Lab Exercise 1: It's alive!

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1.1 - Objective

The objective of this exercise is to solve a basic microcontroller system, which requires just a simple hardware that can be addressed with simple programming skills, in assembler language. This simple project will allow us to test our breadboard wired embedded system.

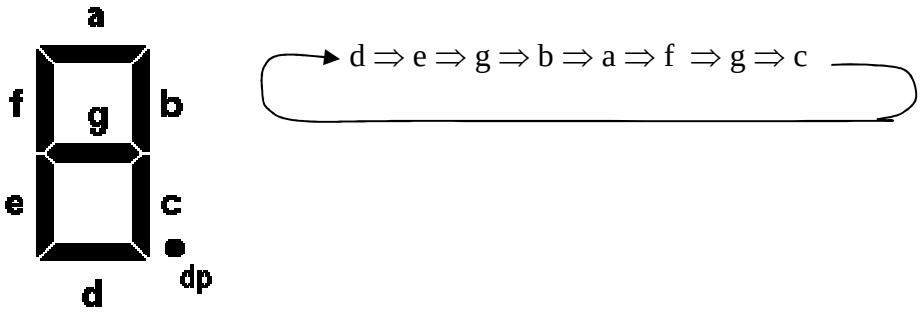
Before you enter the electronics lab, you should have done the following:

- Get the components in the Bill of Materials at the end of this exercise
- Wire the schematic in Figure 1.1 on your breadboard
- Answered the questions on 1.4

1.2 – Problem Description

In this laboratory exercise we are going to turnon for the first time your own microcontroller circuit. To verify its correct functioning, we are going to propose you a simple I/O problem, based on a 7-segment display.

The objective is to turn the segments one at a time, with the following sequence pattern:



1.3 – Problem Solving

In order to successfully develop the task, it is always recommended to divide it into simple steps. Each one of them should solve a simple problem related to the overall goal, and should also minimize the time to achieve success on the following one.

STEP 1 – Wire your Hardware

On the breadboard, wire the following schematic:

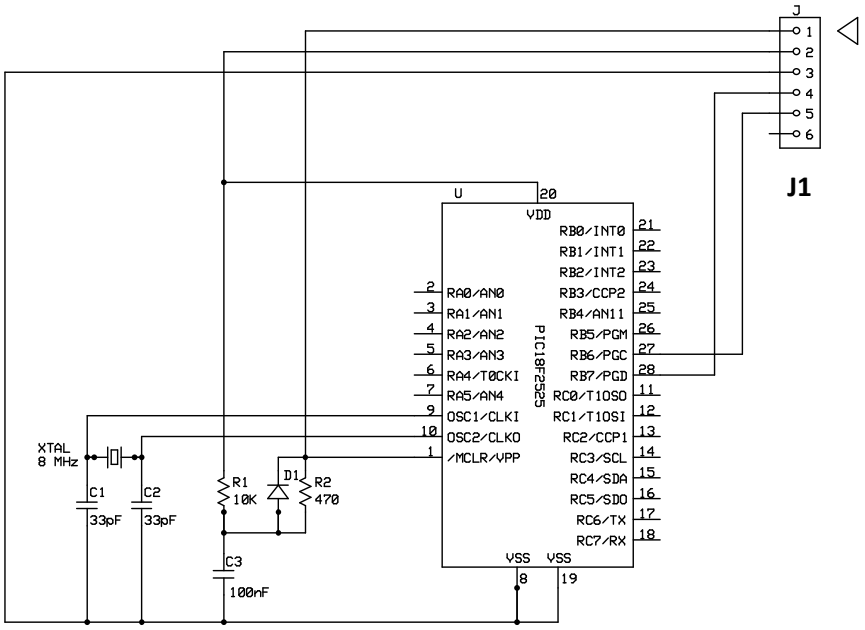


Figure 1.1

It is important to verify that the circuit is wired correctly. For that purpose, we recommend you to the following simple tests:

1.- Conect the debugger to header J1, observing the correct pin connection (the triangle on the PICKit2 debugger to pin 1).

2.- On the Integrated Development Environment, MPASM, select PICKit2 as debugger. Then verify the correct connection between the IDE and your system. A window should announce the proper connection, shown in Figure 1.2.

