ENGINE

Erasmus+

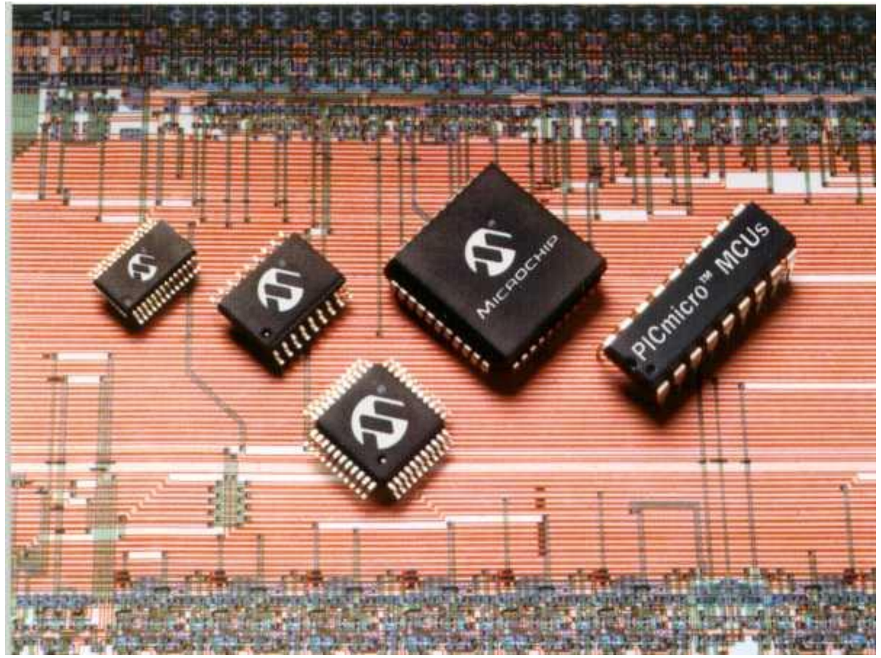
TEACHING ONLINE ELECTRONICS, MICROCONTROLLERS AND PROGRAMMING IN HIGHER EDUCATION

