ECE 3720

Microcomputer Interfacing Laboratory

Section 002

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Lab 3

ABSTRACT:

This lab was designed to show how to use the comparators on the PIC32 microcontroller to compare different voltages and a potentiometer to change the voltage going into the microcontroller.

Introduction:

For this lab the circuit was setup 3.3V would go into a potentiometer that would then send its variable output to three different comparator pins on the microcontroller. A 3.3V reference voltage and a 3V voltage into one of the comparators. The three outputs of the comparators would them be hooked up to three LEDs that would light up sequentially as the voltage across the potentiometer was decreased and the voltage into the microcontroller increased. The first LED would light up at the internal reference voltage of the microcontroller, the second at three quarters of the input reference voltage, and the third at 3V.

Experimental Procedure:

The layout of the circuit can be seen in **FIGURE 1** below. 5 volts was put into the power supply of the microcontroller (pin 1) and the ground was connected to the ground (pins 39 and 40). The output 3.3V of the microcontroller (pin 2) was then connected to the potentiometer and the positive Vref pin (pin 18). The negative Vref was connected to ground so that the Vref that would be used in the comparator voltage was 3.3V. 3.3V was connected to the potentiometer because the input pins for the comparators are not 5V tolerant and to Vref so that CVref (The reference voltage the comparators use) could be made into .75*Vref. 3 volts were sent to comparator 3 input A (pin 17) to compare the output voltage of the potentiometer with 3 volts. The outputs of the potentiometer were connected to comparator 1 input A (pin 23), comparator 2 input D (pin 22), and comparator 3 input D (pin 20), so that the output voltage of the potentiometer could be compared to IVref (1,2V), CVref (.75*Vref), and C3INA (3V) at the same time and the three LEDs connected to the three comparator outputs (pins 24,25, and 26) would light up in order as the voltage across the potentiometer decreased and the voltage into the microcontroller increased.

The first block of code set each pin used in the circuit as input (pins 17, 18,1 9, 20, 22, and 23) or output (pins 24, 25, 26). CMxCONbits.ON = 1 was then used to activate all three of the comparators and CMxCONbits.COE = 1 was used to enable the output bit of all three comparators. CMxCONbits.CPOL was used to set the polarity of the comparator, CMxCONbits.CREF was used to choose either CVref or the specific comparator A input as comparators positive terminal input, and CM3CONbits.CCH was used to choose either IVref, input B, input C, or input D as the comparators negative terminal input. For comparator IVref was compared to input A and 1 was output if input A was greater than IVref. To do this CPOL was set to 0 because input A is going into the positive terminal of the comparator, CREF was set to 0 to use input A instead of CVref, and CCH was set to 0x3 to choose the fourth input on the multiplexer going into the negative terminal of the comparator (IVref). For the second comparator CVref was compared to input D and 1 was output if input D was greater than CVref. To do this CPOL was set to 1 because input D is going into the negative input terminal of the comparator, CVREF was set to 1 to use CVref as the positive terminal input, and CCH was set to 0x2 to choose input D as the input into the negative terminal of the comparator. For comparator 3 input A (the 3V input) was compared to input D (the output of the potentiometer). To do the CPOL was set to 1 because input D was is going into the negative input terminal of the comparator, CVREF was set to 0 to use input A as the positive input of the terminal, and CCH was set to 0x2 to choose input D as the input into the negative terminal of the comparator. Next CVRCON was used to turn CVref into .75*Vref. CVRCONbits.ON = 1 was used to activate the module, CVRCONbits.CVRR = 0 because we wanted CVref in the range 0.25Vref to .75 Vref, CVRCONbtis CVRSS = 1 to set CVrsrc equal to Vref, and CVRCONbits.CVR = 0xF was used so the final equation for CVref would equal .25*CVrsrc+(15/32)*CVrsrc which is about

.75*Vref. Finally a loop was entered that continually output the value of the three comparators to the three LEDs.

RESULTS and DISCUSSION:

The final observed behavior of the circuit was that if the potentiometer was set to its highest resistance none of the LEDs would be on then, as the resistance of the potentiometer was decreased, the LEDs would light up one at a time in order. The only problem I had with this Lab was that two of the LEDs were lighting up at the same voltage because I had CVREF of comparator 2 and 3 set to 1. This problem was fixed by changing CVREF of comparator 3 to 0 so that it would use input A (the 3V input) instead of CVref. The comparators can be useful anytime two voltages need to be compared or if you want something to turn on or off after a certain voltage has been reached. The potentiometer can be used if a variable resistor is needed instead of a constant resistor.

