MICROCONTROLLER
Design Guide

Microcontroller solutions for customers' most demanding needs

Industry's best security technology to protect money, software IP, or secret data
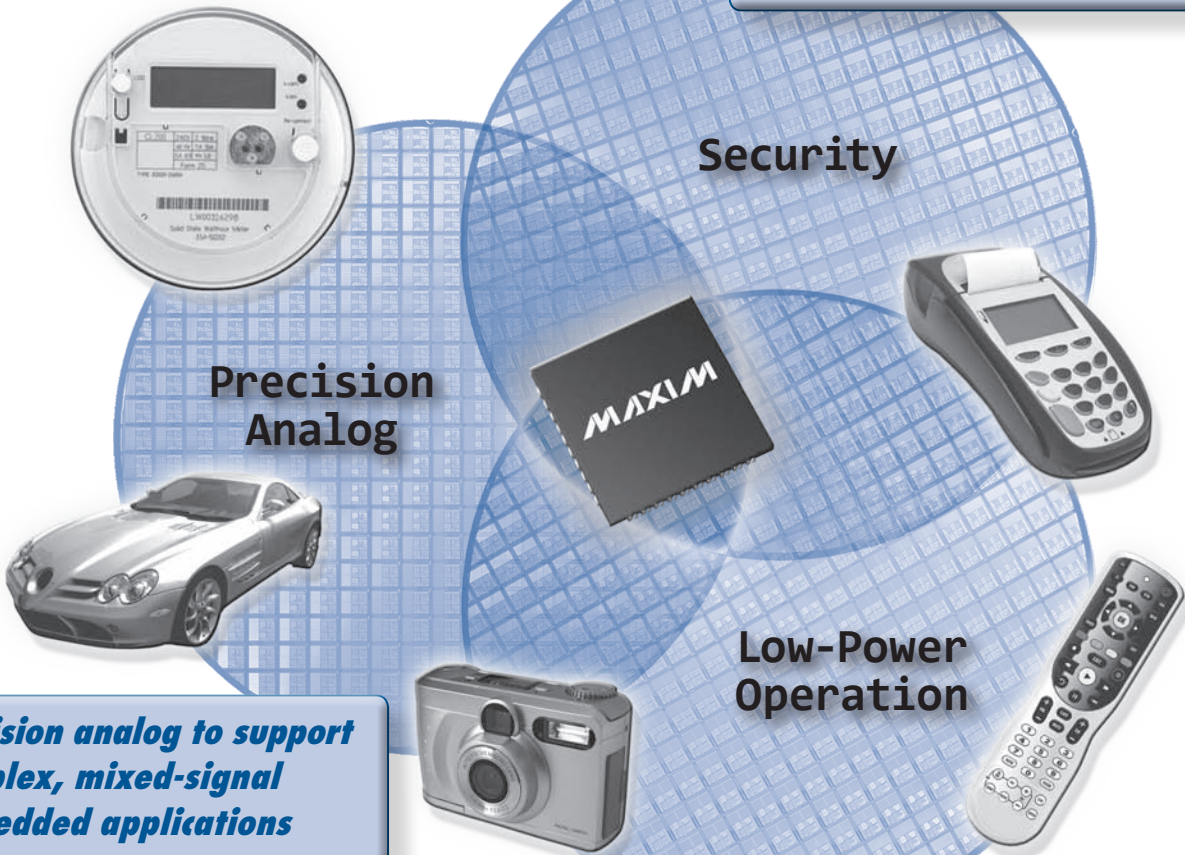
Security

Precision Analog

MAXIM

Low-Power Operation

Precision analog to support complex, mixed-signal embedded applications

World-class low power and high performance to make today's battery-powered equipment run faster and longer
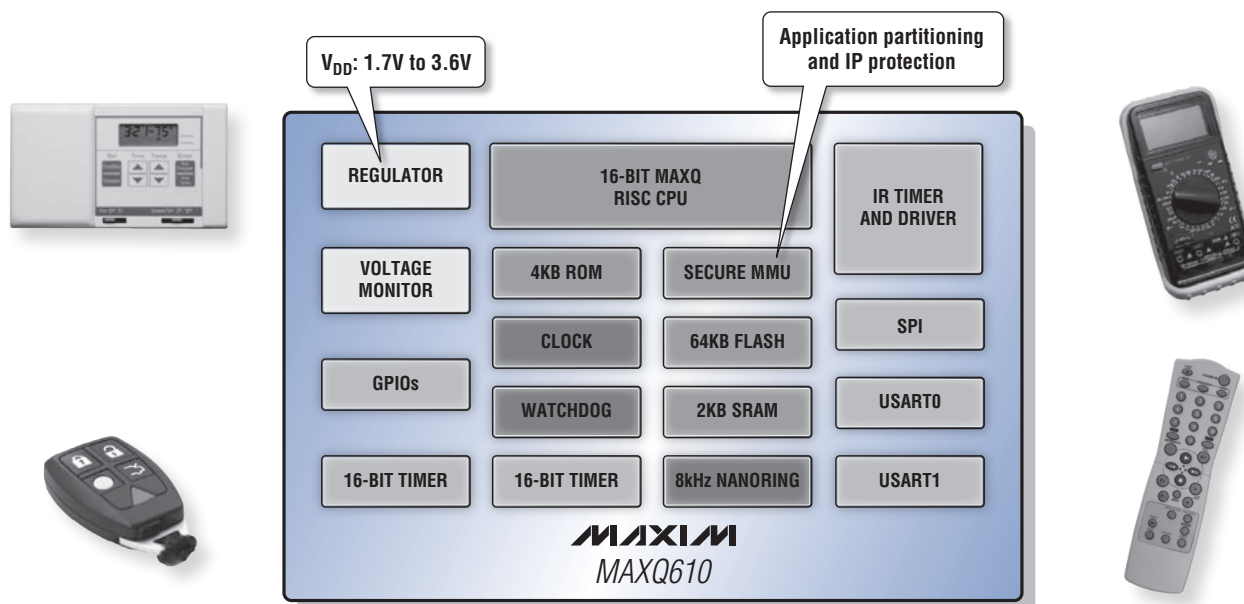
MAXIM

Maxim's line of low-power μCs are designed to specifically address the most pressing demands on today's battery-powered electronics. These μCs extend battery life, enable advanced feature sets through higher performance and integration, and allow small form factors with reduced footprint solutions.

Give your customer months of extra time

16-bit MAXQ® μCs greatly extend battery life in portable equipment

The MAXQ610 is designed for low-cost, high-performance, battery-powered applications. This 16-bit, RISC-based μC has a wide operating range (down to 1.7V) for long battery life and ultra-low power consumption. Its anticloning features and secure MMU enable you to protect your IP.

