Engineers’ Guide to Ultra Low-Power Systems

The Right Ultra-Low-Power MCU for Your IoT Design

Q&A on Ultra-Low-Power-Design

www.eecatalog.com/lps
eXtreme Low Power MCUs Extend Battery Life

Low Sleep Currents with Flexible Wake-up Sources
- Sleep current down to 9 nA
- Brown-Out Reset down to 45 nA
- Real-Time Clock down to 400 nA

Low Dynamic Currents
- As low as 30 μA/MHz
- Power-efficient execution

Large Portfolio of XLP MCUs
- 8–100 pins, 4–128 KB Flash
- Wide selection of packages, including chip scale packages

Battery-Friendly Features
- Enable battery lifetime > 20 years
- Operate down to 1.8V with self write and analog functions
- Low-power supervisors for safe operation (BOR, WDT)

Flexible Peripheral Set
- Integrated USB, LCD, RTC and touch sensing
- Eliminates costly external components

www.microchip.com/xlp
Introducing Zilog’s Z8 Encore! XP F6482 Series of Flash Microcontrollers!

Based on Zilog’s advanced 8-bit eZ8 CPU core, these MCUs support 1.8 V to 3.6 V low-voltage operation with extremely low Active, Halt, and Stop Mode currents

**FEATURES:**
- 24MHz eZ8 CPU core
- 16KB, 32KB, 60KB or 64KB Flash memory
- 2KB or 3.75KB internal RAM
- Two Enhanced Serial Peripheral Interface (SPI) controllers
- I²C controller which supports Master/Slave modes
- Watchdog Timer (WDT)
- 32-, 44-, 64-, and 80-pin packages
- -40°C to +85°C (extended) operating temperature range
- And many more!

**APPLICATIONS:**
- Battery Powered Sensors
- Wired/Wireless Keypads
- PIR Motion Detection
- Lighting Control
- Safety and Security
- Utility Metering
- Digital Power Supervisory
- Hand Held Electronics
- Wireless Controller
- LCD Keypads

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Visit the Zilog website for additional parts included in this Series.

**Z8F6482 Series Block Diagram**

**The F6482 Series Development Kit** is a complete development solution containing the following tools:
- F6482 Series Development Board
- USB SmartCable (for connecting the PC to the F6482 Series Development Board)
- USB A to Mini B cable
- RS-232 interface module

For more information about the F6482 Series, or to download product collateral and software, please visit www.zilog.com.
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Tips for Selecting the Right Ultra-Low-Power, ARM-Based MCU for Your IoT Design

Despite appearances, not all MCUs based on ARM architecture offer the same level of energy efficiency and performance, so it’s important to ask the right questions and make the best choice for your power-sensitive Internet of Things (IoT) application.

By Alf Syvertsen, Silicon Labs

The variety of ultra-low-power 32-bit microcontroller unit (MCU) options has never been higher. Many MCU vendor portfolios include hundreds of variants based on package options, memory size, performance and peripheral set. Although it may seem like the emergence of ARM Cortex-M based MCUs is at the heart of this vast choice, in reality there has always been a wide field of low-power 32-bit options from which to choose.

In the past, support for any given instruction set was just one (albeit an important) element in the selection process, but thanks to ARM the relevance of the instruction set may have become largely moot. The ecosystem surrounding Cortex-M cores means engineers can justifiably standardize on just one architecture. But this still leaves many features to compare, especially when seeking a low-power MCU. For today’s power-sensitive IoT applications, this puts the focus squarely on a short list of parameters that can still be measured against requirements. Let’s examine eight of the most important MCU features that need to be considered.

ACTIVE POWER

As with all integrated devices manufactured using CMOS technology, MCUs only consume power when their logic gates are changing state. The number of CMOS gates in a modern MCU means power consumption can become significant, particularly at high clock rates.

