

# MEDICAL

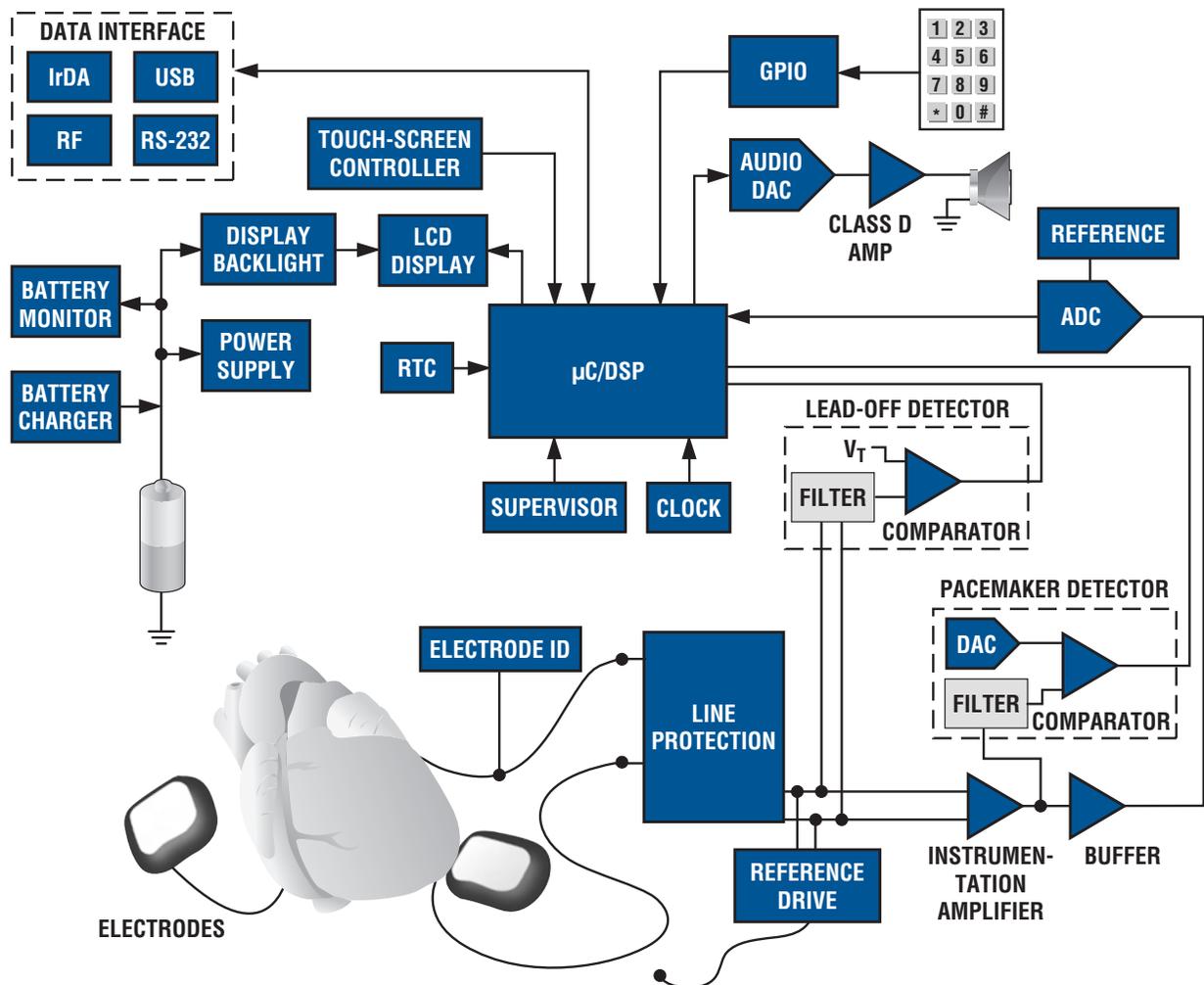
## Design Guide

1st Edition

February 2009

## Broadest selection of silicon solutions for medical designs

Many Maxim devices are designed into a heart-monitoring system



- Interfacing
- Power management
- Signal processing
- Microcontrollers
- Displays
- Sensor calibration/identification
- Timing and clocks

Maxim products are not authorized for use in, or in connection with, surgical implants, nor are they authorized for use as critical components in any medical device or system in which failure to perform can reasonably be expected to cause significant injury to the user, without the express written approval of an Executive Officer of Maxim. Manufacturers and designers are responsible for ensuring that their systems (and any Maxim product incorporated in their systems) meet all applicable safety, regulatory, and system-level performance requirements. For Maxim's complete Legal Notice regarding the usage of Maxim products in medical devices or systems, please visit: [www.maxim-ic.com/legal](http://www.maxim-ic.com/legal). Maxim is a registered trademark of Maxim Integrated Products, Inc. © 2009 Maxim Integrated Products, Inc. All rights reserved.

# Proven electronic authentication solutions protect your development investment

1-Wire® memory products offer a wide range of low-cost†, well tested, and proven authentication solutions. Options range from customization of the unique, 64-bit serial number that is factory-lasered into each device (providing controlled procurement access) to secure crypto-strong, ISO/IEC 10118-3 SHA-1-based challenge and response for mutual authentication.



High-Value Probes and Sensors



Instrumentation

**Your security requirements**

- HW/SW license management
- Soft feature-setting control
- System copy/clone protection
- Safety/quality assurance

## Our Solutions

Part	Description	Authentication Feature
DS28E01-100*	1Kb EEPROM with SHA-1 authentication	Bidirectional SHA-1 challenge and response
DS2401/DS2411	64-bit ROM serial number	Customized 64-bit ROM
DS2431	1Kb EEPROM	Customization, write-protection/OTP modes
DS2460*	SHA-1 coprocessor	Secure storage of system secrets
DS1963S*	4Kb SHA-1 iButton®	Bidirectional SHA-1 challenge and response

For more information, including pricing, samples, data sheets, and application notes, go to: [www.maxim-ic.com/Medical](http://www.maxim-ic.com/Medical)

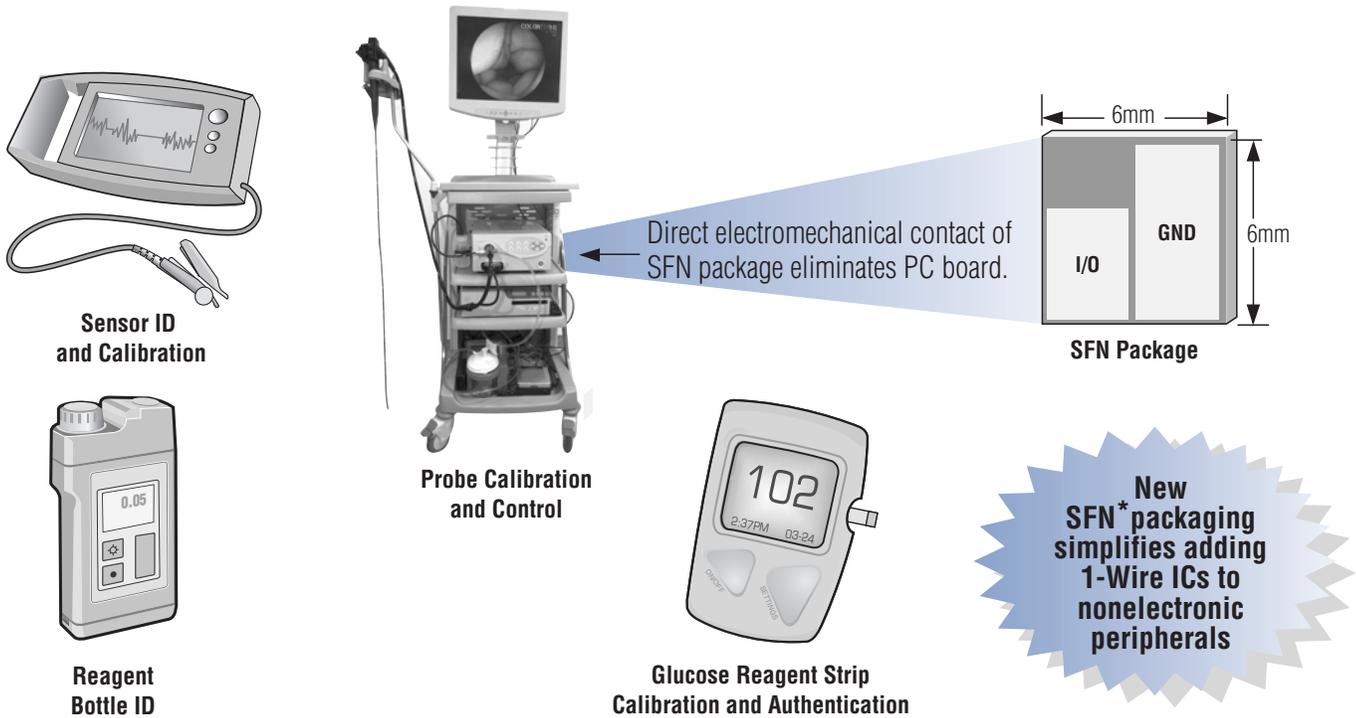
1-Wire and iButton are registered trademarks of Maxim Integrated Products, Inc.

\*Data sheet provided under NDA.

†Authentication solutions start as low as \$0.15 for consumer electronics volumes. Prices provided are for design guidance and are FOB USA. International prices will differ due to local duties, taxes, and exchange rates. Not all packages are offered in 1k increments, and some may require minimum order quantities.

# 1-Wire—industry’s most efficient solution for accessory and sensor calibration, identification, and control

Spare connector pins between a host system and sensor are typically constrained, making it difficult to add electronic identification/calibration without increasing connector complexity and cost. The 1-Wire product line meets these requirements and implements system and accessory connection with a single, dedicated connector contact.



## 1-Wire-enabled medical devices

- Automatically calibrate sensors or accessories
- Determine host-system operating mode appropriate to the attached sensor
- Control accessory operating modes or visual indicators
- Ensure reliability and quality, unlike low-quality, OEM knock-off products
- Provide exceptional ESD performance: Up to  $\pm 15\text{kV}$  (typ) IEC 61000-4-2

Part	Memory Type	Memory Size (Bits)	Additional Features
DS2401/DS2411	ROM only	64	1.5V operation with DS2411
DS2431	EEPROM	1K	Write-protection, OTP modes
DS28E01-100**	EEPROM	1K	SHA-1 authentication
DS2433	EEPROM	4K	—
DS250x	EPROM	1K, 16K, 64K	Write protection
DS2413	ROM only	64	Dual GPIO

\*SFN = Single Flat No lead  
 \*\*Data sheet provided under NDA.

