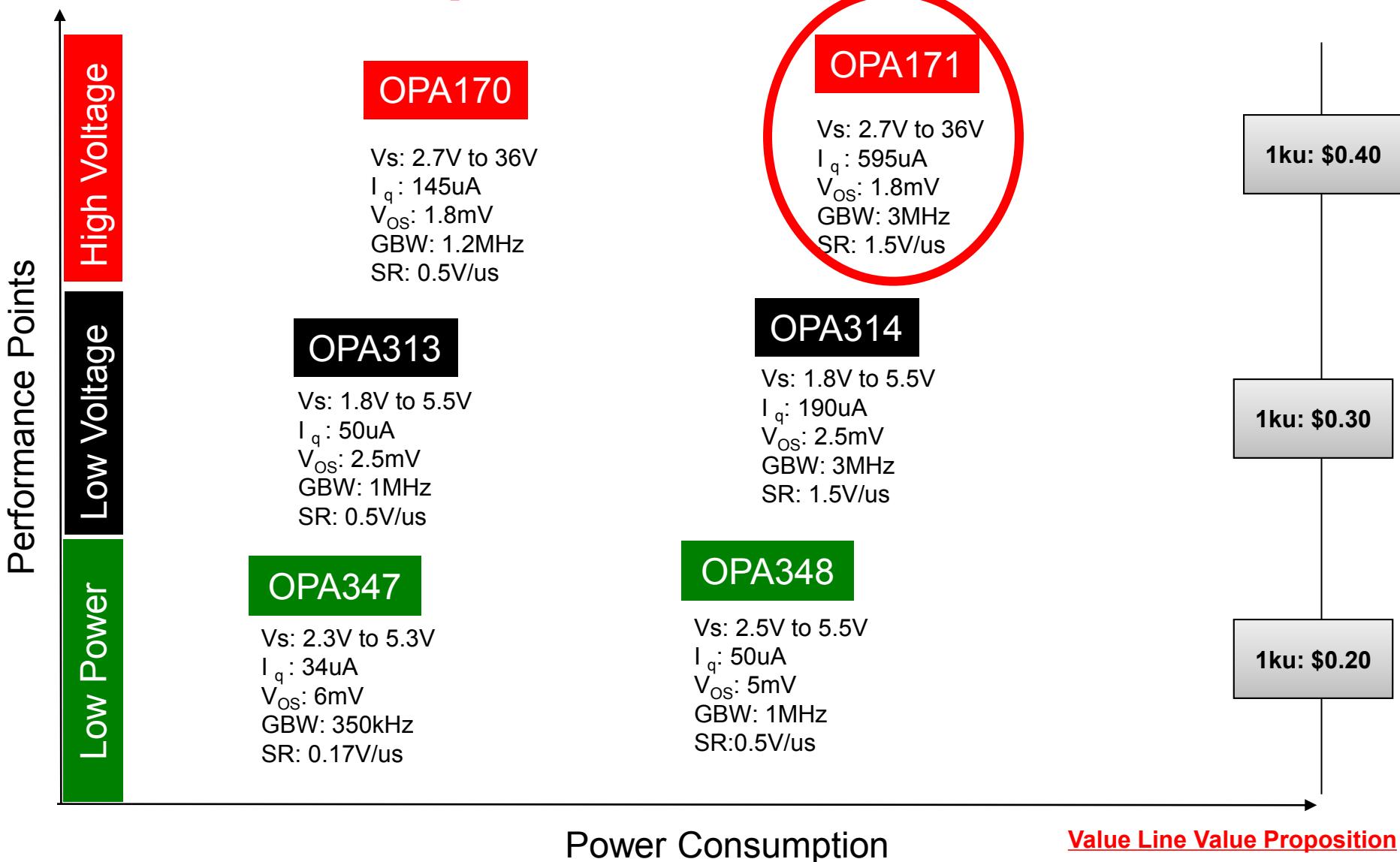
### Wide Bandwidth (GBW $\geq 5MHz$ )



### Low Offset Voltage ( $<500\mu V$ )



# Precision Amplifier Value Line Portfolio



# OPA171 / OPA2171 / OPA4171

Industry's smallest 36V Low Power RRO General Purpose Op Amp

## Features

- Industry's smallest 36V Packages:
  - Single in SOT553, Dual in VSSOP-8
- Rail to Rail Output
  - +2.7V to +36V or  $\pm 1.35V$  to  $\pm 18V$
  - High CMRR: 104dB
  - Low Noise:  $14nV/\sqrt{Hz}$  at 1kHz
- Low Quiescent Current:  $475\mu A/ch$
- DC Precision
  - Offset Voltage:  $1.8mV$  (max)
  - Offset Voltage Drift:  $0.3\mu V/^\circ C$
  - Low Bias Current:  $8pA$
- EMI/RFI Filtered Inputs
  - GBW: 3 MHz
- Slew Rate:  $1.5V/\mu s$

## Applications

- Tracking Amplifiers in Power Modules
- Merchant Power Supplies
- Transducer Amplifiers
- Strain Gage Amplifier
- Precision Integrator
- Battery Powered Instruments

## Benefits

- Micro-packages use >50% less board space than the larger SOT23 and MSOP packages
- Maximizes input voltage range for use with low voltage sensor outputs
  - Versatility in design for ease of use with different supply rail systems
- Enables battery powered operation
- Accuracy and stability over the entire industrial temperature range
- Improved noise immunity from wireless interference
- Wide Signal sources and fast response suitable to drive high performance ADCs

**OPA171**  
1ku: \$0.40

**OPA2171**  
1ku: \$0.60

**OPA4171**  
1ku: \$0.90



SOT23-5  
 $3 \times 3 \times 1.45$



VSSOP  
 $3.1 \times 2 \times 0.9$



SOT553  
 $1.6 \times 1.6 \times 0.6$

### Packaging options:

**Single:** SO-8, SOT23-5, SOT553  
**Dual:** SO-8, MSOP-8, VSSOP-8  
**Quad:** SO-14, TSSOP-14



# OPA314 / OPA2314 / OPA4314

1.8V | 3MHz | 190uA | RRIO General Purpose CMOS Amplifier

Features	Benefits
<ul style="list-style-type: none"><li>Best combination of Power and Performance</li><li>Iq: 190<math>\mu</math>A/ch (max)</li><li>Low Noise: 14nV/<math>\sqrt{\text{Hz}}</math> at 1kHz</li><li>Offset Voltage: 2.5mV (max)</li></ul>	<ul style="list-style-type: none"><li>Up to 30% lower noise than the nearest competitors – maintains high signal-to-noise ratios which is critical for low-level signal amplifications</li></ul>
<ul style="list-style-type: none"><li>Rail-to-Rail Input / Output</li><li>Supply Voltage: 1.8V to 5.5V</li><li>EMI/RFI Filtered Inputs</li></ul>	<ul style="list-style-type: none"><li>RRIO maximizes input dynamic range with full use of single supply range, enabling use in a very wide variety of applications</li></ul>
<ul style="list-style-type: none"><li>GBW: 3MHz</li></ul>	<ul style="list-style-type: none"><li>High gain bandwidth for fast pulse response - 47.5% better power to speed ratio than the nearest competitor</li></ul>
<ul style="list-style-type: none"><li>Low Ib: 0.2pA (typ)</li></ul>	<ul style="list-style-type: none"><li>~50% lower than nearest competitors – designed for high source impedance applications</li></ul>

## Applications

- Photodiode Amplifier
- Sensor Signal Conditioning
- Low-Side Current Sense
- CO/Smoke detectors
- Portable Medical and Instrumentation

### Package Options:

Single: SC70-5, SOT23-5

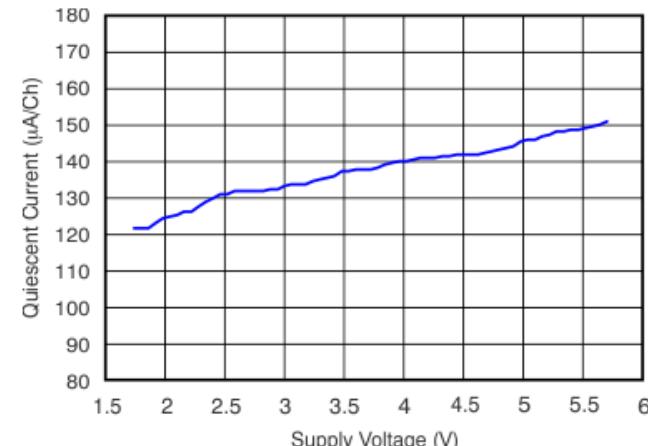
Dual: MSOP-8, SO-8, DFN-8

Quad: TSSOP-14

**OPA314**  
1ku: \$0.30

**OPA2314**  
1ku: \$0.45

**OPA4314**  
1ku: \$0.65

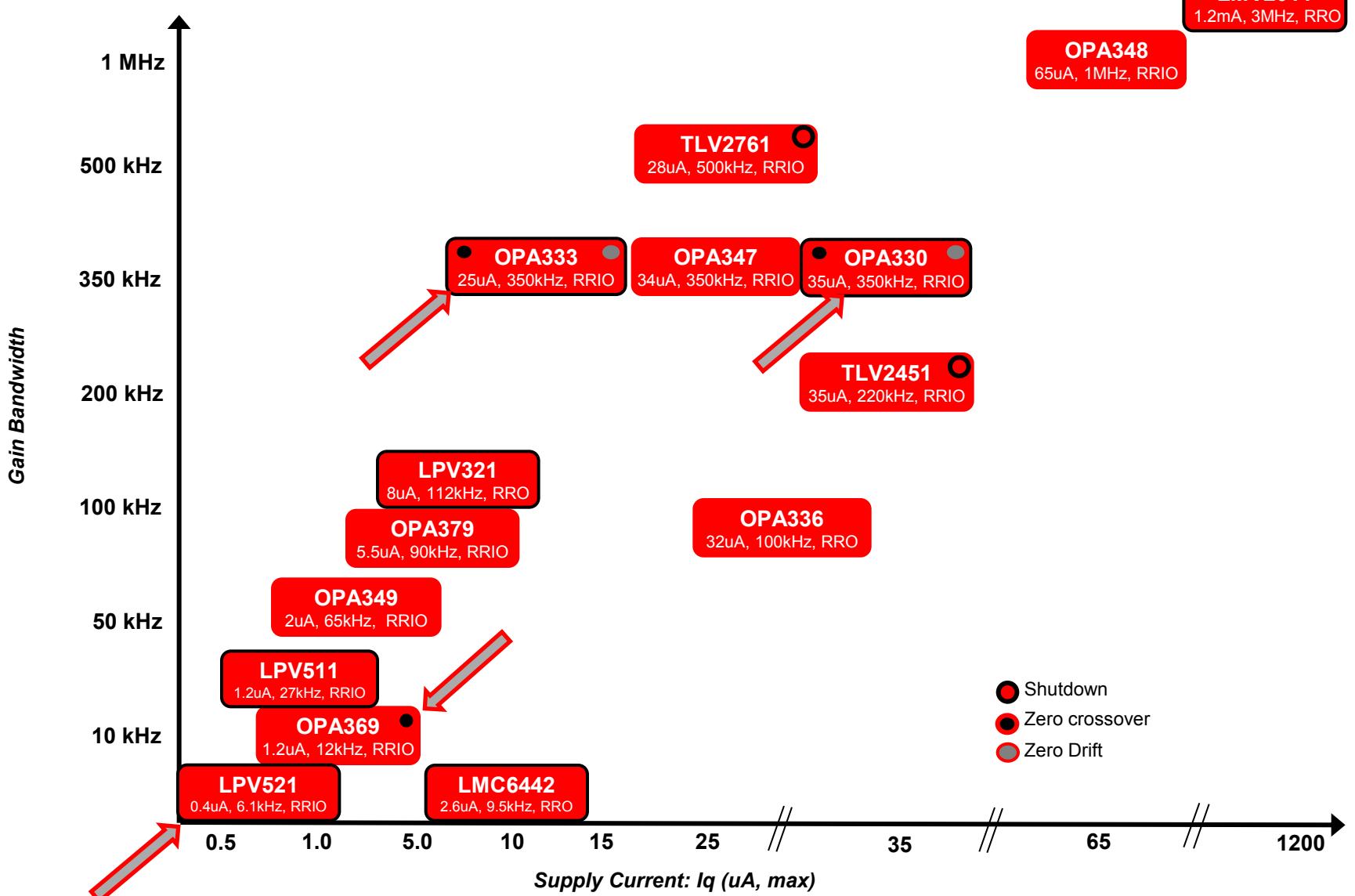


## Low Power Op-Amps

	Total Supply Voltage (Min) (+5V=5, +/-5V=10)	Total Supply Voltage (Max) (+5V=5, +/-5V=10)	Slew Rate (Typ)(V/ $\mu$ s)	V <sub>io</sub> (25°C) (Max) (mV)	V <sub>n</sub> @ 1kHz (Typ) (nV/ $\sqrt$ Hz)	I <sub>IB</sub> (Max)(pA)	CMRR (Min)(dB)	Shutdown	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>LPV511</u></a>	2.7	12	0.0077	3	320	1900	70		5SOT	0.45
<a href="#"><u>LMC6442</u></a>	1.8	11	0.0041	3	170	4	70		8PDIP, 8SOIC	1.02
<a href="#"><u>TLV2451</u></a>	2.7	6	0.11	1.5	51	5000	62		5SOT-23, 8PDIP, 8SOIC	0.6
<a href="#"><u>OPA333</u></a>	1.8	5.5	0.16	0.01	55	200	106		5SOT-23, 5SC70, 8SOIC	0.95
<a href="#"><u>OPA330</u></a>	1.8	5.5	0.16	0.05	55	500	100		5DSBGA, 5SC70, 5SOT-23, 8SOIC	0.45
<a href="#"><u>OPA336</u></a>	2.3	5.5	0.03	0.125	40	10	80		5SOT-23, 8SOIC	0.4
<a href="#"><u>OPA369</u></a>	1.8	5.5	0.005	0.75	290	50	100		5SC70	0.65
<a href="#"><u>LPV521</u></a>	1.6	5.5	0.0024	1	255	50	102		5SOT	0.49
<a href="#"><u>OPA379</u></a>	1.8	5.5	0.03	1.5	80	50	90		5SC70, 5SOT-23, 8SOIC	0.65
<a href="#"><u>OPA348</u></a>	2.1	5.5	0.5	5	35	10	70		5SC70, 5SOT-23, 8SOIC	0.2
<a href="#"><u>OPA347</u></a>	2.3	5.5	0.17	6	60	10	70		5SC70, 5SOT-23, 8PDIP, 8SOIC	0.2
<a href="#"><u>OPA349</u></a>	1.8	5.5	0.02	10	300	10	52		5SC70, 5SOT-23, 8SOIC	0.45
<a href="#"><u>LMV2011</u></a>	2.7	5	4	0.025	35	5	130		5SOT, 8SOIC	0.95
<a href="#"><u>TLV2761</u></a>	1.8	3.6	0.2	3.5	95	15	50	✓	5SOT-23, 8PDIP, 8SOIC	0.6



# Low Power Op-Amps



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to  
Parametric

NEW

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EXISTING

ROADMAP

# OPA333 | OPA2333

Lowest noise | Zero-Drift Operational Amplifier

## Features

Low Offset Voltage: **10 $\mu$ V (max)**

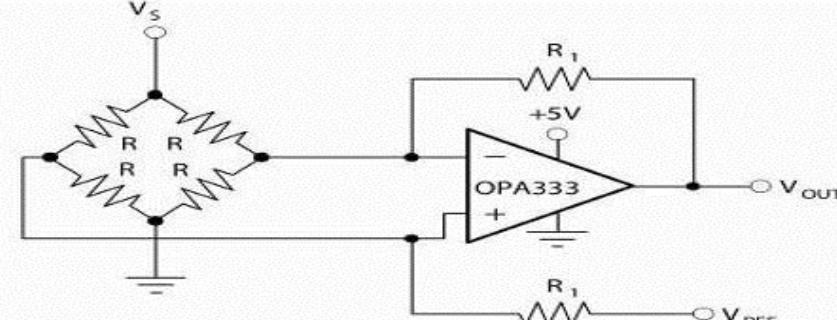
- Offset Voltage Drift: **0.05 $\mu$ V/ $^{\circ}$ C (max)**
- Very Low Noise:
  - **1.1 $\mu$ Vpp, 0.1 to 10Hz**
  - **55nV/ $\sqrt$ Hz @ 1kHz**
- Ultra-Low Quiescent Current: **25 $\mu$ A (max)**
- Supply Voltage **1.8V to 5.5V**
- Rail-to-Rail Input and Output
- EMI Input Filter

## Applications

- Battery-Powered Instruments
- Temperature Measurement
- Precision Strain Gages
- Precision Sensor Applications
- Medical Instrumentation
- Handheld Test Equipment

## Key Benefits

- 30% Lower Drift than the nearest competitor
- Low offset and drift removes need for calibration
- Lowest Noise among the competition enabling high gain without distortion
- 1.8V Supply and low Quiescent Current make this ideal for portable applications
- RRIO Increases Dynamic Range
- Minimizes EMI induced offset errors



Single Op Amp Bridge Amplifier

Packages: SC70-5, SOT23-5, SO-8, QFN-8, SO-8

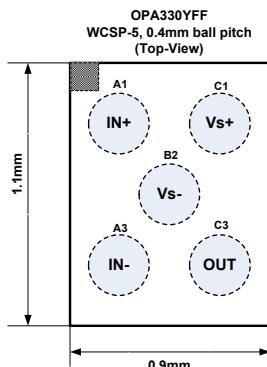


# OPA330/2330/4330

Single | Dual | Quad Micro-Power | Zero-Drift Operational Amplifier

## Features

- Economical alternative to OPA333
- Low Quiescent Current:
  - 25 $\mu$ A (typ), 35 $\mu$ A (max)
- Low Offset Voltage: 50 $\mu$ V (max)
- Offset Voltage Drift: 0.25 $\mu$ V/ $^{\circ}$ C (max)
- Low Noise: 1.1  $\mu$ V<sub>P-P</sub>
- Flat 1/f Noise
- Bandwidth: 350kHz
- Rail-to-Rail Input and Output
- 1.8V to 5.5V Supply Voltage
- OPA330YFF: WCSP – 1.1mm x 0.9mm, 5-ball
- EMI Input Filtered



## Benefits

- Best performance/price offering on the market
  - 30% lower 1k price than the competition
- Low Offset and Zero-Drift Removes need for Calibration
- No noise related errors especially for near DC and low frequency sensor signal applications.
- RRIO Increases Dynamic Range
- Tiny Chip-Scale Package Saves Board Space
  - 60% Space Savings over an SC70 package
- Input filtering enables precision performance in a RF sensitive environment

## Applications

- Battery-Powered Instruments
- Temperature Measurement
- Precision Strain Gages
- Precision Sensor Applications
- Handheld Test Equipment

# LPV511 / LPV521 / LPV531

## Micro/Nano-power Operational Amplifiers in Small Packages

Features	Benefits
<ul style="list-style-type: none"><li>• LPV511<ul style="list-style-type: none"><li>• <math>I_q = 1.2\mu A</math></li><li>• Supply voltage range: 2.7V to 12V</li><li>• Rail to Rail Input and Output</li><li>• Micro-package: SC70-5</li></ul></li><li>• LPV521 <b>World's Lowest supply current</b><ul style="list-style-type: none"><li>• <math>I_q = 400nA</math> max (704 <math>\mu W</math> @ 1.6V)</li><li>• Supply voltage: 1.6V to 5.5V</li><li>• Rail to Rail Input and Output</li><li>• Micro-package: SC70-5</li></ul></li><li>• LPV531 Programmable Power and Bandwidth<ul style="list-style-type: none"><li>• <math>I_q = 5\mu A</math> to 435<math>\mu A</math> (programmable)</li><li>• TSOT23-6 package</li></ul></li></ul>	<ul style="list-style-type: none"><li>• Microwatt Power Consumption</li><li>• Long Battery Life in Portable Applications</li><li>• Programmable supply current (LPV531)</li><li>• Minimum board area</li></ul>

## Applications

- Battery powered systems
- Security systems
- Micropower thermostats
- Solar powered systems
- Portable instrumentation
- Micropower filter
- Remote sensor amplifier

LPV511  
1ku: \$0.45

LPV521  
1ku: \$0.65

LPV531  
1ku: \$0.45

**Package Options:**  
**LPV511:** SC70-5  
**LPV521:** SC70-5  
**LPV531:** TSOT23-6

## Lowest Nanopower Op Amp



EVM PART 551012922-001/NOPB

# OPA369

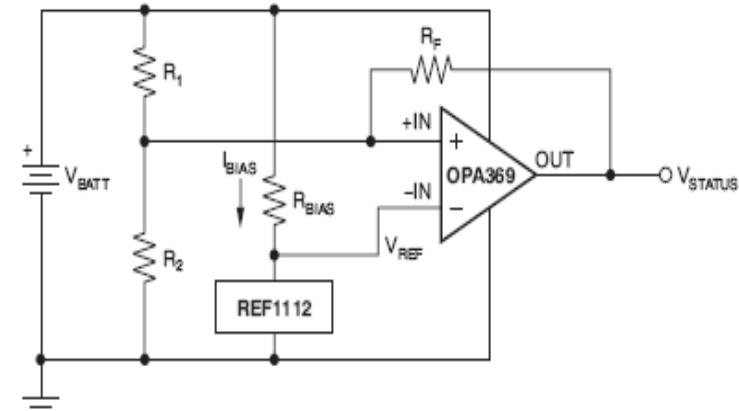
nanOPower | Zero-Crossover | RRIO Precision Amp

## Features

- **nanOPower:**  
OPA369: **800nA**  
OPA2369: **700nA/amplifier**
- **ZERO-CROSSOVER**  
**LOW OFFSET VOLTAGE: 250uV**  
Linear Offset over ENTIRE Input Range
- **RAIL-TO-RAIL INPUT/OUTPUT**
- **LOW OFFSET DRIFT: 0.4uV/°C**
- **DC PRECISION:**  
CMRR: **114dB**  
PSRR: **106dB**  
AOL: **134dB**
- **GAIN BANDWIDTH PRODUCT: 12kHz**  
**SUPPLY VOLTAGE: 1.8V to 5.5V**

## Benefits

- Excellent signal linearity over entire input common mode range
- RRIO maximizes input dynamic range with full use of single supply range
- Optimized for low power data acquisition



## Applications

- Portable Instrumentation
- Portable Medical
- Portable Consumer Devices
- Sensor Signal Conditioning
- Many more.....

### Battery Monitor Application

• Space Saving Packages: SC70, SOT23, MSOP



# Low Offset Voltage Op-Amps

	Total Supply Voltage (Min) (+5V=5, +/-5V=10)	Total Supply Voltage (Max) (+5V=5, +/-5V=10)	Slew Rate (Typ)(V/ $\mu$ s)	V <sub>io</sub> (25°C) (Max) (mV)	V <sub>n</sub> @ 1kHz (Typ) (nV/ $\sqrt$ Hz)	I <sub>IB</sub> (Max)(pA)	CMRR (Min)(dB)	Shutdown	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>OPA335</u></a>	2.7	5.5	1.6	0.005	62	200	110		5SOT-23, 8SOIC	1
<a href="#"><u>OPA334</u></a>	2.7	5.5	1.6	0.005	62	200	110	✓	6SOT-23	1
<a href="#"><u>LMP2021</u></a>	2.2	5.5	2.6	0.005	11	300	139		5SOT, 8SOIC	1.25
<a href="#"><u>OPA333</u></a>	1.8	5.5	0.16	0.01	55	200	106		5SOT-23, 5SC70, 8SOIC	0.95
<a href="#"><u>OPA376</u></a>	2.2	5.5	2	0.025	7.5	10	76		5SC70, 5SOT-23, 8SOIC	0.65
<a href="#"><u>OPA330</u></a>	1.8	5.5	0.16	0.05	55	500	100		5DSBGA, 5SC70, 5SOT-23, 8SOIC	0.45
<a href="#"><u>OPA378</u></a>	2.2	5.5	0.4	0.05	20	550	100		5SC70, 5SOT-23	0.7
<a href="#"><u>OPA336</u></a>	2.3	5.5	0.03	0.125	40	10	80		5SOT-23, 8SOIC	0.4
<a href="#"><u>OPA320</u></a>	1.8	5.5	10	0.15	8.5	0.9	100		5SOT-23	0.8
<a href="#"><u>OPA365</u></a>	2.2	5.5	25	0.2	13	10	100		5SOT-23, 8SOIC	0.65
<a href="#"><u>OPA364</u></a>	1.8	5.5	5	0.5	17	10	74		5SOT-23, 8SOIC	0.6
<a href="#"><u>OPA363</u></a>	1.8	5.5	5	0.5	17	10	74	✓	6SOT-23, 8SOIC	0.6

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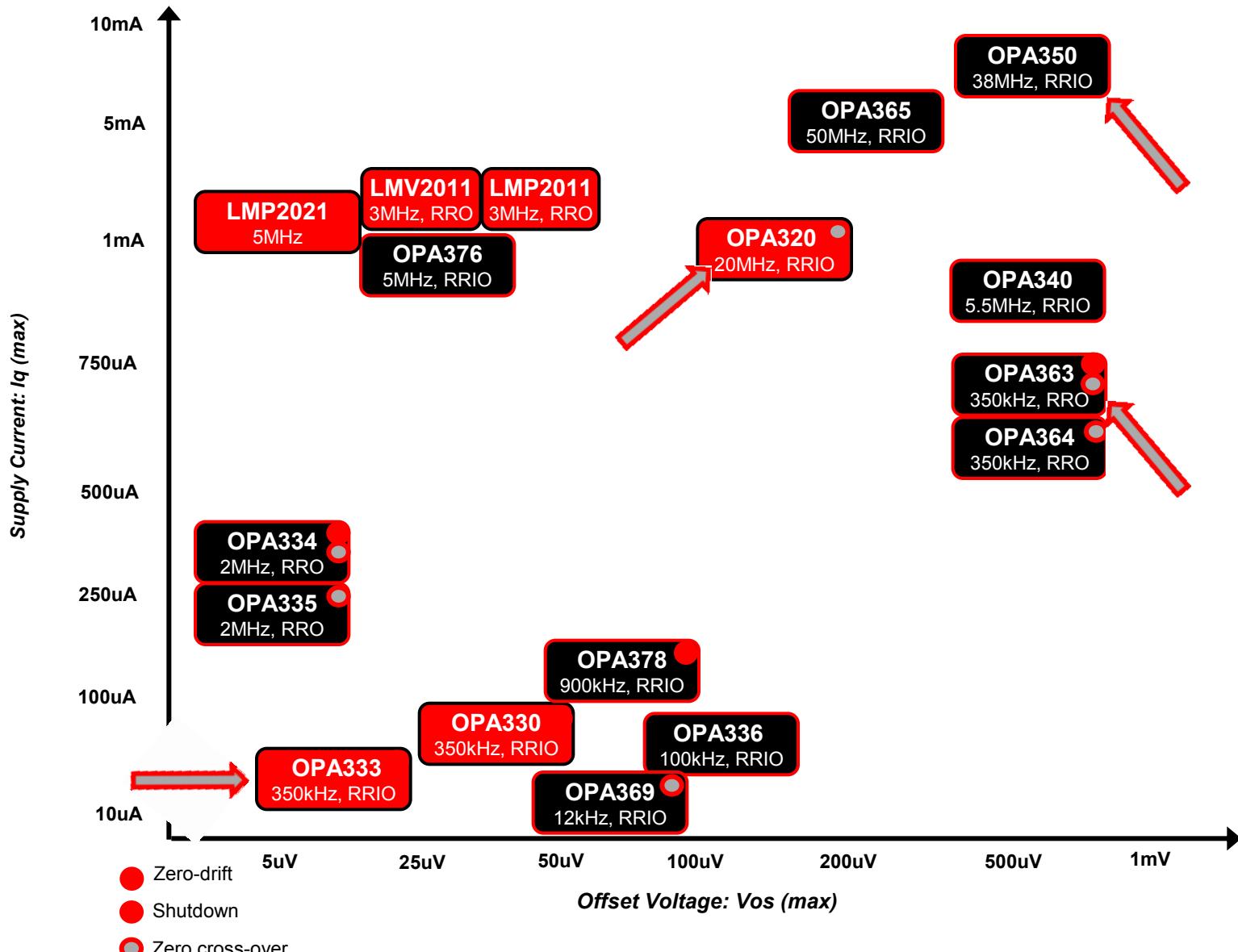
## Low Offset Voltage Op-Amps

	Total Supply Voltage (Min) (+5V=5, +/-5V=10)	Total Supply Voltage (Max) (+5V=5, +/-5V=10)	Slew Rate (Typ)(V/ $\mu$ s)	V <sub>io</sub> (25°C) (Max) (mV)	V <sub>n</sub> @ 1kHz (Typ) (nV/ $\sqrt$ Hz)	I <sub>IB</sub> (Max)(pA)	CMRR (Min)(dB)	Shutdown	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>OPA340</u></a>	2.7	5.5	6	0.5	25	10	80		5SOT-23, 8PDIP, 8SOIC	0.95
<a href="#"><u>OPA350</u></a>	2.7	5.5	22	0.5	18	10	74		8MSOP, 8PDIP, 8SOIC	1.15
<a href="#"><u>OPA369</u></a>	1.8	5.5	0.005	0.75	290	50	100		5SC70	0.65
<a href="#"><u>LMV2011</u></a>	2.7	5	4	0.025	35	5	130		5SOT, 8SOIC	0.95
<a href="#"><u>LMP2011</u></a>	2.7	5	4	0.025	35	5	130		5SOT, 8SOIC	1.05

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# OPA333 | OPA2333

Lowest noise | Zero-Drift Operational Amplifier

## Features

Low Offset Voltage: **10 $\mu$ V (max)**

- Offset Voltage Drift: **0.05 $\mu$ V/ $^{\circ}$ C (max)**

- Very Low Noise:

- **1.1 $\mu$ Vpp, 0.1 to 10Hz**
- **55nV/ $\sqrt$ Hz @ 1kHz**

- Ultra-Low Quiescent Current: **25 $\mu$ A (max)**

- Supply Voltage **1.8V to 5.5V**

- Rail-to-Rail Input and Output

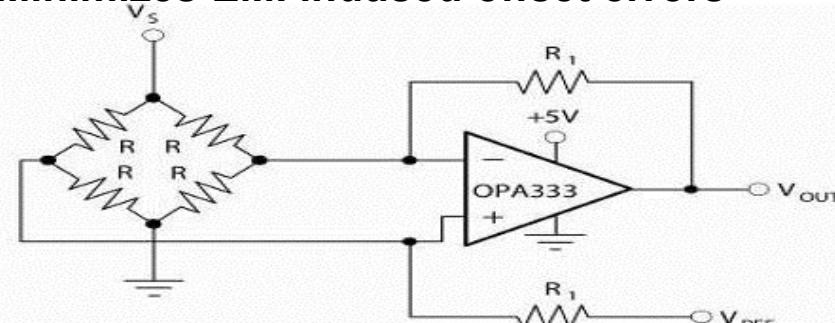
- EMI Input Filter

## Applications

- Battery-Powered Instruments
- Temperature Measurement
- Precision Strain Gages
- Precision Sensor Applications
- Medical Instrumentation
- Handheld Test Equipment

