

## Objective

This example explains how to setup a 32-bit free-running counter using two 16-bit counters of Multi-Counter Watchdog Timer (MCWDT) on PSoC® 6 MCU, using ModusToolbox™ IDE.

## Requirements

**Tool:** [ModusToolbox™ IDE 1.0](#)

**Programming Language:** C

**Associated Parts:** All [PSoC 6 MCU](#) parts

**Related Hardware:** [PSoC 6 BLE Pioneer Kit](#), [PSoC 6 WiFi-BT Pioneer Kit](#), [PSoC 6 WiFi-BT Prototyping Kit](#)

## Overview

There are many applications where there is a need to timestamp different events in a system for timekeeping or debugging. In this example, the time gap between successive switch press events is measured in seconds and displayed on a UART terminal.

## Hardware Setup

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

**Note:** The PSoC 6 BLE Pioneer kit and the PSoC 6 WiFi-BT Pioneer Kit ships with KitProg2. ModusToolbox only works with KitProg3. Before using this code example, make sure that the kit is upgraded to KitProg3. See [ModusToolbox Help > ModusToolbox IDE Documentation > User Guide; section PSoC 6 MCU KitProg Firmware Loader](#). If you do not upgrade, you will see an error like “unable to find CMSIS-DAP device” or “KitProg firmware is out of date”.

## Software Setup

This example uses a terminal emulator. Install one if you don't have one. The instructions use [Tera Term](#).

## Operation

1. Connect the kit to your PC using the provided USB cable.
2. Open your terminal software and select the KitProg COM port. Set the other serial port parameters as follows:
  - a. Baud rate: 115200bps
  - b. Data: 8 bit
  - c. Parity: None
  - d. Stop: 1 bit
  - e. Flow control: None
3. Import the code example into a new workspace. See [KBA225201](#).
4. Program the PSoC 6 MCU device. In the project explorer, select the **mainapp** project. In the Quick Panel, scroll to the **Launches** section and click the **Program (KitProg3)** configuration.
5. Press and release the switch SW2. Notice the time displayed in seconds.

## Debugging

You can debug the example to step through the code. Use the **Debug (KitProg3)** configuration. See [KBA224621](#) to learn how to start a debug session with ModusToolbox IDE.

## Design and Implementation

MCWDT has two 16-bit counters (Counter 0 and Counter 1) and one 32-bit counter (Counter 2). In the application, Counter 0 and Counter 1 are configured in free-running mode. Counter 0 is clocked by LFCLK and Counter 1 is clocked from the Counter 0 cascade. LFCLK source is set to ILO (nominal 32 kHz). The combined counter counts from 0 to 0xFFFFFFFF, which is equivalent to 134217 s (~1.5 day). The 32-bit counter, Counter 2, is not used.

A switch is used to mark the start and end points of MCWDT counting. Debounce logic is implemented in firmware to avoid false press events. The counter value is stored for each switch press. The time interval between two switch presses is evaluated in seconds and displayed on UART terminal.

In the case of failure in the initialization of MCWDT or UART, the red LED is turned ON.

