PSOC 3, PSOC 5, & PSOC Creator

Cypress's Programmable System-on-Chip

Your Problem Solver-on-Chip
Agenda

What is PSoC?
PSoC 3 & PSoC 5 Overview
PSoC Building Blocks
PSoC End-Equipment Solutions
Getting Started with PSoC
PSoc is the world’s only *programmable embedded SoC* integrating configurable analog and digital peripheral functions, memory and a microcontroller on a single chip.
Powered by Revolutionary PSoC Creator

Design the way you think
- Schematic-based design
- Libraries of peripheral functions
- Intuitive configuration wizards

Concurrent H/W & S/W design
- Place & configure H/W peripherals
- Write application S/W with standard C-based compilers
- Easy-to-use peripheral APIs

Innovate in your space
- Easily create, share, and reuse your own customized IP
PSoC Value: Integration

Industry leading precision analog

Powerful programmable logic-based digital system

Integrate analog & digital peripherals with rich library of configurable components

Wide range of communication peripherals

High performance and full-featured CPU subsystems
PSoC Value: Programmable Analog

Highly configurable analog blocks providing ultimate design flexibility

Flexible analog routing enables user-defined Signal Chains

Seamless integration with CPU and programmable logic

Simple configuration & routing through PSoC Creator
PSoC Value: Flexibility

Change is the only constant—adapt quickly and easily with PSoC

Design the way you think with schematic-based capture tools

Easily retarget between PSoC devices—no redesign, just build

Auto and optimized internal signal routing powered by PSoC Software

Any analog and digital function to any GPIO pin
Explosive PSoC Growth

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Freescale</td>
<td>Microchip</td>
<td>Microchip</td>
<td>Microchip</td>
</tr>
<tr>
<td>2</td>
<td>Renesas</td>
<td>Freescale</td>
<td>Freescale</td>
<td>NEC</td>
</tr>
<tr>
<td>3</td>
<td>Microchip</td>
<td>Renesas</td>
<td>NEC</td>
<td>ST Micro</td>
</tr>
<tr>
<td>4</td>
<td>NEC</td>
<td>NEC</td>
<td>Renesas</td>
<td>Freescale</td>
</tr>
<tr>
<td>5</td>
<td>ST Micro</td>
<td>ST Micro</td>
<td>ST Micro</td>
<td>Atmel</td>
</tr>
<tr>
<td>6</td>
<td>Atmel</td>
<td>Atmel</td>
<td>Atmel</td>
<td>Renesas</td>
</tr>
<tr>
<td>7</td>
<td>Toshiba</td>
<td>Toshiba</td>
<td>NXP</td>
<td>NXP</td>
</tr>
<tr>
<td>8</td>
<td>Philips</td>
<td>NXP</td>
<td>Toshiba</td>
<td>Sony</td>
</tr>
<tr>
<td>9</td>
<td>Fujitsu</td>
<td>Sony</td>
<td>Fujitsu</td>
<td>Fujitsu</td>
</tr>
<tr>
<td>10</td>
<td>Panasonic</td>
<td>Panasonic</td>
<td>Sony</td>
<td>Panasonic</td>
</tr>
<tr>
<td>11</td>
<td>Samsung</td>
<td>Samsung</td>
<td>Panasonic</td>
<td>Toshiba</td>
</tr>
<tr>
<td>12</td>
<td>Sanyo</td>
<td>Sanyo</td>
<td>Cypress</td>
<td>Cypress</td>
</tr>
<tr>
<td>13</td>
<td>Sony</td>
<td>Philips</td>
<td>Cypress</td>
<td>Cypress</td>
</tr>
<tr>
<td>14</td>
<td>Infineon</td>
<td>Holtek</td>
<td>Silicon Labs</td>
<td>Samsung</td>
</tr>
<tr>
<td>15</td>
<td>Sunplus</td>
<td>Micronas</td>
<td>Sanyo</td>
<td>Datang</td>
</tr>
<tr>
<td>16</td>
<td>Micronas</td>
<td>Sanyo</td>
<td>Infineon</td>
<td>Silicon Labs</td>
</tr>
<tr>
<td>17</td>
<td>Zilog</td>
<td>Infineon</td>
<td>Micronas</td>
<td>Holtek</td>
</tr>
<tr>
<td>18</td>
<td>Novatek</td>
<td>Zilog</td>
<td>Cypress</td>
<td>Cypress</td>
</tr>
<tr>
<td>19</td>
<td>Holtek</td>
<td>Winbond</td>
<td>Winbond</td>
<td>Winbond</td>
</tr>
<tr>
<td>20</td>
<td>National Semi</td>
<td>National Semi</td>
<td>Holtek</td>
<td>Denso</td>
</tr>
<tr>
<td>21</td>
<td>Intel</td>
<td>Silicon Labs</td>
<td>Elan</td>
<td>EM Micro</td>
</tr>
<tr>
<td>22</td>
<td>Winbond</td>
<td>Novatek</td>
<td>Novatek</td>
<td>Zilog</td>
</tr>
<tr>
<td>23</td>
<td>TI</td>
<td>Denso</td>
<td>Denso</td>
<td>Seiko Epson</td>
</tr>
<tr>
<td>24</td>
<td>EM Micro</td>
<td>National Semi</td>
<td>National Semi</td>
<td>Rohm</td>
</tr>
<tr>
<td>25</td>
<td>Elan</td>
<td>EM Micro</td>
<td>EM Micro</td>
<td>Sonix</td>
</tr>
<tr>
<td>26</td>
<td>Maxim</td>
<td>Sonix</td>
<td>Sonix</td>
<td>Micronas</td>
</tr>
<tr>
<td>27</td>
<td>Rohm</td>
<td>Maxim</td>
<td>Maxim</td>
<td>Maxim</td>
</tr>
<tr>
<td>28</td>
<td>Silicon Labs</td>
<td>Intel</td>
<td>Intel</td>
<td>National Semi</td>
</tr>
<tr>
<td>29</td>
<td>Magnachip</td>
<td>Maxim</td>
<td>Sunplus</td>
<td>Sunplus</td>
</tr>
<tr>
<td>30</td>
<td></td>
<td>Rohm</td>
<td>Rohm</td>
<td>Hangzhou Silan</td>
</tr>
</tbody>
</table>

Source: Gartner Dataquest Semiconductor Industry Worldwide Annual Market Share Database, March 2010

Over ¾ Billion PSoCs Sold!
# PSoC Is Everywhere

<table>
<thead>
<tr>
<th>HANDHELD DEVICES</th>
<th>APPLIANCES</th>
<th>INDUSTRIAL</th>
<th>ENTERTAINMENT/ DISPLAYS</th>
<th>SECURITY/ MONITORING</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Handheld Devices" /></td>
<td><img src="image2" alt="Appliances" /></td>
<td><img src="image3" alt="Industrial" /></td>
<td><img src="image4" alt="Entertainment" /></td>
<td><img src="image5" alt="Security" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TOYS/GAMING</th>
<th>DIGITAL PHOTOGRAPHY</th>
<th>SPORTS/ FITNESS</th>
<th>COMPUTERS</th>
<th>PRESENTER TOOLS</th>
<th>HOME THEATER</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image6" alt="Toys/Gaming" /></td>
<td><img src="image7" alt="Digital Photography" /></td>
<td><img src="image8" alt="Sports/Fitness" /></td>
<td><img src="image9" alt="Computers" /></td>
<td><img src="image10" alt="Presenter Tools" /></td>
<td><img src="image11" alt="Home Theater" /></td>
</tr>
</tbody>
</table>
Cypress PSoC Portfolio

