

Objective

This example shows how to use the PSoC® Creator™ Timer Counter Pulse Width Modulator (TCPWM) Component configured as a PWM in a PSoC 4 device.

Requirements

Tool: [PSoC Creator 4.2](#)

Programming Language: C (Arm® GCC 5.4.1)

Associated Parts: [PSoC 4 family](#)

Related Hardware: [CY8CKIT-042 PSoC 4 Pioneer Kit](#)

Overview

This example contains two projects that use the PWM Component. The TCPWM_PWM_LED_RateSwap project demonstrates how PWM drives an LED with the option of changing the blink rate from slow to fast and vice versa. The TCPWM_PWM_ThreePhase project demonstrates three LEDs driven by three PWMs that are 120 degrees out-of-phase from one another.

Hardware Setup

No hardware setup is required for this code example.

Software Setup

No software setup is required for this code example.

Operation

1. Connect the USB cable between the PC and the PSoC 4 Pioneer Kit.
2. Build the project and program it into the PSoC 4 device. Choose **Debug > Program**. For more information on device programming, see PSoC Creator Help.
3. For the TCPWM_PWM_LED_RateSwap project: Each time SW2 is pressed, you will observe the LED's blink rate change.
4. For the TCPWM_PWM_ThreePhase project: The LED will cycle through colors to show the PWMs are 120 degrees out-of-phase.

Design and Implementation

There are two projects in this example:

TCPWM_PWM_LED_BlinkRateSwap

The TCPWM_PWM_LED_BlinkRateSwap example performs the following functions:

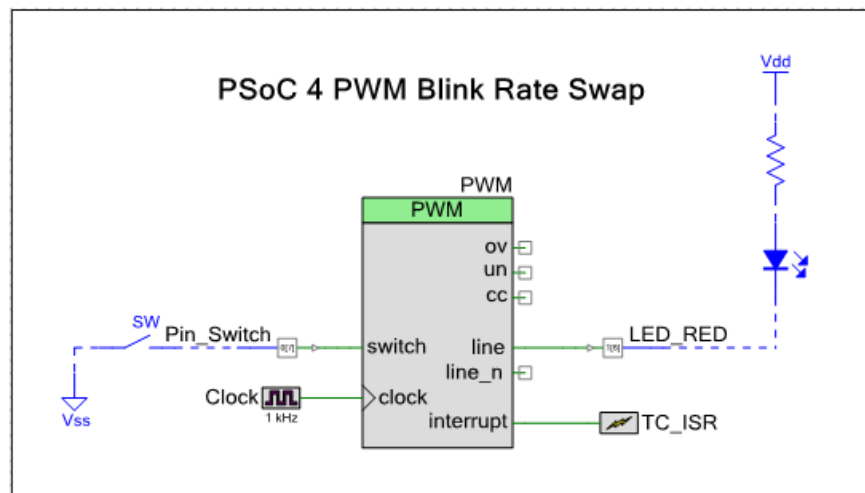
1. Configures the TC_ISR_Handler PWM interrupt handler function.
2. Starts PWM.
3. Initiates an interrupt when the count reaches terminal count.
4. When the switch (controlled by Pin_Switch) goes HIGH, the code example swaps the period register values. The period value controls the blink rate of LED_RED.

The TC_ISR_Handler function does the following:

1. Clears the interrupt for terminal count.
2. Toggles the LED ON/OFF state.

The top-level schematic of the PSoC Creator project is shown in [Figure 1](#).

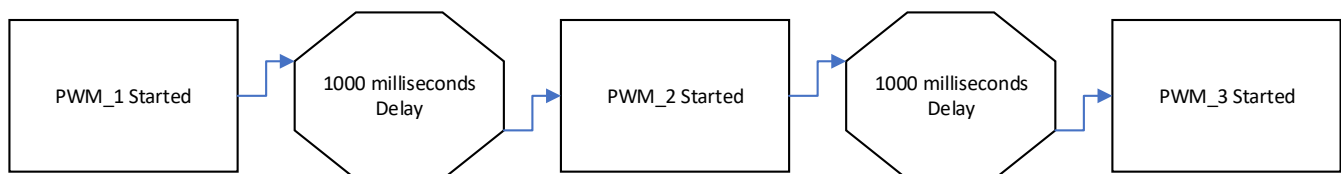
Figure 1. TCPWM_PWM_LED_RateSwap



TCPWM_PWM_ThreePhase

[Figure 2](#) shows the functions performed in the TCPWM_PWM_ThreePhase example.

Figure 2. Functions of TCPWM_PWM_ThreePhase



The top-level schematic of the PSoC Creator project is shown in [Figure 3](#).

The delay between the start of PWMs creates the 120 degrees out-of-phase alignment in the waveform shown in [Figure 4](#).

