Assignments

- Read sections 11.3 and 11.4 of the book
  - CCP modules and Illustration: Generating a periodic waveform using an interrupt
- Read the Capture/Compare/PMW (CCP) modules section of the datasheets
- The CCP module serves three functions
  - Capturing the 16 bit register value of a timer when an event happens on an input pin
  - Comparing the CCP 16 bit register with the 16 bit register of a timer and changing the output value of a pin and setting the CCPIF flag
  - In PWM mode the CCP module can generate an output pulse wave form with a specified frequency and duty cycle
- Only discussing PWM tonight

CCP Modules

- Enhanced CCP modules (ECCP)
  - Difference from standard CCP modules is related to the PWM function – can output to multiple pins
- PIC18F46K22
  - Two standard CCP modules
  - Three enhanced CCP modes (ECCP)
- PIC18F8722
  - Two standard CCP modules
  - Three enhanced CCP modes (ECCP)
- PIC16F917
  - Two standard CCP modules

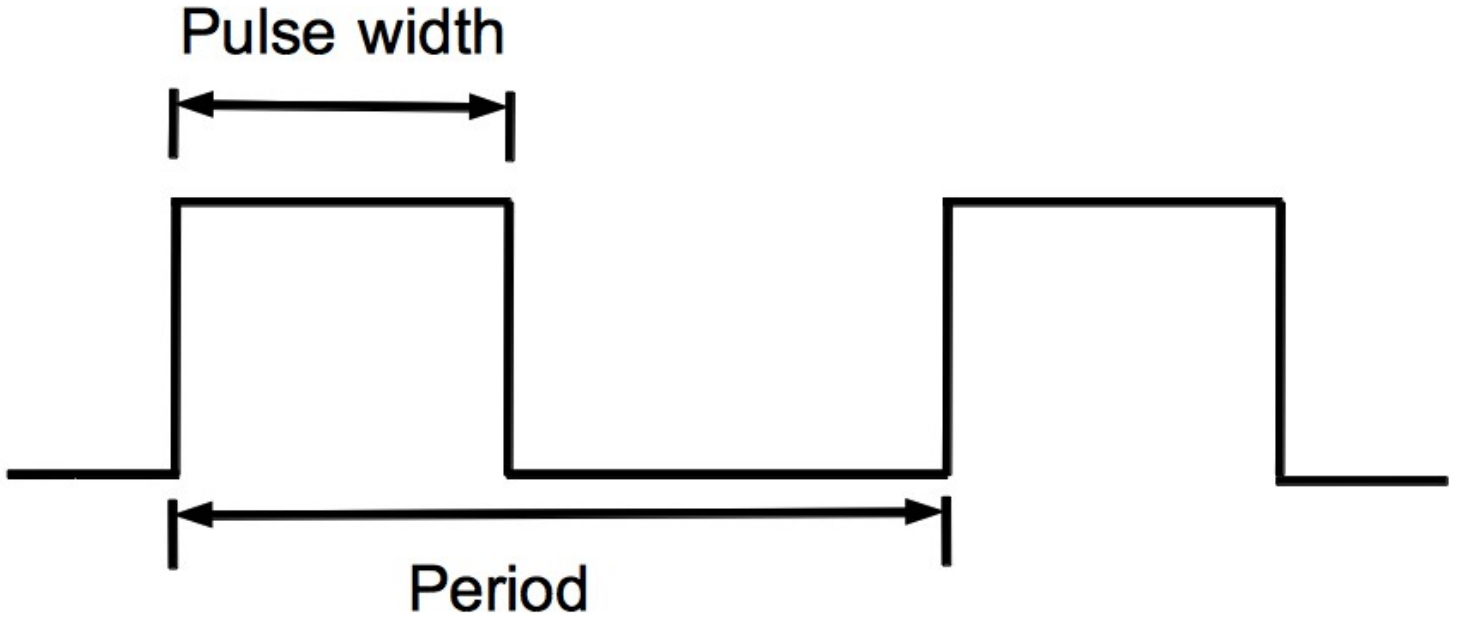
CCP Module Resources

- PIC18F46K22
  - CCP modules can be configured to use timer1, timer3, or timer5 for capture and compare modes
  - CCP modules can be configures to use timer2, timer4, or timer6 for PWM modes
- PIC18F8722
  - CCP modules can be configured to use timer1 or timer3 for capture and compare modes
  - CCP modules can be configures to use timer2 or timer4 for PWM modes
- PIC16F917
  - CCP use timer1 for capture and compare modes
  - CCP use timer2 for PWM modes

PWM Mode

- The PWM (pulse width modulation) mode is used to output an on/off signal
  - Typically used to drive some kind of electric device
    - Electric motor (Mechatronics board)
    - Piezo buzzer (DEM 2 board)
  - The on signal is full power
  - The off signal is no power
  - The combination, turned on and off rapidly, is treated as an average of the two
    - Varying percent time on changes the average
    - Simulates partial power
    - Can use to vary the speed of an electric motor

PMW Mode



- The period is the duration of a complete cycle
  - Period = 1/frequency
- The pulse width is the time that the output is high or on
- The duty cycle is the percentage of time that the output is high versus total time
  - Duty cycle = (pulse width)/(period)

PMW Mode

- Basic operation
  - The pulse period is specified using the selected 8 bit timer and associated PRx register
  - The duty cycle period (or pulse width) is specified using a 10 bit value
    - The 8 MSBs are specified in CCPRxL
    - The 2 LSBs are specified in CCPxCON
      - The 2 LSBs are fractional values and are matched with the 2 bit internal clock or 2 bits of the pre scaler
      - Remember, the system clock increment 4 times per instruction
  - When the timer matches PRx, the output pin (CCPx) is set high (beginning of pulse)
  - When the timer matches the 8 bit CCPRxH and two bits from CCPxCON, the output pin (CCPx) is set low (end of pulse)

PMW Mode Equations

- Computing the PWM period
  - Period = (PRx + 1) x 4 x (1/Fosc) x (timer pre scale)
  - Solve for PRx
- Computing the pulse width
  - Pulse width = CCPRxL:CCPxCON<5:4> x (1/Fosc) x (timer pre scale)
- Computing the duty cycle
  - Duty cycle = (CCPRxL:CCPxCON<5:4>)/(4 x (PRx + 1))
- Given duty cycle
  - Compute pulse width integer portion (DC x PRx)
  - Compute fractional part – 0, 25, 50, 75 (00, 01, 10, 11)

PWM Mode

- General operation
  - Setup the CCP module
    - Disable output pin (CCPx)
    - Select the timer (CCPTMRSx)
    - Load the PWM period into PRx
    - Load CCPRxL with 8 MSBs of PWM duty cycle
    - Load CCPxCON with 2 LSBs of PWM duty cycle
  - Timer setup
    - Clear TMRxIF
    - Set the timer prescale
    - Enable the timer
  - Wait until timer overflows (full pulse width on first pulse)
    - Enable the CCPx pin for output

Lab 6

- Use the PWM mode to the CCP module on the PICDEM DEM 2 board to drive the piezo buzzer
- Use the functionality developed in lab 5 (hex/decimal/binary display)
- Display current setting for PWM frequency, oscillator frequency (in kHz), PWM duty cycle (%) on line 1
- Display the current setting for PWM period, PWM duty cycle 8 MSBs, and PWM duty cycle 2 LSBs in decimal on line 2
- Default is potentiometer varies the range of the PMW period
- First push of right most button has the potentiometer vary the range of the PWM duty cycle period
- Second push of right most button returns to default mode