PSoC 3 & PSoC 5 architectures extend the world’s only programmable embedded-system design platform, delivering unmatched integration, flexibility and time-to-market.
# Cypress PSoC Portfolio – At a Glance

<table>
<thead>
<tr>
<th>Feature</th>
<th>PSoC 1</th>
<th>PSoC 3</th>
<th>PSoC 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>CORE</td>
<td>8-bit M8C 4 MIPS</td>
<td>8-bit 8051 33 MIPS</td>
<td>ARM Cortex-M3 100 DMIPS</td>
</tr>
<tr>
<td>FLASH</td>
<td>4 KB – 32 KB</td>
<td>16 KB – 64 KB</td>
<td>32 KB – 256 KB</td>
</tr>
<tr>
<td>SRAM</td>
<td>256B – 2 KB</td>
<td>2 KB – 8 KB</td>
<td>16 KB – 64 KB</td>
</tr>
<tr>
<td>EEPROM</td>
<td>–</td>
<td>512B – 2 KB</td>
<td>512B – 2 KB</td>
</tr>
<tr>
<td>POWER</td>
<td>Active: 2mA Sleep: 3μA</td>
<td>Active: 1.2mA Sleep: 1μA Hibernate: 200nA</td>
<td>Active: 2mA Sleep: 2μA Hibernate: 300nA</td>
</tr>
<tr>
<td>ADC</td>
<td>6- to 14-bit ΔΣ</td>
<td>12- to 20-bit ΔΣ</td>
<td>12- to 20-bit ΔΣ 2x 12-bit SAR (1 Msps)</td>
</tr>
<tr>
<td>DAC</td>
<td>6- to 8-bit</td>
<td>8- to 12-bit</td>
<td>8- to 12-bit</td>
</tr>
<tr>
<td>VOLTAGE REFERENCE</td>
<td>± 1.53% Vref Accuracy</td>
<td>± 0.1% Vref Accuracy</td>
<td>± 0.1% Vref Accuracy</td>
</tr>
<tr>
<td>DIGITAL BLOCKS</td>
<td>Up to 16 Digital Blocks</td>
<td>Up to 24 UDBs PLD-based</td>
<td>Up to 24 UDBs PLD-based</td>
</tr>
<tr>
<td>CONNECTIVITY</td>
<td>UART, I2C, SPI, USB</td>
<td>UART, I2C, SPI, USB, CAN, LIN, I2S</td>
<td>UART, I2C, SPI, USB, CAN, LIN, I2S</td>
</tr>
<tr>
<td>I/Os</td>
<td>Up to 64</td>
<td>Up to 72</td>
<td>Up to 72</td>
</tr>
</tbody>
</table>
PSoC 3 & PSoc 5: Platform Architecture
High-Performance CPU Subsystem

High-Performance Cores
- ARM® Cortex™-M3 (80 MHz / 100 DMIPS)
- 8051 (67 MHz / 33 MIPS)

Off-load CPU w/ 24-Channel DMA

On-Chip Debug / Trace (on all devices)
- JTAG, SWD, SWV Debug

Dedicated CAN, FS USB 2.0, I2C
Precision Programmable Analog

Best-in-class precision analog
- 12- to 20-bit Delta-Sigma ADC
- 1.024V Vref with ±0.1% accuracy

Programmable Signal Chain
- Programmable analog blocks
- Flexible analog routing
- CPU & programmable logic integration
- DSP-like digital filter capability
- 2 separate filter channels
- 4 cascaded filters per channel

Integrate discrete analog devices with rich library of pre-built, characterized components
Powerful, Flexible Digital Logic

Powerful programmable logic-based digital system

**UDB = Universal Digital Blocks**
- Structural Logic (Data-path)
- Uncommitted Logic (PLD)
- Flexible interconnect

Rich library of pre-built, characterized components

Build custom digital peripherals & logic functions

Flexible routing allows any GPIO to digital I/O
Programmable Routing / Interconnect

Any pin to any peripheral/function
Auto or customizable I/O routing
Up to 4 independent voltage domains
PSoC 3 Device Families

**Performance Analog**
- **CY8C38xxx**
  - Enhanced 8051, 67 MHz
  - 32KB – 64KB Flash, 20-24 UDBs
  - 1x20-bit $\Sigma\Delta$ ADC, DFB
  - 4x DAC, 4x OpAmps, 4x Analog Blocks, 4x CMPs

**Performance Analog**
- **CY8C36xxx**
  - Enhanced 8051, 67 MHz
  - 32KB – 64KB Flash, 20-24 UDBs
  - 1x12-bit $\Sigma\Delta$ ADC, DFB
  - 4x DAC, 4x OpAmps, 4x Analog Blocks, 4x CMPs

**Analog Lite**
- **CY8C34xxx**
  - Enhanced 8051, 48 MHz
  - 16KB – 64KB Flash, 16-24
  - 1x12-bit $\Sigma\Delta$ ADC
  - 2x DAC, 2x OpAmps, 2x Analog Blocks, 4x CMPs

**Programmable Digital**
- **CY8C32xxx**
  - Enhanced 8051, 48 MHz
  - 16KB – 64KB Flash, 16-24 UDBs
  - 1x12-bit $\Sigma\Delta$ ADC
  - 1x DAC, 2x CMPs
PSoC 5: Convergence of ARM + PSoC

Revolutionizing the 8-bit uC market was just a warm up

ARM Cortex
The Fastest Growing
32-bit Embedded Core

Cyress PSoC
The Fastest Growing
Embedded Controller

- Revolutionary ARM-based Programmable System-on-Chip
- World’s first ARM solution with programmable precision analog
- Unmatched flexibility with programmable logic based digital
- Game changing PSoC Creator Software Design Environment
PSoC 5 Device Families

- **Cy8C52xxx**
  - ARM Cortex-M3, 40 MHz
  - 32KB – 256KB Flash, 20-24 UDBs
  - 1x12-bit SAR ADC
  - 1x DAC, 2x CMPs

- **Cy8C53xxx**
  - ARM Cortex-M3, 80 MHz
  - 32KB – 256KB Flash, 20-24
  - 1x12-bit SAR ADC
  - 2x DAC, 2x OpAmps, 2x Analog Blocks, 4x CMPs

- **Cy8C54xxx**
  - ARM Cortex-M3, 80 MHz
  - 32KB – 256KB Flash, 20-24 UDBs
  - 2x12-bit SAR ADC, DFB
  - 4x DAC, 4x OpAmps, 4x Analog Blocks, 4x CMPs

- **Cy8C55xxx**
  - ARM Cortex-M3, 80 MHz
  - 32KB – 256KB Flash, 20-24 UDBs
  - 1x20-bit ΔΣ ADC, 2x12-bit SAR ADC, DFB
  - 4x DAC, 4x OpAmps, 4x Analog Blocks, 4x CMPs

