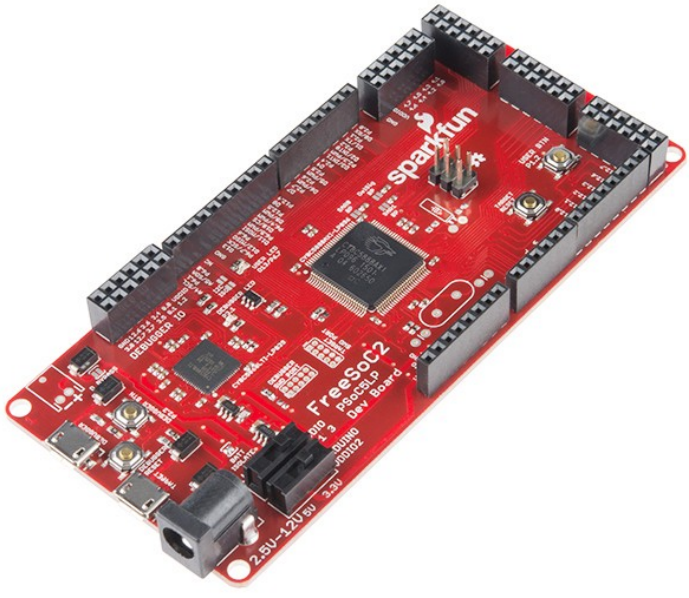
TENET TECHNETRONICS

2016

Non-inverting Amplifier in FreeSoc2 (PSoC 5LP) using PSoC Creator



Author: Gurudatta Palankar

Version: 1.0

Introduction:

The FreeSoC2 micro-controller based on the PSoC 5LP (Programmable System on a Chip) brings together features of the programmable devices and micro-controller-type systems on chips into one package. By placing a programmable fabric between the peripherals and the pins, the FreeSoC2 allows any function to be routed to any pin! Moreover, the on-board PSoC includes a number of programmable blocks which allow the user to define arbitrary digital and analog circuits for their specific application. To get the most out of the device, you will need to use the PSoC Creator IDE.

Step 1: Open PSOC creator IDE.

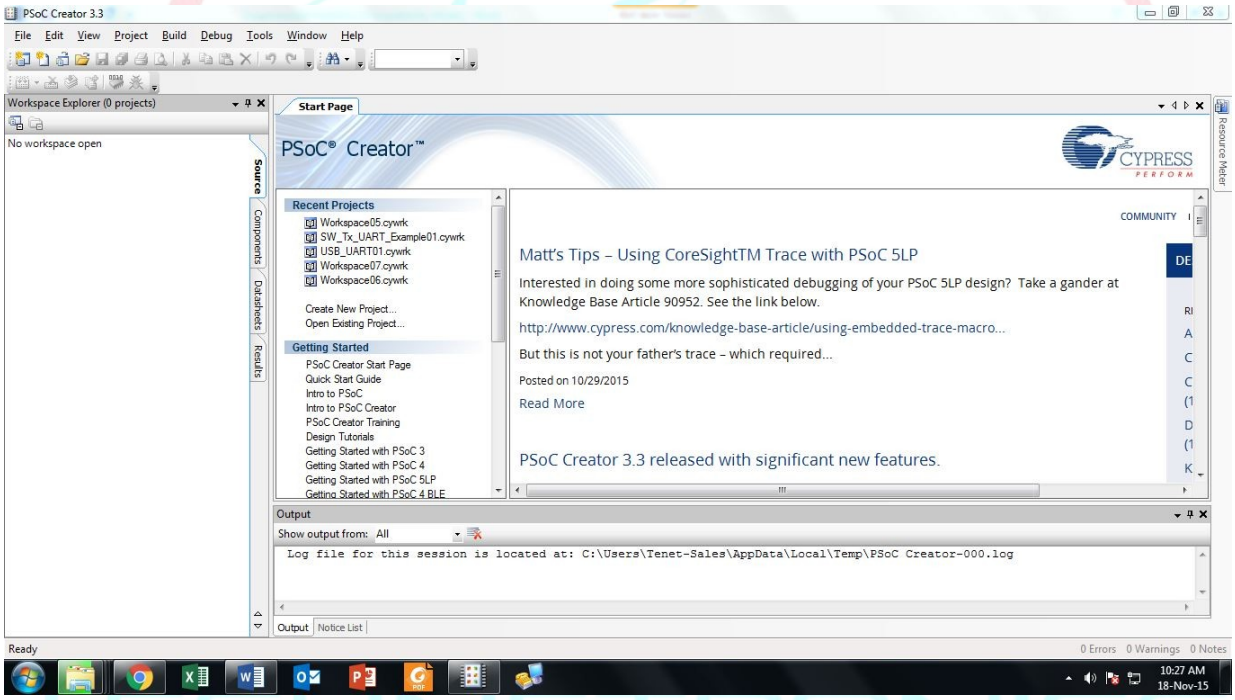


Figure 1

Step 2: File-> new project -> design -> PSoC 5LP design & save with desired name.

