16-Bit Timer Datasheet Timer16 V 1.1

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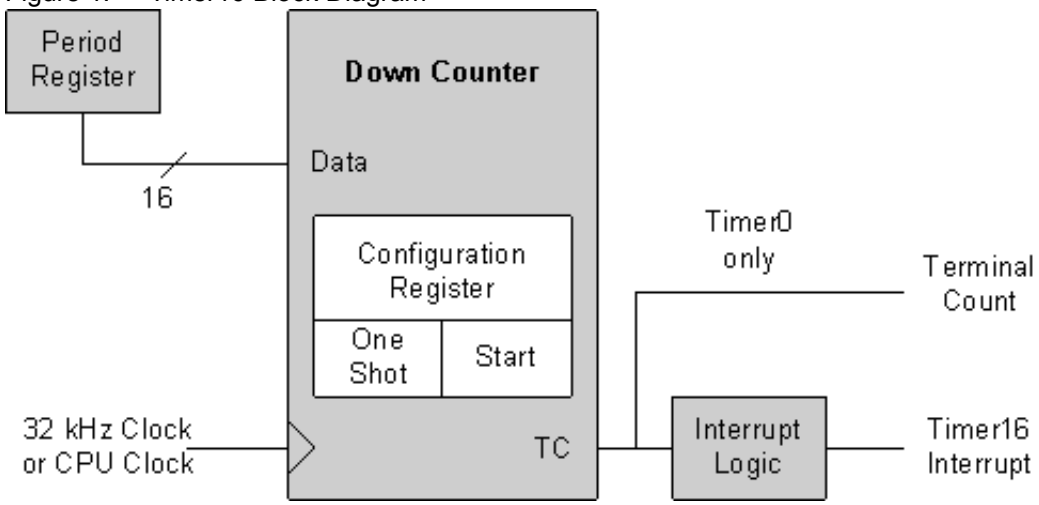
Resources	PSoC® Blocks				API Memory (Bytes)		Pins per senor
	CapSense®	I2C/SPI	Timer	Comparator	Flash	RAM	
CY8C20x66, CY8C20x36, CY8C20336AN, CY8C20436AN, CY8C20636AN, CY8C20xx6AS, CY8C20XX6L, CY8C20x46, CY8C20x96, CY8C20045, CY8C20055, CY7C64xxx, CY7C60413, CY7C60424, CY7C6053x, CYONS2010, CYONS2011, CYONSFN2051, CYONSFN2053, CYONSFN2061, CYONSFN2151, CYONSFN2161, CYONSFN2162, CYONSFN2010-BFXC, CYONSCN2024-BFXC, CYONSCN2028-BFXC, CYONSCN2020-BFXC, CYONSKN2033-BFXC, CYONSKN2035-BFXC, CYONSKN2030-BFXC, CYONSTN2040, CY8CTST200, CY8CTMG2xx, CY8C20xx7/7S, CYRF89x35, CY8C20065, CY8C24x93, CY7C69xxx							
			1		36	0	None

Features and Overview

- 16-bit programmable countdown timer
- One shot countdown option where the period is not reloaded on Terminal Count
- Interrupt occurs on Terminal Count
- Uses the internal 32 kHz clock or the CPU clock

The user module is a 16-bit programmable timer with interrupt call back. It is clocked by the internal 32 kHz clock or the CPU clock.

Figure 1. Timer16 Block Diagram



Functional Description

The Timer16 User Module either does a one shot countdown (one shot mode) or continuously repeats the countdown (continuous mode) given a certain period. The default Mode and Period values are set in the parameters section of the Device Editor, or programmatically using the SetMode() and SetPeriod() as described in the Application Programming Interface (API) section.

DC and AC Electrical Characteristics

Table 1. Timer16 DC and AC Electrical Characteristics

Parameter	Conditions and Notes	Typical	Limit	Units
F_{32K1}		32	-	kHz

Timing

When started, the programmable timer loads the value contained in its data registers and counts down to its terminal count of zero. The timer outputs an active high terminal count pulse for one clock cycle upon reaching the terminal count. The low time of the terminal count pulse is equal to the loaded decimal count value, multiplied by the clock period. (TCpw = COUNT VALUEdecimal * CLKperiod). The period of the terminal count output is the pulse width of the terminal count, plus one clock period. (TCperiod = TCpw + CLKperiod).