*Some Cy8C55xxx parts only have 1x12-bit SAR ADC*
PSoC Creator Design Flow

**Design** the on-chip peripherals you need, instead of settling for a part that has most of what you need and a lot of what you don’t

**Develop** with standard C-based compilers and Cypress-provided peripheral APIs for maximum portability

**Debug** with all the features of a modern cross-debugger to view status of internal on-chip components

**Reuse** unique portions of a design across multiple designs by building your own components
PSOC Creator Walkthrough
PSoC Building Blocks
PSoC 3 & PSoC 5 Building Blocks

Programmable Signal Chain
Precision Analog
Programmable Digital
Low Power
Connectivity
User Interface
Best-in-Class Precision Analog Integration – measure uVolts!
- 12- to 20-bit resolution Delta-Sigma ADCs with up to 192 ksps rates
- 1.024V internal voltage reference with ±0.1% initial accuracy
- Precision analog capability across entire voltage (0.5V – 5.5V)

Unique PSoC Programmable Signal Chain
- Unmatched Analog Integration
- Flexible Analog Routing
- Programmable Analog Blocks
- Integration with CPU + Programmable Logic

Revolutionary PSoC Creator Software
- Easy-to-use schematic design entry
- User intuitive configuration GUIs
- Simple APIs for software integration
Integrated 20-bit Delta-Sigma ADC

- Configurable resolution 8-bits to 20-bits
- Configurable sample rates up to 375Ksps
- Single & differential input modes
- Up to 62 channels
- Offset less than +/- 100uV
- INL / DNL less than 1 LSB
- Gain Error less than +/- 0.2%

Easy Configuration in PSoC Creator

Significant BOM savings through integration

<table>
<thead>
<tr>
<th></th>
<th>PSoC 3 or 5</th>
<th>TI ADS1230</th>
<th>PSoC</th>
<th>AD73360</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>20-bit</td>
<td>20-bit</td>
<td>16-bit</td>
<td>16-bit</td>
</tr>
<tr>
<td>Sampling Rate</td>
<td>180 sps</td>
<td>80sp</td>
<td>48Ksp</td>
<td>64Ksp</td>
</tr>
<tr>
<td>SNR</td>
<td>110dB</td>
<td>110dB</td>
<td>90dB</td>
<td>77dB</td>
</tr>
<tr>
<td>Pricing</td>
<td>~$2.50</td>
<td>~$1.80</td>
<td>~$1.80</td>
<td>~$1.80</td>
</tr>
</tbody>
</table>
## Unmatched Analog Integration

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost per Item</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 4x Comparators (~LM338)</td>
<td>~$0.08</td>
<td>~$0.32</td>
</tr>
<tr>
<td>±2mV Input Offset, 75ns response time, Max 32mV Hysteresis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 4x OpAmps (~LMV712)</td>
<td>~$0.28</td>
<td>~$1.12</td>
</tr>
<tr>
<td>0.5mV Input Offset, 6MHz Bandwidth, 25 mA drive capability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 4x VDACs / IDACs (~DAC084)</td>
<td>~$0.35</td>
<td>~$1.40</td>
</tr>
<tr>
<td>1Msps VDAC or 8Msps IDAC, Adjustable output in 255 steps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precision Voltage Reference (~LT1790B)</td>
<td>~$1.00</td>
<td>~$1.00</td>
</tr>
<tr>
<td>1.024V internal reference with ±0.1% initial accuracy (@ 25°C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog Mux (~12X CD4051)</td>
<td>~$0.08</td>
<td>~$0.96</td>
</tr>
<tr>
<td>Up to 62 inputs; routing from any pin to all analog components</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 4x Prog. Analog Blocks (No Equivalent)</td>
<td>~$0.35</td>
<td>~$1.40</td>
</tr>
<tr>
<td>Configurable to PGA, TIA, Mixer, and Sample &amp; Hold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 2x 12-bit SAR ADCs (~TI ADS1250)</td>
<td>~$0.80</td>
<td>~$1.60</td>
</tr>
<tr>
<td>Up to 1Msps with INL / DNL less than 1 LSB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital Filter Block (~TI ADS1250)</td>
<td>~$0.50</td>
<td>~$0.50</td>
</tr>
<tr>
<td>24-bit filter co-processor; up to 4 HW IIR &amp; FIR filters</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

> $10.00 of Integration
Modern method of signal acquisition, signal processing, and control with high accuracy, high bandwidth, and high flexibility.

- Highly configurable analog blocks providing flexibility throughout the design
- System solutions enabled by programmable analog blocks & flexible analog routing
- Further flexibility provided by integrated CPU and programmable logic (UDBs)
- BOM Integration: cost, IP protection, board size, power, ease-of-design
- PSoC Creator enables easy component configuration & routing
Programmable Signal Chain Examples

Example #1: Frequency Modulation (FM) using monostable multivibrator

- One of the best methods of FM in terms of Signal to Noise Ratio (SNR) & Total Harmonic Distortion (THD)
- Implements Audio LPF utilizing integrated PSoC OpAmp
- Uses PSoC UDB to implement Universal Shift Register as the differentiator circuit converting square wave into spikes of very low pulse width

See PSoC Application Notes on www.cypress.com for more Programmable Signal Chain examples
Programmable Signal Chain Examples

Example #2: Four-track magnetic card reader with Automatic Gain Control (ACG)

- Uses OpAmps to implement differentiator method to detect magnetic card pulses
- Ample analog resources enables 4-tracks (4 PGAs, 4 OpAmps, 4 CMPs, ADC)
- Amplifies <10mV signals from magnetic card using internal PGAs
- AGC compensates for amplitude variations using dynamic PGA gain settings in PSoC
- Implements decoding via digital logic available in PSoC UDBs

See PSoC Application Notes on www.cypress.com for more Programmable Signal Chain examples
Unmatched Analog Integration

<table>
<thead>
<tr>
<th></th>
<th>Cypresss</th>
<th>Microchip</th>
<th>Texas Instruments</th>
<th>Atmel</th>
<th>Silicon Labs</th>
<th>Microchip</th>
<th>STMicro</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PSoC 3 &amp; 5</td>
<td>PIC18(F2x1x)</td>
<td>MSP430FG439</td>
<td>ATmega640</td>
<td>C8051F062</td>
<td>PIC32MX3XX/4XX</td>
<td>STM32F103xC</td>
</tr>
<tr>
<td>ADC: Sampling Rate (Max)</td>
<td>192Ksps</td>
<td>200Ksps</td>
<td>250Ksps</td>
<td>77Ksps</td>
<td>1Msps</td>
<td>1Msps [SAR]</td>
<td>1Msps [SAR]</td>
</tr>
<tr>
<td>DAC: Resolution (Max)</td>
<td>12-bit*</td>
<td>None</td>
<td>12-bit</td>
<td>None</td>
<td>12-bit</td>
<td>None</td>
<td>12-bit</td>
</tr>
<tr>
<td>DAC: Sampling Rate (Max)</td>
<td>1Msps</td>
<td>None</td>
<td>1Msps</td>
<td>None</td>
<td>1Msps</td>
<td>None</td>
<td>1Msps</td>
</tr>
<tr>
<td>Op Amps</td>
<td>4</td>
<td>None</td>
<td>2</td>
<td>1</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Comparators</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>None</td>
</tr>
<tr>
<td>Programmable Analog (PGA, TIA, Mixer, etc)</td>
<td>Up to 4</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Filtering</td>
<td>DFB &amp; Analog</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Analog Inputs</td>
<td>62</td>
<td>10</td>
<td>10</td>
<td>16</td>
<td>8</td>
<td>16</td>
<td>21</td>
</tr>
</tbody>
</table>

* Can use Programmable Signal Chain to implement >8-bit DACs
PSoC 3 & PSoC 5 Analog Applications

Speed (Samples/Second)

Resolution (bits)

8 10 12 14 16 18 20

10 100 1000 10K 100K 1M 10M ...