# Industry's lowest power, octal, 12-bit 40/50/65MSPs ADCs

**Serial LVDS ADCs save space and offer outstanding 90dBc SFDR**

Maxim expands its ultra-low-power, 12-bit ADC family by announcing a family of pin-compatible octal ADCs. The octal MAX1434/MAX1436/MAX1437/MAX1438 join the quad MAX1126/MAX1127 in offering high-performance, low-power, 12-bit ADC cores that are integrated into a single package. These products are targeted at high-channel-count applications, such as medical imaging and wireless communications, which can have as many as 512 ADC channels and require both high performance and low power.

To address high-density requirements, this family of octal and quad ADCs offers a choice of either a low-voltage differential signaling (LVDS) interface or a scalable low-voltage signaling (SLVS) interface. The serial LVDS/SLVS interface significantly reduces pin count, resulting in a smaller package size and minimized board-trace clutter.

**Ideal for medical imaging and other high-channel-count applications**

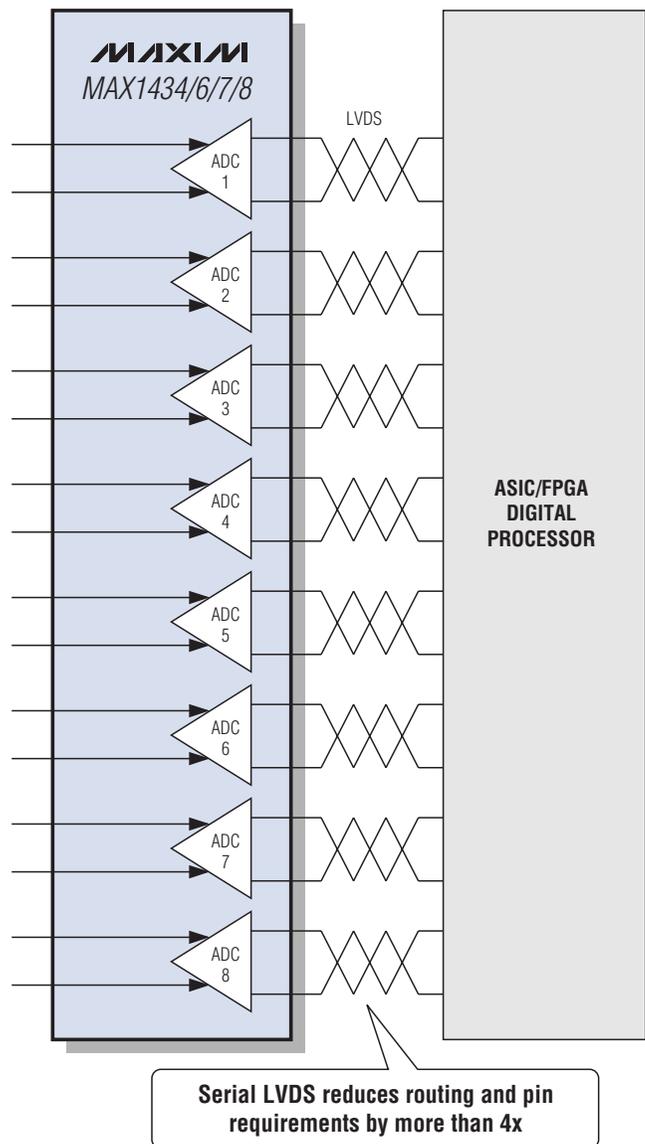
### Outstanding dynamic performance

- 69.6dB SNR at  $f_{IN} = 20\text{MHz}$
- 90dBc SFDR at  $f_{IN} = 20\text{MHz}$
- -95dB crosstalk

### 20% to 50% lower power than the competition

- 93mW per channel (MAX1436)
- 96mW per channel (MAX1437)

Part	No. of Channels	Resolution (Bits)	Speed (MSPs)
MAX1438	8	12	65
MAX1437	8	12	50
MAX1436	8	12	40
MAX1434	8	10	50
MAX1127	4	12	65
MAX1126	4	12	40



To speed designs, obtain an EV kit at:  
[www.maxim-ic.com/MAX1438EVKIT](http://www.maxim-ic.com/MAX1438EVKIT)

# New front-end chipset is optimized for medical imaging

## LNAs designed specifically for high-end ultrasound imaging modalities

The MAX2034 quad ultra-low-noise amplifier (LNA) with programmable input impedances supports a variety of transducer source inputs, thus enhancing overall ultrasound performance.

### Improves performance

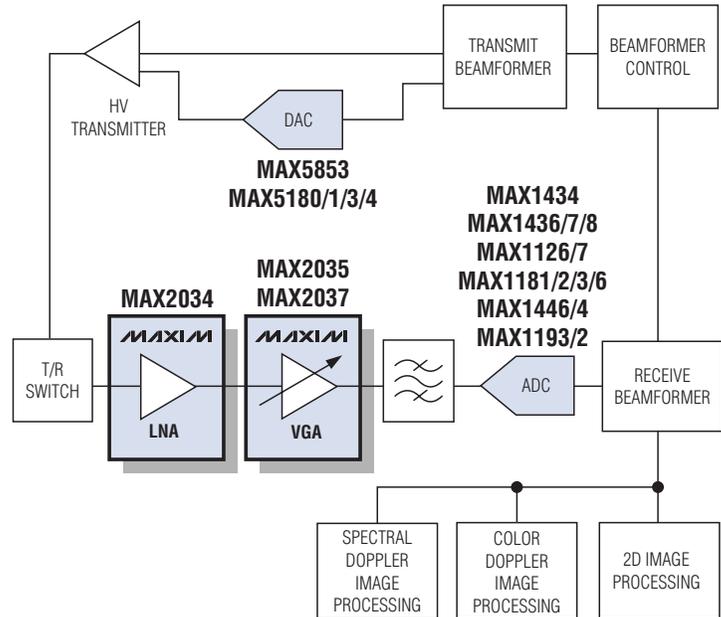
- Ultra-low 2.2dB NF performance
- -68dBc HD2 enhances second harmonic imaging performance
- -55dBc two-tone ultrasound-specific\* IMD3 enables exceptional PW/CW doppler performance

### Increases flexibility and ease of use

- 50Ω, 100Ω, 200Ω, and 1kΩ selectable input impedances eliminate externally switched feedback resistors
- Integrated input clamp protects the rest of the lineup from an overdrive condition
- Integrated input-damping capacitor eliminates external capacitor

### Saves space

- Integrates four LNAs in a 7mm x 7mm, 48-pin TQFN



## Highest integration ultrasound VGA tailored for 12-bit ADCs

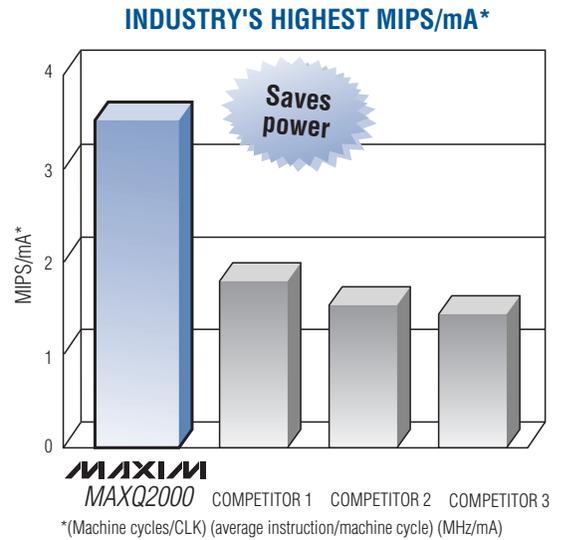
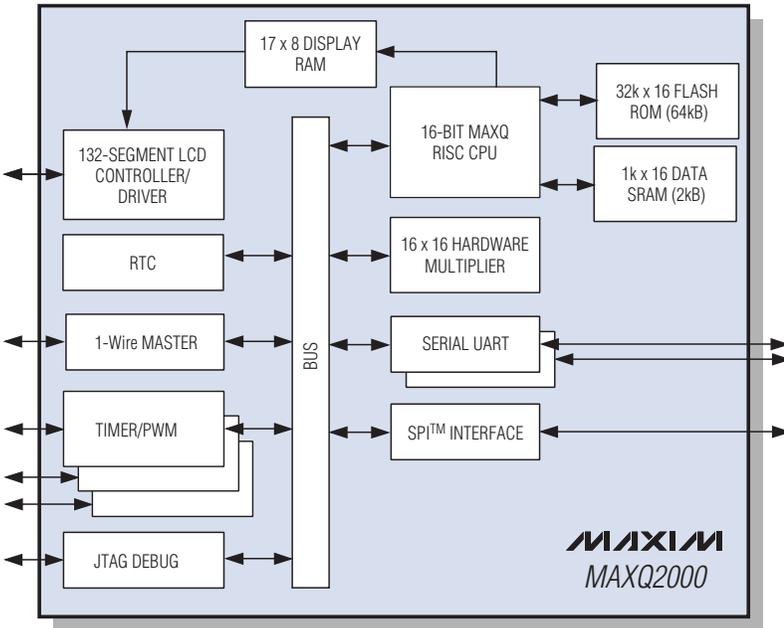
The MAX2037 8-channel variable-gain amplifier (VGA) is designed for high-linearity, high-dynamic-range, and low-noise performance in ultrasound imaging and Doppler applications.

- Optimized for 12-bit ADCs
  - Maximum gain of 29.5dB
  - Total gain range of 42dB
  - 22nV/ $\sqrt{\text{Hz}}$  ultra-low output-referred noise at 5MHz
- 10-bit pin compatibility (MAX2035)
- $\pm 0.25\text{dB}$  absolute gain error
- Switchable output VGA clamp eliminates ADC overdrive
- Fully differential VGA outputs for direct ADC drive
- Variable gain range achieves 42dB dynamic range
- -70dBc HD2 at  $V_{\text{OUT}} = 1.5\text{Vp-p}$  and  $f_{\text{IN}} = 5\text{MHz}$
- -52dBc two-tone ultrasound-specific\* IMD3 at  $V_{\text{OUT}} = 1.5\text{Vp-p}$  and  $f_{\text{IN}} = 5\text{MHz}$
- 120mW consumption per channel

\*See the ultrasound-specific IMD3 specification in the Applications Information section of the data sheet.