Only TIMER0 outputs this terminal count output. TIMER1 and TIMER2 do not have a terminal count output.

Figure 2. Timer16 Continuous Operation

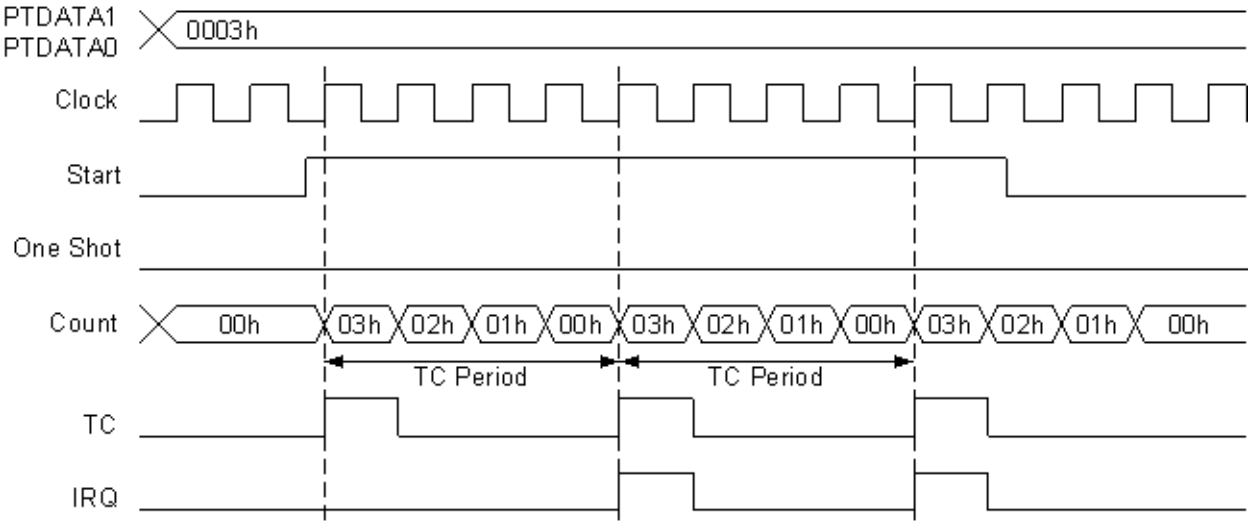
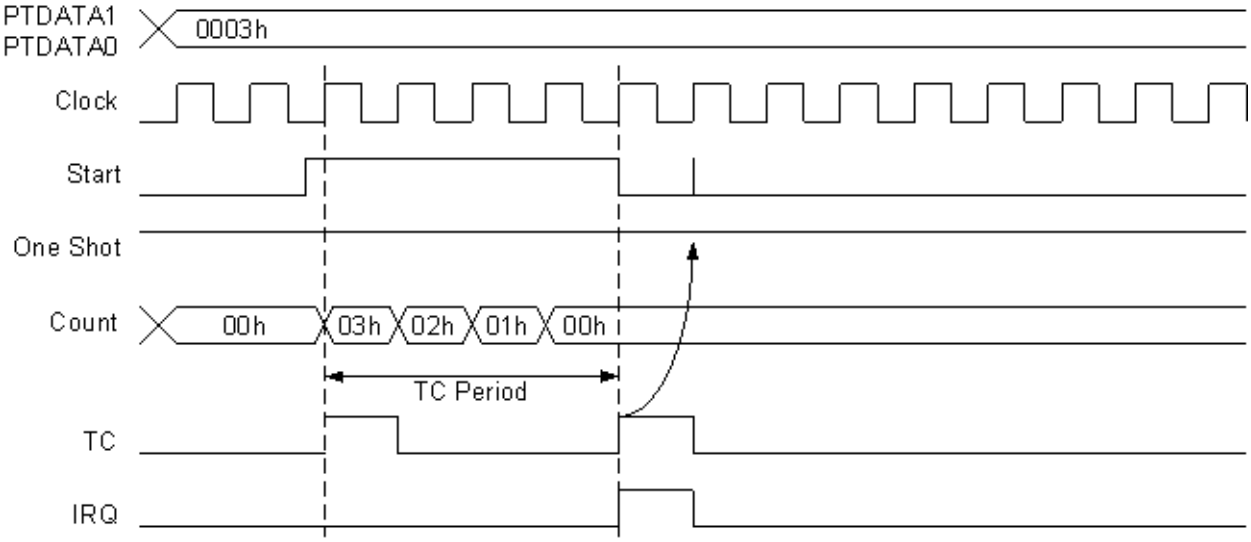


