ECE 4175
Project One
Introduction to the Microcontroller Development Environment

A+ Due Date: Friday, January 13

References:

Chapter 2 - CPU architecture (skim, for now)
Chapter 3 - Instruction set (skim, for now)
Section 16.3 - Timer2 operation
Page 421 - QwikFlash board schematic
Appendix A4 - skim

Before Lab

[ ] Attend the demo.

[ ] On the "team" signup sheet, put a "handle" together with your name and that of your partner. You will want to get lined up with a lab partner **even though I suggest that you work on this specific project individually**.

Using QwikBug

[ ] The QwikBug monitor, described in Appendix A4, supports the use of the “L” key (or the F3 key) to load your assembled user code, P1.HEX. The “R” key (or the F7 key) will then run your program. It can also be run, once loaded, by toggling the power switch or by pressing the reset pushbutton, SW2.

[ ] Turn on one of the PCs, if necessary.

[ ] Logon to the PC. If a warning or error occurs during login or bootup, please contact the TA.

[ ] We suggest that you do all of your work from files temporarily loaded into the C:\WORK folder while at the same time maintaining (and updating often) a copy of your source file on your network drive . In this way you will gain the speedy execution of the assembler. Copy P1.asm from a floppy available in the lab to the C:\WORK folder. As you change your source file, remember to periodically back up the P1.asm file to your network drive.

WARNING: All user files are deleted from the PC's hard disk whenever the computer is rebooted or a new user logs on. **If you ever quit your work and then realize that you have not saved your source file to your network drive, DO NOT log on again. As long as the computer is not rebooted or logged onto again, the TA can retrieve your source file for you**.

[ ] Open the P1 source file (P1.asm) into the editor by sliding the P1.asm icon on the desktop into the open editor window. Move and/or resize the resulting window to make it easy to read and use.

[ ] Insert your handle and name(s) somewhere within the first few lines of the program. Be sure that a semicolon is placed at the beginning of the line so that your handle and name(s) will be considered to be comments by the assembler. Add a line to the **Initial** subroutine to initialize the **ALIVECNT** variable to a value of 200 with the line

```
MOVLF   200,ALIVECNT
```

[ ] Save your updated source file to your network drive.

[ ] To assemble your P1 source file, go to the DOS window into the C:\WORK folder and type

```
mpasmwin   p1   <Return>
```

to invoke Microchip's free assembler, mpasmwin.exe. This will produce the ".HEX" file needed by the microcontroller's QwikBug monitor program., the ".LST" file to get a hardcopy printout of the assembled output, and an ".ERR" file for a concise listing of assembly errors (if any occurred). Modify the source file, save it, and re-assemble until all errors have been corrected.

NOTE: Treat all warnings generated during assembly as errors. Several forms of "typos" will result in warnings being generated during assembly rather than errors. The warnings usually result in assembled code that does not perform as expected.

[ ] Drag the P1.asm desktop icon into the editor window and print a copy of it to familiarize yourself with the printing process.

[ ] Use the mouse to select the Tera Term Pro terminal emulation window. The target board should have the serial cable from the PC connected to its DB-9 socket. Turn on power to the target board using the toggle switch located in the lower left-hand corner of the board. You should get the QwikBug help screen that ends with the message

```
QwikBug is autostarting user code
Press any key to abort: [#    ]
```

Within three seconds press any key on the PC's keyboard to avoid running previously loaded user code. If you don't do this quickly enough (and if user code was previously loaded), you will get the message

```
Running...
```

Just press the white reset button (SW2) or toggle the power switch to start over, this time with faster reaction time in pressing a PC key. Now you will get the QwikBug prompt

```
QB>
```

[ ] To repeat the brief **h**elp menu of QwikBug commands at any time, press the "h" key (or the F1 key).

[ ] To **l**oad your new file, press the "l" (lower-case "L") key (or the F3 key), resulting in the response

User program memory erased - Send HEX File Now

Do not press any PC keys! Rather, just drag the P1.HEX label from the C:\WORK directory into the Tera Term Pro window to send it to the target board.

