

## Laboratorio 3 - Temario B – LCD

Utilizando el microcontrolador PIC16F887 con el compilador XC8

### Parte 1

Implemente una rutina la cual obtenga a partir de dos potenciómetros el valor de voltaje de cada uno simulando dos sensores analógicos y lo despliegue en la LCD como se muestra en la figura del circuito. **Deberá utilizar su librería de ADC y su librería de 8 bits para inicializar la LCD.**

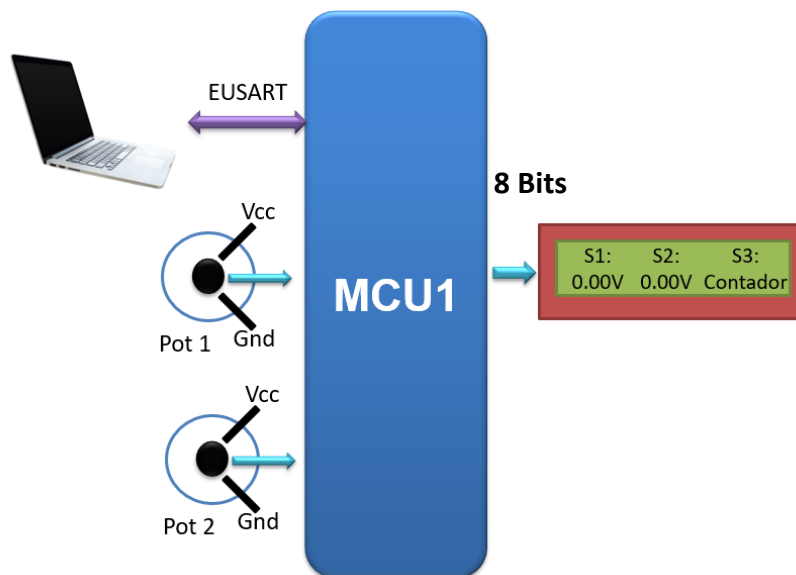
### Parte 2

Implemente la comunicación USART con la computadora para poder enviar y recibir datos. Desde el microcontrolador tendrá que enviar el resultado de los dos potenciómetros. **Deberá utilizar su librería para la comunicación USART.**

### Parte 3

Desde consola deberá poder incrementar un contador en el microcontrolador enviando los caracteres “+” y “-” respectivamente para incrementar o decrementar. Tendrá que desplegar el valor del contador en la LCD como sensor 3.

Figura 1. Circuito



## Lista de pines

| FUNCTION             | PIN NUMBER | NAME | LOGIC STATE           | DESCRIPTION  |
|----------------------|------------|------|-----------------------|--|
| Ground               | 1          | Vss  | -                     | 0V   |
| Power supply         | 2          | Vdd  | -                     | +5V  |
| Contrast             | 3          | Vee  | -                     | 0 - Vdd  |
| Control of operating | 4          | RS   | 0<br>1                | D0 - D7 are interpreted as commands<br>D0 - D7 are interpreted as data             |
|                      | 5          | R/W  | 0<br>1                | Write data (from controller to LCD)<br>Read data (from LCD to controller)          |
|                      | 6          | E    | 0<br>1<br>From 1 to 0 | Access to LCD disabled<br>Normal operating<br>Data/commands are transferred to LCD |
| Data / commands      | 7          | D0   | 0/1                   | Bit 0 LSB  |
|                      | 8          | D1   | 0/1                   | Bit 1  |
|                      | 9          | D2   | 0/1                   | Bit 2  |
|                      | 10         | D3   | 0/1                   | Bit 3  |
|                      | 11         | D4   | 0/1                   | Bit 4  |
|                      | 12         | D5   | 0/1                   | Bit 5  |
|                      | 13         | D6   | 0/1                   | Bit 6  |
|                      | 14         | D7   | 0/1                   | Bit 7 MSB  |

## Lista de comandos

| COMMAND                  | RS | RW | D7 | D6            | D5            | D4 | D3  | D2  | D1  | D0 | EXECUTION TIME |
|--------------------------|----|----|----|---------------|---------------|----|-----|-----|-----|----|----------------|
| Clear display            | 0  | 0  | 0  | 0             | 0             | 0  | 0   | 0   | 0   | 1  | 1.64mS         |
| Cursor home              | 0  | 0  | 0  | 0             | 0             | 0  | 0   | 0   | 1   | x  | 1.64mS         |
| Entry mode set           | 0  | 0  | 0  | 0             | 0             | 0  | 0   | 1   | I/D | S  | 40uS           |
| Display on/off control   | 0  | 0  | 0  | 0             | 0             | 0  | 1   | D   | U   | B  | 40uS           |
| Cursor/Display Shift     | 0  | 0  | 0  | 0             | 0             | 1  | D/C | R/L | x   | x  | 40uS           |
| Function set             | 0  | 0  | 0  | 0             | 1             | DL | N   | F   | x   | x  | 40uS           |
| Set CGRAM address        | 0  | 0  | 0  | 1             | CGRAM address |    |     |     |     |    | 40uS           |
| Set DDRAM address        | 0  | 0  | 1  | DDRAM address |               |    |     |     |     |    | 40uS           |
| Read "BUSY" flag (BF)    | 0  | 1  | BF | DDRAM address |               |    |     |     |     |    | -              |
| Write to CGRAM or DDRAM  | 1  | 0  | D7 | D6            | D5            | D4 | D3  | D2  | D1  | D0 | 40uS           |
| Read from CGRAM or DDRAM | 1  | 1  | D7 | D6            | D5            | D4 | D3  | D2  | D1  | D0 | 40uS           |

