Skit-PIC Station3

Multi-processor starter kit for PIC microcontroller

Kit content :

- PIC Station-3 experiment board
  (includes PIC10F222 module x2, PIC12F683, PIC16F648 and PIC16F887)
- PX-200 programmer
- USB cable
- CX-232 Serial port cable
- DC adaptor
- 16x2 LCD module with cable
- Wire jumper set
- CD-ROM and Technical leaflet

INNOVATIVE EXPERIMENT

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PIC Station-3 Multi-processor experiment board for PIC microcontroller technical brief

This is the latest generation of INEX's PIC microcontroller experiment kit. PIC Station-3 supports lots of PIC microcontroler package and all can work in same time. No need swap the chip in each socket. It means experimenters could be learn and develop the multi-processor system in only one experiment platform.

PIC Station- 3 experiment board and also the necessary experimental components. It was designed to allow students or engineers to easily exercise and explore the capabilities of the PI C microcontrollers.

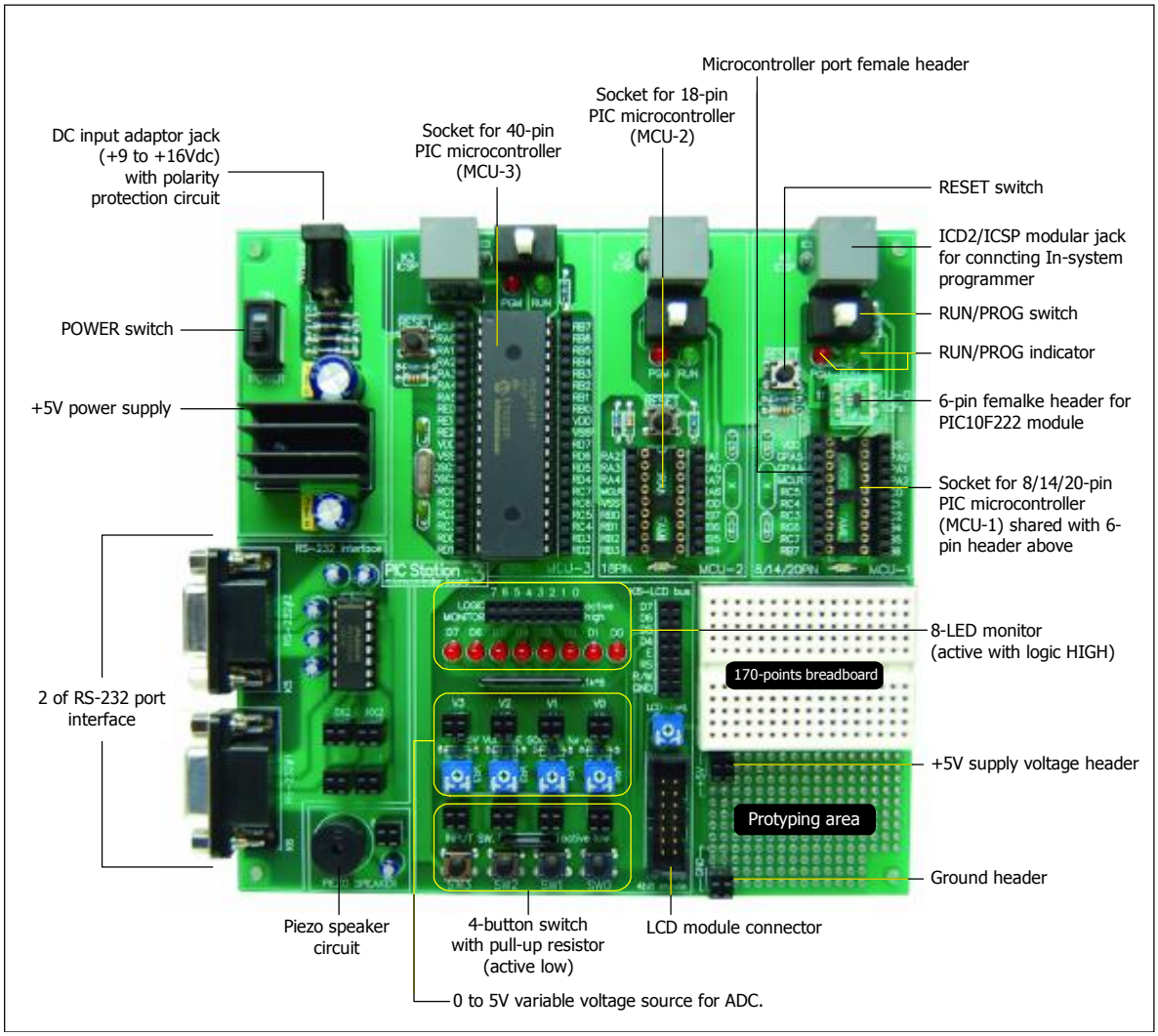


Figure 1 : PIC Station-3 experiment board layout

PIC Station -3 supports all popular software development tools such as Microchip's MPLAB IDE, CCS C compiler, MikroBasic, MikroPascal, MikroC etc. The CD-ROM contains MPLAB IDE, some the limit version of popular Basic and C compiler. Figure 1 shows the layout of PIC Station-3 board.

PIC Station-3 also requires the external In-system programmer board. We suggest to PX-200 or PX-700 USB In-System Programmer board. However INEX set the special starter kit; Skit-PIC Station3. This startetr kit is bundled the PIC Station-3 board and PX-200 programmer and numbers of accessories such as LCD module with cable, Serial LCD module, Wire jumpers, DC adaptor.

PIC Station-3 technical features

Microcontroller section

● 3 of PIC microcontroller main sockets for supporting the different package of PIC micrcontroller. It includes :

- 40-pin socket that inserted PIC16F887 chip. Also, you can change to any 40-pin DIP of PIC16f/18F microcontroller

-18-pin socket that inserted PIC16F648 chip. Also, you can change to any 18-pin DIP of PIC16F/18F microcontroller

- 20-pin socket; you can change to any 8/14/20-pin DIP of PIC16F/18F microcontroller and special bonus; the 6 pin female header for supporting the PIC10F222 module - bundled with this experiment board (must use only one package in a time)

● Each microcontroller socket has ICD2 jack for supporting the In-system programming (PX-200 or PX-700 USB programmer is recommended). You can program and run all 3 sockets in same time. No need to change !

● Fixed 20MHz crystal clock for 40-pin microcontroller and 4MHz crystal for 18-pin PIC microcontroller

● Free clock source selection for 20-pin PIC microcontroller socket

● Prepare all I/O port of PIC microcontroller in each socket

● Direct downloading via ICD2 jack by Microchip's PicKit-2 software. It can operate with WindowsXP and Vista. You can set the full option of configuration bits for each microcontroller

● One mode switch for program and run in each microcontroller socket with Mode LED indicators.

● Support the multi-processor experiments and applications.

Experiment tools :

- +5Vdc supply voltage
- 8-LED are active with logic "1"
- LCD connector support 16x2 LCD up to 20x4 LCD
- 4 of push-button switches with pull-up resistor
- 2 of RS-232 serial port interfacing circuits
- Pulse generator 1Hz, 10Hz, 100Hz and 1kHz with LED indicators
- 4 of 0 to +5V Variable voltage sources for A/D converter experiment
- Freely Piezo speaker
- Mini-breadboard 4.5 x 3.5 cm. 170 points
- 187 soldering pads prototyping area

PIC Station-3 circuit description

Figrue 2 shows the microcontroller circuit section 1. It supports PIC devices in 10F series and 8/14/20-pin PIC12F/16F/18F devices. The 6-pin female header; MCU-0 supports PIC10F2x2 module (bundled PIC10F222 with PIC Station-3). The MCU-1 socket supports PIC12F/16F and 18F in 8/14/20-pin DIP package. You must select to use only one socket in same time between MCU-0 and MCU-1. Because all ports are shared. Figure 2-3 illustrares PIC devices installation of MCU-1 socket for PIC Station-3 board.