Monitor
DSL
Joystick
Industrial Measurement
Strain Gauge
Thermocouples
Pressure
HiFi Audio
Accelerometer
Power Monitor
Thermister
Fan Control
Gyroscope
Telephony
Motor Control
Power Supply Monitor
Joystick
Magnetic Card

PSoC 3 & PSoC 5

PSoC 5

RF Comm
Video

PSoC 3 & PSoC 5 Programmable System-on-Chip Presentation
Getting Started with PSoC Analog

CY8CKIT-007 Precision Voltmeter Demo Kit
- Showcases 20-bit resolution Delta-Sigma ADC
- Input: -30V to 30V, DC Only
- PSoC also performs CapSense & LCD Drive

CY8CKIT-030 Precision Analog Development Kit
- >18-bit ENOB Analog performance
- Designed for low-power & low-voltage
- 2x Expansion Connectors for plug-in sensor boards

Other Analog resources available at www.cypress.com/go/PSoC
- Analog ComponentDatasheets
- Analog Applications Notes & Example Projects
- Cypress Developer Community: Videos, Training, Forums
Universal Digital Blocks = UDBs

UDBs deliver unmatched digital flexibility & integration
- Collection of uncommitted logic (PLD) & structural logic (Datapath)
- Create standard & advanced digital peripherals + custom logic functions
- Flexible routing allows any function to any other function or any GPIO

Revolutionary PSoC Creator Software
- Rich library of pre-built & characterized peripheral
- Synthesize, place, and route automatically
- Easily customize your own Creator Components

Programmable Digital Use-Case Advantages
- Support for new or less common functions
- Using hardware to offload the CPU
- General purpose logic and state machines
- Integrate low power CPLD functionality
Programmable Logic for Specific Function Combination

Use Case:

Large number of independently controlled PWMs to control a display panel

PSoC Solution:

A single PSoC can support up to 52 PWM outputs

Alternatives:

Multiple MCUs, each controlling a smaller number of PWMs, or
MCU plus discrete CPLD/FPGA

Advantages of PSoC Integrated Programmable Logic:

Easily control the operation of all the PWMs using a single CPU
Same HW/SW usage model regardless of number of PWMs used in the design!
Programmable Logic for Less Common Interface Functions

Use Case:
Support for the SGPIO interface (standardized by the SFF Committee)

PSOC Solution:
Component (Hardware design & APIs) using programmable digital logic in PSoC

Alternatives:
Microcontroller plus CPLD/FPGA

Advantages of PSoC Integrated Programmable Logic:
Integrated solution of software and hardware in one SW environment
Single Device: no issues of bridging from one interface to another!
Easy to maintain and reusable!
Programmable Logic to Offload the CPU

Use Case:
Sensored Brushless DC (BLDC) Motor Control for multiple motors

PSoC Solution:
Commutation implemented using a hardware state machine
Allows support for any speed motor and multiple motors

Alternatives:
Dedicated MCU per motor

Advantages of PSoC Integrated Solution:
Fast and predictable hardware response time not subject to interrupt latency!
Single device: no multiprocessor communication complexity!
Run additional software without constant interruption!
Programmable Logic for Control

Use Case:
Hot Swap Controller

PSoc Solution:
Monitor multiple voltage levels with integrated Programmable Analog
Implement a State Machine to generate Digital AND Analog control signals

Alternatives:
Microcontroller plus CPLD/FPGA and discrete analog

Advantages of PSOC Integrated Solution:
Single-chip for Analog (CMPs & DAC), Digital (State Machine) & Control (CPU)
8-bit digital voltage output value sent to on-chip DAC (no external devices)
Multiple control registers, easily updated by the CPU
Getting Started with Programmable Digital

Revolutionary PSoC Creator Software IDE
- Rich library of pre-built, documented & characterized peripherals
- Synthesize, place, and route automatically
- Easily customize your own Creator Components in Verilog

On-Demand Training
- PSoC 3 & PSoC 5 103: Intro to Digital Peripherals
- Creator 110: Schematic Components
- Creator 111: Component Parameters
- Creator 112: Intro to Component API Generation
- Creator 113: PLD Based Verilog Components
PSoC 3 & PSoC 5 Low Power Overview

Flexible power modes to optimize power & performance

<table>
<thead>
<tr>
<th>Power mode</th>
<th>Current (PSoC 3)</th>
<th>Current (PSoC 5)</th>
<th>Code Execution</th>
<th>Digital Available</th>
<th>Analog Available</th>
<th>Clock Sources Available</th>
<th>Wakeup Sources</th>
<th>Reset Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>1.2mA @ 6MHz</td>
<td>2mA @ 6MHz</td>
<td>Yes</td>
<td>All</td>
<td>All</td>
<td>All</td>
<td>N/A</td>
<td>All</td>
</tr>
<tr>
<td>Alt. Active</td>
<td>TBD</td>
<td>TBD</td>
<td>User Defined</td>
<td>User Defined</td>
<td>User Defined</td>
<td>All</td>
<td>N/A</td>
<td>All</td>
</tr>
<tr>
<td>Sleep</td>
<td>1uA</td>
<td>2uA</td>
<td>No</td>
<td>I2C</td>
<td>CMP</td>
<td>Low Speed &amp; 32 KHz Osc</td>
<td>IO, I2C, RTC, sleep timer, CMP</td>
<td>XRES, LVD, WDR</td>
</tr>
<tr>
<td>Hibernate</td>
<td>200nA</td>
<td>300nA</td>
<td>No</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>IO</td>
<td>XRES, LVD</td>
</tr>
</tbody>
</table>

World’s widest voltage range
- 0.5V to 5.5V; Only Embedded Controller with full analog below 1.8V
- Integrated voltage regulator & boost converter

Unique power saving features
- On-chip programmable logic (UDBs) offloads CPU
- Integrated peripherals reducing system level power

Revolutionary PSoC Creator Software
- Provides easy to use control APIs for quick power management
- Allows code and register manipulation for in-depth control
World’s Widest Supply Voltage

CPU FREQUENCY (MHz)

SUPPLY VOLTAGE (V)

COMPETITOR A

COMPETITOR B

COMPETITOR C

COMPETITOR D

WITH BOOST

WITHOUT BOOST

PSoC 5

PSoC 3

COMP A

COMP B

COMP C

COMP D

Solar Cell Range

1AA/AAA CELL RANGE

CR2032 COIN CELL RANGE

2 AA/AAA CELL RANGE
Full Analog Operation Across Voltage

Solar Cell Range

1AA/AAA CELL RANGE

2 AA/AAA CELL RANGE

CR2032 COIN CELL RANGE

V_{DD}

0.0V

1.0V

2.0V

3.0V

4.0V

5.0V

PSoC 3 & PSoC 5

FULL PRECISION ANALOG

Comp A

NO ANALOG

FULL ANALOG

Comp B

FULL ANALOG

Comp C

DERATED ANALOG
(not specified)