## Key Benefits

- 30% Lower Drift than the nearest competitor
- Low offset and drift removes need for calibration
- Lowest Noise among the competition enabling high gain without distortion
- 1.8V Supply and low Quiescent Current make this ideal for portable applications
- RRIO Increases Dynamic Range
- Minimizes EMI induced offset errors



Single Op Amp Bridge Amplifier

Packages: SC70-5, SOT23-5, SO-8, QFN-8, SO-8



# OPA320 / OPA2320

Precision 20MHz | Ib=0.9pA | RRIO CMOS Op Amp

## Features

- Precision with Zero Crossover Distortion
  - Low Offset Voltage: 150 $\mu$ V (max)
  - High CMRR: 114dB
  - Rail-to-Rail I/O
- Wide Gain-Bandwidth: 20MHz
  - High Slew-rate: 10V/us
  - Low Noise: 7nV/ $\sqrt$ Hz at 10kHz
- Input bias: 0.9pA (max)
- Supply Voltage: 1.8V to 5.5V
  - Quiescent Current: 1.6mA/ch, max

## Benefits

- Assures high precision and excellent signal linearity over the entire input common mode range making it ideal for driving sampling ADCs
- Wide GBW and slew rate for frequency and time domain applications and 16-bit resolution systems
  - 35% lower noise than the OPA365
- Lowest input bias current of 5V CMOS op amps for supporting high source impedance applications
- Excellent power/bandwidth ratio (80 $\mu$ A/MHz) resulting in 50% higher efficiency operation than the OPA376

## Applications

- Transimpedance Amplifier
- Precision Data Acquisition Systems
- High-Z Sensors and Signal Conditioning
- Programmable Logic Controllers (PLCs)
- Motor Control Loops
- Active Filters

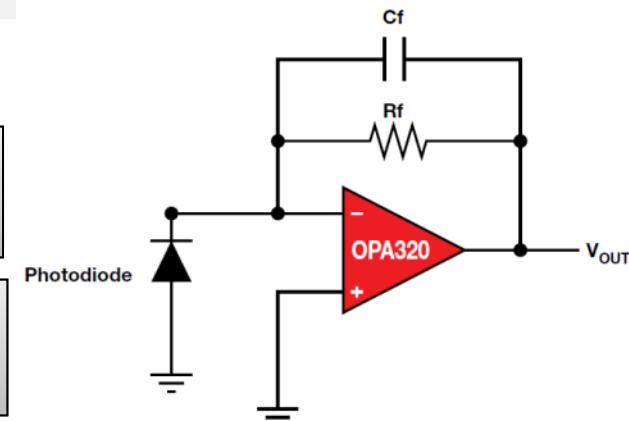
Packaging options:

Single: SOT23-5

Dual: MSOP-8, SON-8

**OPA320**  
1ku: \$0.80

**OPA2320**  
1ku: \$1.25



# OPA350

High-speed | single-supply | rail-to-rail op amp

## Features

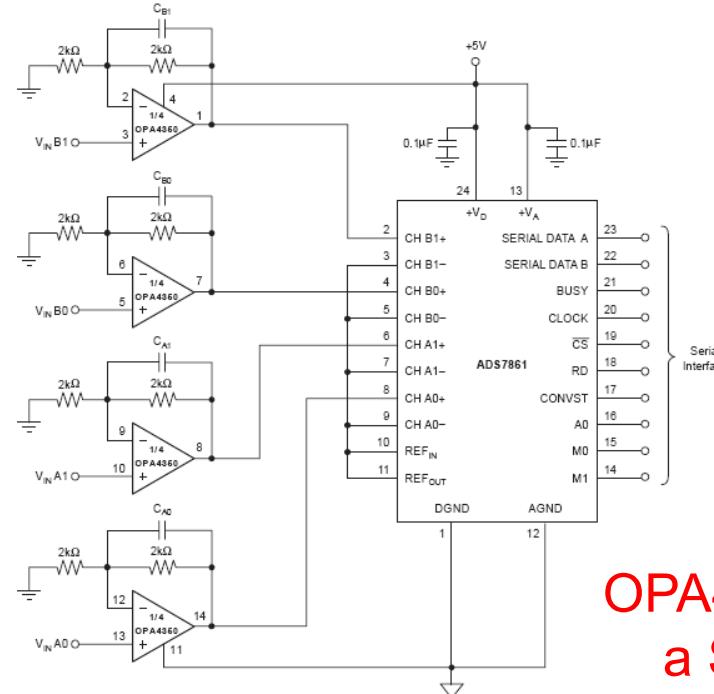
- Rail-to-rail input
- Rail-to-rail output (within 10mV)
- Wide bandwidth: 38MHz
- High slew rate: 22V/ $\mu$ s
- Low offset: 500 $\mu$ V max
- Low noise: 5nV/ $\sqrt{\text{Hz}}$
- Low THD + Noise: 0.0006%
- -55°C to 150°C operation

## Applications

- Mobile phone PA control loop
- Driving A/D converters
- Data acquisition systems
- Process control
- Audio processing
- Communications
- Active filters
- Test equipment

## Benefits

- Rail-to-rail CMOS op amp optimized for driving SAR ADC's
- Excellent combination of AC performance and DC precision
- Well suited for mobile phone PA control loops



OPA4350 driving  
a SAR ADC



# OPA363 / OPA364

Zero-Crossover | RRIO | 7MHz Single Supply Amplifier

## Features

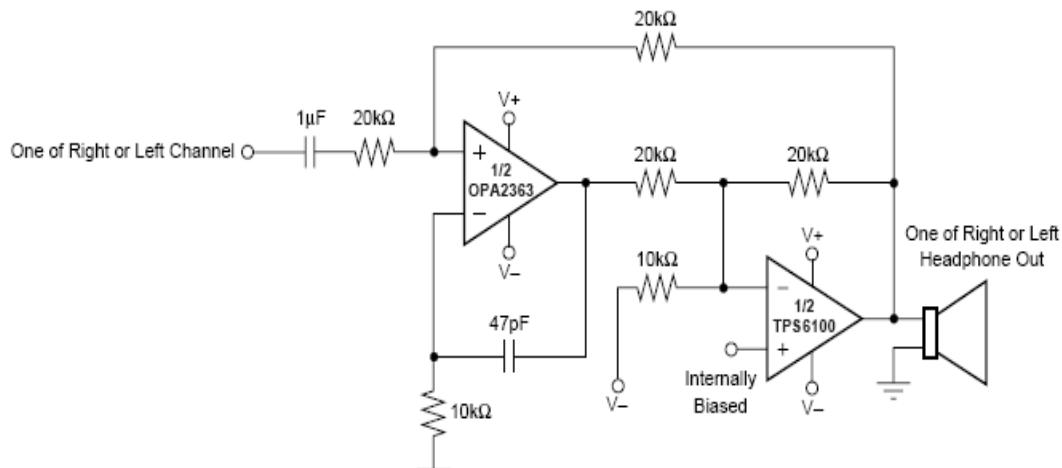
- Zero-Crossover Input Topology
  - Low Power: **750µA**
  - Excellent CMRR: **90dB**
  - Rail-to-rail input/Output  
Input 100mV Beyond Supply Rails
  - Linear CMR over entire input range
- Speed:
  - Gain bandwidth: 7MHz
- Low offset: 500µV
- **1.8V to 5.5V operation**
- Single, Dual, Quad Available

## Applications

- Handheld Test and Measurement
- Single Supply Data Acquisition
- Active Filters
- Portable Audio

## Benefits

- Excellent signal linearity over entire input common mode range
- RRIO maximizes input dynamic range with full use of single supply range
- Optimized for low power performance applications



OPA363 as a Half Stereo Headphone Driver

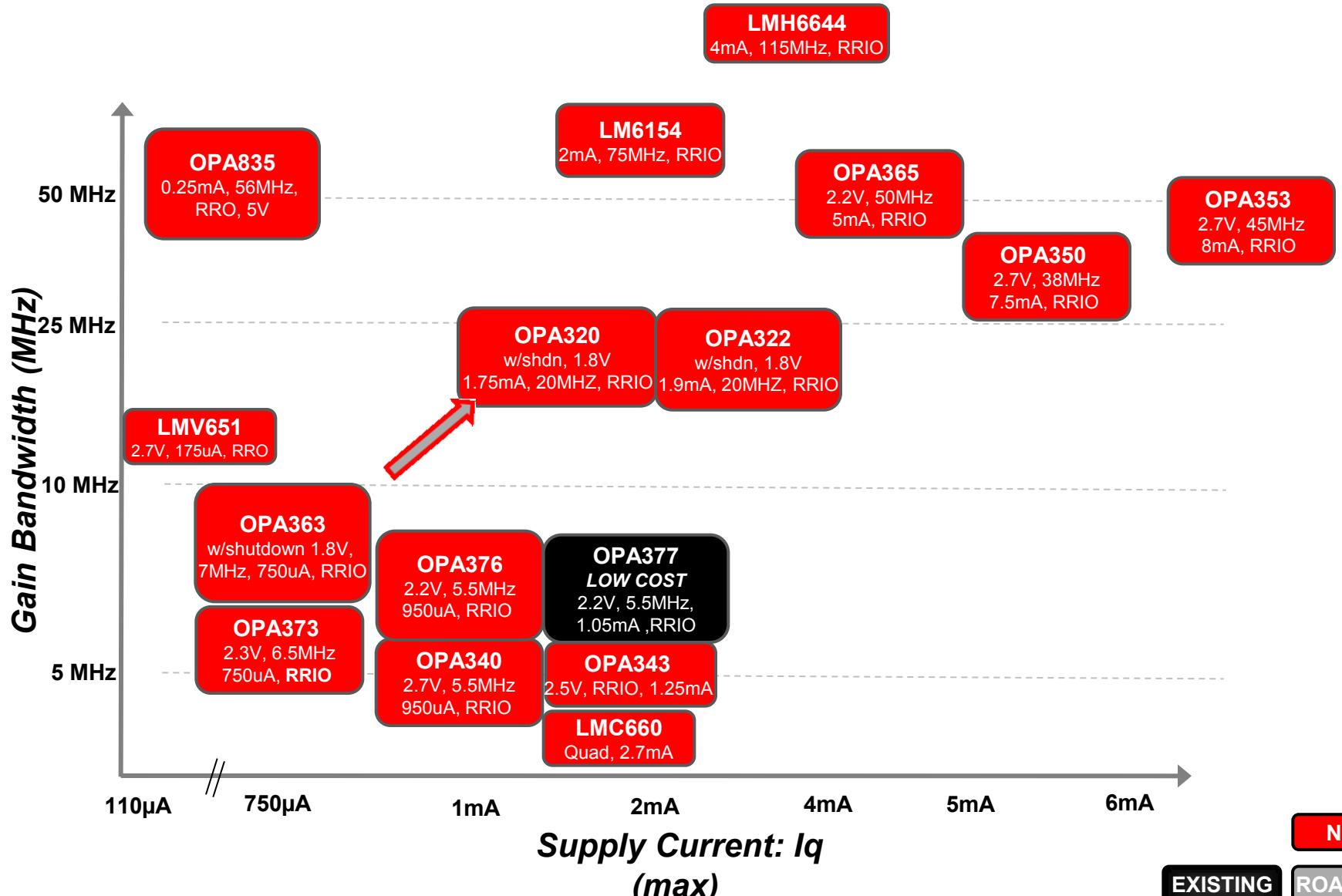


## Wide Bandwidth Op-Amps

	Total Supply Voltage (Min)	Total Supply Voltage (Max)	Slew Rate (Typ)(V/ $\mu$ s)	V <sub>io</sub> (25°C) (Max) (mV)	V <sub>n</sub> @ 1kHz (Typ) (nV/ $\sqrt$ Hz)	I <sub>IB</sub> (Max)(pA)	CMRR (Min)(dB)	Shutdown	Pin/Pkg	Approx. Price (US\$)
<a href="#">LM6154</a>	2.7	24	30	5	9	1500000	70		14SOIC	2.7
<a href="#">LMC660</a>	4.75	15.5	1.1	3	22	2	70		14PDIP, 14SOIC	0.74
<a href="#">LMH6644</a>	2.7	12.8	135	5	17	2.6uA	72		14SOIC, 14TSSOP	1.3
<a href="#">OPA376</a>	2.2	5.5	2	0.025	7.5	10	76		5SC70, 5SOT-23, 8SOIC	0.65
<a href="#">OPA320</a>	1.8	5.5	10	0.15	8.5	0.9	100		5SOT-23	0.8
<a href="#">OPA365</a>	2.2	5.5	25	0.2	13	10	100		5SOT-23, 8SOIC	0.65
<a href="#">OPA363</a>	1.8	5.5	5	0.5	17	10	74		6SOT-23, 8SOIC	0.6
<a href="#">OPA340</a>	2.7	5.5	6	0.5	25	10	80		5SOT-23, 8PDIP, 8SOIC	0.95
<a href="#">OPA350</a>	2.7	5.5	22	0.5	18	10	74		8MSOP, 8PDIP, 8SOIC	1.15
<a href="#">OPA377</a>	2.2	5.5	2	1	7.5	10	70		5SC70, 5SOT-23, 8SOIC	0.4
<a href="#">LMV651</a>	2.7	5.5	2.8	1.5	17	100000	90		5SOT	0.4
<a href="#">OPA322</a>	1.8	5.5	10	2	8.5	10	90	✓	5SOT-23, 6SOT-23	0.5
<a href="#">OPA373</a>	2.3	5.5	5	5	30	10	80		6SOT-23, 8SOIC	0.36
<a href="#">OPA353</a>	2.7	5.5	22	8	18	10	76		5SOT-23, 8SOIC	1
<a href="#">OPA835</a>	2.5	5.5	160	0.5	9.3	400000	88	✓	10QFN, 6SOT-23	0.85



# Wide Bandwidth Op-Amps



# OPA320 / OPA2320

Precision 20MHz | Ib=0.9pA | RRIO CMOS Op Amp

## Features

- Precision with Zero Crossover Distortion
  - Low Offset Voltage: 150 $\mu$ V (max)
  - High CMRR: 114dB
  - Rail-to-Rail I/O
- Wide Gain-Bandwidth: 20MHz
  - High Slew-rate: 10V/us
  - Low Noise: 7nV/ $\sqrt$ Hz at 10kHz
- Input bias: 0.9pA (max)
- Supply Voltage: 1.8V to 5.5V
  - Quiescent Current: 1.6mA/ch, max

## Benefits

- Assures high precision and excellent signal linearity over the entire input common mode range making it ideal for driving sampling ADCs
- Wide GBW and slew rate for frequency and time domain applications and 16-bit resolution systems
  - 35% lower noise than the OPA365
- Lowest input bias current of 5V CMOS op amps for supporting high source impedance applications
- Excellent power/bandwidth ratio (80 $\mu$ A/MHz) resulting in 50% higher efficiency operation than the OPA376

## Applications

- Transimpedance Amplifier
- Precision Data Acquisition Systems
- High-Z Sensors and Signal Conditioning
- Programmable Logic Controllers (PLCs)
- Motor Control Loops
- Active Filters

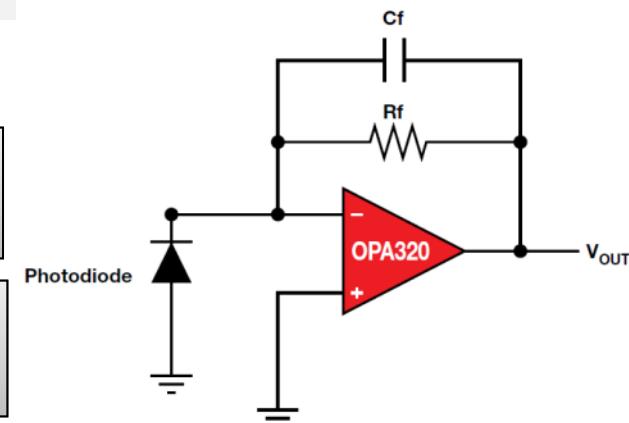
Packaging options:

Single: SOT23-5

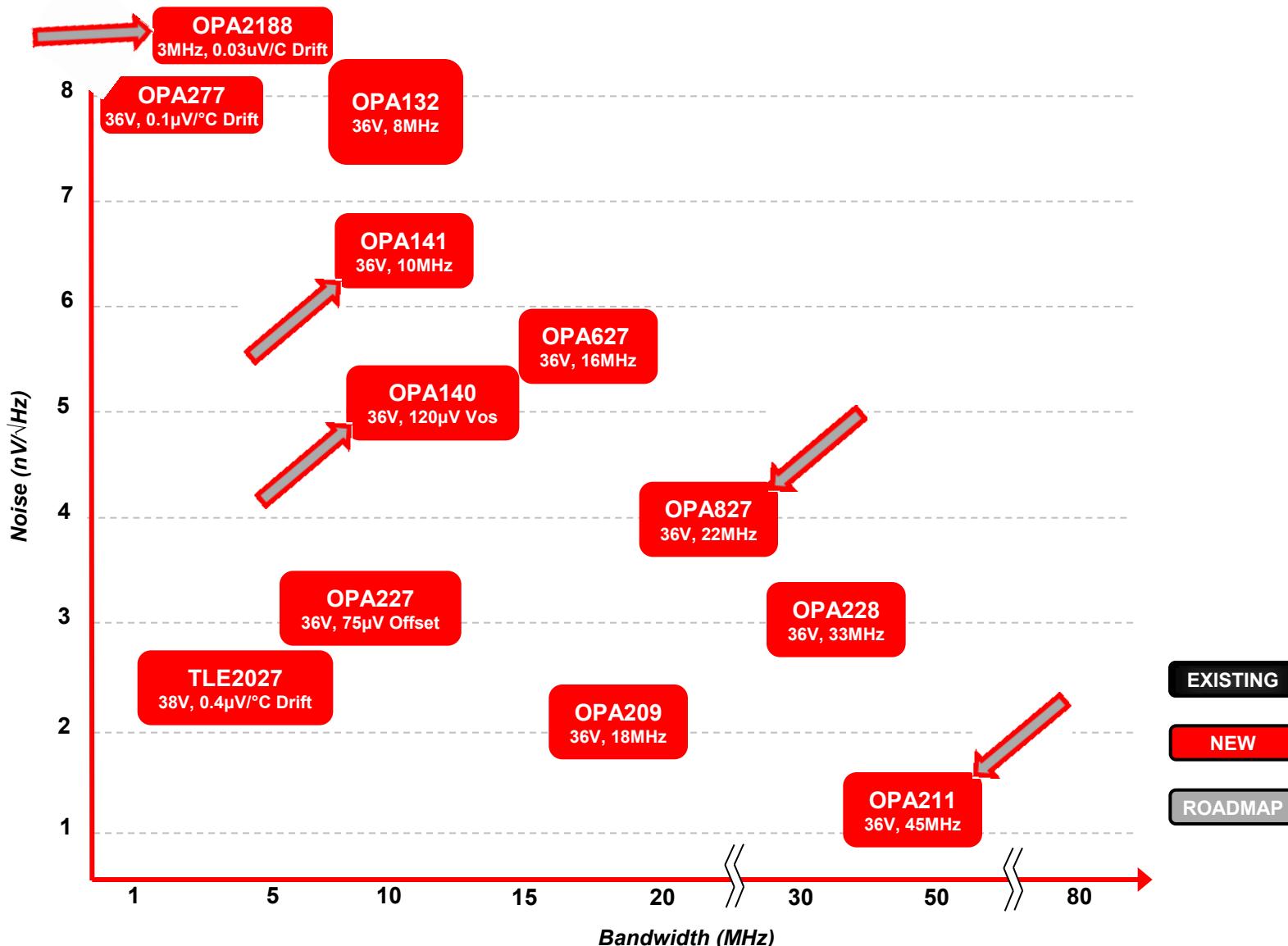
Dual: MSOP-8, SON-8

**OPA320**  
1ku: \$0.80

**OPA2320**  
1ku: \$1.25



# Low Noise Op-Amps



## Low Noise Op-Amps

	Total Supply Voltage (Min) (+5V=5, +/-5V=10)	Total Supply Voltage (Max) (+5V=5, +/-5V=10)	Slew Rate (Typ)(V/ $\mu$ s)	V <sub>io</sub> (25°C) (Max) (mV)	V <sub>n</sub> @ 1kHz (Typ) (nV/ $\sqrt{\text{Hz}}$ )	I <sub>IB</sub> (Max)(pA)	CMRR (Min)(dB)	Shutdown	PSRR(dB)	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>TLE2027</u></a>	8	38	2.8	0.1	2.5	90000	100			8SOIC	0.9
<a href="#"><u>OPA277</u></a>	4	36	0.8	0.02	8	1000	130			8PDIP, 8SOIC, 8VSON	0.85
<a href="#"><u>OPA2188</u></a>	4	36	0.8	0.025	8.8	850	120			8MSOP, 8SOIC	1.4
<a href="#"><u>OPA211</u></a>	4.5	36	27	0.05	1.1	125000	114	No		8MSOP, 8SOIC, 8SON	5.15
<a href="#"><u>OPA140</u></a>	4.5	36	20	0.12	5.1	10	126			8MSOP, 8SOIC, 5SOT-23	1.55
<a href="#"><u>OPA209</u></a>	4.5	36	6.4	0.15	2.2	4500	120	No		5SOT-23, 8MSOP, 8SOIC	0.95
<a href="#"><u>OPA827</u></a>	8	36	28	0.15	4	50	114	No		8MSOP, 8SOIC	3.75
<a href="#"><u>OPA627</u></a>	9	36	55	0.25	5.6	10	100			8PDIP, 8SOIC	12.25
<a href="#"><u>OPA132</u></a>	5	36	20	0.5	8	50	96			8SOIC	1.45
<a href="#"><u>OPA141</u></a>	4.5	36	20	3.5	6.5	20	120			8MSOP, 8SOIC	0.85
<a href="#"><u>OPA227</u></a>	5	36	2.3	0.075	3	10000	120	No		8PDIP, 8SOIC	1.1
<a href="#"><u>OPA228</u></a>	5	36	11	0.075	3	10000	120	No		8PDIP, 8SOIC	1.1



# OPA188 / OPA2188 / OPA4188

## 0.03 $\mu$ V/ $^{\circ}$ C | 25 $\mu$ V Vos | 36V Zerø-Drift Operational Amplifier

### Features

- Very Low Offset and Drift
  - Offset Voltage: 25 $\mu$ V (max)
  - Offset Voltage Drift: 0.085 $\mu$ V/ $^{\circ}$  C max
  - CMRR, PSRR, AOL = 130dB (min)
- Noise Voltage: 8.8nV/ $\sqrt$ Hz at 1kHz
  - Noise voltage at 0.1Hz to 10Hz: 0.25uVpp
- GBW : 2MHz
  - Low Quiescent Current: 475 $\mu$ A (max)
- Low Bias Current: 160pA (typ)
- Supply Range: +4.0V to +36V or  $\pm$ 2V to  $\pm$ 18V
  - Rail to Rail Output
  - EMI/RFI Filtered Inputs
  - Input common mode range extending from negative rail to within 1.5V of the positive rail

### Applications

- Electronic Weigh Scales
- Bridge Amplifier
- Strain Gauge
- Automated Test Equipment
- Transducer amplifier
- Medical Instrumentation
- Resistor Thermal Detector

### Benefits

- Improved high accuracy and stability
  - Over the previous generation OPA277: 91.5% better input offset drift (max)
  - Over nearest competition: 58% lower input offset voltage (max) and 88% lower input offset voltage drift (max)
- Allows for high sensitivity, high resolution systems
- Better power to speed ratio: nearest competitor has a max quiescent current of 500 $\mu$ A, but GBW at 1.3MHz. This ratio is about 62% higher than the OPA2188
- Typically, OPA2188 will have 68% less error caused by input bias current , than the nearest competition
- Flexibility in design, enabling low power 5V single supply operation. Nearest competitor part's minimum input range is at 1.5V from negative rail, thus no single supply operation is possible.

#### Packaging options:

Single: SO-8, MSOP-8, SOT-23

Dual: SO-8, MSOP-8

Quad: SO-14, TSSOP-14

(Released / Sampling / Preview)

OPA188  
1ku: \$0.80  
RTM 1Q'13

OPA2188  
1ku: \$1.40

OPA4188  
1ku: \$2.45



# OPA140 / OPA2140 / OPA4140

## 11MHz Precision Low Noise RRO JFET Operational Amplifier

### Features

- Very Low Offset and Drift
  - Offset Voltage:  $120\mu\text{V}$  (max)
  - Offset Drift:  $1\mu\text{V}/^\circ\text{C}$  (max)
- Low Noise:  $5.1\text{nV}/\sqrt{\text{Hz}}$  (1kHz)
  - 1/f Noise:  $250\text{nVpp}$  (0.1-10Hz)
- FET Input:  $I_B = 10\text{pA}$  (max)
- GBW: 11MHz
  - Slew Rate:  $20\text{V}/\mu\text{s}$
- Wide Supply Range:
  - $+4.5\text{V}$  to  $+36\text{V}$  or  $\pm 2.25\text{V}$  to  $\pm 18\text{V}$
  - Low power:  $2.0\text{mA}/\text{ch}$

### Benefits

- Guaranteed high accuracy and stability over the full industrial temperature range
- Allows for high sensitivity, high resolution systems across a wide frequency range
- Better matching to high impedance sources such as sensor outputs
  - 60% lower  $I_B$  than previous generation OPA132
- High GBW and slew rate make it ideal for driving 16-bit ADC's
- Enabling low power 5V supply systems
  - 13% less power consumption per channel vs. competition

### Applications

- Sensor Signal Conditioning
- Security Scanner
- Photodiode Measurement
- Active Filters
- Medical Instrumentation

#### Packaging options:

Single: SO-8, MSOP-8, SOT-23

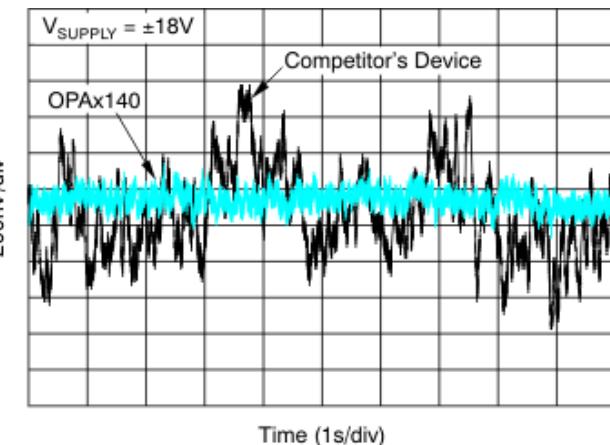
Dual: SO-8, MSOP-8

Quad: SO-14, TSSOP-14

**OPA140**  
1ku: \$1.55

**OPA2140**  
1ku: \$2.70

**OPA4140**  
1ku: \$4.75



# OPA141 / OPA2141 / OPA4141

10MHz | Precision FET-Input Op Amp

## Features

- FET Input:  $I_B = 20\text{pA}$  (max)
- Offset Drift:  $10\mu\text{V}/^\circ\text{C}$  (max)
  - Initial Offset : 1mV
- Low Noise
  - Voltage Noise:  $6.5\text{nV}/\sqrt{\text{Hz}}$  (1kHz)
  - 1/f Noise:  $250\text{nVpp}$  (0.1-10Hz)
- Single Supply and RRO
- Wide Supply Voltage Range
  - +4.5V to +36V or +2.25V to +18V

1ku @ \$0.85

RTM March 2010

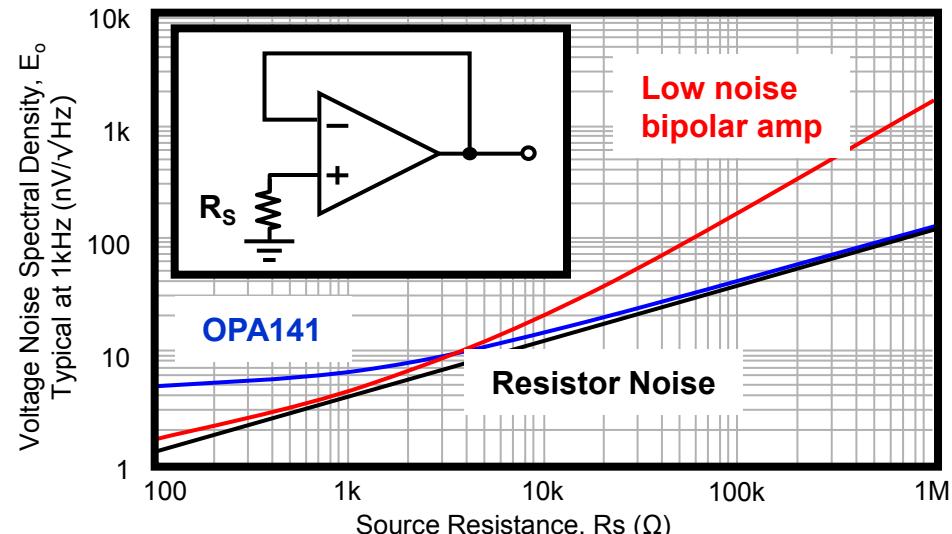
Packaging options  
Single: SO-8, MSOP-8  
Dual: SO-8, MOP-8  
Quad: TSSOP-14, SO-14

## Applications

- Sensor Signal Conditioning
- Security Scanner
- Photodiode Measurement
- Active Filters
- Medical Instrumentation

## Benefits

- 75% lower  $I_B$  for better matching to high impedance sources.
- 37% lower drift for stability over temp.
- Lowest voltage noise and lowest 1/f noise, 90% less than nearest competitor, provides a low noise solution across full operating frequency range at only 2.3mA/ch (max).
- Only device in this class to include V- on input CMV
- Operates with voltage supplies 50% lower than competition



# OPA211 / OPA211A and OPA2211A

Lowest Power  $1.1\text{nV}/\sqrt{\text{Hz}}$  | 36V Op Amp

## Features

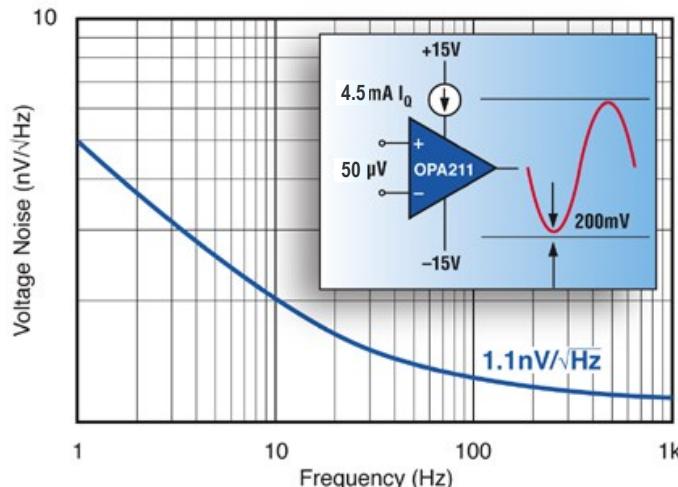
- Low Noise Bipolar Input:  $1.1\text{nV}/\sqrt{\text{Hz}}$  at 1kHz
- Low Offset Voltage:  $50\mu\text{V}^*$  (max)
  - $125\mu\text{V}$  (max, OPA211AI)
  - $150\mu\text{V}$  (max, OPA2211AI)
- Low Drift:  $1.5\mu\text{V}/^\circ\text{C}$ ,  $0.85\mu\text{V}/^\circ\text{C}^*$  (max)
- Low Quiescent Current:  $4.5\text{mA}/\text{ch}$  (max)
- Wide Gain Bandwidth: 80MHz @ G=100
- Wide Supply Range:  $\pm 2.25$  to  $\pm 18\text{V}$
- Rail-to-Rail Output (unique in industry)
- Packaging: DFN-8, MSOP-8, SO-8 (Single)  
DFN-8, SO-8 (Dual)