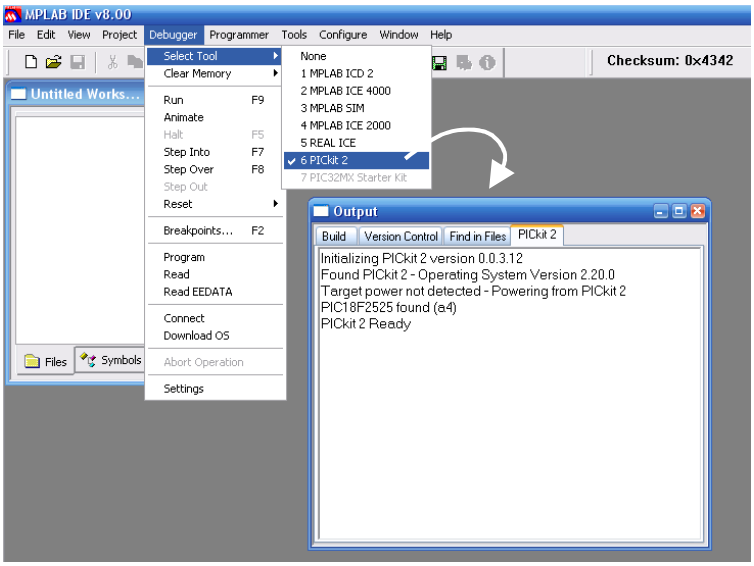


Figure 1.2

STEP 2 – Write your code

3.- Open a new project, creating a new folder for it. It is recommended that folder branches from C:, to avoid long path chains.

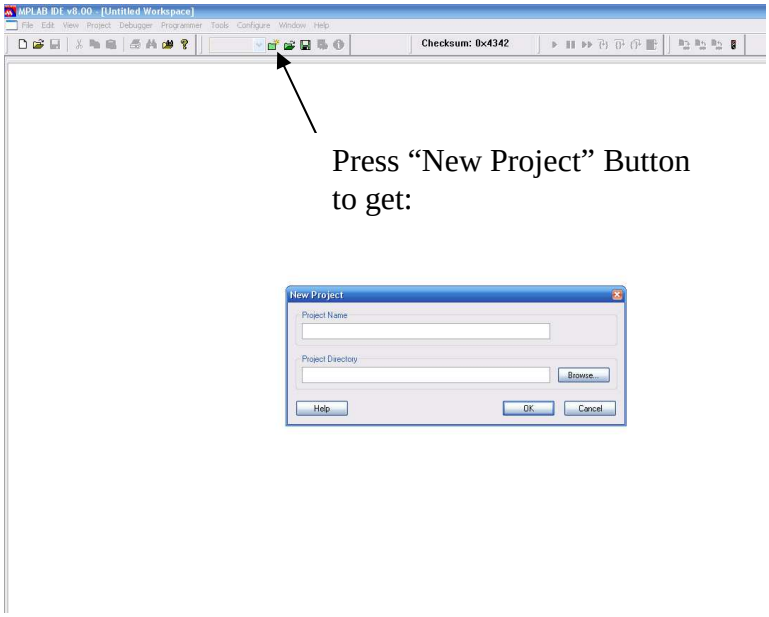


Figure 1.3

You can also use in the “Project” menu, the “Project Wizard” help

4.- Press New File, and write a code that turns on and off one the the 7 segments on the display. This task is easy enough to test the port connections. The code for it is listed on the annexes.

Save this code, and associate it with the project that you just created. For this, you can just open the “Project” window, and left click on the “Source Files” entry of the menu. A dialog box to select a source file should open up.