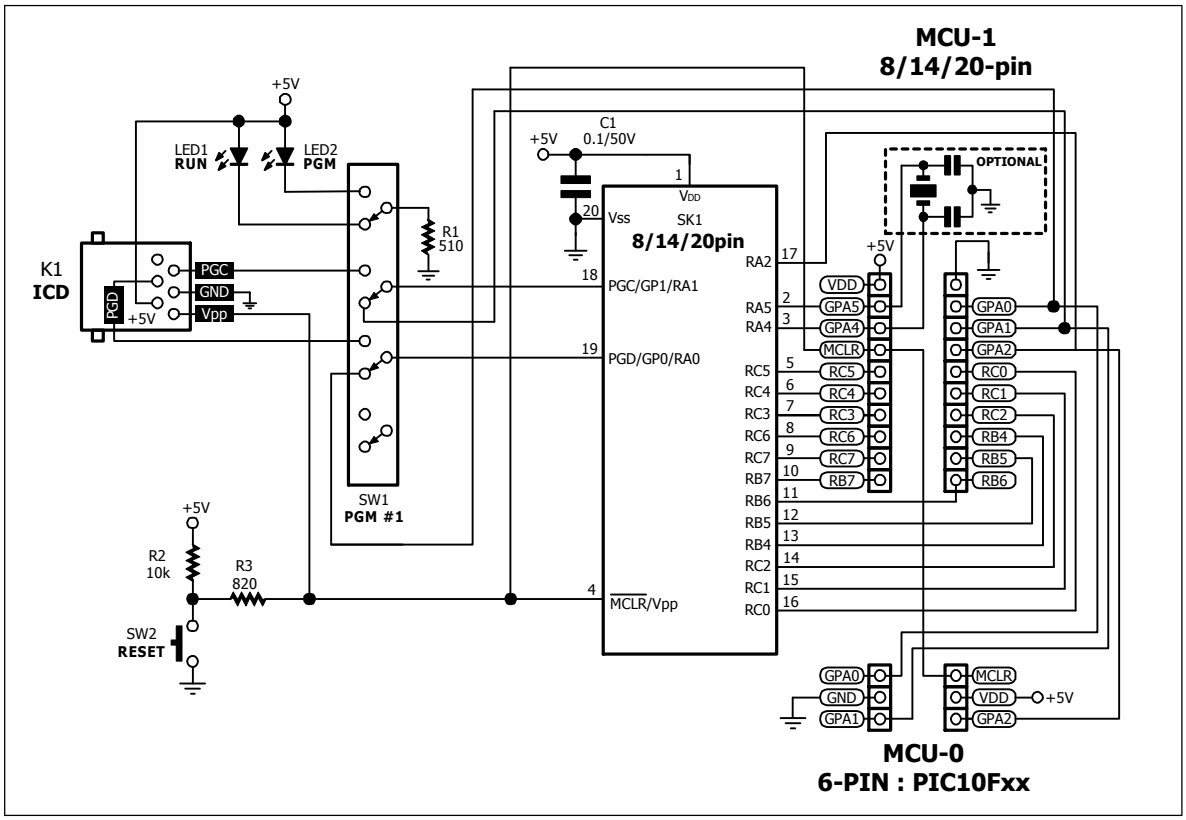


Figure 2 : Schematic diagram of microcontroller sction 1. It supports MCU-0 and MCU-1 socket

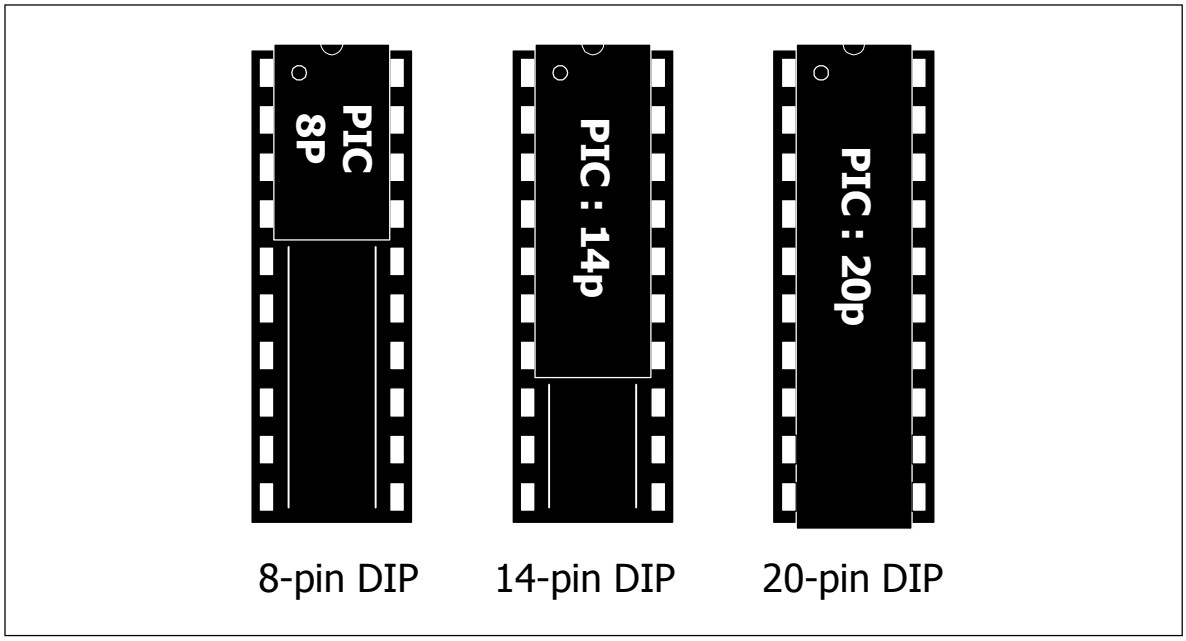


Figure 3 : Installation devices on MCU-1 socket of PIC Station-3 experiment board

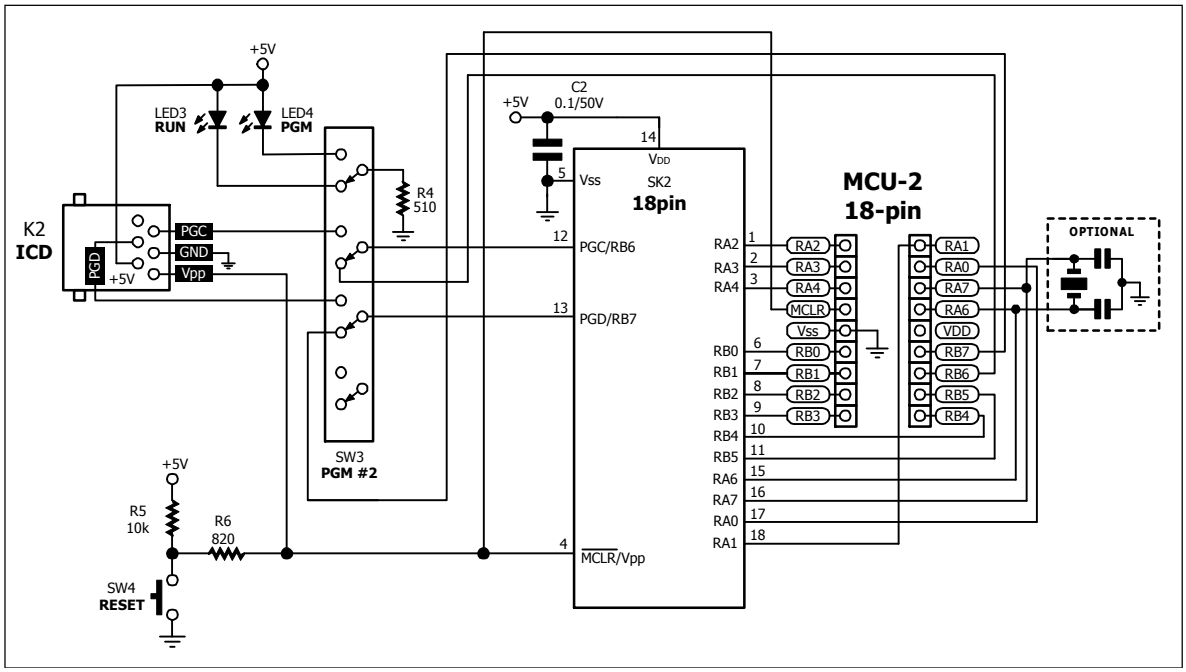


Figure 4 : Schematic diagram of microcontroller section 2. It supports 18-pin DIP package

Downloading code is operated via ICD or ICSP modular jack. PX-200 or PX-700 programmer is recommended. The mode switch is availabled on the PIC Station-3 boatd for choosing RUN and PROGRAM mode with LED indicators.

All microconttroller port are connected to female header pin directly. Experimenters can connect all port to test and experiment fully. Also support all oscillator modes. You can solder the optional oscillator devices such as crytal, capacitors and resistors for suitable osciilator circuit.

Figrue 4 shows the microcontroller circuit section 2. It supports PIC devices in 18-pin DIP package. The recommended device is PIC16F648 and PIC16F88.