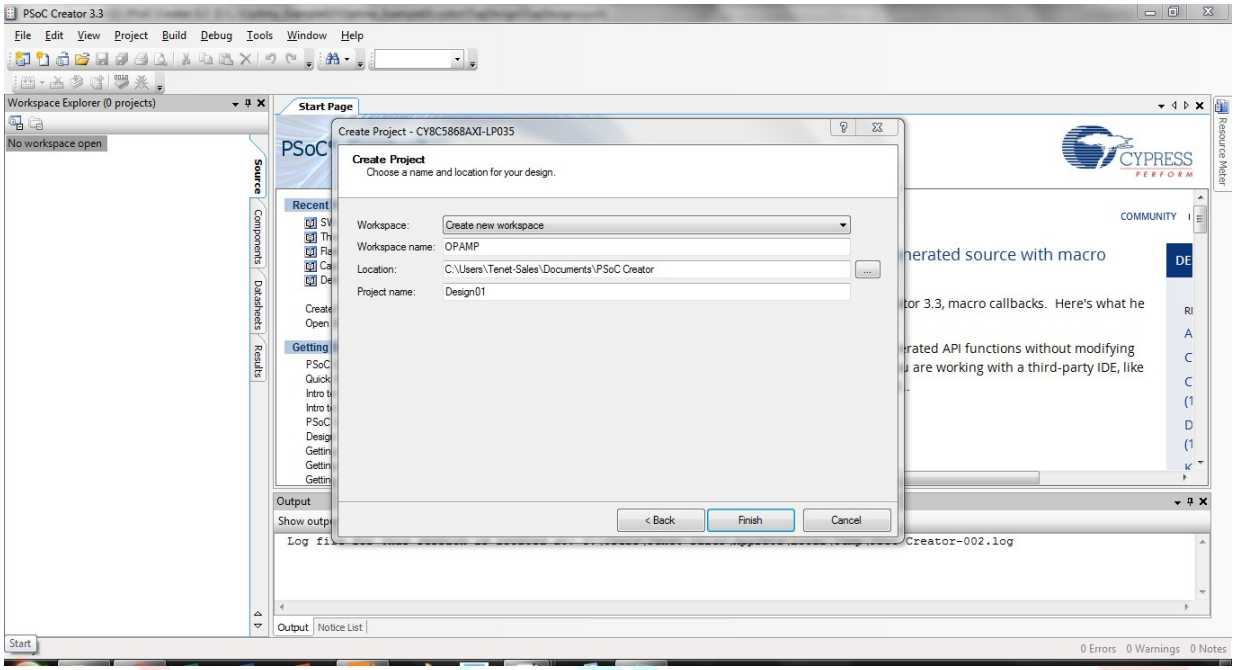


Figure 1

Step 3: Open TopDesign.cysch from workspace explorer.

