CE220799 – PSoC 6 MCU: Direction Detection Using Quadrature Decoder

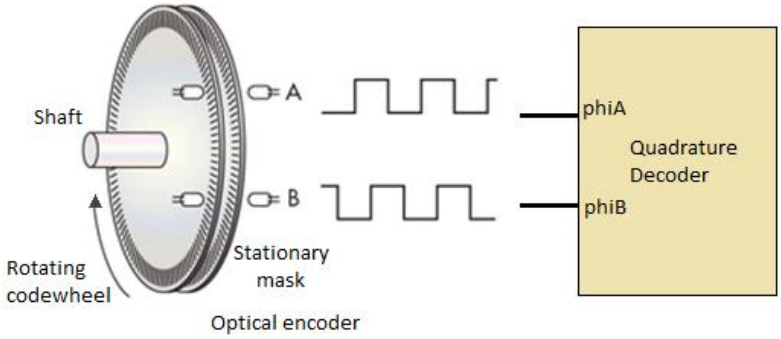
Objective

This code example demonstrates how to use the TCPWM Component in quadrature decoder mode in PSoC® 6 MCU.

Overview

This code example shows the TCPWM Component is configured in quadrature decoder mode, to detect the direction of rotation of a shaft. This example emulates an optical encoder (Figure 1) that detects shaft rotation. If the shaft rotates clockwise, **A** leads **B**; if it rotates anti-clockwise, **B** leads **A**. The result is shown using LEDs: for clockwise rotation, a red LED is ON; for anti-clockwise rotation, a green LED is ON. When rotation stops, both LEDs are turned off.

Figure 1.Project Overview



This code example assumes that you are familiar with the PSoC 6 MCU device and the PSoC Creator™ IDE. If you are new to PSoC 6 MCU, see the application note AN210781 – Getting Started with PSoC 6 MCU with Bluetooth Low Energy (BLE) Connectivity.

Requirements

Tool: PSoC Creator 4.2

Programming Language: C (ARM® GCC 5.4.1, ARM MDK 5.22)

Associated Parts: PSoC 6 MCU

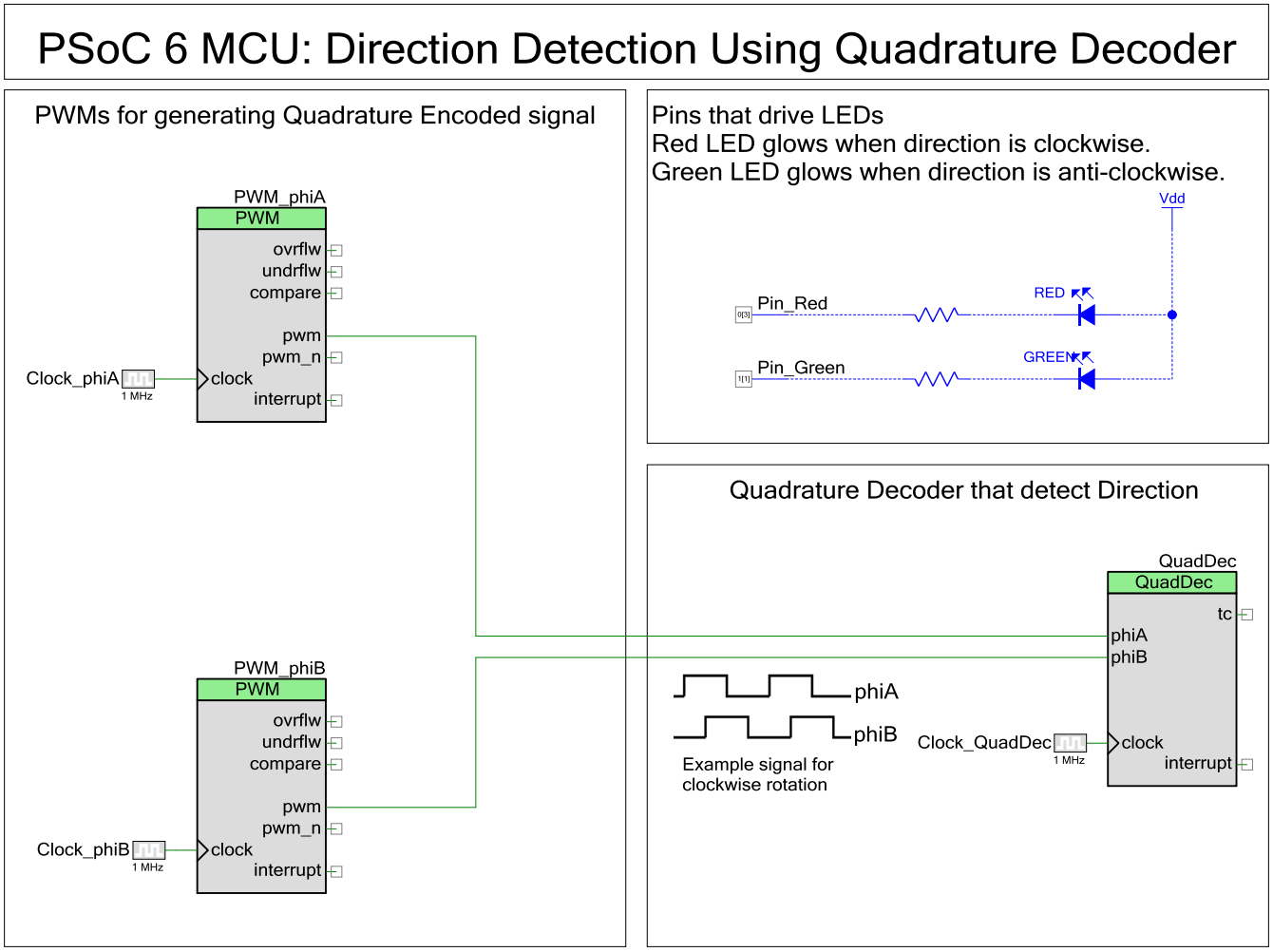
Related Hardware: CY8CKIT-062-BLE PSoC 6 BLE Pioneer Kit

