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CE195293 – Analog Voltage Comparator with PSoC 4

Objective

This code example demonstrates the PSoC® 4 Comparator Component in the Inverting polarity and calibrating feature.

Overview

This code example uses the Comparator Component to compare input voltages and the Analog Mux Component to switch the comparator's inputs between operation and calibration modes. Calibration mode is used to minimize the Comparator's input voltage offset. The Comparator's output value is shown using a LED.

Requirements

Tool: PSoC Creator™ 4.1 Update 1

Programming Language: C (Arm® GCC 5.4-2016-q2-update and Arm MDK 5.22)

Associated Parts: PSoC 4200, PSoC 4200 BLE, PSoC 4200M, PSoC 4200L

Related Hardware: CY8CKIT-042, CY8CKIT-042-BLE, CY8CKIT-042-BLE-A, CY8CKIT-044, CY8CKIT-046

Hardware Setup

This example uses the kit's default configuration with the VDD SELECT jumper set to 5V. Refer to the kit guide to ensure that the kit is configured correctly.

For the voltage reference, connect the voltage divider or any other voltage reference to the Vminus pin as shown in Figure 1. To achieve the minimum input offset, voltage reference value must be the same in calibration and operation modes.

This example project is designed to run on the CY8CKIT-042 development kit from Cypress Semiconductor. The project requires the target device change to run on other kits. Table 1 lists the supported kits and corresponding devices. To switch from CY8CKIT-042 to any other kit, change the project's device with **Device Selector** called from the project's context menu.

Note: For Cypress kits, you can quickly select the target device. In **Device Selector**, right-click anywhere in the table area and select **Select Default Device**, then select your kit's device series. For the series name, refer to Table 1.

Table 1. Supported Kits and Devices

Development Kit	Series	Device
CY8CKIT-042	PSoC 4200	CY8C4245AXI-483
CY8CKIT-042-BLE	PSoC 4200 BLE	CY8C4247LQI-BL483
CY8CKIT-042-BLE-A	PSoC 4200 BLE	CY8C4248LQI-BL483
CY8CKIT-044	PSoC 4200M	CY8C4247AZI-M485
CY8CKIT-046	PSoC 4200L	CY8C4248BZI-L489

The pin assignments for the supported kits are provided in Table 2. For these kits, the project includes control files to automatically assign the pins with respect to the kit hardware connections during the project build. To change the pin assignments, over-ride the control file selections in the Pin Editor of the Design Wide Resources by selecting the new port or pin number.

Table 2. Pin Assignments

Development Kit	Pin Assignment		
	Vplus	Vminus	LED
CY8CKIT-042	P1[0]	P1[1]	P0[2]
CY8CKIT-042-BLE			P3[6]
CY8CKIT-042-BLE-A			P3[6]
CY8CKIT-044			P2[6]
CY8CKIT-046			P5[3]

Software Setup

None.

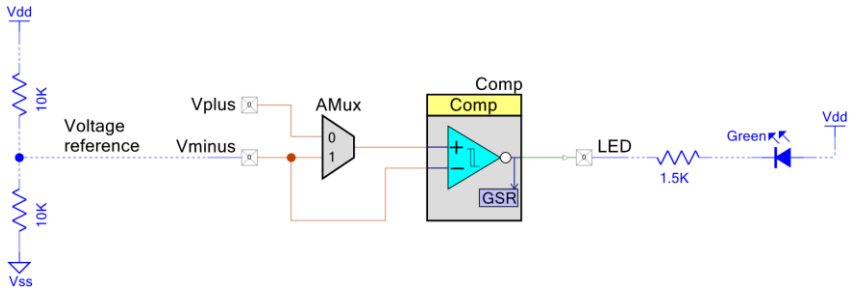
Operation

1. Plug your kit board into your computer's USB port.
2. Build the project and program it into the PSoC 4 device. Choose **Debug** > **Program**. For more information on device programming, see the PSoC Creator Help.
3. Connect the voltage reference to the Vminus pin. As voltage reference, you may use kit's 3.3V source.
4. Press the kit's **Reset** button to calibrate the Comparator.
5. Connect the Vplus pin to Gnd or Vdd and observe the LED state. If the voltage on the Vplus pin is greater than the voltage on the Vminus pin, the LED turns ON, otherwise the LED turns OFF.

Note: You can use external variable voltage source such as variable resistor to provide the input voltage for the Comparator.

