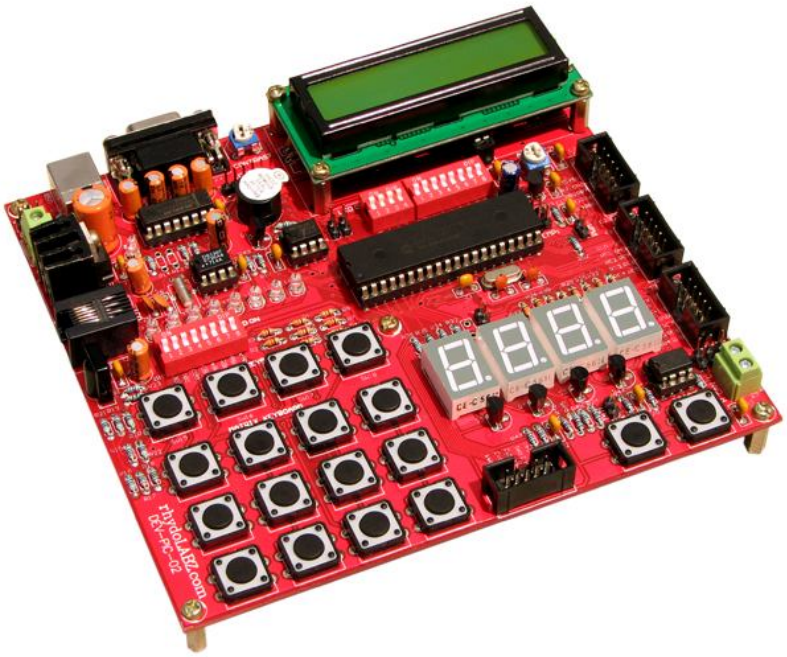
eCee PIC 18F4520

Development Board

User Manual



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CONTENTS

CHAPTER-1: OVERVIEW

The eCee PIC18F4520 Development and Evaluation Board from RhydoLabz can be used to evaluate and demonstrate the capabilities of microchip PIC18F4520 microcontrollers. The board is designed for general purpose applications and includes a variety of hardware to exercise microcontroller peripherals. Ideally suitable for training and development purposes.

eCee PIC18F4520 BOARD FEATURES

- Compact and Ready to use design
- Professional and Fully EMI/RFI Complaint PCB Layout Design for Noise Reduction
- Includes PIC18F4520 Microcontroller
- Board Supports PIC 16F877/18F 4580/4550* Microcontrollers
- No separate programmer required (Built in Boot loader)
- No Separate power adapter required (USB power source)
- Screw terminal for External power Supply (with Jumper Select Option)
- External Power Supply range of 7V to 20V
- Adaptor (any standard 9-12V power supply) option
- RS-232 Interface (For direct connection to PC's serial port)
- On board Two Line LCD Display (2x16)
- On board I^2C EEPROM (4K-AT24C04)
- On board I^2C RTC (DS 1307) with Crystal and Battery
- On board 32.768 KHz Crystal for RTC
- Four multiplexed 7-Segment LED Display
- Built in Matrix keyboard (12 keys)
- Built in Pull-Up (4 Keys) Keyboard
- Built in IR Sensor Interface – TSOP 1738
- Built in 8 LED Interface to test I/O
- On Board External Interrupt and Reset buttons
- Built in Potentiometer interface for ADC

- On Board Temperature Sensor Interface
- On Board Buzzer Interface
- On Board PWM Output pin
- On Board ICD Connector for Debugging/Programming
- On Board ICSP Connector
- On Board 20 MHz Crystal Oscillator
- On Board Power LED Indicator
- On Board DB9 Connector
- On Board USB Connector
- All Port Pins available at IDC (2x5) Connector
- Power Supply Reverse Polarity Protection
- On Board 1 Amp Voltage Regulator
- Can be used as main board for developing applications
- Demo HEX codes included for testing of board features
- Example codes included

eCee PIC18F4520 PACKAGE CONTENTS

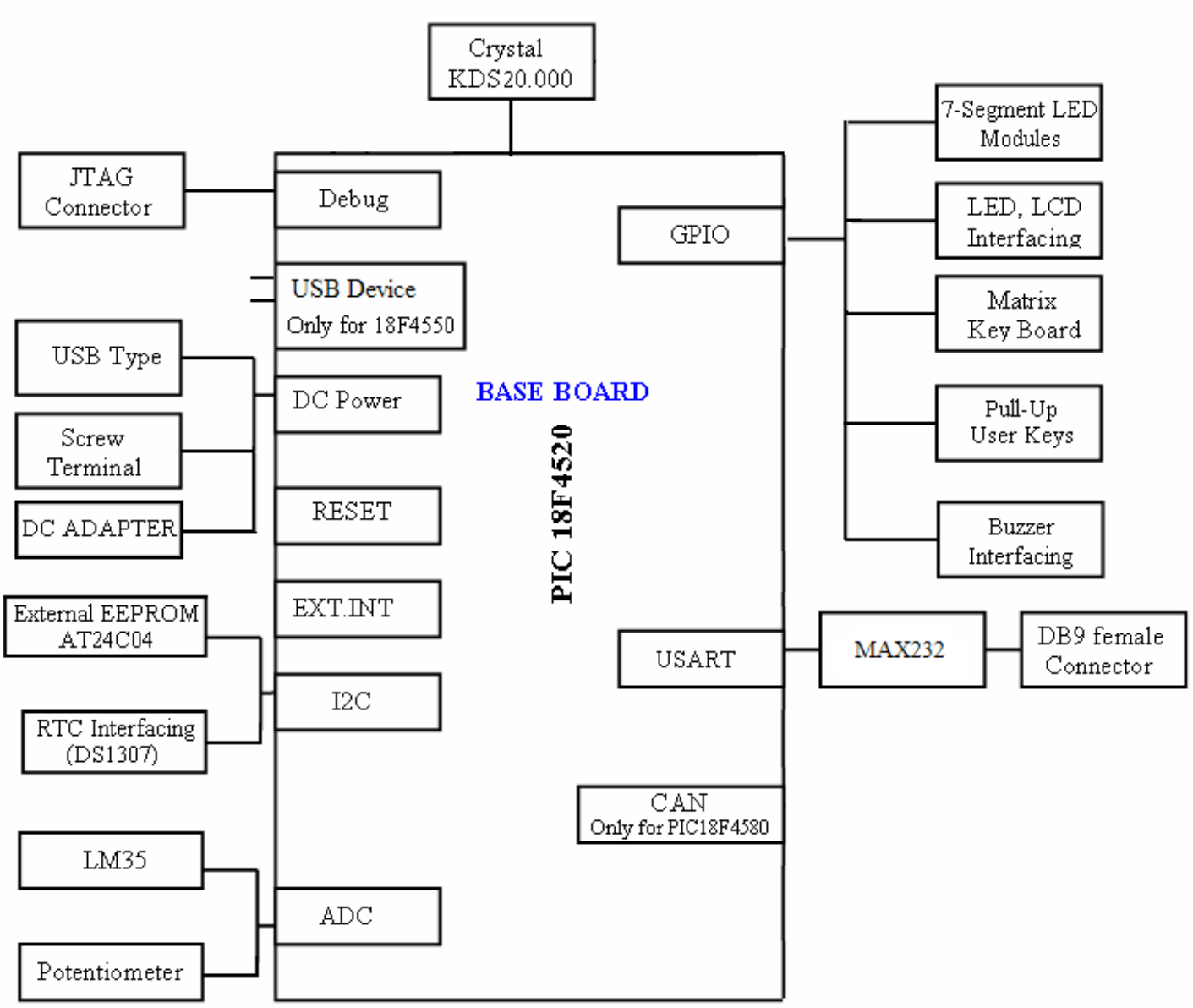
- Fully Assembled and Tested eCee PIC18F4520 Development board
- Software CDROM with
  - Schematic
  - Programming Software
  - Sample Hex Code
  - Example Codes for
    - Led Blinking
    - Matrix Keyboard
    - I^2C Protocol
    - Led Control with Timer0
    - PWM Generation
    - ADC Interfacing
    - Capture Module
    - Timer 1
    - LCD Display
    - External Interrupt Interfacing
    - 7-Segment Display
    - UART Communication
    - Buzzer Interfacing
    - Pull-Up Keyboard
    - Compare Module
    - Timer 2

