Please note that Cypress is an Infineon Technologies Company.
The document following this cover page is marked as “Cypress” document as this is the company that originally developed the product. Please note that Infineon will continue to offer the product to new and existing customers as part of the Infineon product portfolio.

Continuity of document content
The fact that Infineon offers the following product as part of the Infineon product portfolio does not lead to any changes to this document. Future revisions will occur when appropriate, and any changes will be set out on the document history page.

Continuity of ordering part numbers
Infineon continues to support existing part numbers. Please continue to use the ordering part numbers listed in the datasheet for ordering.

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.

Requirements

Tool: PSoC Creator™ 4.2; Peripheral Driver Library (PDL) 3.0.3

Programming Language: C (Arm® GCC 5.4.1 and Arm MDK 5.22)

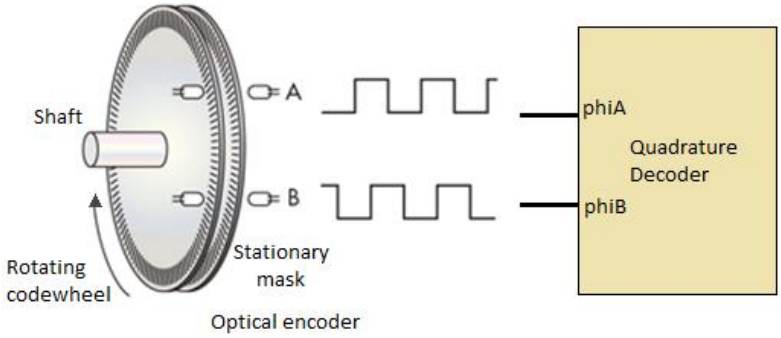
Associated Parts: All PSoC 6 MCU parts

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

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 integrated development environment (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.

Hardware Setup

This example uses the kit's default configuration. See the kit guide to ensure that the kit is configured correctly.

Software Setup

None.

Operation

1. Plug the CY8CKIT-062 kit board into your computer's USB port.
2. In the *main_cm4.c* file, select direction **`CLOCKWISE`**, **`ANTI_CLOCKWISE`**, or **`NO_ROTATION`** by changing the value of variable **`emulated_rotation`**.