\*High-Grade Specification

OPA211 1ku @ \$5.15  
OPA211A 1ku @ \$3.45  
OPA2211A 1ku @ \$5.20

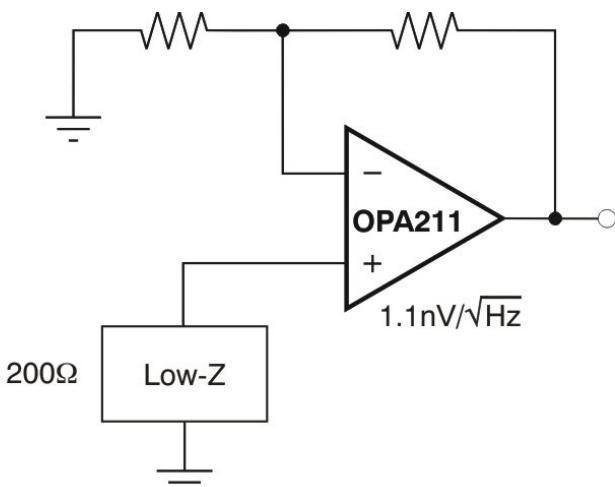
## Applications

- Test & Measurement
- Instrumentation
- Imaging
- Medical
- Audio
- Process Control
- And many more



## Benefits

- Provides Minimal Signal Distortion
- Very High Signal Accuracy
- Minimal Offset Change Over Temp
- Lowest Power at this Noise Level
- Very Wide Dynamic Range
- Spans 5V to Full Industrial Range
- Maximum Amplification at any Vcc Range
- Smallest Package at Performance Node
- Lowest Priced 36V,  $1.1\text{nV}/\sqrt{\text{Hz}}$  Amplifier



Op Amp Noise < Resistance (R) Noise

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# OPA827

Lowest Noise | JFET | 36V Operational Amplifier

## OPA827 Features

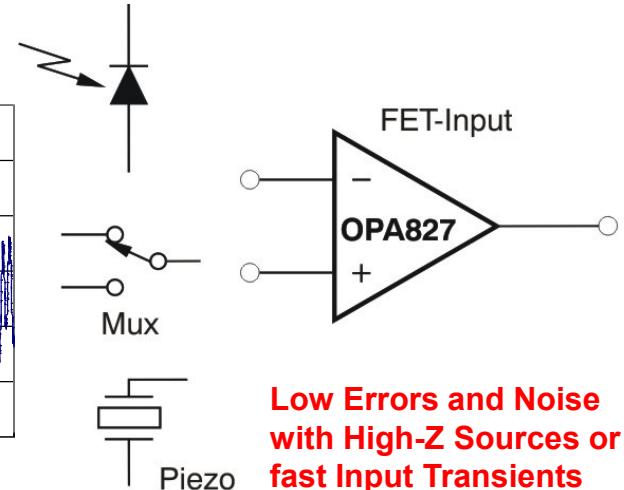
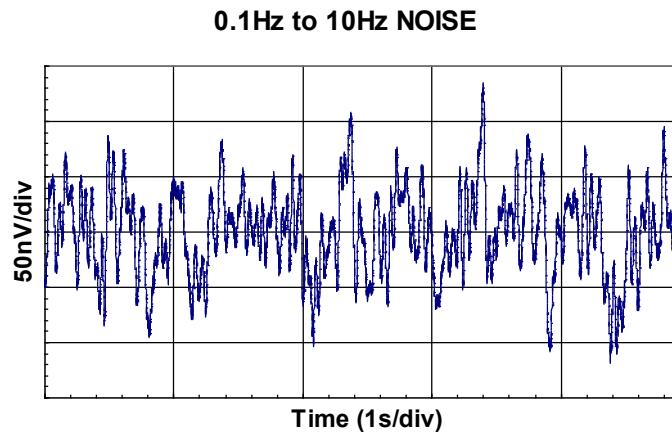
- ◆ Low Noise Voltage:  $4\text{nV}/\sqrt{\text{Hz}}$  at 1kHz
- ◆ Low Offset Voltage:  $150\mu\text{V}$  max
- ◆ JFET Input:  $I_B = 15\text{pA}$  typ
- ◆ Low Quiescent Current:  $4.8\text{mA}$  typ
- ◆ Wide Supply Range:  $\pm 4\text{V}$  to  $\pm 18\text{V}$
- ◆ Low Distortion: -128dB THD+N
- ◆ Wide Bandwidth: 22MHz
- ◆ Packaging: MSOP-8, SO-8
- ◆ Pricing: \$5.75 in 1k units

## Benefits

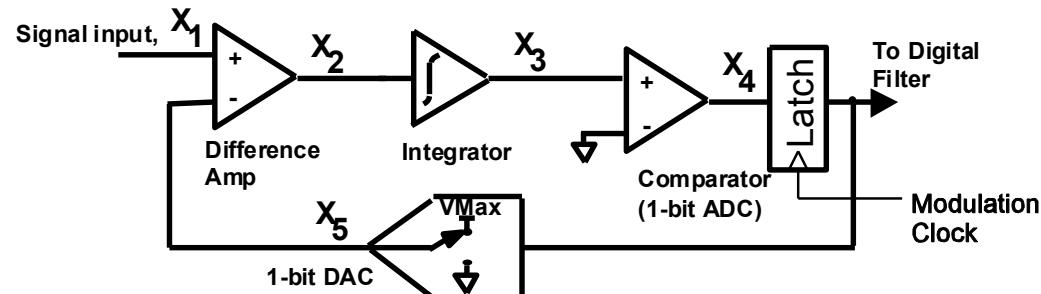
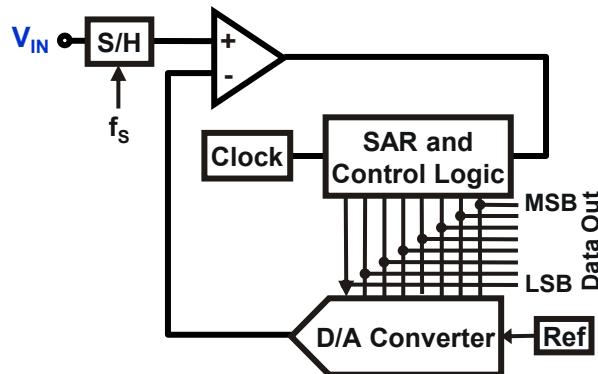
- ◆ Improves Signal to Noise Ratio
- ◆ Accurate Signal Reproduction
- ◆ Supports High Impedance Sources
- ◆ Provides System Power Savings
- ◆ Meets Standard Supply Voltages  $\pm 5\text{V}$ ,  $\pm 12\text{V}$ ,  $\pm 15\text{V}$
- ◆ Excellent AC Reproduction
- ◆ Provides for a Wide Range of Signal Sources
- ◆ MSOP Offers Smallest Package Size/Performance
- ◆ Sets a New Price Point at this Performance Node

## Applications

- ◆ Data Acquisition
- ◆ Instrumentation
- ◆ Automated Test Equipment
- ◆ High-End Audio
- ◆ Imaging
- ◆ And many more



# ADC Architectures



## SAR / Nyquist

- “Workhorses” of ADCs
  - Data Loggers
  - Temp Sensors
  - Bridge Sensors
  - General Purpose
- **SAR ADC Performance**
  - 8 to 18 bits of resolution
  - Speed range: > DC to < 5 Msps

## Delta-Sigma / Oversampling

- Best suited for precision applications
  - Weigh Scales
  - Temperature Measurement
  - Pressure Measurement
  - Wheatstone Bridges
- **Delta-Sigma ADC Performance**
  - 16 to 24 bits of resolution
  - Speed range: > DC to < 10 Msps

## 12-bit Bipolar SAR ADCs

	# of Ch.	Speed (kSPS)	Interface	Max Pwr (mW)	AVDD	$V_{REF} = V_A$	PGA	Int OSC	Int Ref.	Extra	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>ADS8528</u></a>	8	650	Parallel CMOS, Serial SPI	335	4.5-5.5				✓		64/LQFP, 64/VQFN	9.50   1ku
<a href="#"><u>ADS8638</u></a>	8	1000	Serial	14.45	2.7-5.25				✓		24/VQFN	3.25   1ku
<a href="#"><u>ADS8512</u></a>	1	40	Serial SPI	24	4.75-5.25				✓		16/SOIC	7.00   1ku
<a href="#"><u>ADS8506</u></a>	1	40	Parallel CMOS, Serial SPI	24	4.75-5.25				✓		28/SOIC	7.00   1ku
<a href="#"><u>ADS8508</u></a>	1	250	Serial SPI	70	4.75-5.25				✓		20/SOIC	9.95   1ku
<a href="#"><u>ADS8504</u></a>	1	250	Parallel CMOS	70	4.75-5.25				✓		28/SOIC	10.50   1ku
<a href="#"><u>ADS8634</u></a>	4	1000	Serial	14.45	2.7-5.25				✓		24/VQFN	2.85   1ku

12-bit

14-bit

16-bit

\*only SD<sub>OUT</sub>, no SD<sub>IN</sub>



## 14-bit Bipolar SAR ADCs

	# of Ch.	Speed (kSPS)	Interface	Max Pwr (mW)	AVDD	$V_{REF} = V_A$	PGA	Int OSC	Int Ref.	Extra	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>ADS8548</u></a>	8	600kSPS	Parallel CMOS, Serial SPI	335	4.5	5.5			✓		64/LQFP, 64/VQFN	12.50   1ku
<a href="#"><u>TLC3578</u></a>	8	200kSPS	Serial SPI	29	4.5	5.5					24/SOIC, 24/TSSOP	10.85   1ku
<a href="#"><u>TLC3574</u></a>	4	200kSPS	Serial SPI	29	4.5	5.5					20/PDIP, 20/SOIC, 20/TSSOP	8.60   1ku

**12-bit**

**14-bit**

**16-bit**

\*only SD<sub>OUT</sub>, no SD<sub>IN</sub>

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## 16-bit Bipolar SAR ADCs

	# of Ch.	Speed (kSPS)	Interface	Max Pwr (mW)	AVDD	$V_{REF} = V_A$	PGA	Int OSC	Int Ref.	Extra	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>ADS8568</u></a>	8	500kSPS	Parallel CMOS, Serial SPI	335	4.5-5.5				✓		64/LQFP, 64/VQFN	15.90   1ku
<a href="#"><u>ADS8515</u></a>	1	250kSPS	Parallel CMOS	100	4.75-5.25				✓		28/SSOP	10.95   1ku
<a href="#"><u>ADS8507</u></a>	1	40kSPS	Parallel CMOS	24	4.75-5.25				✓		28/SOIC	13.00   1ku
<a href="#"><u>ADS8505</u></a>	1	250kSPS	Parallel CMOS	70	4.75-5.25				✓		28/SOIC, 28/SSOP	12.95   1ku
<a href="#"><u>ADS8509</u></a>	1	250kSPS	Serial SPI	70	4.75-5.25				✓		20/SOIC, 28/SSOP	9.95   1ku
<a href="#"><u>ADS8342</u></a>	4	250kSPS	Parallel CMOS	200	4.75-5.25						48/TQFP	15.65   1ku
<a href="#"><u>ADS8513</u></a>	1	40kSPS	Serial SPI	24	4.75-5.25				✓		16/SOIC	12.00   1ku

**12-bit**

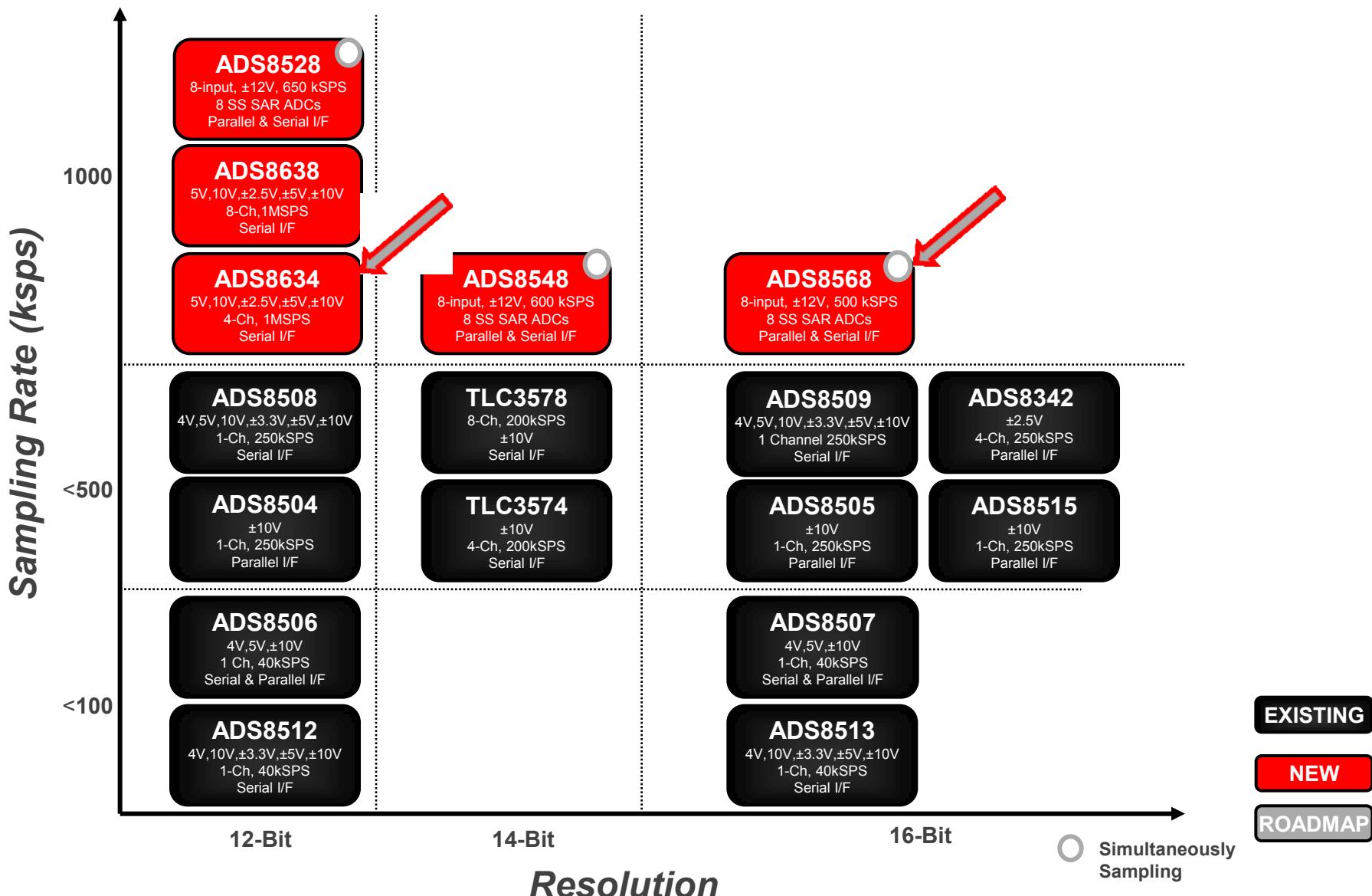
**14-bit**

**16-bit**

\*only SD<sub>OUT</sub>, no SD<sub>IN</sub>



# Bipolar SAR ADCs



# ADS8634

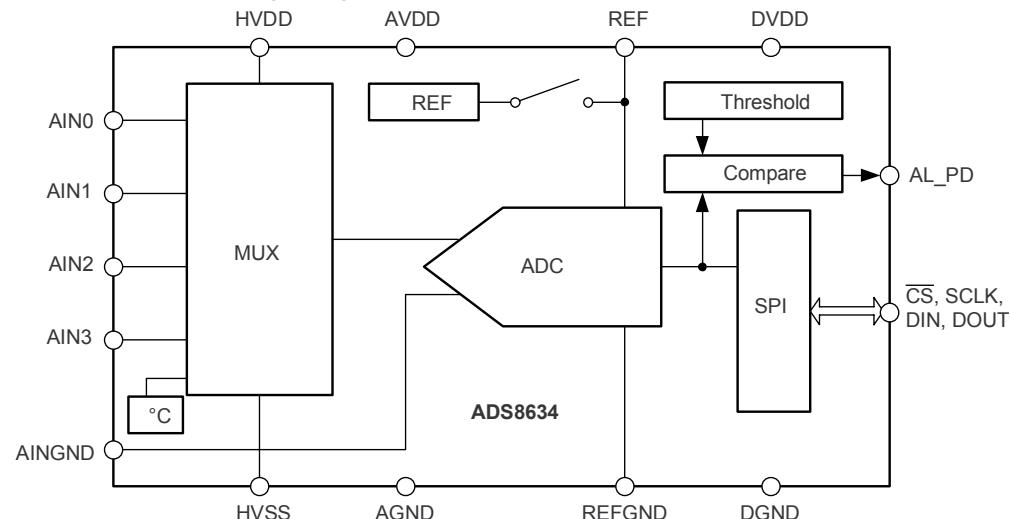
12-Bit | 1MSPS | 4-Ch | True Bipolar |  $\mu$ -power | serial | SAR ADC

## Features

- Flexible, Cost-Saving, Design
  - SW selectable input ranges selection  
 $\pm 10, \pm 5, \pm 2.5V, 0-5V, 0-10V$
  - Wide Digital Supply 1.65 to 5.25V
- Integration and Precision
  - Internal reference and temperature sensor
  - Two programmable alarm thresholds / channel
  - Alarm / temp threshold output
- Small Footprint Product Family
  - Pin compatible with ADS7951
  - SPI Serial Interface
  - 4x4 QFN
  - -40 to 125 Specified Temperature Range

## Benefits

- Single chip solution for wide range of inputs; and direct interface with low voltage processors without the need for level shifting
- Integration reduces system cost and complexity; while threshold detection reduces the number of accesses required by host processor in monitoring applications
- Enables designers to change resolution without redesigning their board or control software

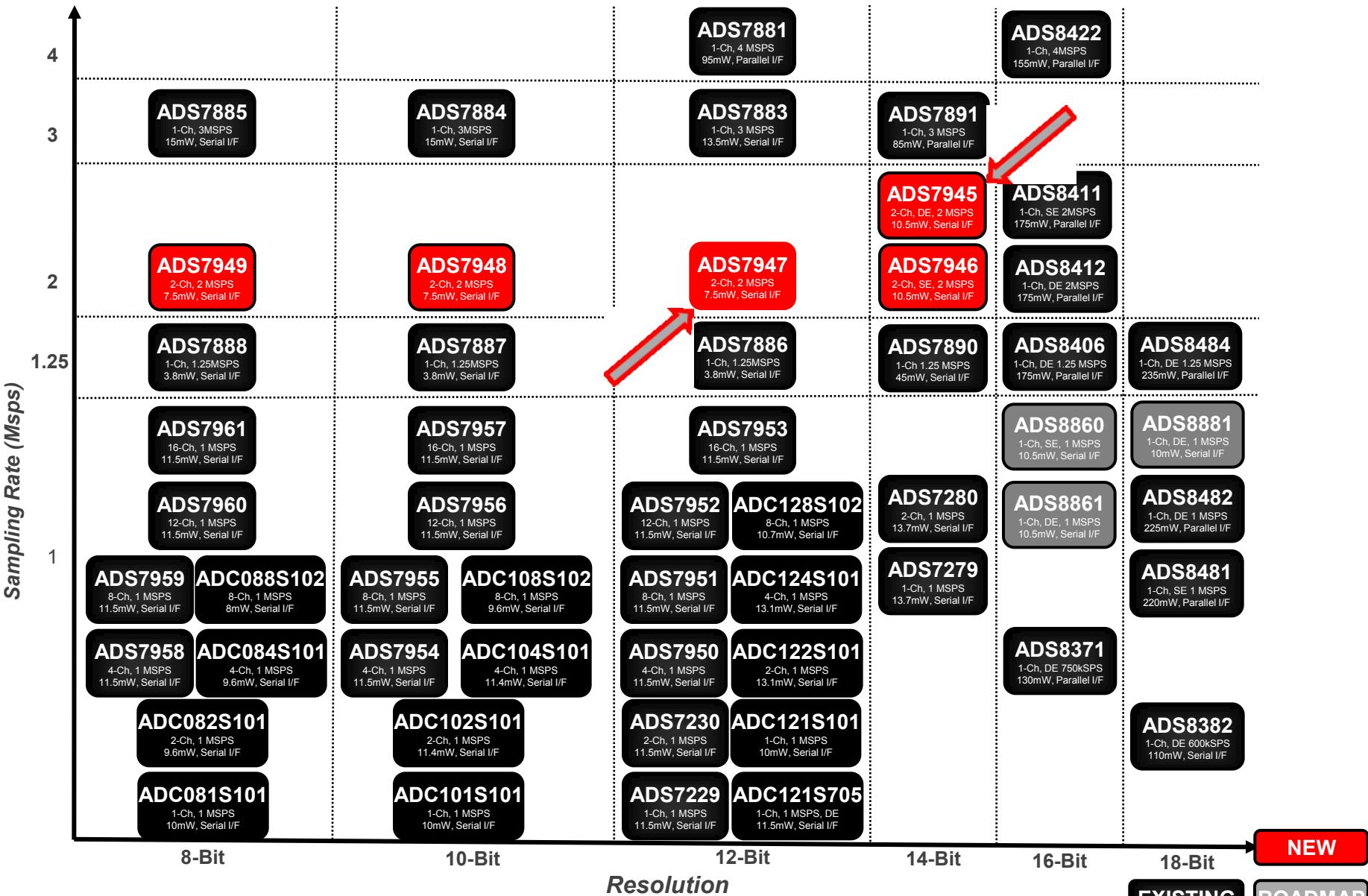


## Applications

- Industrial Process Controls (PLC)
- High-Speed Data Acquisition Systems
- High-Speed Closed-Loop Applications
  - Digital Power Supply



# 600kSPS – 4MSPS SAR ADCs



## 8-bit Fast Sampling SAR ADCs

	# of Ch.	Speed (kSPS)	Interface	Max Pwr (mW)	AVDD	$V_{REF} = V_A$	PGA	Int OSC	Int Ref.	Extra	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>ADC081S101</u></a>	1	1000	SPI*	16	2.7-5.25	✓					6/SOT-23 6/LLP	0.83   1ku
<a href="#"><u>ADC082S101</u></a>	2	1000	SPI	12.6	2.7-5.25	✓					8/SOIC	1.05   1ku
<a href="#"><u>ADC084S101</u></a>	4	1000	SPI	12.6	2.7-5.25	✓					10/SOIC	1.25   1ku
<a href="#"><u>ADC088S102</u></a>	8	1000	SPI	11.0	2.7-5.25	✓					16/TSSOP	1.50   1ku
<a href="#"><u>ADS7958</u></a>	4	1000	SPI	15.75	2.7-5.25					Alarms	24/VQFN 30/TSSOP	1.15   1ku
<a href="#"><u>ADS7959</u></a>	8	1000	SPI	15.75	2.7-5.25					Alarms	24/VQFN 30/TSSOP	1.50   1ku
<a href="#"><u>ADS7960</u></a>	12	1000	SPI	15.75	2.7-5.25					Alarms	32/QFN 38/TSSOP	1.85   1ku
<a href="#"><u>ADS7961</u></a>	16	1000	SPI	15.75	2.7-5.25					Alarms	32/QFN 38/TSSOP	2.25   1ku
<a href="#"><u>ADS7888</u></a>	1	1250	SPI*	10	2.35-5.25	✓					6/SC70 6/SOT-23	0.85   1ku
<a href="#"><u>ADS7949</u></a>	2	2000	SPI*	19.25	2.7-5.25						16/WQFN	0.99   1ku
<a href="#"><u>ADS7885</u></a>	1	3000	SPI*	20	2.7-5.5	✓					6/SOT-23	0.95   1ku

**8-bit**

**10-bit**

**12-bit**

**14-bit**

**16-bit**

**18-bit**

\*only SD<sub>OUT</sub>, no SD<sub>IN</sub>



## 10-bit Fast Sampling SAR ADCs

	# of Ch.	Speed (kSPS)	Interface	Max Pwr (mW)	AVDD	$V_{REF} = V_A$	PGA	Int OSC	Int Ref.	Extra	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>ADC101S101</u></a>	1	1000	SPI*	16	2.7-5.25	✓					6/SOT-23 6/LLP	1.43   1ku
<a href="#"><u>ADC102S101</u></a>	2	1000	SPI	14.2	2.7-5.25	✓					8/SOIC	1.70   1ku
<a href="#"><u>ADC104S101</u></a>	4	1000	SPI	14.2	2.7-5.25	✓					10/SOIC	2.00   1ku
<a href="#"><u>ADC108S102</u></a>	8	1000	SPI	13.6	2.7-5.25	✓					16/TSSOP	2.69   1ku
<a href="#"><u>ADS7954</u></a>	4	1000	SPI	15.75	2.7-5.25					Alarms	24/VQFN 30/TSSOP	1.90   1ku
<a href="#"><u>ADS7955</u></a>	8	1000	SPI	15.75	2.7-5.25					Alarms		2.45   1ku
<a href="#"><u>ADS7956</u></a>	12	1000	SPI	15.75	2.7-5.25					Alarms		3.00   1ku
<a href="#"><u>ADS7957</u></a>	16	1000	SPI	15.75	2.7-5.25					Alarms		3.55   1ku
<a href="#"><u>ADS7887</u></a>	1	1250	SPI*	10	2.35-5.25	✓					6/SC70 6/SOT-23	1.50   1ku
<a href="#"><u>ADS7948</u></a>	2	2000	SPI*	19.25	2.7-5.5						16/QFN	1.70   1ku
<a href="#"><u>ADS7884</u></a>	1	3000	SPI*	20	2.7-5.5	✓					6/SOT-23	1.60   1ku

8-bit

10-bit

12-bit

14-bit

16-bit

18-bit

\*only SD<sub>OUT</sub>, no SD<sub>IN</sub>

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TEXAS INSTRUMENTS

## 12-bit Fast Sampling SAR ADCs

	# of Ch.	Speed (kSPS)	Interface	Max Pwr (mW)	AVDD	V <sub>REF</sub> =V <sub>A</sub>	PGA	Int OSC	Int Ref.	Extra	Pin/Pkg	Approx. Price (US\$)	
<a href="#">ADC121S705</a>	1	1000	SPI	11.5	4.5-5.5						8/SOIC	1.97   1ku	
<a href="#">ADC121S101</a>	1	1000	SPI	16	2.7-5.25	✓					6/SOT-23 6/LLP	1.60   1ku	
<a href="#">ADC122S101</a>	2	1000	SPI	15.8	2.7-5.25	✓					8/SOIC	1.95   1ku	
<a href="#">ADC124S101</a>	4	1000	SPI	15.8	2.7-5.25	✓					10/SOIC	2.20   1ku	
<a href="#">ADC128S102</a>	8	1000	SPI	15.5	2.7-5.25	✓					16/TSSOP	2.75   1ku	
<a href="#">ADS7229</a>	1	1000	SPI	21.6	2.7-5.5			✓			16/QFN 16/TSSOP	2.30   1ku	
<a href="#">ADS7230</a>	2	1000	SPI	21.6	2.7-5.5			✓				2.50   1ku	
<a href="#">ADS7950</a>	4	1000	SPI	15.75	2.7-5.25					Alarms		2.10   1ku	
<a href="#">ADS7951</a>	8	1000	SPI	15.75	2.7-5.25					Alarms		2.70   1ku	
<a href="#">ADS7952</a>	12	1000	SPI	15.75	2.7-5.25					Alarms		3.35   1ku	
<a href="#">ADS7953</a>	16	1000	SPI	15.75	2.7-5.25					Alarms		4.05   1ku	
<a href="#">ADS7886</a>	1	1000	SPI	50	2.35-5.25						6/SC70 6/SOT-23	1.70   1ku	
<a href="#">ADS7947</a>	2	2000	SPI	19.25	2.7-5.5						16/WQFN	1.95   1ku	
<a href="#">ADS7883</a>	1	3000	SPI*	20	2.7-5.5	✓					6/SOT-23	1.85   1ku	
<a href="#">ADS7881</a>	1	4000	Parallel	110	4.75-5.25				✓	✓		48/TQFP 48/VQFN	7.35   1ku

8-bit

10-bit

12-bit

14-bit

16-bit

18-bit

\*only SD<sub>OUT</sub>, no SD<sub>IN</sub>

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## 14-bit Fast Sampling SAR ADCs

	# of Ch.	Speed (kSPS)	Interface	Max Pwr (mW)	AVDD	$V_{REF} = V_A$	PGA	Int OSC	Int Ref.	Extra	Pin/Pkg	Approx. Price (US\$)
<a href="#">ADS7945</a>	2	2000	Serial SPI	10.5	2.7-10.5						16/WQFN	3.95   1ku
<a href="#">ADS7280</a>	2	1000	Serial SPI	13.7	2.7-13.7						16/QFN, 16/TSSOP	4.50   1ku
<a href="#">ADS7279</a>	1	1000	Serial SPI	13.7	2.7-13.7						16/QFN, 16/TSSOP	4.20   1ku
<a href="#">ADS7891</a>	1	3000	Parallel CMOS	85	4.75-85				✓		48/TQFP	13.15   1ku
<a href="#">ADS7890</a>	1	1250	Serial SPI	45	4.75-45				✓		48/TQFP	14.65   1ku
<a href="#">ADS7946</a>	2	2000	Serial SPI	10.5	2.7-10.5						16/WQFN	3.80   1ku

8-bit

10-bit

12-bit

14-bit

16-bit

18-bit

\*only SD<sub>OUT</sub>, no SD<sub>IN</sub>

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## 16-bit Fast Sampling SAR ADCs