Figure 3. Timer16 One Shot Operation



Placement

The Timer16 User Module can be placed to any Timer block available. This user module occupies only one Timer block. Note that the TIMER0 block is the only block with a terminal count output; TIMER1 and TIMER2 blocks do not have a terminal count output.

Parameters and Resources

Period

A 16-bit value that ranges from 1-65535 to determine the countdown period.

Mode

Sets the mode of the Timer16. The two options are One Shot or Continuous mode. In One Shot mode, the timer completes one full count cycle and terminates. At termination, the START bit in this register is cleared. In Continuous mode, the timer reloads the count value each time at completion of its count cycle and repeats.

Clock Select

Selects the input clock. Select from one of the available clocks.

Application Programming Interface

The Application Programming Interface (API) routines are provided as part of the user module to allow you to deal with the module at a higher level. This section specifies the interface to each function together with related constants provided by the include files.

Note

In this, as in all user module APIs, the values of the A and X register are altered by calling an API function. It is the responsibility of the calling function to preserve the values of A and X before the call if those values are required after the call. This "registers are volatile" policy was selected for efficiency reasons and has been in force since version 1.0 of PSoC Designer. The C compiler automatically takes care of this requirement. Assembly language programmers must ensure that their code observes the policy, as well. Though some user module API functions may leave A and X unchanged, there is no guarantee they may do so in the future.

For Large Memory Model devices, it is also the caller's responsibility to preserve any value in the CUR_PP, IDX_PP, MVR_PP, and MVW_PP registers. Even though some of these registers may not be modified now, there is no guarantee that will remain the case in future releases.

Here is the list of Timer16 supplied API functions:

Timer16_Start

Description:

Enables the Timer16 by writing a one to the start bit.

C Prototype:

```
void  Timer16_Start(void)
```

Assembly:

```
lcall  Timer16_Start
```

Parameters:

None

Return Value:

None

Side Effects:

The A and X registers may be altered by this function.

Timer16_Stop

Description:

Disables the Timer16 by clearing the start bit.

C Prototype:

```
void  Timer16_Stop(void)
```

Assembly:

```
lcall  Timer16_Stop
```

Parameters:

None

Return Value:

None

Side Effects:

The A and X registers may be altered by this function.

Timer16_EnableInt

Description:

Enables the Timer16 terminal count interrupt.

C Prototype:

```
void Timer16_EnableInt(void)
```

Assembly:

```
lcall  Timer16_EnableInt
```

Parameters:

None

Return Value:

None

Side Effects:

The A and X registers may be altered by this function.

Timer16_DisableInt

Description:

Disables the Timer16 terminal count interrupt.

C Prototype:

```
void  Timer16_DisableInt(void)
```

Assembly:

```
lcall  Timer16_DisableInt
```

Parameters:

None

Return Value:

None

Side Effects:

The A and X registers may be altered by this function.

Timer16_SetMode

Description:

Sets the mode by writing the mode bit value to the configuration register.

C Prototype:

```
void  Timer16_SetMode(BYTE bMode)
```

Assembly:

```
mov   A, [bMode] ; place bMode in A
lcall  Timer16_SetMode
```

Parameters:

BYTE bMode: The mode, OneShot (bit value 1) or Continuous (bit value 0). Defines to be provided.

Return Value:

None

Side Effects:

The A and X registers may be altered by this function.

Timer16_SetPeriod

Description:

Sets the period by writing the 16-bit value to the period register.

C Prototype:

```
void  Timer16_SetPeriod(WORD wPeriod)
```

Assembly:

```
mov   X, [wPeriod+0] ; place MSB in X
mov   A, [wPeriod+1] ; place LSB in A
lcall  Timer16_SetPeriod
```

Parameters:

wPeriod - a 16-bit period value

Return Value:

None

Side Effects:

The A and X registers may be altered by this function.

