



System Level Laboratory

Digital Fundamentals: Implement Comparator using pSoC

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, to ADC/DAC, to communication blocks. You will then use it to implement a comparator – important component of digital signal processing.

Exercise: Build a Comparator

1) Launch PSoC designer, create a new project with the name “ELET3403_Exp6_COMP”.

Note: DO NOT change any base part. Use the default configuration and make sure the main file is generated using “C”. Press **finish** to start building the project.

2) Go to user module window, select “AMPLIFIERS” - “CMPPRG”, and double click it, to place the comparator in the circuit. Once it is done you can see the block changing to blue.

3) Go to **Device Editor** to see the layout. You can see the pin configuration on the left down of the screen.

a. To navigate through the layout Hold down Alt key and move the mouse. (You can see that the arrow changes to palm when you hold down Alt key and similar it changes to zoom when you hold down Ctrl key.)

4) Zoom into the block to view more clearly the connections available. To zoom in CTRL + left mouse click, to zoom out CTRL + SHIFT + left mouse click

5) Left click on the **Input** of the block to see a drop down menu and select “**AnalogColumn_InputMux_0**” as the input.

6) Set the low limit to Vss (left click on low limit to see the drop down menu).

7) Connect the Analog Bus to “AnalogOutBus_0”. Left click on **Analog Bus** and select “**AnalogOutBus_0**”

8) Left click “Buff 0”, then select “port_0_3”.

9) Go to the port connected to the input, you can see a dark blue line highlighting once you place the pointer on the input port. Left click on the port connected (**Port_0_1**) and choose “select” from the menu. Then select “**Analog Input**” from the drop down menu.

Congratulations! The layout design is over and now we need to write the C code.



- 1) Go to **Workspace Explorer**. Click on source files where you can see to your left a set of tree folders. Go to main.c in the source files. Once the editor is opened, click on user module datasheet button.
- 2) Go to sample code, copy the code in C and paste it in the editor. Edit the name of the block used as per the name given by the layout. (**Replace every “CMPPRG” by “CMPPRG_1” in the code.**)
- 3) Build the source code by clicking on the “**build**” button. **Make sure that there are zero errors.** Now the chip is ready for the programming.
- 4) Connect the programming board to USB port and you can see a green light glowing which indicates that the programming board has the power.
- 5) Click “Program”-“PSoC Programmer” and program to program the chip
- 6) Once the Status is verified, you have your chip programmed correctly.

Show and Tell:

1. Verify the threshold value of the comparator using a DMM.
2. Validate all the functional aspects of the comparator as mentioned in the manual.
3. Check the comparator for various input and reference values and observe the changes.
4. Demo your comparator to the instructor.
5. Get familiar with pSoC – different blocks, their functions, pins and parameters.

Post lab Question:

- 1) Does the pSoC provide other comparator blocks?
- 2) What ADC/DAC blocks pSoC provides?
- 3) How we can connect sensors onto pSoC?



Sample Codes for Comparator:

```
//-----  
// Sample C Code for the CMPPRG  
// Turn on power and set RefValue (threshold) to 0.500.  
// Sets RefValue to Vlowlimit + 0.5* Vdd-Vlowlimit  
// = 3.75 V with 5.00 V supply  
//  
//-----  
  
#include <m8c.h> // Part specific constants and macros  
#include "PSoC_API.h" // PSoC API definitions for all User Modules  
  
Void main()  
{  
  
    CMPPRG_1_SetRef(CMPPRG_1_REF0_500); // Set RefValue  
  
    CMPPRG_1_Start(CMPPRG_1_MEDPOWER); // Set power level and turn it on  
  
}
```