

CE 6302.001 – Microprocessor and Embedded Systems – F22

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Timer – Lab Report

- MSP-EXP432P4111 board is used in this project to implement timer and PWM modules.
- Timer 0 is used to output PWM signals.
- We generate square waves of 10Hz with 50% duty cycle.
- Three of the timer modes are implemented:
 - Mode2: Toggle/Reset
 - Mode4: Toggle
 - Mode7: Set/Reset
- Two of the counting modes are implemented.
 - Up-Down mode
 - Up mode
- We check the generation of the square wave on an LCD at Educational Booster Pack
- Port 2.3 is the input port and Port 2.5 is the output port. The input and the output ports are connected.

Calculations

Two counting modes, that is Up and Up-Down Modes are implemented. Two counters are used. “COUNT” and “COUNT2”. In order to switch between the modes, the values of COUNT and COUNT2 are supposed to be modified accordingly.

Calculations for the same are shown below.

Counter mode: UP mode

Output mode: 2

Toggle/Reset Mode

COUNT is calculated as $32768/10 = 3276.8$

COUNT2 is calculated as $32768/10/2 = 1638.4$

Output mode: 4

Toggle Mode

COUNT is calculated as $32768/20 = 1638.4$

COUNT2 is calculated as $32768/20/2 = 819.2$

Output mode: 7

Reset/Set

COUNT is calculated as $32768/10 = 3276.8$

COUNT2 is calculated as $32768/20 = 1638.4$

Counter: UP-DOWN Mode

Output mode: 2

Toggle/Reset

COUNT is calculated as $32768/25 = 1310.72$

COUNT2 is calculated as $32768/25/2 = 655.36$

Output mode: 7

COUNT is calculated as $32768/20 = 1638.4$

COUNT2 will be 0

Output mode: 4

Toggle Mode

COUNT is calculated as $32768/20 = 1638.4$

COUNT2 is calculated as $32768/40 = 819.2$

Modified part of the code

```
////setting up timer_A0 connected to ACLK in UP mode(counting modes)
```

```
TIMER_A0->CTL = (UP | ACLK);
```

```
TIMER_A0->CCR[0] = COUNT;
```

```
////setting up P2.5 as output mode.
```

```
P2->DIR = BIT5;
```

```
////setting up P2.5 connected to timer0.
```

```
P2->SEL0 |= BIT5;
```

```

P2->SEL1 &= ~(BIT5);

////setting up timer output mode as toggle(mode 3) (connected to P2.5)
TIMER_A0->CCTL[2] = TIMER_A_CCTLN_OUTMOD_4;

////setting up duty cycle (connected to P2.5)
TIMER_A0->CCR[2] = COUNT2;

////end of code modification

```

According to these calculations, the given code is modified for each mode.

```

#define CONT 0x0020
#define HALT 0x0000
//32kHz ACLK (32768)
#define ACLK 0x0100

#define COUNT 32768/10
#define COUNT2 32768/20

void setup() {
    WDT_A->CTL = WDT_A_CTL_PW | WDT_A_CTL_HOLD; // stop watchdog timer
    myScreen.begin();
    myScreen.setPenSolid(true);
    pinMode(74, INPUT_PULLUP); ////74 -> P1.4 pushbutton
    pinMode(34, INPUT_PULLUP);////34 -> p2_3

    ////***** please modify the following code *****/

    ////setting up timer_A0 connected to ACLK in UP mode(counting modes)
    TIMER_A0->CTL = (UP | ACLK);

    TIMER_A0->CCR[0] = COUNT;
    ////setting up P2.5 as output mode.
    P2->DIR = BIT5;
    ////setting up P2.5 connected to timer0.
    P2->SEL0 |= BIT5;
    P2->SEL1 &= ~(BIT5);
    ////setting up timer output mode as toggle(mode 3) (connected to P2.5)
    TIMER_A0->CCTL[2] = TIMER_A_CCTLN_OUTMOD_4;
    ////setting up duty cycle (connected to P2.5)
    TIMER_A0->CCR[2] = COUNT2;

    ////***** please modify the above code *****/

}

```

This is an example of code modification for Toggle Mode in Up-Down Counter.

Results



Expected waveform for the given calculation

On the LCD, a square wave of 10Hz is obtained for toggle mode in Up-Down mode implementation. The output mode is set as 4 and the above calculated values of COUNT and COUNT2 for toggle mode in Up-Down mode are assigned.