Design and Implementation

Figure 1. Top Design Schematic



This example project consists of the Comparator and Analog Mux Components. The Comparator Component is used to compare the input voltage to an external voltage reference. The Analog Mux Component is used to switch the comparator's inputs between operation and calibration modes. Calibration of the Comparator minimizes the error for a set of conditions: the comparator reference voltage, supply voltage, and operating temperature and allows to achieve the input offset less than 1mV. In calibration mode, the reference voltage, Negative and Positive inputs of the comparator are connected. In operation mode, the Positive input of the comparator is connected to the Vplus pin.

The firmware performs the following functions:

1. Starts the Comparator and Analog Mux Components.

2. Performs Comparator calibration by connecting the Positive and Negative inputs of the Comparator with the voltage reference using Analog Mux and calls the `Comp_ZeroCal()` function.

3. Prepares the Comparator to the normal operation: the Analog Mux connects the Positive input of the Comparator to the Vplus pin.

Components and Settings

Table 3 lists the PSoC Creator Components used in this example, how they are used in the design, and the non-default settings required so they function as intended.

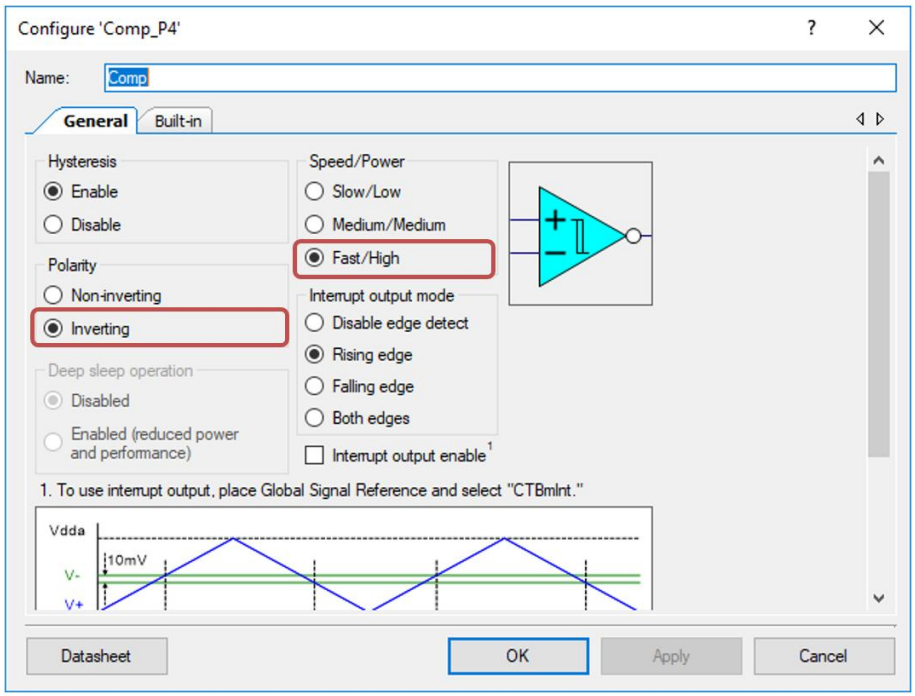
Table 3. PSoC Creator Components

Component	Instance Name	Purpose	Non-default Settings
Comparator	Comp	Compare input voltage values	See Figure 2
Analog Mux	AMux	Connect the Comparators inputs for calibration	Channels: 2
Analog Pin	Vplus	Analog inputs of the Comparator	None.
	Vminus		
Digital Output Pin	LED	Output signal from the Comparator	None.

For information on the hardware resources used by the Component, see the Component datasheet.

Figure 2 shows the Comparator Component configuration with the highlighted non-default settings.

Figure 2. Comparator Component Configuration



Reusing This Example

This example is designed to run on the PSoC 4 Cypress kits listed in Table 1. To port the design to a different supported PSoC 4 device, change the target device using **Device Selector** and update the pin assignments in the Design Wide Resources Pins settings.

This example may be adapted to work with other PSoC 4 devices which have a hardware comparator but do not have Universal Digital Blocks (UDB) used to invert the comparator's output. To work with another PSoC 4 device, set Polarity to Non-Inverting in the Comparator's Component settings.

Related Documents

Application Notes	
AN79953 – Getting Started with PSoC 4	Introduces the PSoC 4 architecture and development tools.
PSoC Creator Component Datasheets	
Voltage Comparator	Supports internal hardware comparator of PSoC 4
Analog Multiplexer	Supports configurable analog signal connections to a different common analog signal
Pins	Supports connection of hardware resources to physical pins
Device Documentation	
PSoC 4 Datasheets	PSoC 4 Technical Reference Manuals
Development Kit Documentation	
PSoC 4 Kits	

Document History

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**	5987265	MYKZTMP1	12/08/2017	New code example

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