CE216778 - FM0+ Pulse Width Counter

This application uses a pulse width counter, implemented in a Base Timer, to time the duration of a button press.

Overview

This example uses the Base Timer (BT) in Pulse Width Counter (PWC) mode. The PWC counts between configurable start and end events on the TIOB input to the Base Timer block. Counting starts on a high to low transition (button press) and stops on the reverse (button release). The count value is then converted into seconds and the green LED is blinked for that number of times.

Requirements

Tool: PSoC Creator 4.0

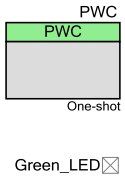
Programming Language: C (GCC 4.9.3)

Associated Parts: All S6E1 parts

Related Hardware: FM0-V48-S6E1A1 and FM0-64L-S6E1C3

Design

The schematic includes the PDL_BT Component in PWC mode and a GPIO for the LED.



The firmware performs following functions:

1. Initialize the LED (initially off)
2. Route the TIOB input signal from the pin to the PWC
3. Initialize the PWC component
4. Enable counting to start when the switch is pressed
5. In main loop, detect a completed measurement (switch down and up)
6. Read the measurement and convert to time
7. Blink the LED once for every whole or part of a second
8. Re-enable the one-shot PWC counting

Design Considerations

One-Shot Mode

The Component supports continuous and one-shot operation. Continuous is more commonly used because it avoids the need to re-enable counting after a measurement is taken. In this application, however, the consequence of taking the measurement is a very long LED blinking routine. Button presses need to be ignored during this routine and so one-shot mode is a convenient way to automatically stop the Component. A call the Bt_Pwc_EnableCount() function is all that is required to restart the timing.

Pin Selection

The project includes control files to automatically place the TIOB and LED IO onto the appropriate pins for the supported kit hardware. To change the pin selection, delete the control file or over-ride the control file selections in the Design Wide Resources Pin Editor.

PDL Installation

The project assumes that you have installed the PDL in the location specified in the **Project Management** panel of the **Tools** > **Options** dialog. If that location is incorrect you will see the build error “The given PDL path is invalid. Unable to find required PDSC file.” To correct this problem in a newly-created project open the **Project** > **Properties** dialog and enter the correct path to the PDL. To avoid the problem in projects you create in the future, make sure you put the correct path in the **Tools** > **Options** dialog.

Hardware Setup

The GPIO is connected to the green LED. The TIOB signal is connected to a pin that enables the user to apply a changing digital signal to the pin. On the FM0-V48-S6E1A1 and FM0-64L-S6E1C3 kits the TIOB is connected to the user switch (SW3 and SW2 respectively). On the FM0-100L-S6E1B8 kit this is not possible and so P4C, which is accessible on header D14 (I2C-SDA), is used.

Table 1 lists the pin connections required to use this code example on FM0+ kits.

Table 1. List of Pins

Pin	FM0-V48-S6E1A1	FM0-64L-S6E1C3
Green_LED:GPIO	P61	P3E
PWC:TIOB	P04	P30

Components

Table 2 lists the PSoC Creator Components used in this example, as well as the hardware resources used by each.

Table 2. List of PSoC Creator Components

Component	Version	Hardware Resources
PDL_BT	1.0	Base Timer block
PDL_GPIO	1.0	GPIO pin

Parameter Settings

The PDL_BT Component uses default parameter settings, with these exceptions.

Table 3: Component Settings

Tab	Setting	Value
none	Name	PWC
Basic	BTConfig	PWC
	ConnectTIOB	true
PWC	enPwcMeasureEdge	Falling to Rising
	enPwcMode	One-shot
	enPwcPres	1/2048
	enPwcSize	32-bit

The measurement is taken between a falling edge and a rising edge so that the duration of a switch being closed (connected to ground) may be timed.

The prescalar is set to slow down the timing because the application needs very coarse granularity (whole second precision).

The size is set to 32-bits so that it takes a very long time for the counter to overflow. There is no checking for this in the program.

Operation

Program the kit, then press and hold the user switch (SW2 on FM0-64L-S6E1C3, SW3 on FM0-V48-S6E1A1) for a few seconds. When you release the switch the green LED blinks on and off once for every (part of a) second. The program repeats and so you can experiment with short and long button presses.

Related Documents

Table 4 lists relevant application notes, code examples, knowledge base articles, device datasheets, and Component datasheets.

Table 4. Related Documents

PSoC Creator Component Datasheets	
PDL_BT	Supports PWM, PPG, PWC, and RT modes, with interrupts appropriate to the mode of operation. Right-click the Component to access.
Device Documentation	
S6E1A	FM0+ S6E1A-Series 5V Robust ARM® Cortex®-M0+ Microcontroller (MCU) Family
S6E1C	FM0+ S6E1C-Series Ultra Low Power ARM® Cortex®-M0+ Microcontroller (MCU) Family
Development Kit (DVK) Documentation	
FM0-V48-S6E1A1	ARM® Cortex®-M0+ FM0+ MCU Evaluation Board
FM0-64L-S6E1C3	ARM® Cortex®-M0+ MCU Starter Kit with USB and Digital Audio Interface

Document History

Document Title: CE216778 - FM0+ Pulse Width Counter

Document Number: 002-16778

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	5400188	YFS	09/23/16	New Code Example.
*A	5472637	YFS	10/12/16	Clarified operating instructions to ensure the jumper wire does not float.
*B	5776652	YFS	6/16/17	Added search keyword so that user can quickly find Code Examples from the component instance popup menu. Updated logo and copyright date.
*C	5988525	YFS	12/8/17	Removed S6E1B support.

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