V_{DD}: 1.7V to 3.6V

Application partitioning and IP protection

REGULATOR | 16-BIT MAXQ RISC CPU | IR TIMER AND DRIVER
VOLTAGE MONITOR | 4KB ROM | SECURE MMU | SPI
CLOCK | 64KB FLASH
GPIOs | WATCHDOG | 2KB SRAM | USART0
16-BIT TIMER | 16-BIT TIMER | 8kHz NANORING | USART1

MAXIM
MAXQ610

Microcontroller

- **16-bit MAXQ RISC core**
- **64KB flash memory, 2KB SRAM**
- **Ultra-low supply current**
  - **Active mode: 3.75mA at 12MHz**
  - **Stop mode: 200nA (typ), 2.0μA (max)**
- **Wide, 1.7V to 3.6V operating voltage range**
- **IP protection**
  - **Secure MMU supports multiple privilege levels, helps protect code from copying and reverse engineering**

Peripherals

- **Two USARTs and one SPI™ master/slave communication port**
- **Two 16-bit timers/counters**
- **8kHz nanoring functions as programmable wakeup timer**
- **IR timer simplifies support for low-speed infrared communication**
- **IR driver capable of 25mA sink current**

Part	Temp Range (°C)	Program Memory	Data Memory	Operating Voltage (V)	Package
MAXQ610A	0 to 70	64KB flash	2KB SRAM	1.7 to 3.6	32-TQFN
MAXQ610J	0 to 70	64KB flash	2KB SRAM	1.7 to 3.6	40-TQFN

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

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Application focus: Universal remote controls

Maxim now offers the widest range of devices with integrated infrared drivers and timers for IR communications, due to its acquisition of the Classic IR and Crimzon® lines from Zilog. Combined with the unmatched ability to extend battery life and integrate multiple features, Maxim's µCs are the ideal choice for remote-control designs.
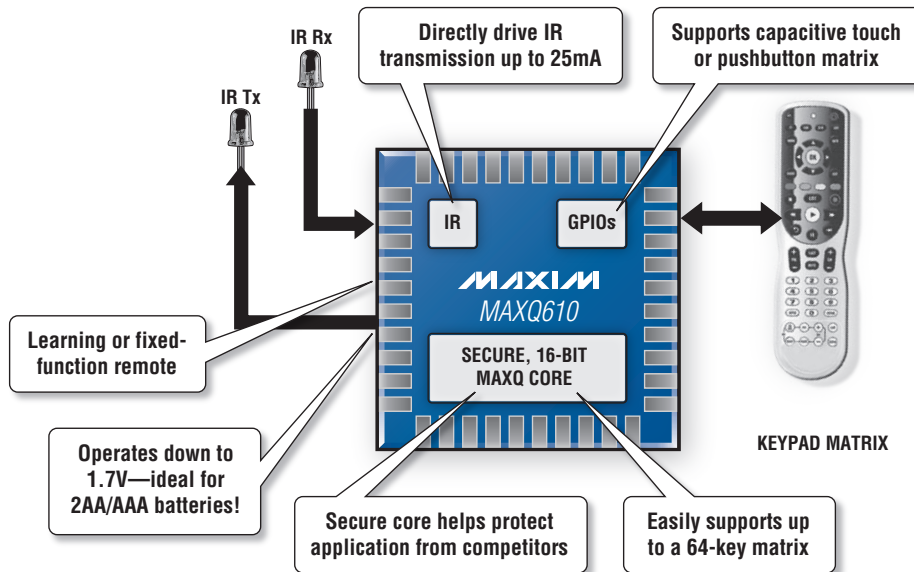
Part	Program Memory	ROM (KB)	RAM (Bytes)	8-/16-Bit Timers	Features	Speed (MHz)	I/Os	Supply Voltage (V)	Recommended Upgrade
Z8 Core									
ZLF645S	Flash	32, 64	512	2/1	2 comparators, POR, IR learning amp, LVD, HVD, T8/T16 timer pair, UART	8	16, 24, 40	2.0 to 3.6	MAXQ610
ZLF645E	Flash	32, 64	1K	2/1	2 comparators, POR, IR learning amp, LVD, HVD, T8/T16 timer pair, UART	8	16, 24, 40	2.0 to 3.6	MAXQ610
ZLR32300	ROM	4, 8, 16, 24, 32	237	1/1	2 comparators, POR, LVD, HVD, UART	8	16, 24, 32	2.0 to 3.6	MAXQ61H
ZLR64400	ROM	32, 64	1004	2/1	2 comparators, POR, LVD, HVD, dedicated IR amp, UART	8	16, 24	2.0 to 3.6	MAXQ61H
ZLP12840	OTP	32, 64, 96, 128	1004	2/1	2 comparators, POR, IR learning amp, capture timers for learning, UART, LVD, HVD	8	16, 24	2.0 to 3.6	MAXQ610
ZLR16300	ROM	1, 2, 4, 8, 16	237	1/1	2 comparators, POR, LVD, HVD	8	16, 24	2.0 to 3.6	MAXQ61H
Z86L88	ROM	16	237	1/1	2 comparators, POR, LVD, mask-selectable pullups	8	23	2.0 to 3.6	MAXQ61H
Z86L98	ROM	64	237	1/1	2 comparators, POR, LVD, mask-selectable pullups	8	23	2.0 to 3.6	MAXQ61H
Z86L81	ROM	24	237	1/1	2 comparators, POR, LVD, mask-selectable pullups	8	23	2.0 to 3.6	MAXQ61H
Z86L82	ROM	4	237	1/1	2 comparators, POR, LVD, mask-selectable pullups	8	23	2.0 to 3.6	MAXQ61H
Z86L85	ROM	8	237	1/1	2 comparators, POR, LVD, mask-selectable pullups	8	23	2.0 to 3.6	MAXQ61H
Z86L86	ROM	32	237	1/1	2 comparators, POR, LVD, mask-selectable pullups	8	23	2.0 to 3.6	MAXQ61H
Z86L87	ROM	16	237	1/1	2 comparators, POR, LVD, mask-selectable pullups	8	31	2.0 to 3.6	MAXQ61H
Z86L89	ROM	24	237	1/1	2 comparators, POR, LVD, mask-selectable pullups	8	31	2.0 to 3.6	MAXQ61H
Z89L73	ROM	32	237	1/1	2 comparators, POR, LVD, mask-selectable pullups	8	31	2.0 to 3.6	MAXQ61H
Z86L987	ROM	64	237	1/1	2 comparators, POR, LVD, mask-selectable pullups	8	31	2.0 to 3.6	MAXQ61H
MAXQ20 Core									
MAXQ610	Flash	64	2K	2	Capture/compare, POR, IR frequency generation/modulation, SPI, 2 USARTs, ring oscillator, wakeup timer	12	32	1.7 to 3.6	—

Crimzon is a registered trademark of Universal Electronics, Inc.

