User Manual for

Micro-PIC18F (V3)

www.microembedded.in

Contents

1. Introduction.

1.1 Overview

PIC is a family of modified Harvard architecture microcontrollers made by Microchip Technology. The PIC microcontroller is the most widely used controller in the automation industry today. It is the most preferred choice of engineers working in the field of industrial electronics solutions.

The Micro-PIC18F kit has interfaced the PIC18F series microcontroller, to various peripherals on the board. Devices like LED's and LCD, I2C interface based memory devices, RTC, SD/MMC Card interface, Matrix Keypad, ADC, DAC, graphical LCD, Stepper motor can also be interfaced on the board.

1.2 Features

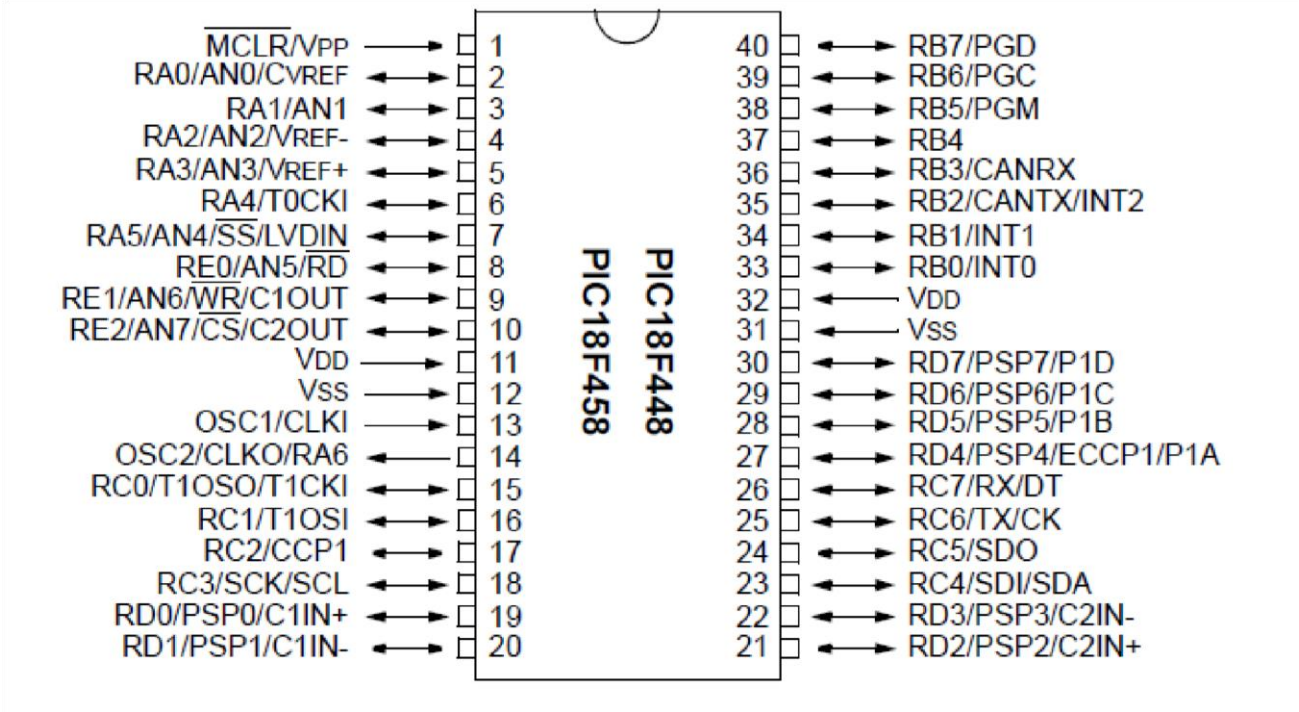
The Micro-PIC18F microcontroller board has been specifically designed keeping in mind the needs of students for learning the PIC architecture. The board gives a complete overview for interfacing various peripheral devices which are used in the industry and consumer devices alike. A hands-on with the board will develop in the student the experience to design and implement various devices and products based on the PIC Microcontroller.

Following are the features of the PIC18F Family of microcontrollers;

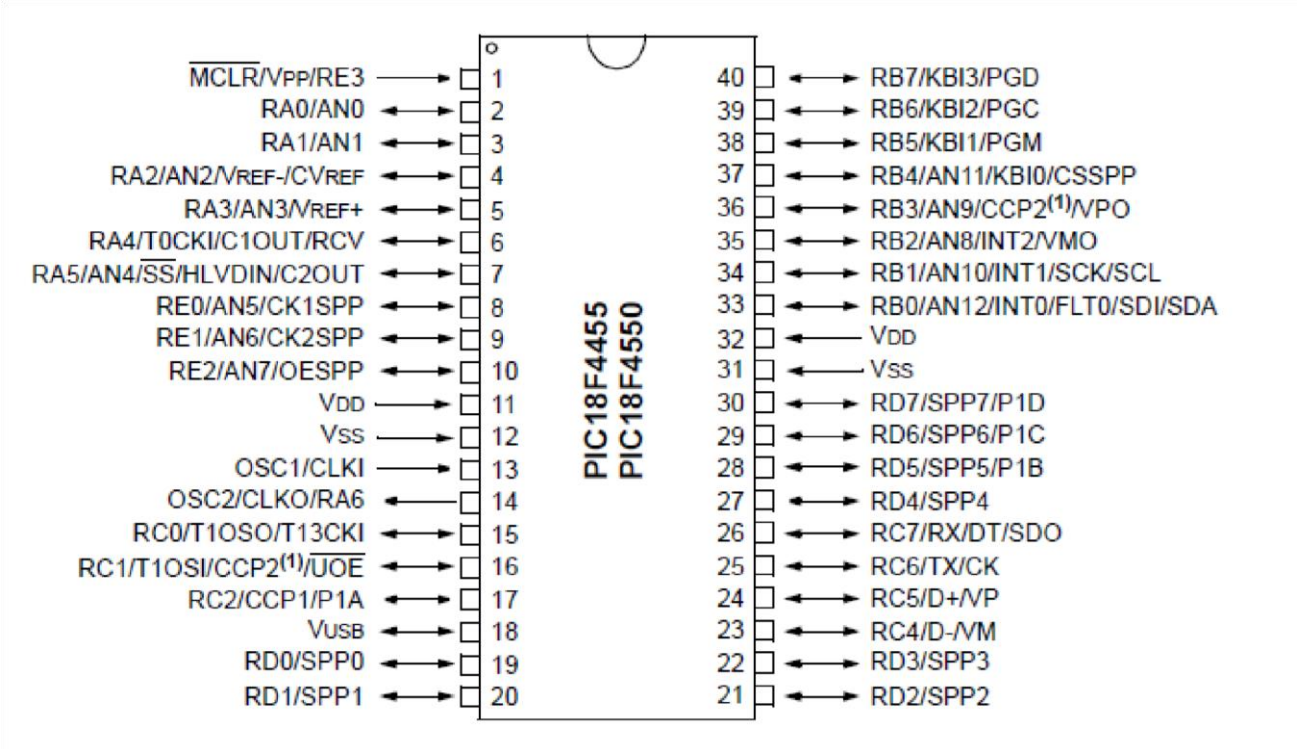
- **High Performance RISC CPU.**
    - 77 instructions ○ C Language friendly. ○ Linear program and data memory space. ○ Up to 48 MHz and 10 MIPS operation. ○ Priority levels for interrupts. ○ 16 bit wide instructions and 8 bit wide data path.
    - 8x8 hardware multiplier.
- **Peripheral Features.**
    - Up to 25 ma current source and sink. ○ Up to 4 external interrupt pins. ○ Up to 3 16 bit timer counters. ○ Timer, counter and PWM operations. ○ MSSP ports with support for SPI and I2C protocols.
    - Addressable USART modules. ○ Up to 16 channel 10 bit ADC with high sampling rate. ○ Comparators. ○ Low Voltage and Brown out detector.
    - Watchdog timer and In-System programming via two pins.
- **Power Managed Features.**
    - Dynamic switching to low power oscillator. ○ SLEEP Mode.
    - 6 power managed modes.