PIC18F4520 SPECIFICATIONS

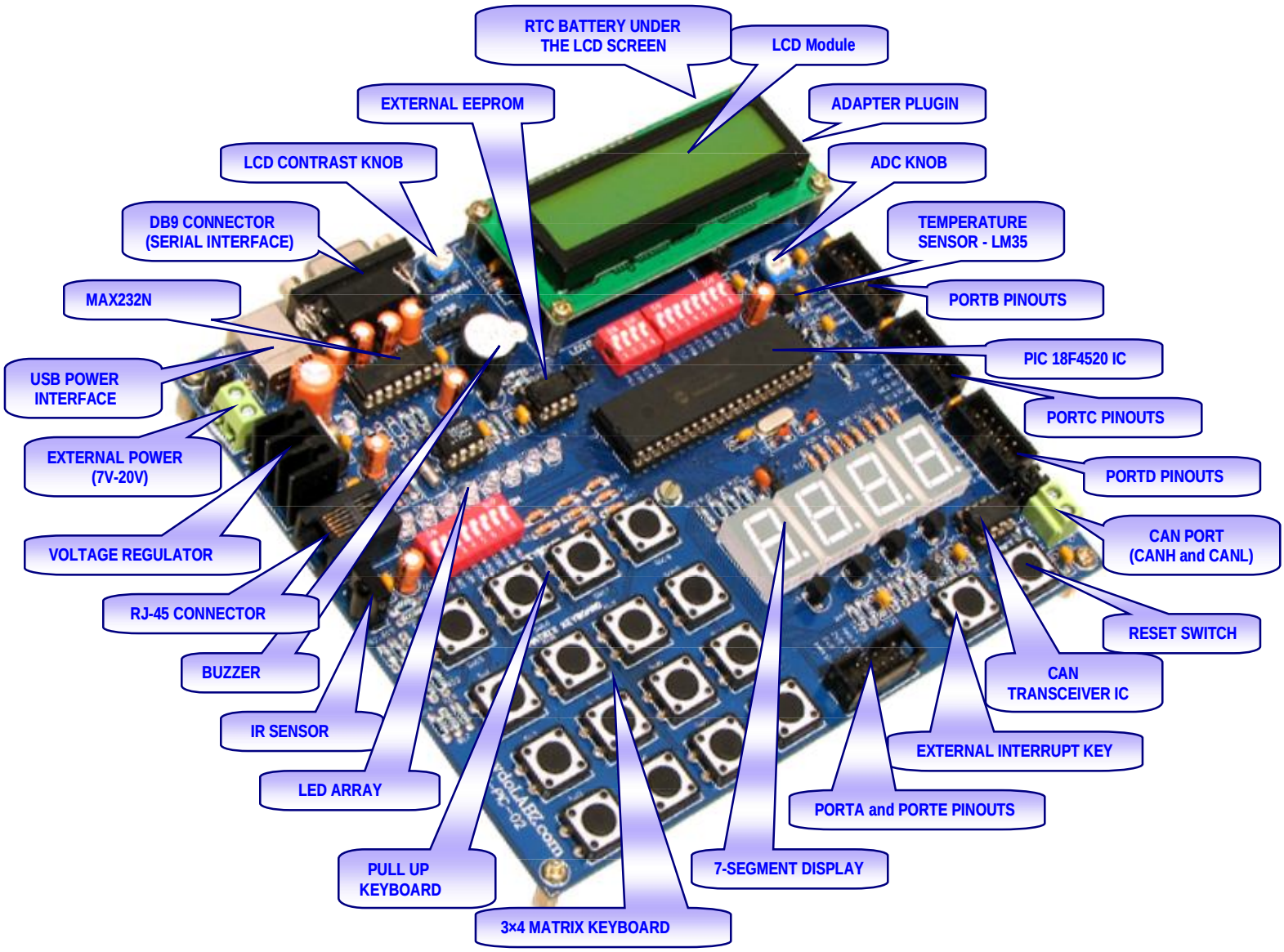
- Microchip PIC 18F4520 with 20 MHz Crystal Oscillator (With Boot loader Software)
- High Performance RISC CPU
- 32 KB Programmable Flash Memory
- 1536 bytes Data Memory (RAM)
- 256 bytes EEPROM
- Up to 40 MHz Operation
- 36 I/O pins
- 13-Channel 10-bit Analog to Digital Converter (ADC)
- Two PWM Channels
- One CCP modules and One ECCP modules
- Dual Analog Comparator Module
- One 8-Bit Timer/Counter
- Three 16-Bit Timer/Counter
- One Serial USART (Supports RS-232,RS-485 and LIN 1.2)
- One Master Synchronous Serial Port (MSSP)
- One Serial Peripheral Interface(SPI) Module
- One Inter-Integrated Circuit (I^2C) Module
- Power-On Reset (POR), Power-Up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Interrupt Capability (up to 20 sources)
- ICSP Programming
- Brown Out Reset
- Low Voltage Programming
- Power Saving Sleep Mode
- Programmable Code Protection
- Fully Static Design
- Wide Operating Voltage 2.0V to 5.5V
- Low Power Consumption

CHAPTER-2 : HARDWARE INTRODUCTION

FUNCTIONAL BLOCK



INTERFACE OVERVIEW



PERIPHERALS	DESCRIPTIONS
U1	Buzzer Interface
U2	PIC 18F4520 IC
U3	Voltage Regulator - LM7805
U4	External EEPROM - AT24C04
U5	Temperature Sensor - LM35
U6	MAX232
U7	Real Time Clock(RTC) – DS1307
CONTRAST (P1)	LCD Contrast Control Knob
ADC (P2)	ADC Knob
7- Segment DISP1 - DISP3	7-Segment Display Modules
MATRIX KEYBOARD Switches SW1 – SW12	A 3×4 Matix User Keys interfaced in this development board. Each row can be selected using PORTB pins RB5, RB6 and RB7. The Columns are selected using the PORTB pins RB1, RB2, RB3 and RB4.