The delay is determined by 1/3 (120 out of 360 degrees) the period of PWM: $1/3 \times 3000 = 1000$ ms delay.

Note that varying the PWM period also varies the LED blink rate.

Figure 3. TCPWM_PWM_ThreePhase

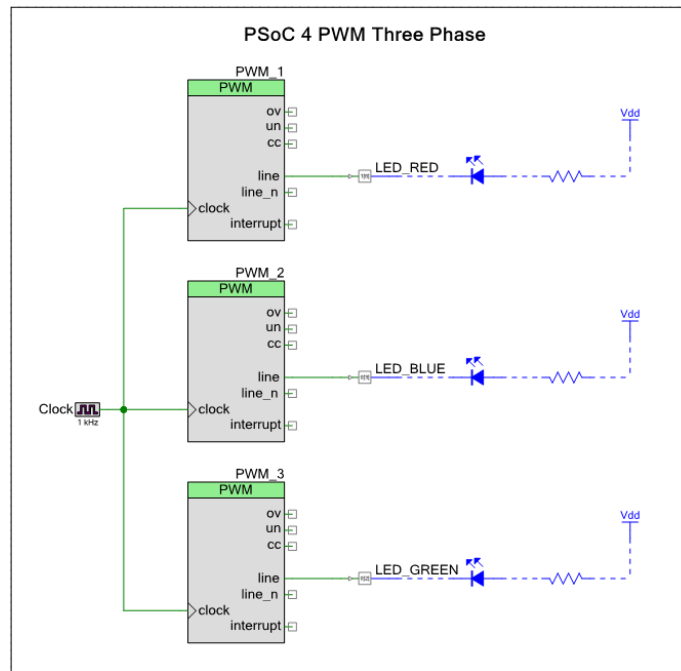
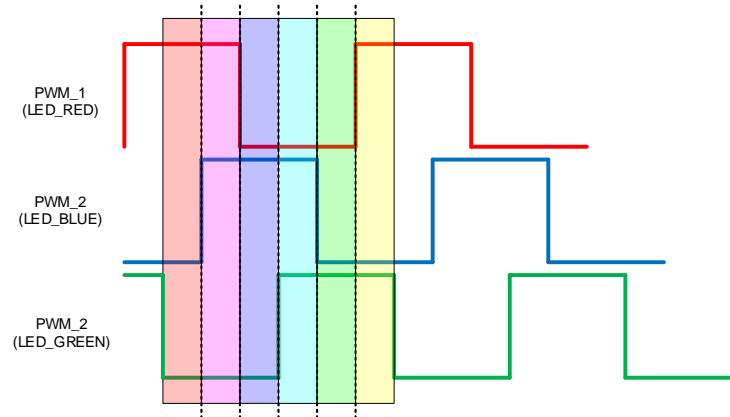


Figure 4. Expected LED Pattern (Red, Violet, Blue, Cyan, Green, Yellow)



Components and Settings

Table 1 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 1. PSoC Creator Components

Component	Instance Name	Purpose	Non-default Settings
Digital Input Pin	Pin_Switch	Handle the SW2 connection on device	See Figure 5
PWM (TCPWM mode) [v2.10]	PWM	Handle the PWM operation	See Figure 6
Digital Output Pin	LED_RED	Handle any LED color on device	Make sure external terminal is checked.
PWM (TCPWM mode) [v2.10]	PWM_1 (_2 & _3)	Handle the PWM operation	See Figure 7