Most MCUs will strive to reach a balance between active power consumption and processing performance. Even when the same core lies at the heart of the device, this parameter can vary significantly based on the design expertise of the MCU vendor. While many MCU vendors have focused on reducing active power in recent years, low-power MCU designs that emphasize autonomous low-energy peripheral operation (without direct CPU involvement) are also quite effective in minimizing overall system power consumption.

PERFORMANCE

Reported MCU performance is directly related to active power. It’s important to understand performance metrics, particularly when consulting a data sheet, as the specs are often reported under “ideal” (or more aptly unsustainable) operating conditions or even when running unusable code. Delivering both high performance and low active power is difficult and, again, an area where MCU vendors can differentiate their product offerings. Carefully compare data sheet performance specs and question the MCU vendor about the real-world operating conditions underlying the results.

RESPONSIVENESS

One way of keeping active power low is to reduce the operating frequency, which inevitably and quite naturally leads to sleep modes. Any MCU can be put into a mode where it consumes the least amount of active and static power, but invariably this is achieved through clock- and power-gating, i.e., removing the
clock and/or power to specific areas of the MCU. The penalty for employing this technique without due consideration to the requirements of the target application can result in an MCU that is slow to resume its duties when needed. Fast wake-up from deep sleep modes is a fiercely contested parameter among MCU vendors.

ENERGY EFFICIENCY
If reduced responsiveness is the penalty for using sleep modes, the benefit is lower energy consumption. Here, the trend is—and has been for some time—to implement a range of sleep modes that offer the right level of efficiency for the right operating condition. Sleep modes that offer reduced power consumption and fast wake-up should complement deep sleep modes that reduce power consumption to an absolute minimum—even at the cost of longer wake-up times—when required by the application. The combination of ultra-low-power active and sleep modes and very fast wake-up time defines an MCU’s energy efficiency. (See Figure 1.)

PERIPHERALS
A recent development in MCU design has been to implement greater intelligence in the peripheral subsystems, allowing various peripherals to operate autonomously. In addition to bringing a new dimension to application development, the overriding benefit of autonomous peripherals is that they allow the core to remain in a (deep) sleep mode much longer. Instead of having to periodically emerge from a deep, power-saving sleep mode to check for an event, autonomous peripherals are able to register an event and decide whether it requires the intervention of the core. If your application demands excellent energy efficiency, be sure to choose an MCU with an architecture that supports autonomous peripheral operation even in the lower sleep modes.

INTELLIGENCE
Autonomy doesn’t need to end with a single event; some MCUs now implement systems that allow multiple peripherals to interoperate and thus parse more complex conditions or a series of interdependent events before waking the CPU core. This feature is far less widely supported by MCU vendors but can deliver significant benefits in specific applications, typically those that are battery-powered and are required to detect infrequent events or conditions, such as environmental changes (humidity, smoke and CO2) or intrusion.

INTERFACES
A few vendors offer MCUs with the ability to interface directly and intelligently to a wider range of signals. MCUs are inherently digital but often feature a high level of mixed-signal capability, such as integrating analog-to-digital and/or digital-to-analog converter(s). However, as the world we live in remains analog by nature, it is becoming increasingly necessary to offer greater support for analog signals, particularly those that emanate from sensors. While most advanced IoT applications use sensors with digital interfaces, some sensors will still remain analog either because of current consumption (analog is generally lower power) or because of...
budget (analog sensors tend to be more cost-effective than digital sensors). The ability to interface directly to small capacitive, inductive or resistive sensors and intelligently parse the signals before waking the CPU will undoubtedly become a common use-case for IoT-oriented designs.

SOFTWARE
Although, as mentioned earlier, the ARM Cortex family enjoys a strong and growing ecosystem of software providers, end-applications still need dedicated application code. Software development is now recognized as the single largest consumer of engineering resources, and so when selecting the right MCU it’s important to consider the level of software support and quality of tools available from both the ecosystem and the MCU vendor. It is still imperative that the MCU vendor offers robust, user-friendly software development tools. Even if a preferred partner supplies the IDE, elements of support will be required for specific differentiating features. Look for MCU vendors that provide comprehensive development ecosystems designed to simplify the design process, as well as energy profiling and battery estimator tools that enable low-energy system optimizations.

