PSoC® PROGRAMMABLE SYSTEM-ON-CHIP
For embedded systems designers, the imperative is unrelenting: increase functionality, reduce board size and chip count, adapt to ever-changing design requirements—and still beat the competition to market. Unfortunately, traditional discrete analog and digital components and fixed-function microcontrollers (MCUs) limit the ability of designers to achieve these goals.

Cypress® PSOC programmable system-on-chip combine dynamic, configurable analog and digital blocks and an 8-bit MCU on a single chip, replacing multiple discrete components while delivering the advanced flexibility and functionality designers need to meet aggressive schedules. Together with PSOC development tools and kits, they form the industry’s most complete solution for embedded systems.
MASTER MIXED-SIGNAL COMPLEXITY

Developing mixed-signal embedded designs with fixed-function solutions requires coding, part swapping, debugging, and—most of all—time and resources.

PSOC devices let designers create mixed-signal solutions in minutes—with no coding required—because mixed-signal functionality is built into the architecture. Configurable analog and digital blocks that implement a wide variety of discrete components, including ADCs, DACs, PGAs, and filters, provide a versatile foundation for mixed-signal development. What’s more, you can reconfigure the blocks at will—including at run-time—to accommodate changing design requirements.

ACCELERATE EMBEDDED DEVELOPMENT

PSOC solutions help you get to market fast. Unmatched programmability enables designers to quickly add, subtract, and modify analog and digital functionality, shrinking time-to-market by weeks or months. Moreover, a single PSOC device replaces a wide variety of discrete components—from amplifiers and ADCs to UARTs and USB 2.0 controllers—dramatically reducing board size, chip count, and BOM cost while improving manufacturability.

JOIN THE MOST SUCCESSFUL BRANDS IN THE WORLD

Adidas®, Cisco®, Continental, Haier, Hitachi, HP, Lenovo™, LG Electronics, Nintendo®, Pentax®, and Pioneer are just a few of the leading global brands accelerating their embedded systems development with the PSOC programmable system-on-chip. To date, more than 8,000 active customers have benefited from Cypress’s unique, time-saving, efficient approach.

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THE PSoC VALUE PROPOSITION

Only PSoC devices give designers the flexibility, programmability, and integration they need to adapt to changing demands and get to market faster.

CHANGE HAPPENS

Design requirements change quickly and frequently. PSoC devices’ configurable analog and digital blocks can be quickly modified, letting designers:

- Adapt to changing feature requirements
- Meet aggressive development deadlines
- Make products that satisfy market demands
- Tune/adjust designs during debug/system bring-up

MORE WITH LESS THROUGH INTEGRATION

One PSoC programmable system-on-chip integrates an MCU with as many as 100 peripheral functions, so designers can:

- Lower costs through BOM integration
- Maximize functionality
- Reduce chip counts and streamline manufacturability
- Improve power efficiency

ROBUST ANALOG FUNCTIONALITY

Developing embedded digital systems with advanced analog sensing, monitoring, and control capabilities is easy thanks to configurable analog blocks and the powerful PSoC visual embedded system design environment that includes a broad portfolio of pre-configured and characterized mixed-signal user modules for:

- Capacitive sensing
- Voltage monitoring
- Environment sensing
- Fan/motor control

Turn to page 10 to see how the PSoC visual design environment works.

In one example (shown at right), PSoC technology enabled a leading communications customer to integrate FSK detection for caller ID, DTMF generation, sinusoid ringtone generation and telephone line voltage monitoring. This reduced the product’s BOM from 12 ICs to 3. What’s more, the entire product became almost 50% smaller and easier to manufacture.
BUILDING SYSTEM VALUE

SAVE MONEY ON DEVELOPMENT AND MANUFACTURING

- Reduce R&D costs and cycle time with technology that doesn’t force you to lock in design specifications up front.
- Eliminate or reduce debugging, C and assembly coding, with pre-characterized, pre-verified modules.
- Reuse designs across platforms.
- Cut manufacturing, assembly, and test costs by shrinking PCBs.