Figure 5. Pin_Switch Parameter Settings

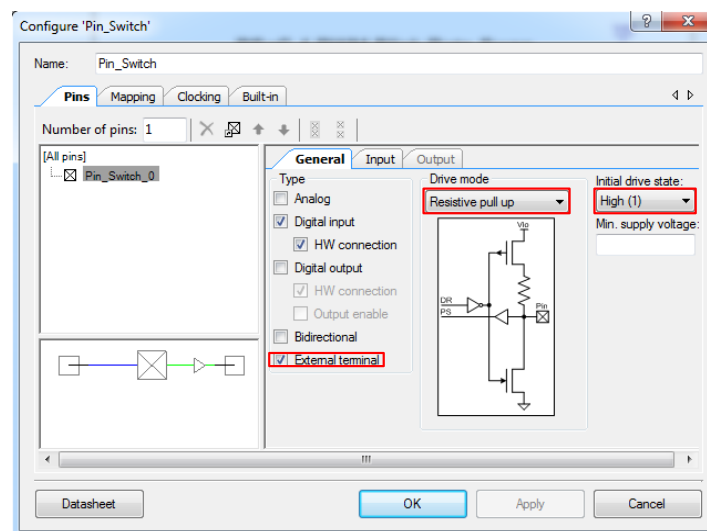
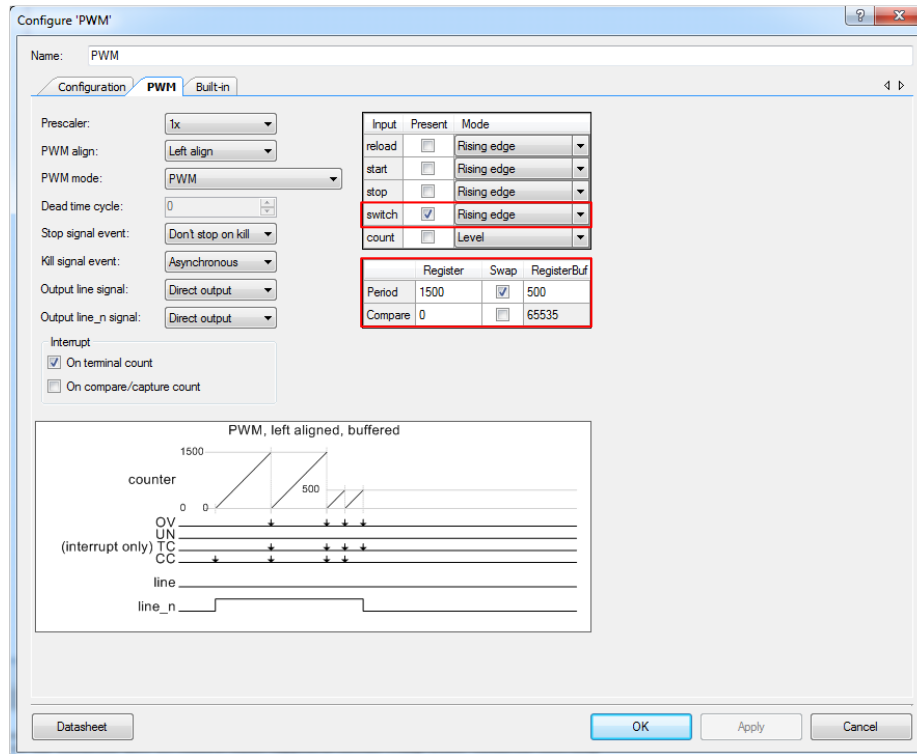


Figure 6. PWM Parameter Settings



Configure 'PWM'

Name: PWM

Configuration **PWM** Built-in

Prescaler: 1x

PWM align: Left align

PWM mode: PWM

Dead time cycle: 0

Stop signal event: Don't stop on kill

Kill signal event: Asynchronous

Output line signal: Direct output

Output line_n signal: Direct output

Interrupt

- ☒ On terminal count
- ☐ On compare/capture count

Input	Present	Mode
reload	<input type="checkbox"/>	Rising edge
start	<input type="checkbox"/>	Rising edge
stop	<input type="checkbox"/>	Rising edge
switch	<input checked="" type="checkbox"/>	Rising edge
count	<input type="checkbox"/>	Level

	Register	Swap	RegisterBuf
Period	1500	<input checked="" type="checkbox"/>	500
Compare	0	<input type="checkbox"/>	65535