Secure microcontrollers

With the acquisition of Innova Card and the secure transaction Zatara® product line from Zilog, the secure µC product line from Maxim now offers the broadest range of products for the high-security, financial-terminal market. Combining Maxim's high-security silicon technology, Innova Card's application knowledge and support, and Zatara's impressive integration, Maxim now has the best knowledge, technology, and products to support the most demanding security applications.

Need a PCI 2.0 silicon provider?

Look no further

The universal secure integrated platform professional IC (USIP™ PRO) is the industry's highest performance, most secure 32-bit MIPS® microprocessor. It supports Linux® operating systems and enables next-generation EMV® and PCI PED-compliant applications.
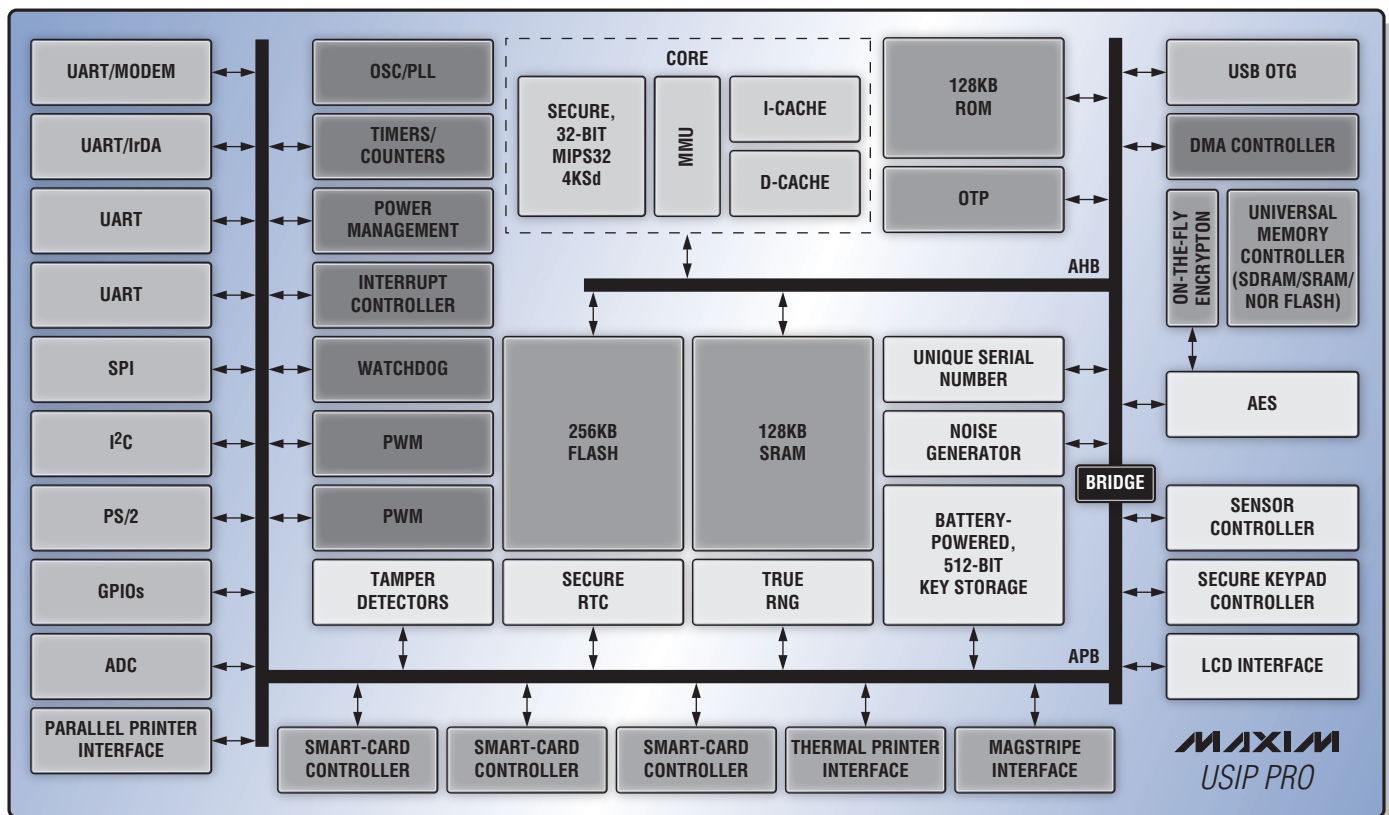
Key features

- **MIPS32® 4KSd™ 32-bit RISC processor**
- **Embedded memories (128KB SRAM, 256KB flash)**
- **Patented security and cryptographic features**
- **Highly integrated—includes ISO 7816 smart card, USB, and SPI controllers**

Benefits

- **Facilitates EMV/PCI PED compliance**
- **Reduces BOM cost**
- **Enables migration to open platforms and new form-factor devices**
- **Reference design and precertified software speed time to market**