# Industry's highest MIPS/mA, 16-bit flash $\mu$ C cuts power by 50%

Ideally suited for medical applications requiring an LCD controller, the MAXQ2000 microcontroller is designed around an innovative, one-clock-per-instruction, 16-bit RISC architecture. MAXQ<sup>®</sup> technology combines high performance and low power with a variety of complex peripheral functions.



## Microcontroller features

- 20MHz (max) operating frequency
- Performance approaches 1 MIPS/MHz
- 64kB flash, 2kB SRAM
- 16-bit instruction, ALU, and data path
- 33 total instructions simplify programming

## Low-power features

- < 1 $\mu$ A (typ) stop-mode current
- 5.1mA flash operating current at 20 MIPS

## Peripherals

- 2 UARTs, SPI master/slave interface
- Up to 132-segment LCD controller
- 16 x 16 hardware multiplier with 48-bit accumulator
- 32-bit binary real-time clock (RTC)

## Tools

- Complete range of development tools includes C compiler, ICE, and IDE

Part	Temperature Range (°C)	Program Memory (kB Flash)	Data Memory (kB SRAM)	LCD Segments	External Interrupts	Package
MAXQ2000-RAX	-40 to +85	64	2	132	16	68-QFN
MAXQ2000-RBX				100	14	56-TQFN

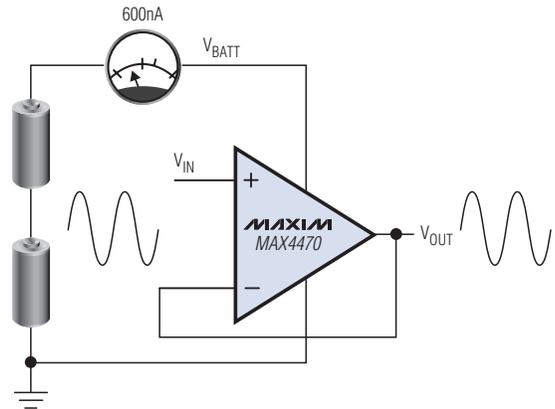
[www.maxim-ic.com/MAXQ](http://www.maxim-ic.com/MAXQ)

MAXQ is a registered trademark of Maxim Integrated Products, Inc.  
SPI is a trademark of Motorola, Inc.

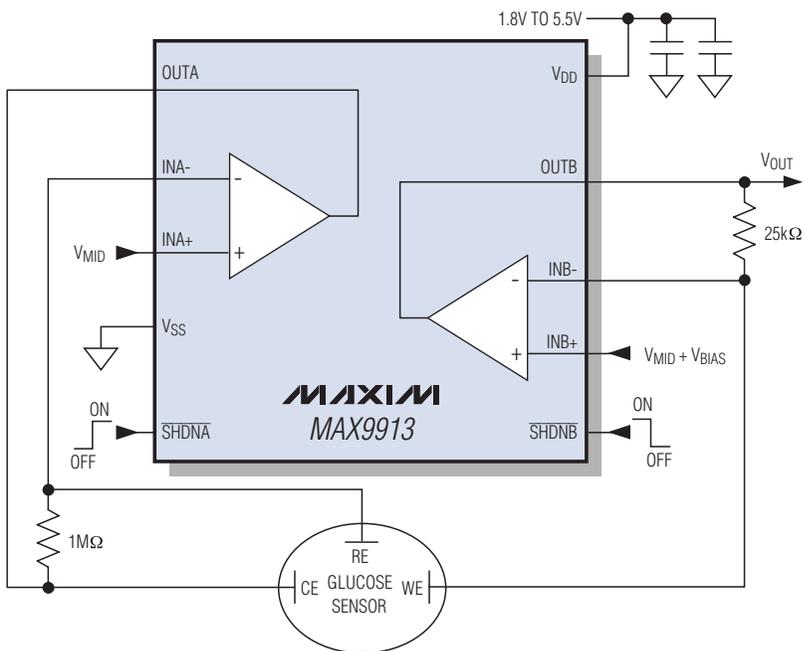
# Ultra-low-power op amps are ideal for glucose meters

## Best speed-to-power ratio op amps

- Rail-to-rail CMOS inputs and rail-to-rail output
- 200kHz BW with 5 $\mu$ A (max) supply current
- 1MHz BW with 25 $\mu$ A (max) supply current



## Three-electrode glucose-meter application with shutdown



Extends battery life



Blood Glucose Monitor

Part Family	No. of Amps	Supply Current ( $\mu$ A/ch, typ)	Gain Bandwidth (kHz, typ)	V <sub>CC</sub> Operating Range (V)	Features	Package
MAX4470	1, 2, 4	0.6	9/40	1.8 to 5.5	Decomp gain > 5	SC70/SOT23/ $\mu$ MAX <sup>®</sup> /SO/TSSOP
MAX4036	1, 2	0.8/1.9	4	1.4/1.8 to 3.6	+125°C version available, internal 1.2V reference available	UCSPTM/SC70/SOT23/TQFN
MAX406	1, 2, 4	1	8/40/150	2.5 to 10	Decomp gain > 2; > 10 version available	SO/DIP
MAX9913	1, 2	4	200	1.8 to 5.5	Rail-to-rail CMOS input with shutdown	SC70/SOT23/ $\mu$ MAX
MAX4289	1	9	17	1.0 to 5.5	Operates down to 0.9V at +25°C	SOT23/SO
MAX9914	1, 2	20	1000	1.8 to 5.5	Rail-to-rail CMOS input with shutdown	SC70/SOT23/ $\mu$ MAX

For information on Maxim's complete line of products for glucose meters, visit: [www.maxim-ic.com/Glucose](http://www.maxim-ic.com/Glucose)

$\mu$ MAX is a registered trademark and UCSPTM is a trademark of Maxim Integrated Products, Inc.

# Precision low-noise amplifiers for high-performance medical instrumentation

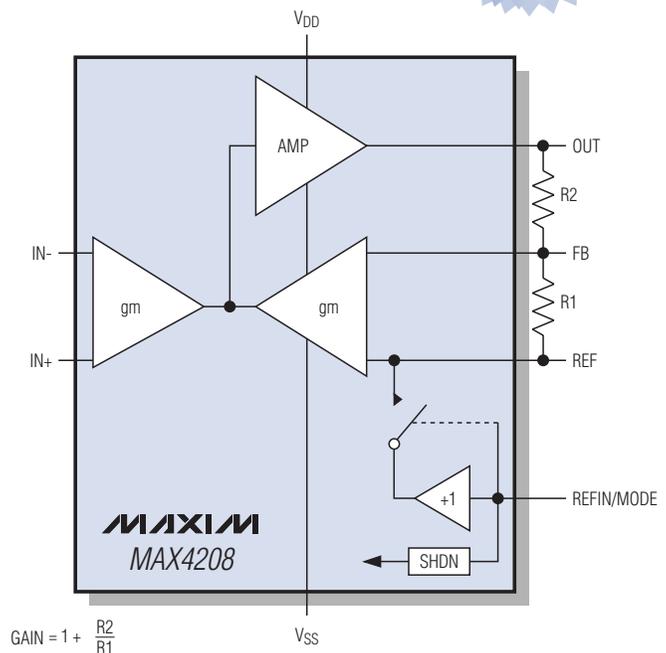
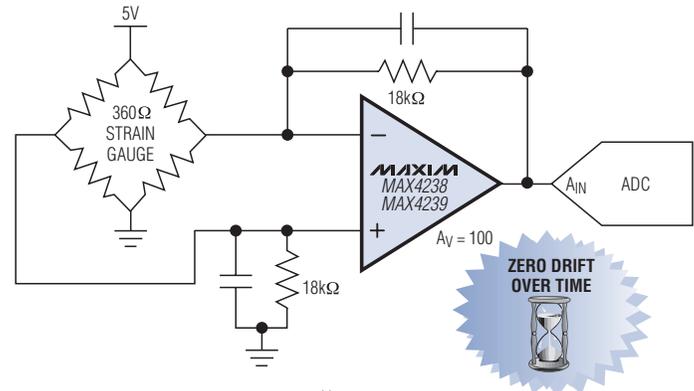
## Precision operational amplifiers

- MAX4238/MAX4239 with 2 $\mu$ V (max)  $V_{OS}$ 
  - Spread-spectrum zero drift with time and temperature
  - Higher bandwidth with decompensated gain > 5
- MAX4236/MAX4237 with 20 $\mu$ V (max)  $V_{OS}$ 
  - Post-package trimmed
  - Higher bandwidth with decompensated gain > 5

## Precision instrumentation amplifiers

- 15 $\mu$ V (max)  $V_{OS}$  (MAX4208/MAX4209)
- Spread-spectrum zero drift
- Superior active feedback architecture vs. conventional three-op-amp architecture
- Includes internal buffer for REF
- Fixed gain available (MAX4209)
- Adjustable gain set by external resistor ratio enables controlled gain drift across temperature (MAX4208)

### HIGH-GAIN STRAIN-GAUGE INTERFACE



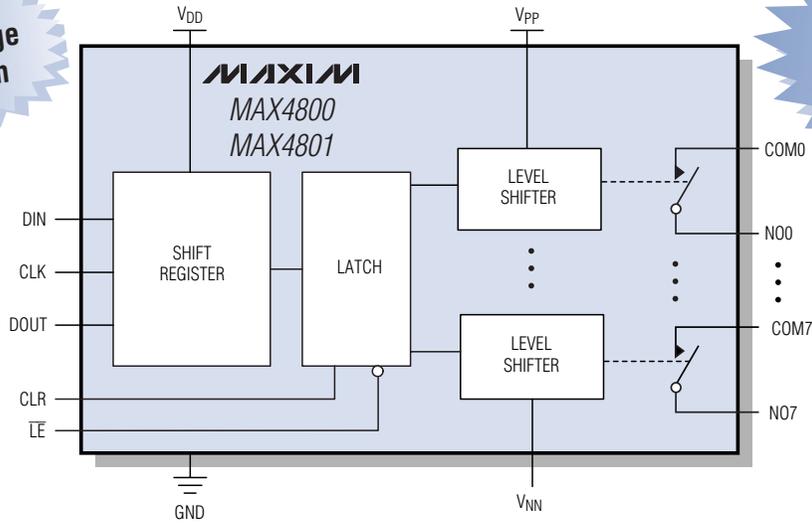
Input common-mode voltage includes ground for single-supply applications