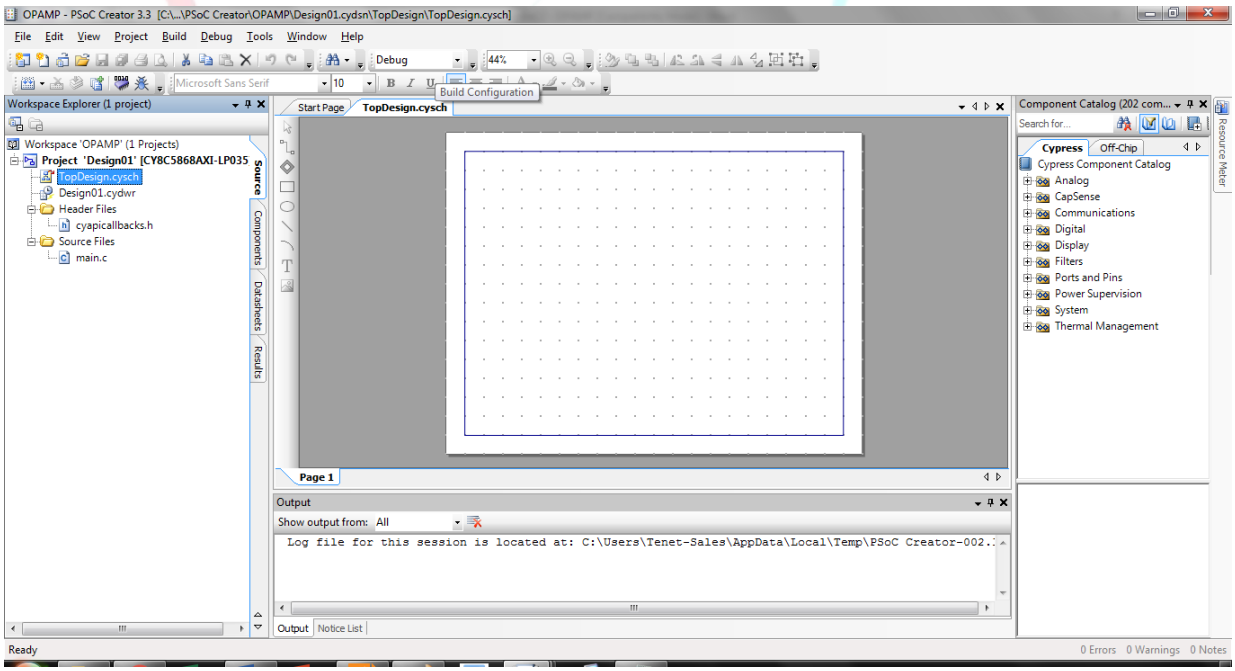


Figure 2

Step 4: Search for Op-amp block from the Component catalog on right side of the window. Drag the Op-amp block onto the workspace. Double click on the Op-amp block and change the name if you wish to. Configure it as High Power, Op-amp Mode.

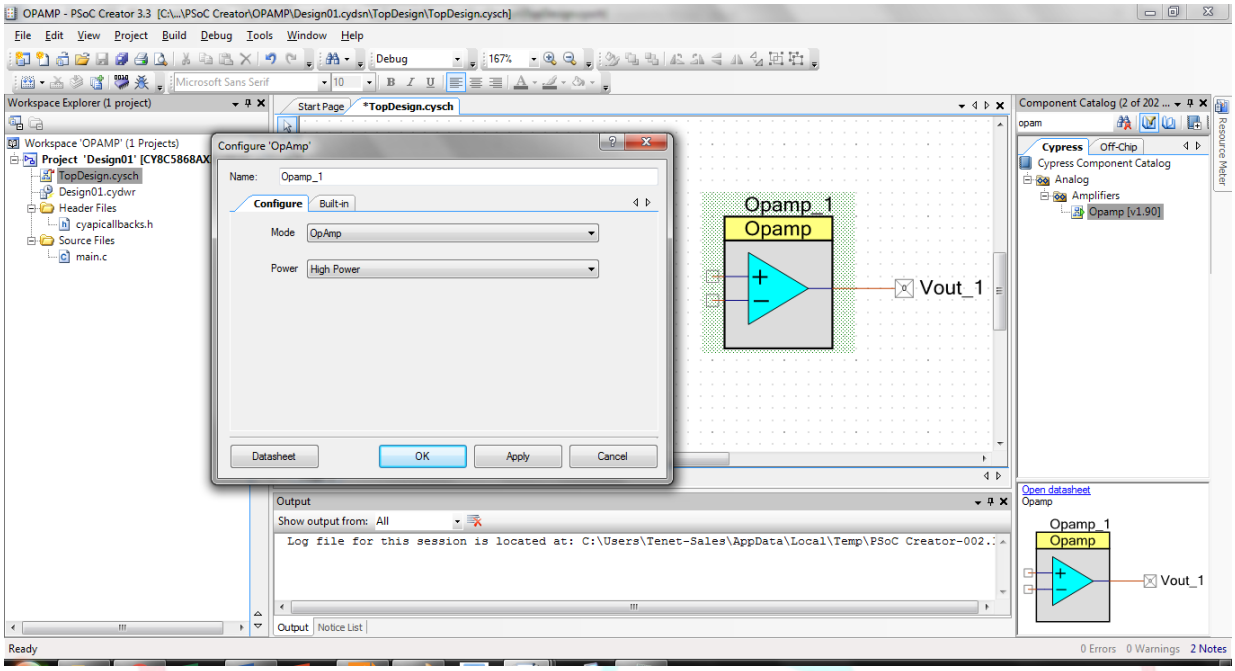


Figure 3

Step 5: Similarly drag Voltage DAC (VDAC) onto the workspace. Configure the Range and Value as shown. In this we have set VDAC value of 400 mV. Connect VDAC to Non-inverting terminal.