1.3 Pin Diagram

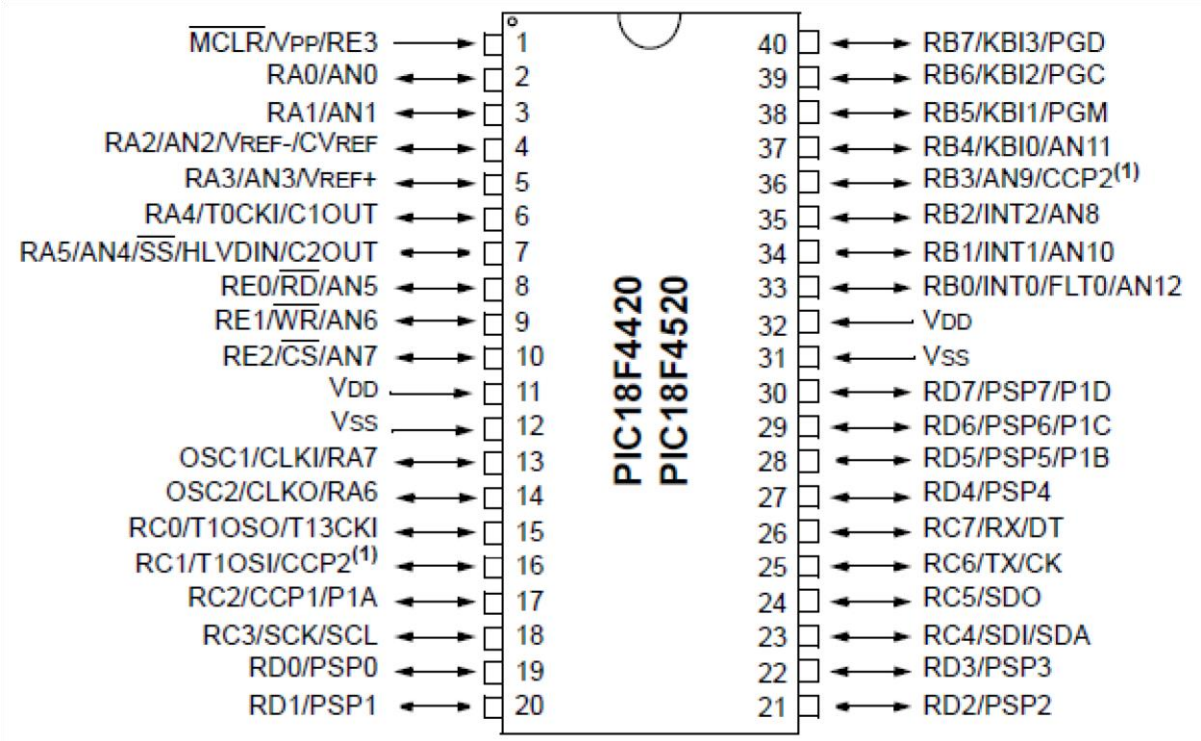
a) PIC18F458



b) PIC18F4550



c) PIC18F4520



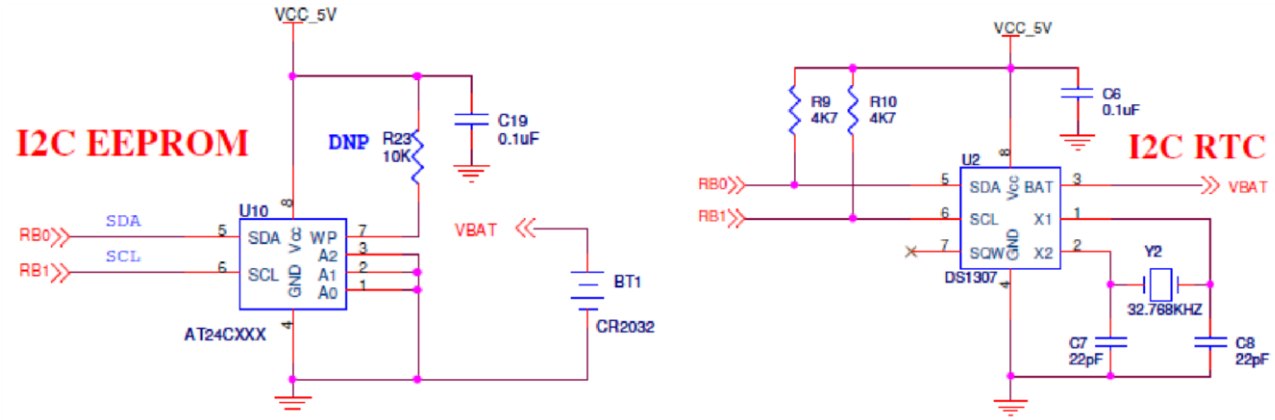
2. Hardware: Functional Description and Interfacing.

The Micro-PIC18F microcontroller board has been specifically designed keeping in mind the needs of students for learning the PIC architecture. The board gives a complete overview for interfacing various peripheral devices which are used in the industry and consumer devices alike. A hands-on with the board will develop in the student the experience to design and implement various devices and products based on the PIC Microcontroller.

Following are the features of the Micro-PIC18F Microcontroller board.

- PIC18F microcontroller from Microchip running at maximum 48 MHz.
- UART with USB to Serial driver for PC Connectivity.
- Provision for 16x2 character LCD module and 128x64 Graphical LCD.
- Provision for 4x4 Matrix Keypad.
- Provision for 8 general purpose LED's.
- Provision for Common Anode Seven Segment display.
- DS1307 I2C RTC with power backup.
- Provision for EEPROM with I2C interface.
- Provision for SD/MMC card on SPI interface.
- Two ADC channels of 10 bit on Chip ADC interfaced to External voltage source.
- LM35 temperature sensor interface
- Provision for Stepper Motor and DC Motor Driver with L293D Chip.
- Provision for Relay and Buzzer.
- Two General Purpose switches.
- Switch for External Interrupt event generation.