MAXIM

Industry's fastest, most secure ARM®-based SoC µC meets PCI 2.0 requirements

Integrates security and application-management functions needed for the next generation of trusted devices
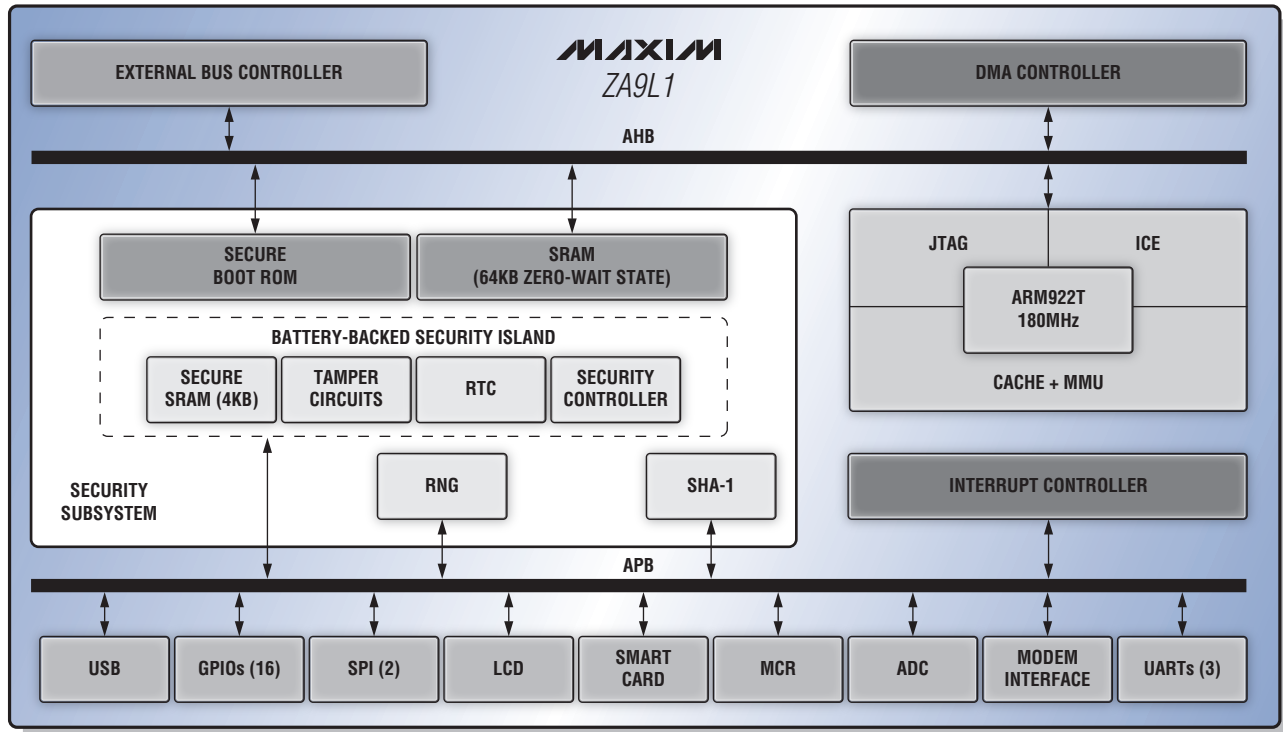
- **ARM922T™ 16-bit (ZA9L0) or 32-bit (ZA9L1) core**
- **Security subsystem**
  - **Embedded secure boot ROM**
  - **Battery-backed security island**
  - **NIST 800-22-compliant RNG**
  - **FIPS 180-2-compliant, SHA-1 hash generator**
  - **64KB of embedded zero-wait-state SRAM, 4KB of embedded secure SRAM with fast zeroization**

- **Magnetic card reader (MCR)**
- **Smart-card controllers**
- **Integrated modem and USB interfaces (ZA9L1)**
- **76 GPIOs and pin multiplexing (16 dedicated)**
- **DMA, SDRAM, and interrupt controllers**
- **Power management**

Part	Core	Flash (KB)	SRAM (KB)	External Memory (MB)	Other Interface(s)	Timers	GPIOs	USARTs	USB	Code Encryption	User Encryption				RTC	RNG	Speed (MHz, max)	Battery Leakage (+25°C, µA, typ)	Supply Voltage (V)	Package
											DES/3DES	RSA/DSA/ECDSA	AES	SHA-1/SHA-2						
USIP PRO	MIPS32 4KSd	256	128	32	SPI, I²C	4	32	4	✓	AES			✓		✓	✓	96	2.9	DC[1]	
ZA9L0	ARM922T	—	64	512	SPI, LCD	9	76	3		—				✓			180	21	DC[2]	256-CSBGA
ZA9L1	ARM922T	—	64	512	SPI, LCD, magstripe	9	76	3	✓	—				✓			200	23	DC[2]	

ARM922T is a trademark and ARM is a registered trademark of ARM Ltd.
Note 1: DC++ = Dual-core 1.7V to 1.9V and 3.0V to 3.6V supplies required.
Note 2: DC+++ = Dual-core 1.71V to 1.89V and 3.0V to 3.6V supplies required.

Lowest pin count, secure µC for financial-terminal applications

Smallest footprint available for applications that require a high level of physical and logical security
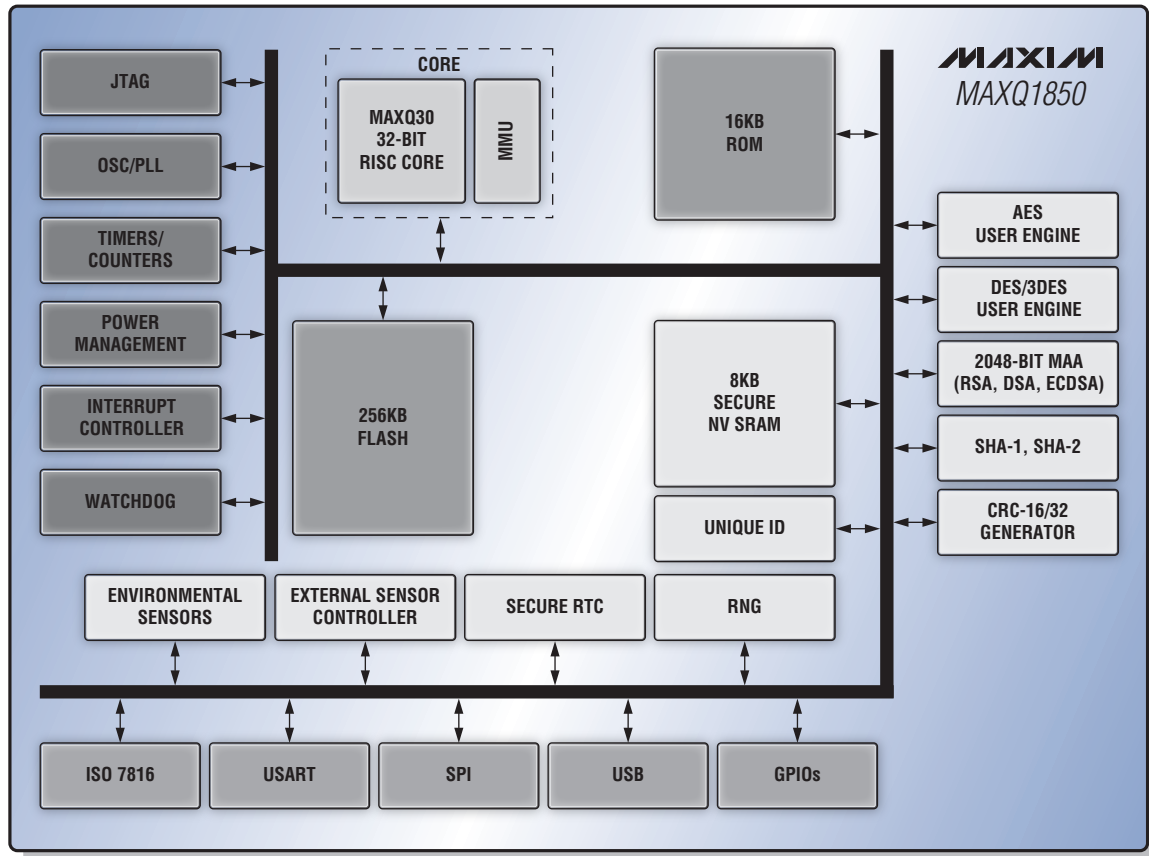
- • **Cryptographic hardware accelerators for RSA, DSA, ECDSA, SHA-1, SHA-2, AES, DES, and 3DES**
- • **Extremely low pin count and small package size: good for security and product cost**
- • **Security supervisor provides tamper detection and reaction**