BENCHMARKING ULTRA-LOW-POWER MCUS
Comparing and selecting ultra-low-power MCUs based on claimed current consumption specifications can be challenging. In most cases, developers initially look at the first page of an MCU vendor datasheet to glean various operating specs. This approach works well to determine the overall functionality of a device but is not as useful when trying to gauge low-power characteristics in real-world applications. To get a full view of ultra-low-power operation, developers must take into consideration active and sleep mode current consumption, state retention, wake-up time, wake-up sources and low-energy peripherals that are capable of operating while in low-power mode.

Many MCU vendors usually list the lowest power achievable on the first page of the datasheet. Although the device may be capable of achieving this specification, the actual operating mode may not be practical and useful in a real-world application. Some of the non-advertised features of the lowest power mode may include a very slow wake time, no state or RAM retention, brown-out detector (BOD) turned off or a reduced operating voltage range.

Today’s developers need a consistent, reliable way to measure the true low-power capabilities of an MCU to be used in power-sensitive IoT applications. To address this need, the Embedded Microprocessor Benchmark Consortium (EEMBC) has collaborated with leading MCU vendors to create a new ultra-low power benchmark called ULPBench. Released in September 2014, the initial version of ULPBench focuses on CPU core and RTC behaviors for 8-, 16- and 32-bit MCUs in a blend of active and low-power conditions. (See Figure 2 for example screen of ULPBench EnergyMonitor.)

While still in its infancy, the initial release of EEMBC’s ULPBench is welcome news for the embedded industry as it provides developers with the first benchmarking tool that enables them to assess MCU energy efficiency based on objective criteria. Future versions of ULPBench will additionally focus on a common set of peripherals to provide a more comprehensive system-level view of energy efficiency. The next generation of ULPBench will support more real-world low-energy use cases, enabling developers to use the benchmarking tool to distinguish ultra-low-power MCUs with autonomous peripherals from the not-so-low-power MCU options of the world.

Alf Petter Syvertsen is a product manager for Silicon Labs’ 32-bit EFM32 Gecko MCU portfolio. He joined Silicon Labs in 2013 following the acquisition of Energy Micro, where he had worked since 2010. While working as a digital designer at Energy Micro and now Silicon Labs, Mr. Syvertsen brought several EFM32 devices to tape-out including Wonder Gecko, Leopard Gecko, Zero Gecko and now Happy Gecko. He has a thorough understanding of the requirements for low-power MCUs, ranging from circuit design and transistor placement to marketing requirements. Mr. Syvertsen holds a master’s of science degree in nanotechnology from the Norwegian University of Science and Technology (NTNU).
Optimizing and Simplifying the Process: Q&A with a Systems/IC Architect on Ultra-Low-Power-Design

What will it take for ultra-low-power designs to become more prevalent—that’s one of the questions fielded here (think commitment to sub-threshold design) but far from the only one.

By Anne Fisher, Managing Editor

Our thanks to Andy Kelly, Systems/IC Architect, Cactus Semiconductor, Inc., for his insights and observations on topics including accomplishing device miniaturization, prioritizing requirements and top-down design and simulation tools, among other subjects.

EECatalog: In what areas are you finding designers struggling most as they strive to optimize and simplify the design process, particularly when working on ultra-low power designs?

Andy Kelly, Cactus Semiconductor: The biggest challenge I see with our full-custom IC design projects is on the requirements definition—more so than in the design execution. Since our devices are fully customized, customers often start off under the assumption that they can have the highest performance AND the lowest power consumption AND the smallest circuit area. In practice, these requirements all need to be prioritized, and compromises must be made in order to reach a set of requirements that can be met on a reasonable budget and schedule.

EECatalog: What is being done within the semiconductor industry in general to address the challenges named in Question (1) and what role more specifically is Cactus playing?

