Amplifier with Dynamic Gain Switching Example Project 1.0

Features

- Opamp as non-inverting amplifier
- ADC used in single ended mode
- HyperTerminal displays ADC results sent via UART
- LED indicates whenADC input is outside defined voltage window
- Analog Muxes multiplex three inputs and their corresponding gains
- Debouncer detects valid switch press

General Description

This example project is also a PSoC Creator starter design for the PSoC 4 device. It demonstrates the unique and flexible analog routing capability of PSoC 4 to change the Opamp input and feedback network in the real time. In this project, every input has corresponding dedicated feedback networks and hence different gains. The user can change the active channel by pressing a switch.

Development Kit Configuration

This example project is designed to run on the CY8CKIT-042 kit from Cypress Semiconductor. A full description of the kit, along with more example programs and ordering information, can be found at http://www.cypress.com/go/cy8ckit-042.

The project requires the following configuration settings changes in order to run on CY8CKIT-042 BLE from Cypress Semiconductor. A full description of the kit, along with more example programs and ordering information, can be found at http://www.cypress.com/go/cy8ckit-042-ble.

In order to switch from CY8CKIT-042 to CY8CKIT-042 BLE the following steps are performed:

1. Change the project's device from CY8C4245AXI-483 to CY8C4247LQI-BL483 with Device Selector called from the project's context menu.
2. Assign t Pin Components to physical pins. In the Workspace Explorer window, double-click the project's design-wide resource file and assign the pins as shown in Table 1.

Table 1. Pin Assignment

Pin Name	Development Kit	
	CY8CKIT-042	CY8CKIT-042-BLE
A_Out	P1[2]	P1[2]
UART	P0[5]	P1[5]
LED	P1[6]	P2[6]
Input Signals	P2[2:0]	P2[2:0]
Opamp feedback	P2[3], P2[4], P2[5]	P2[3], P2[4], P2[5]
Switch	P0[7]	P2[7]

The following configuration instructions provide a guideline to test this design. For simplicity, the instructions describe the stepwise process to be followed when testing this design with the PSoC 4 Pioneer Kit (CY8CKIT-042).

1. Set jumper J9 (J16 for CY8CKIT-042-BLE) to 5.0V position.
2. Connect three input signals to P2[0], P2[1], P2[2].
3. Connect all the external resistors as shown in the top design schematic.
4. Connect P0[5] to pin P12[6] on header J8. For example project operation on CY8CKIT-042-BLE no extra connection required.
5. Connect a USB cable to the PSoC 4 Pioneer Kit DVK and PC with the HyperTerminal program.

Project Configuration

This example project consists of ADC SAR Seq, Opamp, AMuxSeq, UART, and Debouncer components. The top design schematic is shown in Figure 1. The Opamp is used to amplify the input signal; the input channel is selected using Input_AMux and the feedback network is selected using Gain_AMux. A UART is used to send ADC results to HyperTerminal. Debouncer is used to remove glitches from the input switch. The SAR ADC converts the analog output of the Opamp, into digital values. The ADC also generates an interrupt when its input is outside the defined voltage window (250mV – 750mV). The LED turns on when the ADC generates this interrupt. The UART component sends the ADC output of the active channel along with the channel number to HyperTerminal.