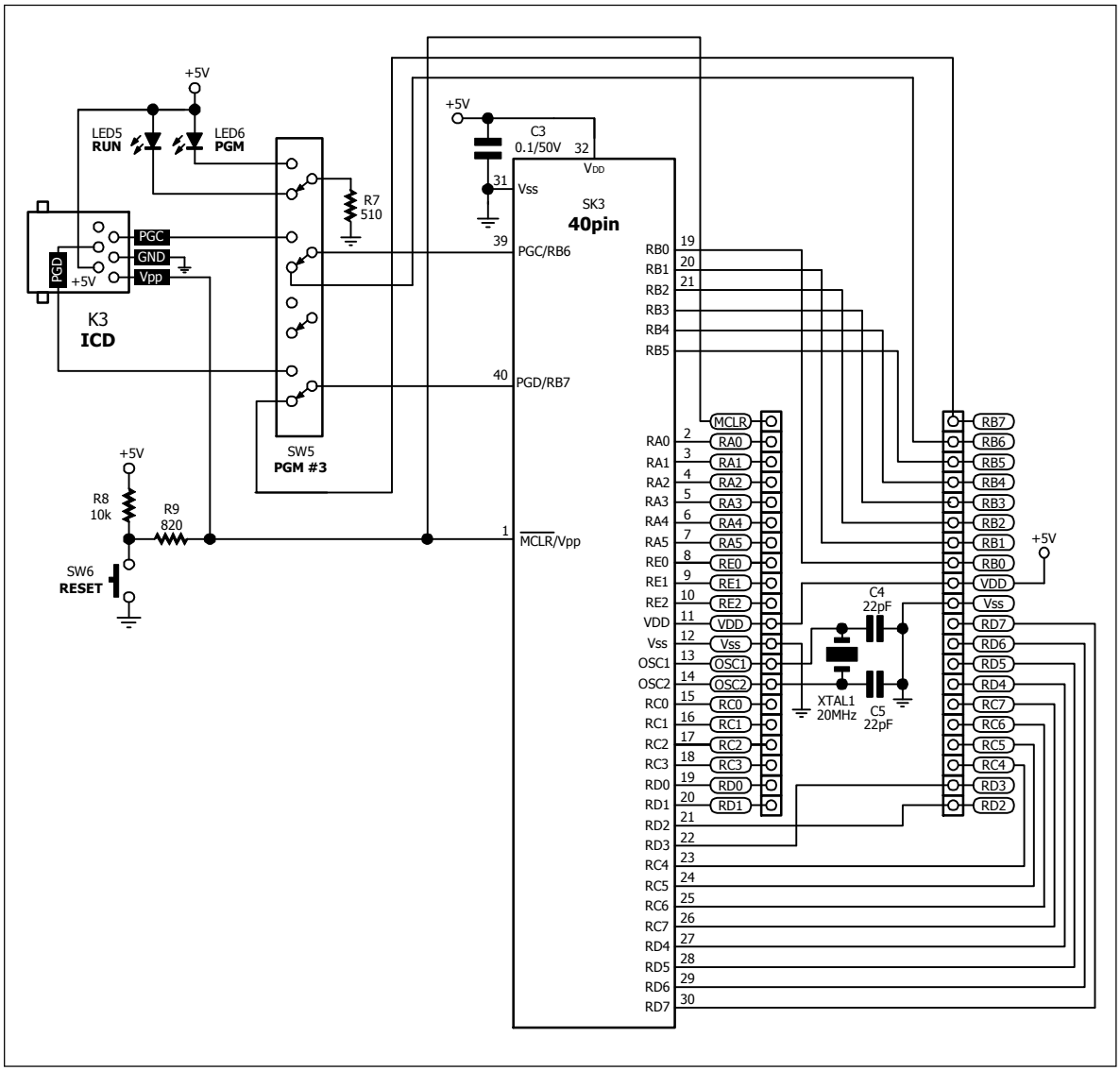
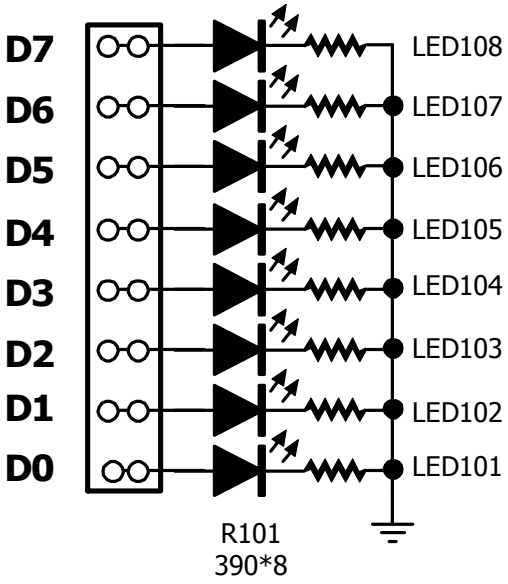


Figure 5 : Schematic diagram of microcontroller section 3. It supports 40-pin DIP package

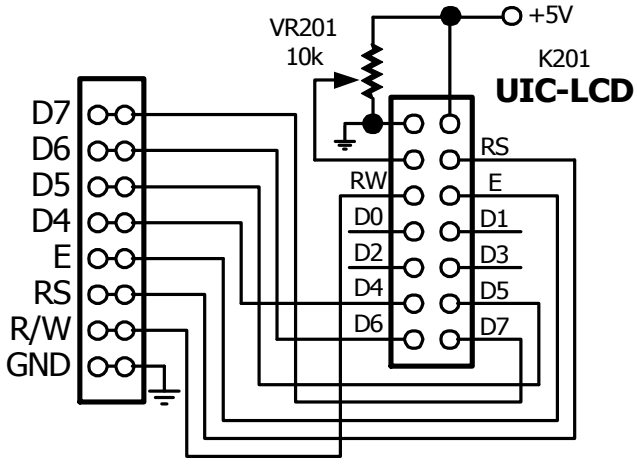
Figure 5 shows the microcontroller circuit section 3. It supports PIC devices in 40-pin DIP package. The bundled device is PIC16F887. Downloading code is operated via ICD or ICSP modular jack. The mode switch is availabled on the PIC Station-3 boatd for choosing RUN and PROGRAM mode with LED indicators. We choose the 20MHz clock circuit for this microcontroller circuit. The oscillator configuration must select to HS type.

The experiment compoments on PIC Station-3 board includes :

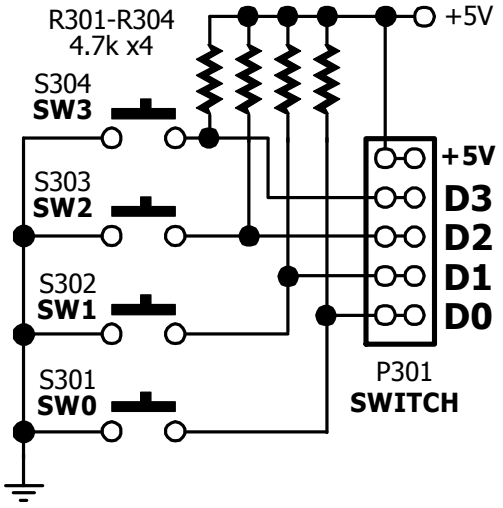
1. **8-LED monitos** : Active with logic HIGH. The limit-current resisitrors are connected ready.



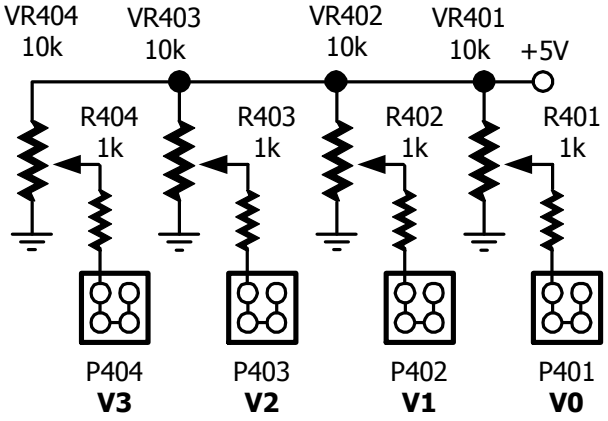
2. **LCD module interface** : At this connector can connect with 16-characters 2-lines LCD module that bundle in experiment board set. It prepare variable resisitor for LCD's contrast adjustment.



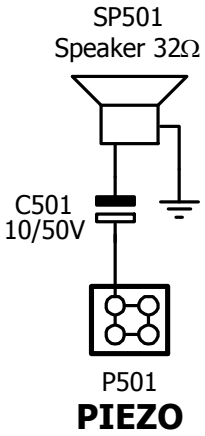
3. **4-button switch input** : Switch is the type of input device for microcontroller experiment. Four normally-open push-button switches are made available via connectors. The buttons switches are wired in an active-low configuration, with an pull-up resistor.



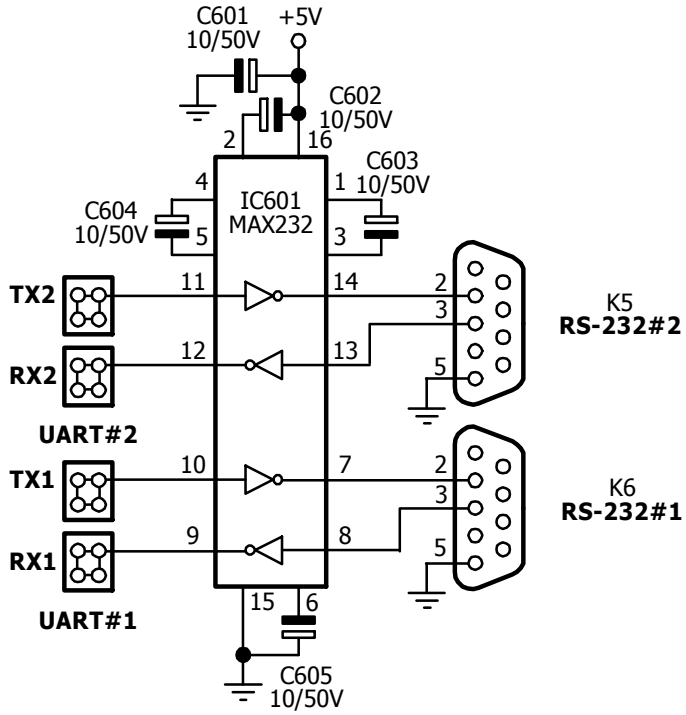
4. **The 0 to +5V Reference Voltage Source**: For support analog experiment, PIC Station-3 board provides 4 channels of 0 to 5V analog voltage source to supply analog voltage for ADC circuit purpose only.



5. **Piezo speaker circuit** : Sounding device on this experiment board is Piezo speaker. It connects with 10mF electrolytic capacitor in series to coupling only signal to speaker. The piezospeaker has resonance frequency at 2 to 3 kHz. If the resonance frequecncy apply to the piezo speaker, it lounds maximum. The amplifier device is BC547 transistor.



6. **RS-232 circuit** : RS-232 serial port interface to microcontroller, This experiment board provides 2 of interfacing circuits. The schematic diagram is shown below.



7. **Solderless Breadboard** : Most experiments will involve components placed in the solderless breadboard. The breadboard on this experiment board size is 4.5 x 3.5cm. 170 point-contacts.