Part Family	Type	$V_{OS}$ ( $\mu$ V at +25°C, max)	Gain Bandwidth (MHz, typ)	$V_{CC}$ Operating Range (V)	Package
<b>PRECISION AMPLIFIERS</b>					
MAX4238	Precision op amp	2	1/6.5	2.7 to 5.5	SOT23/TDFN/SO
MAX4236	Precision op amp	20	1.7/7.5	2.4 to 5.5	SOT23/ $\mu$ MAX/SO
MAX4208	Precision instrumentation amp	15	0.75	2.85 to 5.5	TDFN/ $\mu$ MAX
<b>LOW-NOISE AMPLIFIERS</b>		<b>Voltage Noise (<math>nV/\sqrt{Hz}</math>, typ)</b>			
MAX410	Low-noise op amp	1.5	28	2.4 to 10.5	TDFN/SO/PDIP
MAX4475	Low-noise op amp	4.5	10/42	2.7 to 5.5	SOT23/TDFN/ $\mu$ MAX/SO
MAX4249	Low-noise op amp	8.9	3/22	2.4 to 5.5	UCSP/SOT23/ $\mu$ MAX/SO
MAX4460	Low-noise instrumentation amp	18	2.5	2.85 to 5.5	SOT23/TDFN/SO

# High-voltage ultrasound switches enable clear images and fast frame rates

Enhanced pin-compatible replacements for Supertex®  
HV232/HV20220/HV20320

Low-charge injection



Flexible high-voltage supplies (+100V/-100V, +185V/-15V, +40V/-160V)



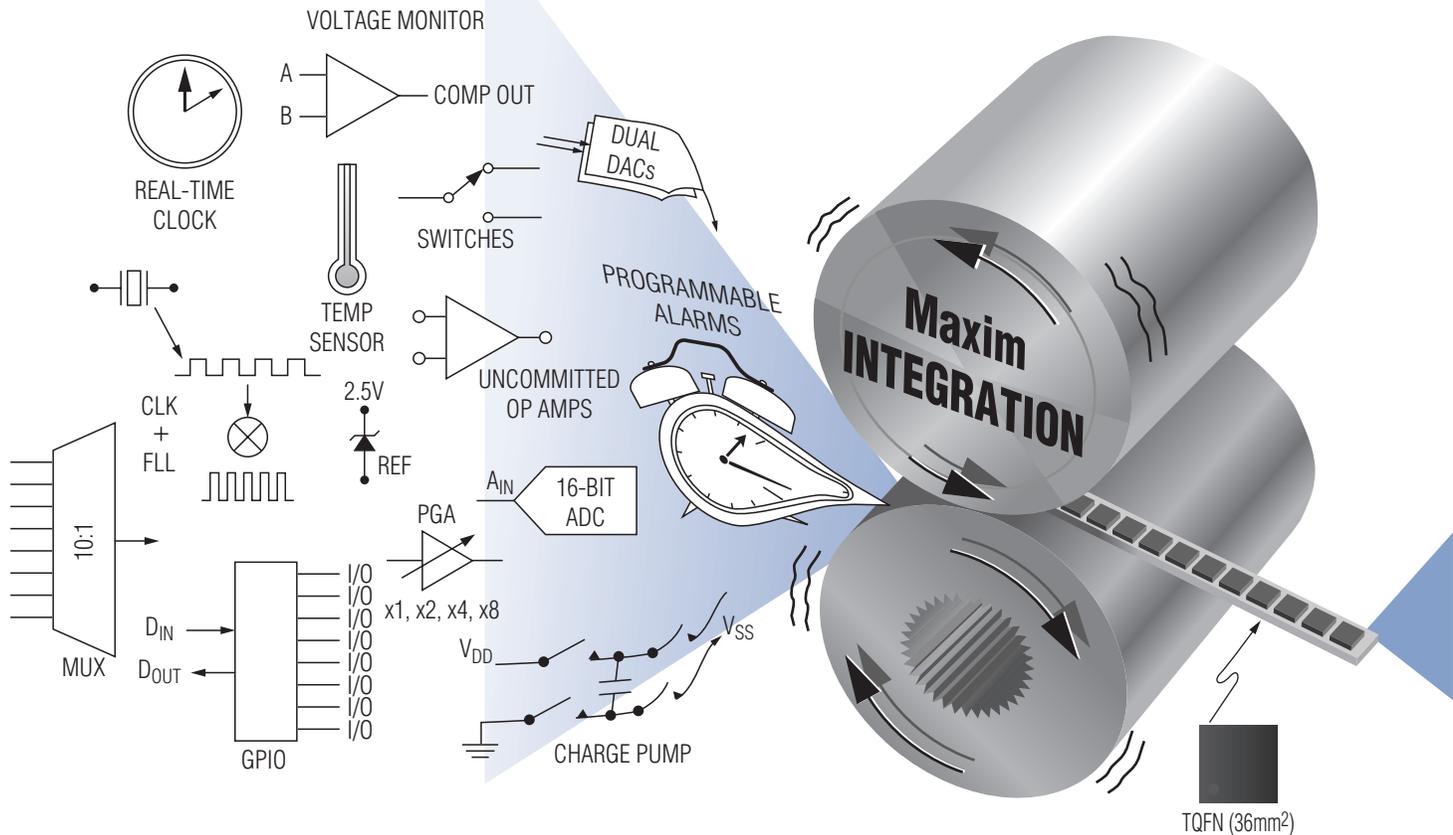
Part	Supply (V)	No. of Channels	R <sub>ON</sub> (Ω)	Quiescent Current (μA)	Bleed Resistors	Shift Register Control	Package
MAX4800	200	8	22	10		✓	48-TQFP, 28-PLCC, 48-TQFN, 26-CSBGA
MAX4801					✓	28-PLCC	
MAX4802					✓	✓	48-TQFP, 28-PLCC, 48-TQFN, 26-CSBGA

For information on Maxim's complete line of ultrasound products, go to: [www.maxim-ic.com/Ultrasound](http://www.maxim-ic.com/Ultrasound)

Supertex is a registered trademark of Supertex, Inc.

# 16-bit, data-acquisition systems

Tiny 6mm x 6mm



## Precision analog

- 16-bit, sigma-delta ADC
- 10sps to 512sps, no missing codes
- PGA with gains of 1, 2, 4, and 8
- Low-leakage SPDT and SPST switches
- Low-noise, uncommitted op amps
- Force-sense DACs (MAX1358/59 only)
- Internal 1.25V, 2.048V, or 2.5V reference
- $\pm 0.5^{\circ}\text{C}$  internal/external temperature sensor

## Microcontroller support

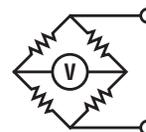
- 32kHz internal oscillator with FLL multiplier and clock output for external devices
- General-purpose I/O
- Programmable interrupts/alarms
- $V_{DD}$  monitor
- Dual voltage monitors
- Watchdog timer
- RTC with 1/256s resolution



Portable Medical Devices



Medical Instruments

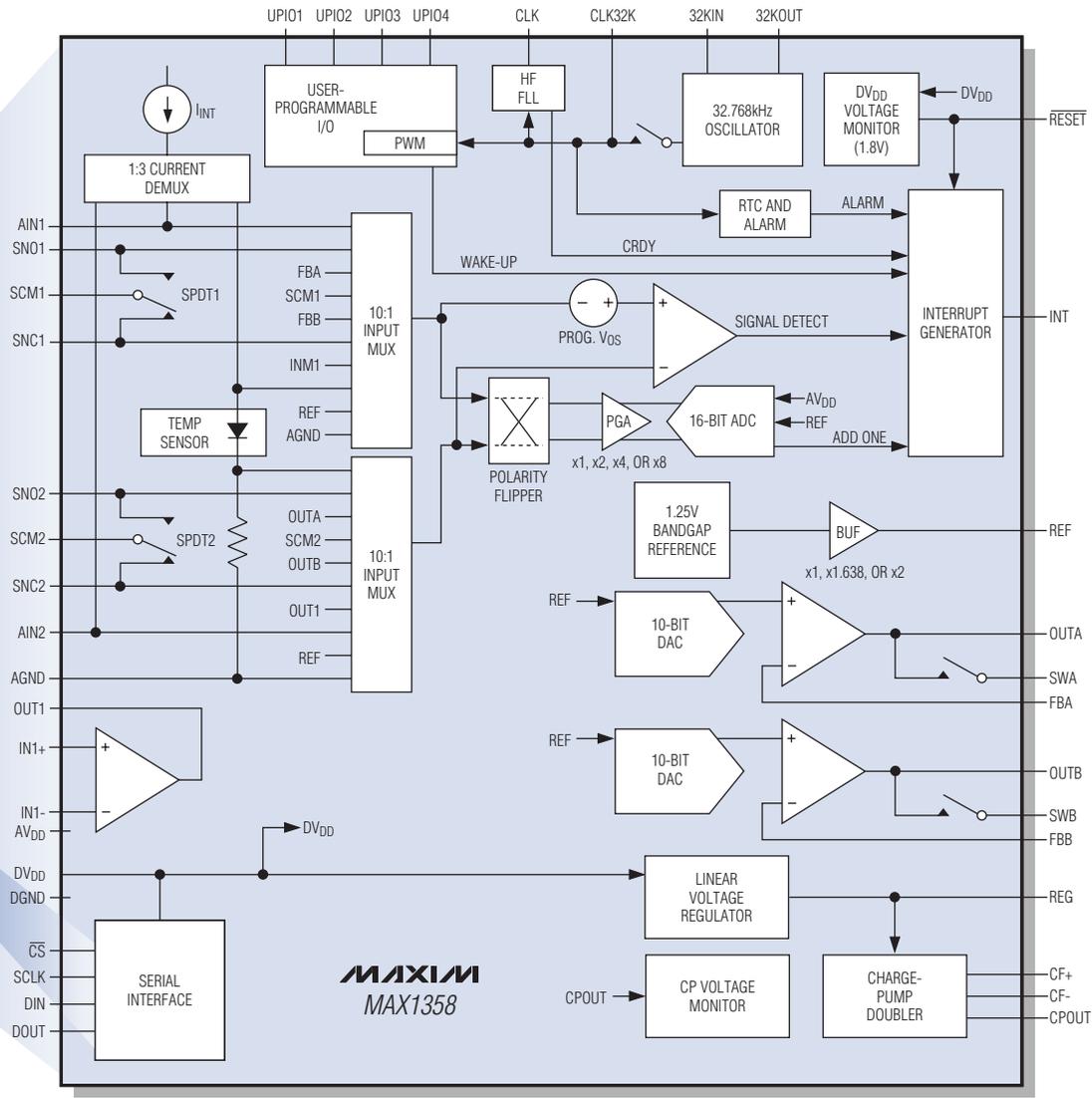


Sensors

# with 10-bit DACs support your $\mu$ C

TQFN package

Joins with low-cost  $\mu$ Cs



- Low-power 1.8V to 3.6V operation
- 1.4mA operating current
- Charge pump provides 3V at 10mA
- 6 $\mu$ A sleep current, 1.5 $\mu$ A shutdown