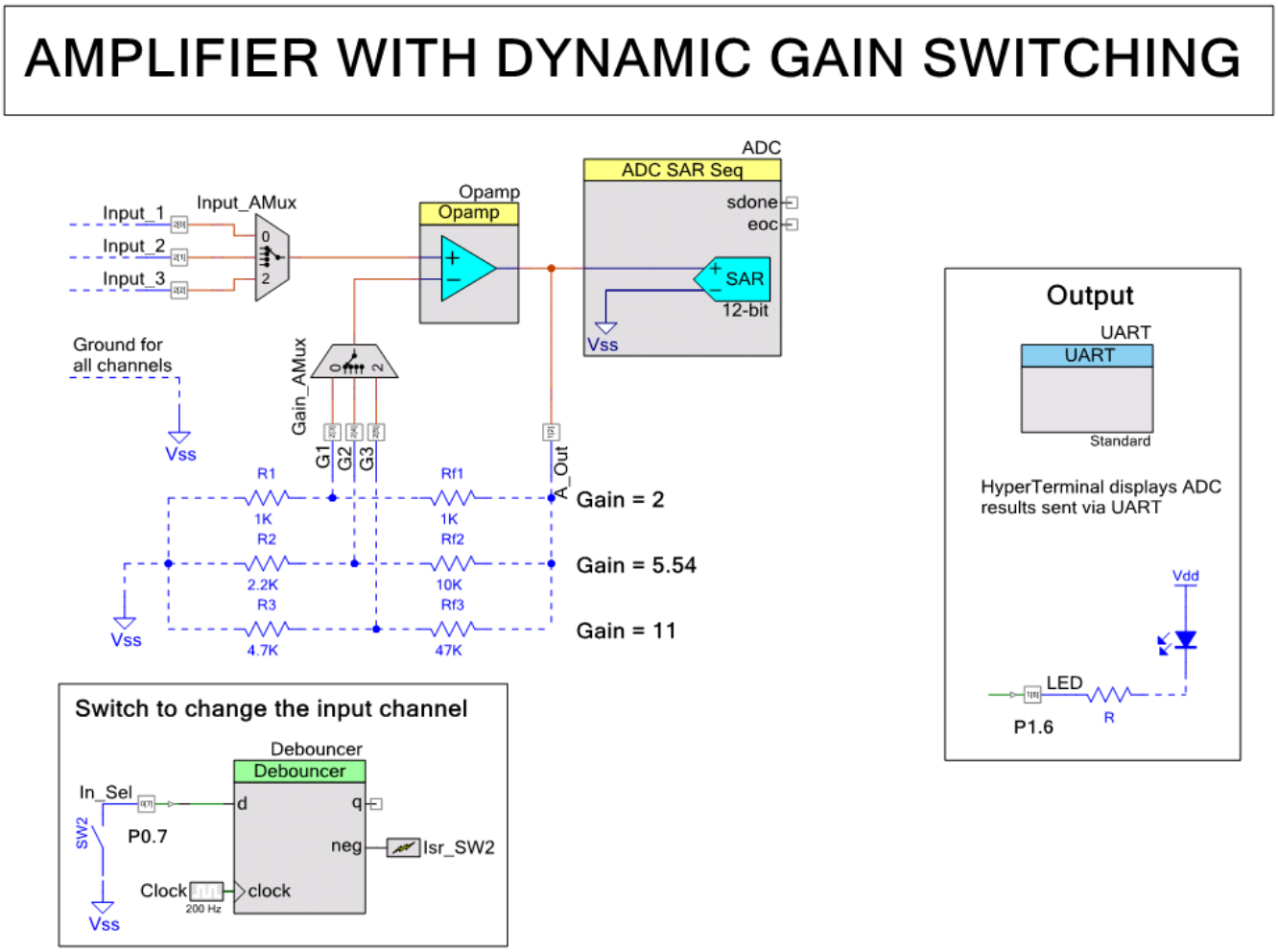

Figure 1. Top Design Schematic

The Opamp is configured in high stability, high power, 10mA output current mode. The ADC is configured in single ended mode. The ADC averages 256 consecutive samples to produce the final result. The ADC component configuration is shown in Figure 2. Switch SW2 and pin In_Sel is used to change the analog mux channels, Input_AMux selects the input channel and Gain_AMux selects the corresponding gain.