2.1 I2C Interface (EEPROM and RTC).



The I2C interface from the processor has been brought out on the Micro-PIC18F board. The Devices such as RTC (DS1307) and EEPROM (AT24Cxx) with I2C interface have been integrated on the board. External I2C based devices can be interfaced at CN16 and CN17.

The Port pins have to be configured to work as I2C clock and Data lines. No jumper settings are needed to use this interface.

Interfacing Details for I2C Interface.

Device	PIC18F4550	PIC18F458
I2C SDA	RB0	RC4
I2C SCL	RB1	RC3

2.2 SPI Interface (EEPROM and SD Card).

The SPI interface from the processor is available on the Micro-PIC18F board. Add-on boards such as SPI based EEPROM and SD/MMC Card can be interfaced using the SPI interface.

The port pins from the processor have to be configured as SPI. No jumper settings are needed to use the SPI interface.

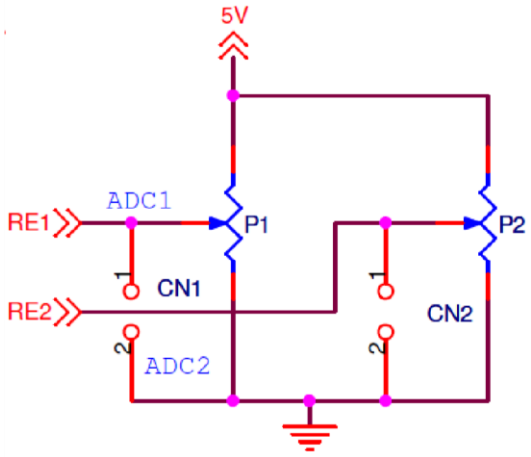
The SPI EEPROM card should be connected on the CN17 header (refer CN17 pin out details).

Interfacing Details for SPI Interface.

Device	PIC18F4550	PIC18F458

SPI SCK	RB 1	RC3
SPI MOSI	RC 7	RC5
SPI MISO	RB 0	RC4
SPI SSEL	RA 5	RA5

2.3 Analog to Digital Converter (ADC).

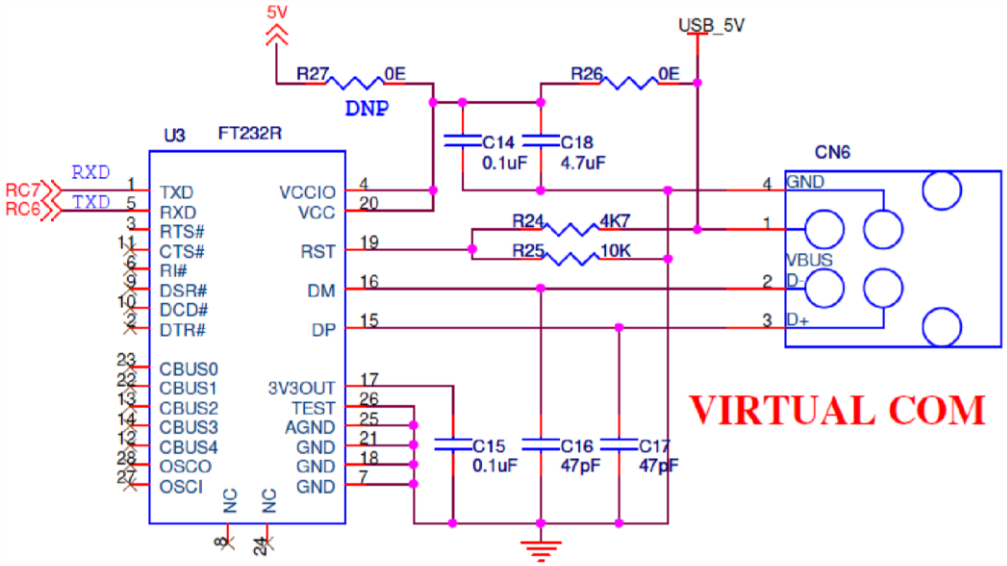


The processor on the Micro-PIC18F contains a 10 bit ADC with 12 channels. The board has provided the user with 2 channels. Analog voltage is provided using potentiometers P2 and P3. ADC Ch7 and ADC Ch6 peripheral is connected to this input. The Analog voltage can be measured at CN3 and CN2 respectively. AN7 can be connected to LM35 temperature sensor by changing the jumper setting position of **J2** to 2-3.

Interfacing Details for ADC.

Device	Pin Details
ADC 2	RE 1 (AN6)
ADC 1 / Temp Sensor	RE 2 (AN7)

2.4 Serial Communication using UART (RS232).

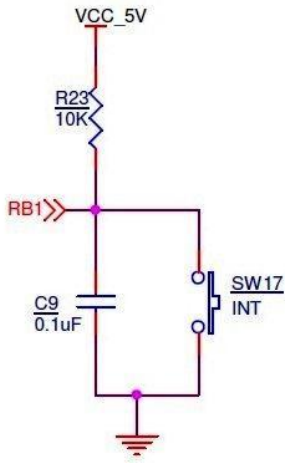


UART interface from the controller is available for the user on the Micro-PIC18F board. UART is connected to USB to Serial.

Interfacing Details for UART.

Device	Pin Details
UART RXD	RC 7
UART TXD	RC 6

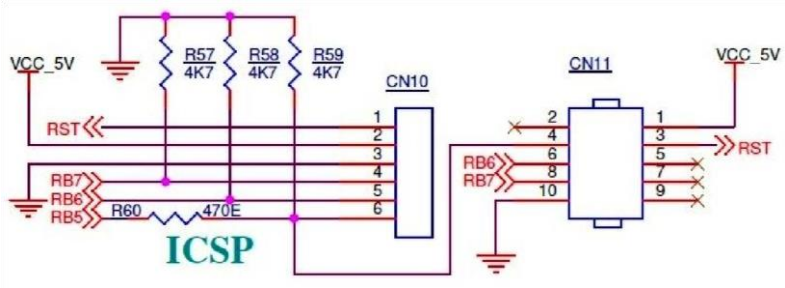
2.5 External Interrupt Switch



The External Interrupt is generated using a switch connected to Port pin RB1.

2.6 Port Extensions

2.6.1 CN10, CN11 (ICSP)



CN10 connector is PICKIT2 and PICKIT3 compatible.