	# of Ch.	Speed (kSPS)	Interface	Max Pwr (mW)	AVDD	$V_{REF}=V_A$	Int Ref.	Extra	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>ADS8860</u></a>	1	1000	SPI	6	2.7-3.6				MSOP/10 SON/10	TBD
<a href="#"><u>ADS8861</u></a>	1	1000	SPI	6	2.7-3.6				MSOP/10 SON/10	TBD
<a href="#"><u>ADS8422</u></a>	1	4000	Parallel CMOS	155	4.75-155		✓		48/TQFP	25.65   1ku
<a href="#"><u>ADS8406</u></a>	1	1250	Parallel CMOS	155	4.75-155		✓		48/TQFP	19.90   1ku
<a href="#"><u>ADS8371</u></a>	1	750	Parallel CMOS	130	4.75-130				48/TQFP	16.50   1ku
<a href="#"><u>ADS8412</u></a>	1	2000	Parallel CMOS	155	4.75-155		✓		48/TQFP	30.35   1ku
<a href="#"><u>ADS8411</u></a>	1	2000	Parallel CMOS	155	4.75-155		✓		48/TQFP	29.00   1ku

8-bit

10-bit

12-bit

14-bit

16-bit

18-bit

\*only SD<sub>OUT</sub>, no SD<sub>IN</sub>

Roadmap device

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## 18-bit Fast Sampling SAR ADCs

	# of Ch.	Speed (kSPS)	Interface	Max Pwr (mW)	AVDD	$V_{REF} = V_A$	PGA	Int OSC	Int Ref.	Extra	Pin/Pkg	Approx. Price (US\$)
<a href="#">ADS8881</a>	1	1000	SPI	6.5	2.7-3.6						MSOP/10 SON/10	TBD
<a href="#">ADS8484</a>	1	1250	Parallel CMOS	235	4.75-235				✓		48/VQFN	21.25   1ku
<a href="#">ADS8482</a>	1	1000	Parallel CMOS	225	4.75-225				✓		48/VQFN	15.60   1ku
<a href="#">ADS8481</a>	1	1000	Parallel CMOS	220	4.75-220				✓		48/VQFN	15.20   1ku
<a href="#">ADS8382</a>	1	600	Serial SPI	115	4.75-115				✓		28/VQFN	16.50   1ku

8-bit

10-bit

12-bit

14-bit

16-bit

18-bit

\*only SD<sub>OUT</sub>, no SD<sub>IN</sub>

Roadmap device

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# ADS7945

14-Bit | 2-CH | 2 MSPS | DE | Micro-power SAR

## Features

- Outstanding Performance
  - ±1.5 LSB offset and gain drift (typ)
  - 82dB SNR (min)
  - True 14-bit performance
- Differential inputs
- Dedicated Power-down Mode Enable Pin
  - Auto power-down scales to 7.7  $\mu$ W/kSPS @ 3V
- Wide-supply, reference, and I/O range
  - 2.8V → 5.25V supply range
  - 2.5V → 5.25V reference range
  - 1.8V → 5V logic family compatible
- Small Robust Design
  - 3mm x 3mm QFN
  - 40°C → 125°C operation
  - SPI Interface

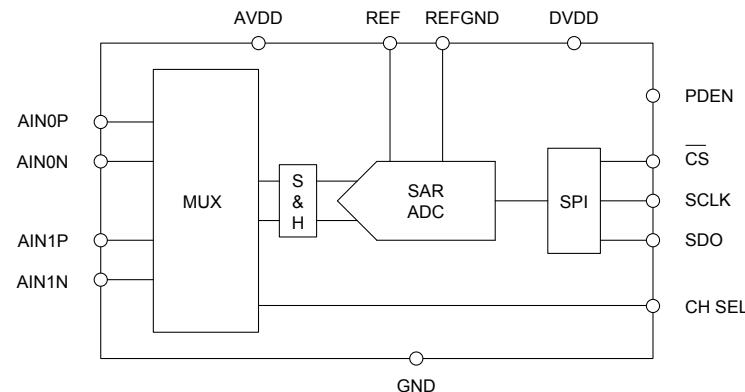
## Benefits

- Precision offset and gain over temperature eliminates the need for temperature calibration and reduces system cost & complexity
- Differential inputs reduce the need for common mode signal conditioning circuitry = lower system cost
- Power down mode implementation is simple
- 82% wider supply and reference range as compared to 3V parts; and, can interface with all common logic interface voltages
- Wide temperature range withstands harsh environments and very small package saves PCB space and makes it ideal for portable applications where reducing board space is critical

## Applications

- Optical networking
- Instrumentation and control systems
- X-Y Positioning
- Portable systems
- Battery monitoring
- High speed data acquisition

EVM Available



# ADS7947

12-Bit | 2-CH | 2MSPS | SE | Micro-power SAR

## Features

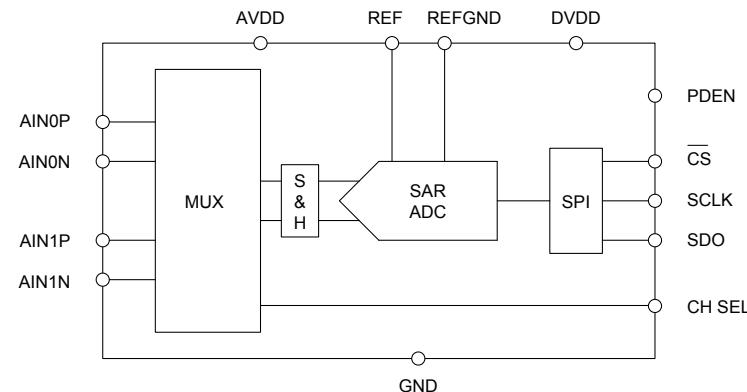
- Outstanding Performance
  - ±1 LSB offset and gain drift (max)
  - 72dB SNR (min)
  - True 12-bit performance
- Pseudo-differential inputs
- Dedicated Power-down Mode Enable Pin
  - Auto power-down scales to 7.7  $\mu$ W/kSPS @ 3V
- Wide-supply, reference, and I/O range
  - 2.8V → 5.25V supply range
  - 2.5V → 5.25V reference range
  - 1.8V → 5V logic family compatible
- Small Robust Design
  - 3mm x 3mm QFN
  - 40°C → 125°C operation
  - SPI Interface

## Applications

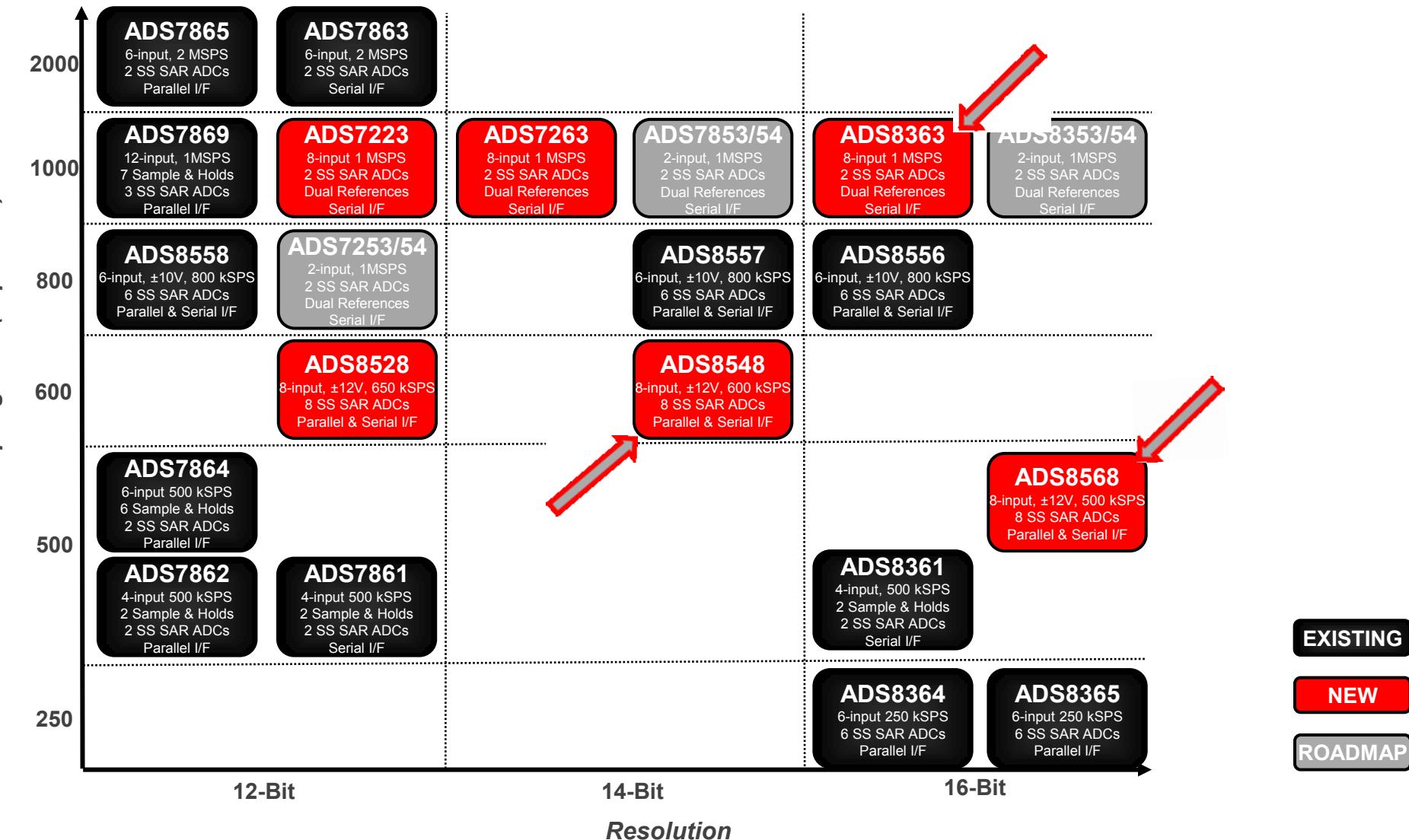
- Optical networking
- Instrumentation and control systems
- X-Y Positioning
- Portable systems
- Battery monitoring
- High speed data acquisition

## Benefits

- Precision offset and gain over temperature eliminates the need for temperature calibration and reduces system cost & complexity
- Pseudo-differential inputs reduce the need for common mode signal conditioning circuitry = lower system cost
- Power down mode implementation is simple
- 82% wider supply and reference range as compared to 3V parts; and, can interface with all common logic interface voltages
- Wide temperature range withstands harsh environments and very small package saves PCB space and makes it ideal for portable applications where reducing board space is critical



# Simultaneous Sampling SAR ADCs



## 12-bit Simultaneous Sampling SAR ADCs

	# of Ch.	Speed (kSPS)	Interface	Max Pwr (mW)	AVDD	$V_{REF} = V_A$	PGA	Int OSC	Int Ref.	Extra	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>ADS8528</u></a>	8	650	Parallel CMOS, Serial SPI	335	4.5-5.5				√		64/LQFP, 64/VQFN	9.50   1ku
<a href="#"><u>ADS8558</u></a>	6	730	Parallel CMOS, Serial SPI	262.2	4.5-5.5				√		64/LQFP	8.95   1ku
<a href="#"><u>ADS7865</u></a>	6	2000	Parallel CMOS	30	2.7-5.5				√		32/TQFP	4.90   1ku
<a href="#"><u>ADS7863</u></a>	4	2000	Serial SPI	35.5	2.7-5.5				√		24/SSOP/QSOP, 24/VQFN	4.90   1ku
<a href="#"><u>ADS7869</u></a>	12	1000	Parallel CMOS, Serial SPI	250	4.5-5.5				√		100/TQFP	15.65   1ku
<a href="#"><u>ADS7864</u></a>	6	500	Parallel CMOS	52.5	4.75-5.25				√		48/TQFP	6.65   1ku
<a href="#"><u>ADS7861</u></a>	4	500	Serial SPI	25	4.75-5.25				√		24/SSOP/QSOP, 32/QFN	4.05   1ku
<a href="#"><u>ADS7862</u></a>	4	500	Parallel CMOS	25	4.75-5.25				√		32/TQFP	5.70   1ku
<a href="#"><u>ADS7223</u></a>	4	1000	Serial	47.2	2.7-5.5				√		32/QFN	3.95   1ku
<a href="#"><u>ADS7253/54</u></a>	2	1000	Serial	TBD	4.75-5.25				√		16/QFN, 16/TSSOP	TBD

12-bit

14-bit

16-bit

\*only SD<sub>OUT</sub>, no SD<sub>IN</sub>

Roadmap device



## 14-bit Simultaneous Sampling SAR ADCs

	# of Ch.	Speed (kSPS)	Interface	Max Pwr (mW)	AVDD	$V_{REF} = V_A$	PGA	Int OSC	Int Ref.	Extra	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>ADS8548</u></a>	8	600	Parallel CMOS, Serial SPI	335	4.5-5.5				✓		64LQFP, 64VQFN	12.50   1ku
<a href="#"><u>ADS7263</u></a>	4	1000	Serial	47.2	2.7-5.5				✓		32QFN	6.95   1ku
<a href="#"><u>ADS8557</u></a>	6	670	Parallel CMOS, Serial SPI	253.2	4.5-5.5				✓		64LQFP	10.95   1ku
<a href="#"><u>ADS7853/54</u></a>	2	1000	Serial	TBD	4.75-5.25				✓		16/QFN, 16/TSSOP	TBD

12-bit

14-bit

16-bit

\*only SD<sub>OUT</sub>, no SD<sub>IN</sub>

Roadmap device

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## 16-bit Simultaneous Sampling SAR ADCs

	# of Ch.	Speed (kSPS)	Interface	Max Pwr (mW)	AVDD	$V_{REF} = V_A$	PGA	Int OSC	Int Ref.	Extra	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>ADS8568</u></a>	8	500	Parallel CMOS, Serial SPI	335	4.5-5.5				✓		64/LQFP, 64/VQFN	15.90   1ku
<a href="#"><u>ADS8363</u></a>	4	1000	Serial	47.2	2.7-5.5				✓		32/QFN	9.95   1ku
<a href="#"><u>ADS8556</u></a>	6	630	Parallel CMOS, Serial SPI	251.7	4.5-5.5				✓		64/LQFP	12.95   1ku
<a href="#"><u>ADS8365</u></a>	6	250	Parallel CMOS	190	4.75-5.25				✓		64/TQFP	16.25   1ku
<a href="#"><u>ADS8361</u></a>	4	500	Serial SPI	150	4.75-5.25				✓		24/SSOP/ QSOP, 32/QFN	8.75   1ku
<a href="#"><u>ADS8364</u></a>	6	250	Parallel CMOS	413	4.75-5.25				✓		64/TQFP	18.10   1ku
<a href="#"><u>ADS8353/54</u></a>	2	1000	Serial	TBD	4.75-5.25				✓		16/QFN, 16/TSSOP	TBD

12-bit

14-bit

16-bit

\*only SD<sub>OUT</sub>, no SD<sub>IN</sub>

Roadmap device

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# ADS8568 / ADS8548 / ADS8528

## Multi-Bit 8-ch Simultaneous Sampling SAR with Bipolar Inputs

- P2P16-/14-/12-Bit Versions

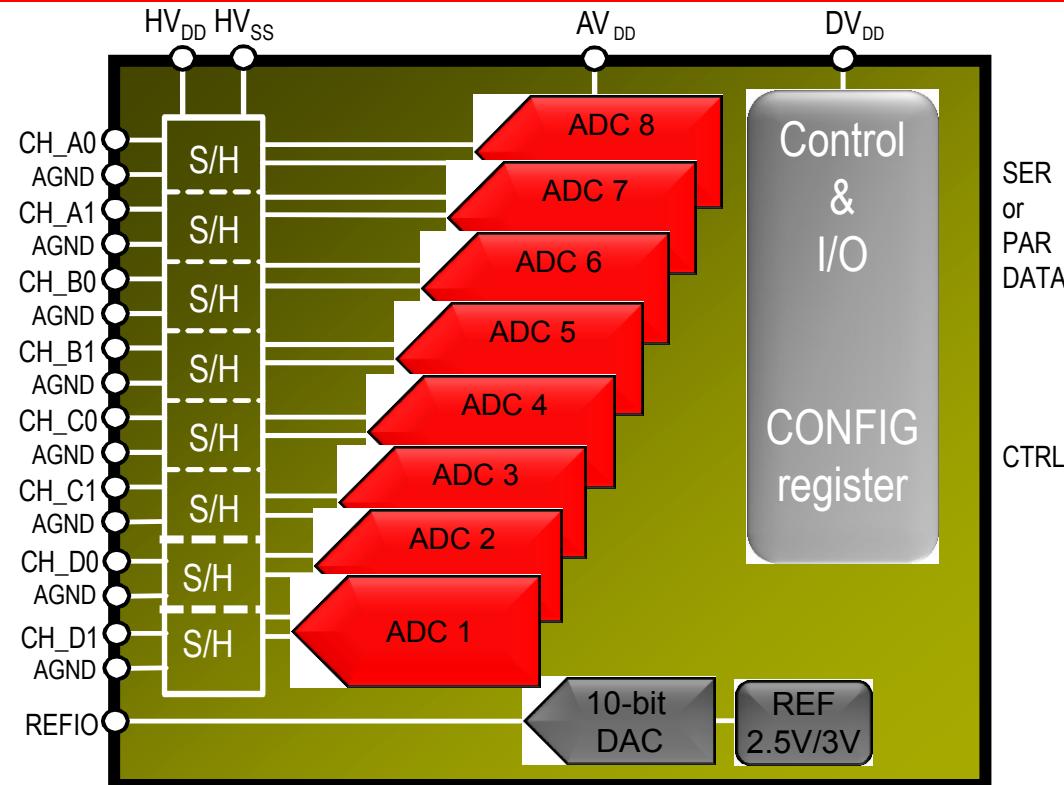
- 510/400kSPS @ 16-bits
- 600/450kSPS @ 14-bits
- 650/480kSPS @ 12-bits

- 8 bipolar inputs:  $\pm 12V$  (max)

- Small, Integrated Industrial Solution

- 2.5V programmable reference
- Fully specified from -40 to 125°C
- QFN-64 & TQFP-64 Packages
- Supports internal and external conversion clock
- Supports *parallel and serial data* interface

- Power Automation:
  - Protection Relays
  - Power performance measuring and monitoring devices (PMD)
- Multiphase Motor Control
- Multi-axis positioning systems
- Industrial automation and Data Acquisition



# ADS8363

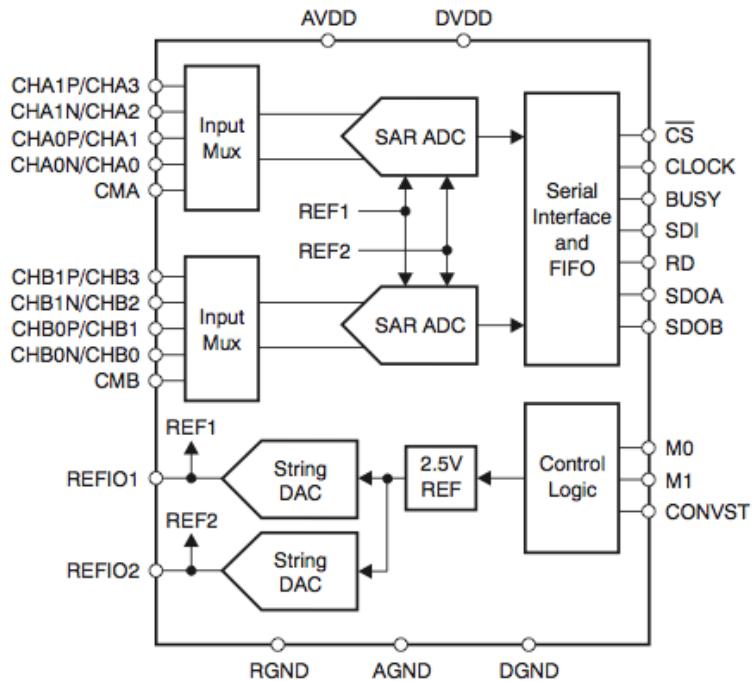
## 16-bit 1MSPS 4x2/2x2 Simultaneous Sampling SAR ADC

### Features

- Dual,4-Ch pseudo-differential or 2-Ch differential configurable inputs coupled with a dual 2.5V programmable reference
- Dual ADCs with true 16-bit Performance
  - NMC @ 93dB SNR (typ)
- Integrated Industrial Solution
  - 4 deep per-channel FIFO
  - Auto-scan Mode
  - Extended temp range: -40 to 125°C
  - Compact packaging: QFN-32

### Benefits

- Input muxes and **dual programmable internal reference** enable input range scaling and monitoring up to 8 different signals
- **Improved application accuracy**
- Integrated FIFO enables a **75% reduction** in the number of host accesses



### Applications

- Motor control
- Power quality measurement
- Protection relays
- Industrial automation



ADS8363 EVM Available

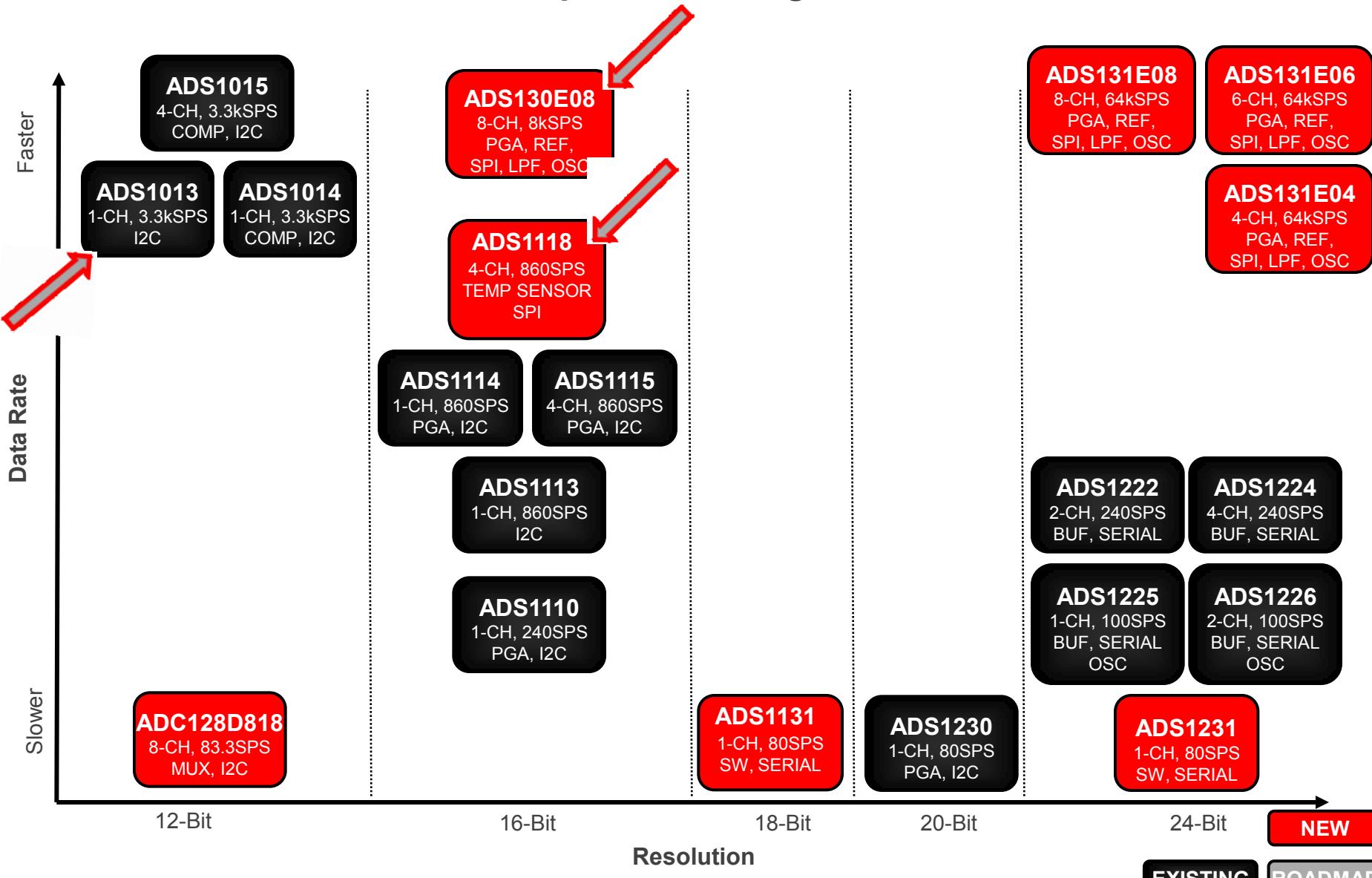
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# General Purpose Delta-Sigma ADCs



## General Purpose Delta-Sigma ADCs

	<b>Resolution (Bits)</b>	<b>Sample Rate (max)(SPS)</b>	<b># Input Channels</b>	<b>Interface</b>	<b>INL (+/-) (Max)(%)</b>	<b>Power (Typ) (mW)</b>	<b>A<sub>VDD</sub></b>	<b>Pin/Pkg</b>	<b>Approx. Price (US\$)</b>
<a href="#"><u>ADS1222</u></a>	24	240SPS	2	Serial SPI	0.0015	1.35	2.7-5.5	14TSSOP	3.20   1ku
<a href="#"><u>ADS1224</u></a>	24	240SPS	4	Serial SPI	0.0015	1.35	2.7-5.5	20TSSOP	3.50   1ku
<a href="#"><u>ADS1225</u></a>	24	100SPS	1	Serial SPI	0.00001	1.6	2.7-5.5	16VQFN	2.95   1ku
<a href="#"><u>ADS1226</u></a>	24	100SPS	2	Serial SPI	0.00001	1.6	2.7-5.5	16VQFN	3.20   1ku
<a href="#"><u>ADS1231</u></a>	24	80SPS	1	Serial SPI		5	2.7-5.3	16SOIC	2.50   1ku
<a href="#"><u>ADS1230</u></a>	20	80SPS	1	Serial SPI		2.9	2.7-5.3	16TSSOP	2.50   1ku
<a href="#"><u>ADS1131</u></a>	18	80SPS	1	Serial	0.0008	5	2.7-5.3	16SOIC	2.10   1ku
<b>ADS1110</b>	16	128SPS	1	Serial I2C	0.00004	0.72	2.7-5.5	6SOT-23	1.95   1ku
<a href="#"><u>ADS1113</u></a>	16	860SPS	1	Serial I2C		0.36	2-5.5	10MSOP, 10X2QFN	1.85   1ku
<a href="#"><u>ADS1114</u></a>	16	860SPS	1	Serial I2C		0.36	2-5.5	10MSOP, 10X2QFN	2.00   1ku

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## General Purpose Delta-Sigma ADCs

	<b>Resolution (Bits)</b>	<b>Sample Rate (max)(SPS)</b>	<b># Input Channels</b>	<b>Interface</b>	<b>INL (+/-) (Max)(%)</b>	<b>Power (Typ) (mW)</b>	<b>A<sub>VDD</sub></b>	<b>Pin/Pkg</b>	<b>Approx. Price (US\$)</b>
<a href="#"><u>ADS1115</u></a>	16	860SPS	4	Serial I2C		0.36	2-5.5	10MSOP, 10X2QFN	2.25   1ku
<a href="#"><u>ADS1118</u></a>	16	860SPS	4	Serial SPI	0.0015	0.3	2-5.5	10MSOP, 10X2QFN	2.25   1ku
<a href="#"><u>ADC128D818</u></a>	12	0	8	Serial I2C		2	3-5.5	16TSSOP	2.95   1ku
<a href="#"><u>ADS1013</u></a>	12	3.3kSPS	1	Serial I2C		0.36	2-5.5	10MSOP, 10X2QFN	0.85   1ku
<a href="#"><u>ADS1014</u></a>	12	3.3kSPS	1	Serial I2C		0.36	2-5.5	10MSOP, 10X2QFN	0.90   1ku
<a href="#"><u>ADS1015</u></a>	12	3.3kSPS	4	Serial I2C		0.36	2-5.5	10MSOP, 10X2QFN	0.99   1ku

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# ADS131E08/06/04 | ADS130E08 :

## Multi-Channel | multi-bit Analog Front End for Energy Applications

### Features

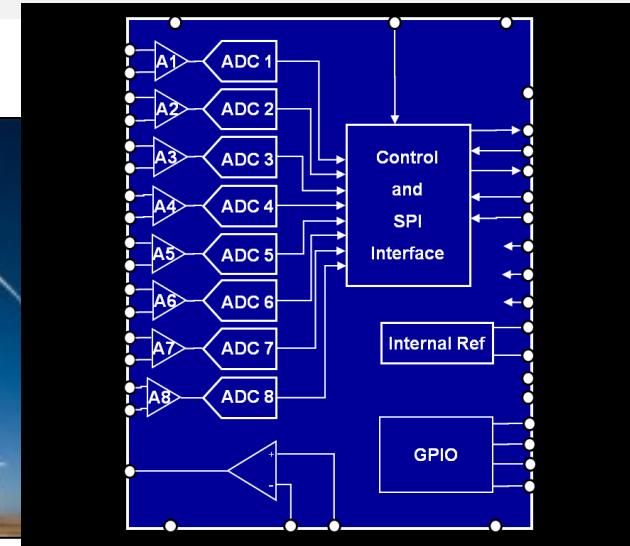
- Pin Compatible 16/24-bit, 8/6/4-channel Versions
  - 90dB SNR, 8kSPS (16-bit)
  - 107dB, 8/16/32/64kSPS (24-bit)
- Fully-Integrated device:
  - PGA w/ multiple gain options (1,2,4,8 & 12)
  - Built in Op-Amp
  - Internal reference
  - Fault detect / Alarm Comparators
  - Built in test signals
- Analog input range of  $\pm 2.4V$
- Power: **2mW/Channel**
- Operating Temp:  $-40^{\circ}C$  to  $+105^{\circ}C$

### Benefits

- **Industry's widest upgrade/downgrade path** allows customers to easily build their metrology around the ADS13xE0x products
- Fully-Integrated analog front end features allow customers to save on board space, overall design effort, time in device procurement, and significantly alleviates overall complexity of the analog signal chain
- **Wide analog input range** by 10%
- Allows designers to **achieve power-sipping solutions** for their energy applications
- Wide temperature range allows the device to be used in a range of harsh environmental conditions

### Applications

- Industrial Power Applications
- Energy Metering
- Power Monitoring, Control, and Protection
- Smart Grid Solutions



# ADS1118

World's Smallest 16-bit ADC | w/0.5°C (max) Accurate Temp Sensor

## Features

- Complete set of integrated functions:
  - Four multiplexed analog inputs
  - Four digital I/O
  - PGA (gains: 0.33, x0.5, x1, x2, x4 or x8)
  - Precision ADC with data rates from 8 to 860 SPS
  - Internal temperature sensor (0.5°C max)
  - Small QFN package (2.05mm x 1.55mm x 0.4mm)
- Versatile supply range and low power consumption
  - Low supply current: 150uA typ
  - Supply 2.0V – 5.5V