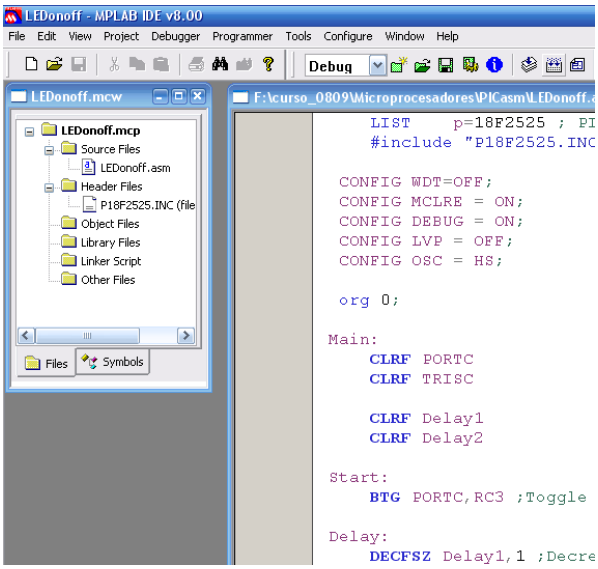


Figure 1.4

5.- Program the chip on the Breadboard, as shown on the figure below

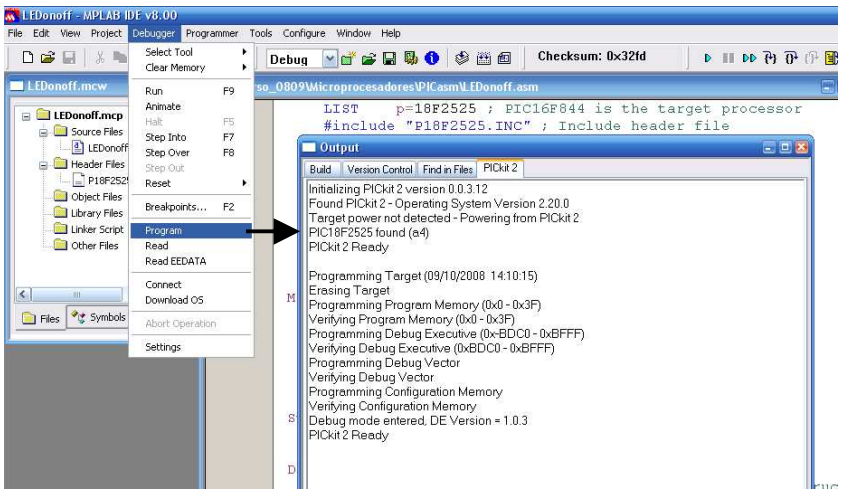


Figure 1.5

6.- Verify that one of the LEDs of the 7 segment display flashes. On the picture below, it is the doc of the display.

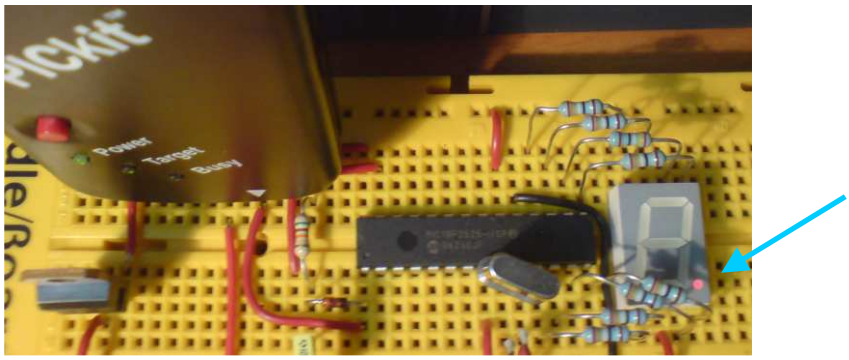
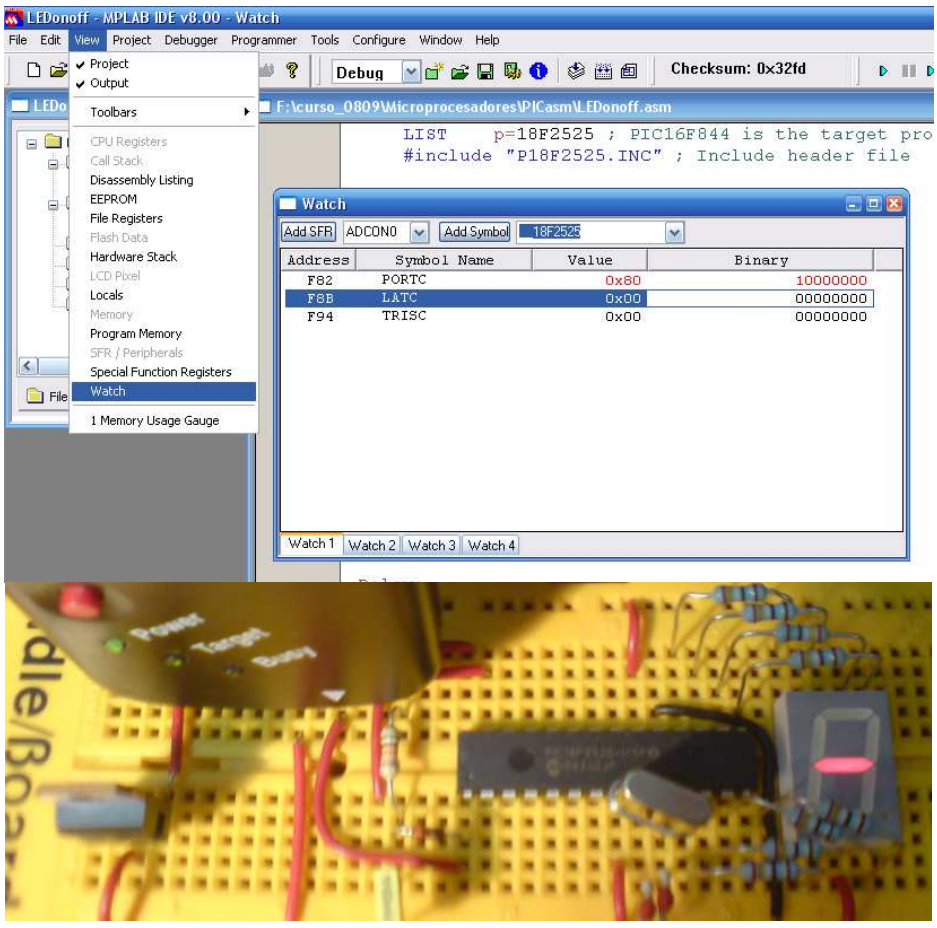


Figure 1.6

7.- Scream “It’s Alive!”