PWM, left aligned, buffered

counter

OV

UN

(interrupt only) TC

CC

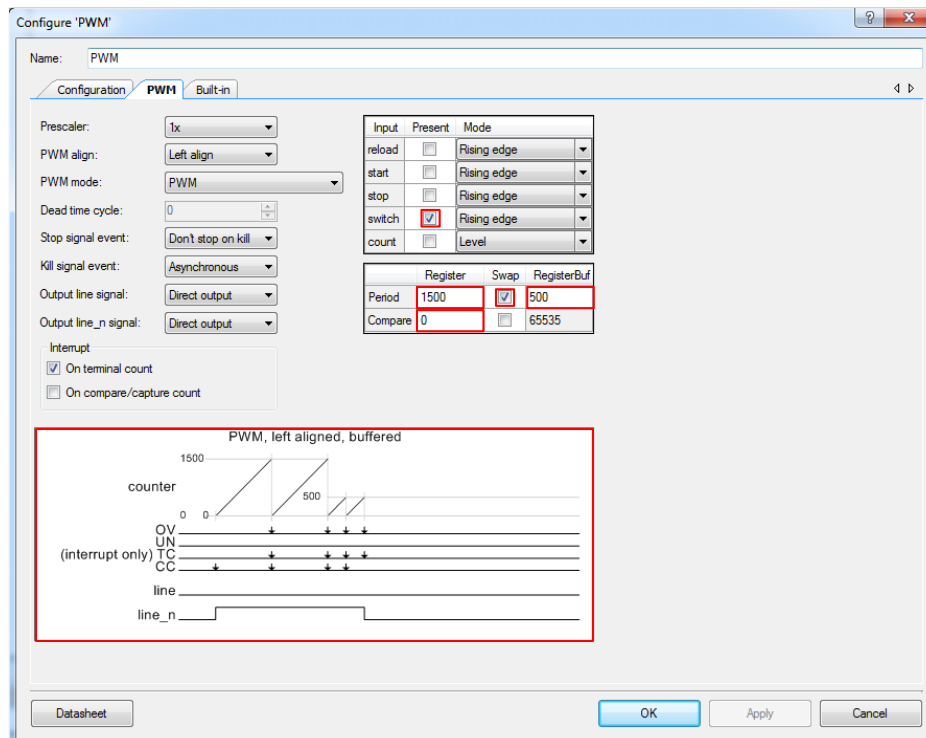
line

line_n

Datasheet

OK Apply Cancel

Figure 7. PWM Parameter Settings



Configure 'PWM'

Name: PWM

Configuration **PWM** Built-in

Prescaler: 1x

PWM align: Left align

PWM mode: PWM

Dead time cycle: 0

Stop signal event: Don't stop on kill

Kill signal event: Asynchronous

Output line signal: Direct output

Output line_n signal: Direct output

Interrupt

- ☒ On terminal count
- ☐ On compare/capture count

Input	Present	Mode
reload	<input type="checkbox"/>	Rising edge
start	<input type="checkbox"/>	Rising edge
stop	<input type="checkbox"/>	Rising edge
switch	<input checked="" type="checkbox"/>	Rising edge
count	<input type="checkbox"/>	Level

	Register	Swap	RegisterBuf
Period	1500	<input checked="" type="checkbox"/>	500
Compare	0	<input type="checkbox"/>	65535

PWM, left aligned, buffered

counter

OV

UN

(interrupt only) TC

CC

line

line_n

Datasheet

OK Apply Cancel

For information on the hardware resources used by a Component, see the [Component datasheet](#).

Reusing this Example

This example is designed for the CY8CKIT-042 pioneer kit. To port this design to a different PSoC 4 device, kit, or both, do the following:

1. In PSoC Creator, select **Project > Device Selector** to change the target device. Select your device as listed in [Table 2](#).
2. Make sure that the **SysClk Desired frequency** is set to 24 MHz after the device is changed.
3. In the PSoC Creator Workspace Explorer, select the **Clocks** interface listed under **Design Wide Resources**.
4. Set the **SysClk Desired Frequency** to 24 MHz, if it is not already.

Table 2. Development Kits and Associated Devices

Development Kit	Device
CY8CKIT-041	CY8C4146AZI-S433
CY8CKIT-042	CY8C4245AXI-483
CY8CKIT-042-BLE	CY8C4247LQI-BL483
CY8CKIT-044	CY8C4247AZI-M485
CY8CKIT-046	CY8C4248BZI-L489
CY8CKIT-048	CY8C4A45AZI-483

In some cases, a resource used by a code example (for example, a Universal Digital Block) is not supported on another device. In that case, the example will not work. If you build the code targeted at such a device, you will get errors. See the device datasheet for information on what a device supports.

Related Documents

Application Notes	
AN79953 Getting Started with PSoC® 4	Describes PSoC 4 devices and shows how to build the associated code example
Code Examples	
CE224564 PSoC 4 TCPWM Counter/Timer	Demonstrates the use of a counter to keep track of the number of button presses to measure the frequency and duty cycle of an input waveform.
CE224595 PSoC 4 TCPWM QuadDec	Demonstrates the use of a Quadrature Decoder to detect the rotational direction as one waveform leads the other. Two PWMs are used to simulate input waveforms.
PSoC Creator Component Datasheets	
TCPWM	A multifunctional Component that can implement the following functionalities: PWM, Timer/Counter, and Quadrature Decoder.
General Purpose Input/Output (GPIO)	A multifunctional Component that allows hardware resources to connect to a physical port-pin and provides access to external signals through an appropriately configured physical I/O pin.
Interrupt	The Interrupt Component defines hardware-triggered interrupts. There are three types of system interrupt waveforms that can be processed by the interrupt controller: Level, Pulse, and Edge.
Device Documentation	
PSoC 4 Datasheets	PSoC 4 Technical Reference Manuals
Development Kit (DVK) Documentation	
CY8CKIT-042 PSoC® 4 Pioneer Kit	
PSoC 4 Kits	
Tool Documentation	
PSoC Creator	Go to the Downloads tab for Quick Start and User Guides

Document History

Document Title: CE224593 – PSoC 4 PWM

Document Number: 002-24593

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	6290692	SYAO	08/31/2018	New code example
*A	6672859	NRSH	09/13/2019	Updated document layout and small changes for clarity.

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