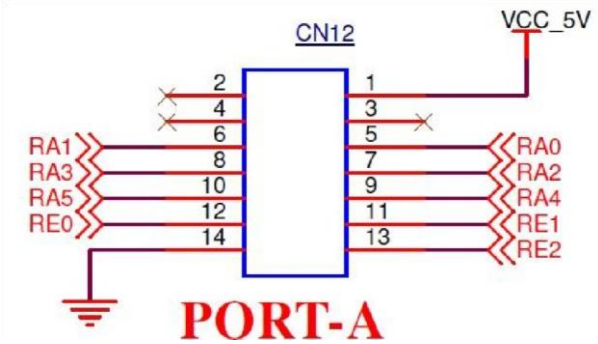
CN10 Interfacing Details

CN10	PIC18F
CN10.1	Reset
CN10.2	+5V
CN10.3	GND
CN10.4	RB7 (PGD)
CN10.5	RB6 (PGC)
CN10.6	RB5 (PGM)

CN11 Interfacing Details

CN11	PIC18F
CN11.1	+5V
CN11.2	NC
CN11.3	Reset
CN11.4	RB5 (PGM)
CN11.5	NC
CN11.6	RB6 (PGC)
CN11.7	NC
CN11.8	RB7 (PGD)
CN11.9	NC
CN11.10	GND

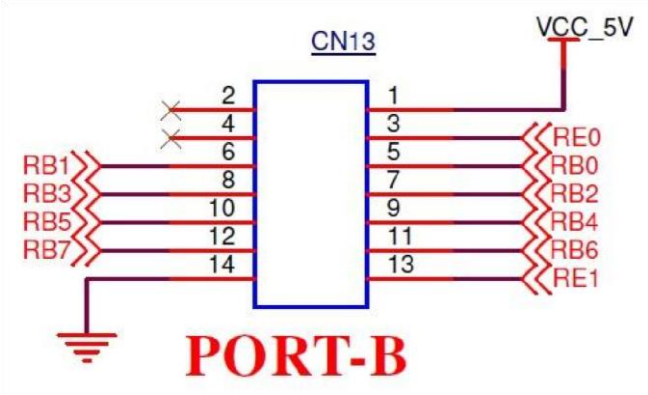
2.6.2 CN12



CN12 Interfacing Details

CN12	PIC18F
CN12.1	+5V
CN12.2	NC
CN12.3	NC
CN12.4	NC
CN12.5	RA0
CN12.6	RA1
CN12.7	RA2
CN12.8	RA3
CN12.9	RA4
CN12.10	RA5
CN12.11	RE1
CN12.12	RE0
CN12.13	RE2
CN12.14	GND

2.6.3 CN13

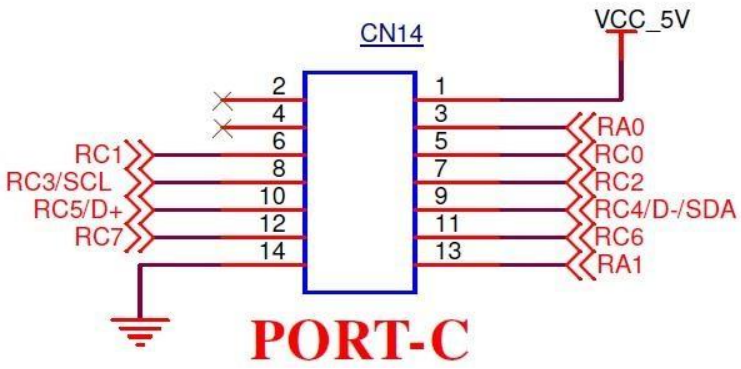


CN13 Interfacing Details

CN13	PIC18F
CN13.1	+5V
CN13.2	NC
CN13.3	RE0
CN13.4	NC
CN13.5	RB0
CN13.6	RB1
CN13.7	RB2
CN13.8	RB3
CN13.9	RB4
CN13.10	RB5
CN13.11	RB6
CN13.12	RB7
CN13.13	RE1
CN13.14	GND

2.6.4

CN14



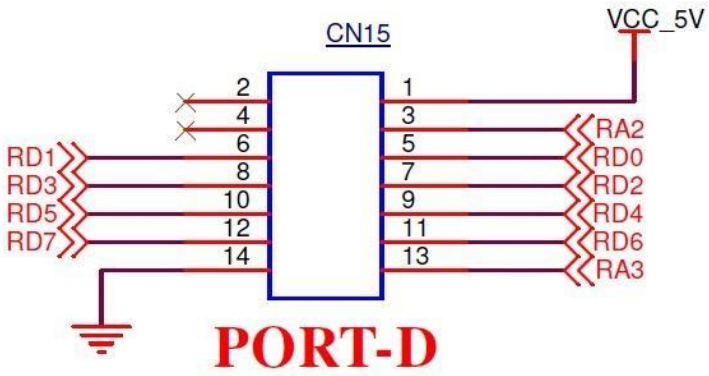
CN14 Interfacing Details

CN14	PIC18F
CN14.1	+5V
CN14.2	NC
CN14.3	RA0
CN14.4	NC
CN14.5	RC0
CN14.6	RC1

2.6.5

CN14.7	RC2
CN14.8	RC3/SCL
CN14.9	RC4/SDA/D-
CN14.10	RC5/D+
CN14.11	RC6
CN14.12	RC2
CN14.13	RA1
CN14.14	GND

CN15



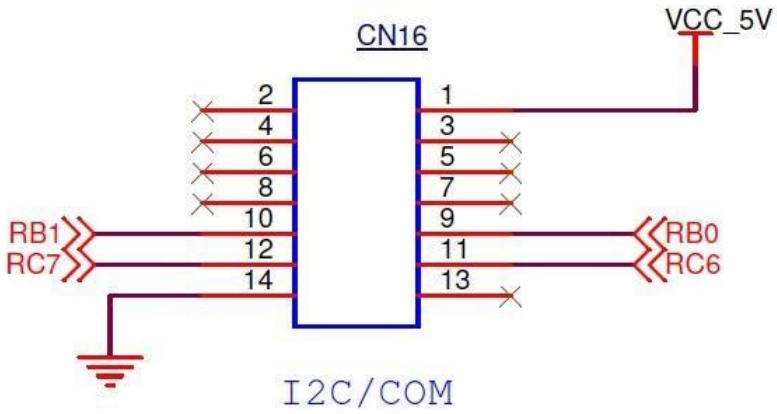
2.6.6

CN15 Interfacing Details

CN15	PIC18F
CN15.1	+5V
CN15.2	NC
CN15.3	RA2
CN15.4	NC
CN15.5	RD0
CN15.6	RD1
CN15.7	RD2
CN15.8	RD3
CN15.9	RD4
CN15.10	RD5
CN15.11	RD6
CN15.12	RD7
CN15.13	RA3
CN15.14	GND

