

## Assignment #7 – Oscillators

### Objectives

- Students will be able to use an oscilloscope to read signals from a microcontroller.
- Students will be able to use external oscillators for a microcontroller.
- Students will be able to determine specific timing of a microcontroller.
- Students will be able to use and understand datasheets.\*

### Goal

Use external oscillators to change the accuracy of serial output's baud rate and decrease the width of a pulse.

### Materials

- Breadboard – wire w/ 5V power regulator, switch, and LED
- PIC18F45K22
- Computer w/ MPLAB XC8
- PICKit™ 3
- Newhaven 2x16 Serial LCD (Optional)
- 20 MHz external oscillator and others
- Oscilloscope

### Directions

- You will be documenting your work in your lab notebook. Include screen captures from the oscilloscope.
- Complete the following at the internal 4 MHz setting.
  - Write programs that goes high, pauses, goes low, pauses, and then loops back. Measure the actual widths using an oscilloscope (include units.)

Trial	High (delay after)	Low (delay after)	Measured high	Measured low
1	20 ms	10 ms		
2	10 $\mu$ s	10 $\mu$ s		
3	1 $\mu$ s	1 $\mu$ s		
4	none	none		

- Complete the following with an external 20 MHz oscillator. You will need to make adjustments to the configuration and do research to determine how to wire the external oscillator that you are provided.
  - Write programs that goes high, pauses, goes low, pauses, and then loops back. Measure the actual widths using an oscilloscope (include units.)

Trial	High (delay after)	Low (delay after)	Measured high	Measured low
1	20 ms	10 ms		
2	10 $\mu$ s	10 $\mu$ s		
3	1 $\mu$ s	1 $\mu$ s		
4	none	none		

- Have Mr. Evans' sign off on the last measurement. \_\_\_\_\_
- Output a single character (byte) serially at 9600 baud with an external 20 MHz oscillator.

- What is the width of one bit? \_\_\_\_\_
- What is the width of 10-bits? \_\_\_\_\_
- What is the actual baud rate? \_\_\_\_\_
- What is the actual error of the baud rate? \_\_\_\_\_
- What was MPLAB's project error? \_\_\_\_\_
- Final conclusions and questions.
  - Make final conclusions based on your experiments.
  - You should cover at least the following:
    - Actual time it takes to loop back with an infinite for loop or infinite while loop?
    - What does it take the time it does to loop back and what is that related to?
    - What is the timing and reason for the time to go from high to low?
  - What other questions do you have after these experiments?

### Grading

- Correctly measures signals. \_\_\_\_\_ 5 points
- Correctly implements the external oscillator. \_\_\_\_\_ 10 points
- Correct and complete conclusions. \_\_\_\_\_ 5 points
- Lab notebook: \_\_\_\_\_ (15 points)