Sample Firmware Source Code

In the following C and Assembly sample code, the global and timer interrupts are enabled to allow the interrupt handler to execute. The Timer16_ISR routine in timer16int.asm must be modified by adding the line 'ljmp _myTimer_ISR_Handler' between the user code banners. The start routine is then called to start the countdown period. The timer ticks are incremented every time the timer reaches the Terminal Count (0). For every 254 timer ticks, the GPIO pin Output is raised and lowered.

Note Please rename the required output pin in the Chip Editor to "Output".

```
#include <m8c.h>        // part specific constants and macros
#include "PSoCAPI.h"    // PSoC API definitions for all User Modules
#include "PSoCGPIOInt.h"

BYTE  timerTicks;

#pragma interrupt_handler myTimer_ISR_Handler;
void              myTimer_ISR_Handler( void );

void main(void)
{
    timerTicks = 0;
    M8C_EnableGInt;

    Timer16_EnableInt();
    Timer16_Start();

while( 1 )
    {
        if (timerTicks > 254)
        {
            timerTicks = 0;
            //Output is set to a Strong Drive
            Output_Data_ADDR |= Output_MASK;  //Raise Output?
            Output_Data_ADDR &= ~Output_MASK; //Lower Output
        }
     }
}


//-------------------------------------------------------------------------
// myTimer_ISR_Handler    // The handler for the Timer ISR
//-------------------------------------------------------------------------
void myTimer_ISR_Handler(void)
{
timerTicks++;
}
```

Here is an example of the equivalent code, written in Assembly language:

```
include "PSoCAPI.inc"
include "m8c.inc"       ; part specific constants and macros
include "PSoCGPIOInt.inc"

area    bss    (RAM,REL)
timerTicks:                blk     1

area text(ROM,REL)
export _main
export _myTimer_ISR_Handler

_main:
    mov   [timerTicks], 0
    M8C_EnableGInt
    lcall  _Timer16_EnableInt
    lcall  _Timer16_Start

loop:
    mov   A,254
    cmp   A,[timerTicks]
    jnc   loop
    mov   [timerTicks], 0
    ;Output is set to a Strong Drive
    or    reg[Output_Data_ADDR],1   ;Raise Output
    and   reg[Output_Data_ADDR],254 ;Lower Output
    jmp   loop

;-----------------------------------------------------------------------
; myTimer_ISR_Handler    // The handler for the Timer ISR
;-----------------------------------------------------------------------
_myTimer_ISR_Handler:
    inc   [timerTicks]
    reti
```

Configuration Registers

The Timer PSoC block registers used to configure this user module are described here:

Table 2. Block Timer16, Timer0 Configuration Register PTx_CFG

Bit	7	6	5	4	3	2	1	0
Value	Reserved					CLKSEL	One Shot	START

CLKSEL - This bit determines if the timer runs on 32 kHz clock or CPU clock. If the bit is set to 1'b1, the timer runs on CPU clock, otherwise the timer runs on 32 kHz clock.

One Shot - This bit determines if the timer runs in one shot mode or continuous mode. In one shot mode the timer completes one full count cycle and terminates. At termination, the START bit in this register is cleared. In continuous mode, the timer reloads the count value each time upon completion of its count cycle and repeats.

START - This bit starts the timer counting from a full count. The full count is determined by the value loaded into the DATA registers. In the one shot mode, this bit is cleared when the timer is running and a full count cycle completes.

Table 3. Block Timer16, Data Register 1, PTx_DATA1

Bit	7	6	5	4	3	2	1	0
Value	Data							

These bits hold the upper 8 bits of the timer's 16-bit period value.

Table 4. Block Timer16, Data Register 0, PTx_DATA0

Bit	7	6	5	4	3	2	1	0
Value	Data							

These bits hold the lower 8 bits of the timer's16-bit period value.

Version History

Version	Originator	Description
1.1	DHA	Added register aliases to Timer16.h and Timer16.inc files.
1.1.b	DHA	Updated description of PTx_DATA1 and PTx_DATA0 registers.

Note PSoC Designer 5.1 introduces a Version History in all user module datasheets. This section documents high level descriptions of the differences between the current and previous user module versions.

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