CE220692 – PSoC 6 MCU Frequency Measurement Using TCPWM

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Objective

This code example demonstrates how to use the TCPWM Component in PSoC® 6 MCU to measure the frequency of a periodic digital signal.

Requirements

Tool: PSoC Creator™ 4.2; Peripheral Driver Library (PDL) 3.1

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

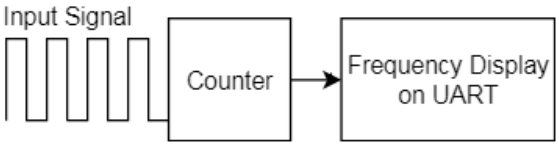
Associated Parts: All PSoC 6 MCU parts

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

Overview

Frequency measurement is counting the number of edges (rising, falling, or both) that occur within a known time interval. To find this number, this project uses a one-second time window and determines the number of counts (rising edges) within that time window.

Note: This project measures digital signals. If you want to measure the frequency of other waveforms, the waveform must be converted to a digital signal before inputting it to the counter.



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.

Hardware Setup

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

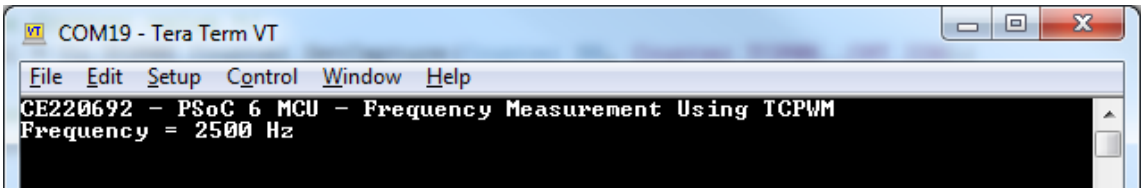
Software Setup

This code example requires a PC terminal emulator such as PuTTY or Tera Term to view the output. For terminal emulator setup, see Operation below.

Operation

1. Plug the CY8CKIT-062-BLE kit board into your computer's USB port.
2. Open terminal emulator software such as PuTTY or Tera Term.
   a. If using PuTTY, select **Serial** under **Connection type**, under **Serial line**, enter the COM port that KitProg is connected to, and under **Speed**, enter **115200**.
   b. If using Tera Term, select **Serial**, and from the drop-down menu, select the COM port connected to KitProg and click OK. Then under the **Setup** tab, select **Serial port** and set the **Speed** to **115200**.
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 UART terminal displays the code example title and the frequency as shown in Figure 1.

Figure 1. UART Terminal Displaying Starting Message and Result



5. To test the code example, change the **Period** and **Compare** values of the PWM_FreqGen Component to generate a different frequency.

Design and Implementation

This example uses three TCPWM Components.

One is set up as a timer/counter (**OneSecTimer**), with a 1-kHz clock, and a period of 999. The overflow output will generate a pulse every second and connect directly to the capture input of the counter.

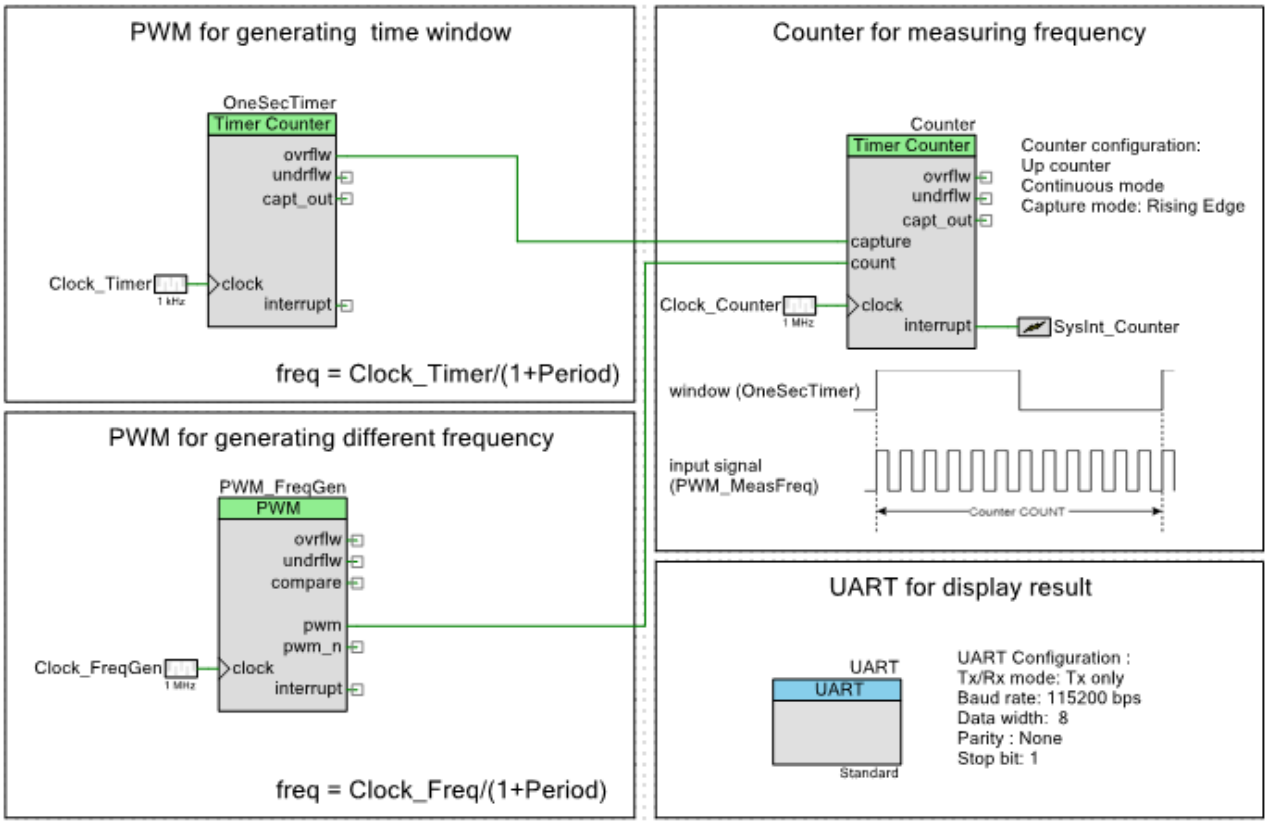
A second is set up as a PWM (**PWM_FreqGen**) with a 1-MHz clock. Based on the “Period” and “Compare” values, it generates a signal at a particular frequency. By default, the Component is configured to generate a signal at 2500 Hz (2.5 kHz).