I/D 1 = Increment (by 1)  
0 = Decrement (by 1)

S 1 = Display shift on  
0 = Display shift off

D 1 = Display on  
0 = Display off

U 1 = Cursor on  
0 = Cursor off

B 1 = Cursor blink on  
0 = Cursor blink off

R/L 1 = Shift right  
0 = Shift left

DL 1 = 8-bit interface  
0 = 4-bit interface

N 1 = Display in two lines  
0 = Display in one line

F 1 = Character format 5x10 dots  
0 = Character format 5x7 dots

D/C 1 = Display shift  
0 = Cursor shift

**Figura 3. Interconexión de la computadora con el microcontrolador**

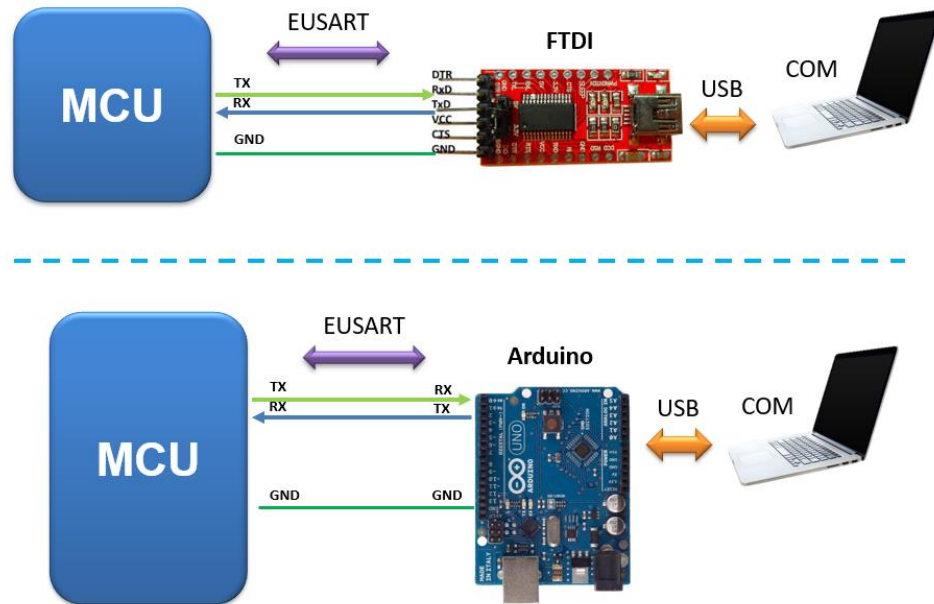


Figura 4. Código de Arduino para implementar FTDI con Arduino

```
MultiSerial Arduino 1.8.10
Archivo Editar Programa Herramientas Ayuda
MultiSerial

This example works only with boards with more than 8 pins.

The circuit:
- any serial device attached to Serial port 1
- Serial Monitor open on Serial port 0

created 30 Dec 2008
modified 20 May 2012
by Tom Igoe & Jed Roach
modified 27 Nov 2015
by Arturo Guadalupi

This example code is in the public domain.
*/

void setup() {
  // initialize both serial ports:
  Serial.begin(9600);
  Serial1.begin(9600);
}

void loop() {
  // read from port 1, send to port 0:
  if (Serial1.available()) {
    int inByte = Serial1.read();
    Serial.write(inByte);
  }

  // read from port 0, send to port 1:
  if (Serial.available()) {
    int inByte = Serial.read();
    Serial1.write(inByte);
  }
}
```

Configurar al baudrate que se  
programó el microcontrolador

Borrar línea

Borrar líneas

Modificar por:  
Serial.write(inByte);

### Links de ayuda:

- <https://pythonprogramming.net/python-3-tkinter-basics-tutorial/>
- <https://pythonprogramming.net/tkinter-python-3-tutorial-adding-buttons/?completed=/python-3-tkinter-basics-tutorial/>
- <https://pythonprogramming.net/tkinter-tutorial-python-3-event-handling/?completed=/tkinter-python-3-tutorial-adding-buttons/>
- <https://www.programcreek.com/python/example/1568/serial.Serial>
- <http://www.varesano.net/blog/fabio/serial%20rs232%20connections%20python>