- • **Supports USB (slave), SPI (master and slave), USART, and ISO 7816-compliant smart-card UART**
- • **Available in 6mm x 6mm, 40-pin TQFN and 7mm x 7mm, 49-ball CSBGA packages**

32-bit µC integrates security supervisor and cryptographic functions

Ideal for any application that requires PCI, FIPS 140-2, Common Criteria, or other security certifications

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┌──────────────────────────────────────────────────────────────────┐
│                                                      MAXIM         │
│   ┌──────────┐   ┌─ CORE ──────────────┐  ┌──────────┐  MAXQ1103   │
│   │  JTAG    │   │ MAXQ30  │MMU│I-CACHE│  │  16KB    │             │
│   └──────────┘   │ 32-BIT  │   │       │  │  ROM     │             │
│   ┌──────────┐   │RISC CORE│   │       │  └──────────┘             │
│   │ OSC/PLL  │   └─────────┴───┴───────┘            EXTERNAL BUS   │
│   └──────────┘                                      WITH CODE      │
│   ┌──────────┐                                      ENCRYPTION     │
│   │ TIMERS/  │                                                     │
│   │ COUNTERS │                                      DES/3DES       │
│   └──────────┘                                      USER ENGINE    │
│   ┌──────────┐   ┌─────────┐   ┌──────────┐                        │
│   │  POWER   │   │         │   │  1KB     │        2048-BIT MAA    │
│   │MANAGEMENT│   │ 512KB   │   │ SECURE   │        (RSA, DSA,      │
│   └──────────┘   │ FLASH   │   │ NV SRAM  │        ECDSA)          │
│   ┌──────────┐   │         │   └──────────┘                        │
│   │INTERRUPT │   │         │                       SHA-1, SHA-2    │
│   │CONTROLLER│   │         │   ┌──────────┐                        │
│   └──────────┘   └─────────┘   │UNIQUE ID │        CRC-16/32       │
│   ┌──────────┐                 └──────────┘        GENERATOR       │
│   │ WATCHDOG │                                                     │
│   └──────────┘                                                     │
│   ┌──────────┐                                                     │
│   │1.8V VOLT.│                                                     │
│   │REGULATOR │                                                     │
│   └──────────┘                                                     │
│  ENVIRONMENTAL  EXTERNAL SENSOR   SECURE RTC    RNG                │
│    SENSORS       CONTROLLER                                        │
│                                                                    │
│   ISO 7816   USART   32KB WORKING   USB    GPIOs                   │
│                         SRAM                                       │
└──────────────────────────────────────────────────────────────────┘
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- **Low-power sensors detect tamper events and erase all sensitive data**
- **High-performance cryptographic engines provide secure communication and authentication for high-speed financial transactions**
- **3DES-encrypted code makes it impossible for an attacker to clone or reverse-engineer an application**
- **Available in 144-pin TQFP and 144-ball CSBGA packages**

Part	Core	Flash (KB)	SRAM (KB)	External Memory (MB)	Other Interface(s)	Timers	GPIOs	USART(s)	USB	Code Encryption	User Encryption DES/3DES	RSA/DSA/ECDSA	AES	SHA-1/SHA-2	RTC	RNG	Speed (MHz, max)	Battery Leakage (+25°C, nA, typ)	Supply Voltage (V)	Package
MAXQ1850	MAXQ30	256	8	—	SPI	2	16	1	✓	—	✓	✓	✓	✓	✓	✓	16	850	2.8 to 3.6	40-TQFN, 49-CSBGA
MAXQ1103	MAXQ30	512	32	8	—	4	32	2	✓	3DES	✓	✓		✓	✓	✓	25	150	DC[1]	144-TQFP/CSBGA

Note 1: DC = Dual-core 1.8V (1.62V to 1.98V) and 3.3V (2.8V to 3.6V) supplies required.

How the PCB is routed can make the difference between an exceptional electricity meter design and a merely acceptable design. Maxim has years of experience in successful analog layout and can help you design an exceptional electricity meter on your first pass. Our engineering team can review your MAXQ-based design to ensure your product's performance.

Electricity meter or power analyzer?

Electricity-metering AFE combines watt-hour and VAR-hour measurement with sophisticated power analysis

The MAXQ3180 AFE is deceptively simple: an 8-channel ADC combined with a single-cycle, 16-bit RISC core to create a complete electricity-metering AFE. But what sets the MAXQ3180 apart from other AFE devices is the set of algorithms embedded into the ROM. The MAXQ3180 performs not just energy accumulation, but also a host of functions for power analysis, advanced reporting, and much more.
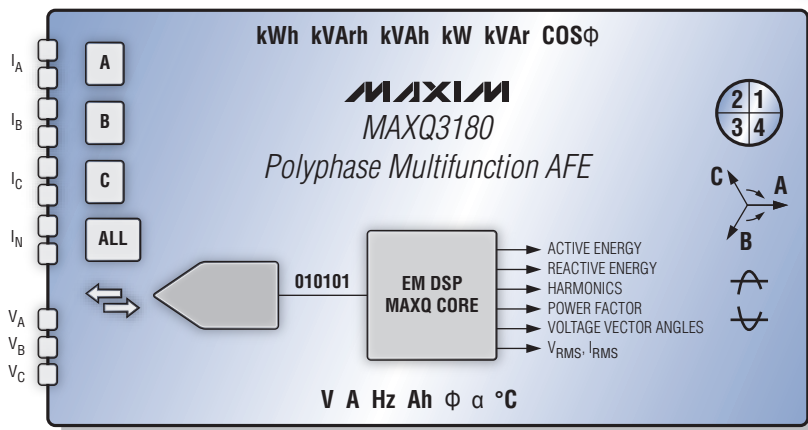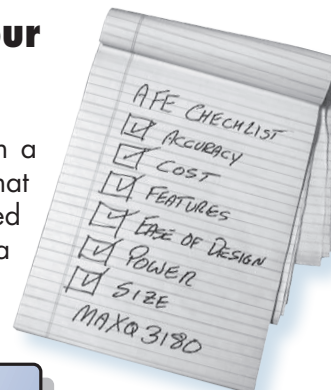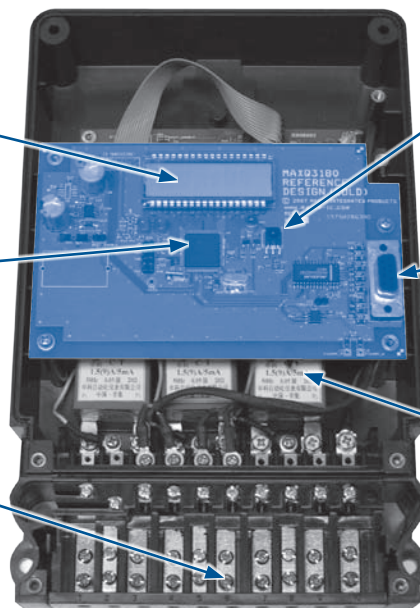