MAKE MORE MONEY, FASTER

- Get to market fast with feature-rich products that sell at a premium. For example, PSoC-based CapSense touch-sensing devices.
- Get to market first, capturing higher-margin early-adopters and selling more units over time.

PROTECT YOUR INVESTMENT AND YOUR ASSETS

- Future proof your products with field-upgradable PSoC technology, reducing costly, troublesome service calls.
- Create competitive barriers to entry with scalable designs.
- Protect your IP by making your designs harder to reverse-engineer.

The more innovative the design, the more likely it is to be copied. Unlike discrete components, or fixed-function peripherals, PSoC devices integrate and conceal key analog and digital components within a single chip. Thus, they are harder to reverse-engineer and make copying prohibitively expensive.

WITH PSoC TECHNOLOGY, YOU CAN:

- INTEGRATE BOM
- REDUCE R&D COSTS
- CUT MANUFACTURING COSTS
- REDUCE RETURNS USING FIELD PROGRAMMABILITY
- LOWER INVENTORY COSTS
- AVOID NRE
- INCREASE SELLING PRICE
- INCREASE SALES VOLUME
- REDUCE TIME-TO-MARKET
- EXTEND PRODUCT LIFETIME
- PROTECT INTELLIGENT PROPERTY

"Horizon Hobby’s Blade CX2 helicopter is the first ready-to-fly RC aircraft with beginner-friendly flight stability and the freedom to fly anywhere, anytime without ever having to worry about interference. The demand for this product is being driven by its innovative features, which would not be possible without the programmability, flexibility, and performance of Cypress’s CyFi Low-Power RF Solution." — Chris Huhn, Category Manager, Horizon Hobby

PSoC technology helps you cut costs, improve your profitability, and protect your assets in 11 critical ways.
THE TECHNOLOGY BEHIND THE PSoC PROGRAMMABLE SYSTEM-ON-CHIP

PSoC ARCHITECTURE OVERVIEW

The Core, Configurable Analog and Digital Blocks, and the Programmable Routing and Interconnect. Configurable blocks are at the heart of PSoC’s flexibility. PSoC devices include up to 16 digital and 12 analog blocks, depending on the model.

THE CORE
A built-in MCU with flash memory and SRAM link to essential system resources:
- Sleep and watchdog timers
- Multiple clock sources that include a PLL
- Internal main and low-speed oscillator
- External crystal oscillator for precision, programmable clocking

PSoC devices can have up to two multiply accumulates (MACs), which provide fast 8-bit multipliers or fast 8-bit multipliers with 32-bit accumulate, up to two decimators for digital signal processing applications, I2C functionality for implementing either I2C slave or master, and availability of a full-speed USB interface.

CONFIGURABLE ANALOG AND DIGITAL BLOCKS
Using configurable analog and digital blocks, designers can create and quickly change advanced mixed-signal embedded applications. The digital blocks are 8-bit resources that designers can configure using pre-built digital functions or, by combining blocks, turn into 16-, 24-, or even 32-bit resources. The analog blocks are composed of an op-amp circuit, allowing complex analog signal flows.

For a partial list of pre-configured modules that include PSoC software, see the sidebar at right. Designers can modify and personalize each module to any design.
HOW MANY DISCRETE COMPONENTS CAN PSoC PROGRAMMABLE SYSTEM-ON-CHIP REPLACE?

The PSoC programmable system-on-chip can perform hundreds of pre-configured and characterized functions. Designers can use them to quickly and easily build advanced mixed-signal solutions, including:

ANALOG MODULES
- ADCs
  - Incremental 6-14 bits
  - Delta Sigma 6-13 bits
- DACs
  - 6-, 8-, and 9-bit
  - 6- and 8-bit Multiplying
- Filters
  - 2-pole Low-pass
  - 2-pole Band-pass
- Modulators
  - Pseudo-random Source (PRS)
  - Cyclic Redundancy Check (CRC)
- Communications Interfaces
  - I2C Master, Slave, and Multi-Master
  - SPI Master and Slave
  - Tx, Rx, and Full-duplex UART
  - Full-speed USB 2.0
  - CyFi Low-Power RF Star Network Protocol