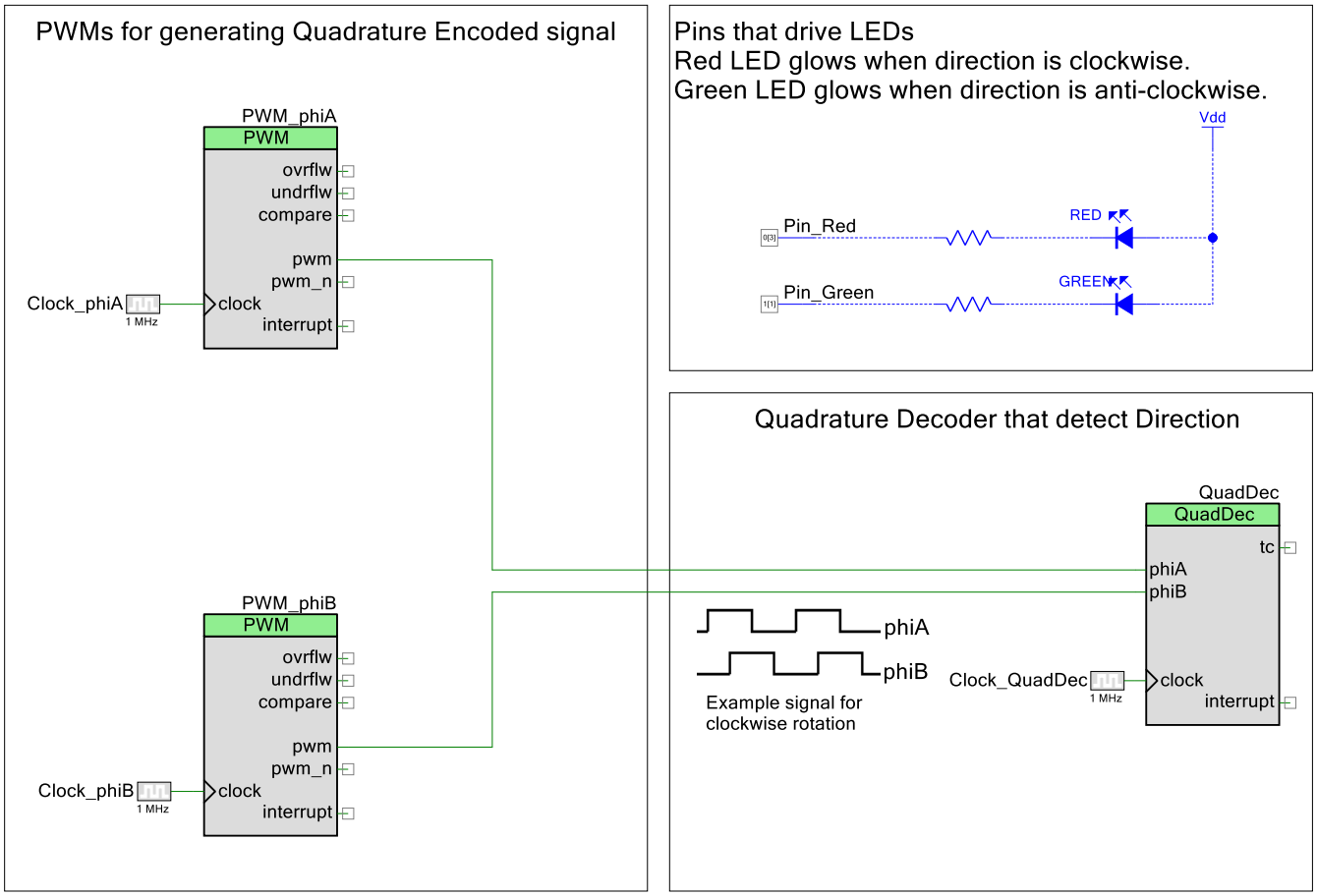
3. Build the project and program it into the PSoC 6 MCU device. Choose **Debug** > **Program**. For more information on device programming, see PSoC Creator Help. Flash for both CPUs is programmed in a single program operation.
4. On successful programming, the red LED glows when the direction is clockwise; the green LED glows when the direction is counter-clockwise. Both LEDs are turned OFF when no rotation is detected.

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 non-default settings required so they function as intended.

Table 1. PSoC Creator Component

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

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]

Related Documents

Application Notes	
AN210781 – Getting Started with PSoC 6 MCU with BLE Connectivity	Describes PSoC 6 MCU with BLE Connectivity devices and how to build your first PSoC Creator project
AN215656 – PSoC 6 MCU Dual-CPU System Design	Describes the dual-CPU architecture in PSoC 6 MCU, and shows how to build a simple dual-CPU design
AN219434 – Importing PSoC Creator Code into an IDE for a PSoC 6 MCU Project	Describes how to import the code generated by PSoC Creator into your preferred IDE
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 PSoC 6 BLE Pioneer Kit	
Tool Documentation	
PSoC Creator	Look in the downloads tab for Quick Start and User Guides

Document History

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

Document Number: 002-20799

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	5896810	AJYA	09/26/2017	New code example
*A	6302648	AJYA	09/11/2018	Document template updated

Worldwide Sales and Design Support

Cypress maintains a worldwide network of offices, solution centers, manufacturer's representatives, and distributors. To find the office closest to you, visit us at Cypress Locations.