## Applications

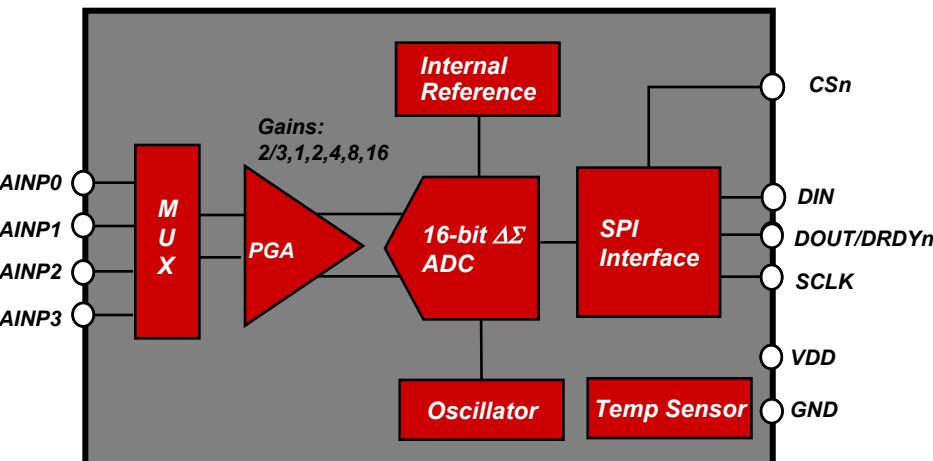
- Temperature Measurement
- Battery Pack
- Portable Instrumentation
- Industrial Process Control
- Gas Monitoring
- Consumer Goods
- Embedded ADC Upgrade



ADS1118 EVM Available

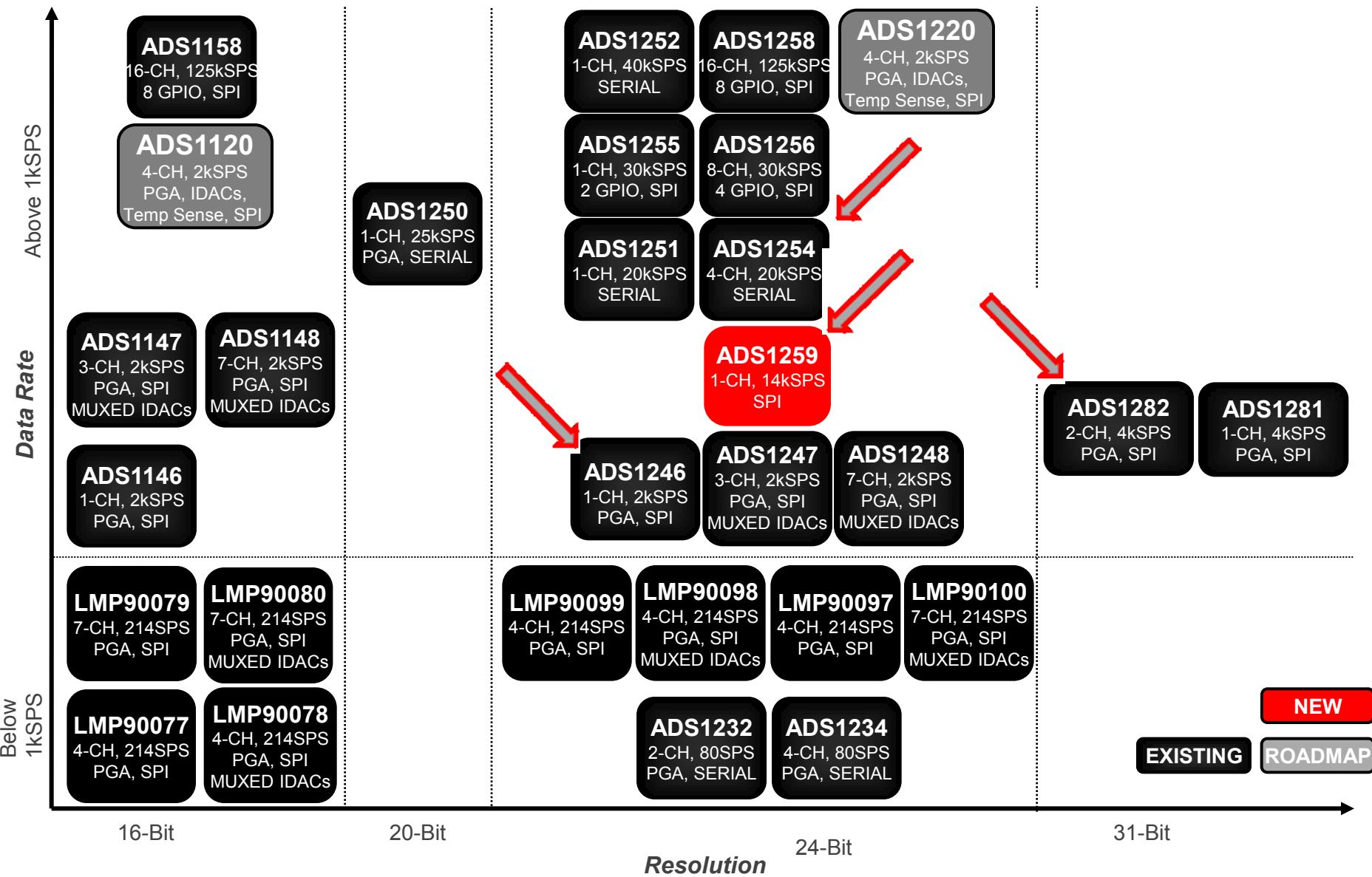
## Benefits

- A single ADS1118 can perform data acquisition of multiple signals from a wide variety of sensors.
- Small package that readily senses ambient temperature to perform cold junction compensation in thermocouple applications.
- Its size and low power consumption make the ADS1118 a great device for portable applications where extended battery life is critical



Tiny QFN(RUG) or MSOP(DGS) Package

# DC Optimized Delta-Sigma ADCs



## 16-bit DC Optimized Delta-Sigma ADCs

	Sample Rate (max)(SPS)	# Input Channels	Interface	INL (+/-) (Max)(%)	Power (Typ) (mW)	A <sub>VDD</sub>	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>ADS1146</u></a>	2kSPS	1	Serial SPI	0.00002	2.3	2.7-5.25	16TSSOP	2.70   1ku
<a href="#"><u>ADS1147</u></a>	2kSPS	3	Serial SPI	0.00002	2.3	2.7-5.25	20TSSOP	3.45   1ku
<a href="#"><u>ADS1148</u></a>	2kSPS	7	Serial SPI	0.00002	2.3	4.75-5.25	28TSSOP	3.95   1ku
<a href="#"><u>ADS1158</u></a>	125kSPS	16	Serial SPI		42	2.85-5.25	48VQFN	5.95   1ku
<a href="#"><u>LMP90077</u></a>	214SPS	4	Serial SPI		1.2	2.85-5.5	28HTSSOP	3.50   1ku
<a href="#"><u>LMP90078</u></a>	214SPS	4	Serial SPI		1.2	2.85-5.5	28HTSSOP	3.50   1ku
<a href="#"><u>LMP90079</u></a>	214SPS	7	Serial SPI		1.2	2.85-5.5	28HTSSOP	3.70   1ku
<a href="#"><u>LMP90080</u></a>	214SPS	7	Serial SPI		1.2	2.85-5.5	28HTSSOP	3.70   1ku
<a href="#"><u>ADS1120</u></a>	2kSPS	4	Serial SPI		0.35	2.3-5.5	16/QFN, 16/TSSOP	TBD

16-bit

20-bit

24-bit

31-bit

Roadmap device



## 20-bit DC Optimized Delta-Sigma ADCs

	Sample Rate (max)(SPS)	# Input Channels	Interface	INL (+/-) (Max)(%)	Power (Typ) (mW)	A <sub>VDD</sub>	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>ADS1250</u></a>	25kSPS	1	Serial SPI	0.00001	75	4.75-5.25	16SOIC	8.70   1ku

16-bit

20-bit

24-bit

31-bit



## 24-bit DC Optimized Delta-Sigma ADCs

	Sample Rate (max)(SPS)	# Input Channels	Interface	INL (+/-) (Max)(%)	Power (Typ) (mW)	A <sub>VDD</sub>	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>ADS1220</u></a>	2kSPS	4	Serial SPI		0.35	2.3-5.5	16/QFN, 16/TSSOP	TBD
<a href="#"><u>ADS1232</u></a>	80SPS	2	Serial SPI		4.3	2.7-5.3	24TSSOP	3.90   1ku
<a href="#"><u>ADS1234</u></a>	80SPS	4	Serial SPI		4.3	2.7-5.3	28TSSOP	4.05   1ku
<a href="#"><u>ADS1246</u></a>	2kSPS	1	Serial SPI	0.00002	2.3	2.7-5.25	16TSSOP	3.45   1ku
<a href="#"><u>ADS1247</u></a>	2kSPS	3	Serial SPI	0.00002	2.3	2.7-5.25	20TSSOP	4.45   1ku
<a href="#"><u>ADS1248</u></a>	2kSPS	7	Serial SPI	0.00002	2.3	2.7-5.25	28TSSOP	4.95   1ku
<a href="#"><u>ADS1251</u></a>	20kSPS	1	Serial SPI	0.0015	7.5	4.75-5.25	8SOIC	6.00   1ku
<a href="#"><u>ADS1252</u></a>	41kSPS	1	Serial SPI	0.0015	40	4.75-5.25	8SOIC	6.45   1ku
<a href="#"><u>ADS1254</u></a>	20kSPS	4	Serial SPI	0.0015	4.36	4.75-5.25	20SSOP/QSOP	7.20   1ku
<a href="#"><u>ADS1255</u></a>	30kSPS	2	Serial SPI	0.001	36	4.75-5.25	20SSOP	7.00   1ku
<a href="#"><u>ADS1256</u></a>	30kSPS	8	Serial SPI	0.001	36	4.75-5.25	28SSOP	7.45   1ku

Page 1

Page 2

16-bit

20-bit

24-bit

31-bit

Roadmap device

## 24-bit DC Optimized Delta-Sigma ADCs

	Sample Rate (max)(SPS)	# Input Channels	Interface	INL (+/-) (Max)(%)	Power (Typ) (mW)	A <sub>VDD</sub>	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>ADS1258</u></a>	125kSPS		16 Serial SPI	0.0015	42	4.75-5.25	48VQFN	12.45   100u
<a href="#"><u>ADS1259</u></a>	14.4kSPS		1 Serial SPI	0.0003	13	4.75-5.25	20TSSOP	5.60   1ku
<a href="#"><u>LMP90097</u></a>	214SPS		4 Serial SPI		1.2	2.85-5.5	28HTSSOP	4.05   1ku
<a href="#"><u>LMP90098</u></a>	214SPS		4 Serial SPI		1.2	2.85-5.5	28HTSSOP	4.30   1ku
<a href="#"><u>LMP90099</u></a>	214SPS		7 Serial SPI		1.2	2.85-5.5	28HTSSOP	4.75   1ku
<a href="#"><u>LMP90100</u></a>	214SPS		7 Serial SPI		1.2	2.85-5.5	28HTSSOP	4.95   1ku

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16-bit

20-bit

24-bit

31-bit



## 31-bit DC Optimized Delta-Sigma ADCs

	<b>Sample Rate (max)(SPS)</b>	<b># Input Channels</b>	<b>Interface</b>	<b>INL (+/-) (Max)(%)</b>	<b>Power (Typ) (mW)</b>	<b>A<sub>VDD</sub></b>	<b>Pin/Pkg</b>	<b>Approx. Price (US\$)</b>
<a href="#"><u>ADS1281</u></a>	4kSPS	1	Serial, Serial SPI		0.0005	4.75-5.25	24TSSOP	28.75   1ku
<a href="#"><u>ADS1282</u></a>	4kSPS	2	Serial, Serial SPI	PGA	0.0004	4.75-5.25	28TSSOP	34.50   1ku

**16-bit**

**20-bit**

**24-bit**

**31-bit**



# ADS1246

## 24-Bit | Single-Channel Temperature Measurement ADC

### Features

#### Device Features:

- 1 Differential or 1 Single-Ended
- True Bipolar  $\pm 2.5V$  or Unipolar 5V
- Max Data Rate – **2kSPS**
- Low Noise PGA:  $40nV @ G = 128$
- **50/60Hz** Simultaneous Rejection Mode (20SPS)

#### On-Chip Integration:

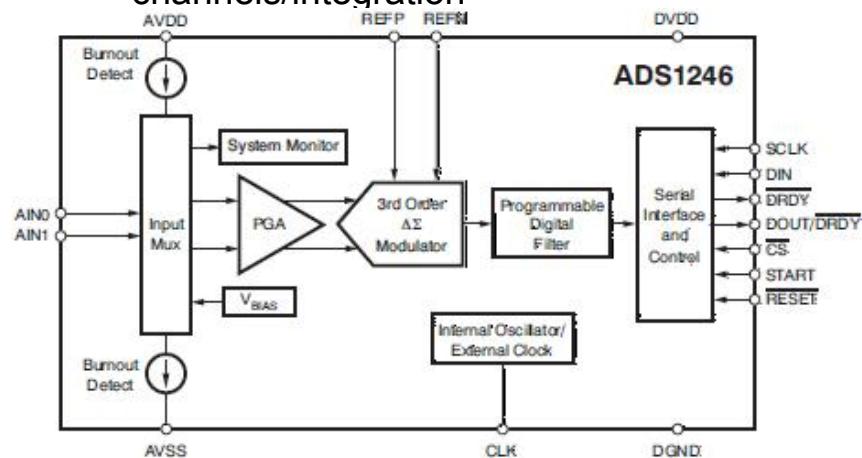
- Oscillator
- Temp Sensor
- Burnout Detect
- 16-Bit version: [ADS1146](#)

### Applications

- Temperature Management
  - RTDs, Thermocouples, Thermistors
- Flow/Pressure Measurement
- Industrial Process Control

### Key Benefits

- High Performance Capabilities Coupled with On-Chip Integration
- Cost Effective Temperature Sensor Measurement Solution
- TRUE Bipolar Inputs Reducing Front End Signal Conditioning Circuitry
- Family options for scalable channels/integration



16-Pin TSSOP



# ADS1146

## 16-Bit | Single-Channel Temperature Measurement ADC

### Features

#### Device Features:

- 1 Differential or 1 Single-Ended
- True Bipolar  $\pm 2.5V$  or Unipolar 5V
- Max Data Rate – **2kSPS**
- **Low Noise PGA:**  $40nV @ G = 128$
- **50/60Hz Simultaneous Rejection Mode** (20SPS)

#### On-Chip Integration:

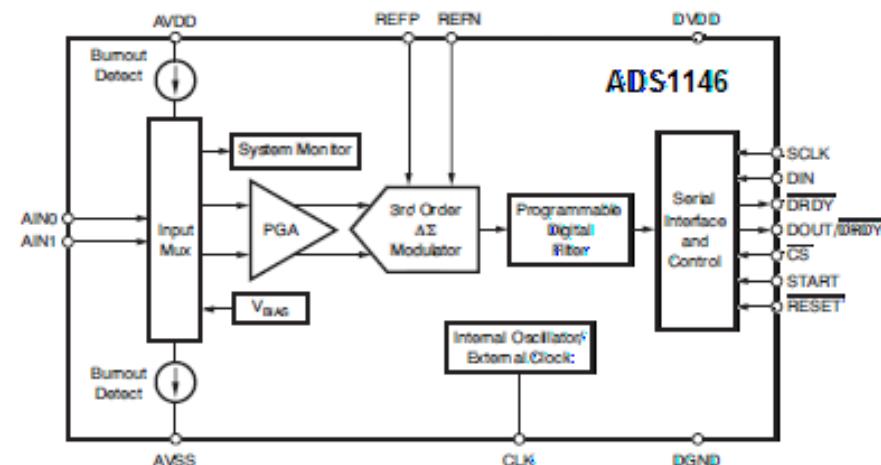
- Oscillator
- Temp Sensor
- Burnout Detect
- **Pin compatible to the 24 Bit ADS1246**

### Applications

- Temperature Management
  - RTDs, Thermocouples, Thermistors
- Flow/Pressure Measurement
- Industrial Process Control

### Key Benefits

- High Performance Capabilities Coupled with On-Chip Integration
- Cost Effective Temperature Sensor Measurement Solution
- TRUE Bipolar Inputs Reducing Front End Signal Conditioning Circuitry
- Family options for scalable channels/integration



16-Pin TSSOP



# ADS1250-ADS1254

## 24-bit Fast | Low-Noise ADCs

### Features

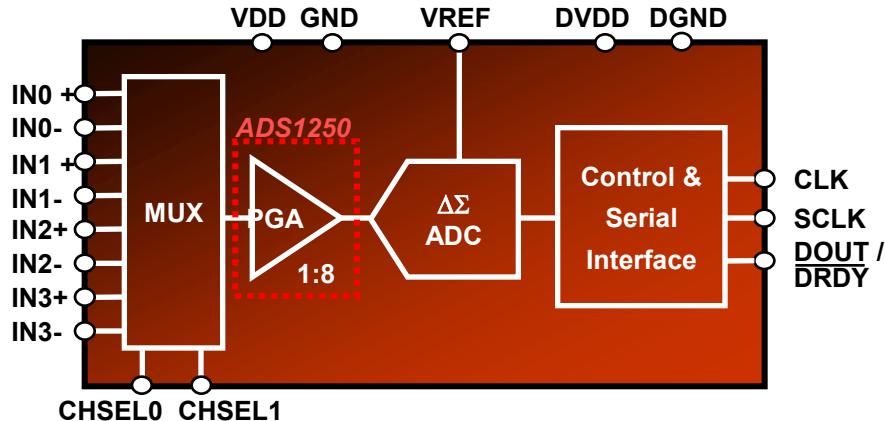
- High-speed 24-bit ADCs - Up to 41kSPS
- *Programmable Gain Amp (ADS1250)*
- Very low noise: 1.5ppm of full-scale
- Up to 19 effective bits of resolution
- Lowest power ADS1254
- Simple read-only serial interface

### Applications

- Medical instrumentation
- Industrial process control
- Liquid/Gas Chromatography
- Seismic Measurement

### Benefits

- *Excellent Performance with Speed and Simplicity*



	Inputs	Data Rate / Power Disp.	Price (1k pcs)
ADS1250	1 SE / 1 Diff	25kSPS 70mW PGA = 1: 8	\$6.95
ADS1251	1 SE / 1 Diff	20kSPS 7.5mW	\$5.60
ADS1252	1 SE / 1 Diff	41kSPS 40mW	\$5.60
ADS1253	4 SE / 4 Diff	20kSPS 7.5mW Mux	\$6.70
ADS1254	1 SE / 1 Diff	20kSPS 4.3mW Mux & Separate Supplies	\$6.70



# ADS1220/ADS1120

*Preview*

## 24/16-Bit | 4-Channel | Analog Front Ends for DC Sensors

### Features

- Outstanding Performance  
24-bit and 16-bit Delta Sigma Modulator  
70nVrms Noise in HP mode (ADS1220)  
190nVrms Noise in HP mode (ADS1120)  
20 to 2000SPS
- Low power  
Includes IDACs, Mux, Burnout current sources, low side switch, temperature sensor and internal reference.
- Low power  
275uA in HP mode with PGA and Internal Vref  
100uA in LP mode with PGA and Internal Vref
- Wide-supply range  
2.3V → 5.5V supply range
- Small Robust Design  
3.5mm x 3.5mm QFN or 16 pin TSSOP  
-40°C → 125°C operation  
SPI Interface

Samples Available  
RTM – 4Q '12

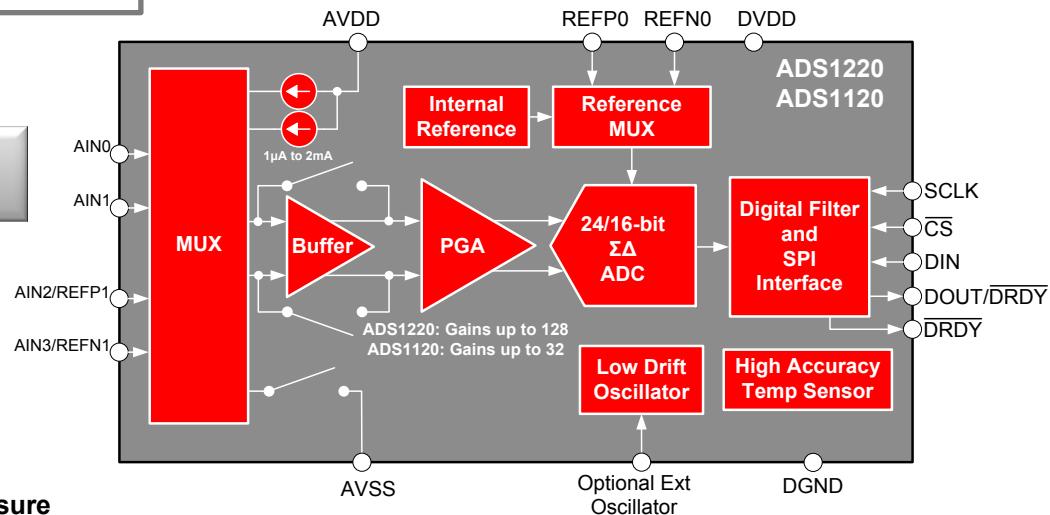
### Applications

Next Slide more  
spec's

- Thermocouple measurement
- RTD measurement
- Bridge sensor measurement
- Pressure measurement
- Flow measurement
- Industrial process control

### Benefits

- PGA optimizes input referred noise when used with DC Sensors.
- Integrated programmable FIR filter provides simultaneous 50/60Hz rejection.
- Dual matched IDACs create a one chip solution for RTD measurement.
- Integrated temperature sensor offers industry leading 0.5C temperature accuracy.
- Flexible buffer offers either very high input impedance or the option to allow signals to reach and exceed the supply rails.



TI Proprietary Information – Selective Disclosure

Home



Last Slide



TEXAS  
INSTRUMENTS

# ADS1282

## Ultra-High Performance $\Delta\Sigma$ ADC with PGA

### Features

- Extremely High Resolution
  - SNR: 130dB (250SPS, G=1)
  - SNR: 125dB (250SPS, G=16)
- Ultra-Linear
  - THD -122dB, INL: 0.5ppm
- Flexible Data Rate
  - 250SPS to 4kSPS
- Onboard High Performance Digital Filter
  - SINC + FIR + IIR (selectable)
  - Linear or Minimum Phase
  - 0.5Hz to 7.5Hz High Pass
  - Filter Bypass Mode
- Low Power
  - ADS1282: 25mW (17mW Low Power Mode)

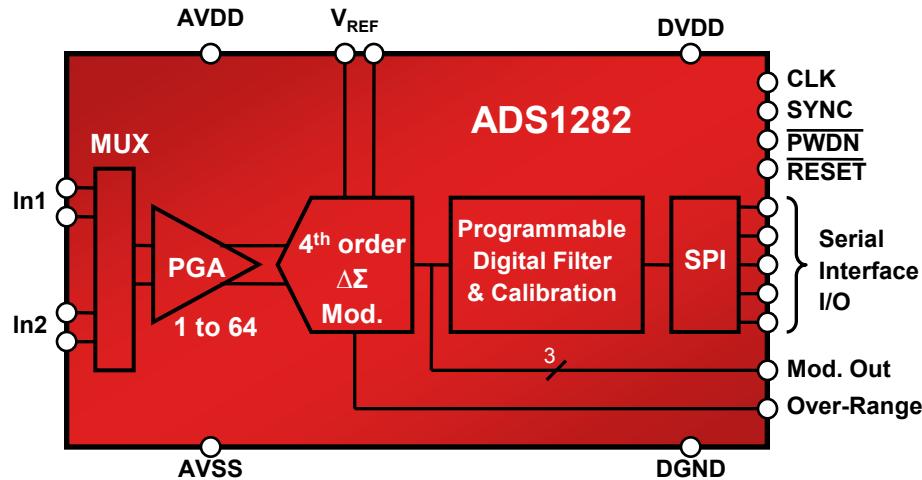
### Applications

- Seismic / Energy Exploration
- Geophone / Hydrophone Recording
- Earthquake/Building Monitoring
- Scientific Instrumentation

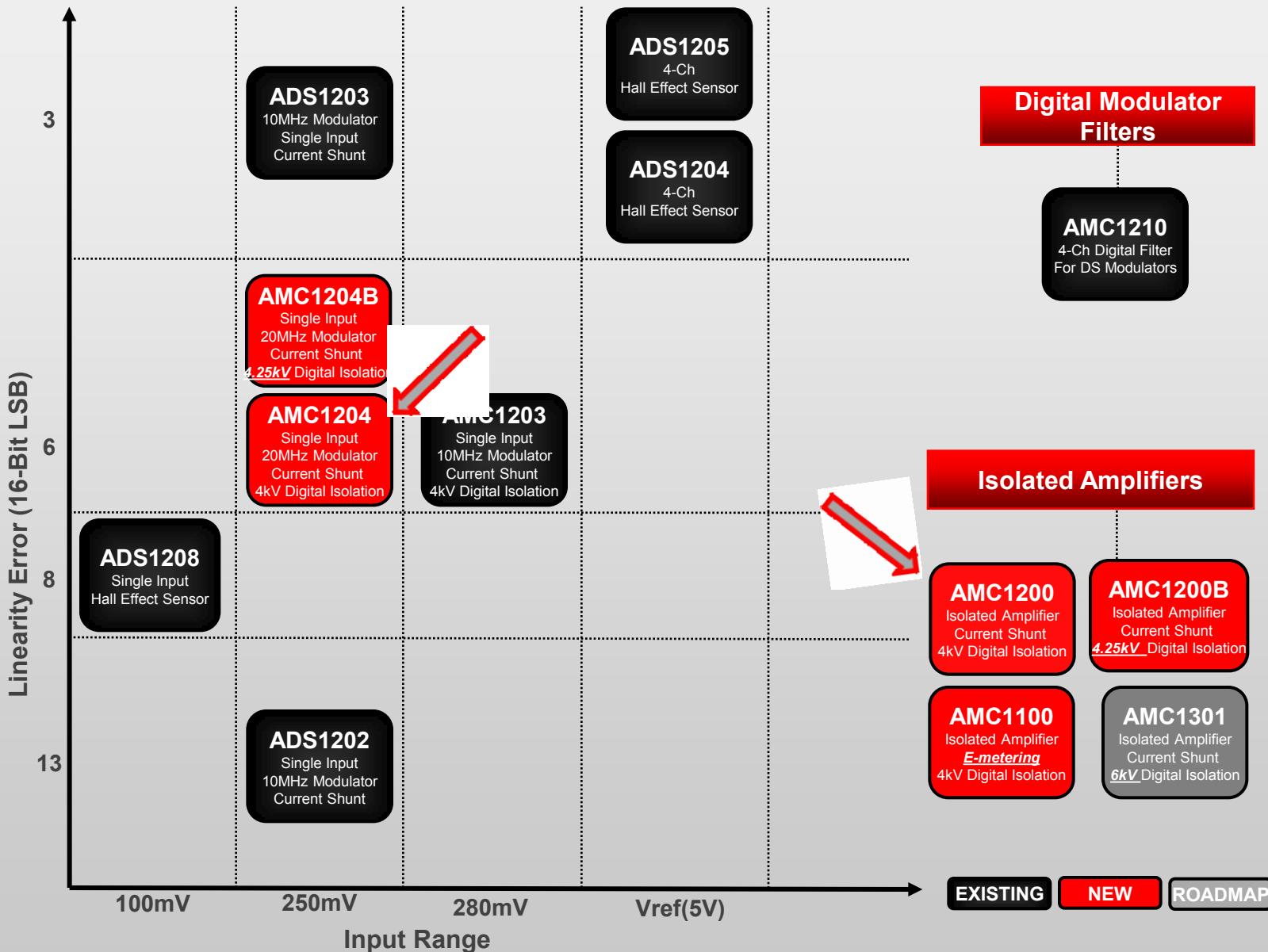
### Benefits

- Unmatched Performance, Integration and Low-power Operation
- Single-chip Solution for Digitizing Geophones or Hydrophones
- Filter Bypass Mode Allows Direct Access to Modulator Data for Use with External Digital Filter

### ADS1282: MUX + PGA + Mod. + Dig. Filter



# Modulators / Isolated Delta-Sigma ADCs



## Modulators/Isolated Delta-Sigma ADCs

	<b>Resolution (Bits)</b>	<b>Sample Rate (max)(SPS)</b>	<b># Input Channels</b>	<b>Interface</b>	<b>INL (+/-) (Max)(%)</b>	<b>Power (Typ) (mW)</b>	<b>A<sub>VDD</sub></b>	<b>Pin/Pkg</b>	<b>Approx. Price (US\$)</b>
<a href="#"><u>ADS1202</u></a>	16	40kSPS	1		0.018	30	4.75-5.25	8TSSOP	2.50   1ku
<a href="#"><u>ADS1203</u></a>	16	40kSPS	1		0.005	33	4.5-5.5	16QFN, 8TSSOP	2.85   1ku
<a href="#"><u>ADS1205</u></a>	16	40kSPS	2		0.005	59	4.5-5.5	24VQFN	4.95   1ku
<a href="#"><u>ADS1208</u></a>	16	40kSPS	1		0.012	64	4.5-5.5	16TSSOP	3.15   1ku
<a href="#"><u>AMC1203</u></a>	16	40kSPS	1	Serial		80	4.5-5.5	16SOIC, 8SOP	3.35   1ku
<a href="#"><u>AMC1204</u></a>	16	78kSPS	1	Serial		88	4.5-5.5	16SOIC	3.45   1ku
<a href="#"><u>AMC1200</u></a>			1		0.05	82.5	4.5-5.5	8SOP	2.20   1ku
<a href="#"><u>AMC1210</u></a>		40kSPS	4	Parallel CMOS, Serial SPI		24.5		40VQFN	1.35   1ku



# AMC1204(B)

4kV<sub>PEAK</sub> (4.25kV<sub>PEAK</sub>) Isolated 20MHz ΔΣ modulator

## Features

- Integrated Capacitive Isolation Barrier
  - Continuous working voltage: **1200V<sub>PEAK</sub>**
- External Clock: 5 to 20MHz
- INL: **±8LSB max**
- Outstanding AC Performance: SNR: **84dB min**, THD: **-80dB max**
- P2P dropin vs. HCPL7860 & AD7401A and spec over the extended industrial temperature range

## Applications

Shunt-based Current measurement in:

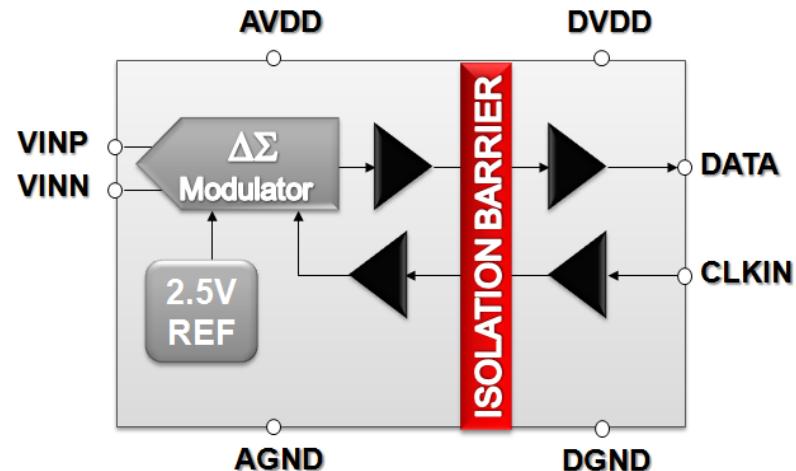
- Motor Control
- Green Energy
- Frequency Inverter Applications
- Uninterruptible Power Supplies



