

Microcontroladores

Laboratorio Sesión 11

Semestre: 2021-2

Profesor: Kalun José Lau Gan

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Preguntas previas:

- ?

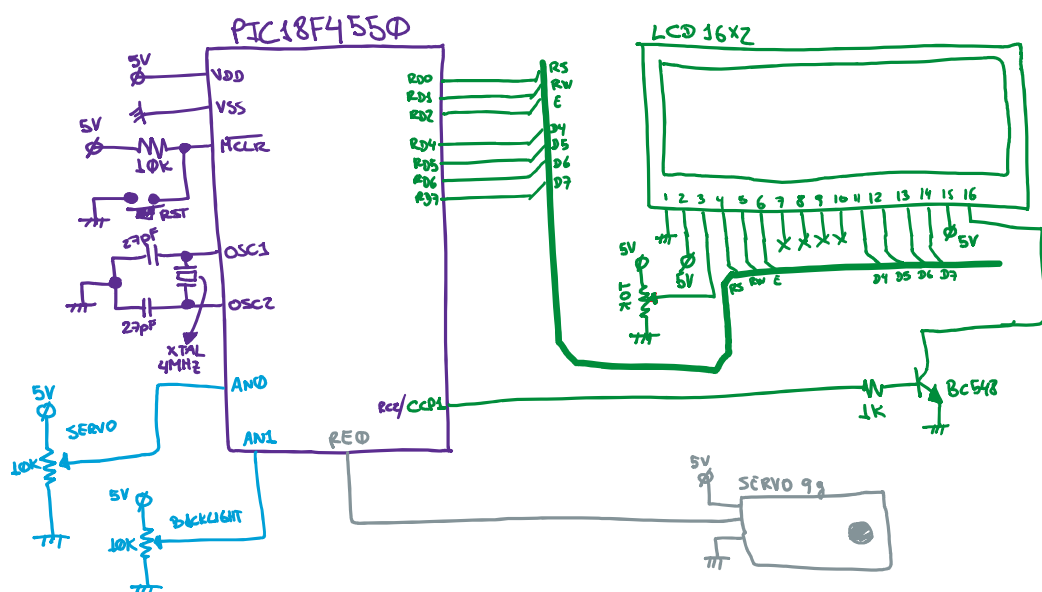
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Agenda:

- Interface a servomecanismos
- Interacción entre el conversor A/D con diferentes periféricos internos del microcontrolador.
- Movimiento del servo a través de un potenciómetro

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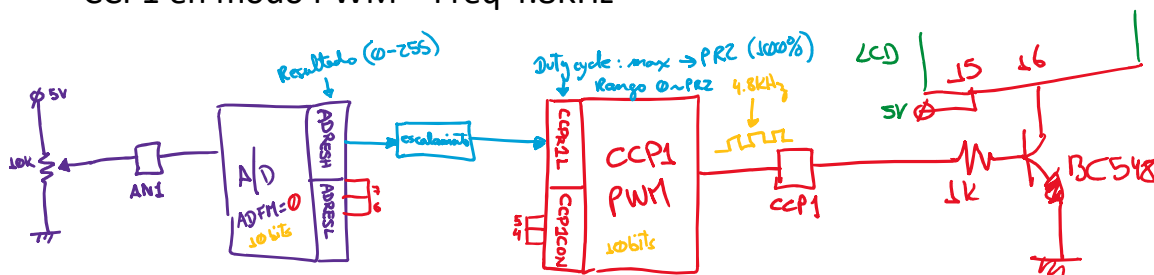
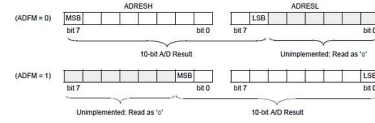
Implementar el siguiente circuito



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Análisis:

- Atacar el problema por partes:
 - Conversor A/D con el control de luz de fondo (AN.1 con CCP1-PWM)
 - Conversor A/D con el servo (AN.0 con cuenta inicial de Timer0 ó Timer3)
- Habilitar dos canales analógicos en el A/D:
 - ADCON1
- Conversor A/D va a funcionar con just izquierda (ADFM=0)
- CCP1 en modo PWM = Freq 4.8KHz