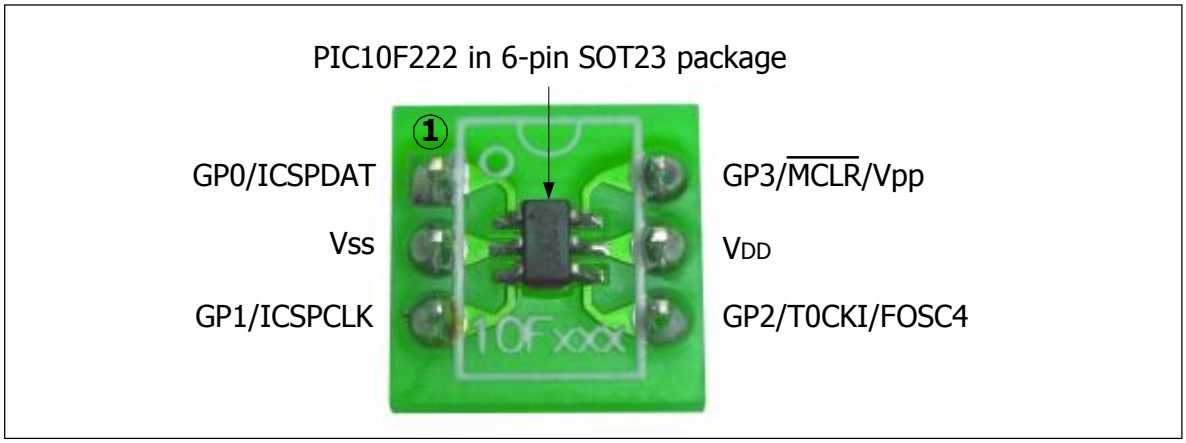
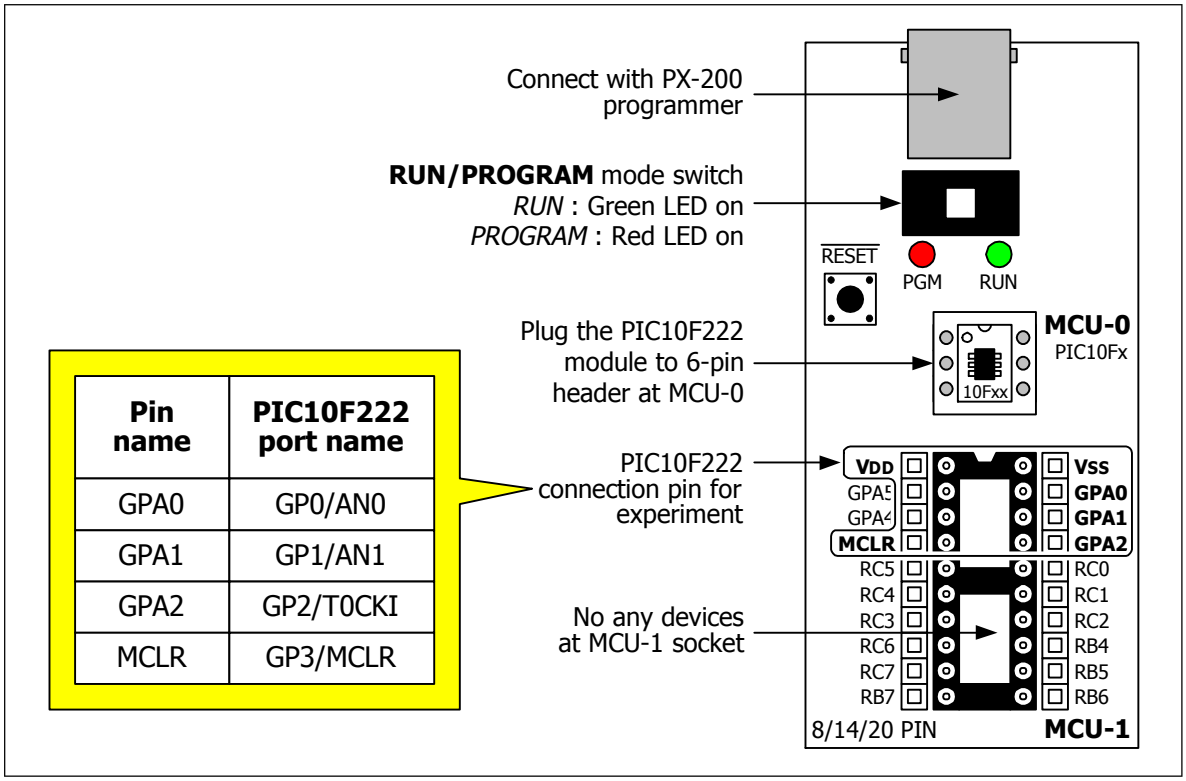


Figure 6 : The PIC10F222 microcontroller module of PIC Station-3 board

PIC10F222 microcontroller module

Figure 6 shows the detaiils and pin assignment of PIC10F222 module that work with PIC Station-3 experiment board.

Using the PIC10F222 microcontroller module is very easy. Plug it on the MCU-0 female header on PIC Station-3 borad. The connection pin is assigned following the figure 7. When construct the experiment circuit, must careful about pin position and MCU-1 socket must no any device. ***This is highly recommended when you experiment with PIC10F222.***



Pin name	PIC10F222 port name
GPA0	GP0/AN0
GPA1	GP1/AN1
GPA2	GP2/T0CKI
MCLR	GP3/MCLR

Figure 7 : Using the port connector of PIC10F222 module on PIC Station-3

Introducing the PX-200 programmer

The PX-200 Microcontroller Programmer is a low-cost development programmer. It is capable of programming most of Microchip's Flash microcontrollers. It is OEM from PICkit2 programmer from Microchip. For specific products supported, see the latest information at Microchip website ***www.microchip.com***.

The PX-200 Microcontroller Programmer Operating System (firmware) can be easily upgraded from the programming software. New device support can be added by updating the operating system. The latest firmware is available on Microchip's web site at www.microchip.com.

The PX-200 Microcontroller Programmer overview is shown in Figure 8.

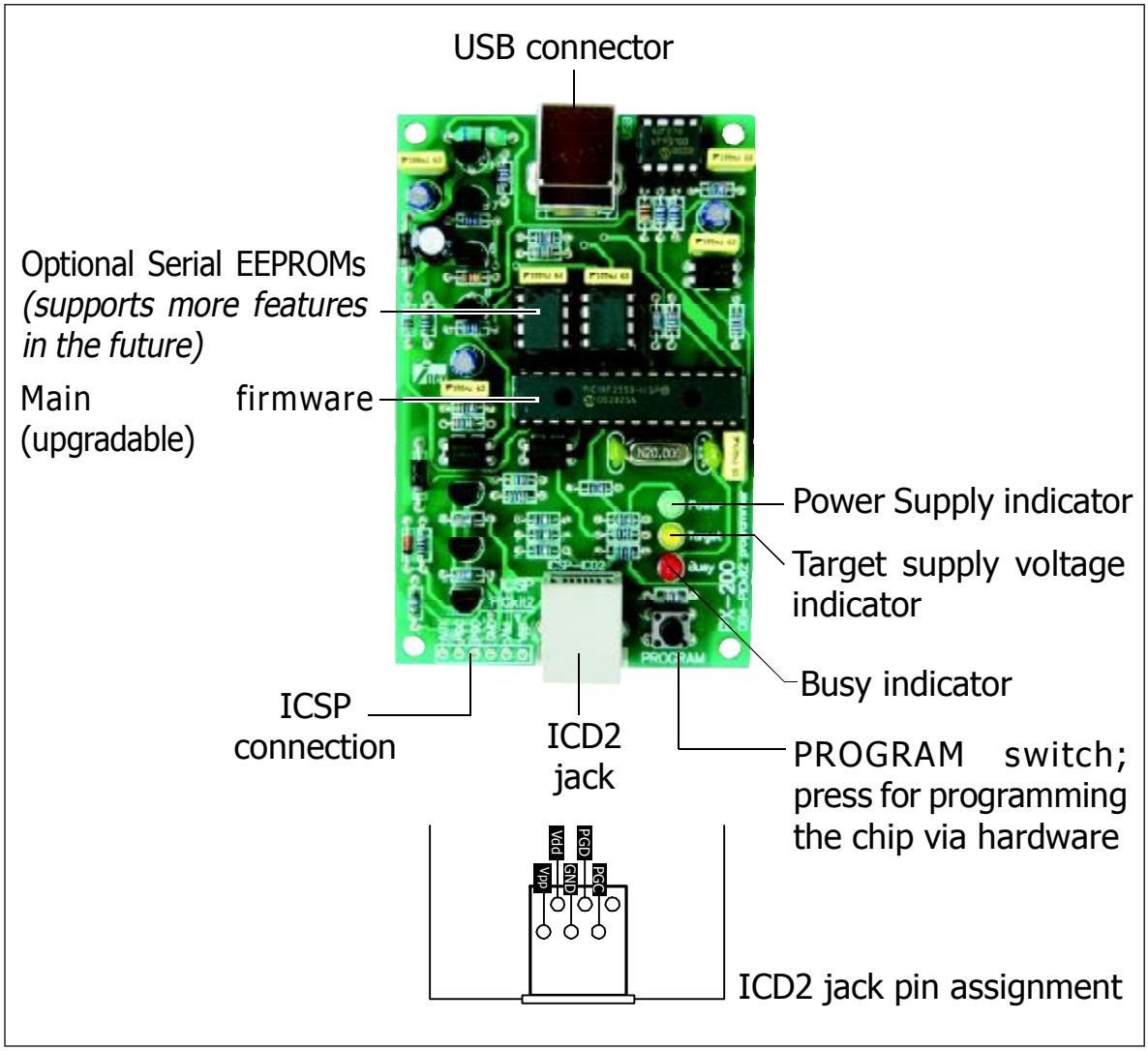


Figure 8 : The overview of PX-200 the In-Circuit Serial Programmer for PIC/ dsPIC microcontroller via USB port

PX-200 Programmer and ICSP

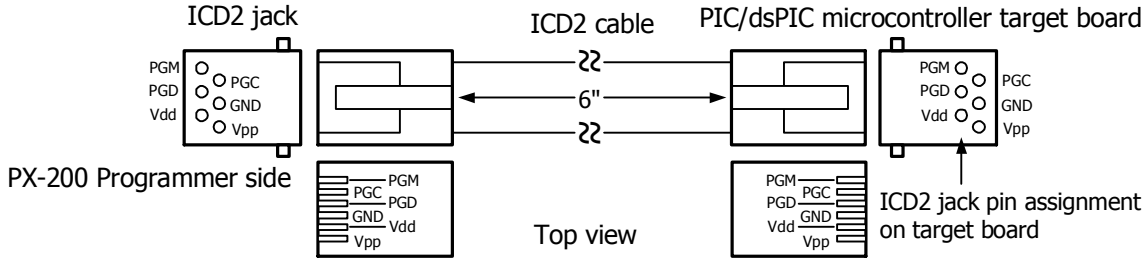
The PX-200 Microcontroller Programmer can program PICmicro® microcontrollers that are installed in an application circuit using In-Circuit Serial Programming™ (ICSP™). In-Circuit Serial Programming (ICSP) requires five signals:

- **V_{PP}** – Programming Voltage; when applied, the device goes into Programming mode.
- **ICSPCLK** or **PGC** – Programming Clock; a unidirectional synchronous serial clock line from the programmer to the target.
- **ICSPDAT** or **PGD** – Programming Data; a bidirectional synchronous serial data line.
- **V_{DD}** – Power Supply positive voltage.
- **V_{SS}** – Power Supply ground reference.