Andy Kelly, Cactus Semiconductor: The industry as a whole has made great progress in the development of “top-down” design and simulation tools. These tools allow the system and IC design teams to build up a virtual circuit based on behavioral models. These models can be integrated into higher-level system simulations. Then tradeoffs can be modeled and assessed with significantly less effort than with detailed circuit design. Once the behavioral modeling is complete and the requirements are finalized, the detailed circuit design can proceed with significantly better efficiency. At Cactus Semiconductor, we recognize the requirements definition as the key to success, and we include a “Definition & Specification” phase at the beginning of every project to ensure we have a good set of requirements before starting the detailed design phase.

EECatalog: What’s the argument for considering a custom ASIC design for a design that requires device miniaturization? What myths, or misconceptions, if any, have you had to dispel in making this argument?

Kelly, Cactus Semiconductor: There are two primary arguments in favor of custom IC design over standard product design. The first is that the custom design can integrate multiple functions in a single IC. This eliminates the packaging and IO overhead of numerous components, devices, and interconnects. It results in an ASIC footprint that can be an order of magnitude smaller than the footprint of the standard products it replaces. The second argument is that custom IC design enables us to design very specifically to the required function and performance. In contrast, standard product designs use a collection of devices and components meant for general purpose, and thus typically result in a sub-optimal design that inevitably consumes more power than an ASIC equivalent. In the case of implantable or hand-held devices, the system’s battery is typically the single largest component in the system. As such, a full-custom IC design can often lead to huge reductions in device size due to battery size reduction. The biggest myth we have to dispel on a fairly regular basis is the idea that once you commit to a full-custom design, you should strive to maximize integration. While this approach logically makes sense, in practice, it is very uncommon for the maximized integration approach to lead to the best overall solution. At Cactus Semiconductor, we strive for “smart integration” in favor of “maximum integration.”

EECatalog: Could you define in more detail what is meant by “smart integration”?

Kelly, Cactus Semiconductor: “Smart Integration” involves a systematic definition of all system requirements, followed by an assessment of optional paths to meeting each requirement. Finally, a tradeoff of each path is covered that includes; electrical performance, power consumption,
device size, development cost and schedule, component cost, reliability and others. When all of these factors are weighed for each system requirement, we often conclude that a mix of custom ICs and standard products will result in the optimal solution. This is what we refer to as “smart integration.” A common example of smart integration comprises a system partition that includes a standard microcontroller along with a full-custom ASIC. While the microcontroller functions could be integrated if necessary, we have found that the performance, power, size, and cost of some newer microcontroller parts make them extremely attractive, and difficult to justify full integration.

**EECatalog:** Can the principles of smart integration apply across a number of areas where ultra-low-power and high performance design is needed, e.g., medical, gaming, digital signage, industrial control and automation?

**Kelly, Cactus Semiconductor:** In my opinion, the principles of smart integration can apply to any discipline or market. The end results will vary greatly due to the different system requirements, but smart integration is a process, not a result—and that process can and should be used for any project.

**EECatalog:** What, if anything, are you seeing as problems or challenges that are not getting their fair share of attention in the area of ultra-low-power design?

**Kelly, Cactus Semiconductor:** For ultra-low-power designs, we often need to apply design techniques whereby the MOS devices in a circuit are operated in their sub-threshold region. Since this is not the operating state of devices for mainstream and traditional designs, the device modeling and circuit library availability is lacking. I have recently seen progress in this area, but for most process technologies, committing to a completely sub-threshold design typically involves some extra development effort and risk. This translates into higher development cost and longer development schedules. If the models and circuit libraries supporting sub-threshold operation were to reach the level that standard operation has achieved, I think we would see a much greater emphasis on this design approach, and ultra-low-power designs would be more prevalent.