Products

Arm® Cortex® Microcontrollers	cypress.com/arm
Automotive	cypress.com/automotive
Clocks & Buffers	cypress.com/clocks
Interface	cypress.com/interface
Internet of Things	cypress.com/iot
Memory	cypress.com/memory
Microcontrollers	cypress.com/mcu
PSoC	cypress.com/psoc
Power Management ICs	cypress.com/pmic
Touch Sensing	cypress.com/touch
USB Controllers	cypress.com/usb
Wireless Connectivity	cypress.com/wireless

PSoC® Solutions

PSoC 1 | PSoC 3 | PSoC 4 | PSoC 5LP | PSoC 6 MCU

Cypress Developer Community

Community | Projects | Videos | Blogs | Training | Components

Technical Support

cypress.com/support

All other trademarks or registered trademarks referenced herein are the property of their respective owners.

Cypress Semiconductor
198 Champion Court
San Jose, CA 95134-1709

© Cypress Semiconductor Corporation, 2017-2018. This document is the property of Cypress Semiconductor Corporation and its subsidiaries, including Spansion LLC ("Cypress"). This document, including any software or firmware included or referenced in this document ("Software"), is owned by Cypress under the intellectual property laws and treaties of the United States and other countries worldwide. Cypress reserves all rights under such laws and treaties and does not, except as specifically stated in this paragraph, grant any license under its patents, copyrights, trademarks, or other intellectual property rights. If the Software is not accompanied by a license agreement and you do not otherwise have a written agreement with Cypress governing the use of the Software, then Cypress hereby grants you a personal, non-exclusive, nontransferable license (without the right to sublicense) (1) under its copyright rights in the Software (a) for Software provided in source code form, to modify and reproduce the Software solely for use with Cypress hardware products, only internally within your organization, and (b) to distribute the Software in binary code form externally to end users (either directly or indirectly through resellers and distributors), solely for use on Cypress hardware product units, and (2) under those claims of Cypress's patents that are infringed by the Software (as provided by Cypress, unmodified) to make, use, distribute, and import the Software solely for use with Cypress hardware products. Any other use, reproduction, modification, translation, or compilation of the Software is prohibited.

TO THE EXTENT PERMITTED BY APPLICABLE LAW, CYPRESS MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARD TO THIS DOCUMENT OR ANY SOFTWARE OR ACCOMPANYING HARDWARE, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. No computing device can be absolutely secure. Therefore, despite security measures implemented in Cypress hardware or software products, Cypress does not assume any liability arising out of any security breach, such as unauthorized access to or use of a Cypress product. In addition, the products described in these materials may contain design defects or errors known as errata which may cause the product to deviate from published specifications. To the extent permitted by applicable law, Cypress reserves the right to make changes to this document without further notice. Cypress does not assume any liability arising out of the application or use of any product or circuit described in this document. Any information provided in this document, including any sample design information or programming code, is provided only for reference purposes. It is the responsibility of the user of this document to properly design, program, and test the functionality and safety of any application made of this information and any resulting product. Cypress products are not designed, intended, or authorized for use as critical components in systems designed or intended for the operation of weapons, weapons systems, nuclear installations, life-support devices or systems, other medical devices or systems (including resuscitation equipment and surgical implants), pollution control or hazardous substances management, or other uses where the failure of the device or system could cause personal injury, death, or property damage ("Unintended Uses"). A critical component is any component of a device or system whose failure to perform can be reasonably expected to cause the failure of the device or system, or to affect its safety or effectiveness. Cypress is not liable, in whole or in part, and you shall and hereby do release Cypress from any claim, damage, or other liability arising from or related to all Unintended Uses of Cypress products. You shall indemnify and hold Cypress harmless from and against all claims, costs, damages, and other liabilities, including claims for personal injury or death, arising from or related to any Unintended Uses of Cypress products.

Cypress, the Cypress logo, Spansion, the Spansion logo, and combinations thereof, WICED, PSoC, CapSense, EZ-USB, F-RAM, and Traveo are trademarks or registered trademarks of Cypress in the United States and other countries. For a more complete list of Cypress trademarks, visit cypress.com. Other names and brands may be claimed as property of their respective owners.