AMC1204 EVM Available

## Benefits

- Provides excellent magnetic immunity and long isolation barrier lifetime
- Enables synchronization of multiple channels
- 30% more linear vs. the nearest competitor which enables more accurate measurements
- AC performance exceeds that of the nearest competitor
- Offers a simple upgrade which reduces power while increasing performance



# AMC1200

4kV<sub>PEAK</sub> Isolated Amplifier

## Features

- Certified Galvanic Isolation Barrier
  - 4kV (**4.25kV**) peak Basic isolation
  - UL1777 and IEC60747-5-2 approved
  - 1.2kVpeak continuous working voltage
- $\pm 250\text{mV}$  input voltage range
- Pin-to-pin performance upgrade for HCPL7800 & HCPL7840
- Specified Temperature range: -40 to 105°C

## Applications

Shunt-based Current measurement in:

- Motor Control
- Green Energy
- Frequency Inverter Applications
- Uninterruptible Power Supplies



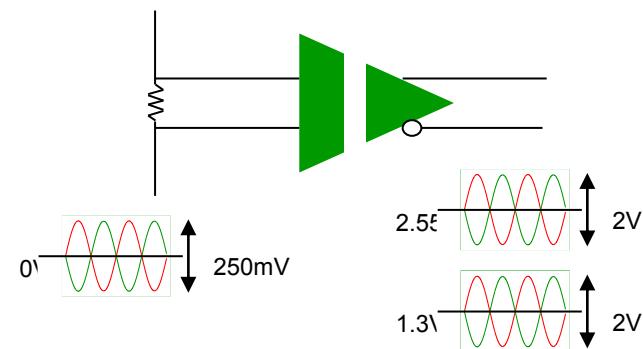
# AMC1200B

4.25kV<sub>PEAK</sub> Isolated Amplifier

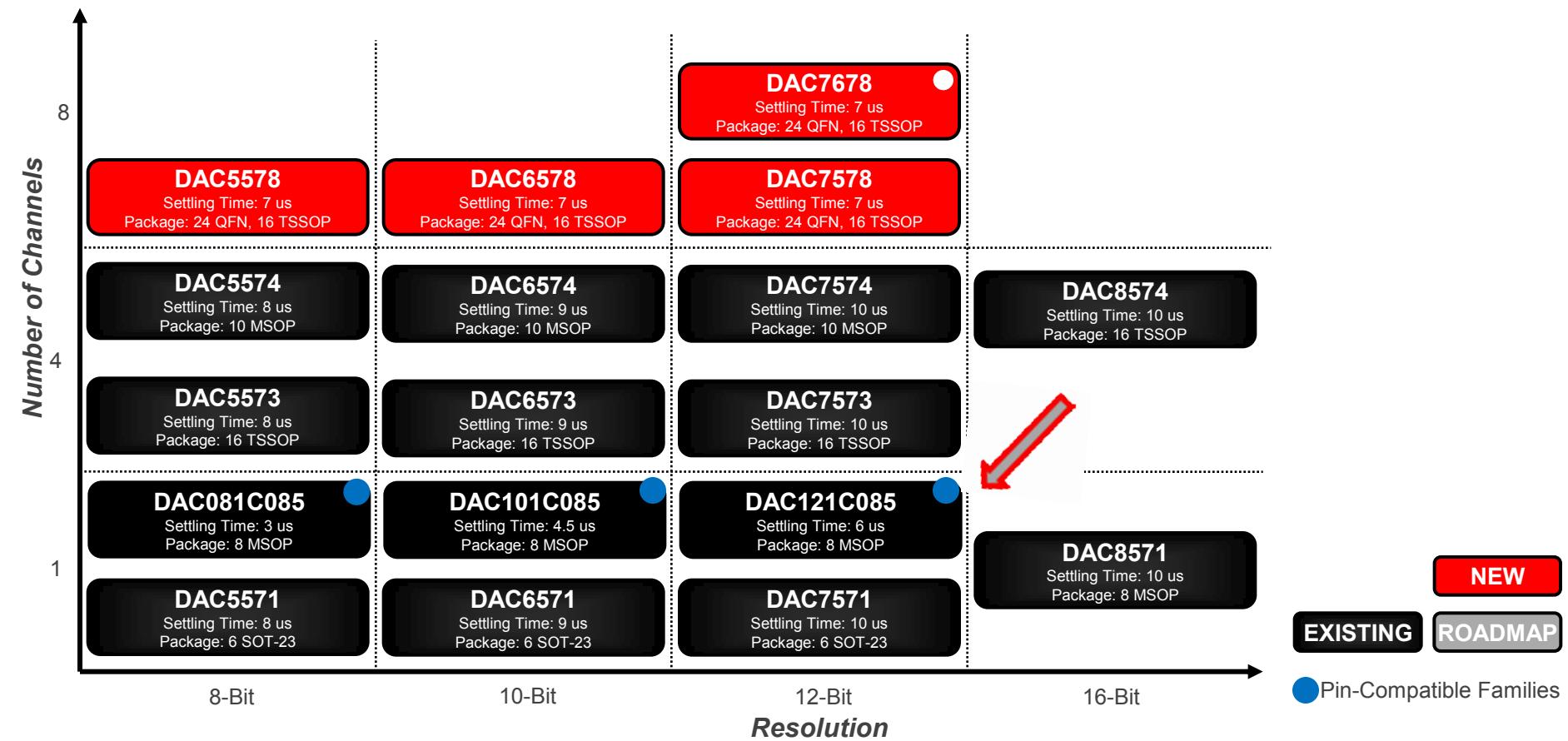
## Benefits

- Galvanic barrier provides EMI immunity and robust isolation barrier lifetime
- Optimized for direct connection to shunt resistors or other low voltage level signal sources
- Over 90% more linear, 80% less gain drift, at 50% of the power
- Extended industrial range offers additional 20°C of fully specified performance

AMC1200 EVM Available



# Low Power, Single Supply DACs with I<sup>2</sup>C Interface



● Contains Internal Reference

## 8-bit Low Power, Single Supply DACs with I2C Interface

	Channels	Interface	Output Type	Output Range Min. (V or mA)	Output Range Max. (V or mA)	Settling Time(μs)	INL(Max)(+/-LSB)	Reference Type	Power Consumption(Typ)(mW)	Pin/Pkg	Approx. Price (US\$)
<a href="#"><b>DAC081C085</b></a>	1	Serial I2C	Voltage	0	5.5	8.5	0.6	Ext	0.38	8VSSOP	0.72   1ku
<a href="#"><b>DAC5571</b></a>	1	Serial I2C	Voltage	0	5.5	8	1	Ext	0.4	6SOT-23	0.90   1ku
<a href="#"><b>DAC5573</b></a>	4	Serial I2C	Voltage	0	5.5	8	0.5	Ext	1.5	16TSSOP	2.55   1ku
<a href="#"><b>DAC5574</b></a>	4	Serial I2C	Voltage	0	5.5	8	0.5	Ext	1.5	10MSOP	2.55   1ku
<a href="#"><b>DAC5578</b></a>	8	Serial I2C	Voltage	0	5.5	7	0.25	Ext	3.4	16TSSOP, 24VQFN	3.00   1ku

**8-bit**

**10-bit**

**12-bit**

**16-bit**



## 10-bit Low Power, Single Supply DACs with I2C Interface

	Channels	Interface	Output Type	Output Range Min. (V or mA)	Output Range Max. (V or mA)	Settling Time(μs)	INL(Max)(+/-LSB)	Reference Type	Power Consumption(Typ)(mW)	Pin/Pkg	Approx. Price (US\$)
<a href="#"><b>DAC101C085</b></a>	1	Serial I2C	Voltage	0	5.5	8.5	2	Ext	0.38	8VSSOP	1.02   1ku
<a href="#"><b>DAC6571</b></a>	1	Serial I2C	Voltage	0	5.5	9	2	Ext	160	6SOT-23	1.40   1ku
<a href="#"><b>DAC6573</b></a>	4	Serial I2C	Voltage	0	5.5	9	2	Ext	500	16TSSOP	3.05   1ku
<a href="#"><b>DAC6574</b></a>	4	Serial I2C	Voltage	0	5.5	9	2	Ext	1.5	10MSOP	3.85   1ku
<a href="#"><b>DAC6578</b></a>	8	Serial I2C	Voltage	0	5.5	7	0.5	Ext	3.4	16TSSOP, 24VQFN	3.90   1ku

8-bit

10-bit

12-bit

16-bit



## 12-bit Low Power, Single Supply DACs with I2C Interface

	Channels	Interface	Output Type	Output Range Min. (V or mA)	Output Range Max. (V or mA)	Settling Time(μs)	INL(Max)(+/-LSB)	Reference Type	Power Consumption(Typ)(mW)	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>DAC121C085</u></a>	1	Serial I2C	Voltage	0	5.5	8.5	8	Ext	0.38	8VSSOP	1.15   1ku
<a href="#"><u>DAC7571</u></a>	1	Serial I2C	Voltage	0	5.5	10	4	Ext	0.85	6SOT-23	1.55   1ku
<a href="#"><u>DAC7573</u></a>	4	Serial I2C	Voltage	0	5.5	10	8	Ext	1.8	16TSSOP	7.65   1ku
<a href="#"><u>DAC7574</u></a>	4	Serial I2C	Voltage	0	5.5	10	8	Ext	0.85	10MSOP	4.00   1ku
<a href="#"><u>DAC7678</u></a>	8	Serial I2C	Voltage	0	5.5	7	1	Int, Ext	3.4	16TSSOP, 24VQFN	6.00   1ku

8-bit

10-bit

12-bit

16-bit



## 16-bit Low Power, Single Supply DACs with I2C Interface

	Channels	Interface	Output Type	Output Range Min. (V or mA)	Output Range Max. (V or mA)	Settling Time(μs)	INL(Max)(+/-LSB)	Ref Type	Power Consumption (Typ)(mW)	Pin/Pkg	Approx Price (US\$)
<a href="#"><b>DAC8571</b></a>	1	Serial I2C	Voltage	0	5.5	10	65	Ext	0.42	8MSOP	3.20   1ku
<a href="#"><b>DAC8574</b></a>	4	Serial I2C	Voltage	-6	6	10	64	Ext	2.7	16TSSOP	7.90   1ku

**8-bit**

**10-bit**

**12-bit**

**16-bit**



# DAC08/101/121C081/085

## 12 Bit Single Channel DAC with I<sup>2</sup>C Interface

### Features

- Guaranteed Monotonicity to 12-bits
- Low Power Operation: 156  $\mu$ A max @ 3.3V
- Extended power supply range (+2.7V to +5.5V)
- I<sup>2</sup>C-Compatible 2-wire Interface
- Rail-to-Rail Voltage Output
- Very Small Package : MSOP-8
- Part for Pin-, Function- Compatible Family

Resolution	Settling Time	TSOT-6 and LLP-6 packages w/ reference from Supply	MSOP-8 package w/ external reference
12 Bit	6 – 8.5 $\mu$ s	DAC121C081	DAC121C085
10 Bit	4.5 – 6 $\mu$ s	DAC101C081	DAC101C085
8 Bit	3 – 4.5 $\mu$ s	DAC081C081	DAC081C085

### Applications

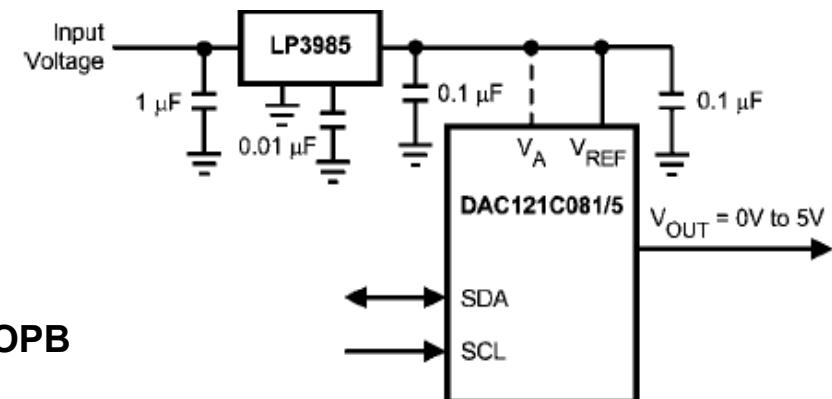
- Industrial Process Control
- Portable Instruments
- Digital Gain and Offset Adjustment
- Programmable Voltage & Current Sources
- Test Equipment



EVM PART #  
DAC121C08XEB/NOPB

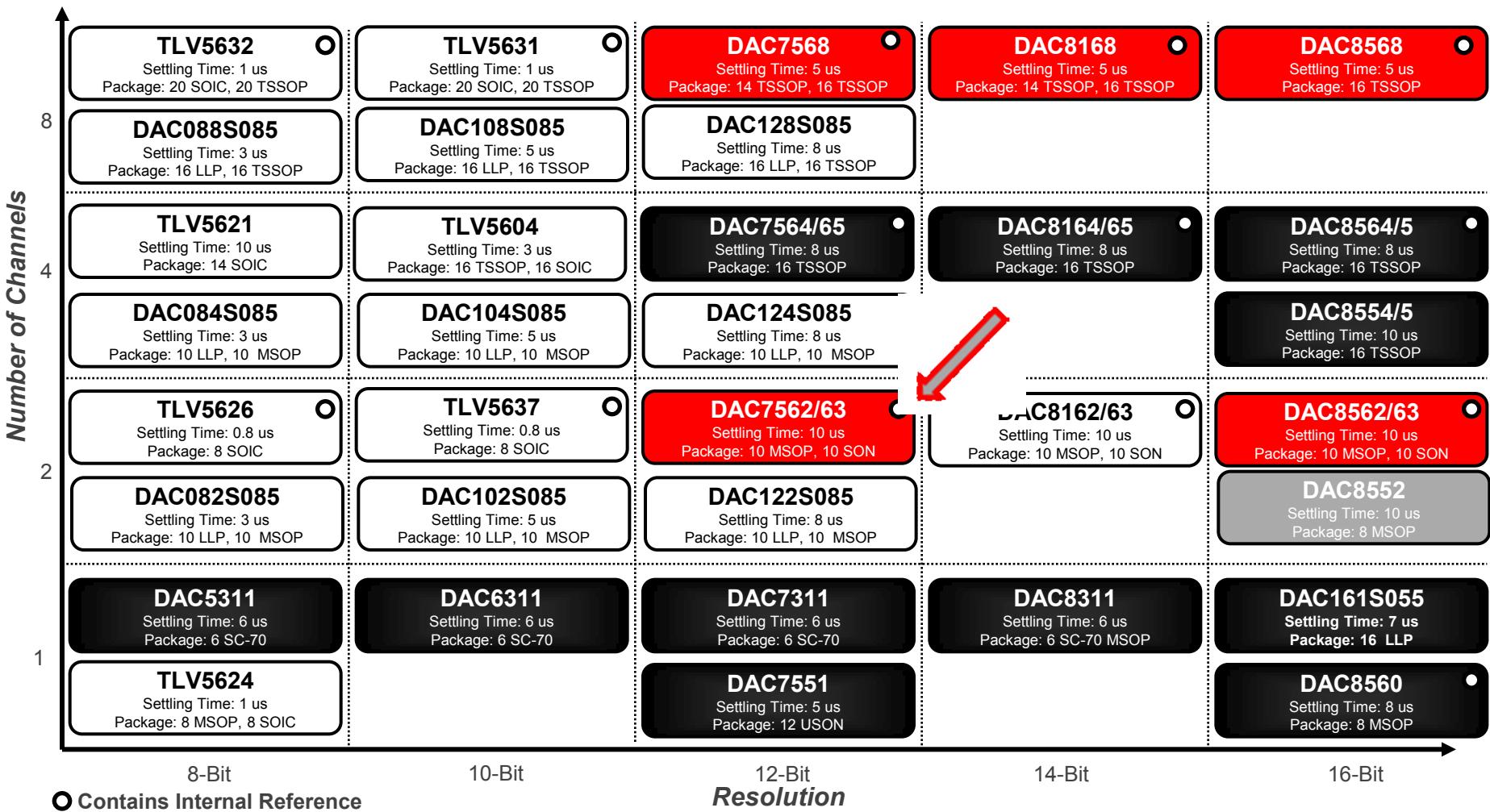
### Benefits

- The output amplifier allows rail-to-rail output swing
- The DAC121C081 uses the supply voltage as the reference to provide the widest possible dynamic output range and typically consumes 132 $\mu$ A while operating at 5.0V.
- A 16-bit register controls the mode of operation, the power-down condition, and the output voltage.
- A power-on reset circuit ensures that the DAC output powers up at 0 V.
- A power-down feature reduces power consumption to less than a microWatt
- Single board layout supports multiple resolutions



Typical Application Circuit

# Low Power, Single Supply DACs with SPI Interface



NEW

LEGACY

EXISTING

ROADMAP



## 8-bit Low Power, Single Supply DACs with SPI Interface

	Channels	Interface	Output Type	Output Range Min. (V or mA)	Output Range Max. (V or mA)	Settling Time(μs)	INL(Max)(+/-LSB)	Ref Type	Power Consumption (Typ)(mW)	Pin/Pkg	Approx Price (US\$)
<a href="#"><b>DAC082S085</b></a>	2	Serial SPI	Voltage	0	5.5	4.5	0.5	Ext	0.6	10QFN, 10SON, 10VSSOP, 10WSON	0.86   1ku
<a href="#"><b>DAC084S085</b></a>	4	Serial SPI	Voltage	0	5.5	8.5	0.5	Ext	1.1	10QFN, 10SON, 10VSSOP, 10WSON	1.08   1ku
<a href="#"><b>DAC088S085</b></a>	8	Serial SPI	Voltage	0	5.5	8	0.5	Ext	1.95	16SON, 16TSSOP, 16WQFN , 16WSON	1.89   1ku
<a href="#"><b>DAC5311</b></a>	1	Serial SPI	Voltage	0	5.5	6	0.25	Ext	0.14	6SC70	0.55   1ku
<a href="#"><b>TLV5621</b></a>	4	Serial SPI	Voltage	0	5.1	10	1	Ext	3.6	14SOIC	2.10   1ku
<a href="#"><b>TLV5624</b></a>	1	Serial SPI	Voltage	0	5.1	1	0.5	Int, Ext	0.9	8MSOP, 8SOIC	1.60   1ku
<a href="#"><b>TLV5626</b></a>	2	Serial SPI	Voltage	0	5.1	0.8	1	Int, Ext	4.2	8SOIC	1.90   1ku
<a href="#"><b>TLV5632</b></a>	8	Serial SPI	Voltage	0	5.1	1	1	Int, Ext	18	20SOIC, 20TSSOP	4.20   1ku

**8-bit**

**10-bit**

**12-bit**

**14-bit**

**16-bit**



## 10-bit Low Power, Single Supply DACs with SPI Interface

	Channels	Interface	Output Type	Output Range Min. (V or mA)	Output Range Max. (V or mA)	Settling Time(μs)	INL(Max)(+/-LSB)	Ref Type	Power Consumption (Typ)(mW)	Pin/Pkg	Approx Price (US\$)
<a href="#"><b>DAC102S085</b></a>	2	Serial SPI	Voltage	0	5.5	6	2	Ext	0.6	10QFN, 10SON, 10VSSOP, 10WSON	1.44   1ku
<a href="#"><b>DAC104S085</b></a>	4	Serial SPI	Voltage	0	5.5	8.5	2	Ext	1.1	10QFN, 10SON, 10VSSOP, 10WSON	2.24   1ku
<a href="#"><b>DAC108S085</b></a>	8	Serial SPI	Voltage	0	5.5	8	2	Ext	1.95	16SON, 16TSSOP, 16WQFN , 16WSON	3.45   1ku
<a href="#"><b>DAC6311</b></a>	1	Serial SPI	Voltage	0	5.5	6	0.5	Ext	0.14	6SC70	0.65   1ku
<a href="#"><b>TLV5604</b></a>	4	Serial SPI	Voltage	0	5.1	3	1	Ext	3	16SOIC, 16TSSOP	3.70   1ku
<a href="#"><b>TLV5631</b></a>	8	Serial SPI	Voltage	0	5.1	1	2	Int, Ext	18	20SOIC, 20TSSOP	5.60   1ku
<a href="#"><b>TLV5637</b></a>	2	Serial SPI	Voltage	0	5.1	0.8	1	Int, Ext	4.2	8SOIC	3.95   1ku

8-bit

10-bit

12-bit

14-bit

16-bit



## 12-bit Low Power, Single Supply DACs with SPI Interface

	Channels	Interface	Output Type	Output Range Min. (V or mA)	Output Range Max. (V or mA)	Settling Time(μs)	INL(Max)(+/-LSB)	Ref Type	Power Consumption (Typ)(mW)	Pin/Pkg	Approx Price (US\$)
<a href="#"><u>DAC122S085</u></a>	2	Serial SPI	Voltage	0	5.5	8.5	8	Ext	0.6	10QFN, 10SON, 10VSSOP, 10WSON	1.85   1ku
<a href="#"><u>DAC124S085</u></a>	4	Serial SPI	Voltage	0	5.5	8.5	8	Ext	1.1	10QFN, 10SON, 10VSSOP, 10WSON	3.10   1ku
<a href="#"><u>DAC128S085</u></a>	8	Serial SPI	Voltage	0	5.5	8	8	Ext	1.95	16SON, 16TSSOP, 16WQFN, 16WSON	5.80   1ku
<a href="#"><u>DAC7311</u></a>	1	Serial SPI	Voltage	0	5.5	6	1	Ext	0.14	6SC70	0.95   1ku
<a href="#"><u>DAC7551</u></a>	1	Serial SPI	Voltage	0	5.5	5	1	Ext	0.27	12USON	1.40   1ku
<a href="#"><u>DAC7562</u></a>	2	Serial SPI	Voltage	0	5	7	0.75	Int, Ext	0.5	10MSOP, 10SON	2.50   1ku
<a href="#"><u>DAC7563</u></a>	2	Serial SPI	Voltage	0	5	7	0.75	Int, Ext	0.5	10MSOP, 10SON	2.50   1ku
<a href="#"><u>DAC7564</u></a>	4	Serial SPI	Voltage	0	5.5	8	1	Int, Ext	2.9	16TSSOP	3.50   1ku
<a href="#"><u>DAC7565</u></a>	4	Serial SPI	Voltage	0	5.5	8	1	Int, Ext	2.9	16TSSOP	3.50   1ku
<a href="#"><u>DAC7568</u></a>	8	Serial SPI	Voltage	0	5.5	5	1	Int, Ext	2.2	16TSSOP, 14TSSOP	7.70   1ku

8-bit

10-bit

12-bit

14-bit

16-bit



## 14-bit Low Power, Single Supply DACs with SPI Interface

	Channels	Interface	Output Type	Output Range Min. (V or mA)	Output Range Max. (V or mA)	Settling Time(μs)	INL(Max)(+/-LSB)	Ref Type	Power Consumption (Typ)(mW)	Pin/Pkg	Approx Price (US\$)
<a href="#"><u>DAC8162</u></a>	2	Serial SPI	Voltage	0	5	7	3	Int, Ext	0.5	10MSOP, 10SON	3.85   1ku
<a href="#"><u>DAC8163</u></a>	2	Serial SPI	Voltage	0	5	7	3	Int, Ext	0.5	10MSOP, 10SON	3.85   1ku
<a href="#"><u>DAC8164</u></a>	4	Serial SPI	Voltage	0	5.5	8	2	Int, Ext	2.9	16TSSOP	5.00   1ku
<a href="#"><u>DAC8165</u></a>	4	Serial SPI	Voltage	0	5.5	8	2	Int, Ext	2.9	16TSSOP	5.00   1ku
<a href="#"><u>DAC8168</u></a>	8	Serial SPI	Voltage	0	5.5	5	4	Int, Ext	2.2	14TSSOP, 16TSSOP	9.20   1ku
<a href="#"><u>DAC8311</u></a>	1	Serial SPI	Voltage	0	5.5	6	4	Ext	0.14	6SC70	2.00   1ku

8-bit

10-bit

12-bit

14-bit

16-bit



## 16-bit Low Power, Single Supply DACs with SPI Interface

	Channels	Interface	Output Type	Output Range Min. (V or mA)	Output Range Max. (V or mA)	Settling Time(μs)	INL(Max)(+/-LSB)	Ref Type	Power Consumption (Typ)(mW)	Pin/Pkg	Approx Price (US\$)
<a href="#"><b>DAC161S055</b></a>	1	Serial SPI	Voltage	0	5.25	5	3	Ext	5.5	16SON, 16WQFN , 16WSON	3.55   1ku
<a href="#"><b>DAC8552</b></a>	2	Serial SPI	Voltage	0	5.5	10	12	Ext	3	8MSOP	3.20   1ku
<a href="#"><b>DAC8560</b></a>	1	Serial SPI	Voltage	0	5.5	8	8	Int, Ext	2.6	8MSOP	2.90   1ku
<a href="#"><b>DAC8562</b></a>	2	Serial SPI	Voltage	0	5	7	12	Int, Ext	0.5	10MSOP , 10SON	4.20   1ku
<a href="#"><b>DAC8563</b></a>	2	Serial SPI	Voltage	0	5	7	12	Int, Ext	0.5	10MSOP , 10SON	4.20   1ku
<a href="#"><b>DAC8564</b></a>	4	Serial SPI	Voltage	0	5.5	8	8	Int, Ext	3.1	16TSSOP	5.95   1ku
<a href="#"><b>DAC8565</b></a>	4	Serial SPI	Voltage	0	5.5	8	8	Int, Ext	3.1	16TSSOP	5.95   1ku
<a href="#"><b>DAC8568</b></a>	8	Serial SPI	Voltage	0	5.5	5	12	Int, Ext	2.2	16TSSOP	10.95   1ku

8-bit

10-bit

12-bit

14-bit

16-bit



# DAC7562/DAC8162/DAC8562:

**Dual 12/14/16 bit Low Power Ultra Low Glitch buffered Voltage Output DAC with 2.5V 4 ppm/°C internal reference in small 3x3 QFN**

## Features

- Excellent low power performance
  - INL(Max): 0.75 LSB(12 bit), Offset error(max): 4 mV
  - Ultra Low glitch energy: 0.1 nV-sec
  - Low Power: 0.27 mW per channel
- Integrated precision internal reference
  - 2.5 V reference, 10 ppm/°C max. drift
  - 1 mV initial accuracy
  - 20 mA sink/source capability
- Small Package
  - 10-pin MSOP(3x5mm) & 10-pin QFN(3x3mm)
- Reset to Zero or Mid Scale option
- Pin compatible family of 12/14/16 bit parts
- Wide Temp Range -40°C to +125°C



## Benefits

- 99% lower glitch, 25% better INL, 60% lower offset error vs competition with no power overhead provides best in class performance
- Integrated reference with low drift and ability to sink/source current (without external buffer) reduces system cost and board space
- 40% Smaller footprint than competition makes it suitable for high density and portable applications
- Flexible use in different control loops
- Easy upgrade / downgrade of system resolution; helps avoid extensive design and layout rework
- Characterized under 20°C higher industrial temp. range than competition

## Applications

Datasheet	Bits	Reset state
DAC7562	12	Zero
DAC8162	14	Mid Scale
DAC8562	16	Zero
DAT8102	12	Mid Scale
DAC7562	12	Zero
DAC7563	12	Mid Scale

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# Integrated ADCs and DACs with SPI & I<sup>2</sup>C Interfaces

Parameter/ Device	AMC7820	AMC7823	AMC7812	LMP92001	LMP92018 AMC7891
<b>Resolution ADC,DAC</b>	12-bits	12-bits	12-bits	12-bits	10-bits
<b>ADC: # Input Channels</b>	8 SE	8 SE	(16 SE) or (12 SE, 2 DE)	16 SE	8 SE
<b>ADC: Sample Rate</b>	100ksps	200ksps	500ksps	100ksps	500ksps
<b>ADC: Input Range</b>	0 to 5V	0 to 5V	-5 to 5V (Diff)	0 to 5V	0 to 5.5V (AMC) 0 to 5.25V (LMP)
<b>DAC: # Outputs</b>	3	8	12	12	4
<b>DAC: Output Range</b>	0 to 5V	0 to 5V	(0 to 5V) or (0 to 12.5V)	(0 to 5V)	0 to 5V
<b>Local Temp Sensors</b>	No	Yes	Yes	Yes	Yes
<b># Remote Temp Sensors</b>	None	None	2	None	None
<b>GPIOs</b>	None	6	8	8	12
<b>Interface</b>	SPI	SPI	SPI or I <sup>2</sup> C	I <sup>2</sup> C/SMBus	SPI
<b>Package</b>	TQFP-48 (9x9mm)	QFN-40 (7x7mm)	QFN-64 (9x9mm)	LLP-56 (QFN,10x5.5mm)	QFN-36 (6x6mm)
<b>Additional Features</b>	<ul style="list-style-type: none"> <li>• 9 Op amps</li> <li>• Current source for thermistors</li> </ul>	Current source for thermistors	Out of Range Alarms	Out of Range Alarms	<a href="#">Roadmap</a> <a href="#">New</a> <a href="#">Existing</a>

# AMC7812

**Highly integrated 12-Bit Analog Monitoring & Control Solution with Multichannel ADC | DACs & Temp. Sensors**

## Features

- **Integration & flexibility in use**

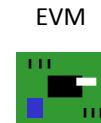
- Twelve 12 bit DACs with programmable outputs
  - 0 to 5V or 0 to 12V
- 16 channel 12 bit ADC with 500ksps
  - Configurable as 16 SE or 12 SE & 2 DE inputs
- 2 Remote Temp Sensors: -40° C to +150° C, ±2° C accuracy
- Internal Temp Sensor: -40° C to +125° C, ± 2.5° C accuracy
- Internal Reference: 2.5V, 25ppm/°C

- **Programmable Interface**

- SPI (Up to 50MHz) or I2C Compatible (up to 3.4MHz)

- **Additional Monitoring and control features**

- Thermal Alarm
- ADC input out of range alarms
- 8 GPIO pins



- **Packages:** 64-pin QFN (9mm\*9mm)

