Lab1: Getting Acquainted with the EasyPIC 7 Demo Board

Introduction and Objectives

The purpose of this lab is to help you become familiar with the EasyPIC 7 Demonstration Board, and some of the software tools which you will use to write programs for this course. You will also test the 4-digit multiplexed 7-segment display. This lab introduces you to the following PIC18 development tools:

- MPLAB X IDE (Integrated Development Environment)
- C18 Compiler
- mikroProg Suite for PIC (by mikroElectronika)

1. Overview of the EasyPIC v7 Demo Board

EasyPIC™ 7 (Figure 1) is the latest version of this popular development tool from MikroElektronika. Now with dual power supplies (3.3V and 5V) it supports over 250 different PIC MCUs. EasyPIC 7 accepts DIP packages from 8 to 40 pins and comes with a PIC18F45K22 installed. It features amazing connectivity, with four different connectors for each port, along with pull up/down resistors, buttons and LEDs on every I/O line. A fast programmer and in-circuit debugger are included, and it also accepts an optional 2x16 character LCD (TMIK005) as well as a 128x64 Graphic LCD with Touch Panel (TMIK004). You can prototype many applications quickly with this versatile tool. You need to identify these major blocks on the demo board:

1. **Dual Power Supply:** Board is equipped with power supply unit capable of supporting both 3.3V and 5V microcontrollers. Board can be powered over USB cable, or external adapter connectors.
2. **Programmer USB connector:** Programmer USB connector is connected to on-board mikroProg, but can also be used to power the board, when the J6 jumper in the Power Supply section is in the USB position.
3. **mikroProg:** On-board mikroProg™ In-Circuit Debugger and programmer supports over 250 microcontrollers from Microchip.
4. **ICD2/ICD3 connector:** If you need to use other external programmer with EasyPIC 7, the ICD2/ICD3 compatible connector has been provided, so you can override the on-board mikroProg.
5. **USB connector:** Board provides USB-B connector necessary for developing applications that use USB communication. Connector can be routed to either PORTC or PORTA, depending on the target microcontroller.

6. **mikroBUS sockets:** EasyPIC 7 is the only board in the world to provide two mikroBUS sockets for mikroElektronika "Click Boards". mikroBUS provides simple and effective Plug-and-Play connectivity solution.
7. **Reset Button:** High quality reset button with surrounding reset circuitry ensures stable reset operation.
8. **RS-232 Connector:** UART communication is implemented through RS-232 connector provided on the board.
9. **USB-UART Connector:** FTDI chip allows the EasyPIC 7 board to be connected with a PC through USB cable over UART connection.
10. **PIC18F45K22:** With just enough RAM and Flash, PIC18F45K22 microcontroller provides designers with enough power for most projects.
11. **Crystal oscillator:** 8MHz oscillator circuit that provides external clock is connected to microcontroller osc pins.
12. **4-digit Multiplexed 7-segment display:** EasyPIC 7 provides a 4-digit multiplexed display for applications requiring visualization of parameters.
13. **LCD 2x16 characters:** Board is equipped with LCD 2x16 connector which allows users to connect LCD 2x16 display and place it securely using plastic distancer, specially designed for this purpose.
14. **LCD contrast potentiometer:** This potentiometer allows adjustment of the contrast level of the pixels on the LCD 2x16 character display.
15. **GLCD 128x64 pixels:** Application developers may place a GLCD 128x64 display directly on the board and firm it in place securely using high-quality plastic distancer, specially designed for this purpose.
16. **GLCD contrast potentiometer:** This potentiometer allows adjustment of the contrast level of the pixels on the GLCD 128x64 display.
17. **GLCD/LCD Backlight:** GLCD and LCD backlight can be driven with PWM signal from the microcontroller, or they can be turned on in full brightness.
18. **Touch Panel Controller:** Touch panel controller with connector is provided for analog resistive touch panels attached to the GLCD 128x64 to form GLCD Touch screen.
19. **Piezo Buzzer:** With piezo buzzer one may debug applications, or generate audible signals. It can be connected to two digital output pins, one of which is the PWM output.
20. **ADC potentiometers:** Analog inputs may be simulated using two provided analog potentiometers which can be connected to each of the 10 supported microcontroller analog input pins.
21. **LM35 Temp Sensor:** The LM35 is a low-cost precision integrated-circuit analog temperature sensor. It can measure temperatures from -55°C to +150°C with 0.25°C accuracy at room temperatures.
22. **DS1820 Temp Sensor:** Board supports Dallas DS1820 One-Wire digital temperature sensor. Users can measure temperatures from -55°C to +125°C with 0.5°C accuracy.
23. **I2C EEPROM:** Users can store 8 x 256 bytes of configuration data or other data into on-board 24AA01 Serial EEPROM with I2C interface.
24. **SMD LEDs:** Each Input/Output PORT group contains red SMD LEDs with low current consumption of only 1mA. Board contains total of 36 LEDs for PORT pins.