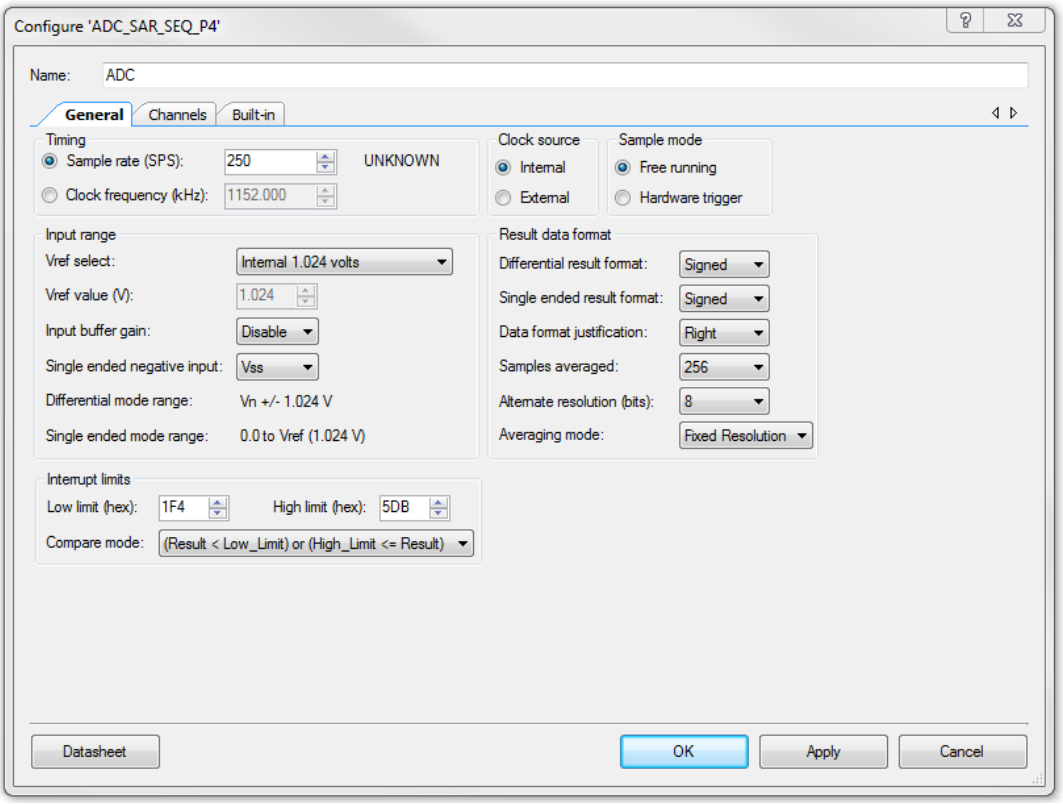

Figure 2. ADC Configuration Window

Project Description

In the main function all components are started, both the analog muxes are initialized to select the channel zero and ADC conversion is started. The “for” loop in the main.c waits for the ADC to finish conversion. When the ADC result is available, it is sent through a UART to HyperTerminal. The ADC continuously generates an interrupt when its input is outside the defined voltage window (250mV –750mV). This interrupt is used to control an LED. This LED is turned ON when the ADC input is outside the window.

Expected Results

The analog input channel should change when switch SW2 is pressed. HyperTerminal displays the active channel and its input voltage. The LED will turn on when the ADC result is outside the voltage window (250mV – 750mV).

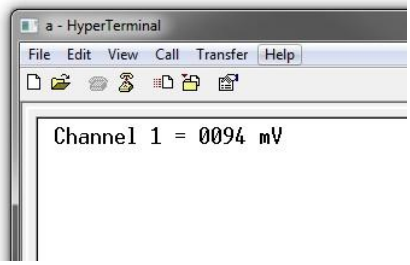

Figure 3. Result

Schematic

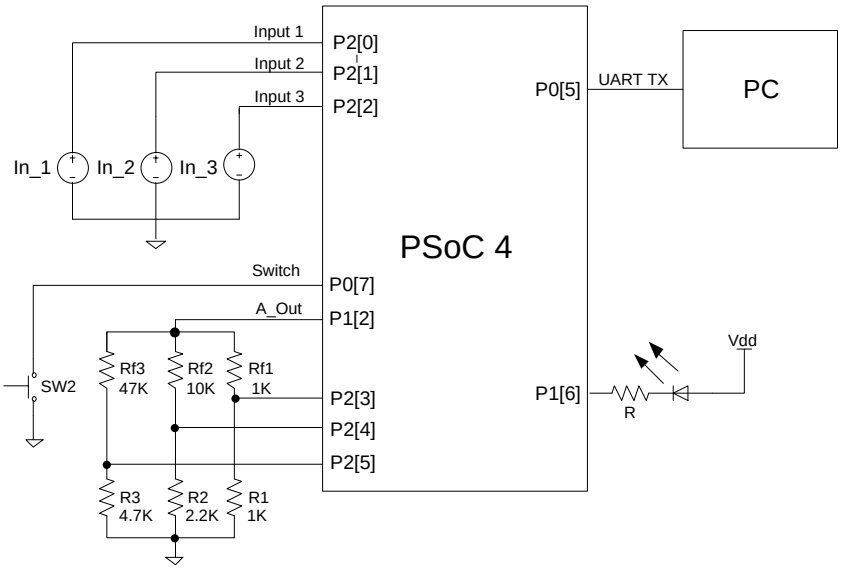

Figure 4. Connection Schematic

Note: If the LED is active HIGH, replace LOW with HIGH to turn the LED ON and vice-versa. The Section of the code that needs to be changed in "main.c" is mentioned below:

```
/* Turn ON the LED when the input is outside the window (250mV - 750mV) */
    LED_Write(LOW);

/* Turn OFF the LED when the input is within the defined window (250mV - 750mV) */
    LED_Write(HIGH)
```

Using UART to communicate with PC Host

This example project communicates with the PC host using a UART. The HyperTerminal program is required in the PC to communicate with PSoC 4. If you don't have the HyperTerminal program installed, download, and install any serial port communication program. Free wares such as HyperTerminal, Bray's Terminal etc. are available on the Web.

Follow these steps to communicate with the PC host.

1. Connect the USB cable between the PC and PSoC 4 Pioneer Kit.
2. Open the device manager program in your PC, find the COM port in which the PSoC 4 is connected, and note the port number.
3. Open the HyperTerminal program and select the COM port in which the PSoC 4 is connected.

4. Configure the Baud rate, Parity, Stop bits, and Flow control information in the HyperTerminal configuration window. These settings should match the configuration of the PSoC Creator UART component in the project

5. Start communicating with the device as explained in the project description.

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