MAXQ3180 reference design

Alphanumeric LCD for display of many meter characteristics

MAXQ2000 supervisory MCU with JTAG programming and debug

Three voltage and current-phase inputs, plus connections for meter pulses and EIA-485 communication

Infrared communication for contactless reading and configuration

RS-232 for reading and configuration during bench test and calibration

Transformer-based current sensing provides better than class 0.5 accuracy (0.5% over the operating range)

Innovative chipset solution reduces BOM in polyphase energy meters

Keeps phases isolated without bulky, expensive current transformers

A major concern when designing a three-phase metering solution is keeping the phases isolated from one another and from external connections. This problem is solved with the MAXQ3108 dual-core metering µC and its companion ADC, the DS8102 dual Σ-Δ modulator with Manchester-encoded output. Using these devices, isolation can be provided by inexpensive capacitors rather than bulky current transformers without compromising accuracy or design flexibility.
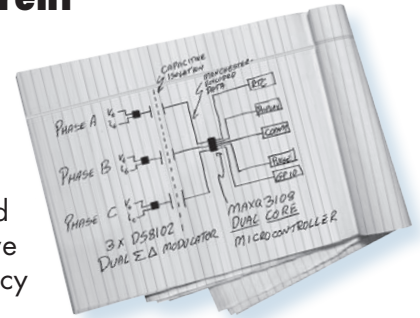
Dual-core, 16-bit RISC µC

User core
- **64KB flash program memory**
- **2KB data SRAM**
- **16B battery-backed (V_{BAT}) data SRAM**
- **Digitally trimmable RTC**
- **SPI, I^{2}C, and dual USART ports**
- **Hardware multiplier, three Manchester decoders, and three cubic-sinc filters**
- **10MHz FLL with 32kHz input**

DSP core
- **8KB user-loadable SRAM code memory**
- **1KB data SRAM**
- **Hardware multiplier**

Dual Σ-Δ modulator plus Manchester encoder

- **Two 2nd-order Σ-Δ modulators**
- **Programmable gain to 32x**
- **Internal 8MHz oscillator**
- **Internal reference**
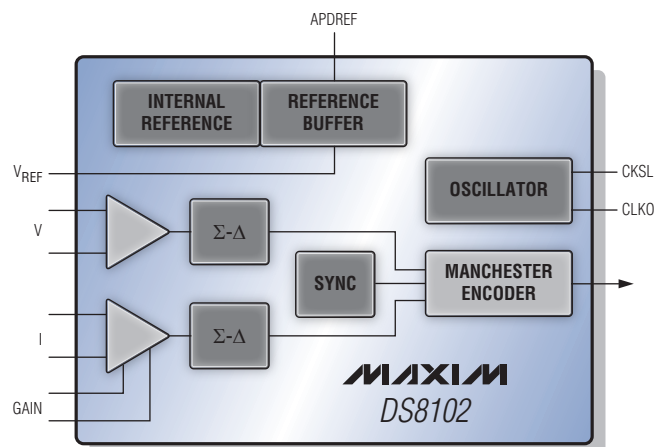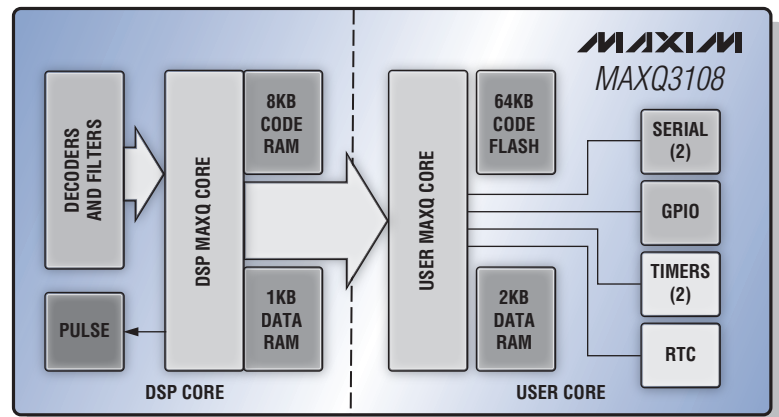
Source code and schematics available