CONCLUSION:

This lab helped build an understanding of how the comparators on the PIC 32 microcontroller are used and the theory and implementation of a potentiometer.

REFERENCES:

Clemson University ECE 3720 Lab 2 PowerPoint.

PIC 32 Family Data Sheet

chipKIT Cmod Reference Manual

FIGURES and TABLES:

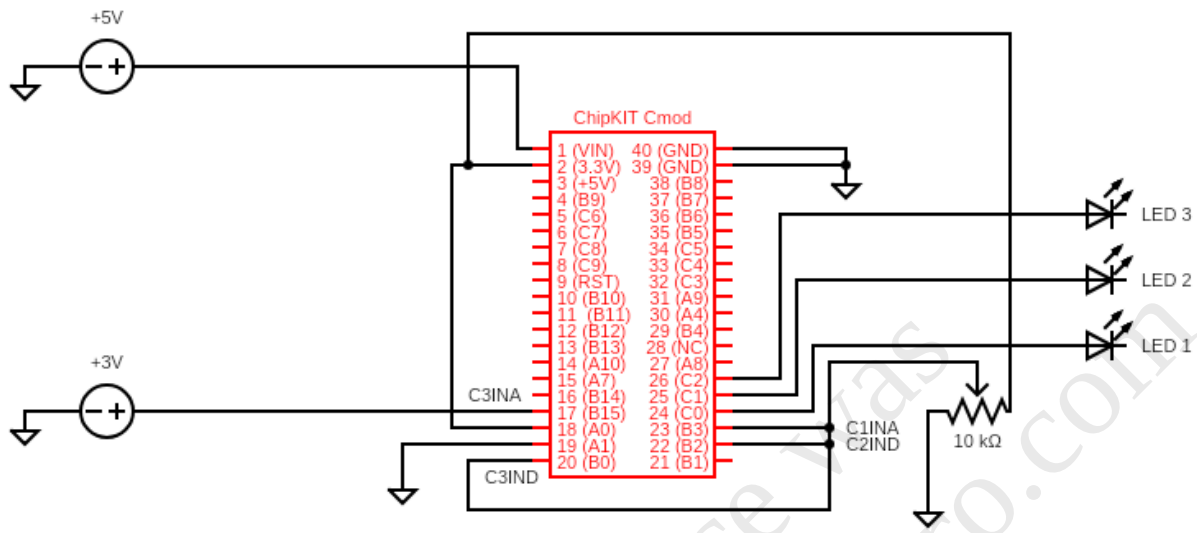

FIGURE 1: Wiring for lab 3(Pin Connections described in Experimental Procedures)

CODE:

```
#include <plib.h>
int main(void){

    TRISBbits.TRISB15 = 1;
    TRISAbits.TRISA0 = 1;
    TRISAbits.TRISA1 = 1;
    TRISBbits.TRISB0 = 1;
    TRISBbits.TRISB2 = 1;
    TRISBbits.TRISB2 = 1;
    TRISCbits.TRISC0 = 0;
    TRISCbits.TRISC1 = 0;
    TRISCbits.TRISC2 = 0;

    CM1CONbits.ON = 1;
    CM2CONbits.ON = 1;
    CM3CONbits.ON = 1;

    CM1CONbits.COE = 1;
    CM2CONbits.COE = 1;
    CM3CONbits.COE = 1;
```

```
    CM1CONbits.CPOL = 0;
    CM2CONbits.CPOL = 1;
    CM3CONbits.CPOL = 1;

    CM1CONbits.CREF = 0;
    CM2CONbits.CREF = 1;
    CM3CONbits.CREF = 0;

    CM1CONbits.CCH = 0x3;
    CM2CONbits.CCH = 0x2;
    CM3CONbits.CCH = 0x2;

    CVRCONbits.ON = 1;
    CVRCONbits.CVRR = 0;
    CVRCONbits.CVRSS = 1;
    CVRCONbits.CVR = 0xF;

    while(1){

        LATCbits.LATC0 = CMSTATbits.C1OUT;
        LATCbits.LATC1 = CMSTATbits.C2OUT;
        LATCbits.LATC2 = CMSTATbits.C3OUT;
    }
}
```

CODE 1