DIGITAL MODULES
- Timers
  - 8-, 16-, 24-, and 32-bit
- Counters
  - 8-, 16-, 24-, and 32-bit
- Pulse-Width Modulators
  - 8-, 16-, 24-, and 32-bit
  - 8- and 16-bit Dead Band Generators
- Pseudo-random Source (PRS)
- Cyclic Redundancy Check (CRC)
- Communications Interfaces
  - I2C Master, Slave, and Multi-Master
  - SPI Master and Slave
  - Tx, Rx, and Full-duplex UART
  - Full-speed USB 2.0
  - CyFi Low-Power RF Star Network Protocol

PROGRAMMABLE ROUTING & INTERCONNECT

The PSoC programmable system-on-chip frees designers to route any signal to any pin, shedding the constraints of a fixed peripheral controller. In addition, global buses allow for signal multiplexing and for performing logic operations, eliminating the need for a complicated digital-logic gate design. Instead, designers can quickly configure a design at the functional level, increasing ease-of-use and reducing costs by obviating detailed digital design, as well as costly and time-consuming PCB redesigns.

Together, those three sections define the heart of the PSoC solution as an extensible platform for the future.

TOUCH-SENSING TECHNOLOGY

Today’s hottest electronic products feature touch-sensitive controls. Cypress’s TrueTouch™ touchscreen and CapSense™ touch-sensing solutions combine the ease of PSoC programmability with the durability and beauty of interfaces such as touch screens, linear sliders, radial sliders and proximity sensing. Their resistance to water, extreme temperatures, and humidity makes them ideal for applications such as cell phones, consumer electronics, automobiles, PCs, white goods, and industrial products.

To learn more about how Cypress’s touch-sensing devices can give products a competitive edge in the marketplace, go to cypress.com/CapSense and cypress.com/TrueTouch.

WIRELESS PSoC TECHNOLOGY

Cypress’s CyFi™ Low-Power RF is a reliable, simple and power-efficient wireless sense and control PSoC technology that operates in the unlicensed 2.4 GHz ISM band. The solution is made up of a PSoC device, CyFi Transceiver and a CyFi Network Protocol Stack. This solution combines ultimate reliability with Direct Sequence Spread Spectrum (DSSS) technology and 80 channels for flexibility; implementation simplicity with a drag-and-drop network protocol user module, and best-in-class power-efficiency. To learn more, please visit cypress.com/CyFi.
CODE OR NO CODE? THE CHOICE IS YOURS

The PSoC embedded design tool, PSoC Designer, offers two compelling environments to design your system: A revolutionary drag-and-drop visual system design environment (called the “System Level View”) or a more traditional development environment (called the “Chip Level View”) that lets designers add their own C or Assembly language code. Both environments, independently or in a hybrid approach, enable rapid development of advanced embedded solutions, rich in analog features, powered by PSoC devices.

PSOC DESIGNER™ SYSTEM-LEVEL VIEW

The following example, a temperature-control application, illustrates how quickly designers, with no code required, can develop embedded solutions with the PSoC Designer system-level view.

1. SELECT COMPONENTS
Drag-and-drop the desired inputs and outputs from a library of pre-configured and characterized real world “drivers” (e.g. sensors, actuators, LEDs, etc.).

2. CONFIGURE COMPONENTS
Access driver’s datasheet and visually setup parameters.

3. ORGANIZE AND CONNECT COMPONENTS
Customize the control of your input and output drivers by creating transfer functions (e.g. truth tables, state machines, etc.).

4. GENERATE, VERIFY AND DEBUG
Using a built-in simulation tool, verify your design prior to programming. Then, after programming, use real-time monitoring to confirm correct function of your design.

PSOC SOFTWARE EASY-TO-USE, FAST, FLEXIBLE
PSoC DESIGNER™ CHIP-LEVEL VIEW—A MORE FLEXIBLE WAY TO WRITE CODE

The PSoC Designer chip-level view combines drag-and-drop convenience with the ability to add sophisticated C or Assembly language code on-the-fly.