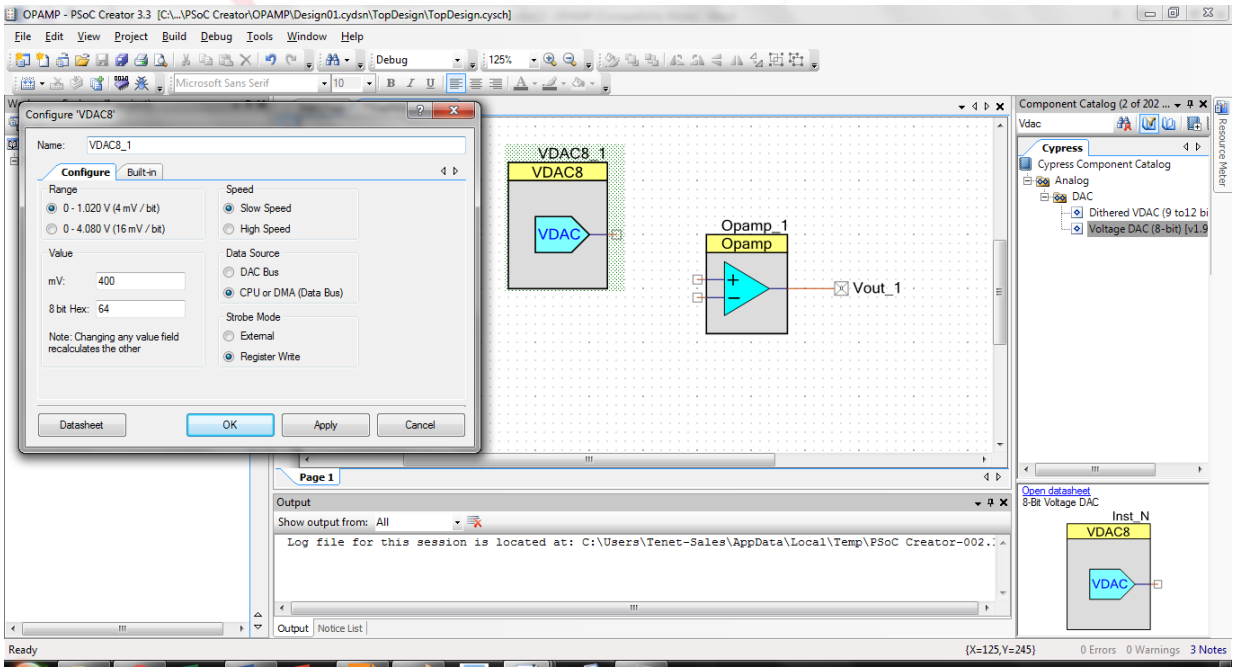


Figure 5

Step 6: Connect Analog pin to inverting terminal of Op-amp as shown.

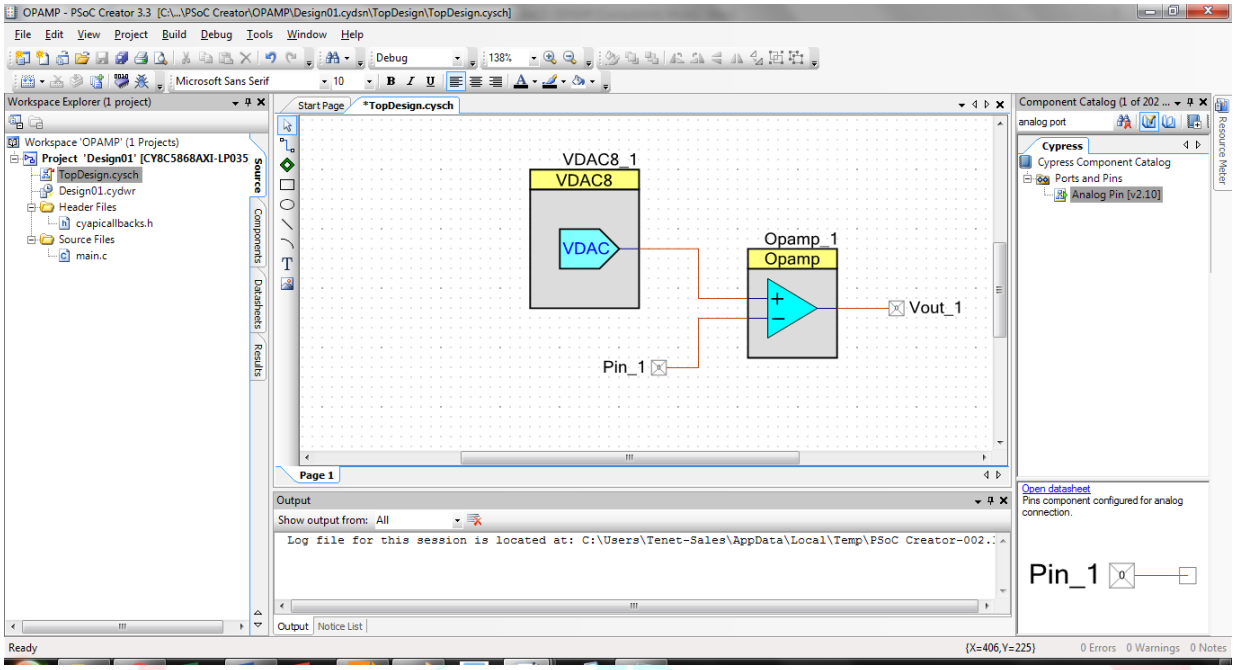


Figure 6

Step 7: To convert analog value of Op-amp to digital we need ADC. Configure ADC as shown below and also configure it as Single ended mode.

