



Malaga University
Electronic Technology Department



ETS Telecommunications Engineering

Bachelor's Degree in Telecommunications Systems Engineering

microcontrollers

Course 2022/2023

Practice 4: Timers

(v1)

1. DESCRIPTION

Practice 4 of the subject presents the basic concepts of microcontroller **Timers**.

It will be developed on the *LaunchPad* and BBP boards, using the 4 Sx pushbuttons, the 4 LEDx and its Buzzer (x = 3..6). It must be taken into account that several buttons will never be pressed simultaneously, so it is not necessary to manage this situation.

IMPORTANT NOTE: In order to develop this practice it is necessary that the first instructions that are executed in the "main" function of the program are:

```
WDTCTL = (WDTPW|WDTHOLD);    // Stop the watchdog
DCOCTL = 0;                  // Set the frequency to 1MHz
BCSCTL1=CALBC1_1MHZ;
DCOCTL=CALDCO_1MHZ;
```

To implement this practice, the modules described below must be developed.

UP MODE

p4.1

Description:

When the Sx button is pressed, the LEDx will light up for 300ms.

Considerations:

- The management of the buttons and timers will be carried out by interruptions. • Timer TA0 and block 0 (TA0CCR0) will be used in ascending mode, with the clock signal SMCLK at 1MHz and the /8 divider.
- The CCIFG interrupt of block 0 (TA0CCR0) will be used.

p4.2

Description:

When the Sx button is pressed, the LEDx will light up for 1.25s.

Considerations:

- The management of the buttons and timers will be carried out by interruptions. • Timer TA0 and block 0 (TA0CCR0) will be used in ascending mode, with the clock signal SMCLK at 1MHz and the /8 divider.
- The CCIFG interrupt of block 0 (TA0CCR0) will be used. • If an interrupt counter is required, a local variable must be used in the RTI of the timer.

CONTINUOUS MODE

p4.3

Description:

When the Sx button is pressed, the LEDx will light up for 300ms.

Considerations:

- The management of the buttons and timers will be carried out by interruptions.
- Timer TA0 and block 1 (TA0CCR1) will be used in continuous mode, with clock signal SMCLK to 1MHz and the /8 divider.

p4.4

Description:

When the Sx button is pressed, the LEDx will light up for 1.25s.

Considerations:

- The management of the buttons and timers will be carried out by interruptions.
- Timer TA0 and block 1 (TA0CCR1) will be used in continuous mode, with clock signal SMCLK to 1MHz and the /8 divider.
- If an interrupt counter is required, a local variable must be used in the RTI of the timer.

p4.5

Description:

When Sx is pressed, LEDx will flash with different frequency depending on whether it is LED3 (1Hz), LED4 (1.25Hz), LED5 (1.5Hz) or LED6 (1.75Hz).

Considerations:

- The management of the buttons and timers will be carried out by interruptions.
- Timer TA0 and block 0 (TA0CCR0) will be used for LED3 and block 1 (TA0CCR1) for LED4 in continuous mode, with the clock signal SMCLK at 1MHz and the divider /8.
- Timer TA1 and block 1 (TA1CCR1) will be used for LED5 and block 2 (TA1CCR2) for LED6 in continuous mode, with the clock signal SMCLK at 1MHz and the divider /8.

PWM

Q4.6

Description:

When the Sx button is pressed, the Buzzer will switch, generating a note with a frequency of 440Hz and a duty cycle of 50%.

Considerations:

- The management of the buttons will be carried out by interruptions.
- The appropriate TA timer will be used, with the clock signal SMCLK at 1MHz and without a divider.

Q4.7Description:

LED6 will turn on, and when the Sx button is pressed, LED5 will flash with a PWM frequency of 50Hz and with a different duty cycle depending on whether S4 (10%), S5 (50%) or S6 (90%) is pressed, and when S3 is pressed, LED5 will turn off.

Considerations:

- The management of the buttons will be carried out by interruptions.
- The appropriate TA timer will be used, with the clock signal SMCLK at 1MHz, without divider and with the mode OUTMOD_7.

ANTI-REBOUND**p4.8**Description:

When the Sx pushbutton is pressed, the LEDx will toggle.

Considerations:

- The management of the buttons and timers will be carried out by interruptions.
- The pushbuttons will have a 32ms debounce, implemented through the watchdog with the signal SMCLK clock at 1MHz.

MULTIFUNCTION**p4.9**Description:

Pressing and releasing Sx for less than 1.25s will toggle the LEDx on release of Sx, and pressing and releasing Sx for 1.25s or more will toggle all LEDs except LEDx on reaching 1.25s.

Considerations:

- The management of the buttons and timers will be carried out by interruptions.
- The pushbuttons will have a 32ms debounce, implemented through the watchdog with the signal SMCLK clock at 1MHz.
- Timer TA0 and block 0 (TA0CCR0) will be used in ascending mode, with the clock signal SMCLK at 1MHz and the /8 divider.
- The CCIFG interrupt of block 0 (TA0CCR0) will be used.