

Microcontroladores

Laboratorio Semana 5

UPC - Ingeniería Electrónica

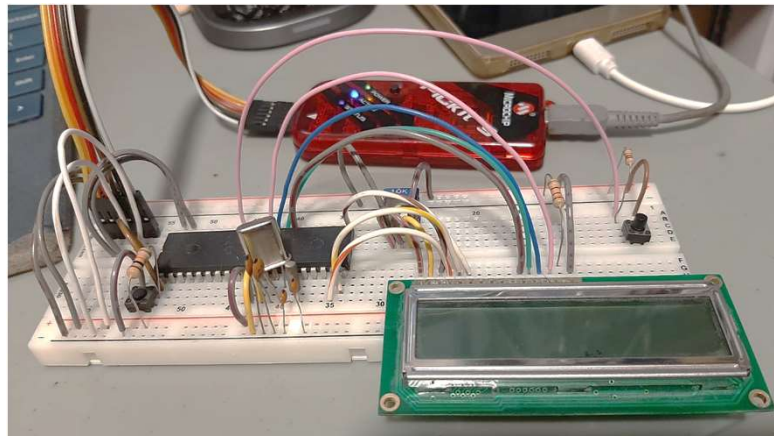
Profesor: Kalun Lau

2021-0

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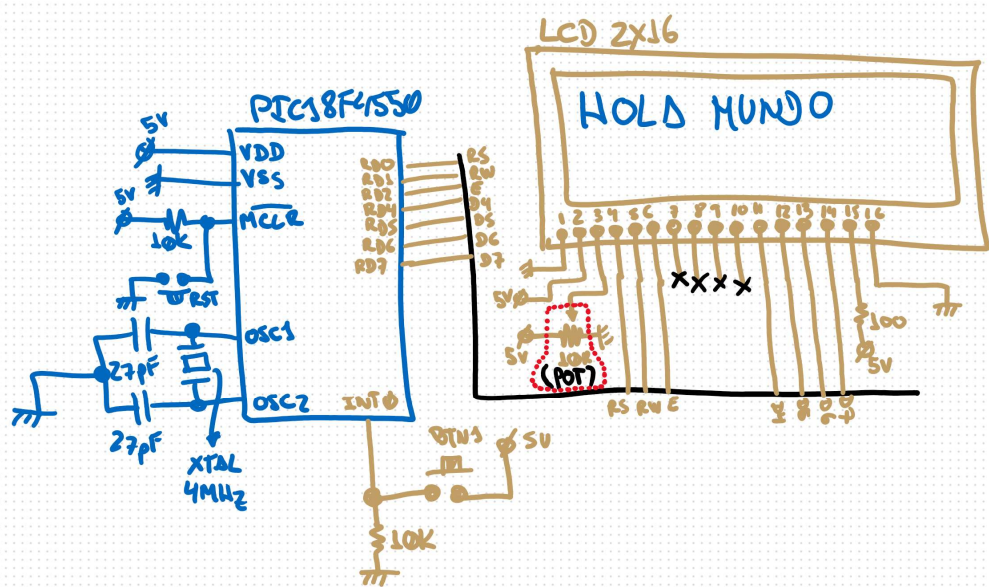
Agenda:

- Implementación de circuitos con el PIC18F4550 y display LCD 2x16



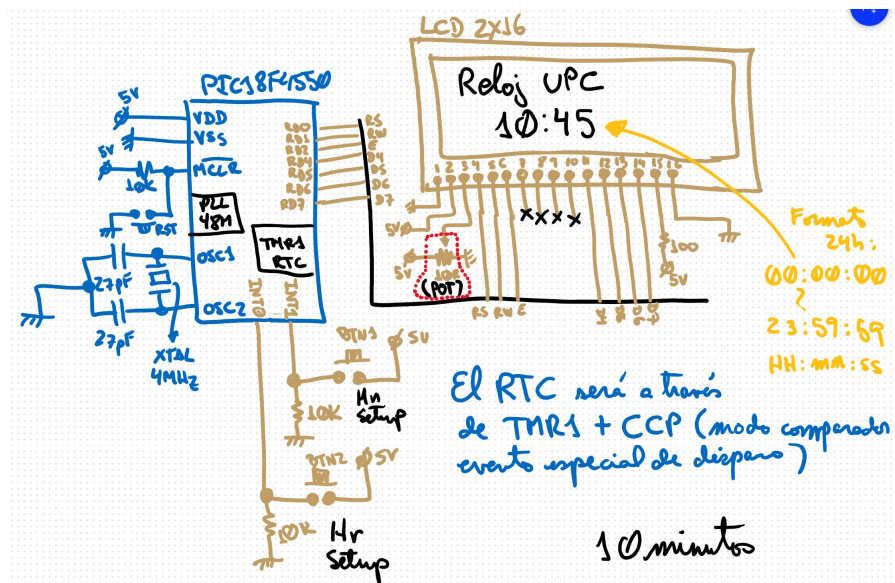
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Implementación:



3

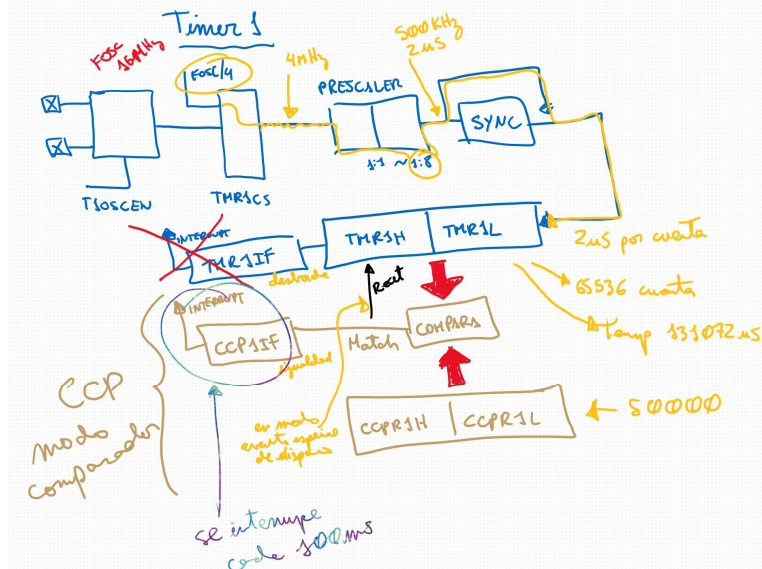
Ejemplo: Reloj UPC



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Reloj UPC

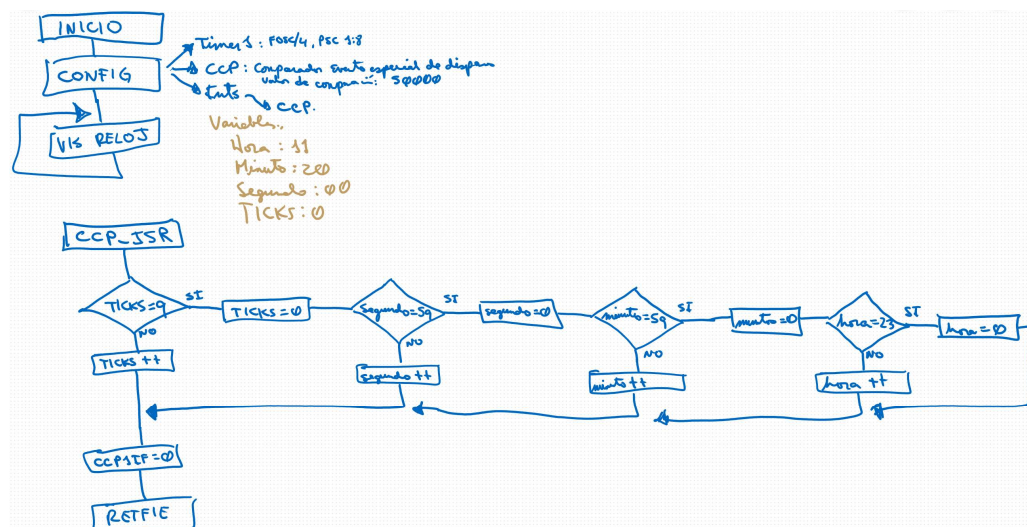
- Configuración Timer1 + CCP en modo comparación evento especial de disparo