25. **Tri-state DIP switches:** Tri-state DIP switches are used to enable 4K7 pull-up or pull-down resistor on any desired PORT pin.
26. **Push buttons:** Push buttons in each Input/Output group enable applications to use digital inputs on each port pin. Buttons are of high quality and have a stable response.
27. **1x10 PROTO headers:** 1x10 soldering pads have been provided for further connectivity in each Input/Output group.
28. **PORT Headers:** Two male IDC10 port headers are available in each Input/Output group, which is convenient for easier access to any PORT pin.
29. **Left PORT Header:** Additional PORT headers on the left side of the board have been provided, so that users may access the desired MCU pins on the other side of the board.
30. **Oscilloscope GNDs:** Three separate GND pins are available on the board for easier connection of GND reference for oscilloscope probes.

You may refer to the full-blown schematic of the demo board as well as the user manual for further details. You may also ask for soft copies from your instructor.

Figure 1: EasyPIC 7 Demo Board

2. Meet the PIC18F45K22 Microcontroller

PIC18F45K22 is the new default chip of the EasyPIC 7 board. Elaborate details on it is found in the PIC18F45K22 datasheet. Here are the main features of this MCU:

- 16 MIPS instruction frequency
- 64 Kbytes of linear program memory
- 3896 bytes of linear data memory
- 1024 bytes of data EEPROM
- Wide range of operating voltage from 1.8V to 5V
- 36 general purpose I/O
- 30 analog input channels
- Digtal-to-Analog converter
- Capacitive touch sensing using charge time measurement unit (CTMU)
- Three 8-bit timers
- Four 16-bit timers
- Pair of each: SPI, I^2C, CCP and comparator modules.
- 2 enhanced USARTs that support RS232, RS485 and LIN along with other attractive features.

3. Prelab Reading:

You need to read chapters 6 and 8 in the instructor's textbook and skim over the processor's datasheet as well as the user manual and schematic of the demo board.

4. Multiplexed Display

Figure 2 shows the 4-digit multiplexed display residing on the EasyPIC 7 demo board. It is used essentially to reduce power consumption and minimize "pin-appropriation". The non-multiplexed scheme usurps 32 MCU pins (8 segments times 4 digits) whereas the multiplexed display uses only 12 pins (8 for the segments and 4 for the digit selectors). It illuminates one digit at a time at a fast rate. Due to the eye persistence, it looks as if all the digits are turned on simultaneously. In order not to see the display flicker, the refresh time must not exceed 25 ms. For the 4-digit display, the "on-time" per digit must be around 6 ms. If only 3 digits were used, the on-time per digit would be 8 ms. As to the power saving gain, the 4-digit multiplexed display consumes only one-fourth the power absorbed by the non-multiplexed display.

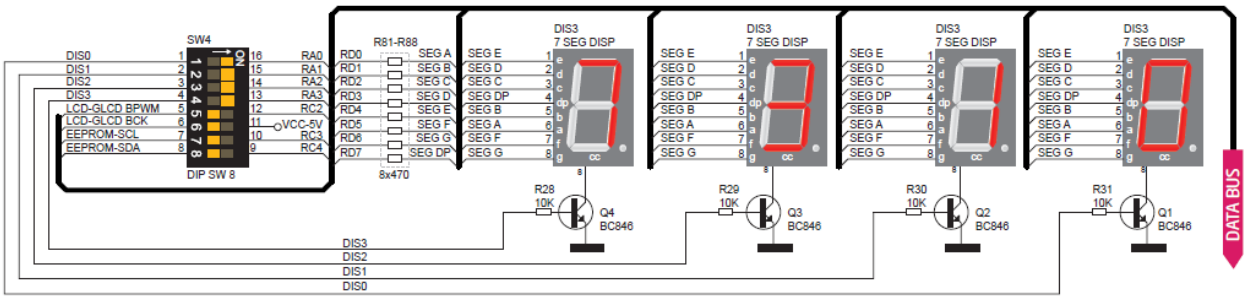


Figure 2: Multiplexed display on the demo board.