Module_2-8. Timers

PIC18F4550 with Proteus Simulation

Contents

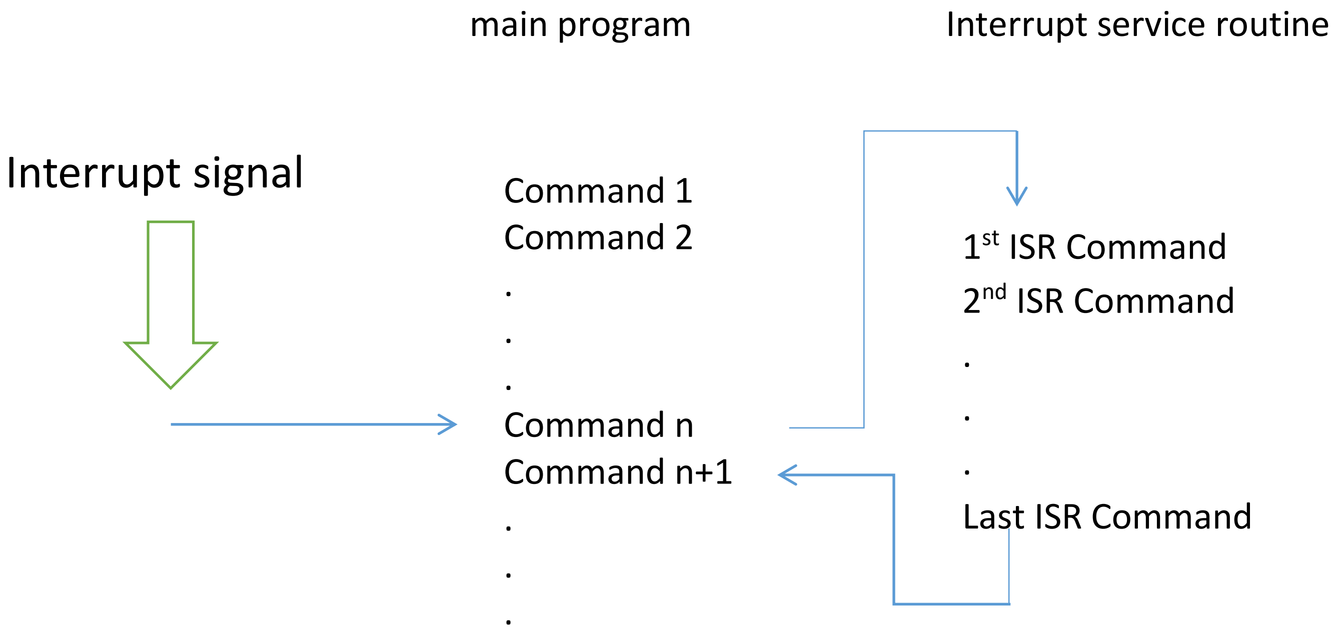
- Interrupt
- Timer



Interrupts

Interrupt is to stop execution of the microcontroller's program flow in order to execute a block of code called an interrupt service routine

Example:



main program

Interrupt service routine

Interrupt signal

Command 1
Command 2
.
.
.
Command n
Command n+1
.
.
.

1st ISR Command
2nd ISR Command
.
.
.
Last ISR Command

Module_2-8. Timers
Timer

Timers are some 8-bit or 16-bit registers whose content is incremented by a specific time interval.

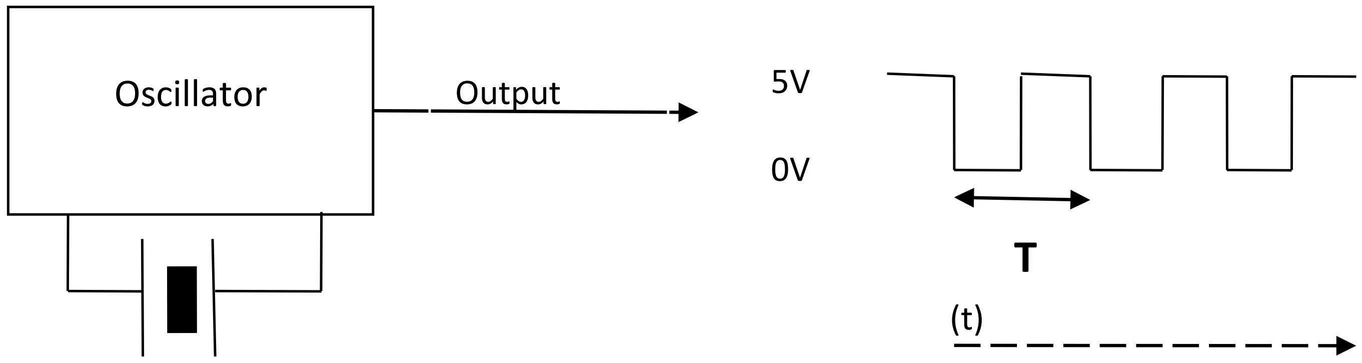
After the value 111 ... 111 the timer takes the value 000 ... 000 (overflow). In this transition we can program an interrupt to occur.

Question: Where do the pulses that increment the Timer value come from?

Answer: They can come from an external source and be applied to a specific pin of the microcontroller
Or come from a circuit inside the microcontroller called an internal oscillator (Oscillator)

In our program with a command we declare the source of the pulses that we want to be used

