Laboratory Assignment Number 6 for ME 218b

Part 0: Pre-Lab

Assignment:

☐ **0.1)** Design the circuitry necessary to complete parts 1 & 2 of the lab assignment. Your circuitry should bi-directionally drive the DC motor provided at the lab bench (see Lab 6 Appendix A) using an SN754410 as the drive stage with a motor voltage of 5V, provide an analog voltage (0-3.3V) from the potentiometer in Part 1.1 to an analog input on the PIC32, provide for a digital input capable of input capture to read the encoder and include the drive circuitry for the bar-graph LED in Part 2. The 5V to drive the motor should come from the bench-top power supply, NOT from the breadboard power supply! Include this schematic in your report. The internal kick-back diodes in the SN754410 have proven to be problematic in prior years, so be sure to include external diodes in your design. Please confirm that the H-bridge specified can drive the motor (quote specifications/measurements to back that up)! You should make a measurement on the motor to confirm this.

☐ **0.2)** Determine which pins on the PIC32 you need to hook up for the complete schematic from part 0.1. Prepare a table of the pin numbers and port connections that correspond to the pins identified in Part 0.1.

☐ **0.3)** Design the event driven software that you will use for Part 1. Include pseudo code for program. Do not worry about getting the specifics of the PWM module ready for the pre-lab. We will cover the PWM subsystem in lecture on Thursday.

☐ **0.4)** Design the software that you will use for Part 2. Include pseudo code for the program.

In the report:

Include the schematic diagram of the circuit you used for 0.1, the table of pin assignments from 0.2, pseudo-code from 0.3 & 0.4 and design calculations. Be sure to indicate on the schematic which bits of which ports of the PIC32 you used, and please include pin numbers.

Answers to prelab

Schematic diagram of circuit is attached as a separate pdf file.

Table of pin assignments is located within the schematic.

Pseudocode for part 1

Pwm calculations

Target PWM Frequency: 200 Hz

PBCLK = 20 MHz (40 MHz SYSCLK / 2)

PWM Period = 1/200 = 5 ms

Formula: PWM Period = (PR + 1) × TPB × Prescaler

With Prescaler 1:4 (TCKPS = 0b010):

5 ms = (PR + 1) × (1/20MHz) × 4

5 ms = (PR + 1) × 200 ns

PR + 1 = 5 ms / 200 ns = 25,000

PR2 = 24,999

Duty Cycle: OC4RS value from 0 to 24,999

- OC4RS = 0   → 0% duty cycle

- OC4RS = 24999 → 100% duty cycle

Motor service

Init function

Set tris and ansel for direction pins

Initialize adc for potentiometer input

Pwm initialization

Disable OC4 during setup

OC4CON = 0x0000

Set initial duty cycle (0% - motor stopped)

OC4R = 0

OC4RS = 0

Configure Timer2

T2CON = 0x0000   // Stop timer, clear settings

TMR2 = 0   // Clear timer count

PR2 = PWM_PERIOD   // Set period for 200Hz

T2CONbits.TCKPS = 0b010   // Prescaler 1:4

Map OC4 output to RB13 (pin 24)

RPB13R = 0b0101   // OC4 → RPB13

Configure OC4 for PWM mode (no fault)

OC4CONbits.OCTSEL = 0   // Use Timer2

OC4CONbits.OCM = 0b110   // PWM mode, fault pin disabled

Enable Timer2 and OC4

T2CONbits.ON = 1   // Start Timer2

OC4CONbits.ON = 1   // Enable OC4

Start the adc read timer

Run function

Switch event type

If adc read timer expires,

Read the potentiometer, scale it to a value between 0 and pwm period and compute the new duty cycle

OC4RS = newDutyCycle

Restart adc read timer

PIN NUMBER	PORT CONNECTIONS
2	AN0,RA0, POT INPUT
3, 9, 10, 12, 17, 21, 22, 26	RA1, RA2, RA3, RA4, RB8, RB10, RB11, RB15 TO 74HCT244
24	OC4,RB13, Enable 1, 2
6	RB2,1A
7	RB3,2A
18	RB9, INPUT CAPTURE

SW1
SW_Push

C1
0.1uF

R2
10k

GND

R1
1k

+3.3V

U1
PIC32MX170F256B

C2
0.1uF

C3
0.1uF

C4
10uF

RV1
RPot1 (10k)

AN0

TO 74HCT244
TO 74HCT244
TO 74HCT244
TO 74HCT244

PRG1
MPLAB_Snap

MCLR/Vpp
Vdd
Vss
PGData
PGClk

U3
USB2Serial
TxD +3.3V
RxD +5V
GND

TO 74HCT244
TO 74HCT244
TO 74HCT244
OC4
TO 74HCT244

IC2
GND
+5V

Quadrature_Encoder
U4
Vcc ChA ChB GND

D9
LED_Dual_Bidirectional

R3
330

BENCHTOP POWER SUPPLY
+5V +5V

U2
SN754410

1A VCC1 VCC2
2A
EN1,2
3A
4A
EN3,4
1Y
2Y
3Y
4Y
GND GND GND GND

Enables for
second motor

OC3

D4 1N4935
D2 1N4935
D6 1N4935
D10 1N4935

D3 1N4935
D5 1N4935
D7 1N4935
D8 1N4935

GND GND GND GND

M2
Motor

Can connect second motor
across these leads

R4
330

D1
LED_Dual_Bidirectional

U5
74HCT244

RA1
RA2
RA3
RA4
RB8
RB10
RB11
RB15

1A0 VCC 1Y0
1A1   1Y1
1A2   1Y2
1A3   1Y3
2A0   2Y0
2A1   2Y1
2A2   2Y2
2A3   2Y3
1OE
2OE

BAR1
LTA-1000HR

R12 150
R11 150
R10 150
R9 150
R8 150
R7 150
R6 150
R5 150

GND

DECOUPLING
CAPACITOR

+5V   +5V
VCC2   74HCT244
SN754410
C5   C6
0.1uF   0.1uF
GND   GND

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