The third Component is set up as a counter (**Counter**). It receives the capture input from the OneSecTimer, and the input signal from the frequency generator. Once per second, it reads the count from the frequency generator. Firmware performs the calculation to identify the input frequency based on how the count changes each second.

A UART PSoC Creator Component with baud rate of 115200 bps is configured to display the result in a terminal application such as Tera Term of PuTTY.

Figure 2 shows the PSoC Creator schematic for this code example.

Figure 2. TopDesign Schematic



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
Timer Counter (TCPWM)	Counter	Count the number of rising edges of the input signal	**[General tab]** Capture input: Rising Edge Interrupt Source: Overflow/Underflow and Compare/Capture **[Input tab]** Count input: Rising edge
	OneSecTimer	Generates a one-second time window	**[Basic tab]** Period:999u
PWM (TCPWM)	PWM_FreqGen	Generates a signal at a particular frequency, based on the period and compare values	**[General tab]** Period:399u Compare:200u
Clock	Clock_Timer	Drive the OneSecTimer at 1 kHz	**Frequency**: 1 kHz
	Clock_FreqGen	Drive the PWM_FreqGen at 1 MHz	**Frequency**: 1 MHz
	Clock_Counter	Drive the Counter at 1 MHz	**Frequency**: 1 MHz
Interrupt	SysInt_Counter	Configure the interrupt	Default settings only
UART (SCB)	UART	Serial communication block for output on a terminal emulator	**[Basic tab]** TX/RX Mode: Tx only

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

Figure 3 shows the configuration for the **Interrupts** tab in the **Design Wide Resources** window. The interrupt is enabled on CM4, and given a priority of 7. These are the default settings for an interrupt. The ISR is compiled as part of the CM4 code.

Figure 3. Interrupt Assignments

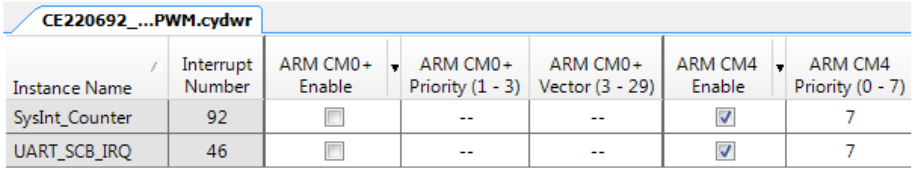
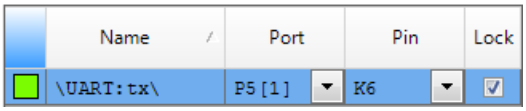


Figure 4 shows the pin assignment for the project done through the **Pins** tab in the **Design Wide Resources** window. These assignments are compatible with CY8CKIT-062-BLE.

Figure 4. Pin Assignments



Reusing This Example

This example is designed for the CY8CKIT-062-BLE pioneer kit. To port the design to a different PSoC 6 MCU device and/or kit, change the target device using the Device Selector and update the pin assignments in the Design Wide Resources Pins settings as needed. For single-CPU PSoC 6 MCU devices, port the code from *main_cm4.c* to *main.c*.

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 particular device supports.

Related Documents

For a comprehensive list of PSoC 6 MCU resources, see KBA223067 in the Cypress community.

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-Core CPU system Design	Describes the dual-core CPU architecture in PSoC 6 MCU, and shows how to build a simple dual-core 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	
Pins	Supports connection of hardware resources to physical pins
Timer Counter (TCPWM)	Supports fixed-function Timer/Counter implementation
Clock	Supports local clock generation
Interrupt	Supports generating interrupts from hardware signals
UART	Provides asynchronous communication interface using SCB hardware
Related Code Examples	
CE220290	PSoC 6 MCU: TCPWM Breathing LED
CE220169	PSoC 6 MCU: Periodic Interrupt using TCPWM
CE220291	PSoC 6 MCU: TCPWM Square Wave
CE220799	PSoC 6 MCU: Direction Detection Using Quadrature Decoder
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

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Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	5896719	AJYA	09/26/2017	New code example
*A	6177969	AJYA	05/18/2018	Updated for PSoC Creator 4.2
*B	6624067	NRSH	07/22/2019	Update document and Creator project for clarity.

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