Anne Fisher is managing editor of EECatalog.com. Her experience has included opportunities to cover a wide range of embedded solutions in the PICMG ecosystem as well as other technologies. Anne enjoys bringing embedded designers and developers solutions to technology challenges as described by their peers as well as insight and analysis from industry leaders. She can be reached at afisher@extensionmedia.com
EMAC Inc

Industrial Temperature SoM-3354

Made in the USA the SoM-3354 is an industrial strength 1 GHz ARM System on Module. Based on the TI AM3354 ARM Cortex-A8 processor it offers 4GB of eMMC Flash (16GB eMMC optional), 16MB of Serial NOR Data Flash, and 512MB of DDR3 RAM and additional Flash provision provided by a SD/MMC Flash Card interface. Using EMAC’s 200-pin SODIMM form factor (67mm x 60mm) the SoM-3354 has a 16 bit TFT LCD controller and 4-wire analog resistive touch controller. The SoM-3354 has 10/100 Base T Ethernet with oscillator shutdown and interrupt for the on-board PHY, 4x serial ports (1 with full handshake), 1x CAN2.0B controller, 2x USB 2.0 high speed host ports, 1x USB 2.0 high speed OTG (Host or Device), 2x SPI with 4 slave selects, synchronous I2S analog audio interface port and 12C hardware port. The SoM-3354 requires a +3.3V source voltage and has on-board core/memory regulators, an industrial temperature range (-40C to +85C), on module status LED, internal real time clock with a battery backed provision, 4x 12-bit A/D inputs, and 2x timer/counters/PWM. The recommended off the shelf carrier board is the SoM-200ES, which is pin compatible with other 200-pin EMAC modules. EMAC provides a QT based development environment which allows easy compiling, linking, downloading, and debugging from one easy to use high level interface. EMAC provides EMAC OE Linux installed on the SoM-3354 with hardware purchase (Android coming). Pricing for Quantity (1) of the SoM-3354 is $160 USD.

For more information please visit our website at: http://www.emacinc.com/products/system_on_module/SoM-3354

FEATURES & BENEFITS

◆ Industrial Temperature -40C to +85C
◆ Small 200-Pin SODIMM form factor (67mm x 60mm)
◆ Access to the Processor Bus
◆ System Reset, Real Time Clock
◆ Timers/Counters, PWM controller

TECHNICAL SPECS

◆ Texas Instruments TI AM3354 Cortex-A8 1 GHz processor
◆ Up to 16GB of eMMC Flash, 16MB Serial NOR Flash, 512MB of DDR3 RAM
◆ 100 BaseT Ethernet, 4x Serial Ports, A/D, SPI, GPIO, PWM, I2C, I2S, & CAN
◆ LCD and Resistive Touch Interfaces
◆ 3x High Speed USB Ports & SDIO Port

APPLICATION AREAS

Industrial IOT, Industrial Automation, Industrial Control, Data Acquisition, Test & Measurement, Instrumentation, Energy & Utilities, Transportation & Harbor, Intelligent Systems

AVAILABILITY

Now

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Microchip Technology Inc.
nanoWatt XLP eXtreme Low Power PIC® MCUs

As more electronic applications require low power or battery power, energy conservation becomes paramount. Today’s applications must consume little power, and in extreme cases, last for up to 20 years, while running from a single battery. To enable applications like these, products with Microchip’s nanoWatt XLP Technology offer the industry’s lowest currents for Run and Sleep, where extreme low power applications spend 90%-99% of their time. Many of today’s low power products need advanced peripherals. Microchip offers low power devices with peripherals like USB, LCD, RTCC and mTouch™ capacitive sensing. This eliminates the need for additional parts in the application, saving cost, current and complexity. Products with nanoWatt XLP have system supervisory circuits specially designed for battery powered products.

FEATURES & BENEFITS

◆ Battery Friendly Features:
  ◆ Enable battery lifetime > 20 years
  ◆ Operates down to 1.8V with self write and analog functions
  ◆ Low-power supervisors for safe operation (BOR, WDT)
  ◆ The Deep Sleep Brown-out Reset protects applications when batteries are depleted or changed, yet consumes a tiny 45 nA of current.
  ◆ The Real-time Clock Calendar is a fully independent module that is unaffected by device resets.