FULL ANALOG

Comp D

FULL ANALOG
Offload traditional CPU functions to integrated H/W

✓ RAM check
✓ CPLD logic in UDB for decision making
✓ State machine implemented in UDB
✓ Simple processing (Add, Subtract, Bit wise operations)
✓ FIR / IIR filters using Digital Filter Block (DFB)
✓ Complex math using DFB
✓ Best-in-class multi-layer 24 channel DMA

Up to 27 integrated processing elements
CPU, DFB, DMA, 24 UDBs (Datapath + PLD)
## PSoC 3 versus MSP430

<table>
<thead>
<tr>
<th>Feature</th>
<th>PSoC 3</th>
<th>MSP430F4xxx</th>
<th>MSP430F5xxx</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supply Voltage Range</strong></td>
<td>1.71V– 5.5 V (0.5V – 5.5V w/boost)</td>
<td>1.8V – 3.6V</td>
<td>1.8- 3.6V</td>
</tr>
<tr>
<td><strong>Min. Voltage for Analog</strong></td>
<td>0.5V</td>
<td>2.2V</td>
<td>2.2V</td>
</tr>
<tr>
<td><strong>Maximum CPU Frequency</strong></td>
<td>67MHz</td>
<td>16MHz</td>
<td>25 MHz</td>
</tr>
<tr>
<td><strong>Active Current @ 8 MHz</strong></td>
<td>220 µA/MHz</td>
<td>400 µA/MHz</td>
<td>165 µA/MHz</td>
</tr>
<tr>
<td><strong>@ 25 MHz</strong></td>
<td>190 µA/MHz</td>
<td>Max CPU speed 16 MHz</td>
<td>250 µA/MHz</td>
</tr>
<tr>
<td><strong>Sleep (LPM3) Current</strong></td>
<td>1 µA</td>
<td>0.7 µA</td>
<td>2.5 µA</td>
</tr>
<tr>
<td><strong>Hibernate (LPM4) Current</strong></td>
<td>0.2 µA</td>
<td>0.1 µA</td>
<td>1.69 µA</td>
</tr>
<tr>
<td><strong>Analog</strong></td>
<td>20-bit ΔΣ @ 180 sps</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>16-bit ΔΣ @ 48 kps</strong></td>
<td>16-bit ΔΣ @ 4 kps</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>12-bit ΔΣ @ 192 kps</strong></td>
<td>12-bit SAR @ 200 kps</td>
<td>12-bit SAR @ 200 kps</td>
<td>12-bit DAC</td>
</tr>
<tr>
<td><strong>Programmable Analog</strong></td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>LCD Segments</strong></td>
<td>736</td>
<td>160</td>
<td>-</td>
</tr>
<tr>
<td><strong>USB, CAN</strong></td>
<td>FS, Yes</td>
<td>No, No</td>
<td>FS, No</td>
</tr>
<tr>
<td><strong>Programmable Logic</strong></td>
<td>Yes*</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Capacitive Sensing</strong></td>
<td>Excellent</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td><strong>DMA Channels</strong></td>
<td>24*</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

**PSoc 3 Better or Equivalent to MSP430 Power**

**PSoc 3 Improves Upon MSP430 In All Other Features**
Getting Started with PSoC Low Power

Low Power Demonstration
- Showcases 1uA sleep current with RTC
- Video demonstration available online today

CY8CKIT-030 Low Power & Voltage Development Kit
- Designed for low-power & low-voltage
- Numerous test points to measure current
- Boost circuitry to run down to 0.5V

Other resources available at www.cypress.com/go/PSoC
- PSoC Creator 1.0 Beta 5 with Power Management features
- On-Demand Low Power Training with Beta 5
- Low Power Design Best Practices Application Note

Available July 2010
Dedicated communication peripherals
- Full-Speed USB 2.0 device with 8 data + 1 control endpoints
- Enhanced full CAN 2.0A/B Controller with 16 RX, 8 TX buffers
- I2C master or slave with data rate up to 400kbps

Flexible Universal Digital Blocks (UDBs) for other communication
- Large library of pre-configured peripherals (SPI, UART, I2C, LIN, I2S, …)
- Customize your own communication peripherals using PLD-based UDBs

Revolutionary PSoC Creator Software
- Implement pre-configured communication peripherals in minutes vs. hours
- Application ready: Fully configurable API through easy to use customizer
- Out of the Box application development
Cypress CAN 2.0A/B

Ease of Design
- CAN in 30 minutes or less
- Drag and drop user modules
- Application ready: Fully configurable API through easy to use customizer
- Out of the Box app. development

CAN 2.0A/B ISO11898 Compliant
- Remote Transmission Request support
- Programmable bit rate up to 1Mbps
- Flexible Routing: Tx, Rx to any GPIO
- CPU independent data transfer using DMA

Transmit path
- 8 transmit message buffers
- Programmable transmit priority

Receive path
- 16 receive message buffers
- 16 acceptance filters/masks
- DeviceNet addressing support
Getting Started with PSoC Connectivity

CY8CKIT-017 CAN/LIN Expansion Board Kit

- 1 CAN transceiver circuit
- 2 LIN transceiver circuits
- Communication status LED indicators
- Works with CY8CKIT-001 Development Kit

More at www.cypress.com/go/PSoC

- Free PSoC Creator Software IDE
- Component datasheets: I2S, UART, SPI, CAN, USB, I2C, LIN, ...
- Application Notes & Example Projects
- Cypress Developer Community: Videos, Training, Forums
LCD Segment Drive & Graphics Control
- LCD direct drive from any GPIO
- Up to 46x16 = 736 segments
- Graphics control solution coming in August 2010

Integrated Cypress Leading Touch Technologies
- CapSense support from any GPIO
- Leadership application expertise in Touch
- TrueTouch touchscreen solutions coming Q4 2010

Revolutionary PSoC Creator Software
- Easy-to-use configuration wizards
- CapSense auto-tuning capability
PSoC 3 & PSoC 5 LCD Segment Drive

Up to 16 Commons
- Requires Fewer LCD Pins
- Leaves More Pins for Peripheral Integration
- Option for Low Pin Count Packages

Any PSoC GPIO a Common or Segment
- Shorter Traces
- Less PCB Layers (No X-over)

Drive up to 736 LCD Segments
- No Helper Chip
- Complex, Large Displays

High Efficiency On-Chip Boost
- Drive 2V-5V LCD from Batt Voltage as Low as 0.5V

Internal Voltage Generation
- No Ext. Resistors
- No Ext. Capacitors
Cypress

- Easy to use pin selection table
  - Map LCD glass segment matrix from LCD vendor to table directly
- Automated Contrast Control