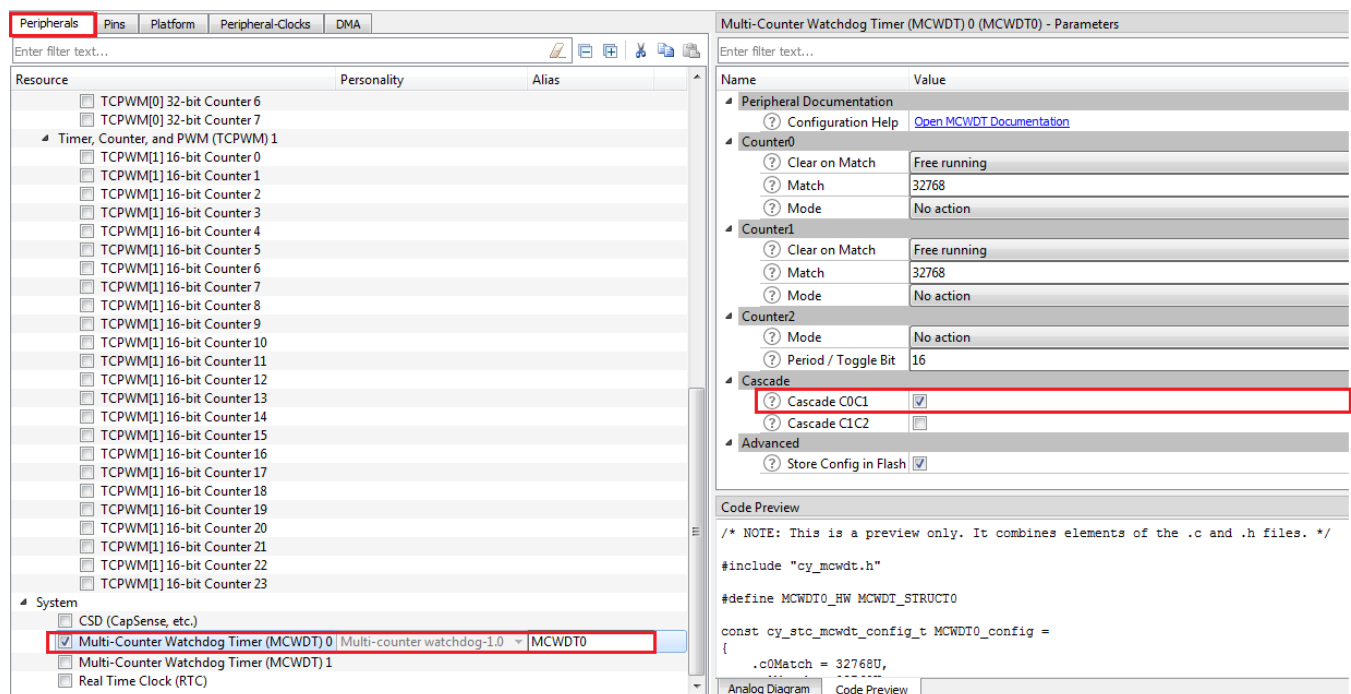
## Resources and Settings

[Table 1](#) lists some of the ModusToolbox resources used in the example, and how they are used in the design. The *design.modus* file contains all the configuration settings. For example, for pin usage and configuration, open the **Pins** tab of the design file.

Table 1. ModusToolbox Resources

Resource	Alias	Purpose	Non-default Settings
Multi-Counter Watchdog Timer (MCWDT) 0	MCWDT0	Used to measure time between switch press events.	Counter 0 and counter 1 cascade enabled. See <a href="#">Figure 1</a> .
UART	KIT_UART	Used to communicate the measured time.	Clock source and TX pin are set. See <a href="#">Figure 2</a> .
Peripheral clock	KIT_UART_CLOCK	Clock input to the UART block.	Clock divider value and peripheral are set. See <a href="#">Figure 3</a> .

Figure 1. MCWDT Configuration



Multi-Counter Watchdog Timer (MCWDT) 0 (MCWDT0) - Parameters

Name	Value
Peripheral Documentation	Configuration Help <a href="#">Open MCWDT Documentation</a>
Counter0	<ul style="list-style-type: none"> <li>Clear on Match: Free running</li> <li>Match: 32768</li> <li>Mode: No action</li> </ul>
Counter1	<ul style="list-style-type: none"> <li>Clear on Match: Free running</li> <li>Match: 32768</li> <li>Mode: No action</li> </ul>
Counter2	<ul style="list-style-type: none"> <li>Mode: No action</li> <li>Period / Toggle Bit: 16</li> </ul>
Cascade	<ul style="list-style-type: none"> <li>Cascade C0C1: <input checked="" type="checkbox"/></li> <li>Cascade C1C2: <input type="checkbox"/></li> </ul>
Advanced	<ul style="list-style-type: none"> <li>Store Config in Flash: <input checked="" type="checkbox"/></li> </ul>

Code Preview

```

/* NOTE: This is a preview only. It combines elements of the .c and .h files. */
#include "cy_mwtdt.h"
#define MCWDT0_HW MCWDT0_STRUCT0
const cy_stc_mwtdt_config_t MCWDT0_config =
{
    .c0Match = 32768U,
    .c0Mode = 0U,
    .c1Match = 32768U,
    .c1Mode = 0U,
    .c2Mode = 0U,
    .c2Period = 16U,
    .c0C1Cascade = 1U,
    .c1C2Cascade = 0U,
    .storeConfigInFlash = 1U
};
  