CN16

2.6.7



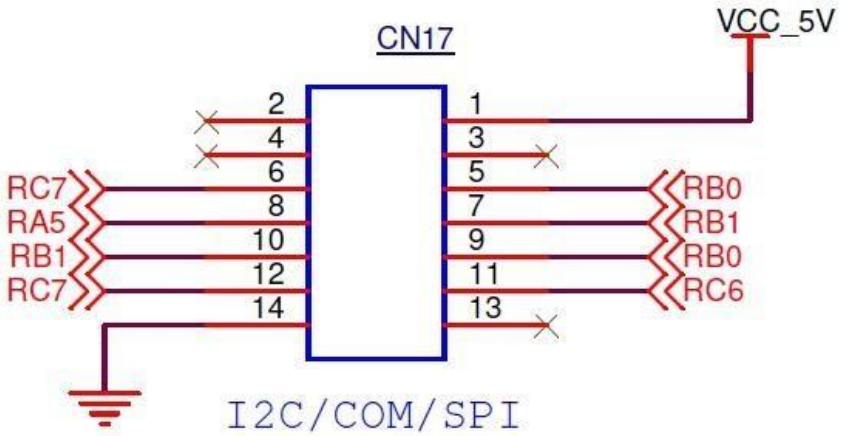
CN16 Interfacing Details

CN16	PIC18F
CN16.1	+5V
CN16.2	NC
CN16.3	NC
CN16.4	NC
CN16.5	NC
CN16.6	NC
CN16.7	NC
CN16.8	NC
CN16.9	RB0

2.6.8

CN16.10	RB1
CN16.11	RC6
CN16.12	RC7
CN16.13	NC
CN16.14	GND

CN17



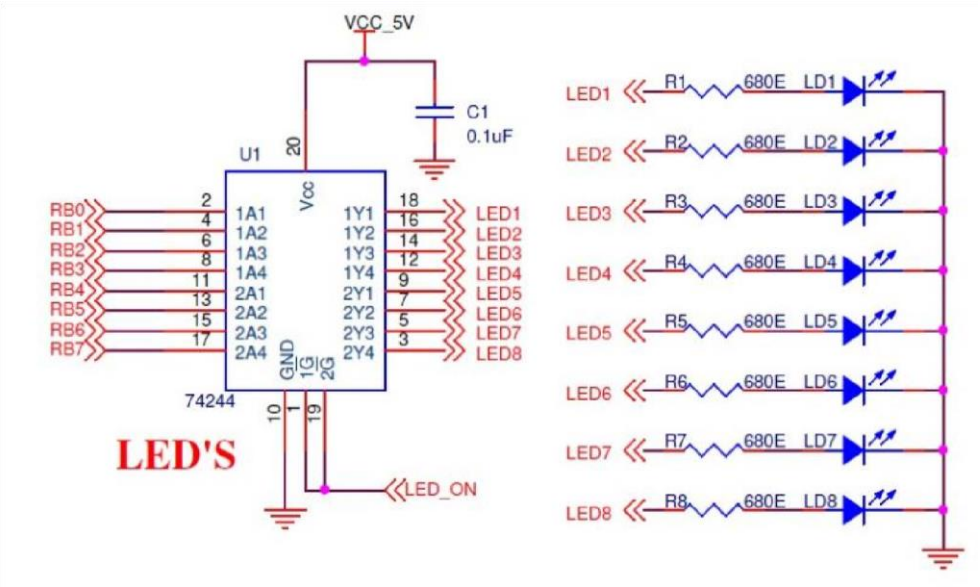
CN17 Interfacing Details

CN17	PIC18F

2.6.9

CN17.1	+5V
CN17.2	NC
CN17.3	NC
CN17.4	NC
CN17.5	RB0
CN17.6	RC7
CN17.7	RB1
CN17.8	RA6
CN17.9	RB0
CN17.10	RB1
CN17.11	RC6
CN17.12	RC7
CN17.13	NC
CN17.14	GND

2.7 LED



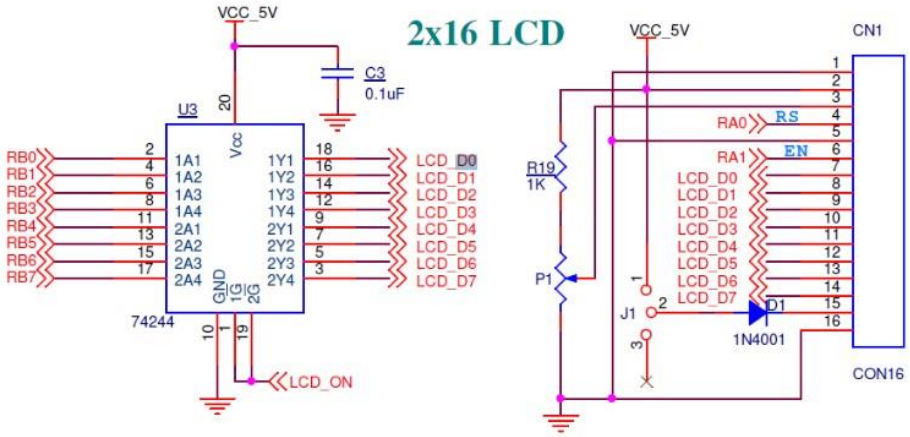
8 general purpose LED's are provided on the Micro-PIC18F V3 Board in common anode configuration. LD1 thru LD8 are interface to Port Pins RB0 thru RB7.

In order to make the LED ON we have to give Logic "1"(HIGH).

For this device to operate correctly connect the switch SW21 between 1-2 and SW22 between 2-3. **Interfacing details for LED**

Device	Pin Details
LED1	RB0
LED2	RB1
LED3	RB2
LED4	RB3
LED5	RB4
LED6	RB5
LED7	RB6
LED8	RB7

2.8 LCD



A 16x2 Character LCD module is interfaced on the Micro-PIC18F board. The LCD is write only i.e. we cannot read from the LCD. Contrast control is adjusted using potentiometer P1.

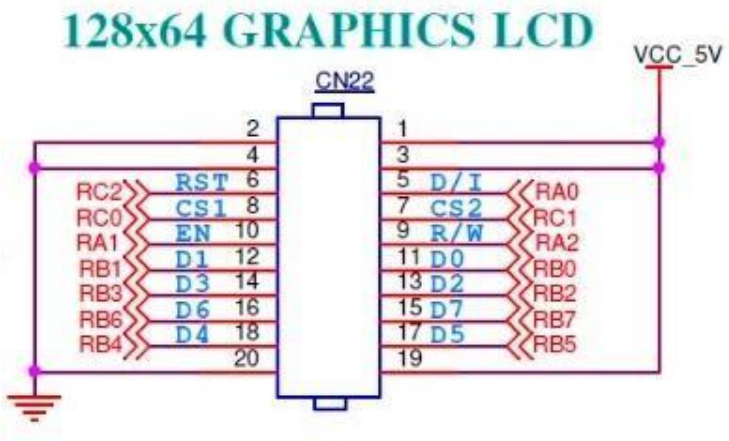
Put the switch SW22 in position 1-2 to use the LCD.