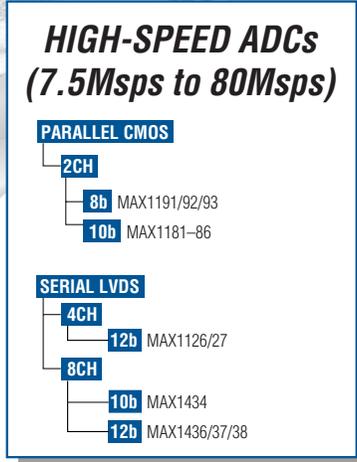
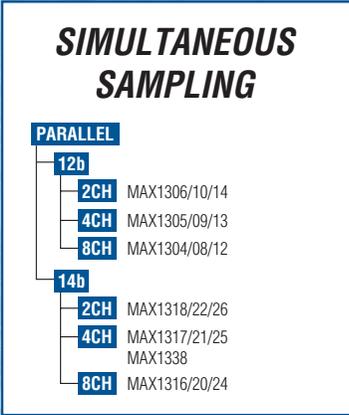
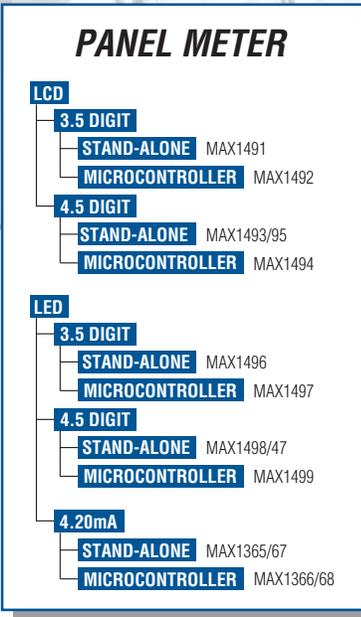
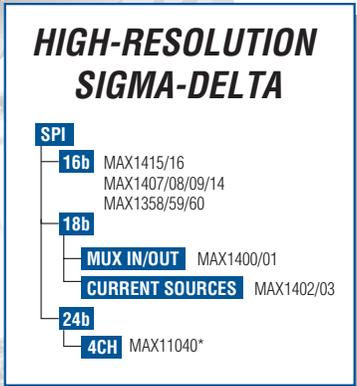
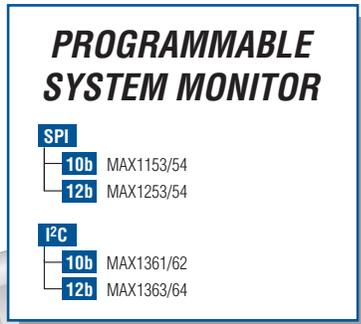
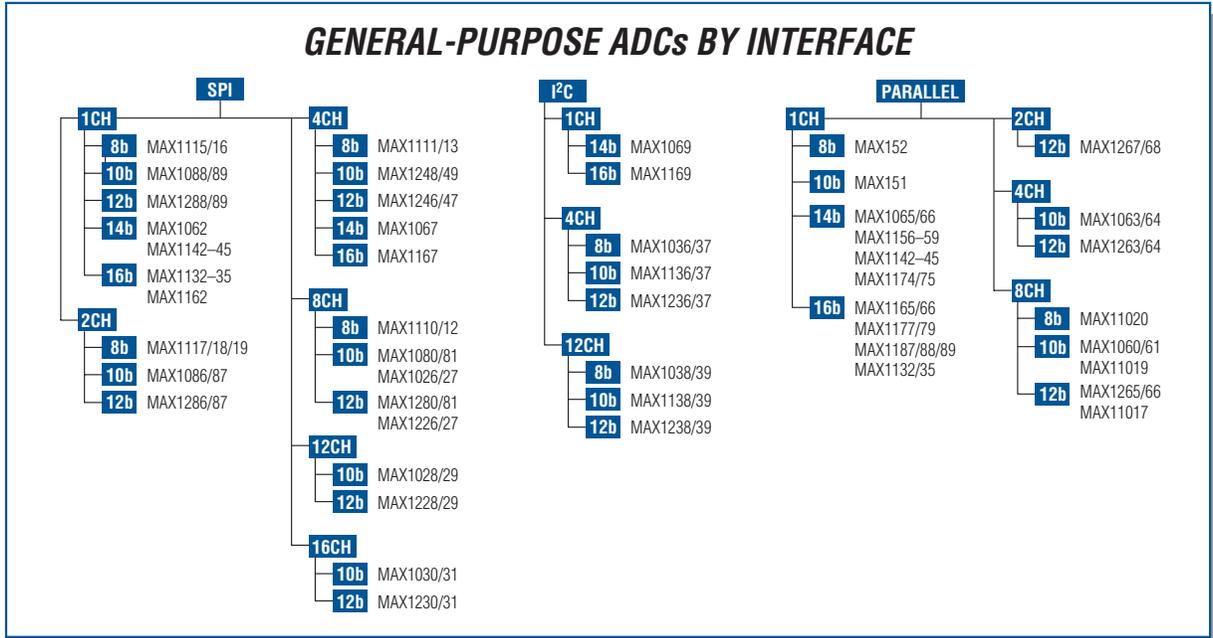
Part	ADC Resolution (Bits, type)	Speed (sps, max)	No. of Aux Input Channels/Total No. of Inputs	DACs	No. of Op Amps	No. of GPIOs	Switches SPDT/SPST	Price <sup>†</sup> (\$)
MAX1407	$\Sigma$ - $\Delta$	60	4/16	2 x 10-bit F/S**	—	1	0/0	7.95
MAX1408			8/16	—				6.25
MAX1409			1/8	1 x 10-bit F/S				5.85
MAX1414			4/16	2 x 10-bit F/S				7.95
MAX1358	$\Sigma$ - $\Delta$	512	2/20	2 x 10-bit F/S	1	4	2/2	8.07
MAX1359				1 x 10-bit F/S	2		2/1	7.45
MAX1360*				—	3		2/0	*
MAX1329	12/16, SAR	300k/1k	2/16	2 x 12-bit F/S	1	8	2/3	7.49
MAX1330*				1 x 12-bit F/S	2		2/3	*
MAX1331*				—	3		2/3	*

\*Future product—contact factory for availability.  
 \*\*F/S = Force-sense.  
<sup>†</sup>1000-up recommended resale. Prices provided are for design guidance and are FOB USA. International prices will differ due to local duties, taxes, and exchange rates. Not all packages are offered in 1k increments, and some may require minimum order quantities.