Design files for the MAXQ3108/DS8102 reference design meter are available. These files include schematics, bills of material, and complete source code written in C. In addition, our support team can help you integrate the MAXQ3108 and DS8102 into your own design. Contact your sales representative for more details.
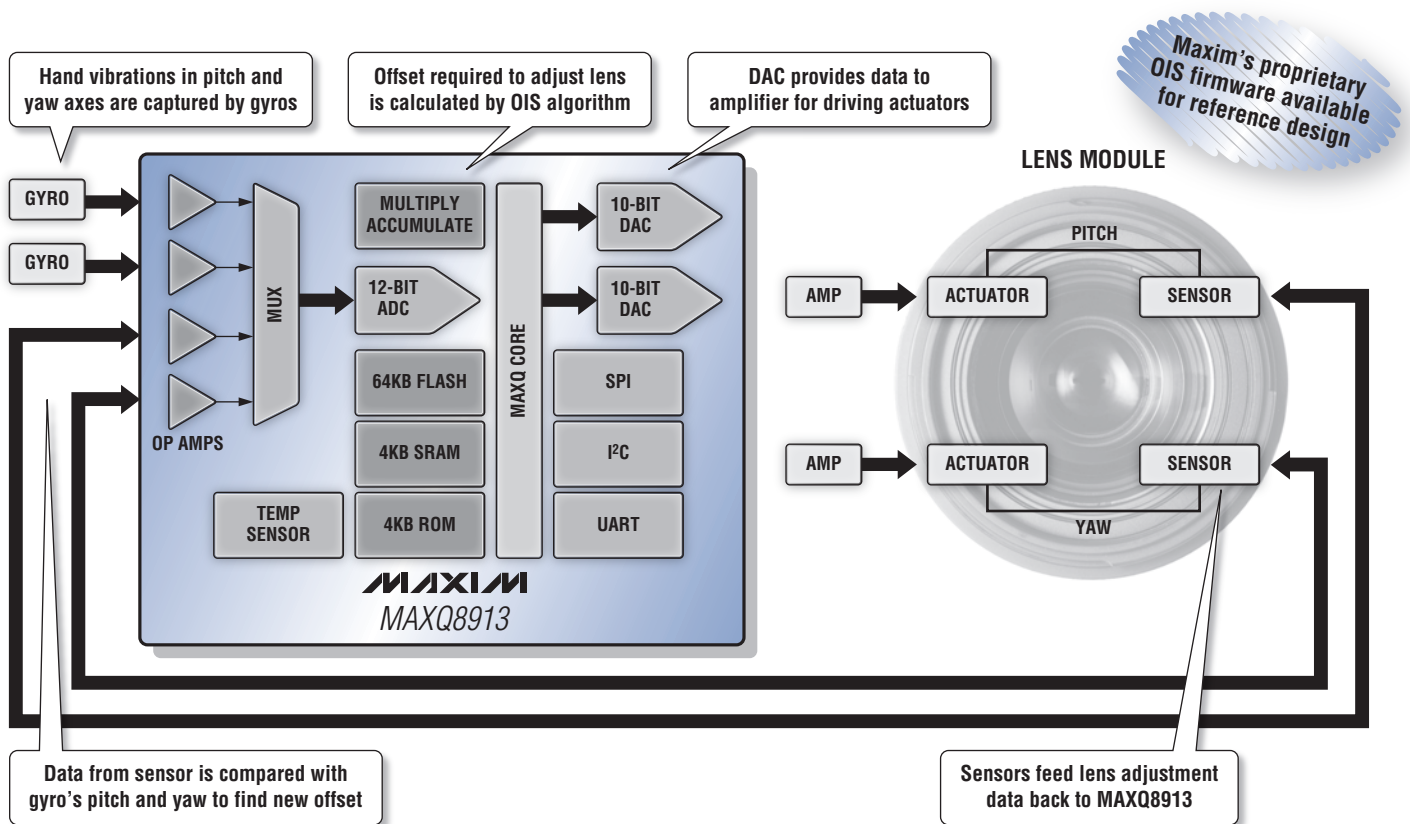
MAXIM

The seamless integration of analog peripherals with the 16-bit, single-cycle MAXQ RISC core and various digital peripherals makes our mixed-signal µCs' performance-to-power characteristics the industry's best among 16-bit µCs.

Give your customers a steady hand

16-bit µC has optical image stabilization to self-correct for higher image quality

The MAXQ8913 provides a complete dual-axis optical image stabilization (OIS) solution for digital and cell-phone cameras. This µC integrates data converters, operational amplifiers, and various communications ports, making it ideal for all-in-one servo loop control by supporting both voice-coil and stepper-motor applications.

Maxim's proprietary OIS firmware available for reference design

Hand vibrations in pitch and yaw axes are captured by gyros

Offset required to adjust lens is calculated by OIS algorithm

DAC provides data to amplifier for driving actuators

LENS MODULE

GYRO · GYRO · OP AMPS · MUX · 12-BIT ADC · MULTIPLY ACCUMULATE · 10-BIT DAC · 10-BIT DAC · MAXQ CORE · 64KB FLASH · 4KB SRAM · 4KB ROM · TEMP SENSOR · SPI · I²C · UART

MAXIM
MAXQ8913

PITCH · AMP · ACTUATOR · SENSOR · YAW · AMP · ACTUATOR · SENSOR

Data from sensor is compared with gyro's pitch and yaw to find new offset

Sensors feed lens adjustment data back to MAXQ8913

- **200nA (typ) stop-mode current**
- **Space-saving, 2.94mm x 4.2mm, 58-bump WLP package**

| Part	Program Memory	ROM (KB)	RAM (KB)	8-/16-Bit Timers	Features	Speed (MHz)	I/Os	Supply Voltage (V)	Package
MAXQ8913	Flash	64	4	1	10-bit SAR with 7 inputs, 2 x 10-bit DACs, 2 x 8-bit DACs, 4 op amps, temp sensor, 2 current sinks, 1.5V reference, 16 x 16 multiplier, USART, SPI, I²C, WDT	10	12	2.7 to 3.6	58-WLP
MAXQ2010	Flash	64	2	3	160-segment LCD display, 12-bit SAR with 8 single-ended or 4 differential inputs, FLL, supply monitor, 16 x 16 multiplier, 32-bit RTC, 2 USARTs, I²C, SPI, WDT	10	55	2.7 to 3.6	100-LQFP

MAXIM

Microcontroller-based sensor interfaces

The continuing demands to enhance automotive safety and improve fuel economy are driving the need for increased electronics content. This, in turn, is increasing the number of µCs and sensors required to meet these demands. Maxim enables automotive electronics suppliers to meet the demands for collision detection and drive-by-wire steering by integrating the analog electronics with the µC, thus providing an intelligent interface to the sensor.

Revolutionary integration enables small sensor conditioners

Integrated µC and high-performance analog circuitry reduce footprint by up to 80%, decrease cost, improve signal integrity, and accelerate sensor development

The MAXQ7666/MAXQ7670 are complete, integrated solutions for processing small-amplitude analog-input signals, such as those from anisotropic magnetoresistive (AMR) or other sensors producing small, sensor-output signals. Applications include automotive steering-angle and torque sensors, CAN-based automotive and industrial sensors, and industrial control.
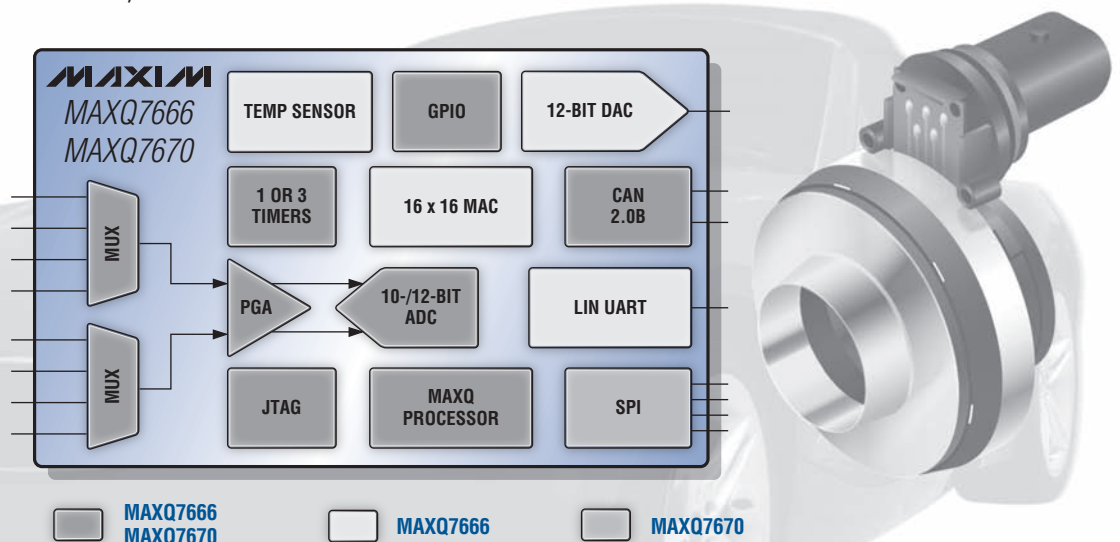
Features

