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Due on 9/28/2017

ECE 3270 Microcontroller Interfacing Lab
Lab 3: Comparator

Abstract

The basic objective of this lab was to utilize the output of the comparator inside of our microcontroller, with inputs coming from a 10k trimming potentiometer, and control three LEDs with those outputs of the comparator. The LEDs should sequentially turn on when their voltages that are being compared have the correct comparator output value for given conditions.

Introduction

The purpose of this lab was to become familiar with the PIC32MX150F128D's comparator, understand how the pinouts work and are configured, and how a trimming potentiometer changes voltage values. In this experiment the objective was to build a circuit that takes voltage inputs from the trimming potentiometer, compares them using the PIC32MX150F128D's comparator, and sequentially turn on 3 LEDs as the comparator outputs change to the desired outputs. Specifically, as the output voltage of the trimming potentiometer changes to either surpass or trail the opposite voltage being used in the comparator, the LEDs will light up.

Experimental Procedures

- The firs thing that should be done is the microcontroller should be wired to have the same configuration as that of Figure 1.
- Next the code will be written for the microcontroller, beginning with setting the different bits for the ANSELB, TRISA, TRISB, CVRCON, and CMXCON.
- Those bits will be set to:
    - ANSELB = 0x8008;
    - TRISA = 0x03, TRISB = 0x800D;
    - CVRCONbits.ON = 1;
    - CVRCONbits.CVRR = 0;
    - CVRCONbits.CVRSS = 1;
    - CVRCONbits.CVR = 0b1111;
    - CMXCONbits.ON = 1, for the first, second, and third comparator;
    - For CM1CON: CH0 = 1, CH1 = 1, and CREF = 0;
    - For CM2CON: CH0 = 0, CH1 = 1, and CREF = 1;
    - For CM3CON: CH0 = 0, CH1 = 1, and CREF = 0;
- Then finally, we run our code, shown in Figure 2, after writing the inside our while loop we will have the LED bits set to the output or the complement of the output of their respective comparator depending on the conditions given in the lab outline which are:
    - The first comparator turns on at IVref.
    - The second comparator turns on at CVref.
    - The third comparator turns on at C3INA.

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Results

Observations of this experiment include the fact that in my case, for my microcontroller I had to invert the comparator response for the second and third case so that the LEDs would change value the correct direction. Another observation would be that the CMSTAT register seems to waste a lot of bus space as it only utilizes its lowest 3 bits. Lastly the pinouts and bit assignments for the comparator seem to be rather haphazard, I'm certain there must be a reasoning behind it, however my observation would be that a lot of bits and resources seem to go to waste. No tables or tabulated values were necessary for this lab.

Discussion

Conclusions of this lab would include the fact that as the comparator output values for the second and third cases were inverted, it is entirely possible that my inverting and non-inverting voltages were switched by mistake. However I'm not entirely certain this is the case as I feel confident that I did not, as I checked and double-checked my wiring. Another conclusion would be that in this experiment, it is exceptionally important to set the comparator ON bit to be a 1, as I spent far too long looking for a bug in my code without noticing the comparators were not set to be ON. Lastly, it can be concluded that a comparator will amplify the difference between the inverting and non-inverting inputs to show a comparison between the two, which generally will output either a Logic High or Logic Low.

Conclusions

To summarize the conclusions discussed above, this experiment and its observations can be used to conclude that, for my instance the non-inverting and inverting voltages may have been flipped, that the comparator must be ON to perform its comparisons between the two voltages given to it, the comparator amplifies the difference in its inputs to show Logic High or Low, and lastly that the trimming potentiometer's ability to modulate voltage values across its terminals can be used in many applications.