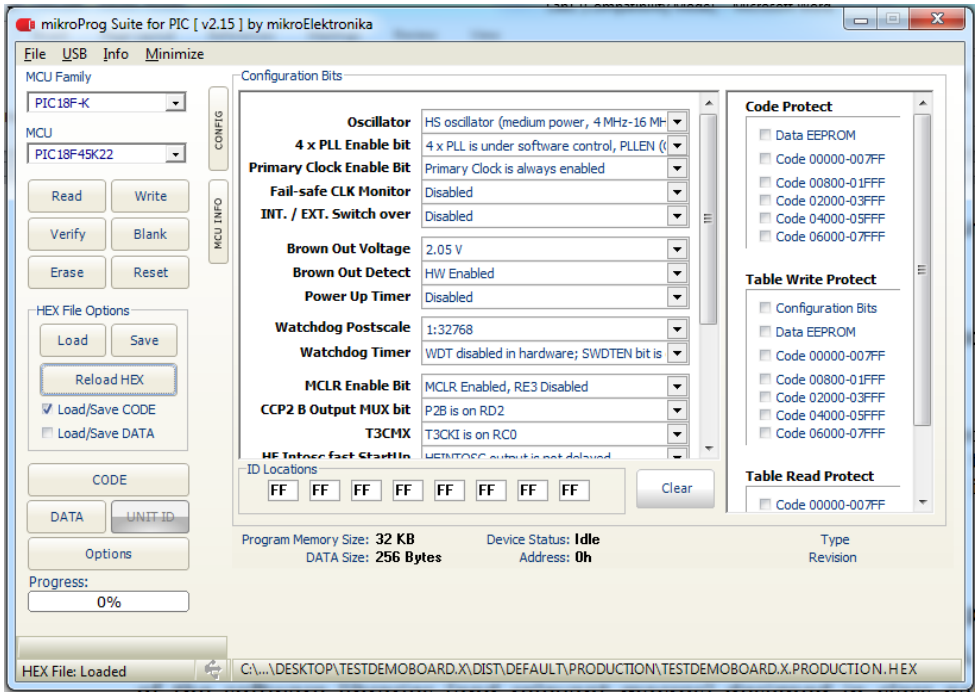
5. Assignment (20 points)

a. Using the multiplexed display, write a program to display a 3-digit up counter (000 to 255) running at a frequency of 1Hz. Use a periodic interrupt of 4 ms to refresh the display. Hint: one second = 250 * 4 ms, therefore you may count 250 interrupts before you increment the counter. *Variations of this program*: digital voltmeter, digital thermometer, programmable timer, etc.

b. Repeat part (a) to display a 4-digit up counter (0000 to 9999) running at 1Hz.

Note: Make sure you add the directives below to the include file `P18F45K22.h`. This will insure that *mikroProg Suite* will have the settings shown in the figure below.

```
#pragma    config    FOSC = HSMP      // High speed medium power
#pragma    config    WDTEN = OFF      // Watchdog timer disabled
#pragma    config    XINST = OFF      // Extended instructions disabled
```



Your instructor will be giving you a demo on how to program the chip as well as the required hardware settings. Do not forget to demonstrate all programs to your instructor or lab assistant. Your instructor may ask you to make improvements to the program if flaws are found. The turned in program must be signed by your instructor.

6. References:

1. Hardware/Software Design with PIC18 Microcontrollers, Nicolas K. Haddad, 2009.
2. PIC18F45K22 Datasheet, Microchip Technology Inc.
3. EasyPIC v7 User's Guide, MikroElectronika Inc.
4. EasyPIC v7 Schematic, MikroElectronika Inc.

"I think this office automation has gone a little too far!"