- **Up to 8 single-ended or 4 differential ADC channels with on-chip input multiplexer**
- **High-precision PGA**
- **Fast, 16-bit MAXQ µC with 16 x 16 MAC**
- **Flexible CAN 2.0B, LIN/UART, and SPI interfaces**

Benefits

- **Reduce BOM cost by 30% to 40%**
- **Allow efficient, on-chip numerical computation**
- **Include a variety of interfaces for automotive and industrial use**

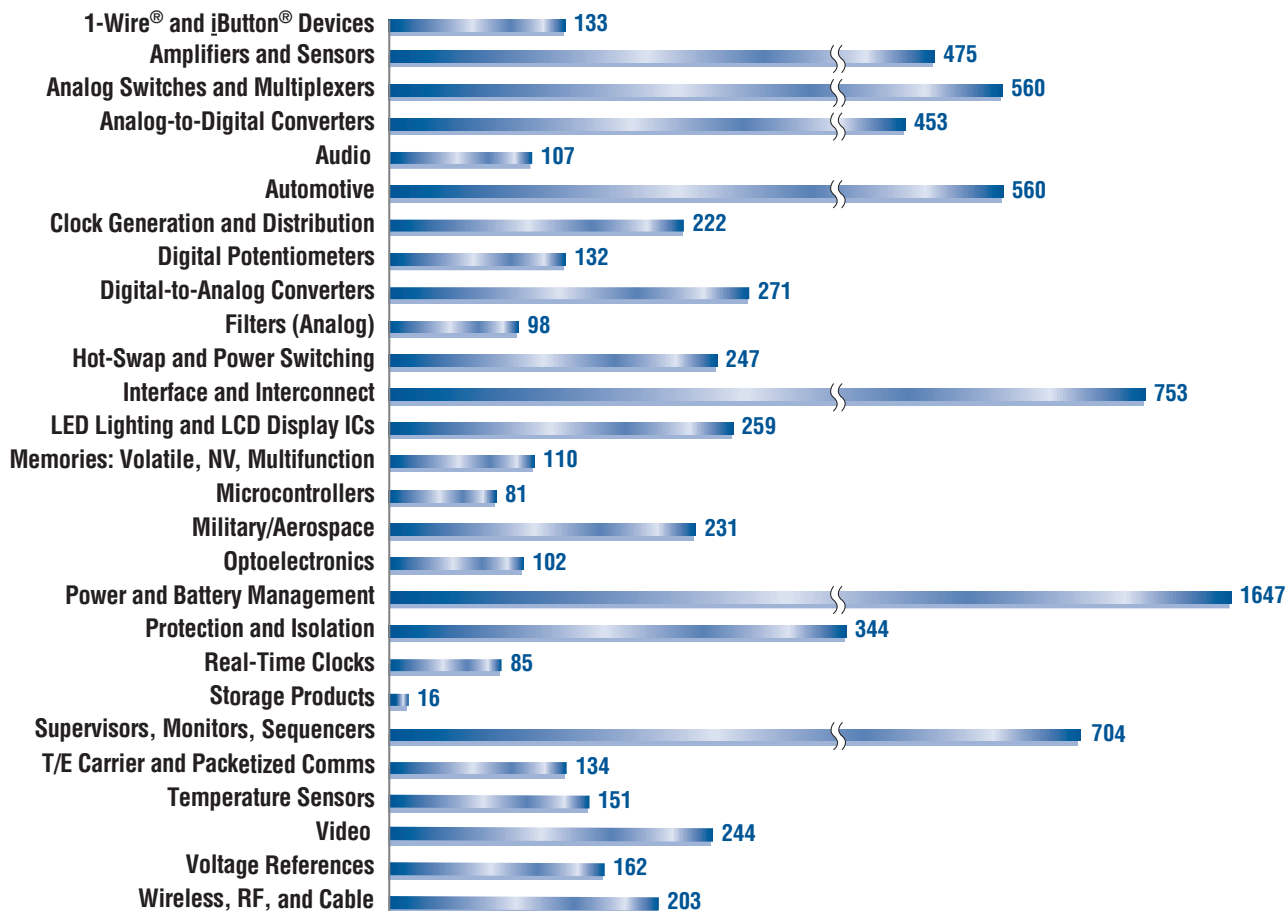| Part	Flash Size (KB)	Temp Range (°C)	Small Package (mm x mm)
MAXQ7666BATM+*	16 (8k x 16)	-40 to +125	48 TQFN-EP (7 x 7)
MAXQ7670ATL+	64 (32k x 16)		40 TQFN-EP (6 x 6)

*Contact factory for availability.

/W/IXI/W

11

Yes, we make that...

Maxim has one of the broadest and deepest analog and mixed-signal portfolios, with over 6000 ICs in 28 categories. We average more than one product introduction per day! For over 25 years, we have delivered innovative engineering solutions that add value to our customers' products.

Over 6000 ICs in 28 Product Categories

Category	Count
1-Wire® and iButton® Devices	133
Amplifiers and Sensors	475
Analog Switches and Multiplexers	560
Analog-to-Digital Converters	453
Audio	107
Automotive	560
Clock Generation and Distribution	222
Digital Potentiometers	132
Digital-to-Analog Converters	271
Filters (Analog)	98
Hot-Swap and Power Switching	247
Interface and Interconnect	753
LED Lighting and LCD Display ICs	259
Memories: Volatile, NV, Multifunction	110
Microcontrollers	81
Military/Aerospace	231
Optoelectronics	102
Power and Battery Management	1647
Protection and Isolation	344
Real-Time Clocks	85
Storage Products	16
Supervisors, Monitors, Sequencers	704
T/E Carrier and Packetized Comms	134
Temperature Sensors	151
Video	244
Voltage References	162
Wireless, RF, and Cable	203

www.maxim-ic.com/yes

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INNOVATION DELIVERED™