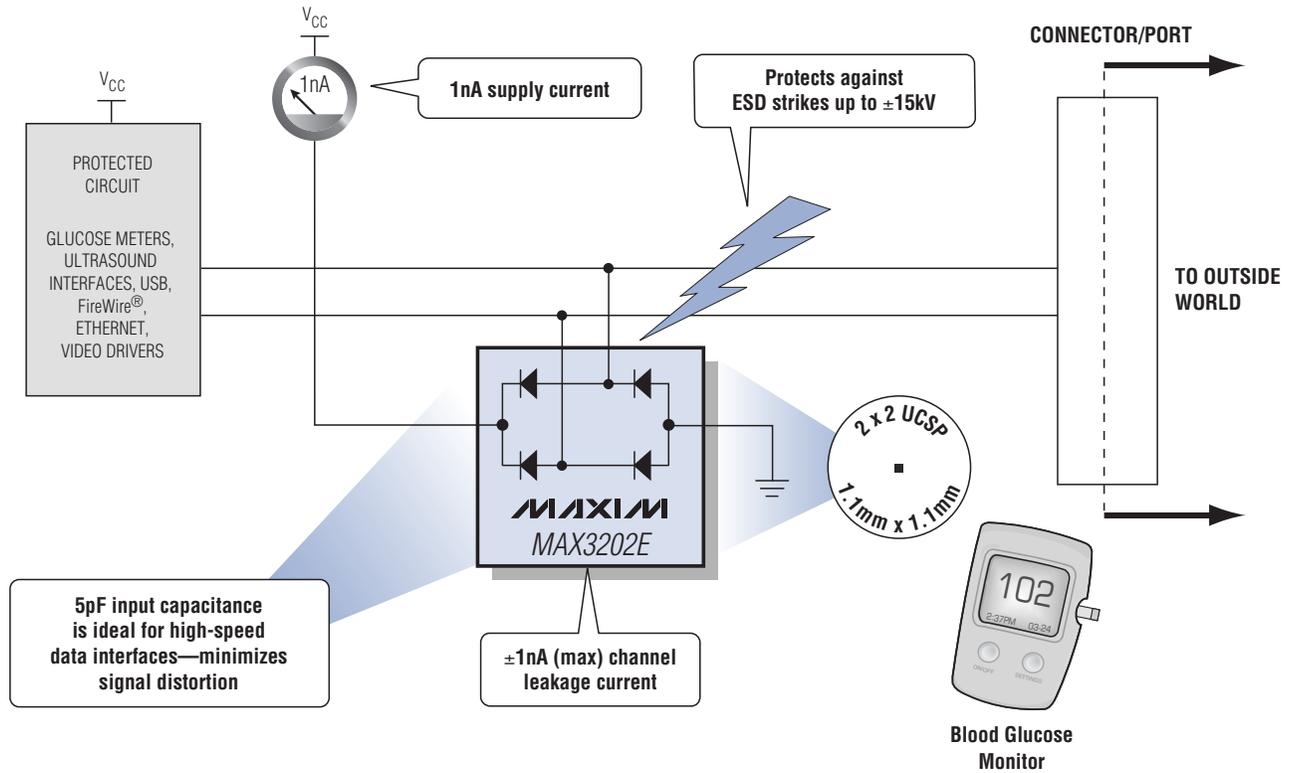
# ADCs for medical designs

## Quick reference



# Lowest capacitance ESD protectors in UCSP for high-speed applications

6x lower capacitance, 60% board savings over existing solutions



Part	V <sub>CC</sub> Supply (V)	No. of ESD Protection Channels	Input Capacitance (pF)	ESD Protection	Supply Current (nA)	Package	Price† (\$)
MAX3202E	0.9 to 5.5	2	5	±15kV Human Body Model, ±8kV IEC 61000-4-2 Contact, ±15kV IEC 61000-4-2 Air Gap	1	2 x 2 UCSP, 6-TQFN	0.37
MAX3203E		3				3 x 2 UCSP, 6-TQFN	0.55
MAX3204E		4				3 x 2 UCSP, 6-TQFN	0.73
MAX3206E		6				3 x 3 UCSP, 6-TQFN	1.11
MAX3205E		6	2.5			9 x 9 UCSP, 16-TQFN	0.82‡
MAX3207E		2	2.5			6-SOT23	0.37‡
MAX3208E		4	2.6			10-μMAX, 16-TQFN	0.55‡
MAX13202E	0.9 to 16	2	6	±15kV Human Body Model, ±14kV IEC 61000-4-2 Contact, ±30kV IEC 61000-4-2 Air Gap	1	6-μDFN	0.29‡
MAX13204E		4				6-μDFN	0.49‡
MAX13206E		6				9-μDFN	0.65‡
MAX13208E		8				10-μDFN	0.80‡

FireWire is a registered trademark of Apple Computer, Inc.

‡2500-up recommended resale. Prices provided are for design guidance and are FOB USA. International prices will differ due to local duties, taxes, and exchange rates. Not all packages are offered in 1k increments, and some may require minimum order quantities.

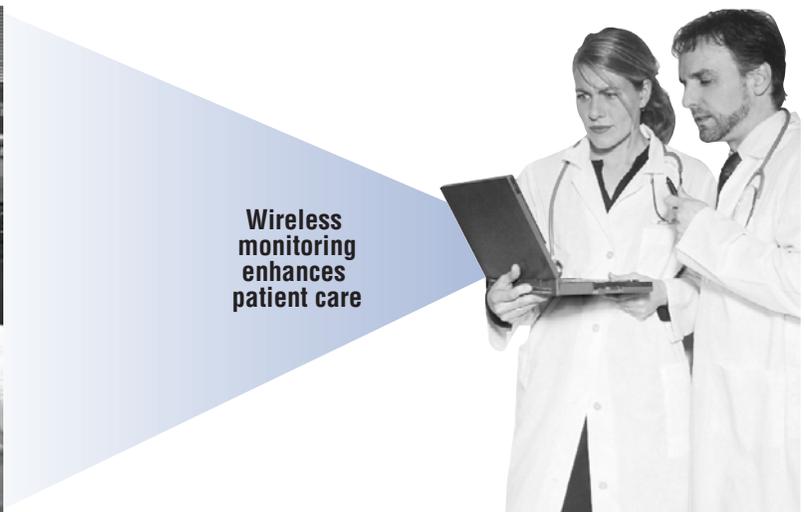
†1000-up recommended resale. Prices provided are for design guidance and are FOB USA. International prices will differ due to local duties, taxes, and exchange rates. Not all packages are offered in 1k increments, and some may require minimum order quantities.

# Increase range and add two-way capabilities to wireless medical equipment

## Industry's highest performance family of 300MHz to 450MHz transmitters, receivers, and transceivers

Maxim offers a range of transmitters, receivers, and transceivers designed for a variety of remote medical applications. The MAX1472/MAX7044/MAX1479 have the highest efficiency of any PLL-based transmitter, and the MAX1470/MAX1473/MAX7033/MAX1471/MAX7042 receivers provide the best RF sensitivity.

The MAX7030/MAX7031/MAX7032 family of crystal-referenced VHF/UHF transceivers are easy-to-use, high-performance devices that allow quick two-way implementation of one-way systems. Housed in small, 5mm x 5mm, 32-pin TQFN packages, these transceivers are perfect for applications where space is critical. These transceivers use a fractional-N PLL for the transmitter and a fixed-N PLL for the receiver, eliminating the need for separate transmit and receive crystal-referenced oscillators.



### Ideal for

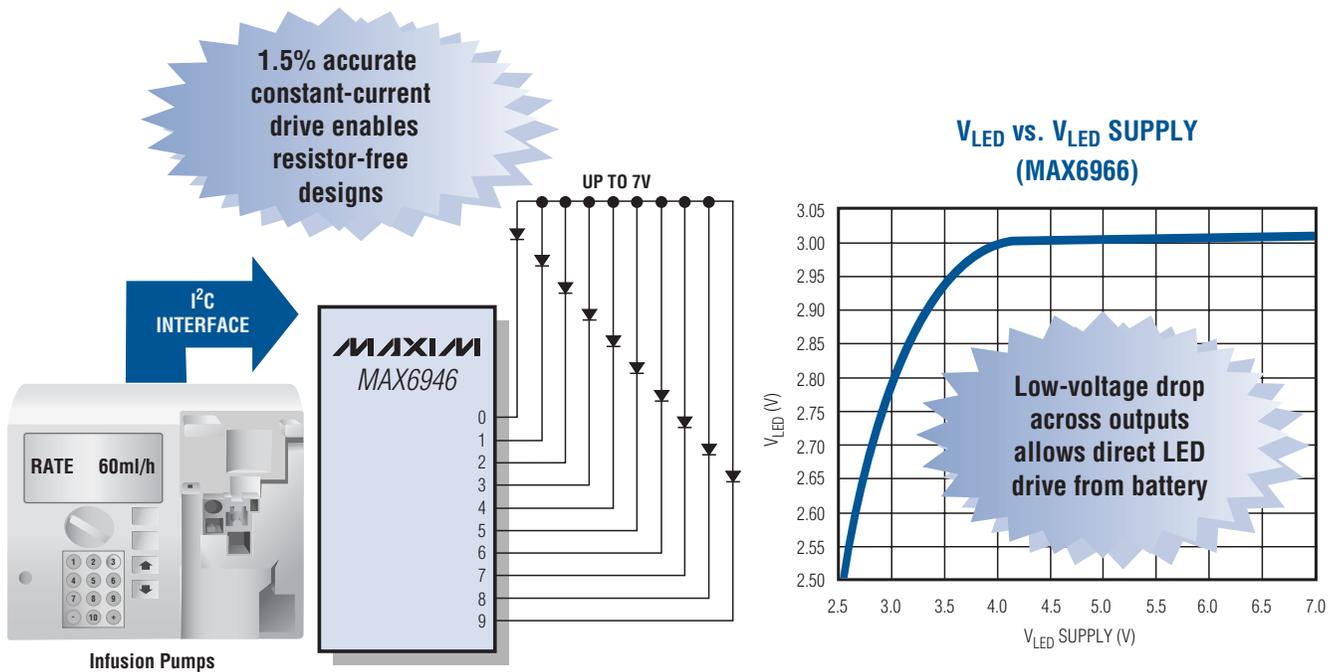
- Wireless medical equipment
- Wireless meters and monitors
- RF remote controls
- Wireless computer peripherals
- Wireless sensors
- Security systems

Part	Type	Temp Range (°C)	Power Consumption (mA, typ)	RF Performance at 315MHz	Modulation
MAX1472	Tx	-40 to +125	5.3 (ASK at 50% duty cycle)	+10dBm output	ASK
MAX7044			7.7 (ASK at 50% duty cycle)	+13dBm output	ASK
MAX1479			6.7 (ASK at 50% duty cycle)	+10dBm output	ASK/FSK
MAX1470	Rx		5.5	-112dBm with 53dB image rejection	ASK
MAX1473			5.2	-114dBm with 50dB image rejection	ASK
MAX7033			5.2	-114dBm with 50dB image rejection	ASK
MAX1471			7.0	-114dBm with 50dB image rejection	ASK/FSK
MAX7042			6.2	-110dBm with (ASK)/-108dBm (FSK) with 45dB image rejection	FSK
MAX7030			Transceiver	Rx: 6.1 Tx: 7.6 (50% duty cycle)	Rx: -114dBm sensitivity Tx: +10dBm output
MAX7031	Rx: 6.4 Tx: 11.6		Rx: -110dBm sensitivity Tx: +10dBm output	FSK	
MAX7032	Rx: 6.1 (ASK)/6.4 (FSK) Tx: 7.6 (ASK)/11.6 (FSK)		Rx: -114dBm (ASK)/-110dBm (FSK) sensitivity; Tx: +10dBm output	ASK/FSK	

# Drive RGB or white LEDs directly from battery and save system cost

**Tiny, 3mm x 3mm TQFN and low standby current (0.8µA, typ) are ideal for portable medical applications**

The MAX6946/MAX6947/MAX6966/MAX6967 10-port, constant-current LED drivers and I/O expanders are ideal for driving RGB or white LEDs. Each port has 1.5% accurate constant-current drive, which matches brightness among LEDs and eliminates the need for external current-limiting resistors. Consequently, LEDs can be powered directly from the battery or power-management IC. Fade all LEDs up or down with an automatically initiated hardware (or software) command while the main microprocessor sleeps.