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Análisis:

- Configuración del A/D:
 - Dos canales: AN.0 y AN.1

$ADCON1 = 0 \times 0 \times 0$

REGISTER 21-2: ADCON1: A/D CONTROL REGISTER 1

| U-0 | U-0 | R/W(1) | R/W(1) | R/W(1) | R/W(1) | R/W(1) | R/W(1) |
|-------|-----|--------|--------|--------|--------|--------|--------|
| — | — | VCFG1 | VCFG0 | PCFG3 | PCFG2 | PCFG1 | PCFG0 |
| 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 7-6: Unimplemented: Read as '0'
 bit 5: VCFG1: Voltage Reference Configuration bit (VREF- source)
 1 = VREF- (AN2)
 0 = VSS

bit 4: VCFG0: Voltage Reference Configuration bit (VREF+ source)
 1 = VREF+ (AN3)
 0 = VDD

bit 3-0: PCFG3:PCFG0: A/D Port Configuration Control bits:

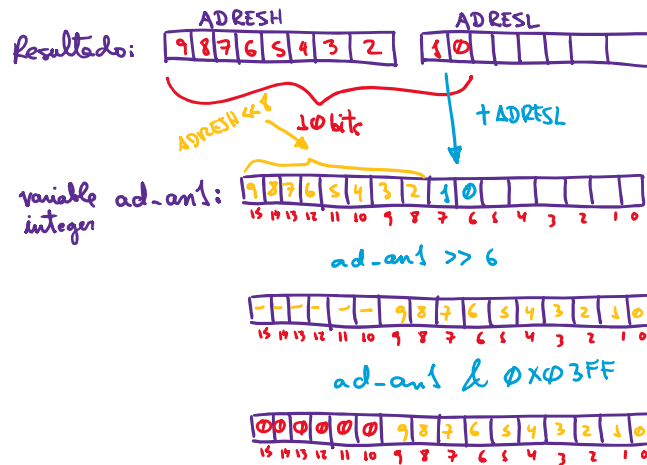
| PCFG3:PCFG0 | AN12 | AN11 | AN10 | AN9 | AN8 | AN7(2) | AN6(2) | AN5(2) | AN4 | AN3 | AN2 | AN1 | AN0 |
|-------------|------|------|------|-----|-----|--------|--------|--------|-----|-----|-----|-----|-----|
| 0000(1) | A | A | A | A | A | A | A | A | A | A | A | A | A |
| 0001 | A | A | A | A | A | A | A | A | A | A | A | A | A |
| 0010 | A | A | A | A | A | A | A | A | A | A | A | A | A |
| 0011 | D | A | A | A | A | A | A | A | A | A | A | A | A |
| 0100 | D | D | A | A | A | A | A | A | A | A | A | A | A |
| 0101 | D | D | D | A | A | A | A | A | A | A | A | A | A |
| 0110 | D | D | D | D | A | A | A | A | A | A | A | A | A |
| 0111(1) | D | D | D | D | D | A | A | A | A | A | A | A | A |
| 1000 | D | D | D | D | D | D | A | A | A | A | A | A | A |
| 1001 | D | D | D | D | D | D | D | A | A | A | A | A | A |
| 1010 | D | D | D | D | D | D | D | D | A | A | A | A | A |
| 1011 | D | D | D | D | D | D | D | D | D | A | A | A | A |
| 1100 | D | D | D | D | D | D | D | D | D | D | A | A | A |
| 1101 | D | D | D | D | D | D | D | D | D | D | D | A | A |
| 1110 | D | D | D | D | D | D | D | D | D | D | D | D | A |
| 1111 | D | D | D | D | D | D | D | D | D | D | D | D | D |