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Reloj UPC

- Diagrama de flujo



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Reloj UPC

• Valores de registros

REGISTER 12-1: T1CON: TIMER1 CONTROL REGISTER

R/W-0	R-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
RD6	T1RUN	T1CKPS1	T1CKPS0	T1OSCEN	T1SYNC	TMR1CS	TMR1ON
bit 7							bit 0

Legend:

R = Readable bit
-n = Value at POR

W = Writable bit
'1' = Bit is set

U = Unimplemented bit, read as '0'
'0' = Bit is cleared
x = Bit is unknown

- bit 7 **RD16**: 16-Bit Read/Write Mode Enable bit
1 = Enables register read/write of Timer1 in one 16-bit operation
0 = Enables register read/write of Timer1 in two 8-bit operations
- bit 6 **T1RUN**: Timer1 System Clock Status bit
1 = Device clock is derived from Timer1 oscillator
0 = Device clock is derived from another source
- bit 5-4 **T1CKPS1:T1CKPS0**: Timer1 Input Clock Prescale Select bits
11 = 1:8 Prescale value
10 = 1:4 Prescale value
01 = 1:2 Prescale value
00 = 1:1 Prescale value
- bit 3 **T1OSCEN**: Timer1 Oscillator Enable bit
1 = Timer1 oscillator is enabled
0 = Timer1 oscillator is shut off
The oscillator inverter and feedback resistor are turned off to eliminate power drain.
- bit 2 **T1SYNC**: Timer1 External Clock Input Synchronization Select bit
When TMR1CS = 1:
1 = Do not synchronize external clock input
0 = Synchronize external clock input
When TMR1CS = 0:
This bit is ignored. Timer1 uses the internal clock when TMR1CS = 0.
- bit 1 **TMR1CS**: Timer1 Clock Source Select bit
1 = External clock from RC0/T1OSO/T13CK1 pin (on the rising edge)
0 = Internal clock (Fosc/4)
- bit 0 **TMR1ON**: Timer1 On bit
1 = Enables Timer1
0 = Stops Timer1

T1CON: 0x31

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Reloj UPC

• Valores de registros

REGISTER 15-1: CCPxCON: STANDARD CCPx CONTROL REGISTER

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
DCxB1	DCxB0	DCxB1	DCxB0	CCPxM3	CCPxM2	CCPxM1	CCPxM0
bit 7							bit 0

Legend:

R = Readable bit
-n = Value at POR

W = Writable bit
'1' = Bit is set

U = Unimplemented bit, read as '0'
'0' = Bit is cleared
x = Bit is unknown

- bit 7-6 **Unimplemented**: Read as '0'⁽¹⁾
- bit 5-4 **DCxB1:DCxB0**: PWM Duty Cycle Bit 1 and Bit 0 for CCPx Module
Capture mode: Unused.
Compare mode: Unused.
PWM mode: These bits are the two LSBs (bit 1 and bit 0) of the 10-bit PWM duty cycle. The eight MSBs of the duty cycle are found in CCP1L.
- bit 3-0 **CCPxM3:CCPxM0**: CCPx Module Mode Select bits
0000 = Capture/Compare/PWM disabled (resets CCPx module)
0001 = Reserved
0010 = Compare mode: toggle output on match (CCPxIF bit is set)
0011 = Reserved
0100 = Capture mode: every falling edge
0101 = Capture mode: every rising edge
0110 = Capture mode: every 4th rising edge
0111 = Capture mode: every 16th rising edge
1000 = Compare mode: initialize CCPx pin low; on compare match, force CCPx pin high (CCPxIF bit is set)
1001 = Compare mode: initialize CCPx pin high; on compare match, force CCPx pin low (CCPxIF bit is set)
1010 = Compare mode: generate software interrupt on compare match (CCPxIF bit is set, CCPx pin reflects I/O state)
1011 = Compare mode: trigger special event, reset timer, start A/D conversion on CCPx match (CCPxIF bit is set)
11xx = PWM mode

CCP1CON: 0x0B

Note 1: These bits are not implemented on 28-pin devices and are read as '0'.