```

Figure 2. UART Configuration

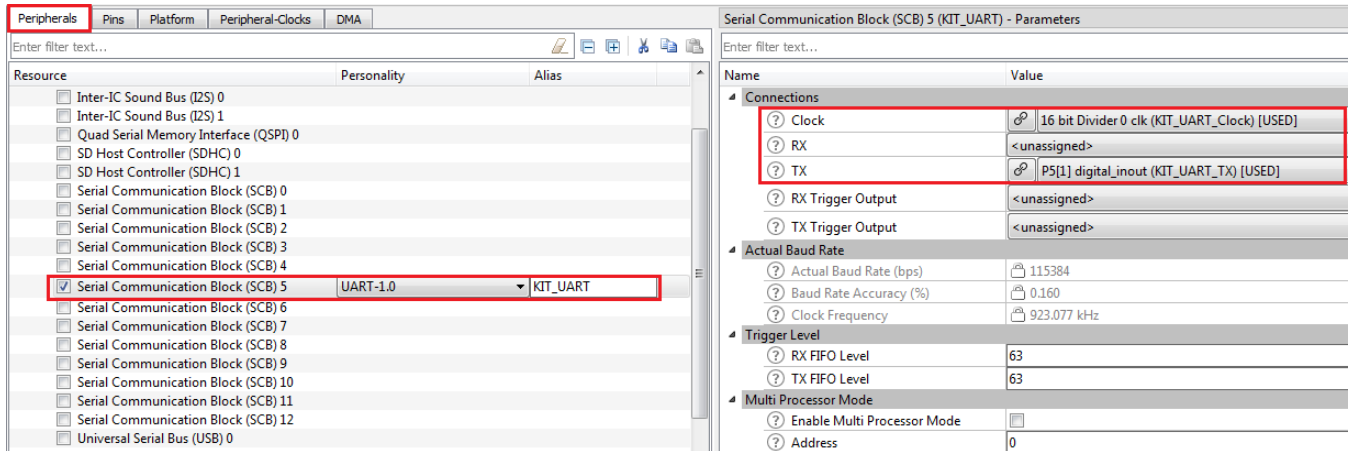
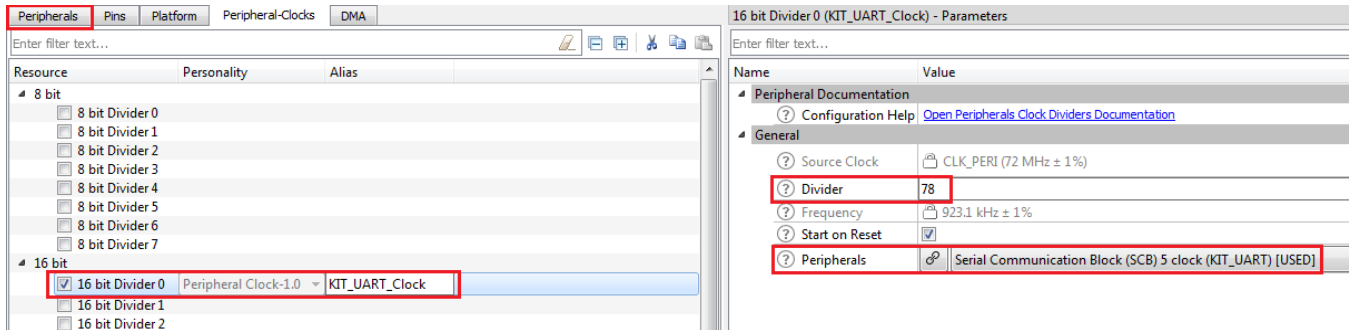


Figure 3. UART Clock Configuration



## Reusing This Example

This example is configured for the supported kits. To port the design to a different PSoC 6 MCU device, right-click an application project and choose **Change ModusToolbox Device**. If changing to a different kit, you may need to reassign pins.

Table 2. Device and Pin Mapping across PSoC 6 MCU Kits

Kit Name	Device Used	LED	UART_TX	Switch
CY8CKIT-062-WiFi-BT	CY8C6247BZI-D54	P13[7]	P5[1]	P0[4]
CY8CKIT-062-BLE	CY8C6347BZI-BLD53	P13[7]	P5[1]	P0[4]
CY8CPROTO-062-4343W	CY8C624ABZI-D44	P13[7]	P5[1]	P0[4]

In some cases, a resource used by a code example (for example, an IP 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 which resources a device supports.

## Related Documents

Application Notes	
<a href="#">AN210781</a> – Getting Started with PSoC 6 MCU with Bluetooth Low Energy (BLE) Connectivity	Describes PSoC 6 MCU with BLE Connectivity devices and how to build your first PSoC Creator project
<a href="#">AN221774</a> – Getting Started with PSoC 6 MCU	Describes PSoC 6 MCU devices and how to build your first ModusToolbox application and PSoC Creator project
Code Examples	
Visit the <a href="#">Cypress GitHub site</a> for a comprehensive collection of code examples using ModusToolbox IDE	
Device Documentation	
<a href="#">PSoC 6 MCU: PSoC 63 with BLE Datasheet</a>	<a href="#">PSoC 6 MCU: PSoC 63 with BLE Architecture Technical Reference Manual</a>
<a href="#">PSoC 6 MCU: PSoC 62 Datasheet</a>	<a href="#">PSoC 6 MCU: PSoC 62 Architecture Technical Reference Manual (TRM)</a>
Development Kits	
<a href="#">CY8CKIT-062-BLE PSoC 6 BLE Pioneer Kit</a>	
<a href="#">CY8CKIT-062-WiFi-BT PSoC 6 WiFi-BT Pioneer Kit</a>	
<a href="#">CY8CPROTO-062-4343W PSoC 6 Wi-Fi BT Prototyping Kit</a>	
Tool Documentation	
<a href="#">ModusToolbox IDE</a>	The Cypress IDE for IoT designers

## Cypress Resources

Cypress provides a wealth of data at [www.cypress.com](http://www.cypress.com) to help you to select the right device, and quickly and effectively integrate the device into your design.

For the PSoC 6 MCU devices, see [KBA223067](#) in the Cypress community for a comprehensive list of PSoC 6 MCU resources.

## Document History

Document Title: CE220498 – PSoC® 6 MCU Free-Running Multi-Counter Watchdog Timer

Document Number: 002-25571

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	6374155	RJVB	11/21/2018	New code example

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