Competition

- Labor intensive matching of individual LCD glass segments in matrix to MCU
- LCD RAM registers

```c
#define X1 LCDATA2bits 01700 // Cos17
#define X2 LCDATA2bits 01703 // Cos17

void S2Num (unsigned char num)
{
    switch (num)
    {
        case 0: S2AON; S2BON; S2CON; S2DCON; S2BON; S2TON; S2OFF; break;
        case 1: S2OFF; S2BON; S2CON; S2DOFF; S2DOFF; S2DOFF; S2DOFF; break;
        case 2: S2AON; S2BON; S2COFF; S2DCON; S2BON; S2TON; S2CON; break;
        case 3: S2AON; S2BON; S2CON; S2DOFF; S2DOFF; S2DOFF; S2DOFF; break;
        case 4: S2OFF; S2BON; S2CON; S2DOFF; S2DOFF; S2DOFF; S2DOFF; break;
        case 5: S2AON; S2BON; S2COFF; S2DCON; S2BON; S2TON; S2CON; break;
        case 6: S2AON; S2BON; S2CON; S2DOFF; S2DOFF; S2DOFF; S2DOFF; break;
        case 7: S2AON; S2BON; S2CON; S2DOFF; S2DOFF; S2DOFF; S2DOFF; break;
        case 8: S2AON; S2BON; S2CON; S2DOFF; S2DOFF; S2DOFF; S2DOFF; break;
        case 9: S2AON; S2BON; S2CON; S2DOFF; S2DOFF; S2DOFF; S2DOFF; break;
        case A: S2AON; S2BON; S2CON; S2DOFF; S2DOFF; S2DOFF; S2DOFF; break;
        case B: S2AON; S2BON; S2CON; S2DOFF; S2DOFF; S2DOFF; S2DOFF; break;
        case C: S2AON; S2BON; S2CON; S2DOFF; S2DOFF; S2DOFF; S2DOFF; break;
        case D: S2AON; S2BON; S2CON; S2DOFF; S2DOFF; S2DOFF; S2DOFF; break;
        case E: S2AON; S2BON; S2CON; S2DOFF; S2DOFF; S2DOFF; S2DOFF; break;
        case F: S2AON; S2BON; S2CON; S2DOFF; S2DOFF; S2DOFF; S2DOFF; break;
    }
}
```
PSOC 3 & PSOC 5 CapSense Touch Sensing

PSOC 3 & PSOC 5 enable CapSense Plus designs with CapSense enabled on all GPIO
Cypress CapSense Leadership

Programmable parts with unique features
- SW programmable for fast Time-to-Market; IP protection
- I2C bootloader for FW upgrades
- Low power, small form factor
- Noise immunity (EMI/RF/LCD)
- Water proofing

Broadeast portfolio of solutions
- CapSense Express
- CapSense Plus

Applications expertise
- Understanding of mechanical aspects
- Dedicated Application support

Worldwide leader in capacitive touch technologies
Getting Started with PSoC User Interface

**CY8CKIT-006 LCD Segment Drive Evaluation Kit**
- Large complex custom LCD with 448 segments
- CapSense buttons, Accelerometer, Thermistor, Buzzer & Protoheaders

**CY8CKIT-029 LCD Segment Drive Expansion Board**
- 7- and 14-segment multi-function display
- Works with CY8CKIT-001 Development Kit

**CY8CKIT-031 CapSense Expansion Boards**
- Various CapSense Boards; I2C header for tuning
- Works with CY8CKIT-001 Development Kit

More at [www.cypress.com/go/PSoC](http://www.cypress.com/go/PSoC)
- Component datasheets:
- Application Notes & Example Projects
- Cypress Developer Community: Videos, Training, Forums

Available July 2010
PSoC Solution: Portable Medical
Precision Analog

- 3nA current measurement resolution (± 1% accuracy)
- Integrated 0.1% Voltage reference
- Configurable analog front end and signal chain

Integration

- Fully integrated LCD drive up to 736 segments, 16 commons
- Dedicated CapSense peripherals
- Comms: USB FS, I2C, SPI, UART, …

Low Power

- Full analog performance down to 0.5V
- Ultra low active, sleep and hibernate
PSoC Integrates:

- Complete analog front end
- Precision voltage reference
- LCD direct drive & backlight
- User Interfaces
- Power management
- Comm. interfaces
- Data logging
- …and the MCU
PSoC Portable Medical Example
#2. Blood Pressure Monitor on Chip

PSoC Integrates:
- Complete AFE
- User Interfaces
- Power management
- Data logging
- Motor/Valve control
- …and the MCU
Getting Started with PSoC for Portable Medical

CY8CKIT-007 Precision Voltmeter Demo Kit
- Showcases 20-bit resolution Delta-Sigma ADC
- Input: -30V to 30V, DC Only
- PSoC also performs CapSense & LCD Drive

CY8CKIT-030 Precision Analog Development Kit
- >18-bit ENOB Analog performance
- Designed for low-power & low-voltage
- 2x Expansion Connectors for plug-in sensor boards

Other resources available at www.cypress.com/go/PSoC
- Application Notes & Design examples
- Cypress Developer Community: Videos, Training, Forums

Available July 2010
PSoC Solution: Made for iPod
PSoC Made for iPod (MFi) Solution

Ultimate Development Platform For iPod, iPhone & iPad Accessories

MFi Overview
- Apple licensing program (communications interface + protocol) for developing accessories
- Whole new market of accessory opportunities with new features enabled by iPhone OS

PSoC & MFi
- Cypress is an official MFi Licensee (Adjunct Technology Supplier)
- Connectivity with iPod/iPhone/iPad is yet another feature integrated into PSoC

Development Boards, Tools, Software
- Complete development platform for MFi accessories
- Easy-to-use PSoC Creator component for MFi connectivity

PSoC-Based MFi Solutions
- Digital (USB) Audio for iPad
- Other PSoC Applications: POS, Portable Medical, …
iPhone OS

What Does The New OS Bring?

- External Accessory framework
  - iPhone/iPad Apps $\leftrightarrow$ Accessories communication and interaction
  - eg. Apps can (a) display data from, (b) act as the user control interface for Accessories

- SDK
  - APIs available for accessories to leverage iPod/iPhone/iPad resources: eg. multi-touch, GPS, accelerometer, network connectivity, etc.

Whole New Realm Of Accessories!

Beneficial To Accessory Manufacturers:

- Leverage Apple’s brand power & loyalty + iPod/iPhone installed base (iPod touch >32Mu, iPhone >43Mu – Jan 25, 2010)
- Minimize touchscreen, UI R&D $\rightarrow$ lower OpEx, focus on core competencies, faster time-to-market
- App: opens up new revenue model; seamless software updates

CY’s MFi Solution
Connectivity to iPhone & iPod encapsulated as an interface component within PSoC

Leverage other PSoC function “building blocks”

Develop application-specific IP to create complete solutions

Diagnostics / Instrumentation
POS
Portable/Home Medical
Audio

MFi
CapSense
LCD Drive
Battery Management
Precision Analog

... other PSoC solutions
... other PSoC functions
Getting Started with PSoC for MFi

CY8CKIT-023 PSoC EBK for iPhone & iPod Accessories

- First MFi development platform – Compatible with iPhone, iPod devices
- Enables basic iPhone, iPod (and even iPad) connectivity with PSoC 3
- Basic audio playback and control, plus metadata display
- EA Console iPhone app: External Accessory framework example
- Works with CY8CKIT-029 – time clock displayed on Segment LCD
- iPhone/iPod Connectivity Component in PSoC Creator
- Available to Made for iPod licensees via Apple’s authorized distributor
- Support for PSoC 1 and PSoC 5 in the future

www.cypress.com/go/CY8CKIT-023
PSoC DVK & EBKs: Configurable & Complete Development Platform