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Reloj UPC

• Valores de registros

REGISTER 9-6: PIE1: PERIPHERAL INTERRUPT ENABLE REGISTER 1

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
SPPIE	ADIE	RCIE	TXIE	SSPIE	CCP1IE	TMR2IE	TMR1IE
bit 7							bit 0

Legend:
 R = Readable bit W = Writable bit U = Unimplemented bit, read as '0'
 -n = Value at POR '1' = Bit is set '0' = Bit is cleared x = Bit is unknown

bit 7 **SPPIE**: Streaming Parallel Port Read/Write Interrupt Enable bit⁽¹⁾
 1 = Enables the SPP read/write interrupt
 0 = Disables the SPP read/write interrupt

bit 6 **ADIE**: A/D Converter Interrupt Enable bit
 1 = Enables the A/D interrupt
 0 = Disables the A/D interrupt

bit 5 **RCIE**: EUSART Receive Interrupt Enable bit
 1 = Enables the EUSART receive interrupt
 0 = Disables the EUSART receive interrupt

bit 4 **TXIE**: EUSART Transmit Interrupt Enable bit
 1 = Enables the EUSART transmit interrupt
 0 = Disables the EUSART transmit interrupt

bit 3 **SSPIE**: Master Synchronous Serial Port Interrupt Enable bit
 1 = Enables the MSSP interrupt
 0 = Disables the MSSP interrupt

bit 2 **CCP1IE**: CCP1 Interrupt Enable bit
 1 = Enables the CCP1 interrupt
 0 = Disables the CCP1 interrupt

bit 1 **TMR2IE**: TMR2 to PR2 Match Interrupt Enable bit
 1 = Enables the TMR2 to PR2 match interrupt
 0 = Disables the TMR2 to PR2 match interrupt

bit 0 **TMR1IE**: TMR1 Overflow Interrupt Enable bit
 1 = Enables the TMR1 overflow interrupt
 0 = Disables the TMR1 overflow interrupt

Note 1: This bit is reserved on 28-pin devices; always maintain this bit clear.

REGISTER 9-1: INTCON: INTERRUPT CONTROL REGISTER

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
GIE/GIEH	PEIE/GIEH	TMR0IE	INT0IE	RBIF	TMR0IF	INT0IF	RBIF
bit 7							bit 0

Legend:
 R = Readable bit W = Writable bit U = Unimplemented bit, read as '0'
 -n = Value at POR '1' = Bit is set '0' = Bit is cleared x = Bit is unknown

bit 7 **GIE/GIEH**: Global Interrupt Enable bit
When IPEN = 0:
 1 = Enables all unmasked interrupts
 0 = Disables all interrupts
When IPEN = 1:
 1 = Enables all high-priority interrupts
 0 = Disables all interrupts

bit 6 **PEIE/GIEH**: Peripheral Interrupt Enable bit
When IPEN = 0:
 1 = Enables all unmasked peripheral interrupts
 0 = Disables all peripheral interrupts
When IPEN = 1:
 1 = Enables all low-priority peripheral interrupts (if GIE/GIEH = 1)
 0 = Disables all low-priority peripheral interrupts

bit 5 **TMR0IE**: TMR0 Overflow Interrupt Enable bit
 1 = Enables the TMR0 overflow interrupt
 0 = Disables the TMR0 overflow interrupt

bit 4 **INT0IE**: INT0 External Interrupt Enable bit
 1 = Enables the INT0 external interrupt
 0 = Disables the INT0 external interrupt

bit 3 **RBIF**: RB Port Change Interrupt Flag bit
 1 = Enables the RB port change interrupt
 0 = Disables the RB port change interrupt

bit 2 **TMR0IF**: TMR0 Overflow Interrupt Flag bit
 1 = TMR0 register has overflowed (must be cleared in software)
 0 = TMR0 register did not overflow

bit 1 **INT0IF**: INT0 External Interrupt Flag bit
 1 = The INT0 external interrupt occurred (must be cleared in software)
 0 = The INT0 external interrupt did not occur

bit 0 **RBIF**: RB Port Change Interrupt Flag bit⁽¹⁾
 1 = At least one of the RB7:RB4 pins changed state (must be cleared in software)
 0 = None of the RB7:RB4 pins have changed state