Reset Switch (SW13)	Development board reset switch to restart the programs
External Interrupt Switch (SW14)	External pulses can be provided to the External interrupt 1 (RB0 pin) pin of the microcontroller to evoke an external interrupt.
PULL UP KEYBOARD Switches SW15 – SW18	4 externally pulled up PINS are incorporated to form a pull up key pad. The PINS used for this are RC0, RC1, RC2 and RC3.
LED Array (LED1 – LED8)	8 LEDs are connected to the PORTB pins through a DIP switch. Each LED is interfaced via a current limiting resistor. To test the LEDs the DIP switches(DIP2) must be in ON position.
LCD Module (LCD1)	16X2 Monochrome LCD with back light
DIP Switch (DIP2)	DIP switch for the selection between LED array and 3×4 matrix user keys.
DIP Switches (DIP1, DIP3)	Selection between LCD module, 7-segment modules and pull Up keys.
IR Sensor (S1)	TSOP1738 signal out is connected to PORTC<pin 5>.
Rj-45 Connector	To connect the In Circuit Debugger to the board.

USB Socket (K1)	Development board can be power using USB connector. Jumper K2 must be in lower position.
Screw Terminal (K3)	12 V DC can be provided to power the Board.
DB9 Connector (K4)	For RS232 interface and to download the programs with boot loader we use this terminal.
ICSP Terminal (K5)	ICSP Terminal for programming the micro-controller.
PORTA/E IDC (K8)	PORTA/E pins are available on 5x2 IDC connector along with +5V and a ground pin.
PORTC IDC (K9)	PORTC pins are available on 5x2 IDC connector along with +5V and a ground pin.
PORTD IDC (K10)	PORTD pins are available on 5x2 IDC connector along with +5V and a ground pin.
PORTB IDC (K11)	PORTB pins are available on 5x2 IDC connector along with +5V and a ground pin.

JUMPER LIST

JUMPER No.	DESCRIPTIONS	SET OPTIONS	SETTING DESCRIPTIONS
K2	Power Supply Options	1 - 2	Select USB Signal Connection.
		2 - 3	Select Vcc Screw Terminal Connection.
K6	PWM Terminal	Short access	PWM wave output
J2	ADC Terminal	Short access	Select ADC Connection
J3	Temperature Sensor Terminal	Short access	Temperature Sensor Select
J5	External Interrupt pin	Short access	External Interrupt user Key Select

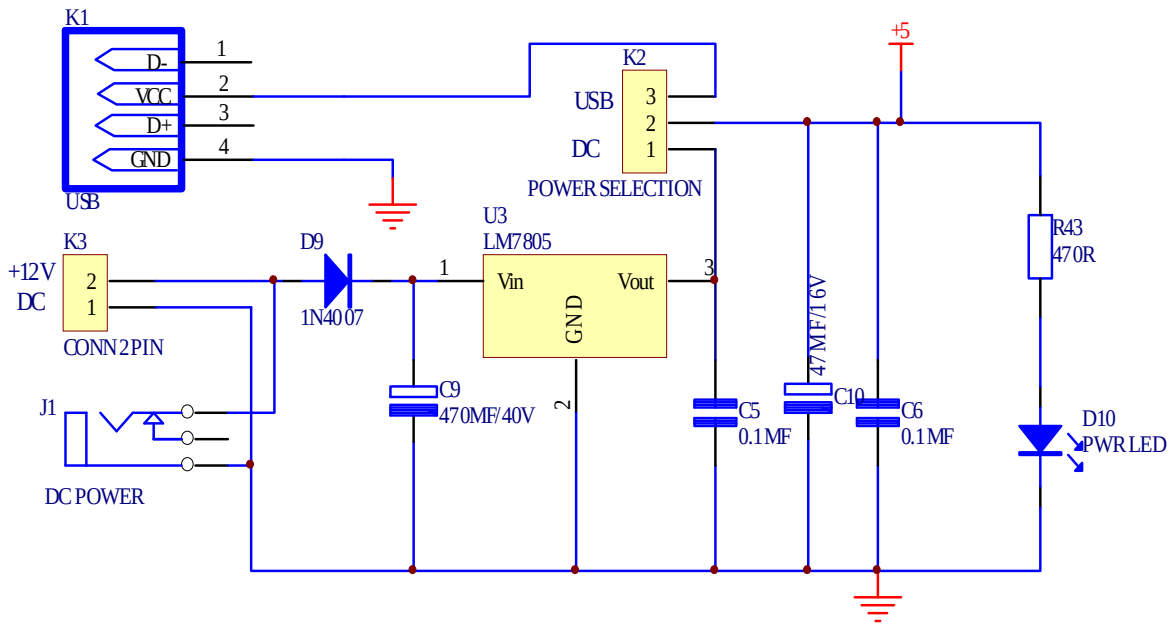
POWER SUPPLY

eCee PIC18F4520 Board has three power supplies; you can choose one of the following ways to supply power :

(1) Through a Screw Terminal (7V - 20V External DC Power Supply)
(2) Through the motherboard USB port
(3) Through an adapter (9V - 12V DC)

Note: For power selection, the appropriate jumper (K6) must be in position.