STEP 3 – Debug

8.- To check the proper connection of each one of the 7 segments, you can turn on one at a time manually, modifying the value on the port using the **Watch** tool of the IDE, which directly writes on the desired register of the device.



1.4 – Developing the Software

The steps above just let you verify that the hardware is working.

Now it is time to work out the application required: Turn the display segments on under a given sequence pattern.

We advice you to write a memory table in the same order in which the segments have to be lighted, in which the contents are the bit combinations that turn the desired segment in each position. As this table should be located in program memory, please revise the code instructions that read a program memory position.

This is the code that each one individually must work out, filling the following memo that has to be handed to the lab instructors as you enter into the lab:

1.- Complete Flux diagram of the program.

2.- Assembler listing of the program.

ANNEX 1: Assembler Template

```
;    Filename:
;    Date:
;    File Version:
;
;    Author:
;    Company:
;
;
;*****************************************************************
;
;    Files required:
;
;*****************************************************************
       LIST P=18F2525                ;directive to define processor
       #include <P18F2525.INC>;      ;processor specific variable

;*****************************************************************
*********
;Configuration bits
;   Oscillator Selection:
    CONFIG  OSC = HS             ; alta velocidad del PIC
    CONFIG  WDT = OFF

;*****************************************************************
;Etiquetas
label          equ     expr


;*****************************************************************
;Reset vector
; This code will start executing when a reset occurs.

               ORG     0x0000
               goto    Main    ;go to start of main code

               ORG     0x0008
               retfie          ;go to high priority interrupt routine

               ORG     0x0018
               retfie          ;go to low priority interrupt routine

Main:
;Configura PIC para utilizar los pines del puerto A como E/S
               MOVF    ADCON1,W,A
               IORLW   0Fh
               MOVWF   ADCON1

               CLRF    TRISA   ; TRISA para que PORTA, todo outputs


PPAL:

               goto PPAL

 END
```

ANNEX 2: 7 segments displays basics

7 segment displays have 8 LEDs, 7 for the different segments from **a** to **g**, and one last LED for the decimal point (**dp**). The spatial distribution of the segments is shown on figure A2.1 a as well as the pin-out on figure A2.2.

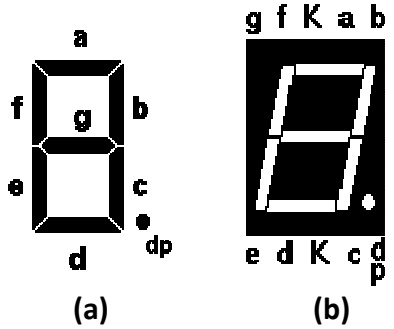


Figura A2.1

LED are two terminal components, with an Anode and a Cathode pin. For the sake of reducing the number of required pins on the packaged, usually one of the LED terminals is common to all.

There are therefore two flavors to 7-segment displays, one is the common cathode, where the cathode is common to all 8 LEDs on the display, with a separate anode for each and the reverse (where the anode is common to all). Both are shown in figure A2.2.

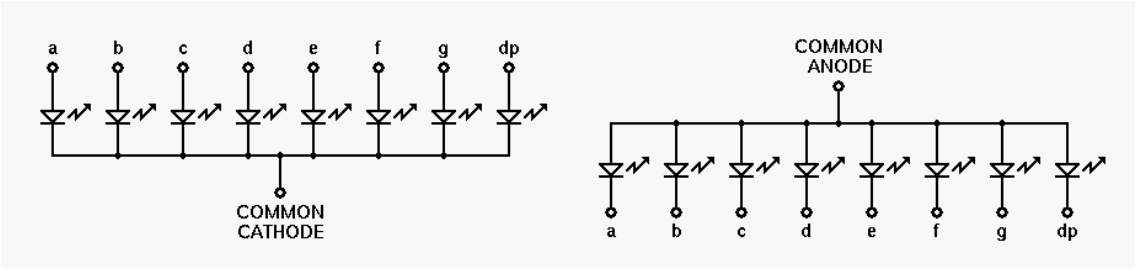


Figura A2.2

ANNEXO 3: Bill of Materials

PIC 18F2525 (DIL package)

Common anode 7-segments display
7 220 Ohm resistors

2 33pF capacitance
1 8MHz XTAL

1 100nF capacitance
10K Resistor
470 Ohm Resistor
Signal Diode

Cable

Pliers