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Figures and Tables

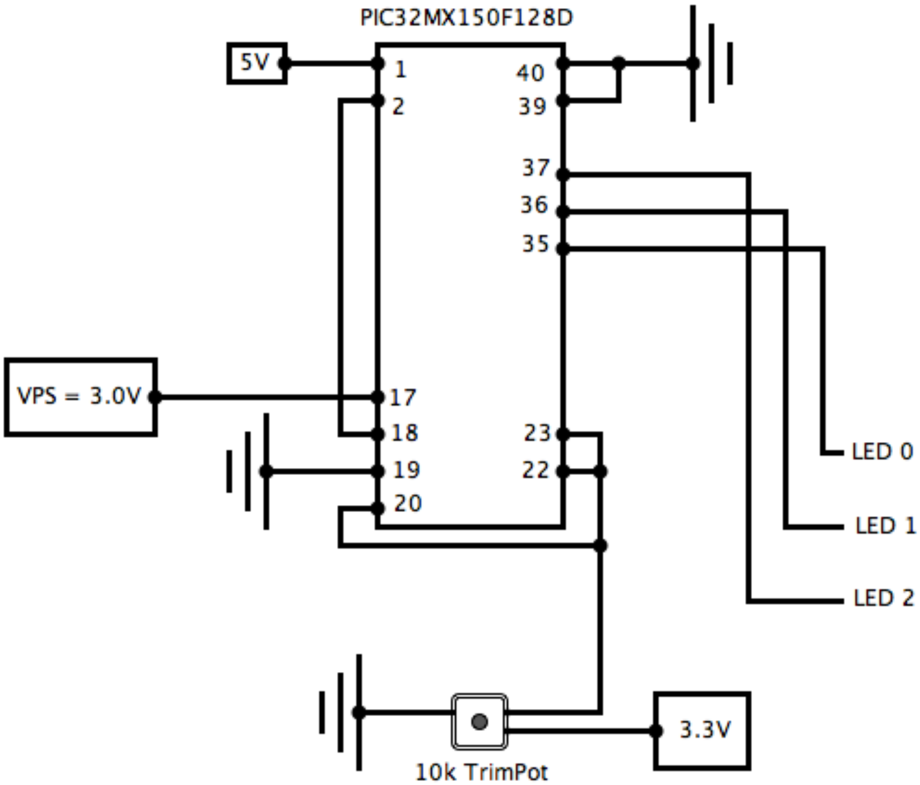

Figure 1: Circuit/Wiring Diagram for Lab 3:Comparator

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```c
/* Christopher Brant
 * Lab 3: Comparator
 * 9/21/2017
 */

#include <plib.h>

int main(void)
{
    // Setting bits 15 and 3 as analog inputs
    ANSELB = 0x8008;

    // Setting bits 1 and 0 as inputs to Port A
    TRISA = 0x03;

    // Setting bits 15, 3, 2, and 0 as inputs to Port B
    TRISB = 0x800D;

    // Setting CVRCON as ON
    CVRCONbits.ON = 1;

    // Setting CVRR
    CVRCONbits.CVRR = 0;

    // Setting CVRSS
    CVRCONbits.CVRSS = 1;

    // Setting lowest 4 bits of CVRCON to set CVR
    CVRCONbits.CVR0 = 1;
    CVRCONbits.CVR1 = 1;
    CVRCONbits.CVR2 = 1;
    CVRCONbits.CVR3 = 1;

    // Turning on each comparator
    CM1CONbits.ON = 1;
    CM2CONbits.ON = 1;
    CM3CONbits.ON = 1;

    /* Setting IVREF as inverting input
     * and C1INA as the non-inverting input
     */
    CM1CONbits.CCH0 = 1;
    CM1CONbits.CCH1 = 1;
    CM1CONbits.CREF = 0;

    /* Setting C2IND as the inverting input
     * and CVREF as the non-inverting input
     */
    CM2CONbits.CCH0 = 0;
    CM2CONbits.CCH1 = 1;
    CM2CONbits.CREF = 1;


    /* Setting C3IND as the inverting input
     * and C3INA as the non-inverting input
     */
    CM3CONbits.CCH0 = 0;
    CM3CONbits.CCH1 = 1;
    CM3CONbits.CREF = 0;

    while(1)
    {
        // Setting LED0 to output of C1 comparison
        LATBbits.LATB5 = CMSTATbits.C1OUT;

        // Setting LED1 to output of C2 comparison
        LATBbits.LATB6 = !(CMSTATbits.C2OUT);

        // Setting LED2 to output of C3 comparison
        LATBbits.LATB7 = !(CMSTATbits.C3OUT);
    }

    return 0;
}
```

Figure 2: Full Code for Lab 3:Comparator