Module_2-8. Timers
Timer



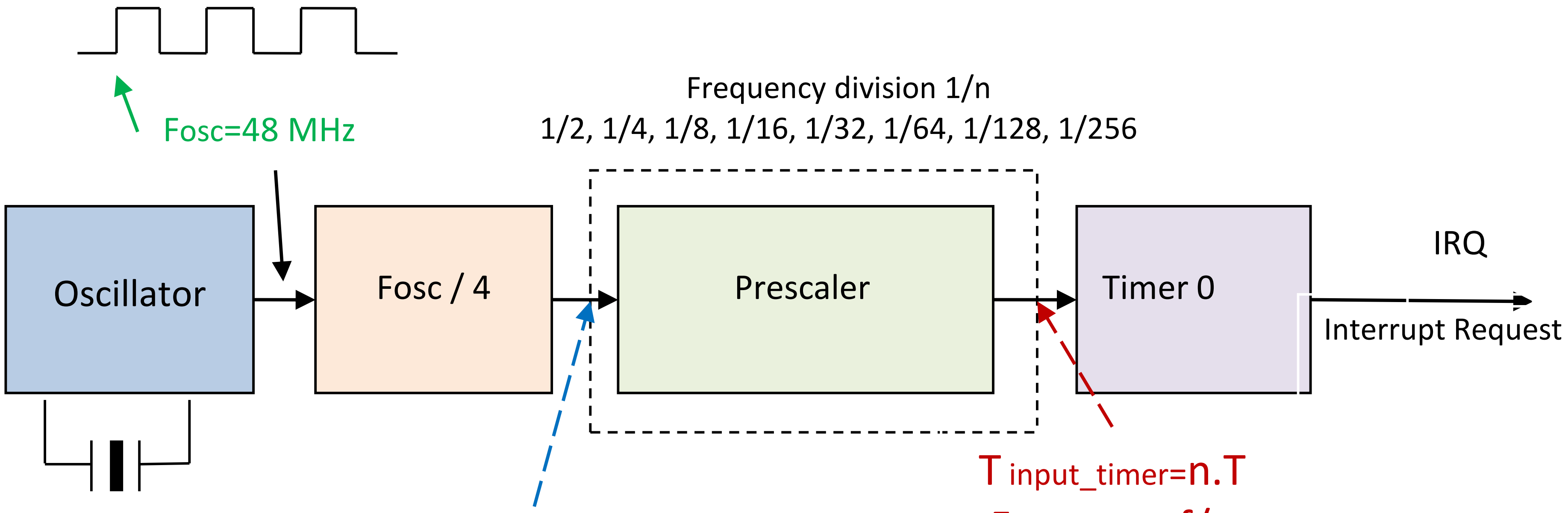
$$f = \frac{1}{T}$$

Timer0

Timer0 is an 8 bit or 16 bit. If we want it to be used as an 8-bit timer, we should fill in the relevant parameter in the timer0 setup command.

```
setup_timer_0(T0_INTERNAL|T0_DIV_256|T0_8_BIT);
```

Module_2-8. Timers
Timer



$T_{\text{input\_timer}}=n.T$

$F_{\text{input\_timer}}=f/n$

T = Machine Cycle

$$T=\frac{1}{12MHz}=\frac{1}{12x10^6Hz}=0{,}08333x10^{-6}=83{,}33x10^{-9}=83{,}33\,ns$$

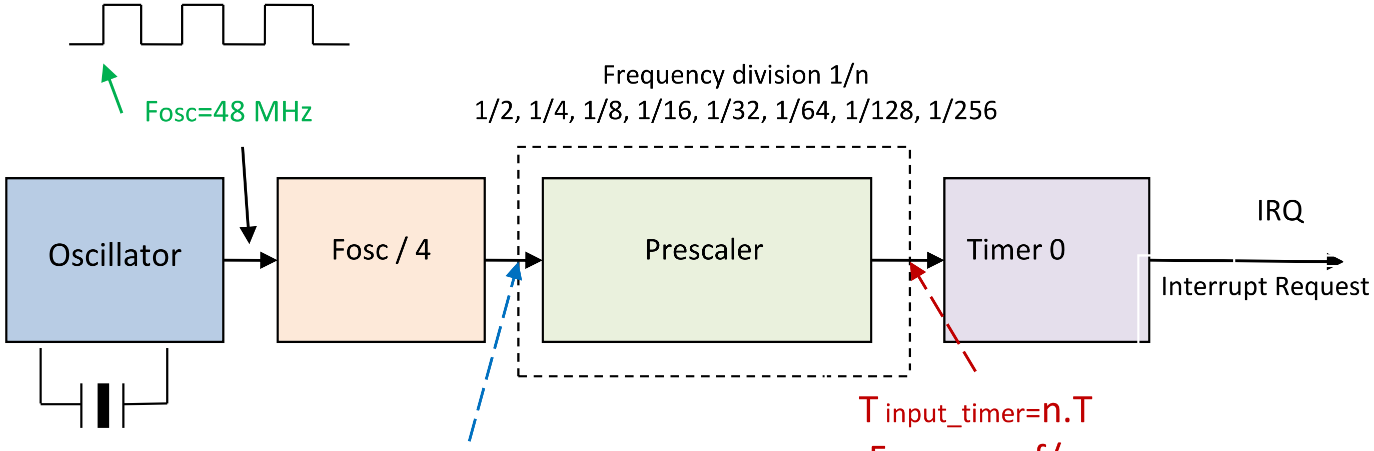
MC = 83,33 ns   MC → Machine Cycle

$f=\frac{1}{T}$ =12 MHz in the input of the prescaler

Prescaler is a configurable clock-divider circuit. It can be used to divide the clock frequency input to the timer module. Prescaler's values: 1, 2, 4, 8, 16, 32, 64, 128, 256