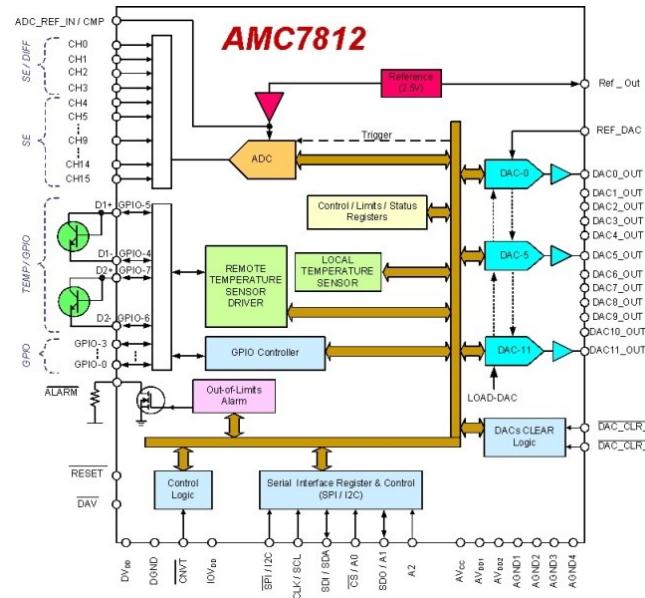
- **Operating Temp. Range:** -40° C to 105° C

## Applications

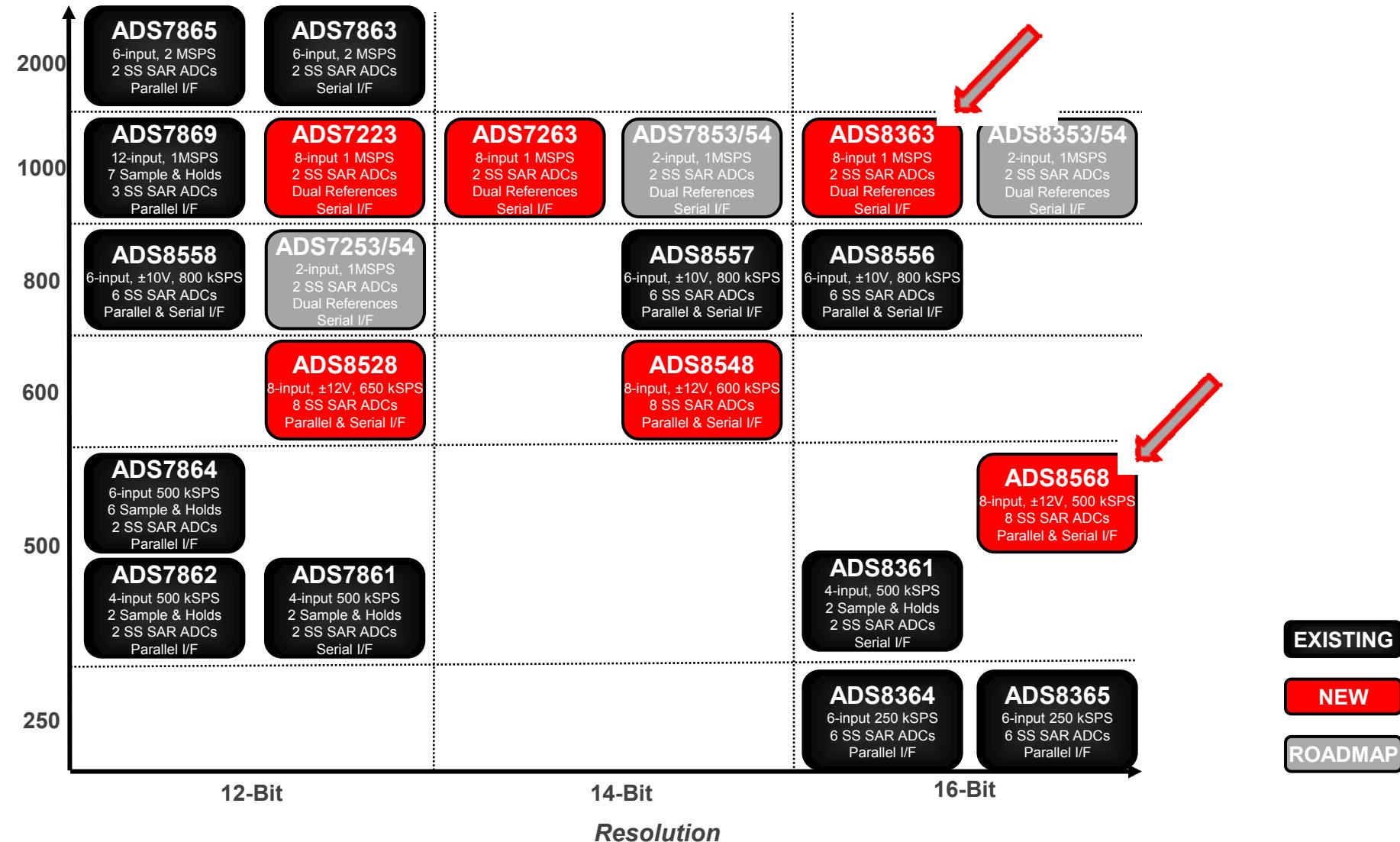
- RF PA Control in base stations
- General purpose monitoring and control
- Industrial Control
- Optical Control

## Benefits

- Highly Integrated device helps customer integrate up to 4 parts thus saving board space and cost and design time as well as simplifying layout
- Flexible Serial Interface enables use of one device for different applications requiring different interfaces
- Alarms and GPIO's offer significant monitoring and control capability and help off load system microcontroller
- Widest operating temperature enables use in harsh environments



# Simultaneous Sampling SAR ADCs



## 12-bit Simultaneous Sampling SAR ADCs

	# of Ch.	Speed (kSPS)	Interface	Max Pwr (mW)	AVDD	$V_{REF} = V_A$	PGA	Int OSC	Int Ref.	Extra	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>ADS8528</u></a>	8	650	Parallel CMOS, Serial SPI	335	4.5-5.5				✓		64/LQFP, 64/VQFN	9.50   1ku
<a href="#"><u>ADS8558</u></a>	6	730	Parallel CMOS, Serial SPI	262.2	4.5-5.5				✓		64/LQFP	8.95   1ku
<a href="#"><u>ADS7865</u></a>	6	2000	Parallel CMOS	30	2.7-5.5				✓		32/TQFP	4.90   1ku
<a href="#"><u>ADS7863</u></a>	4	2000	Serial SPI	35.5	2.7-5.5				✓		24/SSOP/QSOP, 24/VQFN	4.90   1ku
<a href="#"><u>ADS7869</u></a>	12	1000	Parallel CMOS, Serial SPI	250	4.5-5.5				✓		100/TQFP	15.65   1ku
<a href="#"><u>ADS7864</u></a>	6	500	Parallel CMOS	52.5	4.75-5.25				✓		48/TQFP	6.65   1ku
<a href="#"><u>ADS7861</u></a>	4	500	Serial SPI	25	4.75-5.25				✓		24/SSOP/QSOP, 32/QFN	4.05   1ku
<a href="#"><u>ADS7862</u></a>	4	500	Parallel CMOS	25	4.75-5.25				✓		32/TQFP	5.70   1ku
<a href="#"><u>ADS7223</u></a>	4	1000	Serial	47.2	2.7-5.5				✓		32/QFN	3.95   1ku
<a href="#"><u>ADS7253/54</u></a>	2	1000	Serial	TBD	4.75-5.25				✓		16/QFN, 16/TSSOP	TBD

12-bit

14-bit

16-bit

\*only SD<sub>OUT</sub>, no SD<sub>IN</sub>

Roadmap device



## 14-bit Simultaneous Sampling SAR ADCs

	# of Ch.	Speed (kSPS)	Interface	Max Pwr (mW)	AVDD	$V_{REF} = V_A$	PGA	Int OSC	Int Ref.	Extra	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>ADS8548</u></a>	8	600	Parallel CMOS, Serial SPI	335	4.5-5.5				✓		64LQFP, 64VQFN	12.50   1ku
<a href="#"><u>ADS7263</u></a>	4	1000	Serial	47.2	2.7-5.5				✓		32QFN	6.95   1ku
<a href="#"><u>ADS8557</u></a>	6	670	Parallel CMOS, Serial SPI	253.2	4.5-5.5				✓		64LQFP	10.95   1ku
<a href="#"><u>ADS7853/54</u></a>	2	1000	Serial	TBD	4.75-5.25				✓		16/QFN, 16/TSSOP	TBD

12-bit

14-bit

16-bit

\*only SD<sub>OUT</sub>, no SD<sub>IN</sub>

Roadmap device

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## 16-bit Simultaneous Sampling SAR ADCs

	# of Ch.	Speed (kSPS)	Interface	Max Pwr (mW)	AVDD	$V_{REF} = V_A$	PGA	Int OSC	Int Ref.	Extra	Pin/Pkg	Approx. Price (US\$)
<a href="#"><u>ADS8568</u></a>	8	500	Parallel CMOS, Serial SPI	335	4.5-5.5				✓		64/LQFP, 64/VQFN	15.90   1ku
<a href="#"><u>ADS8363</u></a>	4	1000	Serial	47.2	2.7-5.5				✓		32/QFN	9.95   1ku
<a href="#"><u>ADS8556</u></a>	6	630	Parallel CMOS, Serial SPI	251.7	4.5-5.5				✓		64/LQFP	12.95   1ku
<a href="#"><u>ADS8365</u></a>	6	250	Parallel CMOS	190	4.75-5.25				✓		64/TQFP	16.25   1ku
<a href="#"><u>ADS8361</u></a>	4	500	Serial SPI	150	4.75-5.25				✓		24/SSOP/ QSOP, 32/QFN	8.75   1ku
<a href="#"><u>ADS8364</u></a>	6	250	Parallel CMOS	413	4.75-5.25				✓		64/TQFP	18.10   1ku
<a href="#"><u>ADS8353/54</u></a>	2	1000	Serial	TBD	4.75-5.25				✓		16/QFN, 16/TSSOP	TBD

12-bit

14-bit

16-bit

\*only SD<sub>OUT</sub>, no SD<sub>IN</sub>

Roadmap device

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# ADS8363

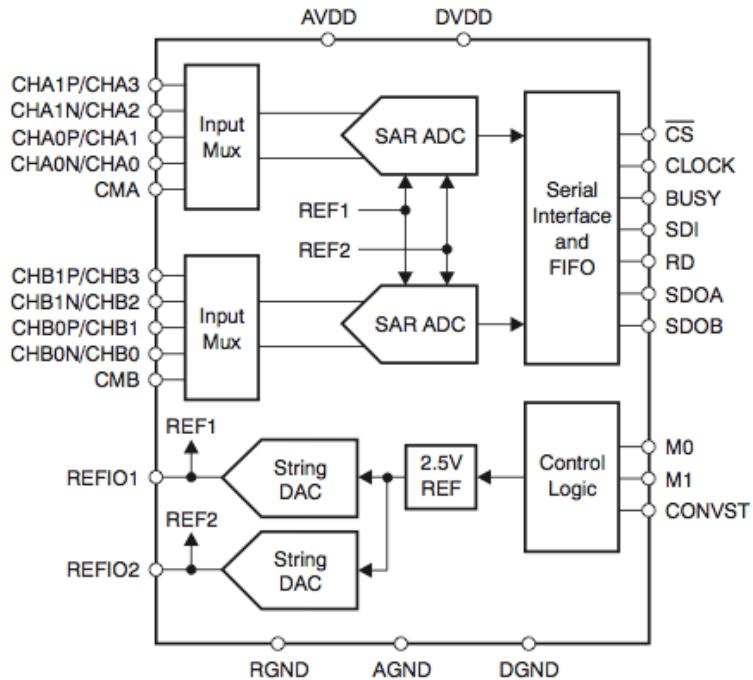
## 16-bit 1MSPS 4x2/2x2 Simultaneous Sampling SAR ADC

### Features

- Dual,4-Ch pseudo-differential or 2-Ch differential configurable inputs coupled with a dual 2.5V programmable reference
- Dual ADCs with true 16-bit Performance
  - NMC @ 93dB SNR (typ)
- Integrated Industrial Solution
  - 4 deep per-channel FIFO
  - Auto-scan Mode
  - Extended temp range: -40 to 125°C
  - Compact packaging: QFN-32

### Benefits

- Input muxes and **dual programmable internal reference** enable input range scaling and monitoring up to 8 different signals
- **Improved application accuracy**
- Integrated FIFO enables a **75% reduction** in the number of host accesses



### Applications

- Motor control
- Power quality measurement
- Protection relays
- Industrial automation



ADS8363 EVM Available

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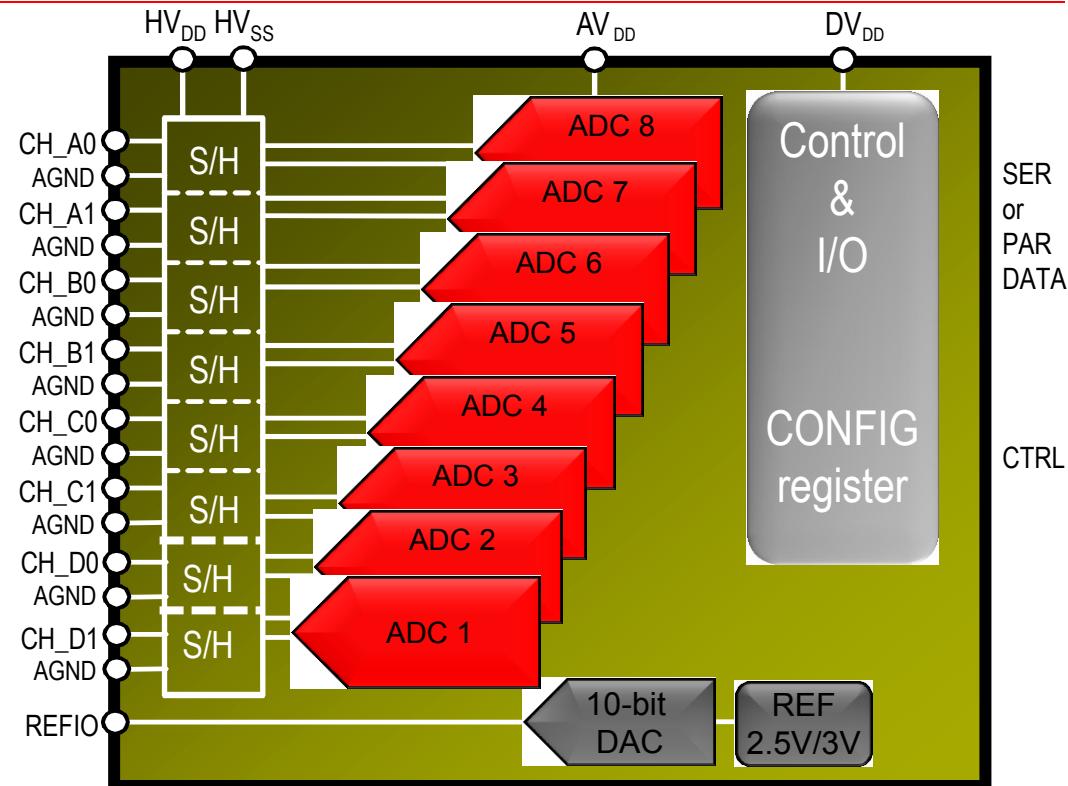
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# ADS8568 / ADS8548 / ADS8528

## Multi-Bit 8-ch Simultaneous Sampling SAR with Bipolar Inputs

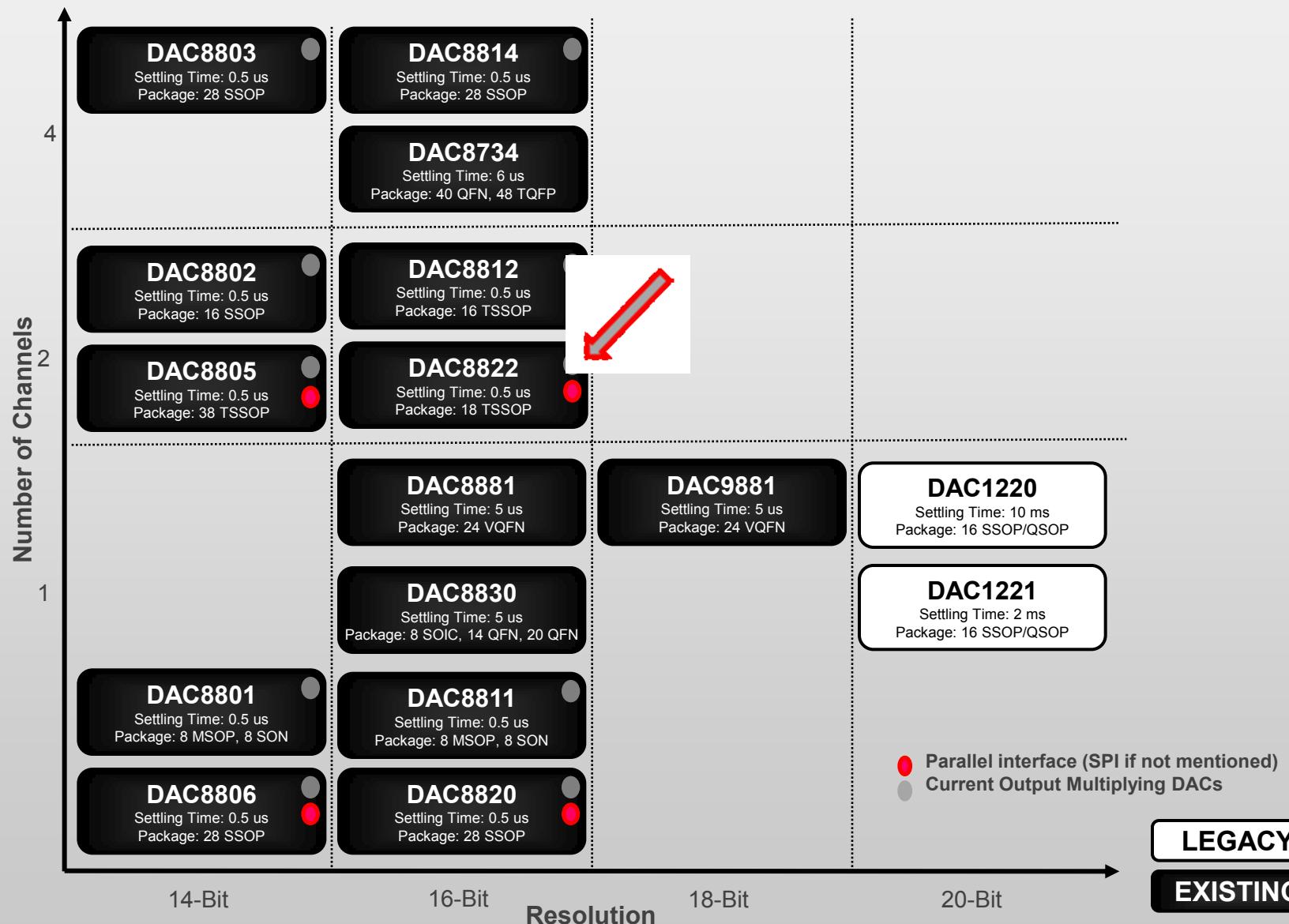
- P2P16-/14-/12-Bit Versions
  - 510/400kSPS @ 16-bits
  - 600/450kSPS @ 14-bits
  - 650/480kSPS @ 12-bits
- 8 bipolar inputs:  $\pm 12V$  (max)
- Small, Integrated Industrial Solution
  - 2.5V programmable reference
  - Fully specified from -40 to 125°C
  - QFN-64 & TQFP-64 Packages
  - Supports internal and external conversion clock
  - Supports *parallel and serial data* interface



- Power Automation:
  - Protection Relays
  - Power performance measuring and monitoring devices (PMD)
- Multiphase Motor Control
- Multi-axis positioning systems
- Industrial automation and Data Acquisition



# High Accuracy DACs ( $\geq$ 14-bits, INL $\leq$ 1LSB) with SPI Interface



## High Accuracy DACs ( $\geq$ 14-bits, INL $\leq$ 1LSB) with SPI Interface

	Resolution	Channels	Interface	Output Type	Output Range Min. (V or mA)	Output Range Max. (V or mA)	Settling Time ( $\mu$ s)	INL(Max)( $\pm$ -LSB)	Ref Type	Power (Typ)(mW)	Pin/Pkg	Approx Price (US\$)
<a href="#"><u>DAC1220</u></a>	20	1	Serial SPI	Voltage	0	5.5	10000	1	Ext	2.5	16SSOP/Q SOP	7.15   1ku
<a href="#"><u>DAC9881</u></a>	18	1	Serial SPI	Voltage	0	5.5	5	2	Ext	6	24VQFN	16.90   1ku
<a href="#"><u>DAC1221</u></a>	20	1	Serial SPI	Voltage	0	2.8	2000	2	Ext	1.2	16SSOP/Q SOP	6.60   1ku
<a href="#"><u>DAC8734</u></a>	16	4	Serial SPI	Voltage	-16.5	16.5	6	1	Ext	280	40VQFN, 48TQFP	20.20   1ku
<a href="#"><u>DAC8811</u></a>	16	1	Serial SPI	Current	0	2	0.5	1	Ext	0.025	8MSOP, 8SON	7.15   1ku
<a href="#"><u>DAC8812</u></a>	16	2	Serial SPI	Current	0	2	0.5	1	Ext	0.025	16TSSOP	8.40   1ku
<a href="#"><u>DAC8814</u></a>	16	4	Serial SPI	Current	0	2	0.5	1	Ext	0.0275	28SSOP	16.95   1ku
<a href="#"><u>DAC8820</u></a>	16	1	Parallel	Current	0	2	0.5	1	Ext	0.025	28SSOP	8.50   1ku
<a href="#"><u>DAC8822</u></a>	16	2	Parallel	Current	0	2	0.5	1	Ext	0.025	38TSSOP	8.65   1ku
<a href="#"><u>DAC8830</u></a>	16	1	Serial SPI	Voltage	0	5.5	1	1	Ext	0.015	8SOIC	5.95   1ku
<a href="#"><u>DAC8881</u></a>	16	1	Serial SPI	Voltage	0	5.5	5	1	Ext	6	24VQFN	8.00   1ku
<a href="#"><u>DAC8801</u></a>	14	1	Serial SPI	Current	0	2	0.5	1	Ext	0.025	8MSOP, 8SON	4.60   1ku
<a href="#"><u>DAC8802</u></a>	14	2	Serial SPI	Current	0	2	0.5	1	Ext	0.025	16TSSOP	6.10   1ku
<a href="#"><u>DAC8803</u></a>	14	4	Serial SPI	Current	0	2	0.5	1	Ext	0.0275	28SSOP	12.65   1ku
<a href="#"><u>DAC8805</u></a>	14	2	Parallel	Current	0	2	0.5	1	Ext	0.025	38TSSOP	6.15   1ku
<a href="#"><u>DAC8806</u></a>	14	1	Parallel	Current	0	2	0.5	1	Ext	0.025	28SSOP	5.50   1ku



# DAC8822

## 16-Bit Dual Channel \ Parallel Interface \ Multiplying DAC

### Features

- Pin-compatible with AD5547
- $\pm 1$  LSB INL (max)
- Fast 0.5us output settling time
- Improved AC Performance
  - -105dB THD
- microPower Operation: 3 $\mu$ A @ 5V

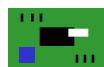
### Applications

- Automatic Test Equipment
- Instrumentation
- Digitally Controlled Calibration
- Digital Waveform Generation
- Data Acquisition Cards

### Tools

- **MDACBufferPro:** Output Amplifier Selection Tool  
<http://focus.ti.com/docs/tools/folders/print/mdacbufferpro.html>

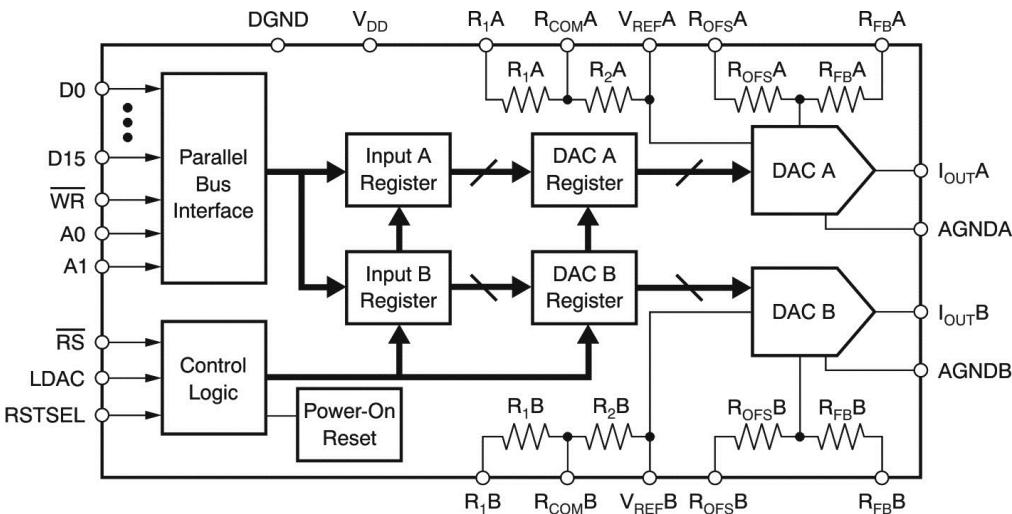
EVM



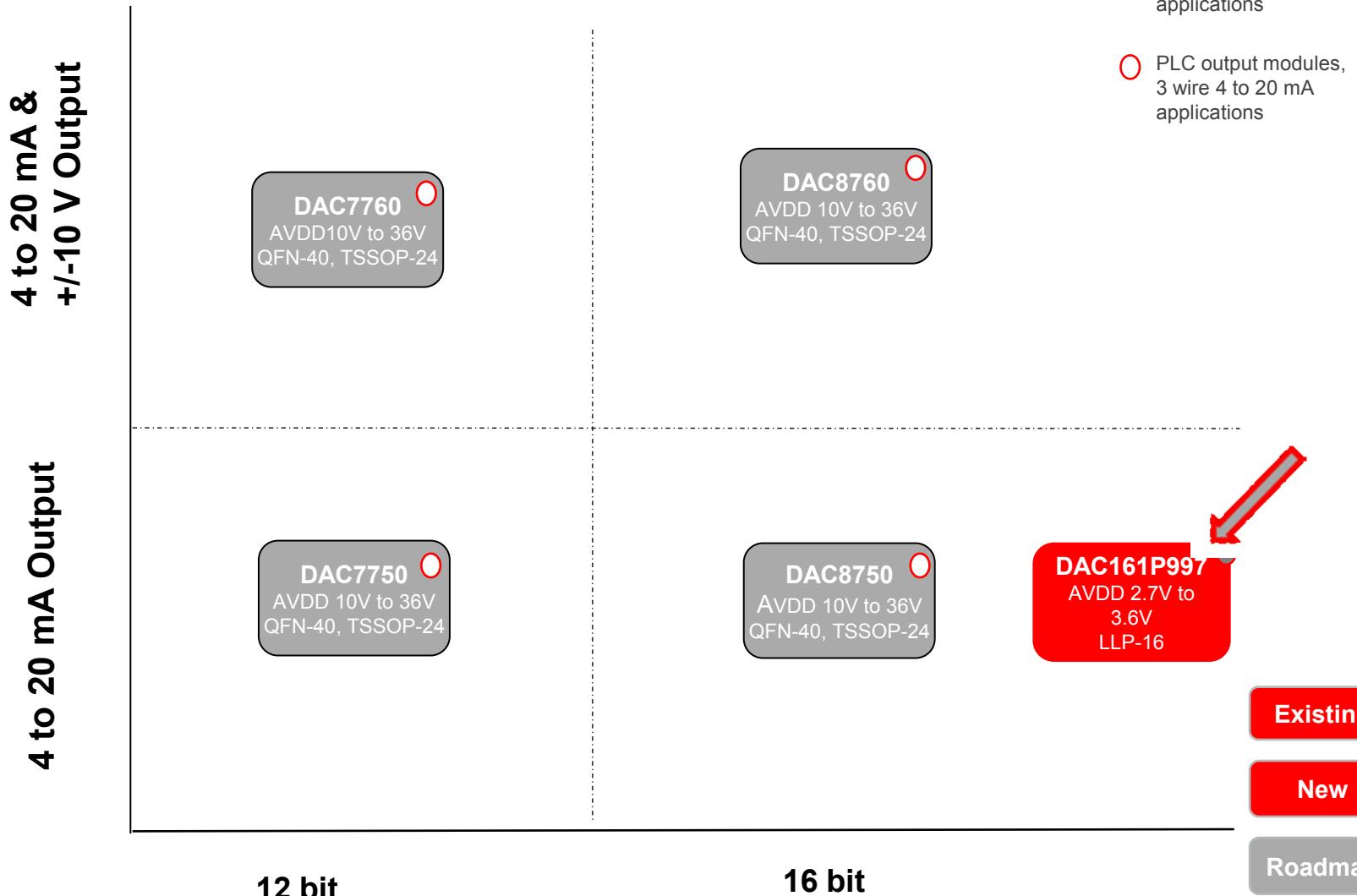
DAC8820EVM  
Available Q1 07

### Benefits

- Improved Alternate Source
- Best Accuracy Dual Channel MDAC!  
Better Accuracy than AD5547's  $\pm 2$  LSB
- Equivalent to AD5547
- 20dB Better THD verses ADI (-85dB)  
➢ Wider Dynamic Range
- 70% Lower Power than ADI (10 $\mu$ A @ 5V)



Targeted towards



# DAC161P997

16bit DAC with Single Wire Interface and “4-20mA” current loop drive

## Features

- 16 bit DAC
- Low Power
- Single Wire Interface (SWI), with handshake
- Programmable start up condition
- Self adjusts over wide baud rate range
- Error detection and reporting
- Programmable output Error Level
- Auxiliary HART input
- Internal Reference

## Applications

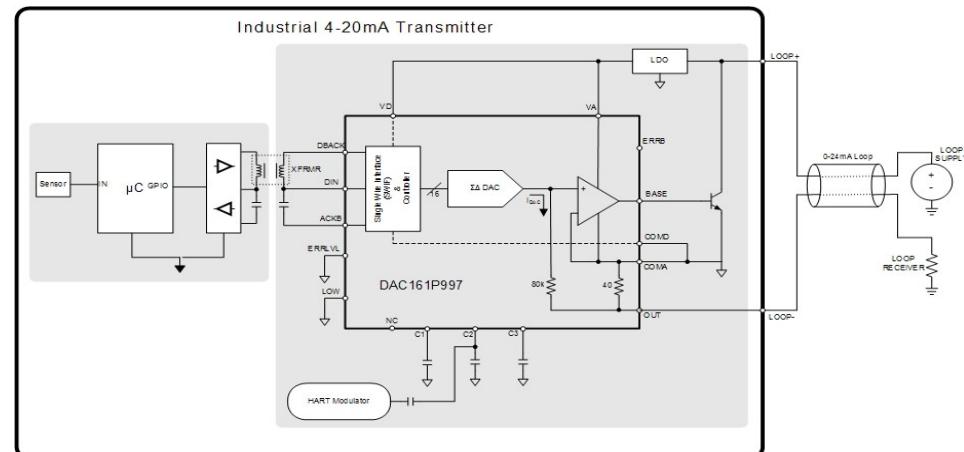
- 4to20mA loop transmitter platforms
  - 2-wire sensor systems
    - Process Control
    - Factory automation
    - Building automation