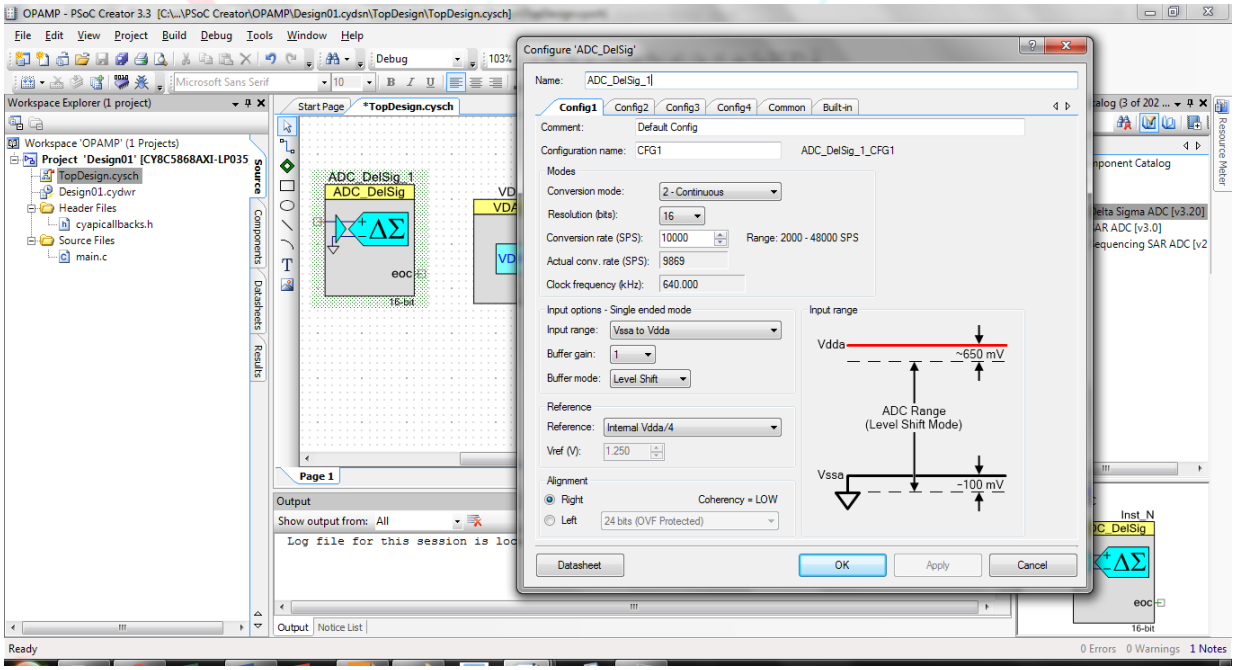


Figure 7

Step 8: To display Op-amp output voltage we employ character LCD as shown. After configuring build the project. As we can generate user-defined APIs which will ease us while writing code. We can see APIs generated in the Workspace Explorer on the left side of the window.