**Highlights**

- Ecosystem of Horizontal Function and Vertical Solution EBKs
- Developed by CY and ecosystem partners
- CY8CKIT-001 + CY8CKIT-023 + CY8CKIT-017 = CAN Diagnostics MFi Accessory!
PSoC In Audio MFi Accessories

Interfaces
- Analog switching
- 4x Op-amp/buffers
- Multiple I2S channels to codecs, digital amplifiers etc.
- S/PDIF

USB Audio
- FS USB with full audio support
- Audio master clock generation
- 16-bit 32KHz, 44.1KHz, 48KHz

Made for iPod
- Official Made for iPod licensee
- Comprehensive PSoC Creator Component
- Supports External Accessory framework

LCD Display Drive
- Up to 16 commons
- Configurable LCD pin location
- Drive up to 736 LCD segments
- High efficiency on-chip boost
- Internal voltage generation
- Backlight control
- RTC for Time Clock

Audio Signal Processing
- Mono 16bit delta-sigma ADC
- 4x voice quality DACs
- User Response Equalizations
- Driver/Box Correction
- Crossover Filtering

CapSense®
- Touch sensing functionality
- Replace mechanical buttons with CapSense buttons, linear/radial sliders, touchpads
- Proximity sensing + LED backlight control for feedback and aesthetics

Power Management
- 1mA @ 6MHz, 1uA (Sleep), 200nA (Hibernate)
- 0.5-5.5V: single-cell operation
- Battery charging – multi-cell & balancing
- Voltage monitoring
- Over-current protection
- Supports iPod/iPhone/iPad charging

IR/RF Remote Control
- IR receive
- 2.4GHz Low-Power RF transceiver

Theoretically Feasible

PSoC 3 & PSoC 5 Programmable System-on-Chip Presentation
A Whole New Realm Of Accessories...

- Health & Wellness
- Storage
- Diagnostics
- Gaming
- Point Of Sale
- Infotainment / Navigation
- Home Control
PSoC In Point-of-Sale

**LCD Display Drive**
- Up to 16 commons
- Configurable LCD pin location
- Drive up to 736 LCD segments
- High efficiency on-chip boost
- Internal voltage generation
- Backlight control
- RTC for Time Clock

**CapSense®**
- Touch sensing functionality
- Replace mechanical buttons with CapSense buttons, linear/radial sliders, touchpads
- Proximity sensing + LED backlight control for feedback and aesthetics

**Motor Control**
- Stepper motor control for thermal printing
- Also supports BLDC sensored, sensorless
- Multi-motor control
- Over-current protection

**Precision Analog**
- Barcode scanning, magnetic card reading
- 20bit Delta-Sigma ADC, 12bit SAR ADC
- +/- 0.1% Internal Ref. Voltage
- DACs: 8-to-10bit resolution, current & voltage
- Configurable PGA (up to x50), Mixer, and TIA

**Power Management**
- 1mA @ 6MHz, 1uA (Sleep), 200nA (Hibernate)
- 0.5-5.5V: single-cell operation
- Battery charging – multi-cell & balancing
- Voltage monitoring
- Over-current protection

**Made for iPod**
- Official Made for iPod licensee
- Comprehensive PSoC Creator Component
- Supports External Accessory framework
PSoC In Portable/Home Medical

**Precision Analog**
- $\mu$-to-\(\mu\)A measurement
- 20bit Delta-Sigma ADC, 12bit SAR ADC
- +/- 0.1% Internal Ref. Voltage
- DACs: 8-to-10bit resolution, current & voltage
- Configurable PGA (up to x50), Mixer, and TIA

**CapSense®**
- Touch sensing functionality
- Replace mechanical buttons with CapSense buttons, linear/radial sliders, touchpads
- CapSense reduces EMI interference (over mechanical buttons)
- Proximity sensing + LED backlight control for feedback and aesthetics

**Power Management**
- 1mA @ 6MHz, 1uA (Sleep), 200nA (Hibernate)
- 0.5-5.5V: single-cell operation

**Interfaces**
- FS USB to sync with PC
- SDIO for expansion

**Made for iPod**
- Official Made for iPod licensee
- Comprehensive PSoC Creator Component
- Supports External Accessory framework

**LCD Display Drive**
- Up to 16 commons
- Configurable LCD pin location
- Drive up to 736 LCD segments
- High efficiency on-chip boost
- Internal voltage generation
- Backlight control
- RTC for Time Clock
PSoC In Diagnostics/Instrumentation

**LCD Display Drive**
- Up to 16 commons
- Configurable LCD pin location
- Drive up to 736 LCD segments
- High efficiency on-chip boost
- Internal voltage generation
- Backlight control
- RTC for Time Clock

**Power Management**
- 1mA @ 6MHz, 1uA (Sleep), 200nA (Hibernate)
- 0.5-5.5V: single-cell operation
- Battery charging – multi-cell & balancing
- Voltage monitoring
- Over-current protection

**Controller Area Network (CAN)**
- CAN 2.0A/B Tx & Rx
- Standard and extended, plus RTR
- Error management

**CapSense®**
- Touch sensing functionality
- Replace mechanical buttons with CapSense buttons, linear/radial sliders, touchpads
- Proximity sensing + LED backlight control for feedback and aesthetics

**Made for iPod**
- Official Made for iPod licensee
- Comprehensive PSoC Creator Component
- Supports External Accessory framework

**Precision Analog**
- µ-to-μA measurement
- 20bit Delta-Sigma ADC, 12bit SAR ADC
- +/- 0.1% Internal Ref. Voltage
- DACs: 8-to-10bit resolution, current & voltage
- Configurable PGA (up to x50), Mixer, and TIA

**Proven As Standalone Function**
PSoC: Systems Management Control
System Management Controller (SMC)

- Think of an SMC as an autonomous system co-processor
- It is responsible for: *Manages “health” of system*
  - Managing power supplies in real-time
  - Managing system cooling in real-time
  - Managing environmental sensors (e.g. shock, humidity, ALS etc.)
  - Handling faults/errors and event logging
  - Providing simple user interface and debug ports
PSoC: A Complete SMC Solution

Power Management
- Voltage and Current monitoring
- Voltage and Current sequencing
- Voltage margining
- In-Rush Current Protection

Thermal Management
- Multiple independent thermal zone support

Communications Protocols
- SGPIO, LPC, PECI, USB, I2C, etc.