Interfacing details for LCD

Device	Pin Details
LCD_D0	RB0
LCD_D1	RB1
LCD_D2	RB2
LCD_D3	RB3
LCD_D4	RB4
LCD_D5	RB5
LCD_D6	RB6
LCD_D7	RB7
LCD_RS	RA0
LCD_EN	RA1

2.9

GLCD



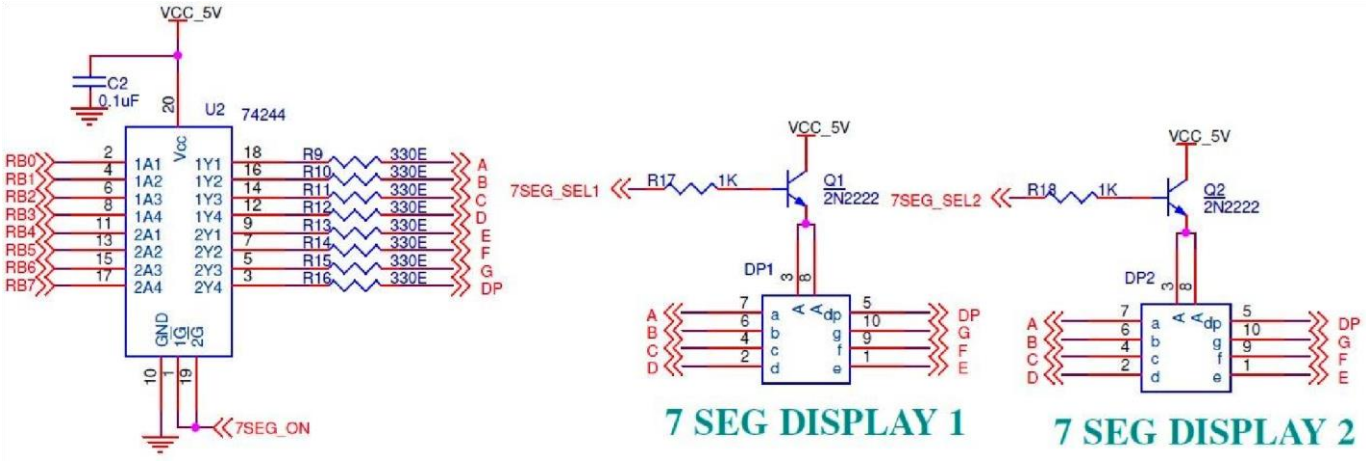
A 128x64 Graphical LCD module can be interfaced on the Micro-PIC18F V3 board. Connect the GLCD module to CN22 on the board.

Interfacing details for GLCD

Device	Pin Details
GLCD D0	RB 0
GLCD D1	RB 1
GLCD D2	RB 2
GLCD D3	RB 3
GLCD D4	RB 4
GLCD D5	RB 5
GLCD D6	RB 6
GLCD D7	RB 7
GLCD D/I	RA 0
GLCD EN	RA 1
GLCD CS1	RC 0
GLCD CS2	RC 1

GLCD RST	RC 2
GLCD R/W	RA 2

2.11 Seven Segment



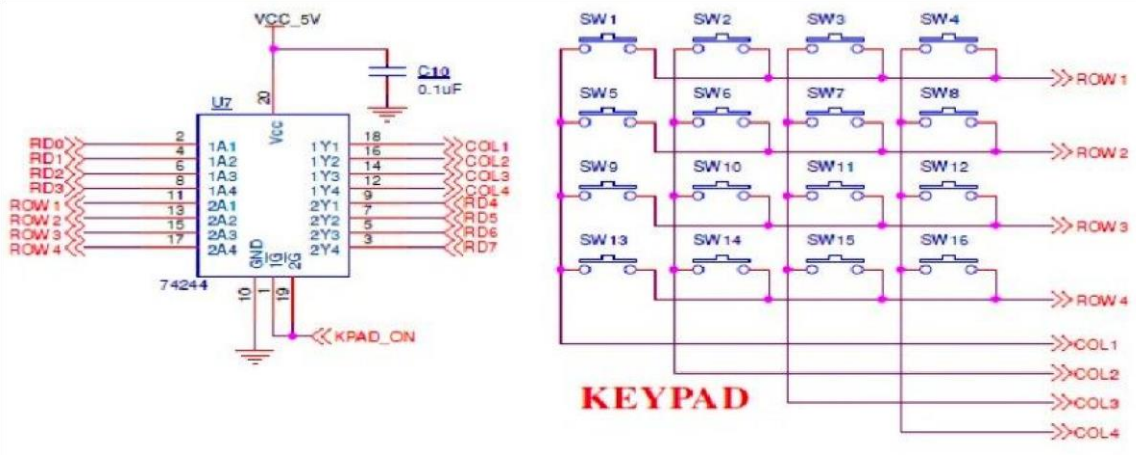
Two **Common Anode** 7 Segment Display modules (DP1 and DP2) are interfaced in multiplexed fashion the Micro-PIC18F board. In order to make the segment ON Logic "0" (Low) has to be applied to the Port Pin.

In order to select the device for operation put switch SW21 in position 2-3 and switch SW22 in position 2-3.

Interfacing details for Seven Segment Display

Device	Pin Details
A	RB 0
B	RB 1
C	RB 2
D	RB 3
E	RB 4
F	RB 5
G	RB 6
DP	RB 7
Seg_Sel1	RA0
Seg_Sel2	RA1

Keypad



A user programmable 16 key keypad in 4x4 matrix fashion is provided on the Micro-PIC18F V3 board. The pins are connected from RD0 thru RD7. RD0-RD3 pins must be configured as output, while RD4-RD7 pins must be configured as inputs.

In order to operate this device switch SW23 must be in 1-2position.

Interfacing details for Keypad

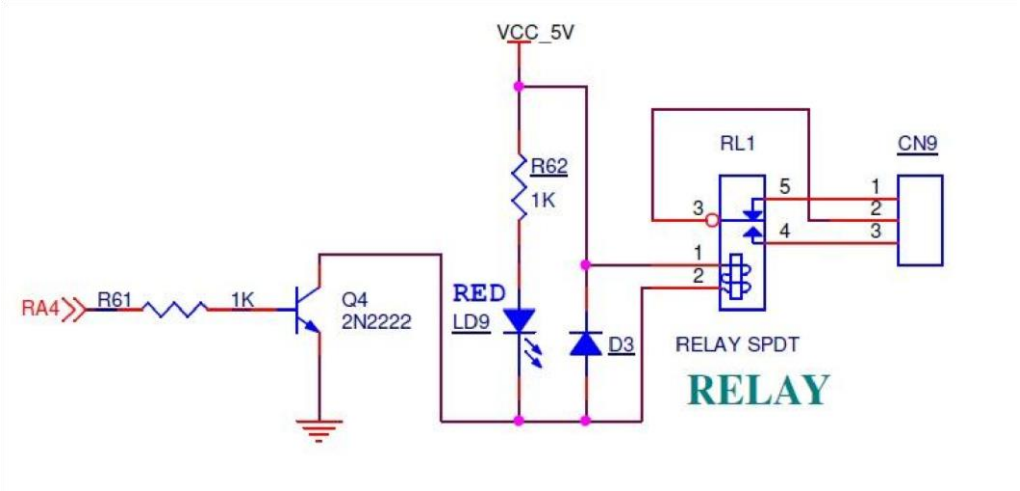
Device	Pin Details
COL1	RD0
COL2	RD1
COL3	RD2
COL4	RD3
ROW1	RD4
ROW2	RD5
ROW3	RD6
ROW4	RD7

Digital input keys SW18 and SW19 are provided for the user to give a general purpose input event.