TECHNICAL SPECS

◆ Low Sleep Currents with Flexible Wake-up Sources:
  ◆ Sleep current down to 9 nA
  ◆ Brown-out Reset down to 45 nA
  ◆ Real Time Clock down to 400 nA

◆ Low Dynamic Currents:
  ◆ As low as 30 μA/MHz
  ◆ Power efficient execution

APPLICATION AREAS

◆ Green Initiatives: Compliance with Regulations, Appliances, Home Electronics

AVAILABILITY

Over 160 XLP PIC MCUs are available now. The XLP products are supported by the XLP 16-bit Development Board (DM240311) and the XLP 8-bit Development Board (DM240313). Download the free XLP Battery Life Estimator to optimize the battery life in your next low power design. Visit www.microchip.com/XLP to learn more.

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XLP 8-bit & 16-bit Development Boards for Extremely Low Power Designs

The XLP 8-bit & 16-bit Development Boards are designed with eXtreme Low Power in mind. Designed as true platforms for low power development, they enable designs with sleep currents as low as 9 nA. Both boards are suitable for prototyping many low power applications including RF sensors, data loggers, temperature sensors, electronic door locks, metering sensors, remote controls, security sensors, smart cards and energy harvesting. The PICtail™ interface supports many of Microchip’s daughter cards for easy evaluation of your next low power application. These low cost boards are the ideal complement to the MPLAB® PICkit™ 3 or MPLAB ICD 3 debugger and programmer realizing a fully-featured, economical, PIC24, PIC18 or PIC16 development environment.

**XLP 8-BIT DEVELOPMENT BOARD FEATURES:**

- PIC18F87K22 (128 KB Flash, 80-pin PIM) installed
- Supports other PIC16LF1947 (28 KB Flash, 64-pin PIM) Separate/Un-programmed
- Current measurement terminals allow device or board level current measurements
- Expansion connector accessing full device pinout and breadboard prototype area
- Convenient connections for MPLAB PICkit 3, ICD 3 or REAL ICE™ in-circuit emulator for in-circuit programming and debugging USB interface for power and PC communication
- 24AA256 Low Power (100 nA Sleep, 1.7V VDD) SPI serial-EEPROM
- Potentiometer (connected to 10-bit A/D, analog input channel)
- Analog output temperature sensor and CTMU based diode temperature sensor
- LEDs for indication
- Power Options: AAA, CR2032, Energy Harvesting, USB, External, or 9V power supply

**XLP 16-BIT DEVELOPMENT BOARD FEATURES**

- PIC24F16KA102 (16 KB Flash, 28-pins, XLP Device with 20 nA Deep Sleep current)
- Supports other PIC24F devices in 20 or 28-pins
- Current measurement terminals allow device or board level current measurements (optional XLP Current Measurement Cable available)
- PICtail™ daughter board connector for connection to expansion boards such as RF, SD/MMC Cards, Speech Playback and more
- mTouch™ capacitive sensing buttons for user input

**AVAILABILITY**

The XLP 8-bit & 16-bit Development boards are available now through Microchip Direct or any of Microchip’s worldwide distribution partners.

- XLP 8-bit Development Board (DM240313)
- XLP 16-bit Development Board (DM240311)

To learn more about these XLP Development Boards visit www.microchip.com/xlp
Microchip Technology Inc.

PIC24 Microcontroller with eXtreme Low Power and Integrated Crypto Engine

The PIC24F “GB2” family integrates a fully featured hardware crypto engine, which includes support for AES, DES and 3DES. It is highly configurable, including options for 128-, 196- or 256-bit AES encryption and decryption. By implementing these features in hardware (instead of software), CPU overhead and processing bandwidth are reduced. The Random Number Generator (RNG) is used to generate keys for data encryption/decryption and authentication. The One-Time-Programmable (OTP) memory includes 512 bits for secure key storage. The power specifications for the “GB2” family are as low as 18 nA in sleep mode and 180 μA/MHz in run mode, which is ideal for battery-powered applications. Users can obtain secure data storage and transfer without sacrificing power consumption, due to the XLP low-power specifications, which lead to longer battery life in portable applications.

