System Level Laboratory

Programmable System on Chip (pSoC) Fundamental

Objective:

You will learn about the Programmable System-on-chips (PSoC) and get familiar with the analog and digital blocks it provides. You will explore the analog and digital signal processing functions the pSoC development environment provide – ranging from different filter design, Op Amp circuits, to ADC/DAC, and communication blocks. In the following experiments you will use pSoC to implement a comparator – an important component of digital signal processing. You will also experiment with the pSoC's capability to control a LCD display.

1. Introduction to PSoC

Cypress' **PSoC(R) mixed-signal arrays** are programmable systems-on-chips (SOCs) that integrate a microcontroller and the analog and digital components that typically surround it in an embedded system. A single PSoC device can integrate as many as 100 peripheral functions with a microcontroller, saving customers design time, board space, and power consumption.

Easy-to-use development tools enable designers to select the precise peripheral functionality they desire, including:

- **Analog** functions (amplifiers, ADCs, DACs, filters and comparators)
- **Digital** functions (timers, counters, PWMs etc.,)
- Communications interface (I2C, SPI, USB...).

The PSoC family's analog features include:

- Programmable gain amplifiers and up to 14-bit ADCs with exceptionally low noise
- Low input leakage and input voltage offset.

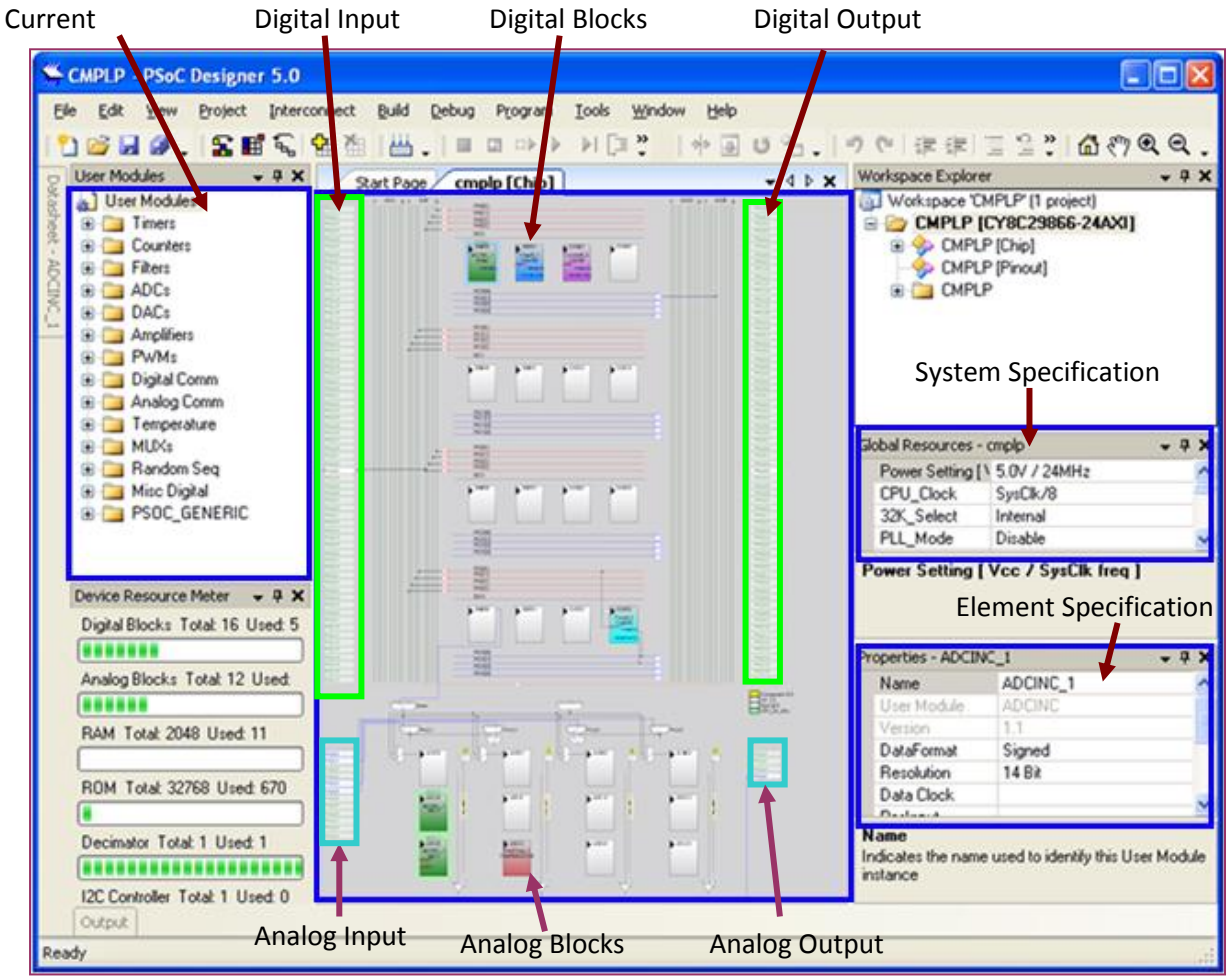
PSoC Designer(TM), the free Integrated Development Environment for PSoC, is a full-featured, GUI-based design tool suite that enables the user to configure design-in silicon. With PSoC Designer, users can code the device in either 'C' or Assembly language and debug the design using features such as event triggers and multiple break points, while debugging the code by single stepping through code in 'C' or Assembly or a mix of both. PSoC Designer is **free** and can be downloaded from http://www.cypress.com/psocdesigner.

In this experiment we will use the C language for PSoC design. The code snippets can be found in the data sheets of each and every single element and copied to your program. Typically, only

slight modification of the code is needed for it to be functioning in your program – such as hardware channel, etc., based on your design.

The official website for PSoC is http://www.cypress.com/ The details and documentation of each device can be found in the Design section.

The figure below shows a new project layout window where programming can be done.



The top section contains 16 digital blocks and the bottom section provides 12 analog blocks that you can program. The first four blocks in the first row of the bottom section function as the Continuous Blocks and the remaining two rows of blocks function as the Switched Capacitor Blocks. Note: The sampling rate should be very carefully determined while using the switched capacitor blocks.

Now it's your turn to explore various blocks pSoC provide for building a micro-controller application. Please select one analog and one digital block and go through their data sheet carefully. Turn in the description of them following the format below for the comparator. Some

examples: PGA, AMPINV, INAMP, DELSIG11, DAC9, LPF2, BPF2, COUNTER8, DELSIG8, TIMER8, Interrupt, ADCINC12, LCD, MDAC8, DUALADC8, PWM8, etc.

Post lab Question:

1) What comparator blocks does the pSoC provide?
2) What ADC/DAC blocks does the pSoC provides?
3) How can we connect sensors to pSoC?
4) How can we connect actuators to pSoC?
5) Select one function block in Filters and learn how to use it. Prepare a lab manual teaching your peers about it.