

CTEC1904/2018W Lab#2, More PIC Programming (Counters, Matrix Keypad)

PIC18F8722 Microcontroller

Pre-Lab Work

Note- Save your program listings for future use.

1. Use the online PIC Delay Calculator application to create a **100 ms** delay subroutine *using a **Timer** delay* (instead of loops).
2. Fill in the Worksheet for the seven segment display.

Lab Work

Program 8

Create a program that will take the output from a software eight-bit counter program and output this to PORTE with a delay. (This is an 8-bit counter that will display a **binary** count.)

Use a GPR for the counter.

Use the 100ms timer delay from the Prelab.

Re-start counting from zero when the counter reaches 255 (11111111 – no extra code is required to do this.)

Program 9

Modify Program 8, so that **9** LEDs are used. (This is a 9-bit counter that will display a binary count from 00000000 [0] to 11111111 [511]).

Halt the processor with a `goto $` or `bra $` instruction when 511 is reached.

You should be using **two** GPRs: one for the low 8 bits of the counter, and the other for the high bit of the counter. Handle the carry condition (at 256.)

Program 10

Modify Program 9 so that it starts counting at 1, stops counting when 300 is reached, and flashes the display showing 300. (Use `cpfseq` instructions to determine when the end count is reached.)

Program 11

Modify Program 8, so that it counts on the seven-segment LED displays. (This is an 8-bit **hexadecimal** counter that counts from 00 [0] to FF [255].)

Note that both DIP switches SW2-2 and SW2-3 should be ON to enable (connect ground to) the 7-segment displays. The first digit (the 1's place) is connected to PORTE. The second digit (the 16's place) is connected to PORTH.

DIP switch SW2-1 should be OFF to disable (disconnect ground from) the BAR LED display.

Use a GPR for your counter. Use a lookup table and subroutine to encode each nibble of the counter register to its corresponding seven-segment code. You will need to use **swapf** and **andlw** instructions to extract and isolate each nibble.

Another strategy is to use two GPRs, one for the 1's digit and the other for the 16's digit. Increment (**incf**) the 1's digit. When the 1's digit gets to 16 (**cpfseq** or **btfss**), reset it back to zero (**clrf**) and increment the 16's digit.

NOTE: If you are doing this lab on the PICPROTO Board, use the LED bargraph display for one of the digits -- display the count for that digit **in binary**.

Program 12

Modify Program 11 to count ***in decimal*** from 0 [00] to 99.

Halt the processor when 99 is displayed.

One strategy (*there are others*) to solve this problem:

Use two GPRs – one for the ones place, the other for the tens place. Use **cpfseq** to detect when the ones place goes to 10, then reset it back to zero and add one to the tens place. If the place also goes to 10 (meaning the count has reached 100), stop.

Program 12 (BONUS)

Use a single GPR with the two nibbles in packed Binary Coded Decimal (BCD) format. Use the **daw** instruction to properly handle the Digit Carry (DC) and Carry (C) conditions. Use **swapf** and **andlw** to extract the digits (one digit per nibble.)

http://en.wikipedia.org/wiki/Binary-coded_decimal

Program 13 (PICTRAINER1 [L19 board] version)

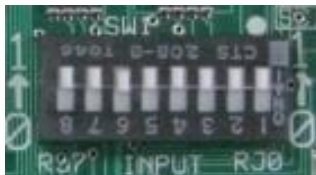
Write a program that continuously scans the lowest row (keys C to F) of the matrix keypad and displays a number on one of the seven-segment LED displays.

Output a 1 when Key C is pressed, 2 for Key D, 3 for Key E, and 4 for Key F.

Set the SW3-1 DIP switch to GND.

Important Note!

Both the pushbuttons and the SW1 DIP switches share PORTJ. If your board contains INPUT DIP switches, make sure that **ALL** SW1 DIP switches are in the OFF position (1) **BEFORE** you run Programs 16 to 23.



Program 13 continued...

Make sure that PORTB (RB5) to output a zero, so that the keys can be scanned.

Set the SW3-1 DIP switch to RB5. If your program is written correctly, you should get the same results if SW3-1 is set to GND.

Program 13 (PICRAINER2 [Fab board] version)

Write a program that continuously scans the first row only (the 1, 2, and 3 keys). Display a 1, 2, or 3 on the seven-segment display.

On the PICRAINER2 board, RC0, RC1 and RC2 (PORTC) are used for the columns, while RB2 is used for row 1.

Important! You have to enable the “PORTB pull-ups” feature (see the data sheet.)

You also have to assert the columns, one at a time (a combination of one `bcf` for the active column and two `bsf`'s for the inactive columns) and `btfs PORTB, RB2` (or `btfs`, depending on your programming logic) each time.

Program 13 (PICPROTO-II/K [binder board] version)

Write a program that continuously scans the bottom keypad row only. Display a 1, 2, 3, or 4 on the seven-segment display.

The keypad on this board is ACTIVE HIGH. You decide what I/O port to use for the KEYPAD COL lines. For the KEYPAD ROW 4, connect it directly to +5V.

Program 14

Modify Program 13 to scan the entire matrix keypad and display the key value on one of the seven-segment LED displays. The last key pressed should remain on the display.

Program 15

Modify Program 14 so that you only display row and column of the key instead of the key value. Use both seven-segment displays. The row and column values should be displayed only as long as a key is depressed. Blank the displays when a key is released.

Program 16

Merge Programs 12 and 13, to do the following:

1. Initially, the program then displays a zero on the first 7-segment digit, with the second 7-segment digit blank (all segments OFF.)
2. Pressing Key C will add 1 to the count displayed on the 7-segment display.
3. Pressing Key D will subtract 1 from the count displayed on the 7-segment display.
4. Pressing Key E will reset the 7-segment display back to zero (as described in #1).
5. Pressing Key F will reset the 7-segment display to 99.
6. Adding 1 to a display of 99 will cause it to go to zero.
7. Subtracting 1 from a display of 0 will cause it to go to 99.

NOTE: If you are using the PICTRAINER2 board, use the following keys:

- 1 – to add 1;
- 3 – to subtract 1;
- 7 – to reset to zero;
- 9 – to reset to 99.

ALL PROGRAMS ARE DUE by end-of-day, Friday, March 23, 2018.

Late labs lose 10% per day late, and receive a zero after 5 days late (Mar. 29).

YOU MUST COMPLETE THE COMMENT BLOCK FOR EACH PROGRAM (1 mark per program [4 @ 0.25]),

- **What the program does**
- **Your name and email address**
- **Modification history (dates and what you did)**
- **Hardware used**

AND

YOU MUST DEMONSTRATE EACH PROGRAM RUNNING IN L19 (1 mark per program),

AND

YOU MUST HAND IN THE CODE FOR EACH PROGRAM (1 marks per programs 8 to 15, 3 marks for program 16), AND

YOU MUST HAND IN THE PRELAB WORKSHEET (7-SEGMENT DIGITS - 1 mark).

Total 30 marks for Lab 2.