- Programmable fade up and down
- I/O capability on every port
- I/Os support hot insertion
- -40°C to +125°C temp range
- 1.5% current match among ports
- Low standby current (< 2µA, max)
- Up to 20mA constant current per port
- 7V-tolerant outputs

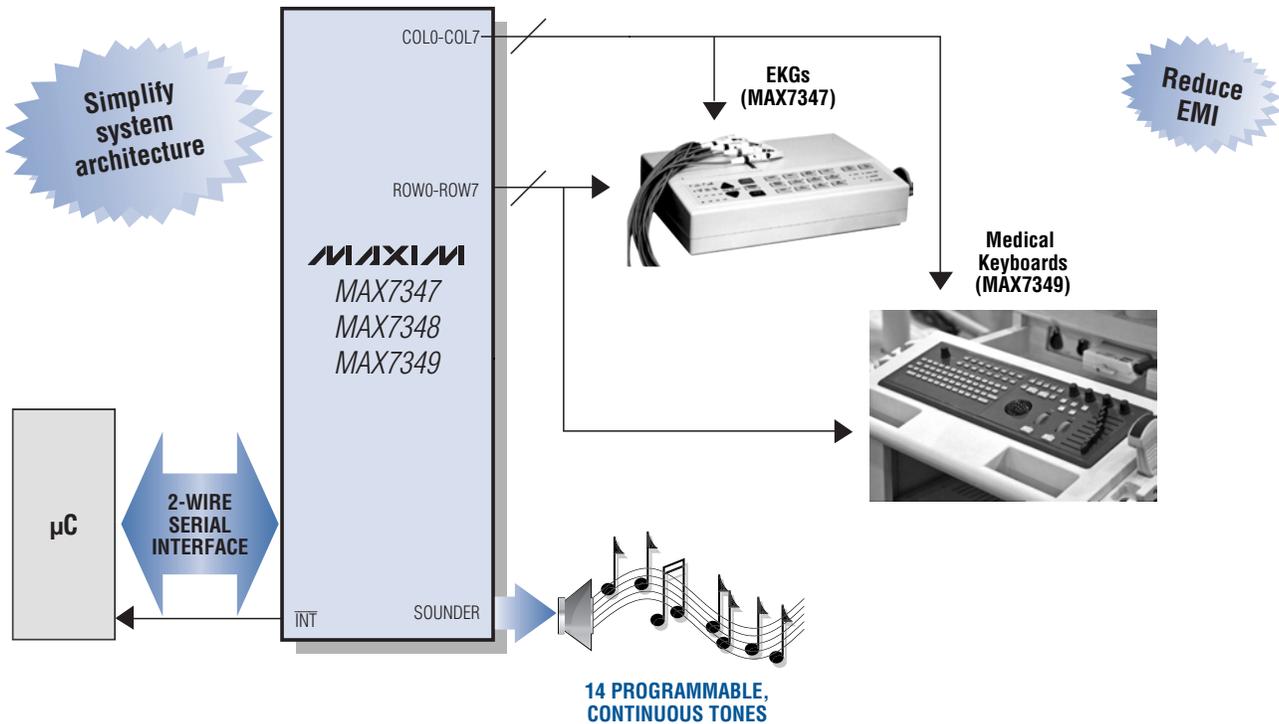
Part	No. of Ports/ Tolerance (V)	Supply (V)	Constant-Current Drive	PWM (Bit)	OSC Input	D <sub>OUT</sub> Output	Interface Type	Package
MAX6946	10/7	2.25 to 3.6	✓	8	✓		I <sup>2</sup> C	16-TQFN
MAX6947		2.25 to 3.7		9		I <sup>2</sup> C	16-TQFN	
MAX6966		2.25 to 3.6		8	✓	SPI	16-TQFN/QSOP	
MAX6967		2.25 to 3.6		8	✓	SPI	16-TQFN/QSOP	

**EV KIT  
AVAILABLE**

For information on Maxim's complete line of display products, go to: [www.maxim-ic.com/Displays](http://www.maxim-ic.com/Displays)

# Low-noise, low-EMI, key-switch controllers support up to 64 keys

The MAX7347/MAX7348/MAX7349 key-switch controllers monitor and debounce 24, 40, or 64 keys, respectively. Static key monitoring ensures low EMI for noise-sensitive applications. The interrupt output (INT) can be configured to alert key presses as they occur or at a programmable minimum interval. An integrated sounder driver can generate automatic key-click sounds. The sounder output can be programmed to operate an electronic sounder, relay, or lamp for a set time instead of generating a frequency.



## Key-switch controller

- 8-key FIFO stores debounced key-switch events
- Integrated ghost-key elimination
- Programmable debounce duration and key autorepeat

## Sounder generator

- Musical tone generator
- Two-tone sound generation
- Automatic key-tone generation for key-click audible feedback

**EV KIT AVAILABLE**

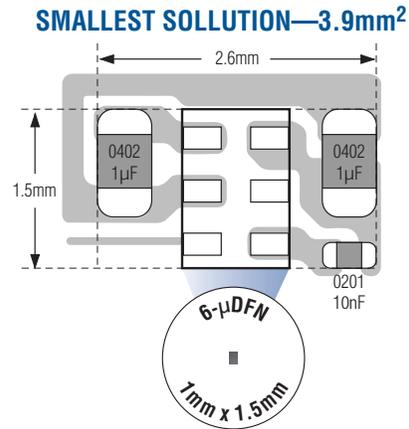
Part	No. of Keys Monitored	No. of GPIOs	Temp Range (°C)	Package
MAX7347AEE	Up to 24	1	-40 to +125	16-QSOP
MAX7348AEP	Up to 40	3		20-QSOP
MAX7349AEG	Up to 64	6		24-QSOP
MAX7349ANG	Up to 64	6		24-PDIP

# Smallest, ultra-low-noise, 150mA linear regulator fits in only 1.5mm<sup>2</sup>

Advanced noise reduction—only 11 $\mu$ V<sub>RMS</sub> of output noise

- 78dB PSRR at 1kHz
- Low 40 $\mu$ A ground current
- 120mV dropout at 120mA
- Adjustable or fixed output voltage

Part*	Features	RoHS Compliance	Price † (\$)
MAX8840ELTx+T	Lowest output noise, fixed-voltage options	✓	0.54
MAX8841ELTx+T	Fixed-voltage options		
MAX8842ELT+T*	Adjustable output voltage		



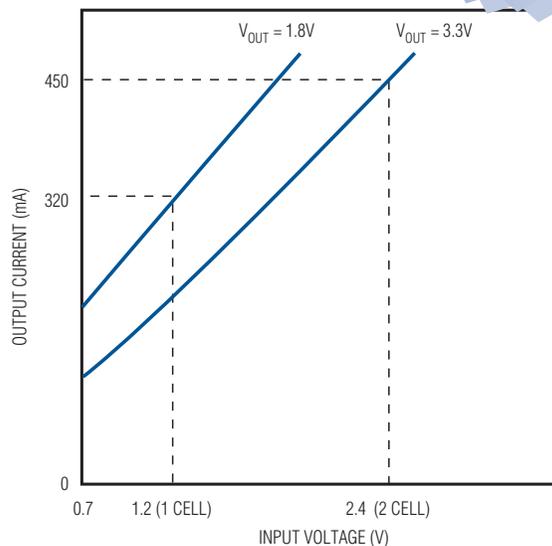
SMALLEST 11 $\mu$ V<sub>RMS</sub> LDO

# Smallest 1.8V output, step-up DC-DC for 1-/2-cell alkaline handhelds

True Shutdown™ minimizes unwanted current drain from battery

- Low 0.7V input and 1.8V output voltage capability
- 800mA, 0.15 $\Omega$  internal n-channel switch
- Built-in 100ms reset output
- Integrated synchronous rectifier
- High 94% efficiency
- 1.8V, 2.5V, 3.0V, and 3.3V fixed output voltages
- Tiny 4.7 $\mu$ H inductor
- Automatic pulse skipping at light loads for extended battery life
- Priced at \$1.55‡
- Evaluation kit available

MAX1947 delivers up to 320mA at 1.8V from 1-cell battery



True Shutdown is a trademark of Maxim Integrated Products, Inc.

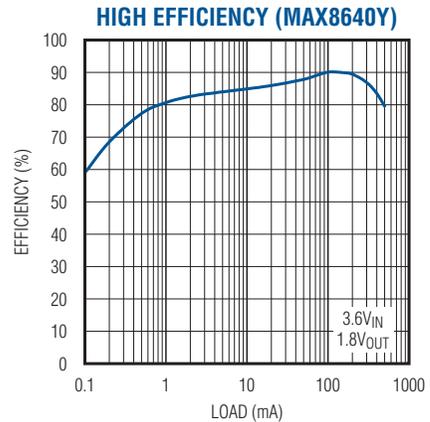
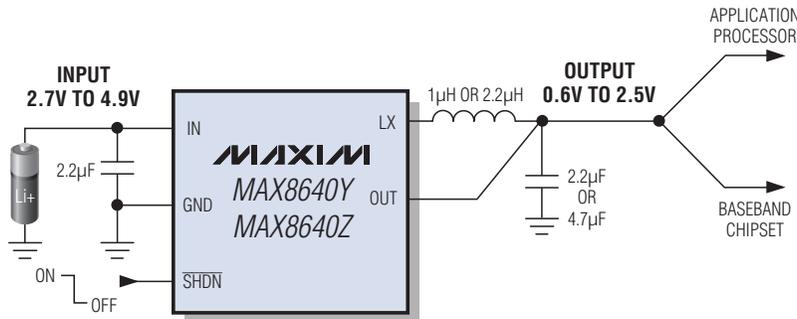
\*xy is the output voltage code. Options available include 1.5V, 1.8V, 2.5V, 2.6V, 2.7V, 2.8V, 2.85V, 3.0V, 3.1V, and 3.3V. Refer to the MAX8840 data sheet for more information.

‡2500-up recommended resale FOB USA. Price provided is for design guidance and is FOB USA. International prices will differ due to local duties, taxes, and exchange rates. Not all packages are offered in 1k increments, and some may require minimum order quantities.

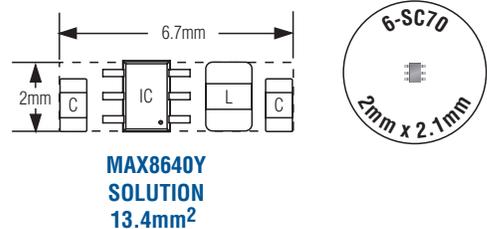
†1000-up recommended resale. Prices provided are for design guidance and are FOB USA. International prices will differ due to local duties, taxes, and exchange rates. Not all packages are offered in 1k increments and some may require minimum order quantities.