1. SELECT COMPONENTS
   Choose from a library of pre-configured and characterized analog and digital user modules.

2. CONFIGURE COMPONENTS
   Setup your global and user module parameters and input/output settings at anytime enabling speedy design changes.

3. ORGANIZE AND CONNECT COMPONENTS
   Easily route global inputs and outputs to any pin via a visual programmable interconnect.

4. GENERATE, VERIFY AND DEBUG
   Program in C or Assembly using user module’s APIs and ISRs. Test with tool’s debugger and in-circuit emulator.
PSOC KITS PROVIDE EVERYTHING YOU NEED TO GET YOUR IDEAS INTO PRODUCTION

STARTER KITS

PSOC
PSOC + Wireless

JUMPSTART DEVELOPMENT WITH OUR EMBEDDED DESIGN STARTER KITS—THE CY3270 PSOC FirstTouch™ OR CY3271 PSOC FirstTouch™ WITH CYFI LOW-POWER RF
Whether you’re interested in capacitive sensing, light sensing, wireless, or a combination of mixed-signal application, these FirstTouch kits are optimized for quick evaluation featuring the most sense and control options than any other starter kit in the market—all in a USB-thumbdrive form factor. Visit cypress.com/FirstTouch to learn more.

EVALUATION KITS

THE CY3209-EXPRESS EVALUATION KIT
The most feature-rich PSOC evaluation kit helps evaluate up to four PSOC programmable system-on-chip in an PC network along with CapSense, USB, voltage-monitoring, and Cypress’s proprietary 2.4GHZ Wireless technology.

THE CY3210-PSOC EVAL1 KIT
The most inexpensive PSOC evaluation kit enables evaluation and prototyping with one PSOC programmable system-on-chip. It features an LCD module, a potentiometer, and a breadboard. The kit also includes a MiniProg programming unit to program PSOC devices directly on the evaluation board or on other boards via a 5-pin header.

THE CY3214-PSOC EVAL USB EVALUATION KIT
Explore and evaluate the CapSensePLUS capabilities of PSOC. Because of the unique PSOC-C architecture, designers are able to implement CapSense functionality while integrating multiple control functions (e.g., LED drivers and LCD displays).

THE CY3280-BK1 UNIVERSAL CAPSENSE DEVELOPMENT KIT
Designed for easy prototyping and debugging of CapSense designs with real-time sensor monitoring and tuning. Includes two controller boards—one for CSA and one for CSD—along with a breadboard and a button/slider module.

THE CY3210-CYFI LOW-POWER RF DEVELOPMENT KIT
This full-featured development kit enables you to prototype and debug your complete wireless application based on PSOC devices, CYFI protocol stacks and CYFI transceivers. The kit comes with two baseboards, two PSOC evaluation pods, and three CYFI RF modules as well as helpful tutorials and demos.

For further information on Cypress’s PSoC tools, additional kits, application notes and support, visit cypress.com/PSoC.

DEVELOPMENT KITS

DEVELOPMENT KITS

THE CY3207-ISP IN-SYSTEM SERIAL PROGRAMMER (ISSP) KIT
Designed in robust packaging to handle production environments and to offer enhanced protection circuitry. The CY3207ISSP programs parts in-system or in the socket and can be integrated into a manufacturing system for automation.

THE CY3215-DK IN-CIRCUIT EMULATOR (ICE) DEBUGGING KIT
This complete development solution for PSOC devices features an In-Circuit Emulator (ICE) driven by the Debugger in the PSOC Development Software. The software interface of the debugger allows you to run, halt, and single-step the processor within the ICE.

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INTRODUCTION TO MIXED-SIGNAL, EMBEDDED DESIGN BY DR. ALEX DOBOLI AND DR. EDWARD CURRIE
This textbook addresses the basics of mixed-signal design, including fundamental embedded architectures and top-down design and optimization techniques for system development. Order your copy at cypress.com/buyonline.