Module_2-8. Timers

Timer



$T_{\text{input\_timer}}$=n.T

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T = Machine Cycle

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MC = 83,33 ns MC → Machine Cycle

$f = \frac{1}{T}$ =12 MHz in the input of the prescaler

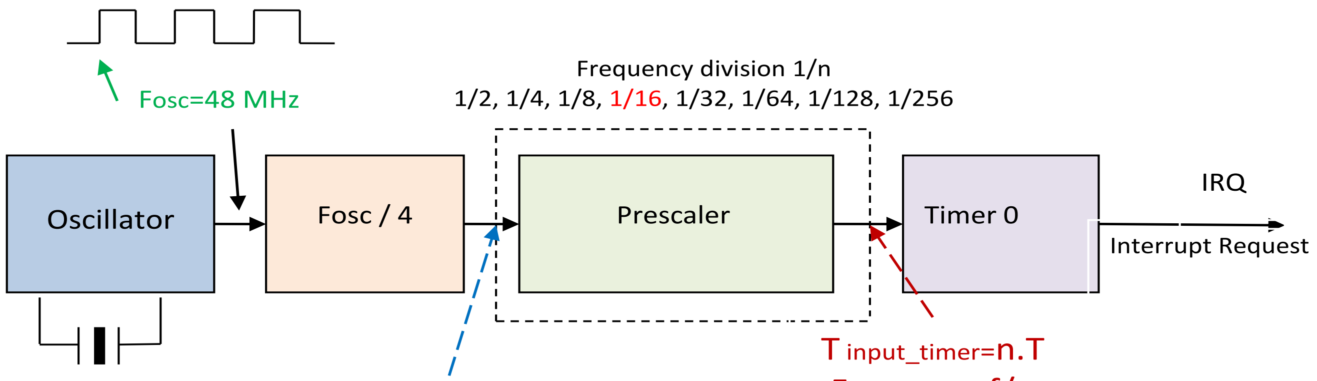
```
enable_interrupts(INT_TIMER0);
// Enable interrupt from timer0

enable_interrupts(GLOBAL);
// enables (if set) all un-masked interrupts or disables (if cleared) all interrupts.

setup_timer_0(T0_INTERNAL|T0_DIV_256);
```

Module_2-8. Timers
Timer

Calculation so that interrupts occur at a specific time interval, for example every 50 ms



T $_{\text{input\_timer}}$=n.T

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MC = 83,33 ns   MC → Machine Cycle

$f = \frac{1}{T}$ =12 MHz in the input of the prescaler

Tinput-timer = 16 x T

Tinput-timer=16 x 83,33 ns=1333,28 ns=1,33328μs

In order to have interruptions every 50 ms, the initial value y set in the timer after each interruption should satisfy the equation:

$$(65536 - y)x1{,}33328\mu s = 50000\mu s \Leftrightarrow 65536 - y = \frac{50000}{1{,}33328} = 37501$$

$$y = 65536 - 37501 = \boxed{28035}$$

This is the initial value that should be set to the Timer so that we have interrupts every 50ms

Module_2-8. Timers

Timer

How do we set it up so that after every interruption the Timer0 does not take the initial value 0 but the value 28035?

```
#INT_TIMER0
// Directive that the next routine is its service routine for Timer0

void timer0_int(void){
  set_timer0(28035)
                                  .......
                                  .......
                                  .......
 }
```

ENGINE Partnership

- Warsaw University of Technology (PL) - *coordinator*
- IHU - International Hellenic University (GR)
- EDUMOTIVA - European Lab for Educational Technology (GR)
- University of Padova (IT)
- University of Applied Sciences in Tarnow (PL)

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