Device	Pin Details
SW18	RA2
SW19	RA3

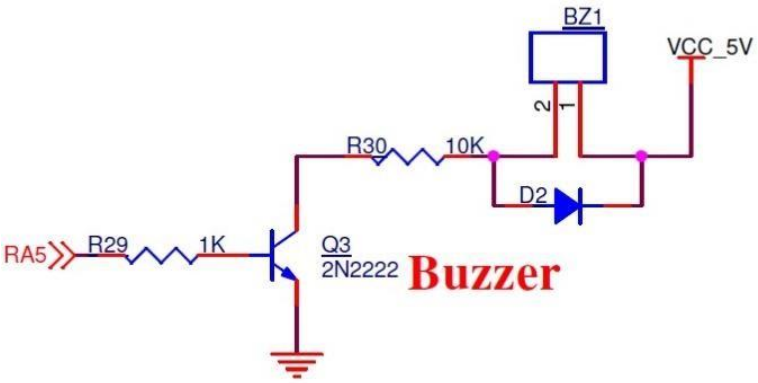
2.13

2.12 Relay Interface



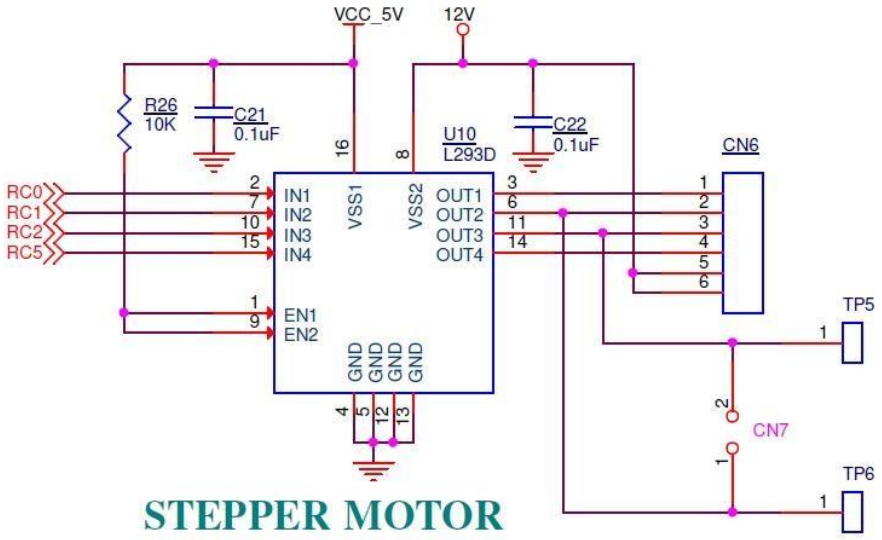
The Relay is provided on the Micro-PIC18F V3 board for user to externally interface a high voltage circuit and also to provide isolation. The relay is connected to the PIC at pin RA4.

2.13 Buzzer Interface



The Buzzer is provided on the micro-PIC18F board for indication purpose. It is connected to the PIC at pin RA5.

2.14 Stepper Motor/DC Motor Interface



A motor driver (L293D) is provided on the Micro-PIC18F board for the user. The user can connect the stepper motor or DC Motor to connector **CN6** and **CN7** respectively.

Interfacing details for Stepper/DC Motor

Device	Pin Details
Stepper Motor 1	RC0
Stepper Motor 2	RC1
Stepper Motor 3	RC2
Stepper Motor 4	RC5
DC Motor 1	RC1
DC Motor 2	RC2

3. Software : Functional Description and Interfacing.

3.1 Programming Overview of Micro-PIC18F.

In order to program the controller on the Micro-PIC18F board the following setup is needed.

1. MPLAB X IDE setup.
2. XC8 Compiler setup.
3. PICLoader Utility for flash programming through USB to Serial.

3.2 PC Connection Setup.

The Micro-PIC18F Board connects to the PC via the USB to Serial port. The Hex files generated by the IDE can be downloaded into the flash memory using the ISP feature on the microcontroller via the USB to Serial port. The Micro-PIC18F Board development kit has a USB cable included in the

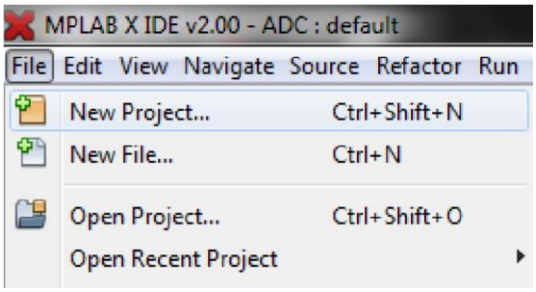
package. Connect the (A type) side of the connector to the PC and the B type side to the Micro-PIC18F Board USB to Serial .

3.3 MPLAB X Programming IDE.

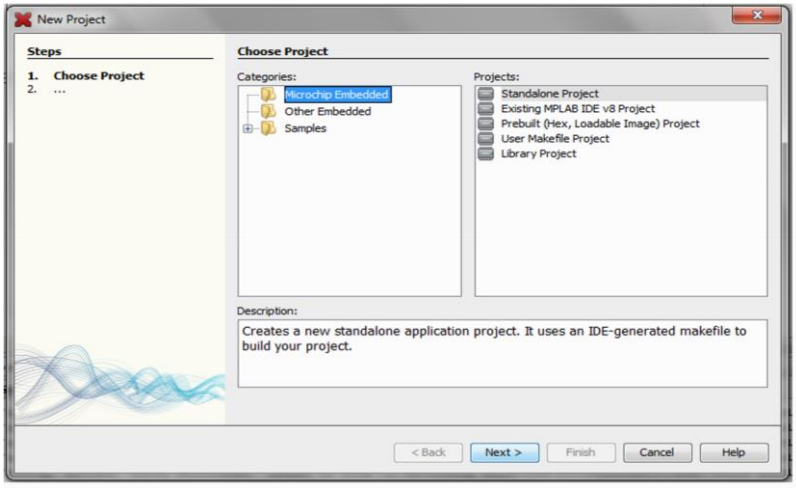
3.3.1. Creating a new project

 Go to the File Tab.