Design

To emulate the optical encoder, the design uses two PWM Components. Each PWM Component uses a TCPWM block in PWM mode. The output frequency of both PWMs is the same, but they are 90° out of phase. The PWM Components are configured to generate signals at 250 Hz.

To detect the direction of rotation, a Quadrature Decoder Component is used. This Component uses a TCPWM block configured as quadrature decoder. The counter of the quadrature decoder is initialized with a midpoint counter value on an index event. The counter value changes (increases/ decreases) based on the quadrature input signal. A positive edge on phiA increments the counter when phiB is 0 and decrements the counter when phiB is 1. Therefore, if phiA leads phiB, the count value of the Quadrature Decoder increases; if phiB leads phiA, the count value decreases. Based on the current and the previous counter values the direction of rotation is determined. Digital Output Pins drive the LEDs. If the rotation is clockwise, the red LED is ON; if it is counter-clockwise, the green LED is ON.

Figure 2. Project Schematic



Components

Table 1 lists the PSoC Creator Components used in this example, as well as the hardware resources used by each.

Table 1. PSoC Creator Component

Components	Instance name	Settings (Non-Default)	Hardware Resources
PWM	PWM_phiA PWM_phiB	**[General tab]** Period:3999u Compare:2000u	2 TCPWM
Quadrature Decoder	QuadDec	**[General tab]** Quadrature mode: x1	1 TCPWM
Clock	Clock_phiA Clock_phiB Clock_Quaddec	Frequency: 1 MHz	3 peripheral clock dividers
Digital Output Pin	Pin_Red Pin_Green	Default settings	2 GPIO pins

Design-Wide Resources

Table 2 shows the physical pins used.

Table 2. Pin Names and Locations

Pin Name	Location
Pin_Red	P0[3]
Pin_Green	P1[1]

Operation

1. Plug the CY8CKIT-062 kit board into your computer's USB port.
2. In the *main_cm0p.c* file, find the line "`#define ROTATION`" and select direction **`CLOCKWISE`**, **`ANTI_CLOCKWISE`** or, **`NO_ROTATION.`**
3. Build the project and program it into the PSoC 6 MCU device. Choose **Debug** > **Program**. For more information on device programming, see PSoC Creator Help. Flash for both CPUs is programmed in a single program operation.
4. On successful programming, the red LED glows when the direction is clockwise; the green LED glows when the direction is counter-clockwise. Both LEDs are turned off when no rotation is detected.

Related Documents

Application Notes	
AN210781 – Getting Started with PSoC 6 MCU with Bluetooth Low Energy (BLE) Connectivity	Introduction of PSoC 6 MCU with Bluetooth Low Energy (BLE)
PSoC Creator Component Datasheets	
TCPWM	Supports configuration of the TCPWM hardware for Timer/Counter functionality
Clock	Supports local clock generation
Pins	Supports connection of hardware resources to physical pins
Device Documentation	
PSoC 6 MCU: PSoC 63 with BLE Datasheet	PSoC 6 MCU: PSoC 63 with BLE Architecture Technical Reference Manual
Development Kit (DVK) Documentation	
CY8CKIT-062-BLE Pioneer Kit	

Document History

Document Title: CE220799 – PSoC 6 MCU: Direction Detection Using Quadrature Decoder

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Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	5896810	AJYA	09/26/2017	New code example

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