A = Analog input

D = Digital I/O

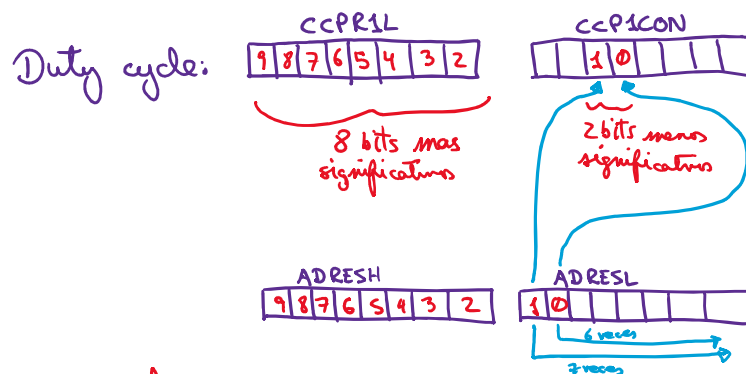
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Cómo hacer operaciones con ADFM=0



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Detalle de los dos bits menos significativos del Duty Cycle del PWM en el CCP



Nota: Análisis en modo puesto que CCPR1L como máximo debe de ser PR2

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Consideracion:

- CCPR1L no debe de exceder PR2

Si PR2 = 155:

CCPR1L = 0 \rightarrow 0%
155 \rightarrow 100%

ADRESH \rightarrow 0-255

$$CCPR1L = ADRESH \left(\frac{155}{255} \right)$$

Duty cycle
 \downarrow

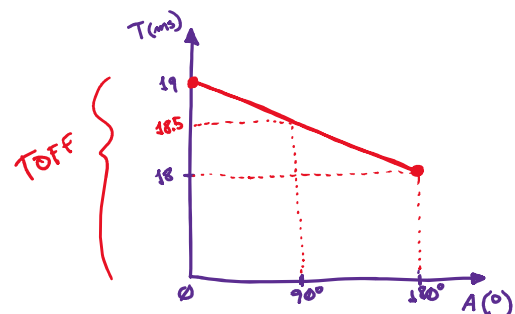
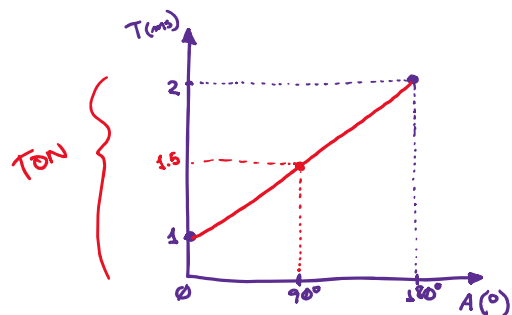
escala
 \downarrow

0.61

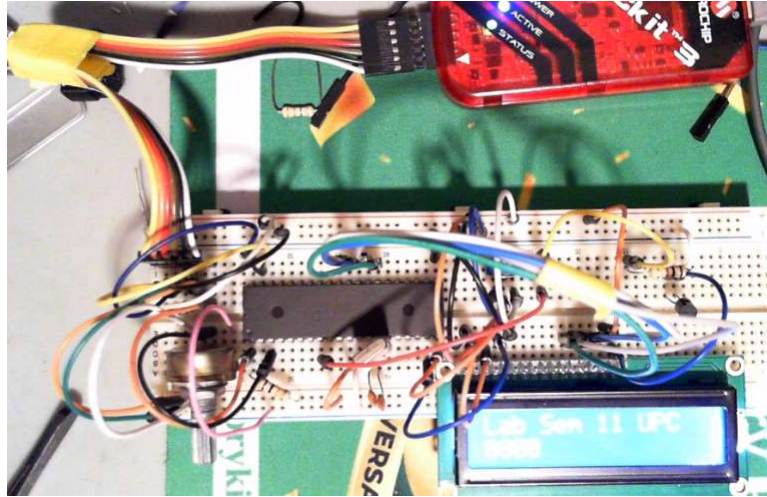
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Análisis:

- Configuración del Timer0 modo 16 bits:

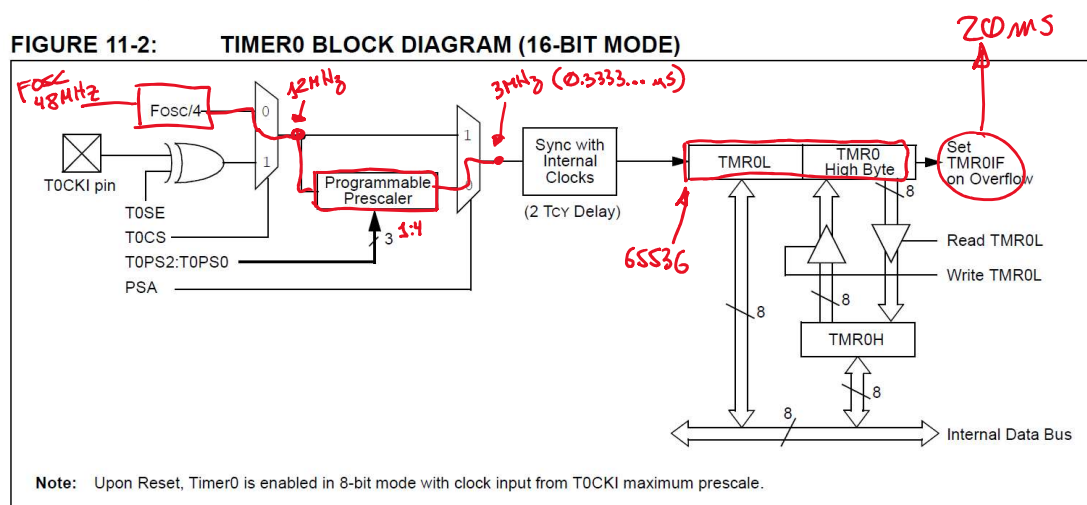


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- Configuración del Timer0 modo 16 bits:

FIGURE 11-2: TIMER0 BLOCK DIAGRAM (16-BIT MODE)



Análisis:

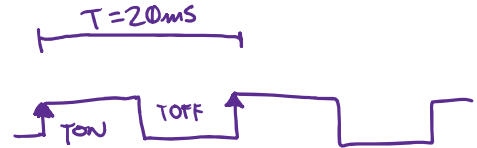
- Configuración del Timer0 modo 16 bits: Temporización 20ms

$$65536 \rightarrow 21.8453\text{ms}$$

$$X \rightarrow 20\text{ms}$$

$$X = \frac{65536 \times 20}{21.8453}$$

$$X = 60000 \leftarrow \begin{array}{l} \text{Total de cuentas} \\ \text{que debe de hacer} \\ \text{Timer 0} \end{array}$$



0x15 0xA0
TMR0H : TMR0L

$$\Rightarrow \text{Cuenta inicial : } 65536 - 60000 = 5536$$

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Análisis:

- Configuración del Timer0 modo 16 bits: Temporización 20ms

Según lo anterior, debo de calcular para 1ms-2ms (TON)

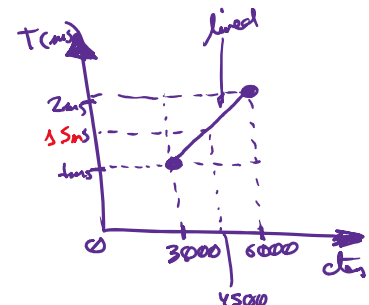
$$\begin{array}{l} 20\text{ms} \rightarrow 60000 \\ 1\text{ms} \rightarrow X \end{array}$$

$$\begin{array}{l} X = \frac{60000}{20} \\ X = 3000 \end{array}$$

$$\begin{array}{l} 20\text{ms} \rightarrow 60000 \\ 2\text{ms} \rightarrow X \end{array}$$

$$\begin{array}{l} X = \frac{60000(2)}{20} \\ X_{2\text{ms}} = 6000 \end{array}$$

$$\begin{array}{l} \text{Cuenta inicial} \\ 65536 - X \end{array}$$



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Hardware de la aplicación

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Diagrama de Flujo

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Codificación

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Simulación

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Pruebas del circuito implementado

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Fin de la sesión!

- Semana 12: LB3

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