# First SC70 step-down DC-DC to deliver 500mA

Ideal for portable medical applications

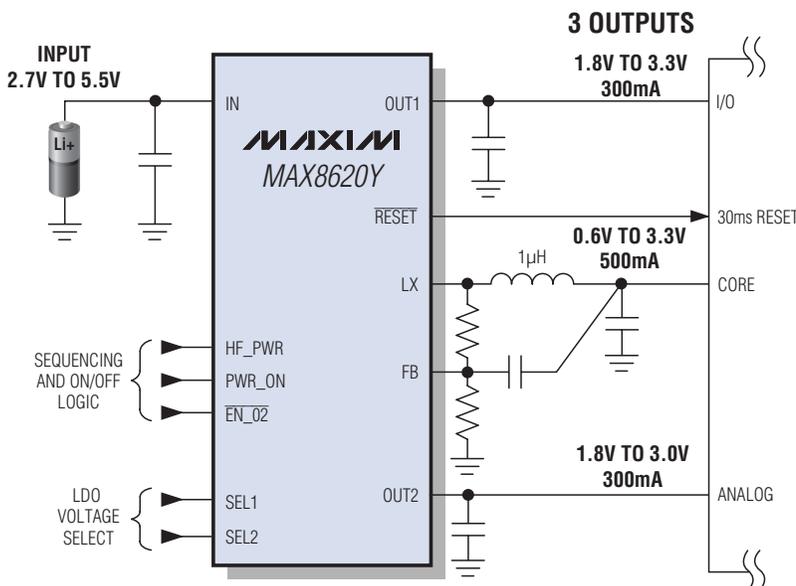


- Up to 4MHz switching
- Low 24µA quiescent current
- Evaluation kit available
- Priced at \$1.58†

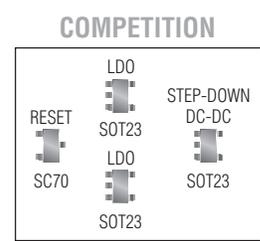


# First step-down DC-DC in a TDFN to integrate two LDOs plus reset

500mA output and > 90% efficiency for low-voltage µP-cased portables



**Integrated solution saves 78% board area vs. the competition**

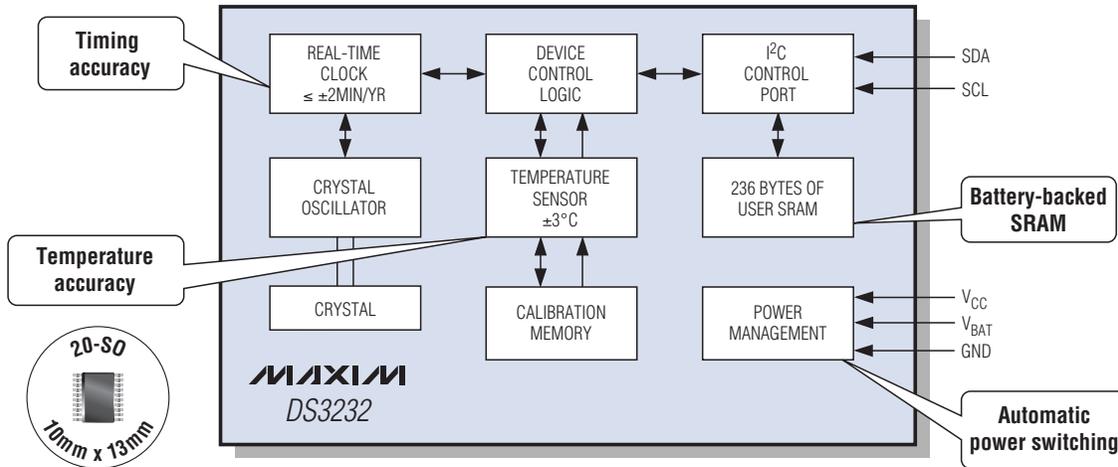


†2500-up recommended resale. Prices provided are for design guidance and are FOB USA. International prices will differ due to local duties, taxes, and exchange rates. Not all packages are offered in 1k increments, and some may require minimum order quantities.

# RTC integrates memory, temp sensor, and crystal

**±1min/year accuracy plus 236 bytes of user SRAM**

Portable battery-backed medical devices require small packages to reduce overall system size and low battery-backed currents to maximize battery life. We offer devices in small packages, such as the 8-/10-pin  $\mu$ SOP and 28-pin TSSOP. Many of our clock oscillators keep time down to +1.3V with a typical current drain of less than 1 $\mu$ A.



## RTCs Solve Unique Timing Needs for Medical Devices

Part	Accuracy*	Bus Type	V <sub>CC</sub> (V)	User RAM (Bytes) S:SRAM E:EEPROM F:FRAM	Minimum V <sub>osc</sub> (V)	Maximum Oscillator Current	Temp Range (°C)	No. of GPIOs	Battery Input	Trickle Charger	Watch-dog Timer	TOD Alarm	Reset Pushbutton Debounce Input	Reset Output
DS1337	2min/month	I <sup>2</sup> C	1.8 to 5.5	—	1.3	600nA at 1.8V	-40 to +85	—				✓		
DS1338			1.8, 3, 3.3 (5)**	56 S		1200nA at 3.7V		—	✓					
DS1339			2.0, 3, 3.3 (5)**	—		700nA at 3.7V		—	✓	✓		✓		
DS1374			1.8, 3, 3.3 (5)**	—		700nA at 3.7V		—	✓	✓	✓	✓	✓	✓
DS1388			3.0, 3.3, 5	512 E		550nA at 3.7V		—	✓	✓	✓	✓	✓	✓
DS28DG02			SPI	3.3		2k E		1.5	4.7 $\mu$ A at 3.0V	12	✓		✓	✓
DS3231	1min/year	I <sup>2</sup> C	3.3	—	2.3	3 $\mu$ A at 3.63V	0 to +70	—	✓			✓	✓	✓
DS3232			3.3 (5)**	236 S	2.3	2.5 $\mu$ A at 3.3V		—	✓			✓	✓	✓
DS32C35			3.3	8k F	2.3	3 $\mu$ A at 3.63V		—	✓			✓	✓	✓
DS3234		SPI	3.3 (5)**	256 S	2	2.3 $\mu$ A at 3.4V		—	✓			✓	✓	✓

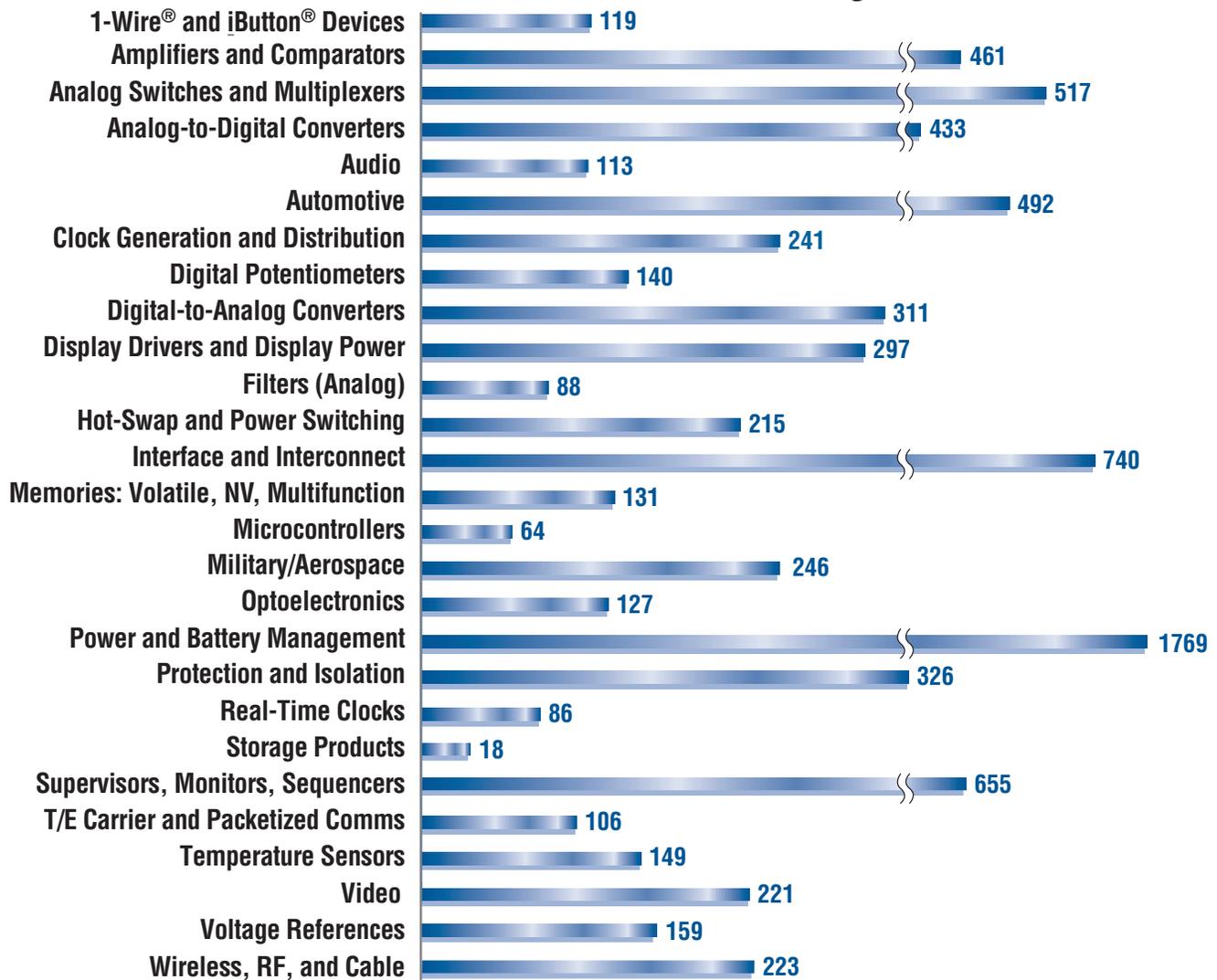
For our complete line of medical RTCs, visit:  
[www.maxim-ic.com/Medical-RTC](http://www.maxim-ic.com/Medical-RTC)

\*2min/month at  $\pm 25^{\circ}\text{C}$ . 1min/year from  $0^{\circ}\text{C}$  to  $+40^{\circ}\text{C}$ . Accuracy is based upon typical crystal selection and PCB layout.  
 \*\*3.3V device is rated to 5.5V (max) V<sub>CC</sub> operation.

# Yes, we make that...

Maxim has one of the broadest and deepest analog and mixed-signal portfolios, with over 5900 ICs in 28 categories. We average more than one product introduction per day! For 25 years, we have delivered innovative engineering solutions that add value to our customers' products.

## 5900 ICs in 28 Product Categories



[www.maxim-ic.com/yes](http://www.maxim-ic.com/yes)

Medical-1 US 2/09



[www.maxim-ic.com](http://www.maxim-ic.com)

Maxim Integrated Products, Inc.  
120 San Gabriel Drive  
Sunnyvale, CA 94086