[ ] When the

. . . . . .

feedback stops with the message

Download successful
Highest Address Programmed: 0x0070
QB>

To **r**un this user program, press the "r" key (or the F7 key) to switch from the QwikBug monitor program. Note that the "Alive" LED located to the left of the PIC18F452 blinks briefly every 2 seconds. Referring to the QwikFlash board schematic on page 421, note that the Alive LED is driven from bit 4 of **PORTA**.

[ ] QwikBug will let you selectively monitor the execution of the P1 program. Hit any key on the PC to return control to the QwikBug monitor program. Press the "h" key if you need to refresh the **h**elp message. Press the "t" key to rese**T** the CPU. Drag the P1.asm label from the C:\WORK folder to the window opened for David Flowers' QwikAddress utility. In the QwikAddress window, obtain the address of the **ALIVECNT** variable. Note that it has been assigned to hex address 000. Click again in the Tera Term Pro window and then to add the address of the **ALIVECNT** variable to the **w**atch list, press the "w" key (or the F6 key) followed by

000 <Enter>

Again, in the QwikAddress window, obtain the address of the **PORTA** special function register (SFR), F80. Add this address to the list of watch variables for display as a binary number with the "w" key followed by

f80 b <Enter>

Now return to the QwikAddress window to obtain the address represented by the program label "Loop". This address is shown to be 0020. Click in the Tera Term Pro window, press the **b**reakpoint key, "b" (or the F5 key), and enter a breakpoint at this address. (At this time do not press the rese**t** key, "t", as this will clear the breakpoint and the watch variable.) Press the "r" key to **r**un from reset to the breakpoint. Note the displayed value of **ALIVECNT**, represented as the hex value, C8. Pressing the "r" key repeatedly will result in the display of the successive values of **ALIVECNT** each time around the mainline loop: C7, C6. C5, etc.

[ ] To **m**odify **ALIVECNT** to a value of 02, use the "m" key (or the F9 key). **D**isplay the trace line by pressing the "d" key (or F4) to see that the **ALIVECNT** watch variable at address 000 is indeed set to 02 and that bit 4 of **PORTA** is a 1 (as it should be with the LED turned off). **R**un to the breakpoint by pressing the "r" key and note that **ALIVECNT** has been decremented to 01 and that the "Alive" LED, D2, is still off. Again, run to the breakpoint. This time around the mainline loop, the **BlinkAlive** subroutine has decremented **ALIVECNT** from 1 to 0 and then reinitialized it to C8, has cleared bit 4 of **PORTA**, and has turned on the Alive LED. Press the "r" key again. This will result in another call of the **BlinkAlive** subroutine, turning off the Alive LED. Note the new values of the two watch variables.

[ ] Again, using the QwikAddress utility, obtain the program address of the subroutine label, **BlinkAlive**, 0056. Set the **b**reakpoint at this new address and **m**odify the value of **ALIVECNT** to 01. **R**un to the breakpoint. Now **s**tep through successive instructions of the **BlinkAlive** subroutine by pressing the "s" key (or the F8 key) repeatedly. Note when the Alive LED turns on and what instruction is indicated by the program counter value at that point. Does the trace line show the program counter as it is before or after the corresponding line of the program code is executed?

[ ] Before [ ] After

[ ] Toggle the power switch off and then on again to reset the chip, eliminate the breakpoint and watch variables, and run the user program. Then use the HP54645A scope's channel 1 probe to monitor bit 0 of PORTB (connected to the pin located on the H1 header of pins at the top of the board and labeled B0/INT0. Connect the scope's ground clip to the GND1 "ground grabber" loop of wire located just above the PIC chip. The code for this project toggles this pin every ten milliseconds, each time around the mainline loop. In this part you are to verify this loop time.

Press the scope's "Setup" key followed by the "Default Setup" softkey to get the scope back to its default state. Next, press the "Autoscale" key to get a waveform on the scope. Now press the "Time" key followed by the "Next Menu" and the "+Width" softkeys. What is the measured time?

_____ ms

Winding Up

[ ] Be sure to save your file(s) onto your network drive.

[ ] Turn off power to the target board, using the toggle switch in the lower left-hand corner of the board.

[ ] Log off of the computer.

[ ] Tell the lab TA to check you off as having completed Project One. You need not turn in anything for this first project.