However, the application circuit must be designed to allow all the programming signals to be connected to the PICmicro device without distorting the programming signals.

ICD2 cable assignment

The PX-200 Microcontroller Programmer comes with an ICD2 cable for connecting between the PX-200 programmer and the target board, the microcontroller. The wire assignment of this cable is shown below.



How to develop PIC microcontroller programming with PIC Station-3

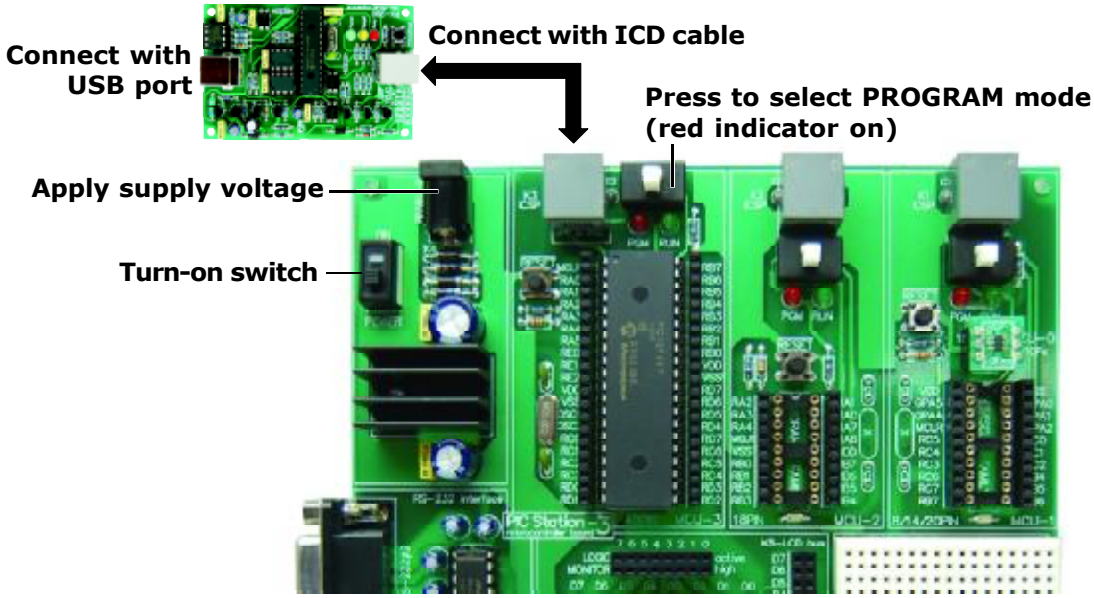
(1) Install all development software tools. Includes MPLAB V8 or higher and HI-TECH C compiler Lite mode.

(2) Use the PIC Station-3 board with Microchip's ICD2 or INEX's PX-200/PX-700 USB programmer.

(3) Construct the experiment circuit on breadboard of PIC Station-3 board.

(4) Create the C project file and source file on MPLAB. Compile the experiment project to get the HEX file for downloading to PIC devices.

(5) Connect PX-200 or PX-700 programmer with PIC Station-3 board.



(6) Apply the supply voltage to the experiment board. Select mode swtich to **PROGRAM**. Download the HEX file to microcontroller. After that, change mode switch to **RUN** for testing the operation.

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Introduction to software development tools

We recommend the use of the free software tools from **Microchip (www.microchip.com)** for the development of the C programming language for PIC10F222 microcontroller.Developers must register before downloading this software at ***www.microchip.com***

The tool set for developing the STM32 microcontroller includes 3 main softwares as follows :

1. **MPLAB IDE** : MPLAB Integrated Development Environment (IDE) is a free, integrated toolset for the development of embedded applications employing Microchip's PIC and dsPIC microcontrollers. MPLAB IDE runs as a 32-bit application on Microsoft Windows is easy to use and includes a host of free software components for fast application development and super-charged debugging. MPLAB IDE also serves as a single, unified graphical user interface for additional Microchip and third party software and hardware development tools. Moving between tools is a snap, and upgrading from the free software simulator to hardware debug and programming tools is done in a flash because MPLAB IDE has the same user interface for all tools.

2. **HI-TECH C Compiler PRO for PIC10/12/16 in Lite mode** : HI-TECH C compiler for PIC10/12/16 MCUs implements the optimizations of Omniscient Code Generation (OCG) - a whole-program compilation technology - to provide denser code and better performance for development on PIC10/12/16 MCUs. HI-TECH Software has provided this freeware compiler, HI-TECH C Compiler for PIC10/12/16 MCUs (Lite mode), as a low-cost tool for hobbyists and students, however the license allows its use for commercial purposes as well. It is ideal as a teaching tool for an introduction into the 'C' language and embedded programming on a PIC10/12/16 MCUs device. Upgrading to PRO mode, contact www.htsoft.com or www.microchip.com.

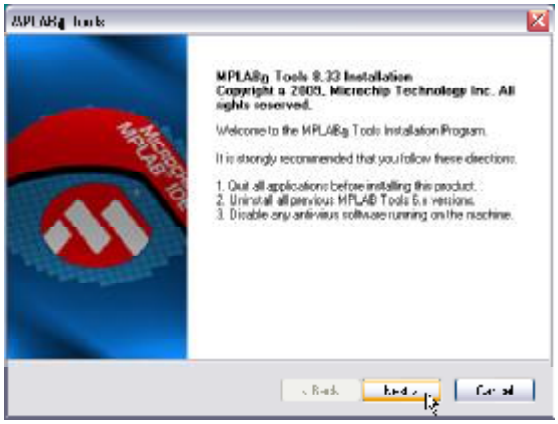
3. **PICkit2 programming software :** It is downloader software from Microchip. A user can download this free of charge at www.microchip.com. This tool requires the .HEX file from C compiler and download to the flash memory of PIC microcontroller via ICSP (In-Circuit Serial Programmer).

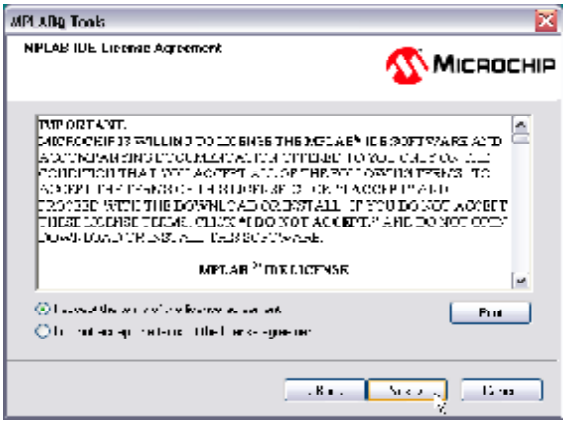
Al l software tools are bundled together with the e board in a CD-ROM.

MPLAB IDE and HI-TECH C Compiler installtion

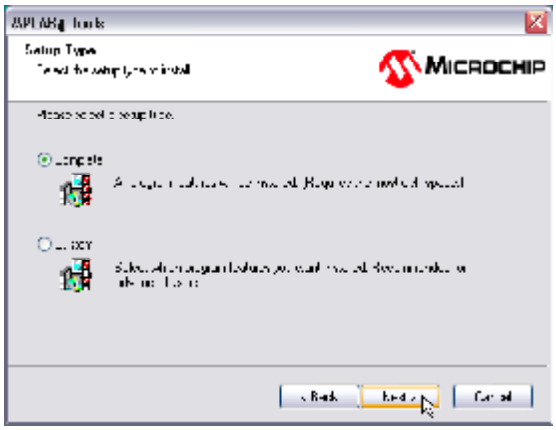
(1) Download the MPLAB IDE installation file from ***www.microchip.com***. Get the ***MPLAB_IDE_8_33.zip*** (The number of version may vary) or from CD-ROM which is bundled with the PIC Station-3 board. Extract this file to your computer.

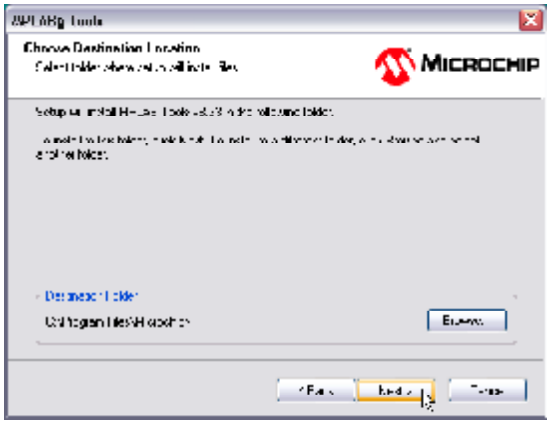
(2) Double click file ***Setup.exe*** to start the installation. You meet the **Welcome** window. Click on the **Next** button to **License agreement** window. Choose **I accept the terms of the license agreement** box following click on the **Next** button.