Note 1: A mismatch condition will continue to set this bit. Reading PORTB, and then waiting one additional instruction cycle, will end the mismatch condition and allow the bit to be cleared.

INTCON = 0x00

PIE1 = 0x04

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Código en XC8

```

1  #pragma config PLLDIV = 1
2  #pragma config CPUDEV = OSC4_PLL6
3  #pragma config FOSC = XTPLL_XT
4  #pragma config FWRT = ON
5  #pragma config BOR = OFF
6  #pragma config BORV = 3
7  #pragma config WDT = OFF
8  #pragma config WDTPS = 32768
9  #pragma config CCP2MX = ON
10 #pragma config PBADEN = OFF
11 #pragma config LPT1OSC = OFF
12 #pragma config MCLRE = ON
13 #pragma config LVP = OFF
14
15 #include <xc.h>
16 #include "LCD.h"
17 #define _XTAL_FREQ 16000000UL
18
19 //Declaracion de variables globales
20 unsigned int d_millar = 0;
21 unsigned int millar = 0;
22 unsigned int centena = 0;
23 unsigned int decena = 0;
24 unsigned int unidad = 0;
25
26 unsigned char ticks = 0;
27 unsigned char segundos = 0;
28 unsigned char minutos = 35;
29 unsigned char horas = 12;
30
31 void lcd_init(void){
32     TRISD = 0x00;
33     LCD_CONFIG();
34     _delay_ms(15);
35     BORRAR_LCD();
36     CURSOR_HOME();
37     CURSOR_ONOFF(OFF);
38 }
39
40 void convierte(unsigned int numero){
41     d_millar = numero / 10000;
42     millar = (numero % 10000) / 1000;
43     centena = (numero % 1000) / 100;
44     decena = (numero % 100) / 10;
45     unidad = numero % 10;
46 }
47
48 void configure(void){
49     lcd_init();
50     T1CON = 0x31; //Timer1_Fosc/4
51     CCP1CON = 0x0B; //Modo comparador
52     CCP1RH = 0xC3; //El valor de com
53     CCP1RL = 0x50;
54     PIE1 = 0x04; //CCP1IE habilita
55     INTCON = 0xC0; //PEIE y GIE habi
56 }
57
58 void main(void){
59     configure();
60     POS_CURSOR(1,0);
61     ESCRIBE_MENSAJE(" Reloj UPCINO",14);
62     while(1){
63         POS_CURSOR(2,3);
64         convierte(horas);
65         ENVIA_CHAR(decena+0x30);
66         ENVIA_CHAR(unidad+0x30);
67         ENVIA_CHAR(':');
68         convierte(minutos);
69         ENVIA_CHAR(decena+0x30);
70         ENVIA_CHAR(unidad+0x30);
71         ENVIA_CHAR(':');
72         convierte(segundos);
73         ENVIA_CHAR(decena+0x30);
74         ENVIA_CHAR(unidad+0x30);
75     }
76 }
77
78 void _interrupt() CCP1_ISR(void){
79     if(ticks == 9){
80         ticks = 0;
81         if(segundos == 59){
82             segundos = 0;
83             if(minutos == 59){
84                 minutos = 0;
85                 if(horas == 23){
86                     horas = 0;
87                 }
88             }
89             else{
90                 horas++;
91             }
92         }
93         else{
94             minutos++;
95         }
96     }
97     else{
98         segundos++;
99     }
100 }
101 }
102 }
103 }
104 }
105 }
106 }

```

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Fin de la sesión