DAC161P997EVAL

## Benefits

- Fully Integrated Solution with well defined specification
  - Easy reuse of design & reduces logistics cost
  - No additional high accuracy components needed
- Satisfies system needs of total power consumption < 30mW
- SWIF interface – saves up to 3 digital isolators
- SWIF interface – low noise
- Defined Start-Up Condition 3.375mA or 21.75mA & pin programmable
- Flexible update-rate/power-consumption trade-off
- Automatic detection of error conditions



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TEXAS  
INSTRUMENTS

# SENSOR AFE

Parameter/ Device	Sensor Type	Lead Application	Release Date
LMP91000	Toxic Gas	Safety, Petro, Gas	In Production
LMP90100	Bridge	Industrial For example: FA, Scales	In Production
LMP91050	NDIR / Gas	CO2 Demand Control Ventilation	In Production
LMP91200	Ph	Water Quality	In Production
ADS1293	ECG	Low Power ECG, Holter Monitors	3Q12

EXISTING

NEW

ROADMAP

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# Sensor AFE Roadmap

Production

Sampling

Development

Future

Sensor	Application	Support Functions		
Temp, Bridge	Industrial Automation, Automotive	<b>LMP90080/79/78/77</b> Bridge Sensor AFE: multi-channel, 16-bit w/ true continuous background calibration	<b>LMP90100/099/098/097</b> Bridge Sensor AFE: multi-channel, 24-bit w/ true continuous background calibration	<b>LMP90080Q</b> Automotive Q1 Grade LMP90080 <i>RTM: End of Sept 2012</i>
Electro-chem. Cells, pH	Water Quality, TDS Meters		<b>LMP91200</b> pH Sensor AFE – Low Ibias, temp compensation, diagnostics	
NDIR, CO <sub>2</sub> , Alcohol Gas	CO <sub>2</sub> Monitors, Demand Ctrl Ventilation	<b>LMP91050</b> Single CO <sub>2</sub> /Alcohol Sensor AFE – PGA, adj. CM generator, “dark phase” offset cancellation	<b>LMP91051</b> Dual CO <sub>2</sub> /Alcohol Sensor AFE – PGA, adj. CM generator, “dark phase” offset cancellation	<i>Samples: Late Q3'12</i> <i>RTM: Q4'12</i>
Toxic Gases: CO, H <sub>2</sub> S, etc.	Air Quality / Safety, Petrochemical H <sub>2</sub> S Monitors	<b>LMP91000</b> Toxic Gas Sensor AFE w/ Adjustable Cell Bias, TIA, Temp Sensor, Diagnostics	<b>LMP91002</b> Low Cost Toxic Gas Sensor AFE w/ Fixed Cell Bias, TIA, Diagnostics	
DC Arc Detection	Solar Inverters, EV Battery Stack	<b>RD-195</b> Complete reference solution – eliminates prototyping for in-system eval + offers programmability		

Released

3Q2012

4Q2012

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# LMP91000

## Configurable AFE Potentiostat for Low-Power Chemical Sensing Applications

Features	Benefits
<ul style="list-style-type: none"><li><b>Integration</b><ul style="list-style-type: none"><li>On board TIA, Cell Bias, Temperature sensor</li><li>On board sensor test</li></ul></li></ul>	<ul style="list-style-type: none"><li>Integrates multiple discrete components to save board space, reduce cost and minimize design time</li></ul>
<ul style="list-style-type: none"><li><b>Industry's first Fully Programmable AFE Potentiostat</b><ul style="list-style-type: none"><li>Programmable transimpedance gain</li><li>Programmable cell bias voltage with low drift</li><li>Cell conditioning currents up to 10mA</li><li>Reference Electrode Bias Current 1000pA (max)</li></ul></li></ul>	<ul style="list-style-type: none"><li>Flexible solution allows use of LMP91000 for a wide variety of gases and wide range of gas concentrations from 0.5 nA/ppm to 9.5 nA/ppm</li></ul>
<ul style="list-style-type: none"><li><b>Ultra Low Power Consumption</b><ul style="list-style-type: none"><li>Supply current (Average over time) &lt;10uA</li><li>Operating supply range: 2.7V to 5.5 V</li></ul></li></ul>	<ul style="list-style-type: none"><li>Optimal for battery-operated systems, as well as 4mA to 20mA transmitter applications</li></ul>
<ul style="list-style-type: none"><li><b>Ease of Evaluation</b><ul style="list-style-type: none"><li>Supported by Webench Sensor AFE Designer</li></ul></li></ul>	<ul style="list-style-type: none"><li>Online evaluation tool enables quick evaluation, prototyping and faster time to market</li></ul>

## Applications

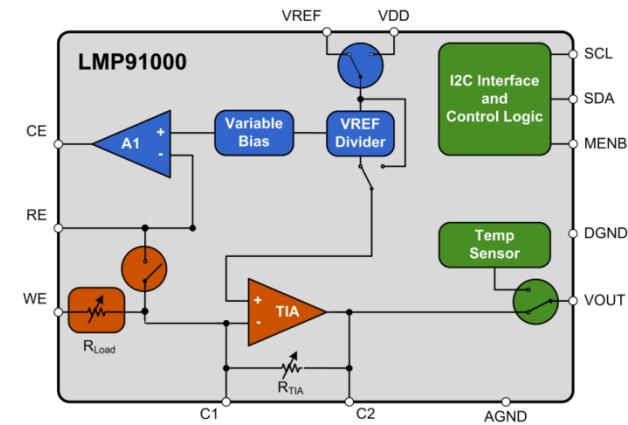
- Toxic gas detection platforms
- Amperometric applications
- Chemical species detection
- Electrochemical blood glucose meter
- 3 lead toxic gas sensors
- 2 lead galvanic cell sensors



**EVM  
NEW!**

**LMP91000SDE/NOPB**

**LMP91000  
1ku: \$2.80**



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# ADS1293

Low-Power | 3-Channel | 24-Bit Analog Front-End for Biopotential Measurements

## Features

- Fully integrated Low power ECG Solution
- Low Power Consumption      1mW full function  
                                      0.3mW /CH
- Input-Referred Noise: 10  $\mu$ Vpp (40Hz BW, G=3.5)
- Input Bias Current: 100 pA
- Data Rate: Up to 25.6kSPS
- CMRR: >100 dB
- Differential Input Voltage Range:  $\pm$ 400mV
- Analog Supply Voltage: +2.7V to +5.5V
- Digital I/O Supply Voltage: +1.65V to +3.6V
- Operating Temp Range: -20 $^{\circ}$ C to +85 $^{\circ}$ C
- Package: 5mm x 5mm x 0.8mm, 28-pin LLP

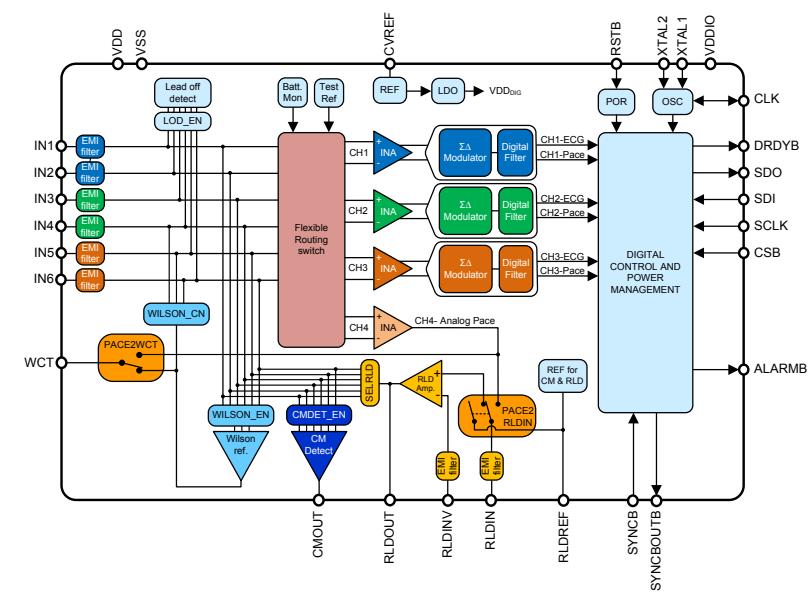
## Applications

### Low Power Portable ECG & Patient Monitors

- Wireless ECG , Patient monitoring modules
- Portable and battery operated ECG
- Holter Monitors
- Patches
- Heart rate monitors
- Wellness equipment

## Benefits

- Simplify the design and shorten development cycle.
- Reduce components count and board space
- Significantly lower power consumption
- Minimum number of external components and small package
- Reduced overall cost



# Current & Power Monitoring

## General Purpose

## High Common Mode Voltage

### INA226

Bidirectional  
(High / Low Side)  
Power Monitoring  
0V to +36V CMR  
**10 $\mu$ V Offset**  
MSOP-10

### INA3221

**Triple Channel** Shunt & Bus  
Voltage Monitor  
0V to +26V CMR  
Programmable Alerts  
QFN-16

### INA209

Bidirectional  
0V to +26V CMR  
100 $\mu$ V Offset  
DAC + Comparators

### INA220A/B

Bidirectional Power Monitoring  
0V to +26V CMR  
50 $\mu$ V Offset  
MSOP

### INA219A/B

Bidirectional (High-Side)  
Power Monitoring  
0V to +26V CMR  
50 $\mu$ V Offset  
SOT-23, SOIC-8

### INA230

Bidirectional  
(High / Low Side)  
Power Monitoring  
0V to +28V CMR  
50 $\mu$ V Offset  
QFN-16

### INA223

Power Monitoring  
Programmable Gain  
0V to +26V CMR  
100 $\mu$ V Offset  
SON-10

### INA210-214

Bidirectional  
-0.3V to 26V CMR  
35 $\mu$ V → 100 $\mu$ V Offset  
Gain: 50, 100, 200, 500V,  
1000V/V  
SC70

### INA216

1.8V to 5.5VCMR  
75 $\mu$ V Offset  
Gain: 25, 50, 100, 200V/V  
0.8 x 0.8mm CSP

### INA199A1-A3

Bidirectional  
-0.3V to 26V CMR  
150 $\mu$ V Offset  
Gain: 50V/V, 100V/V, 200V/V  
SOT-23

### LMP8652

-76V to +76V CMR  
100 $\mu$ V Offset  
Gain: 20, 50, 100,  
200, 500V/V  
MSOP-8 and LLP8

### LMP8480

4.5V to +76V CMR  
265 $\mu$ V Offset  
Gain: 20, 50, 60, 100V/V  
MSOP-8 and LLP8

### LMP8640 / 8645

-2V to +76V CMR  
900 $\mu$ V → 1000 $\mu$ V Offset  
Gain: Adj, 20, 50, 100V/V,  
TSOT-6

### LMP8646

Precision Current Limiter  
-2V to +76V CMR  
TSOT-6

### INA270-271

-16V to +80V CMR  
2.5mV Offset  
Gain: 14V/V or 20V/V  
SOIC

### INA282-286

-14V to +80V CMR  
70 $\mu$ V Offset  
Gain: 50, 100, 200, 500,  
1000V/V  
SOIC

### INA200-208

-16V to +80V CMR  
2.5mV Offset  
Gain: 20V/V, 50V/V, 100V/V  
Dual Comparator & Reference  
Dual Pinouts  
MSOP, SOIC, TSSOP

### LMP8601 - 8603

Bidirectional  
-22V to +60V CMR  
1mV Offset  
Gain : 20V/V, 50V/V, 100V/V  
SOIC-8

### INA193 - 198

-16V to +80V CMR  
2mV Offset  
Gain: 20V/V, 50V/V, 100V/V  
Dual Pinout Options  
SOT-23

### INA170

Bidirectional  
2.7V to +60V CMR  
1mV Offset  
MSOP

### INA169

2.7V to +60V CMR  
1mV Offset  
BW: 440kHz  
SOT-23

### INA168

2.7V to +60V CMR  
1mV Offset  
BW: 440kHz  
SOT-23

### INA139

2.7V to +36V CMR  
1mV Offset  
BW: 440kHz  
SOT-23

### INA138

2.7V to +36V CMR  
1mV Offset  
BW: 80kHz  
SOT-23

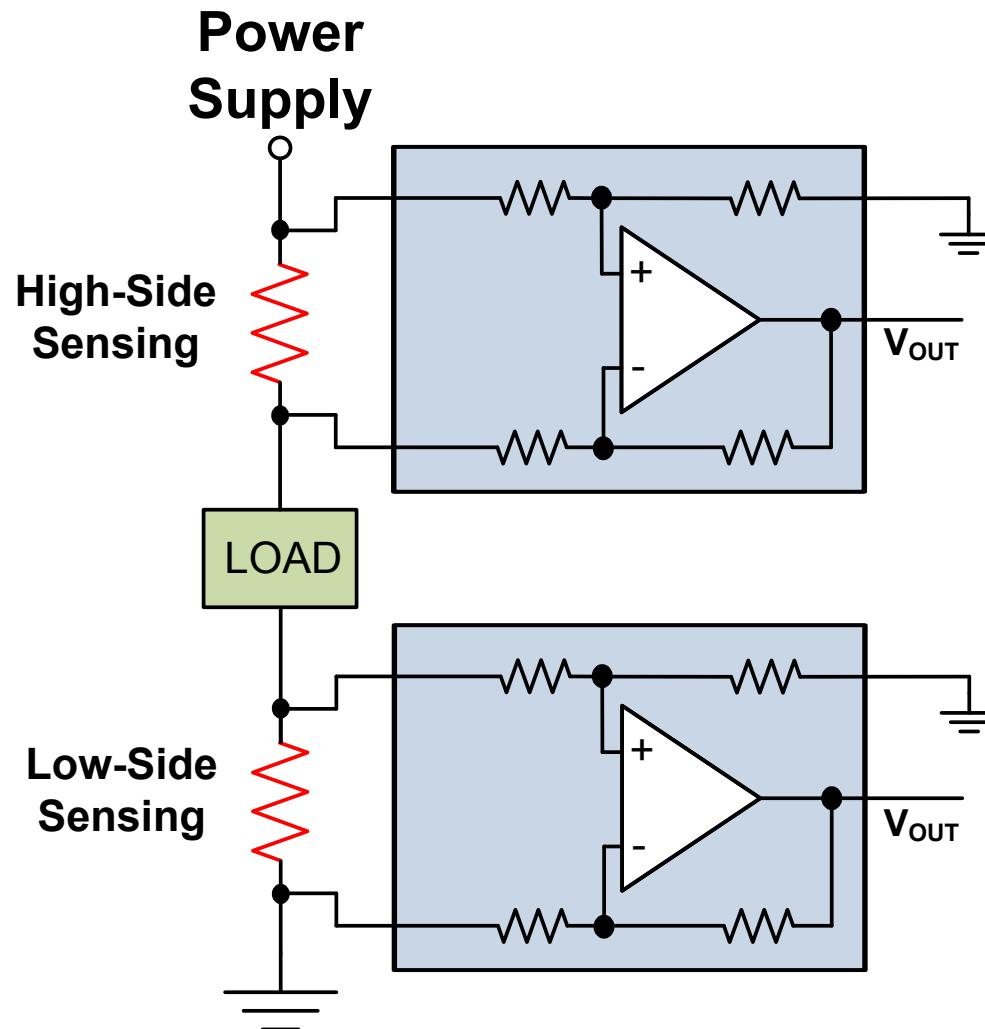
## Digital Output

## Voltage Output

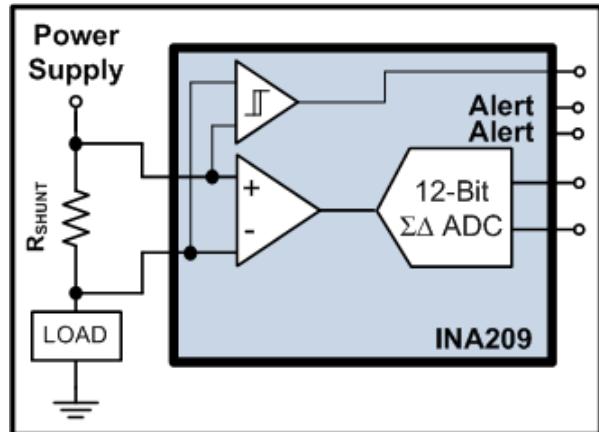
## Current Output



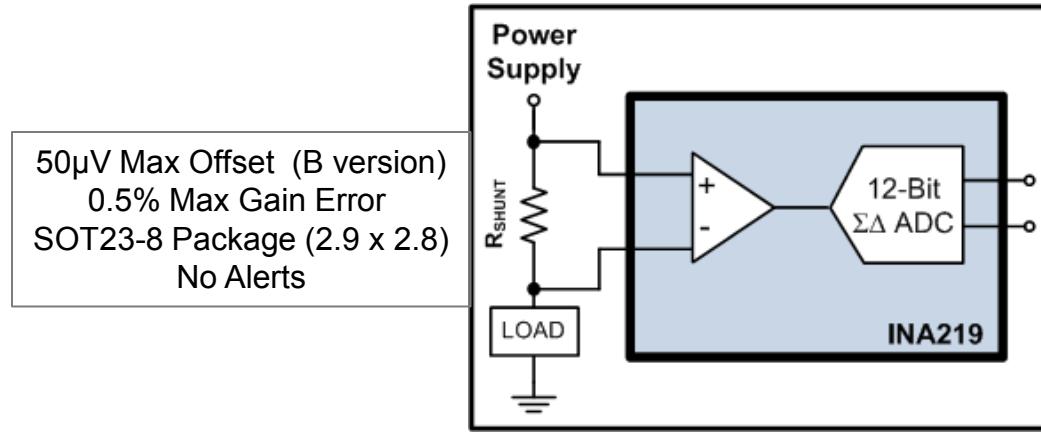
# Current Shunt Sensing Overview



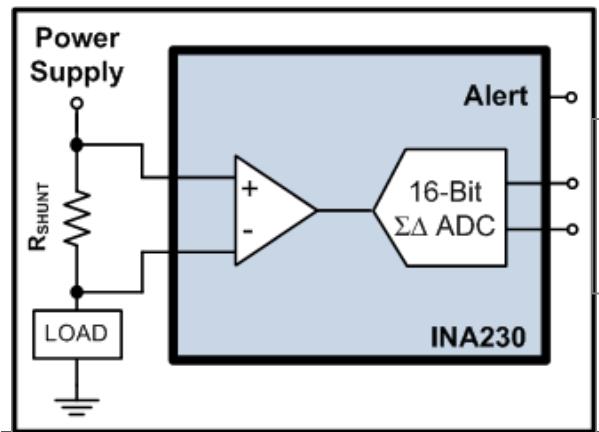
# Digital Power Monitor Snapshot



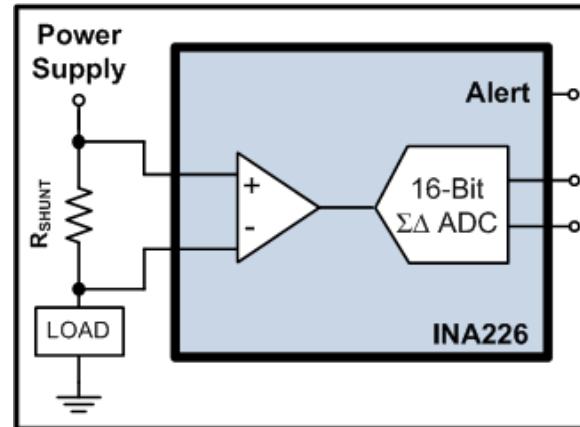
100µV Max Offset  
0.5% Max Gain Error  
TSSOP-16 Package (6.4 x 5)  
Programmable A & D Alerts  
Fast-Path Comparator (5µs)



50µV Max Offset (B version)  
0.5% Max Gain Error  
SOT23-8 Package (2.9 x 2.8)  
No Alerts



50µV Max Offset  
0.5% Max Gain Error  
QFN-16 Package (3 x 3)  
Programmable Digital Alert



10µV Max Offset  
0.1% Max Gain Error  
MSOP-10 Package (3 x 5)  
Programmable Digital Alert



# INA282 to INA286

## High Accuracy -14V to 80V CMR Bi-directional Current Shunt Monitor

### Features

- Wide Common Mode & Noise Rejection
  - $V_{cm} = -14V$  to  $80V$
  - CMRR: 120dB (min)
- High Accuracy
  - Voltage offset:  $20\mu V$  (typ),  $70\mu V$  (max)
  - Offset Drift:  $1.5\mu V/\text{ }^{\circ}\text{C}$  (max)
  - Gain Error: 1.4% (max)
- Integrated reference voltage divider

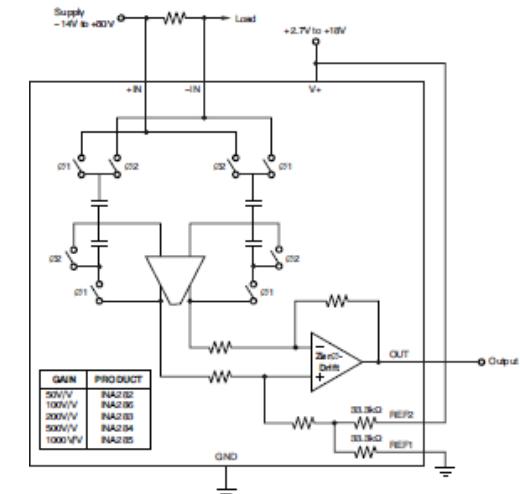
### Benefits

- Maintains accuracy in high voltage applications with high degrees of common mode noise
- Saves system power by allowing for smaller shunt resistors to be used without affecting accuracy.
- Simplifies setup of output bias for interfacing to ADC.

### Applications

- Industrial Power Supplies
- Solar Inverters
- Servers
- Motor Control
- Telecom Power Supply Modules

Part #	Gain
INA282	50 V/V
INA286	100 V/V
INA283	200 V/V
INA284	500 V/V
INA285	1000 V/V



Package: SOIC-8



## Features

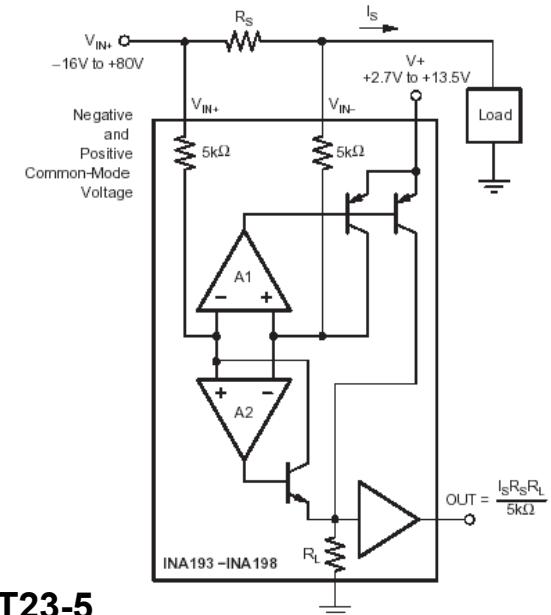
- -16V to 80V Common-Mode Range
- Low 3% max error over -40°C to 125°C
- Low quiescent current: 900µA max
- Three gain options of 20V/V, 50V/V, 100V/V
- Available in two pin-out configurations
  - INA198 is pin-compatible to MAX4376

## Applications

- Computers and Servers
- Power supplies
- Motor control
- White goods
- Test and measurement
- Automotive systems
- E-meter: Reverse current sense
- Use in PWM control loops

## Benefits

- Eliminates need for additional protective components in the event of supply reversals
- Ensures quality performance over large temp range
- Ideal for maximum power efficiency
- Permits versatility for any application need



Packages: SOT23-5

# INA203 – INA208

## Current Monitor + Dual Comparators and Reference

### Features

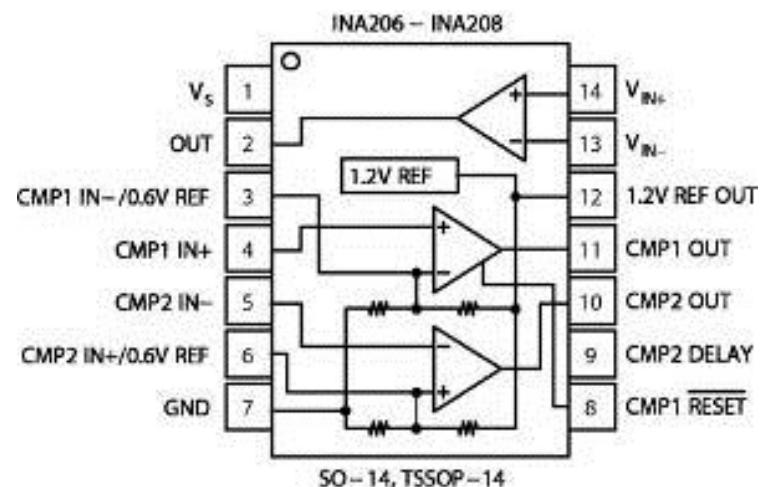
- Complete current sense solution
- -16V to +80V Common-Mode Range
- Dual comparators:
  - Comparator 1 with Latch
  - Comparator 2 with Optional Delay
- Optional external access to the reference voltages
- Three gain options
  - INA203/6: 20 V/V
  - INA204/7: 50 V/V
  - INA205/8: 100 V/V

### Applications

- Battery charger over-current detection for Notebook Computers
- Power supply protection and  $\pm 12V$  supply monitoring for Servers
- Battery chargers
- Automotive power windows and power seats

### Benefits

- Easy design and minimizes board space
- Eliminates need for additional protective components in the event of supply reversals
- Ideal for multiple timing needs and over current and under current detection
- Allows the comparator reference voltages to be set to any voltage the application needs
- Enables a flexible circuit design



Packages: SO-14, TSSOP-14, MSOP-10



# INA209

## Bidirectional Current & Power Monitor for High Side with Watchdog Alerts

### Features

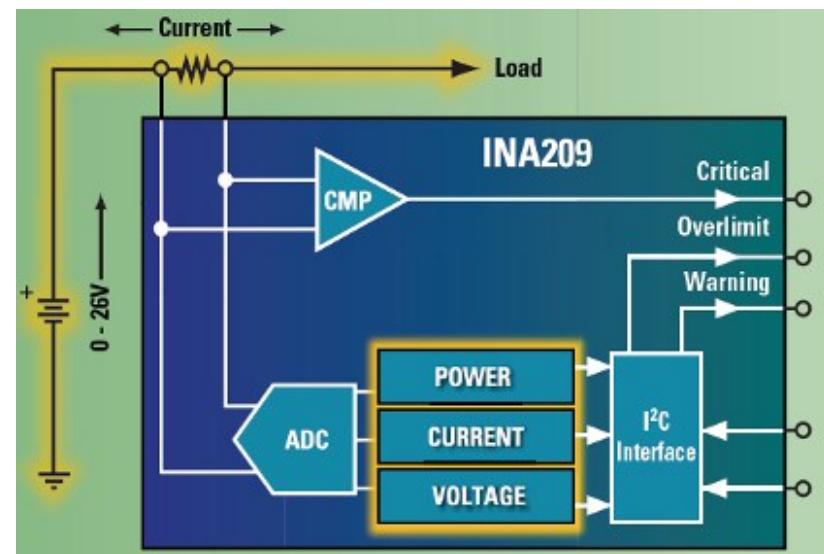
- Monitors Current/ Voltage AND calculates Power
- Full scale current sense (Input) voltage range
  - +/-40mV FSR
  - 1% error (max over temp)
- CMR: 0V to 26V with +3.0V to +5.5V Supply
- Multiple watchdog limits
  - Under-limit/Over-limit Warning
  - Separate FAST analog critical path for shutdown

### Applications

- Power supplies
- Battery management
- Computers
  - Servers
  - Desktop
  - Notebook

### Benefits

- Complete power management solution
- Permits measurement of a bidirectional shunt currents
- ACCURATE at LOW voltage drops – Zero-Drift
- High CM inputs using a low single supply
- Sophisticatedly monitors and protects application circuitry



# INA219

## Bidirectional Current & Power Monitor

### Features

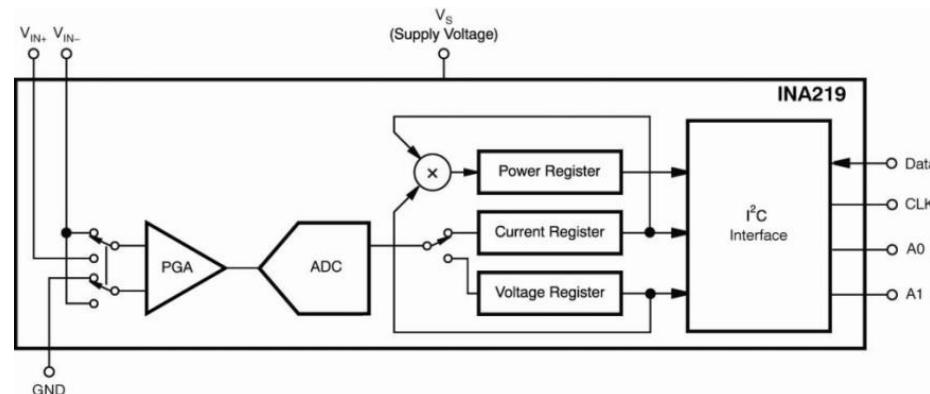
- Monitors Current, Voltage, & Calculates Power
  - Offset Voltage: 50uV (max)
  - Current: 0.5% error (max over temp)
  - Voltage: 1% error (max over temp)
- Ease Of Design
  - Integrated PGA
  - Programmable filtering and Calibration Register
  - Common-mode range: -0.3V to 26V with 3.0 to 5.5V supply

### Applications

- Computers
  - Servers
  - Desktop
  - Notebook
- Power Supplies
- Battery Management

### Benefits

- Allows for easy predictive thermal management to initiate cooling before overheating
  - Low offset enables use of smaller value shunt resistors to reduce IR loss
  - Low voltage and current error allows for highly accurate system control
- Optimize gain to shunt resistance and power
- Customize data acquisitions to balance noise and speed



Package: SOT23-8 or SO-8



# Current Shunt Monitor Solutions

## Digital Output

### I<sup>2</sup>C/SMBus interface

Smallest: INA219  
Lowest Offset: INA226  
Lowest Power: INA226 INA3221  
Tripe Channel: INA3221  
Prog. Alerts: INA230 INA226

## Analog Voltage Output High Common Mode

**Max Common Mode Voltage  $\geq$  60V**

Smallest: INA193 Family  
Lowest Offset: INA282 Family  
Lowest Power: LMP8480  
Highest CMVR: INA282 Family  
Prog. Gain: LMP8645 LMP8646

## Analog Current Output High Common Mode

**Max Common Mode Voltage  $\geq$  60V**

Smallest: INA168 INA169  
Lowest Offset: INA168 INA170  
Lowest Power: INA168

## Analog Voltage Output Standard Common Mode

**Max Common Mode Voltage  $<$  60V**

Smallest: INA216  
Lowest Offset: INA210 Family  
Lowest Power: INA216  
Prog. Gain: INA223 LMP8645

## Analog Current Output Standard Common Mode

**Max Common Mode Voltage  $<$  60V**

Smallest: INA138  
Lowest Offset: INA138 INA139  
Lowest Power: INA139