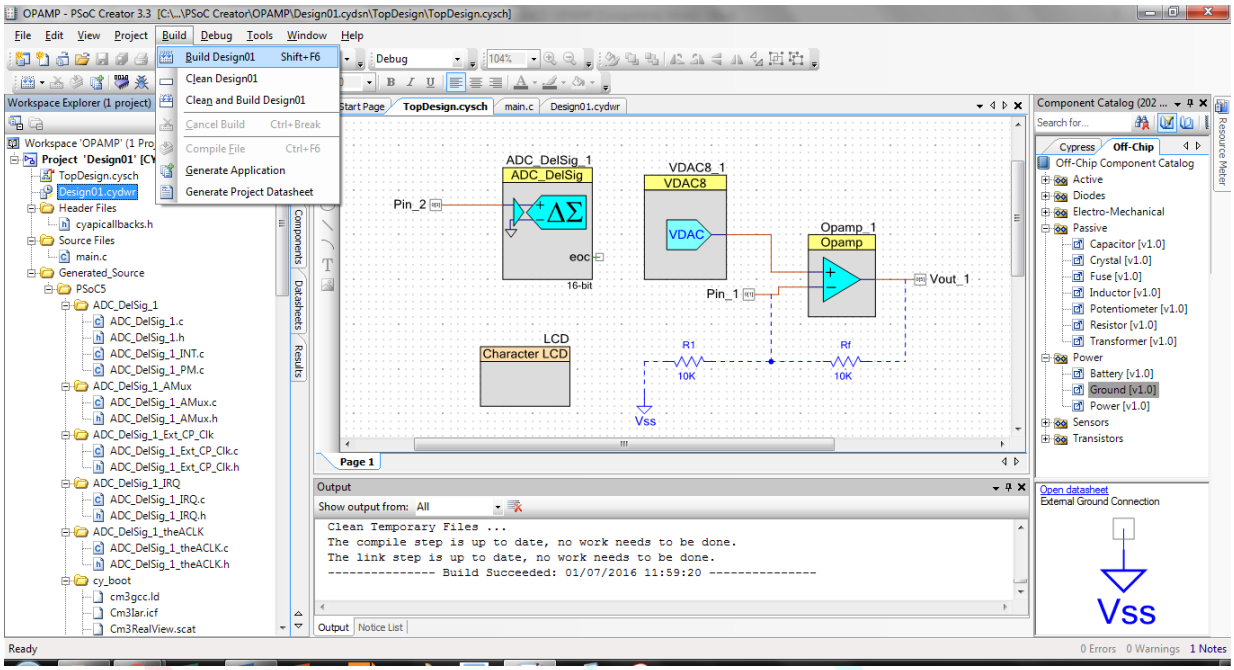


Figure 8

Step 9: Click on main.c from Workspace Explorer. Write the code and Build it.

