ME333 Introduction to Mechatronics
2022 Quiz 6: IO, Counters/Timers, OC, Analog Input

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1. Use the IO SFRs to make pin CN14 an input and enable the pullup resistor:

Pin 53 on the PIC32: PMRD/CN14/RD5
Register for enabling pullup resistors on CNx pins: CNPUE

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TRISDbits.TRISD5 = 1; //enable pin RD5 as input
CNPUEbits.CNPUE14 = 1; //enable pullup resistor on CN14
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2. List two differences between the CoreTimer and Timer2:

Two differences between CoreTimer and Timer2:
- Timer2 can be prescaled by 1, 8, 64, or 256, while you can't prescale the pulses coming in from the core timer--the core timer will always deliver pulses at the clock speed
- Timer2 can be combined with Timer3 to create a 32-bit timer, rather than just a 16-bit timer, for use in generating interrupts or counting upward to a set amount of time

3. Timer1 has been setup to count external pulses, and can have a prescaler of N = 1, 8, 64, or 256. What is the largest number of input pulses that can be counted before the timer rolls over, and what prescaler N and period register PR1 are used to count to this number?

Largest number Timer1 can count: PR1 = 2^16 - 1 = 65535
Only count every Nth pulse, where N = prescaler: N_max = 256
Max pulses = PR1_max * N_max = 16,776,960 pulses

4. OC4 and Timer2 are used to create 2000 Hz PWM with 20% duty cycle.
   a. Assuming you use a prescaler of N = 2 and a PBCLK of 80 MHz, what is the value of PR2?

      (PBCLK /PRE) / PR = freq
      PR = (PBCLK / PRE) / freq
      PR2 = (80MHz / 2) / 2000Hz
      PR2 ~ 20,000

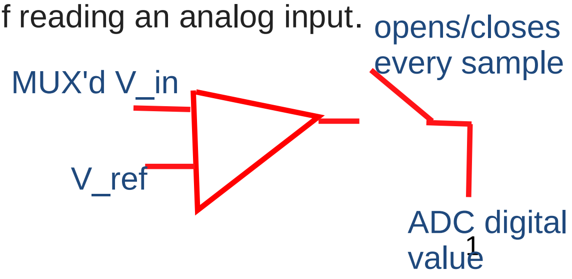
   b. What is the value of OC4RS?

      OC4RS = duty * (PR2+1)
      OC4RS = 0.20 * 20,000
      OC4RS = 4000

5. Describe and draw a picture of the two steps in the process of reading an analog input.

Step 1: sampling. You use the multiplexer to take in possible analog inputs from all 16 analog-capable pins, and send the sampled value of V_in to a differencing op-amp. Sampling happens at a sampling time t1.

Step 2: updating the ADC. Once we have our sampled voltage, we open the SHA switch and keep V constant. The ADC is used to match the value of V_in as closely as possible. It adds resolution to the signal by incrementing the voltage to up to 1024 digital values of V to approximate the value of V_in. This process happens at a certain update time t2.


opens/closes every sample
MUX'd V_in
V_ref
ADC digital value