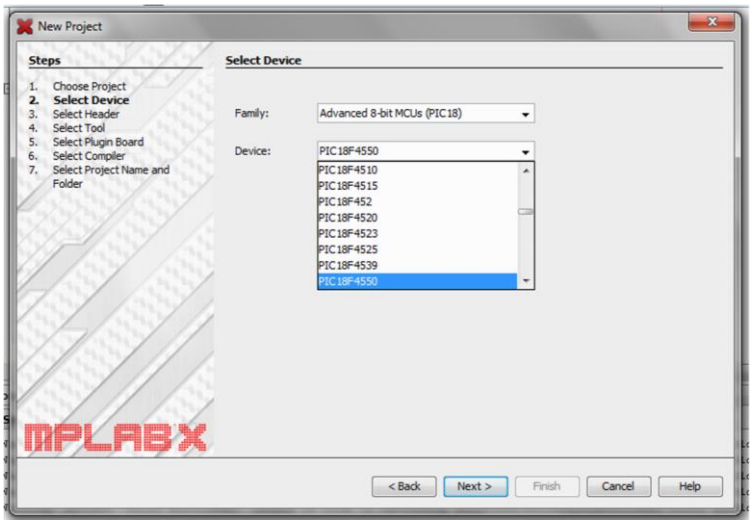
- Click on New Project.



- Step1: Choose Project:
  - Select :Microchip Embedded -> Standalone Project. Click Next.

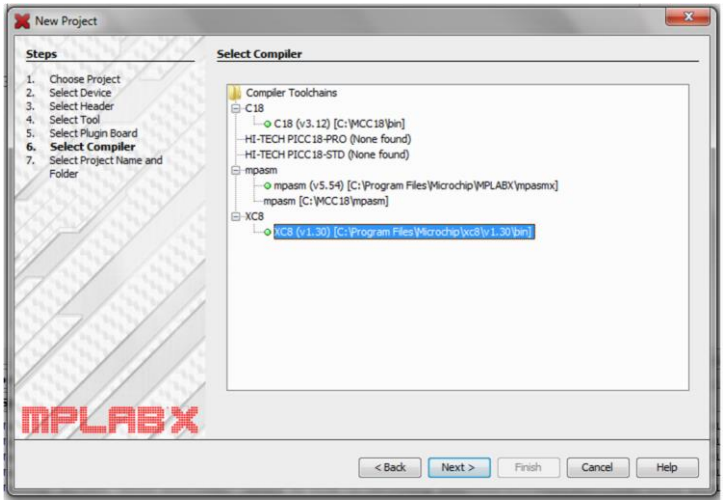


- Step2: Select Device:
  - Select : Family -> Advanced 8 Bit MCU (PIC18). ○ Select : Device: PIC18F4550. Click Next.



- Step3: Select Tool: Simulator. Click Next.

- Step4: Select Compiler ->XC8. Click Next.



- Step5: Select Project Name and Folder. ○ Give Project Name. ○ Select project Location using Browse Button.

  ○ Uncheck **Set as main project option**.

  ○ Click Finish.

Very Important Note:

- Step6: **Adjustment for Bootloader.**
  - ○ Select the project and Go to **properties.**
  - ○ Select **XC8 linker**.
  - ○ In **Option Categories** select **AdditionalOptions.**
  - ○ In Code Offset: write **0x800.**

3.3.2. Opening an existing project.

 Go to the File Tab.

- Select Open Project.

- Browse to the location and select the **projectname.X** file (project file). Click on Open Project

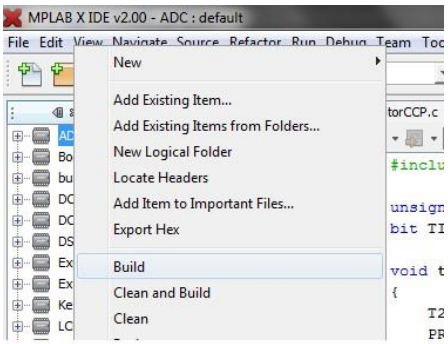
.

3.3.3. Creating a new Source file and Header File.

- Go to the Project location in the Project window.
- Click the + sign to open the project space.
- Right Click on the **Source Files** folder (for a C file) and **Header files** (for a .h file).
    - New - > C Source file / or C Header File.

3.3.4. Compiling Project.

- Step1: Go to project window.
- Right Click on the project folder and select **Build** or **Clean and Build**.



3.4. Executable Flashing Tool (PICLoader.exe).

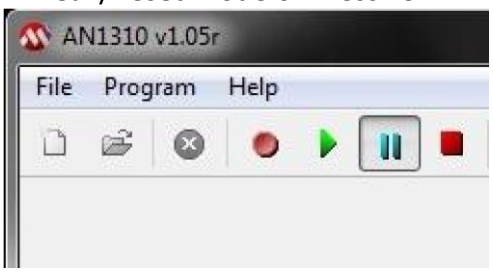
- Connect the USB Cable to the Board.
- Step 1: Double Click the PICloader.exe.

- Step2: Go to Programs -> Settings.

  - Select the USB to serial com port. Click OK.

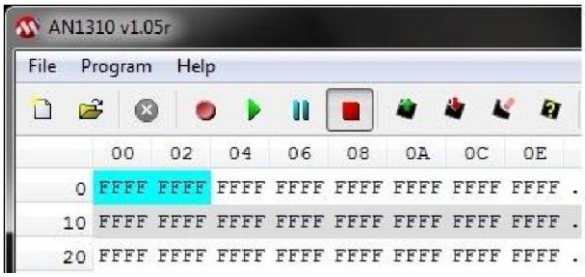
Note: Make sure not to select Config Bits and EEPROM Settings as these can damage the bootloader.

- Step3: Go to Programs -> Break/Reset Mode or Press F3.



- Step4: Press the Reset Switch on the Micro-PIC18F Board.

- Step5: Go to Programs ->Bootloader Mode or Press F4.

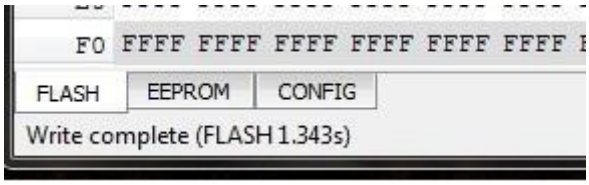


- Step6 : Select Hex file :
    - File -> Open -> Browse to location.

    - Project folder -> dist -> default->production.

- Step7: Go to Programs -> Write Device or Press F6

After successful writing it will display Write Complete at the bottom.



- Step8: Press Reset on the board to Run the program.