PLUS:
- Analog/Digital sensor interface
- Peripheral & User interface

Intelligence
- Supervisor
- Control algorithms
- Event logging

Power Management
- Voltage sequencing, voltage & current monitoring, margining, hot-swap, inrush current limiting

Thermal Management
- Temperature measurement, fan control, thermal zone profiles

Communication
- To host or between management modules in distributed systems

Sensors
- Accelerometer, ALS, humidity, cabinet door latch etc.
- Analog, digital or both

Peripherals / User I/F
- UART, SPI, I2C, SWD, JTAG
- LCD, LEDs, USB, CapSense
PSOC Value: SMC on Chip

Integration
- Key SMC functions in a single device
- Scalable platform solution including 8-to 32-bit migration

Ease of Use
- Simplified graphical schematic-based design & wizards in PSoC Creator
- Definition → Prototype → Production with same rapid development platform

Flexibility
- Custom solutions via software wizards
- Generate your own custom solutions & protocols
- Utilize CY design services and applications support for more advanced solutions
PSoC: Power Management

PSoC Integrates:
- MCUs, ADCs, PGAs and Comparators
- Power Manager Devices (Lattice, TI, etc.)
- PLD state machines
- Inrush Current Limiters

Tech Specs:
- Control up to 16 power supplies
- Voltage & Current monitoring
- Power sequencing
- Closed-loop voltage margining
- In-rush & hot-swap capable

Ease of Use:
- Simple PSoC Creator customization wizard
- S/W APIs greatly easing firmware development
PSoC: Thermal Management

PSoC Integrates:
- Fan Control ICs
- I2C Temp Sensors
- CPLDs
- MCUs

Tech Specs:
- On-chip temperature sense
- Multiple thermal zone management
- Closed-loop PWM and tach fan-control
- Hardware implementation offloads CPU

Ease of Use:
- Simple customization wizard
- S/W APIs greatly easing firmware development
PSoC: SMC Communications

PSoC Integrates:
- CPLDs
- MCUs

Tech Specs:
- I2C Master, Slave, Dual Master/Slave
- CAN 2.0 a/b, SPI, UART, USB
- SGPIO, LPC*, PECI*, IPMI*  *coming Q410
- SMBus, PMBus
- Flexibility for proprietary protocols & unique combinations using PLD-based UDBs

Ease of Use:
- Simple PSoC Creator customization wizard
- S/W APIs greatly easing firmware development
**PSoC Offloads:**

- Power management, measurement and power circuit control
- User Interface: CapSense, LCD drive and external interrupts
- Communications: SPI, UART, USB, etc.
- USB-based FPGA configuration and serial flash programming
PSoC: Programmable SMC on Chip

Non-Volatile Memory
Data and event logging

Highly configurable clock tree
Flexible, automated clock gating.

Ultra Low Power
• 1 µA sleep
• 200 nA hibernate

CPU
• control algorithms
• event logging

Precise CPU frequencies
PLL allows 4,032 different frequencies; tunable power consumption

#1 Analog
Precision analog, +/- 0.1%Vref
20b Sigma-Delta, 12b SAR ADCs
supports >24 channels
wide voltage range 0.5 – 5.0V

#2 On-board DMA Controller
Transfer data from any peripheral to any other peripheral without CPU involvement
lower power

#3 Programmable Logic
Implement control algorithms and CPLD glue logic in hardware all without the CPU,
boost performance, reduce power consumption

#4 Special I/Os
Hot Swap capable
1.2V to 5.5V
25mA sink current
high drive strength

General Purpose I/Os
Analog and Digital on every I/O, flexible routing for easy layout and communication
Getting Started with PSoC for SMC

Power Management Demo Board
- 8 unique DC/DC regulator circuits
- Enable & fault status LED indicators
- Adjustable load and manual fault enable

Xilinx® Spartan®-6 LX16 Evaluation Kit
- FPGA Co-processor with PSoC 3
- Low-cost development kit
- For details visit: [www.em.avnet.com](http://www.em.avnet.com)

More at [www.cypress.com/go/PSoC](http://www.cypress.com/go/PSoC)
- Free PSoC Creator Software IDE
- Component datasheets: I2S, UART, SPI, CAN, USB, I2C, LIN, …
- Application Notes & Example Projects
- Cypress Developer Community: Videos, Training, Forums
Getting Started with PSoC
PSoC Ecosystem

Compilers
- Keil™ CA51 Compiler
- Keil™ RealView® Microcontroller Dev.
- GNU/CodeSourcery Sourcery G++™ Lite

RTOS
- Keil™ RTX51Tiny
- Micrium mC/OS-II™
- SEGGER embOS

Content Marketplaces
- Open Source Development Community
- IP/Component Marketplace
Cypress Developer Community

Highly active 8,000 member community consisting of:

- Direct access to CY experts
- Product Support Forums
- Videos & Demos
- Blogs
Get Your Ideas into Production

PSoc 3 or PSoC 5 FirstTouch™ Starter Kits
(CY8CKIT-003 or CY8CKIT-014)
- Rapid, low-risk evaluation of PSoC technology & PSoC Creator development environment
- Accelerometer, temperature, CapSense® touch-sensing, LED outputs and DIP I/O access

PSoc Development Kit
(CY8CKIT-001)
- MiniProg3 provides full access to program and debug capability
- Processor modules for PSoC 1, PSoC 3 & PSoC 5 development
- Expansion board ports for add-on kits: LCD Drive, Graphics, Made for iPod, etc.

$49

$249
Download PSoC Creator Today!

Free PSoC Creator software:

www.cypress.com/go/psoccreator
Appendix
CY8C38 Precision Analog PSoC 3

Analog Performance:
- Up to 20-bit DelSig ADC
- 4 Dedicated DACs
- 4 Programmable Analog Blocks
- 1 Dedicated Dig. Filter Block
- 4 Dedicated CMPs & OpAmps
- +/- 0.1% Vref accuracy

Digital Performance:
- Up to 24 Programmable Digital Blocks
- 4 Dedicated 16-bit Timer/Ctr/PWMs
- CAN 2.0a/b & FS USB 2.0 options

CPU Performance:
- Up to 67MHz single-cycle 8051
- 32KB to 64KB Flash Memory
Analog Performance:
- Up to 12-bit DelSig ADC
- 4 Dedicated DACs
- 4 Programmable Analog Blocks
- 1 Dedicated Dig. Filter Block
- 4 Dedicated CMPs & OpAmps
- +/- 0.1% Vref accuracy

Digital Performance:
- Up to 24 Programmable Digital Blocks
- 4 Dedicated 16-bit Timer/Ctr/PWMs
- CAN 2.0a/b & FS USB 2.0 options

CPU Performance:
- Up to 67MHz single-cycle 8051
- 32KB to 64KB Flash Memory
Analog Performance:
• Up to 12-bit DelSig ADC
• 2 Dedicated DACs
• 2 Programmable Analog Blocks
• 4 Dedicated CMPs
• 2 Dedicated OpAmps
• +/- 1% Vref accuracy

Digital Performance:
• Up to 24 Programmable Digital Blocks
• 4 Dedicated 16-bit Timer/Ctr/PWMs
• CAN 2.0a/b & FS USB 2.0 options

CPU Performance:
• Up to 48MHz single-cycle 8051
• 32KB to 64KB Flash Memory
Analog Performance:
- Up to 12-bit DelSig ADC
- 1 Dedicated DACs
- 2 Dedicated CMPs
- +/- 1% Vref accuracy

Digital Performance:
- Up to 24 Programmable Digital Blocks
- 4 Dedicated 16-bit Timer/Ctr/PWMs
- CAN 2.0a/b & FS USB 2.0 options

CPU Performance:
- Up to 48MHz single-cycle 8051
- 32KB to 64KB Flash Memory