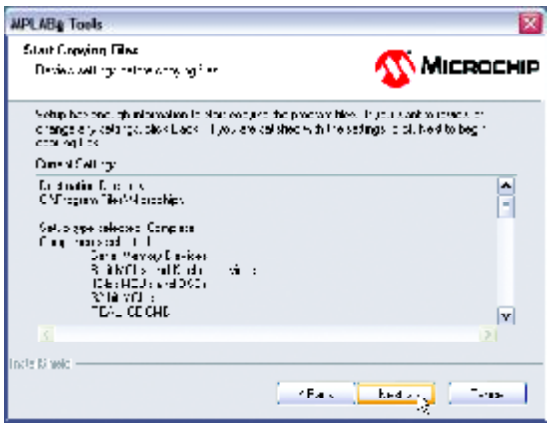
(3) **Setup type** window appears. Choose the installtion type to **Complete** and click on the **Next** button to **Choose the destination location** window. The default location is ***C:\Program Files\Microchip***. We recommended to use default location. Click on the **Next** button.

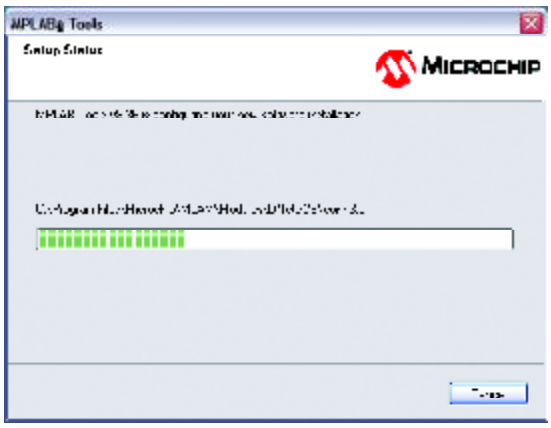




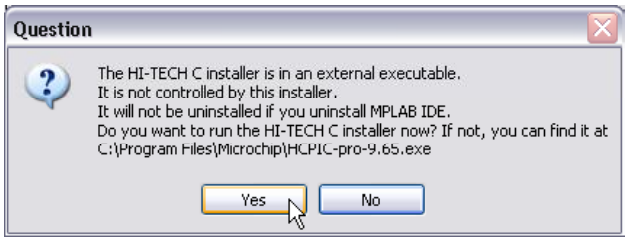
(4) In the current, MPLAB IDE has many development tools add-in. Developer must accept all License agreement.

(5) After that, the installation start and wait for installtion to complete.





(6)After that, the HI-TECH C compiler installtion dialogue box appears to ask the installtion. Click on the **Yes** button.



(7) HI-TECH C Compiler installtion window appears. Click on the **Next** button.

(8) The License agreement window appears. It inform the version of compiler as ***Free HI-TECH C PRO for PIC10/12/16.*** Click on the **Next** button.

(9) Installation start. Wait for installtion to complete.

PICkit2 Programming software installtion

(1) Download the installation file from ***www.microchip.com***. Get the ***PICkit 2 v2.61.00 Setup A.zip*** (number of verion may vary) or from CD-ROM which is bundled with the JX-PIC100 experiment board. Extract this zip file to your computer.

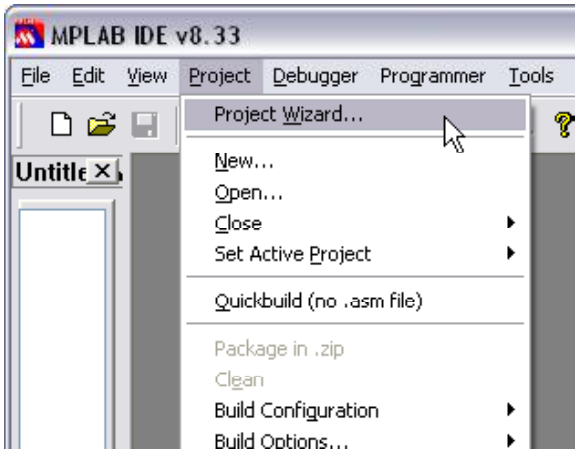
(2) Double click file ***setup.exe*** in ***PICkit 2 v2.61.00 Setup A*** folder to start the installation. Click on the **Next** button to accept every installtion steps until the installation is completed.

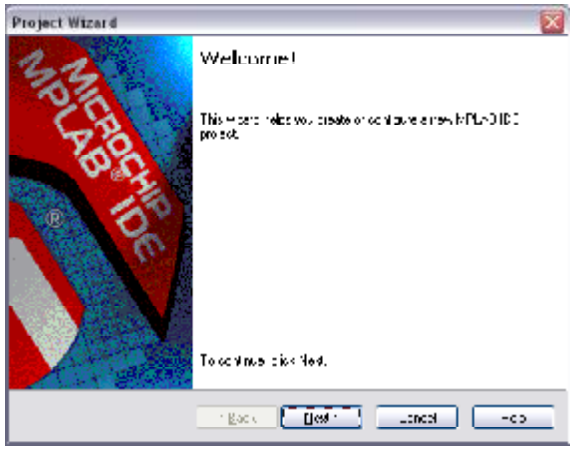
C programming developement for PIC micrcontroller

After install all software tools ready, this chapter explain about how to develop C programming for PIC10F222 by using HI-TECH C Compiler and MPLAB IDE. The first example is LED blinking at GP2 pin of PIC10F222.

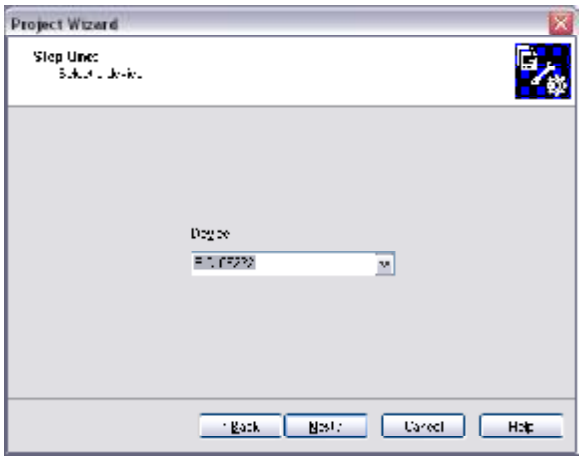
Developing steps

(1) Open MPLAB and select menu **Project → Project Wizard.** The **Welcome** window appears. Click on the **Next** button.

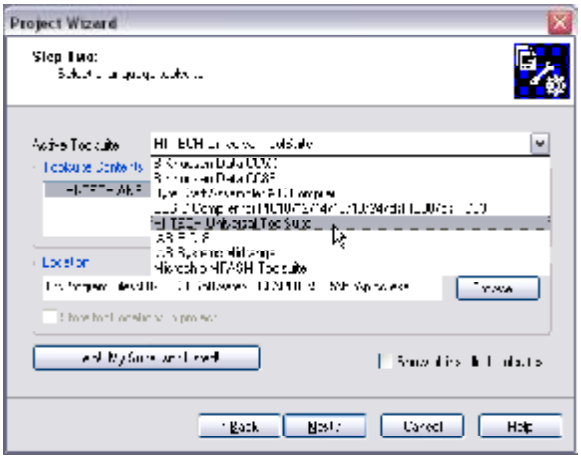




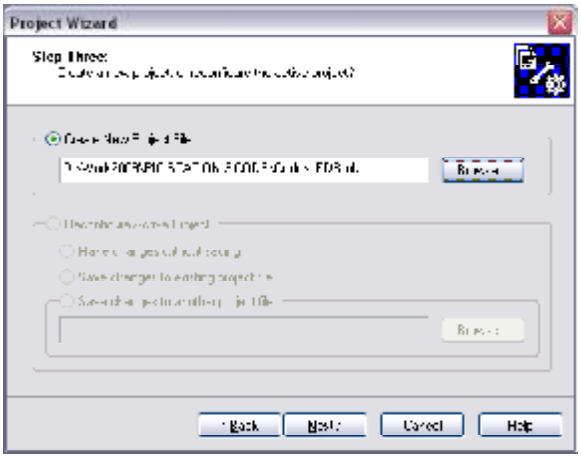
(2) Choose device number as **PIC10F222.** Click on the **Next** button.



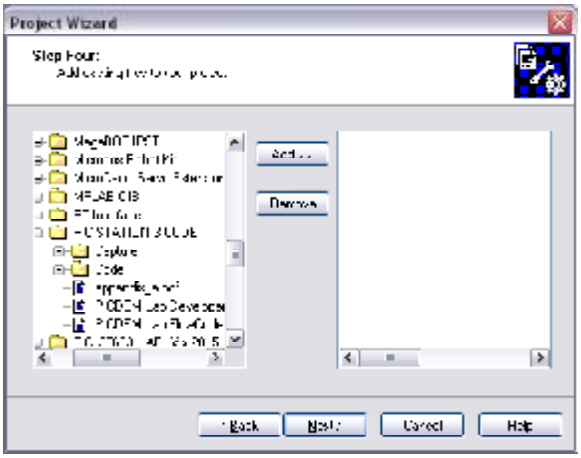
(3) Seelect compiler tools as **HI-TECH Universal ToolSuite.** Click on the **Next** button.