The Power Supply circuit is given below:

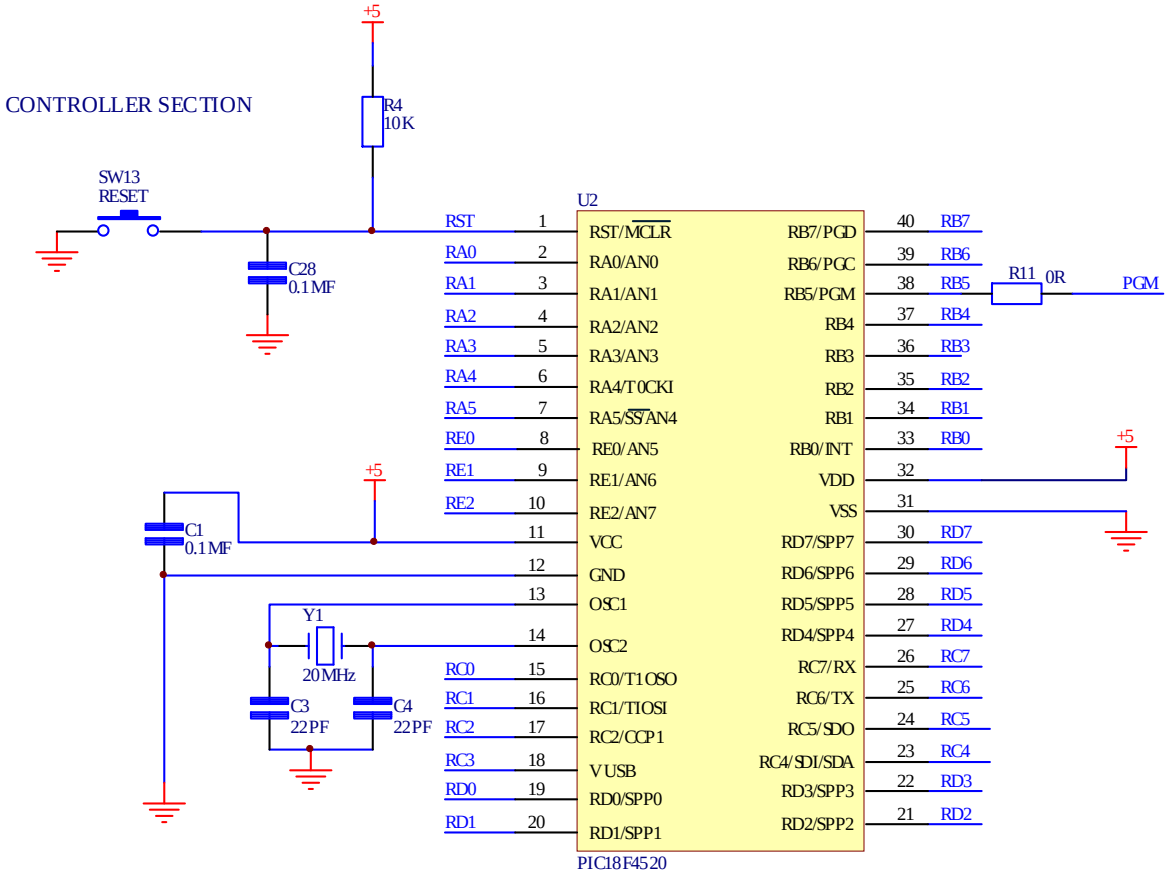


CLOCK SOURCE

eCee PIC18F4520 evaluation board has two clock sources:

- 32.768 KHz Crystal as the RTC clock source
- 20 MHz Crystal as the MCU clock source

MICROCONTROLLER PINOUT

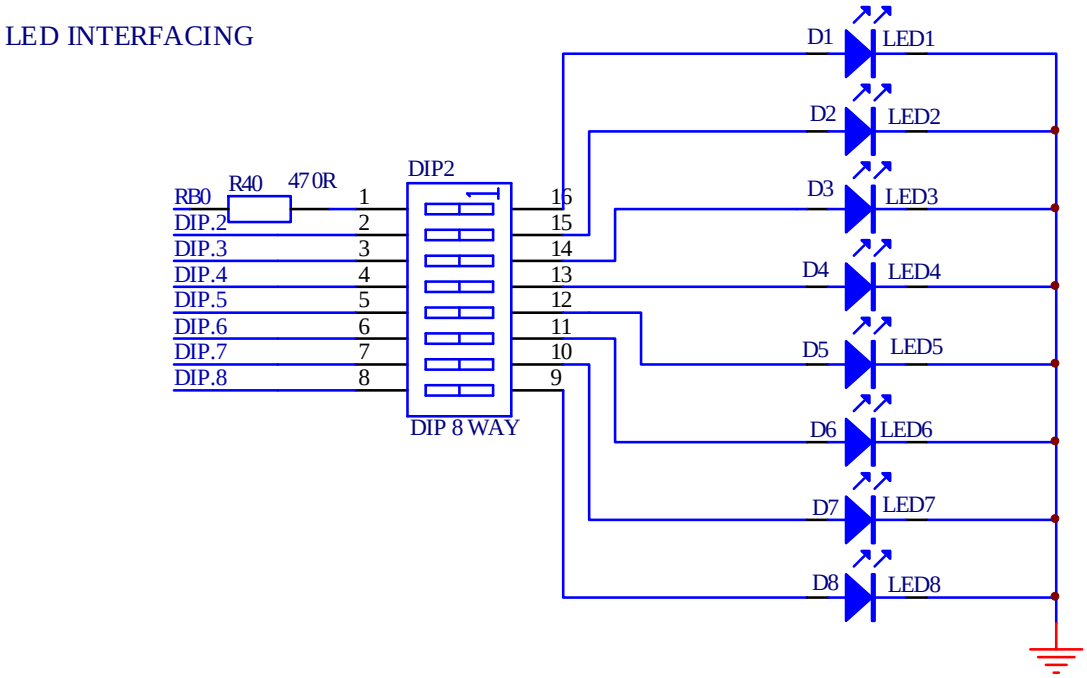


LED INTERFACING

LEDs are semiconductor diodes, electronic devices that permit current to flow in only one direction. The diode is formed by bringing two slightly different materials together to form a PN junction. In a PN junction, the P side contains excess positive charge ("holes," indicating the absence of electrons) while the N side contains excess negative charge (electrons).

When a forward voltage is applied to the semiconducting element forming the PN junction (heretofore referred to as the junction), electrons move from the N area toward the P area and holes move toward the N area. Near the junction, the electrons and holes combine. As this occurs, energy is released in the form of light that is emitted by the LED.