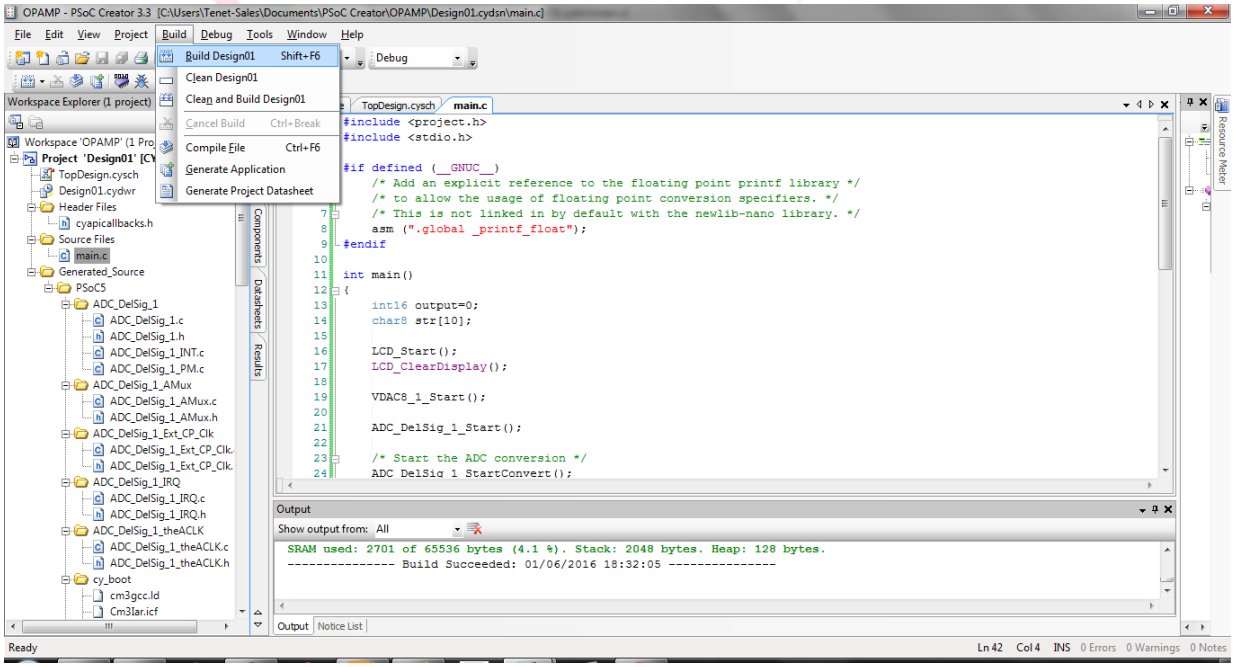


Figure 9

CODE:

```
#include <project.h>
#include <stdio.h>

int main()
{
    int16 output=0;
      char8 str[10];

    LCD_Start();
    LCD_ClearDisplay();

    VDAC8_1_Start();

    ADC_DelSig_1_Start();

    /* Start the ADC conversion */
    ADC_DelSig_1_StartConvert();

    /* Start the OpAmp component */
    Opamp_1_Start();

    /* Sets the OpAmp power mode to High power */
    Opamp_1_SetPower(Opamp_1_HIGHPOWER);


    for(;;)
    {
        if(ADC_DelSig_1_IsEndConversion(ADC_DelSig_1_RETURN_STATUS))
        {
            LCD_Position(0u, 0u);
            LCD_PrintString("OPAMP O/P (G=2)");
            output = ADC_DelSig_1_GetResult16();
            output = ADC_DelSig_1_CountsTo_mVolts(output) ;
            sprintf(str, "%d mV", output);

            LCD_Position(1u, 0u);
            LCD_PrintString(str);
            CyDelay(100u);
        }
    }
}
```

Step 10: Finally, double click on Design01.cydwr and assign pins to desired port and build it.

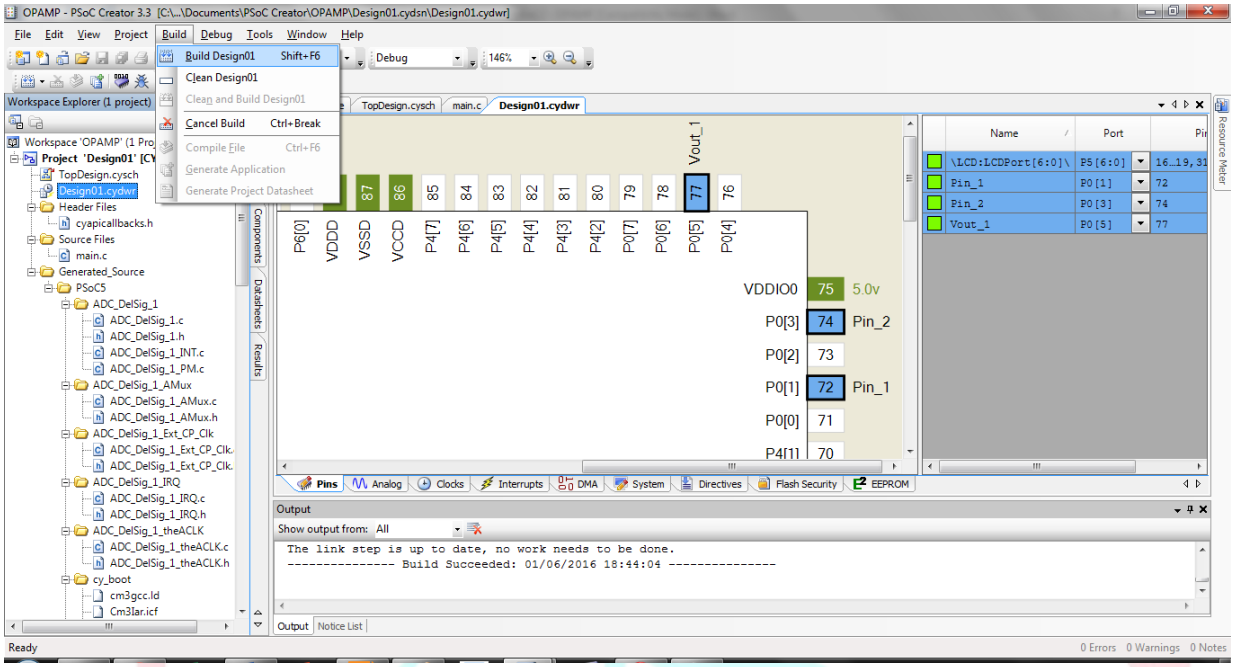


Figure 10

Step 11: If all goes well, go to Debug and click on Program.

