Lab #3

2.3 Questions

Now that everything is set up, you will now be able to play around with different PWM outputs. As an exercise, choose an ARR value and compute the pulse width and duty cycle for the following cases. Make sure to turn this in along with the questions at the end.

$ARR =$ 12

Case	CCR Value	Pulse Width	Pulse Period	Duty Cycle
1	$CCR = \frac{1}{6} \times ARR =$ 2	20ms	130ms	15.38%
2	$CCR = \frac{1}{3} \times ARR =$ 4	40ms	130ms	30.99%
3	$CCR = \frac{1}{2} \times ARR =$ 6	60ms	130ms	46.15%

1. Pulse Width = CCR · clock period
   = (2)(10ms)
   = 20ms
   Pulse Period = (1+ARR) · clock period
   = (1+12)(10ms)
   = 130ms
   Duty Cycle = $\frac{CCR}{ARR+1} \times 100\%$
   = $\frac{2}{13} \times 100\%$
   = 15.38%

2. Pulse Width = CCR · clock period
   = (4)(10ms)
   = 40ms
   Pulse Period = (1+ARR) · clock period
   = (1+12)(10ms)
   = 130ms
   Duty Cycle = $\frac{CCR}{ARR+1} \times 100\%$
   = $\frac{4}{13} \times 100\%$
   = 30.99%

3. Pulse Width = CCR · clock period
   = (6)(10ms)
   = 60ms
   Pulse Period = (1+ARR) · clock period
   = (1+12)(10ms)
   = 130ms
   Duty Cycle = $\frac{CCR}{ARR+1} \times 100\%$
   = $\frac{6}{13} \times 100\%$
   = 46.15%

3.3 Questions

Assume a system clock frequency of 16 MHz, a prescaler value of 25, and the maximum ARR.

1. What is the time resolution (i.e. minimum time unit) of the input capture function?
2. The pulse width of the ultrasonic sensor's output is in the range 150 µs to 38 ms. What are the differences in CCR values between two consecutive interrupts that correspond to the minimum and maximum pulse widths? Assume that the rising edge is triggered at $CCR = 0$.
3. What is the time (in seconds) between two consecutive timer resets?

1.6×10^7 $\frac{1}{25}$ 640000

1. Time Resolution = $\frac{1}{f_{clock} \cdot \text{prescaler value}}$
   = $\frac{1}{(1.6 \times 10^7)(\frac{1}{25})}$
   = $\frac{1}{640000}$
   = 15.625µs

2. CCR Difference = $\frac{\text{Pulse width} \cdot f_{timer}}{\text{prescaler value}}$
   CCR Difference$_{\text{min pulse width}}$ = $\frac{(150)(10^{-6})(1.6 \times 10^7)}{\frac{1}{25}}$
   = 96
   CCR Difference$_{\text{max pulse width}}$ = $\frac{(38)(10^{-3})(1.6 \times 10^7)}{\frac{1}{25}}$
   = 24320

3. Time between Consecutive Resets = (ARR+1)$(\frac{1}{f_{clock}})$(prescaler)
   = (65536)$(\frac{1}{1.6 \times 10^7})$(25)
   = 0.10245