The material used in the semiconducting element of an LED determines its color. LED's are the simplest devices to test port functioning. ***The board contains 8 LEDs connected to PORTB pins 0 to 7 (RB0 to RB7).***

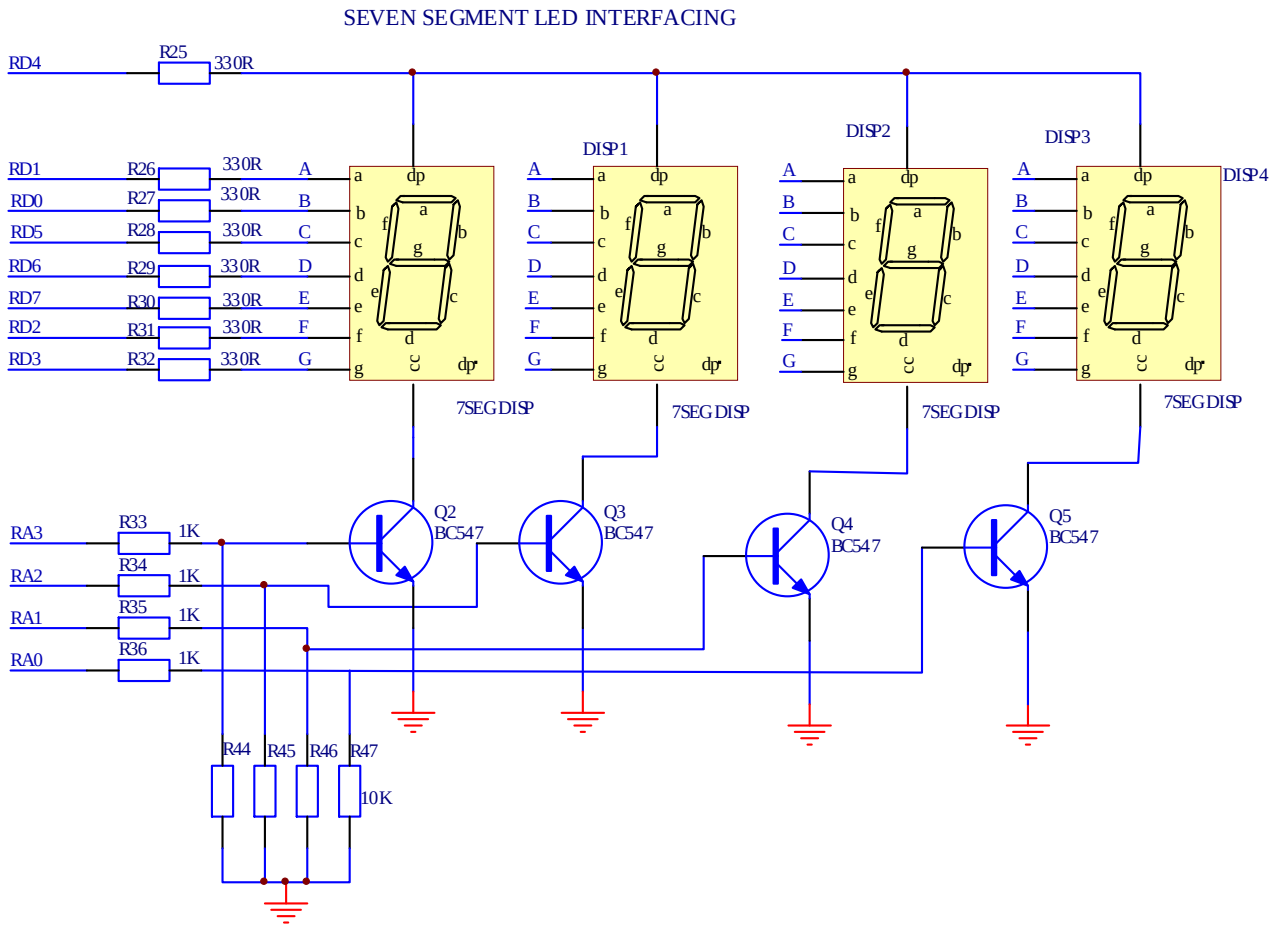


NOTE: For the module to work, DIP switch (DIP2) must be in ON position (positioned Up).

7-SEGMENT LED INTERFACING

Each segment of the 7-segment display is an individual LED. The standard 7-segment LED display in the development kit consists of illuminated segments arranged to show numerical symbols when switched on in the appropriate combination. ***Each segment is driven separately from PORTD via a current-limiting resistor.***

There are 4 seven segment modules in the board. PORTA pins 0,1,2,3 are used to select among the modules.



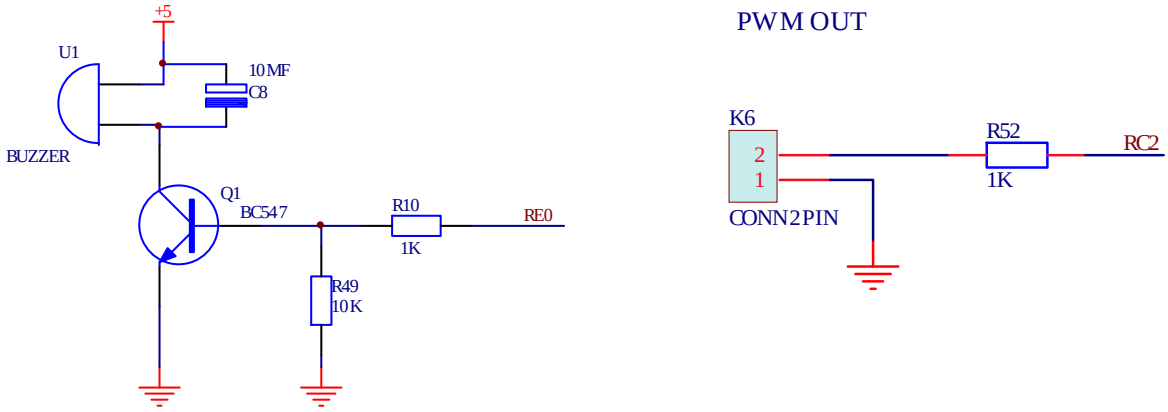
NOTE: For the module to work, all the switches in the DIP switch (DIP3) must be in OFF position.

BUZZER INTERFACE & PWM TERMINAL

A buzzer or beeper is a signaling device, usually electronic, typically used in auto-mobiles household appliances such as microwave oven, or game shows. It indicates a warning in the form of a continuous or intermittent buzzing or beeping sound. Here we use a ceramic-based piezoelectric sounder with a high-pitched tone.

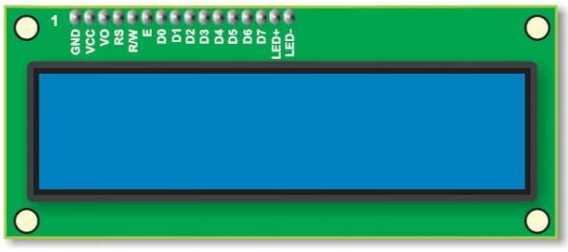
The buzzer is connected to PORTE0 pin and is driven using a bipolar transistor.

PWM Terminal connected to PORTC 2nd pin (RC2).