FEATURES & BENEFITS

- Crypto engine is a Core Independent Peripheral – offload the CPU for lower power consumption and reduced software overhead
- Enables integrity of data without sacrificing power consumption
- eXtreme Low Power Features - 18 nA Sleep, 180 μA/MHz Run
- VBAT allows the device to transition to a backup battery
- Easy connection to USB or certified modules for Wi-Fi®, ZigBee®, Sub-GHz and Bluetooth® Low Energy

TECHNICAL SPECS

- PIC24F family integrates a crypto engine for secure data transfer and storage
- AES engine with 128, 192 or 256-bit key for encryption, decryption and authentication
- DES/Triple DES (TDES) engine for encryption, decryption and authentication
- True Random Number Generator (RNG) - to create unique keys for data encryption/decryption and authentication
- One-time-programmable (OTP) memory includes 512 bits for secure key storage - protects the encryption key from being read or overwritten by software, preventing keys from being stolen or hacked

APPLICATION AREAS

With both low power and data security, the “GB2” family can be used in a wide variety of industrial, computer and medical fitness applications. Examples include secure door locks and access- control systems, whether they operate via keypad, magnetic card or wireless connection. Other applications include security cameras and POS terminals, both of which require a high level of data protection. Also, many Internet of Things (IoT) sensor-node applications can benefit from the low power and data protection, when monitoring things such as pressure, temperature, light or humidity. Typical applications include security door locks and cameras, access control systems, POS terminals, smart card readers, heat/gas meters, IoT sensor nodes, PC peripherals, printers, portable accessories, pedimeters and other wearable/handheld devices.

AVAILABILITY

All devices are available now:

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www.microchip.com
Zilog’s S3 8-Bit Microcontroller Family

Fast and Efficient Processing, Flash Memory, a Wide Range of Integrated Peripherals, and Efficient Register-Oriented Architectures

APPLIICATIONS:
- Induction Heating Cookers
- Small Kitchen/Home Appliances
- Boilers
- Rice Cookers
- Pressure Cookers
- Induction Heaters
- Air Conditioners
- Washing Machines
- Dryer Controller
- Oven Controller
- Vending Machines
- IR Remote Controls with LCD
- Fan Control
- Smoke Detectors
- Cordless Tools & Battery Chargers
- PIR Motion Detectors
- Ambient Light Sensors
- Humidity Detectors
- LED Lighting Control
- System Board Management

FEATURES:
- SAM8 & SAM88 Z8-Compatible CPU Cores
- Flash Memory: 4, 8, 16, and 32 KB
- RAM: 208, 272, 1040, 2086 bytes
- CISC Instructions: 41, 78
- Interrupts: 4, 17, 26
- And many more!

S3 8-BIT MICROCONTROLLER FAMILY
- S3F80P5
- S3F80P9
- S3F80PB
- S3F82NB
- S3F848B
- S3F8515
- S3F94C8

For more information about our S3 Product Family, please visit www.zilog.com/S3

S3F848B Block Diagram

Go With The Best In Motor Control!

Zilog Motor Control Solutions

- Wide range of microcontrollers for your Motor Control applications
- Highly-optimized instruction set that achieves higher performance per clock cycle, with less code space and lower overhead than competing architectures
- World-class development environment for ease of implementation

BLD Universal and Brushed DC Motor Control
- Z8 Encore! F083A Series (28-Pin)

Stepper Motor Control
- Z8 Encore! XP F1680 Series (28-Pin)

3-Phase/Single-Phase AC Induction and PMSM Motor Control
- Permanent Magnet Synchronous Motors 216FMC Series Motor Control
- 2BFMC16100 Series Motor Control

The Right Choice for Your Motor Control Needs

For more information, please visit www.zilog.com/FlashMC