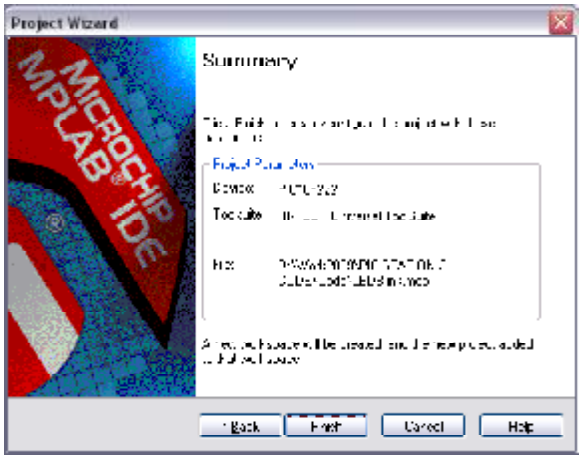
(4) Define the target folder and project. Click on the **Browse** button to defiene the target folder and project. In this example define to **LEDBlink.** Affer that, click on the **Next** button.



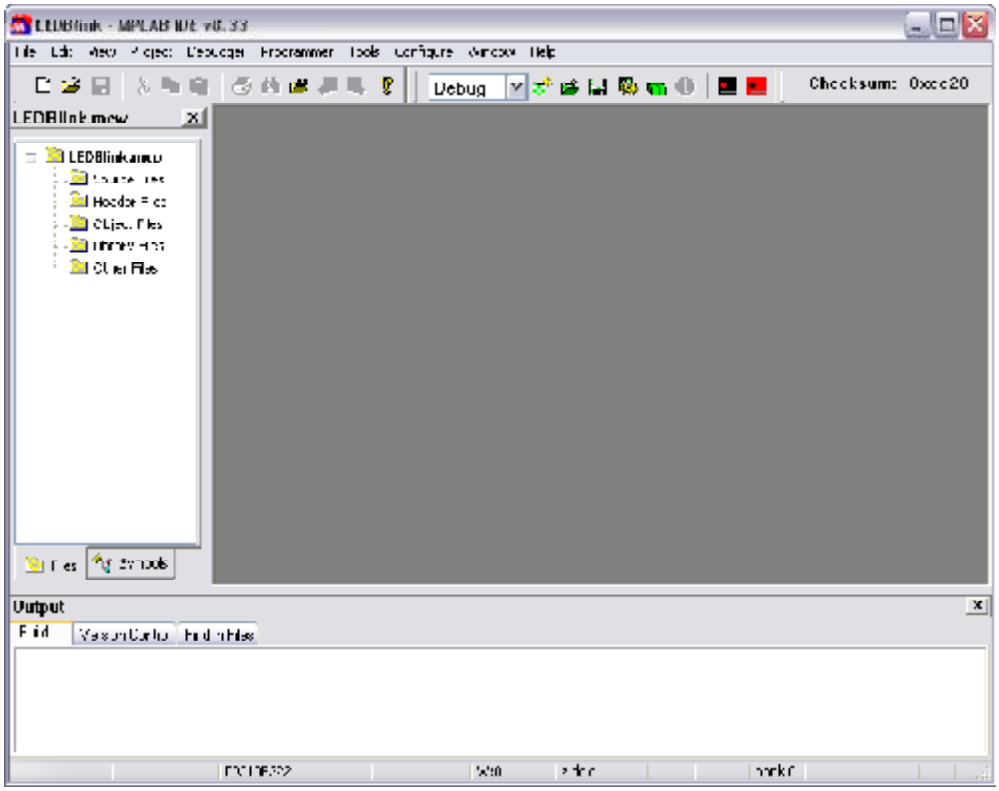
(5) The Add exist files window appears. Not add any file now. Click on the **Next** button to next step.



(6) Summary window appears to report all information of the developed project file. Click on the **Finish** button.



(7) The main window of MPLAB is opened. Select menu **File → New**. The editor window is appeared and create the new source code. Type the code following the Listing 1.

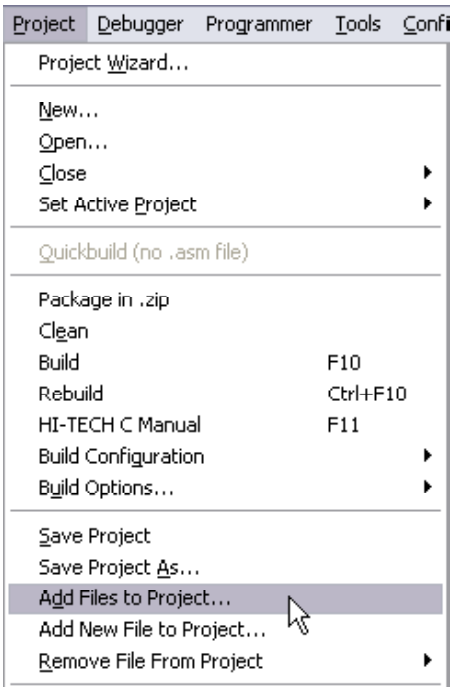


```
#include <htc.h>
#define _XTAL_FREQ 4000000
__CONFIG(OSC_4MHZ&MCPUEN&WDTDIS&UNPROTECT&MCLRDIS);
void main(){
   OPTION=~T0CS;              // Clear bit T0CS GP2=Digital IO
   TRIS=0b11111011;           // Set Only bit GP2=OUTPUT
   while(1){
     GP2=1;                   // LED ON
     __delay_ms(197);         // Maximum Delay in milisecond
     GP2=0;                   // LED OFF
     __delay_ms(197);
   }
}
```

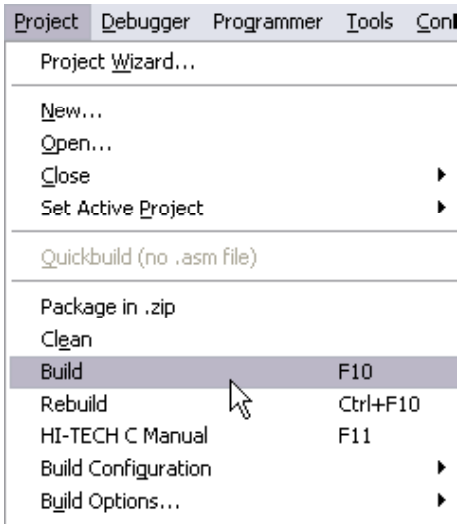
Listing 1 : Example C code for getting start the PIC10F222 programming development with MPLAB and HI-TECH C compiler

(8) Save file as ***LEDBlink.C (must define .C extension)*** to same folder of project file.

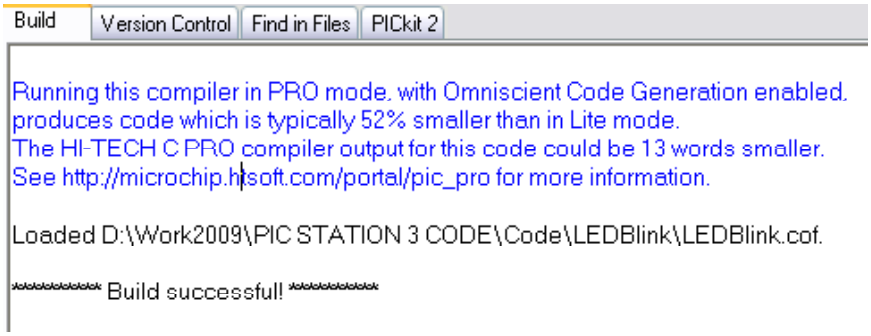
(9) Select to menu **Project → Add Files to Project...**. Next, select ***LEDBlink.C*** file to add with target project file.



(10) Compile the project file by selecting menu **Project → Build All** or click on the button.



(11) Compilation result reports at **Build** window. After compilation is completed, the completed message ********** Build successful! ********** will be appeared on last line of Build window.



If there is error, you must back to edit and correct already first.

(12) The HEX file; ***LEDblink.hex*** is created and located to same project folder. Next, use this HEX file to download to PIC10F222 microcontroller on the PIC Station-3 board.

4.2 Downloading code

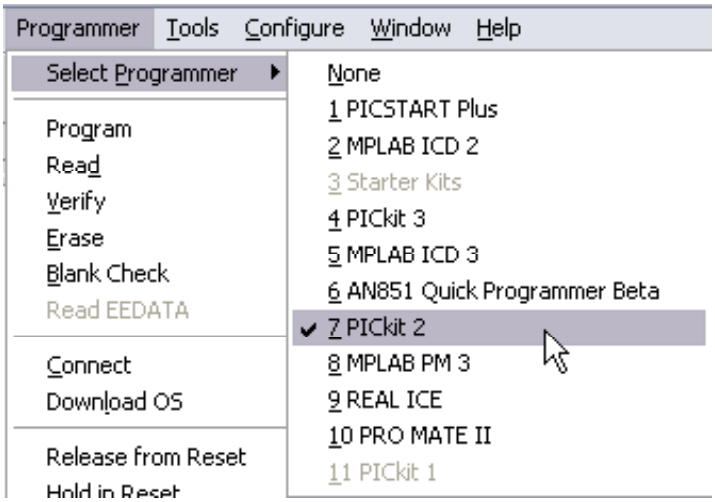
In this example explain about how to downloading the HEX file to PIC Station-3 board with PX-200 progemmer by using MPLAB IDE.

(1) PLug the PIC10F222 module on the MCU-0 female header of PIC Station-3 board.

(2) Connect the PX-200 programmer board with computer's USB port.