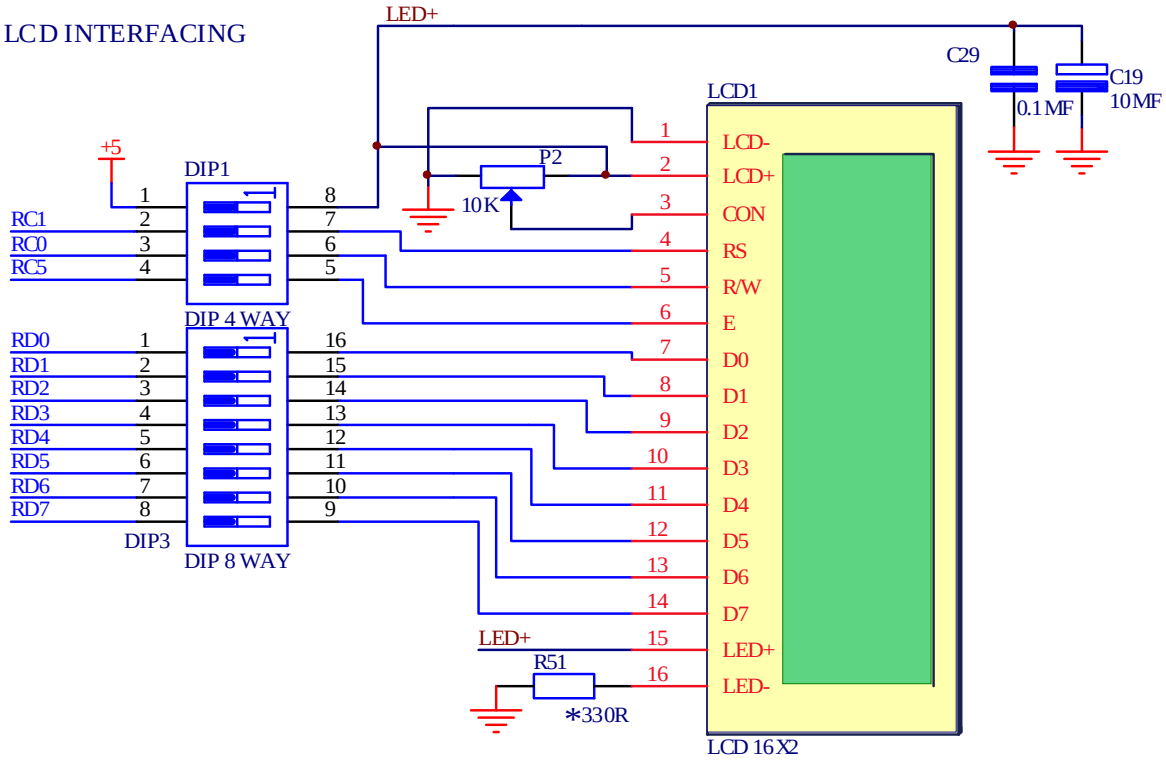
LCD INTERFACING

The display is a standard 2x16 LCD which displays 2 lines of 16 characters. Each character is 40 pixels, making it 1280 pixels overall. The display receives ASCII codes for each character at the data inputs (D0–D7).



Connection Diagram

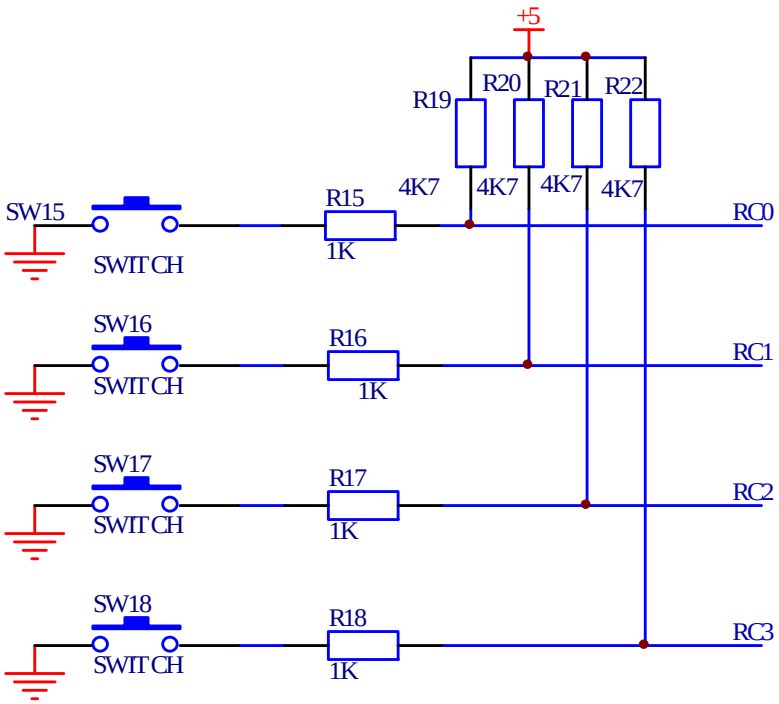
The LCD module can be used in 4-bit or 8-bit mode. The module uses HD44780U (from Hitachi) as the controller IC. The eCee PIC18F4520 development board **uses 8-bit interface**. ***PORTC pins (pins <1> <0> and <5>) and PORTD pins (RD0 to RD7) are used for data/command control pins.*** An On-Board potentiometer enables to adjust the LCD contrast to a better view in every angle.



NOTE: For the module to work, all the switches in the DIP switches DIP1 and DIP3 must be in UP position

PULL-UP KEY INTERFACING

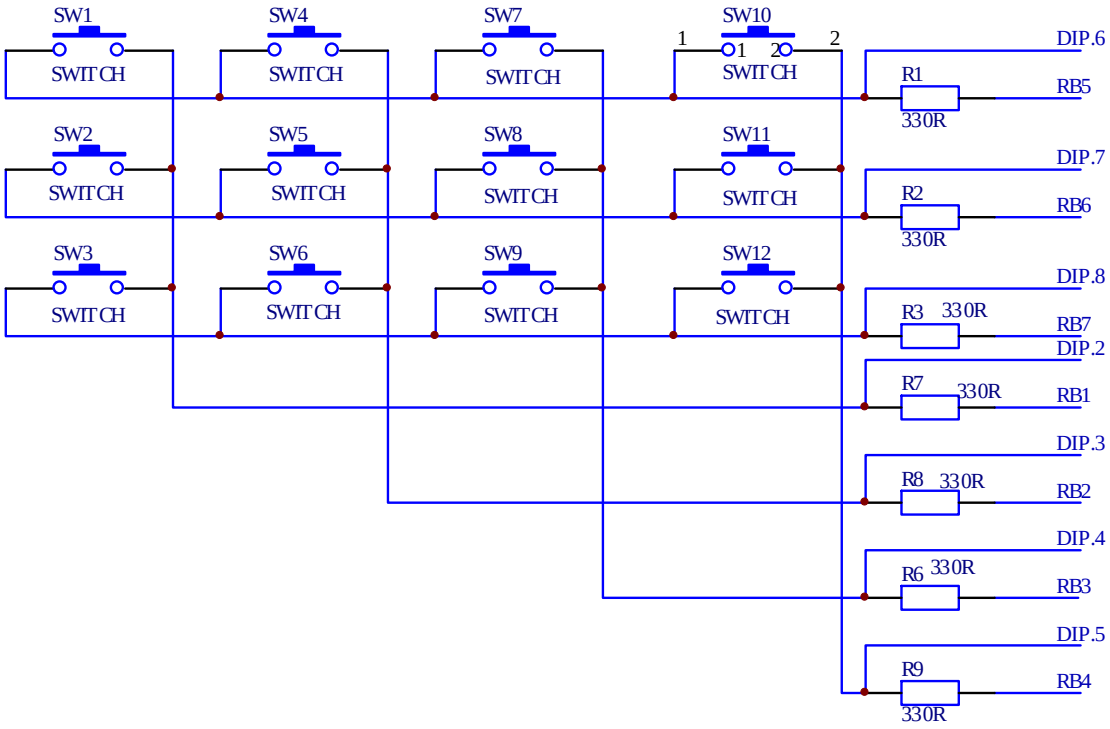
The simplest input to a microcontroller is a switch or push button. This can operate with just one additional support component, a pull-up resistor, but there are still some significant issues to consider, such as input loading and de-bouncing. When the switch is open, the output voltage of the circuit is pulled up to 5V via the resistor. Another way to look at it is that there is no current in the resistor (assuming there is no load on the output), so there is no volt drop, and the output voltage must be the same as the supply (5 V). When the switch is closed the output is connected direct to 0 V; the resistor prevents the supply being shorted to ground. ***There are 4 pull up switches in the board connected to four PORTC bits; 0, 1, 2, 3.***