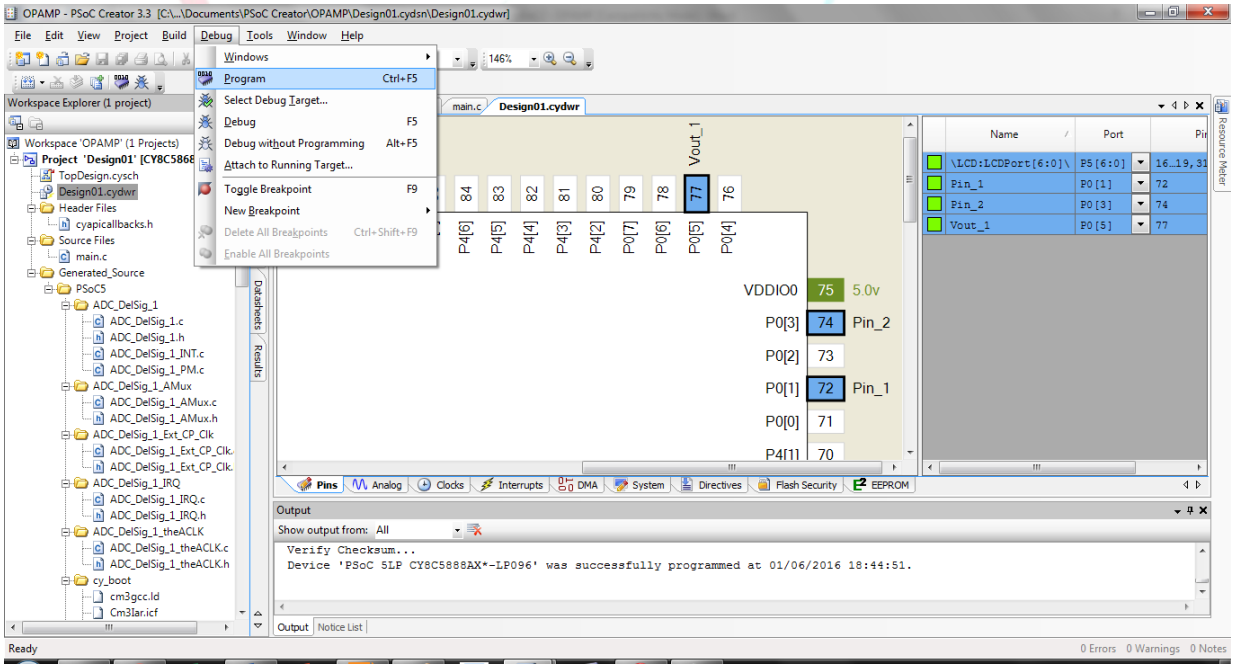
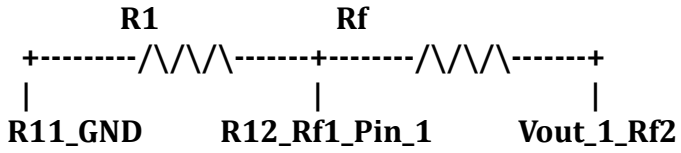


Figure 11

Circuit Explanation:

Op-amp Non-Inverting Mode:



Connect Rf = 10K resistor between Pin_1 and Vout_1
Connect R1= 10K resistor between GND and Pin_1
(Gain = 1+ Rf/R1, Gain = 2 if Rf = R1) (use R1, Rf = 10k Ohms or greater)

Parameter Settings:

Mode: Opamp
Power: High Power

Vout_1 (P0(1): Opamp Inverting input
Pin_1 (P0(3) : Opamp output

The non-inverting input voltage to the Opamp is given using VDAC8.
VDAC8 output is 0.4V

LCD PINOUT:

LCD pin out	FreeSoC2 Pin
1	GND
2	5V
3	GND
4	P5.5
5	P5.6
6	P5.4
7	Left Open
8	Left Open
9	Left Open
10	Left Open
11	P5.0
12	P5.1
13	P5.2
14	P5.3
15	5V
16	GND

Table 1

OUTPUT:

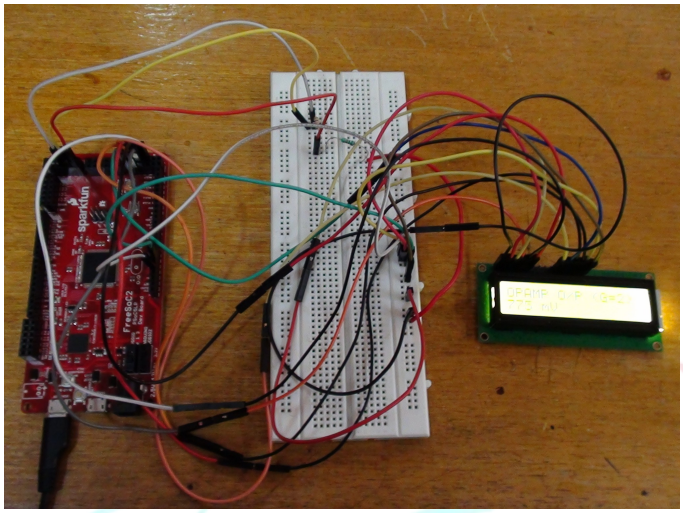


Figure 15

For Non-Inverting Input of 400 mV, R1=Rf=10K, Gain= 1+Rf/R1= 2.
Vout = Vin * Gain = 800 mV

Figure 16

For product link:

1. **http://www.tenettech.com/product/7241/freesoc2-development-board-psoc5lp**
2. **http://www.tenettech.com/product/2442/16-x-2-character-lcd-display-with-backlight-jhd162a-green**