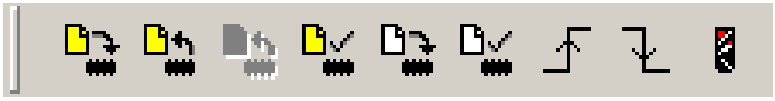
(3) Connect the PX-200 board with PIC Station-3 at K1 jack. Press **MODE** switch to **PROGRAM** mode. The mode indicator is red.

(4) At MPLAB IDE, select menu **Programmer → PICKit 2**

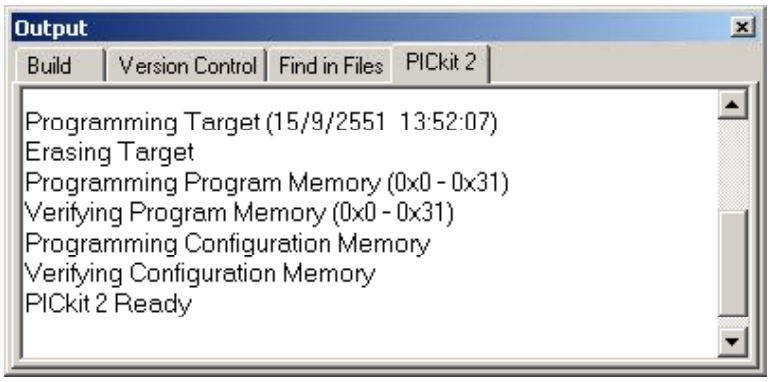


(5) At menu **Programmer**, the command as **Program**, **Read**, **Verify**, **Erase** and **Blank Check** are enabled in Programmer menu.

The Programmer command icons are appeared at the top of MPLAB menu icon too.



(6) Select command **Program** or click on the to download the current HEX file from compilation to PIC10F222. Tab **PICkit 2** of **Output** window shows all steps of programming following the picture below.



However you can use PICkit 2 programmign software to downlaod the HEX file to PIC microcontroller on PIC Station-3 board. See all instructions at PX-200 documentation.

Preparing the PIC10F222 module for PIC Station-3 experiment board

Plug the PIC10F222 microcontroller module to 6-pin female header at MCU-0. The connection pin is assigned following the figure 9. When construct the experiment circuit, must careful about pin position and MCU-1 socket must no any device. ***This is highly recommended when you experiment with PIC10F222.***

Press the MODE switch. The switch's shaft will down and red LED of PGM. mode is turned on. Now the board ready for programming. After downlaoding the HEX file, cheange mode to RUN by pressing the MODE switch again. The switch's shaft releases and green LED of RUN is turned on instead. PIC10F222 run the downloaded code.

Testing

(1) Construct the circuit following the figure 10 on the PIC Station-3 board.

(2) After downlaoding the HEX file , select the mode to run mode.

(3) Observe the LED at GP2 pin operation.

LED blinks with 0.2 second rating.

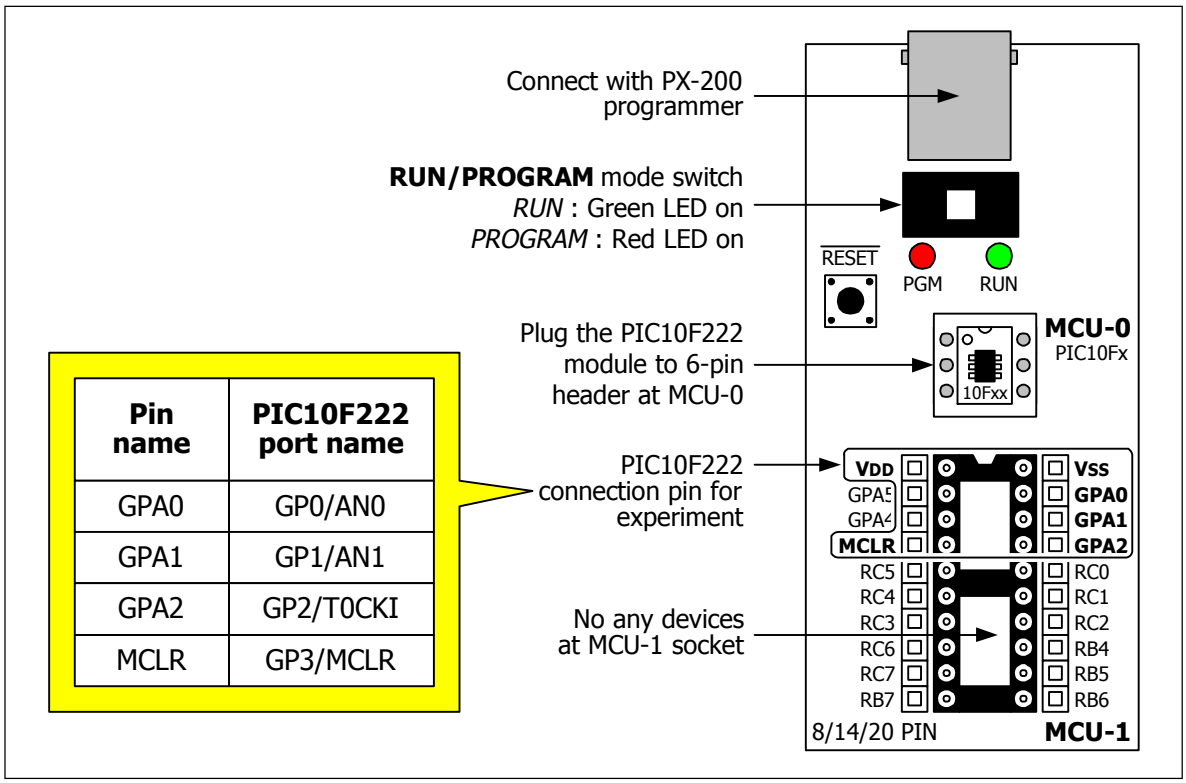


Figure 9 : Using the port connector of PIC10F222 module on PIC Station-3

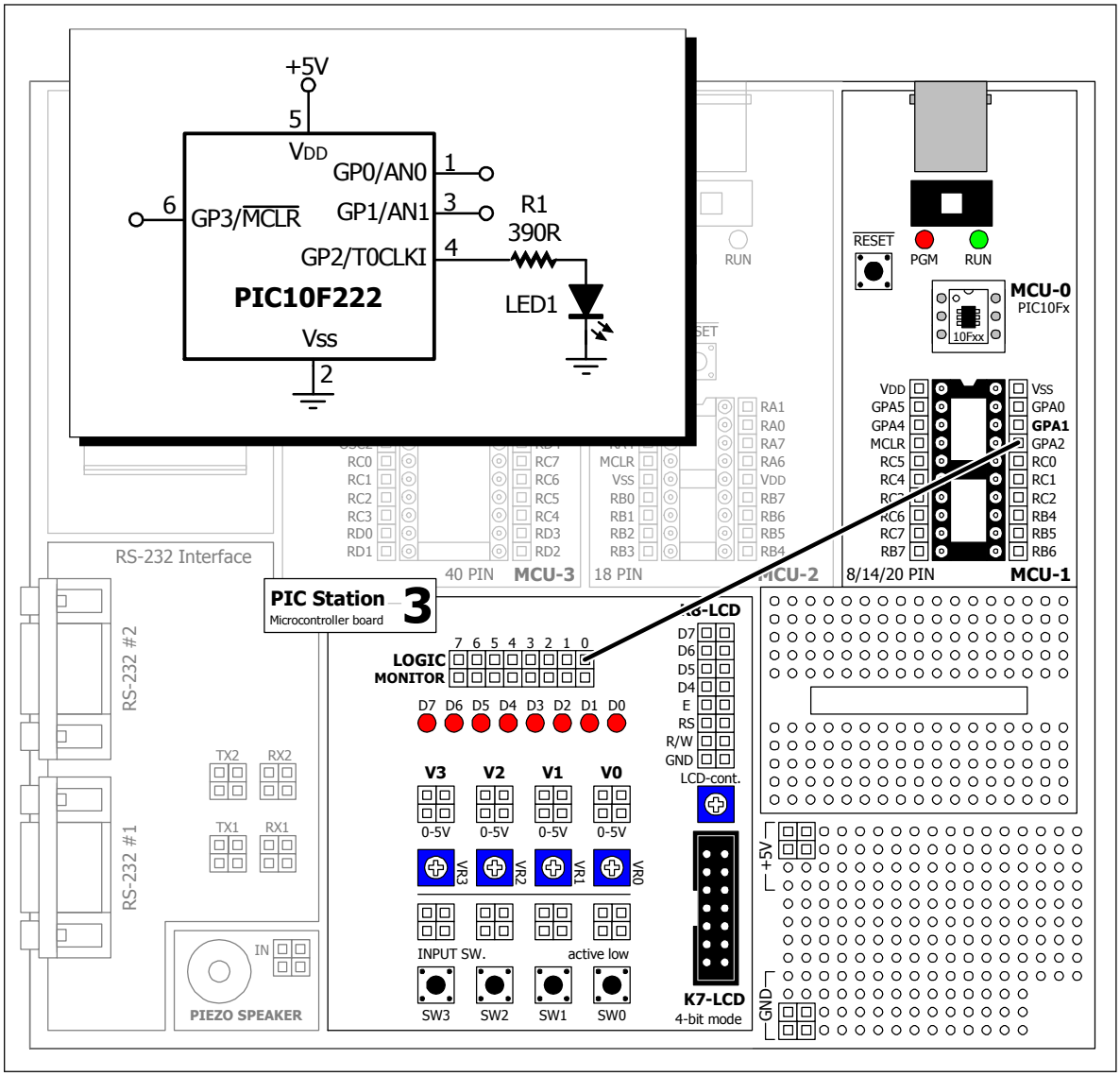


Figure 10 : The example testing circuit for PIC10F222