NOTE: For the module to work, all the switches in the DIP (DIP4) switch must be in down position

MATRIX KEYBOARD INTERFACING

A keypad is simply an array of push buttons connected in rows and columns, so that each can be tested for closure with the minimum number of connections. There are 12 keys arranged in a 3×4 matrix. Assume the columns are labeled 1, 2, 3, 4 and the rows A, B, C. If we assume that all the rows and columns are initially high, a keystroke can be detected by setting each row low in turn and checking each column for a zero. While coding, ***pins RB5 to RB7 should be initialized as outputs and pins RB1 to RB4 as inputs***. These input pins are pulled high (logic 1). The output rows are also initially set to 1. If a 0 is now output on row A, there is no effect on the inputs unless a button in row A is pressed. If these are checked in turn for a 0, a button in this row which is pressed can be identified as a specific combination of output and input bits.

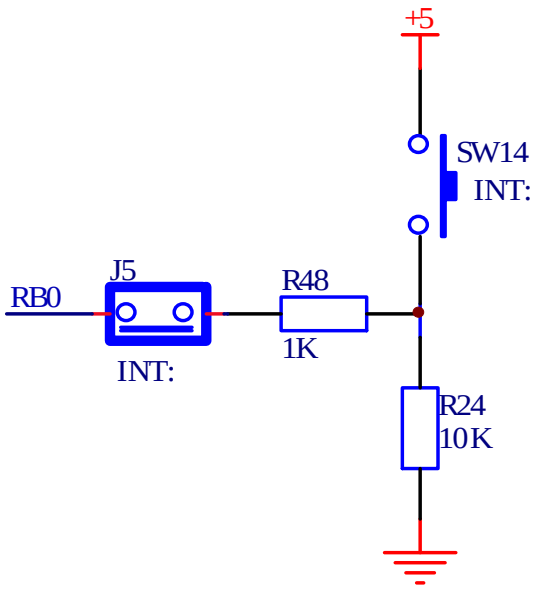


NOTE: For the module to work, DIP switch (DIP2) must be in OFF position (positioned down).

EXTERNAL INTERRUPT

An interrupt is an asynchronous signal calling for processor attention. Interrupts can originate in hardware or in software. The interrupt mechanism is a way to avoid wasting processor time, since without interrupts code has to poll hardware devices in ineffective, closed loops. With interrupts, the processor can continue to do its work since the interrupt mechanism ensures that the CPU receives a signal whenever an event occurs that requires its attention.

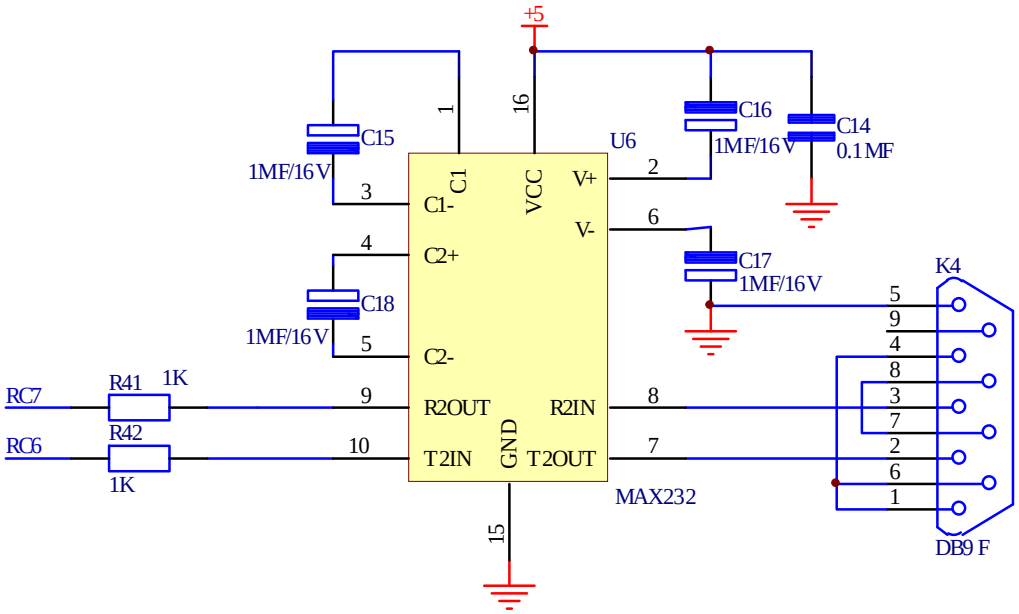
The external interrupt pin of PIC18F4520 is PORTB 0th pin (RB0)



NOTE: For the module to work, the 0th switch in the DIP2 switch must be in OFF position

