EEE 407 Microprocessors and Microcontrollers Laboratory

EXPERIMENT 6 - COUNTERS

1. OBJECTIVES

- To configure the Timer0 module as a hardware counter using an external clock source.
- To understand and implement 7-segment display Multiplexing techniques.
- To practice digit separation algorithms using division and modulo operators.

2. THEORETICAL BACKGROUND

2.1. Timer0 as an External Counter: In PIC18F452, setting the `T0CS` bit to 1 configures Timer0 to increment based on external pulses received at the **RA4/T0CKI** pin. This allows the microcontroller to count external events independently of the CPU instruction cycle.

2.2. Display Multiplexing: Multiplexing is a technique used to drive multiple 7-segment displays using a shared data bus (PORTD). By rapidly switching between digits (RA0, RA1, etc.) at a frequency higher than the human eye's flicker fusion threshold, all displays appear to be active simultaneously.

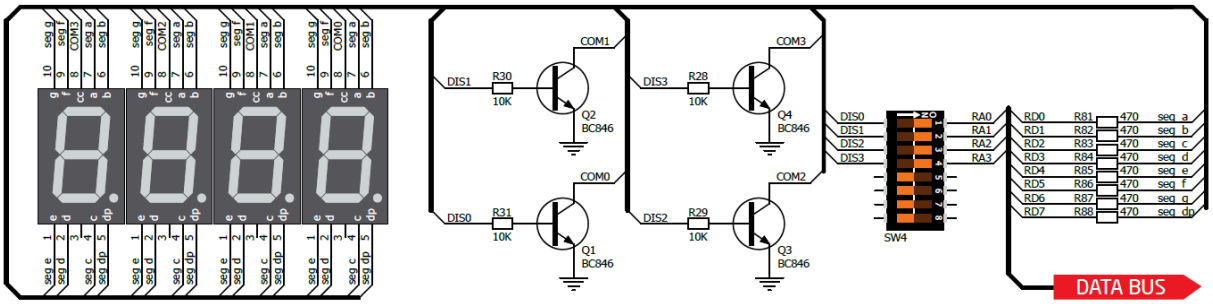
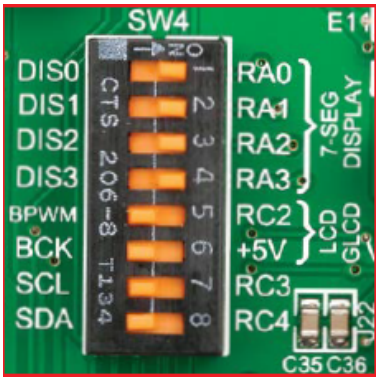


Figure 14-2: 4-digit 7-segment display schematic

Enabling the display:

To enable digit select lines for the 4-digit 7-segment display you have to turn on **SW4.1**, **SW4.2**, **SW4.3** and **SW4.4** switches. Digit select lines are connected to **RA0 – RA3** pins on the microcontroller sockets, while data lines are connected to **RD0 – RD7** pins. Make sure to disconnect other peripherals from the interface lines in order not to interfere with signal/data integrity.



3. PROCEDURE

Part A: 0-9 Single Digit Counter

1. Configure the RA4 pin as an input and ensure the button jumper on the EasyPIC v7 is correctly set to VCC.
2. Initialize Timer0 in 8-bit, external clock mode.
3. Read the TMR0L register in a loop and display the value on the first 7-segment digit (RA0).

Part B: 0-99 Dual Digit Counter (Multiplexing)

1. Modify the code to separate the count value into 'ones' and 'tens' digits using / and % operators.
2. Implement a multiplexing loop: Output 'ones' data → Enable RA0 → Delay (5ms) → Disable RA0.
3. Repeat the process for the 'tens' digit using RA1.
4. Verify that the counter resets to 0 after reaching 99.