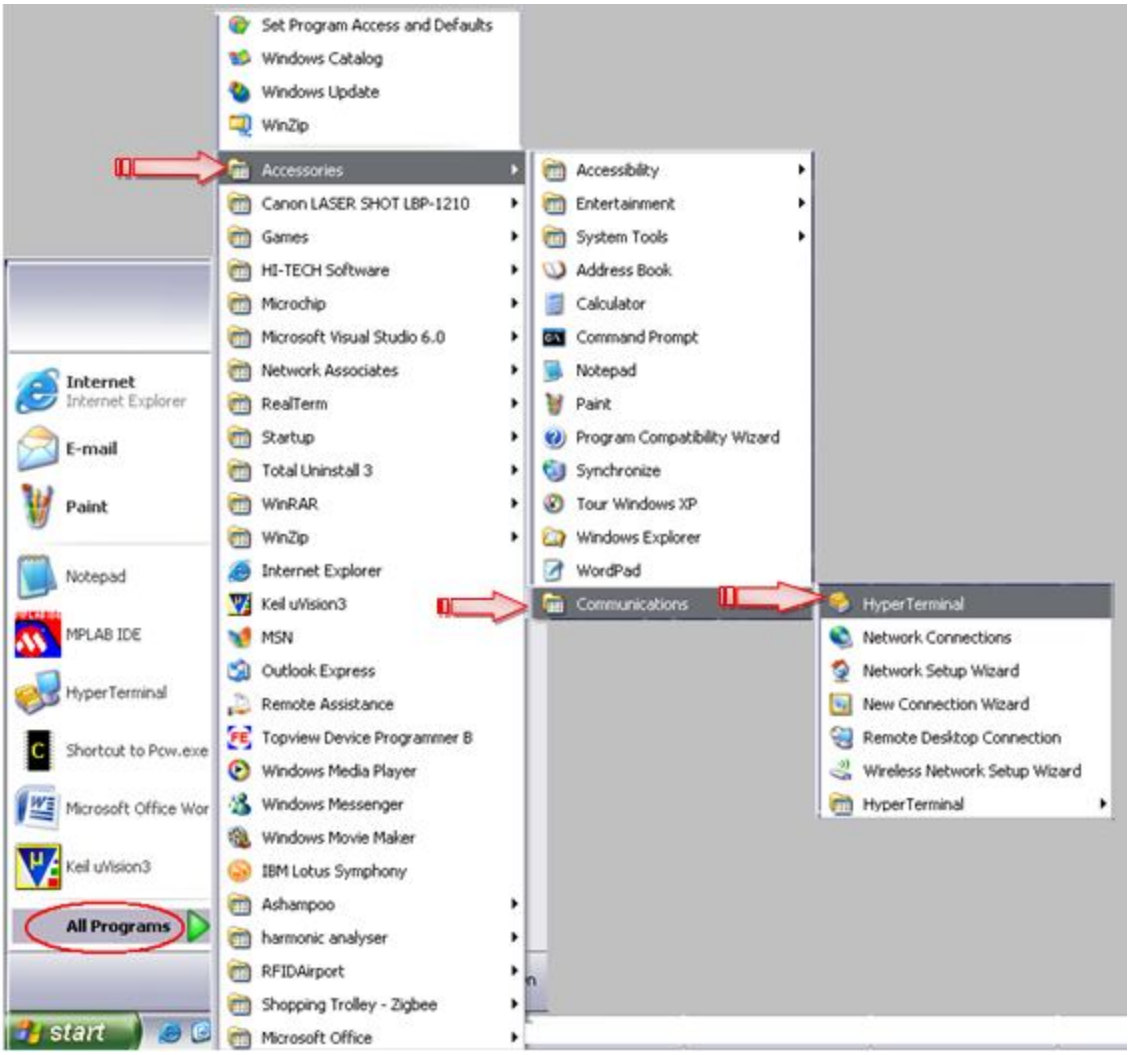
UNIVERSAL SYNCHRONOUS ASYNCHRONOUS RECEIVER TRANSMITTER

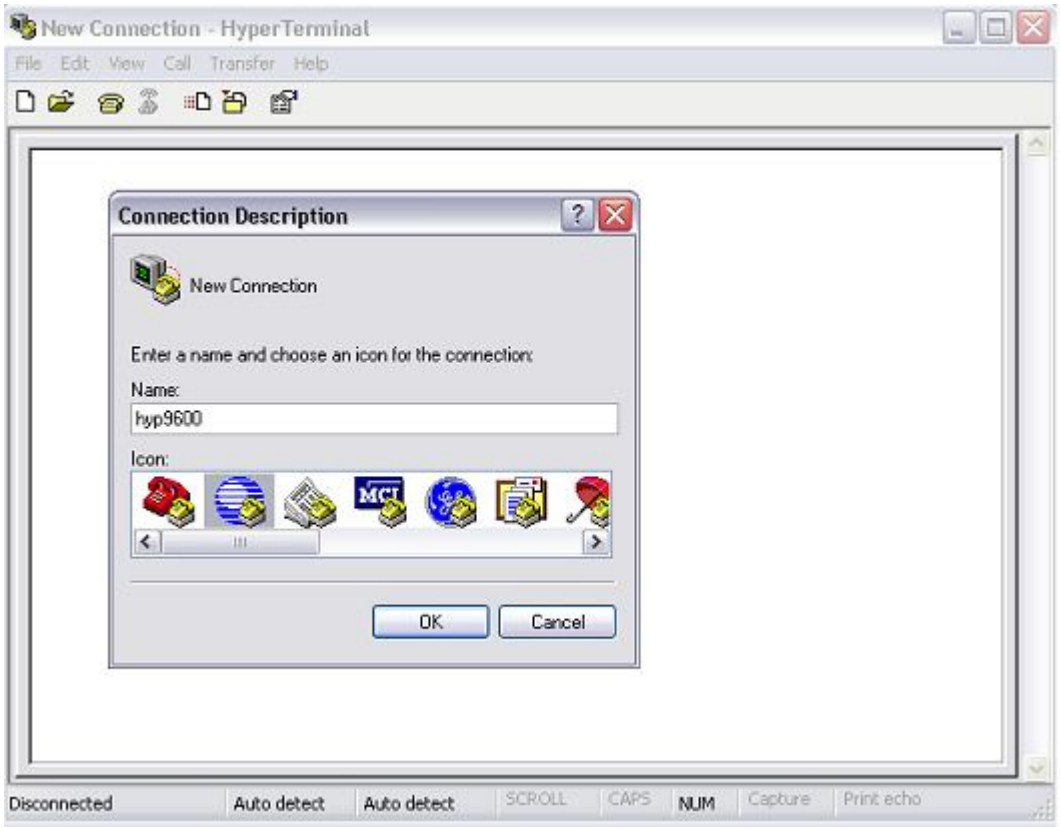
The PIC18F4520 microcontrollers come with a single USART module. It has two modes of operation, asynchronous (independent of clock) and synchronous(clock dependent) mode of operation. The USART module operates through **RC6 (TXD**) and **RC7 (RXD)** pins. The PIC18F4520 USART output itself operates at CMOS voltages, and needs an external serial line driver to convert its output into a higher symmetrical line voltage. The MAX 232 serial driver serves this purpose.



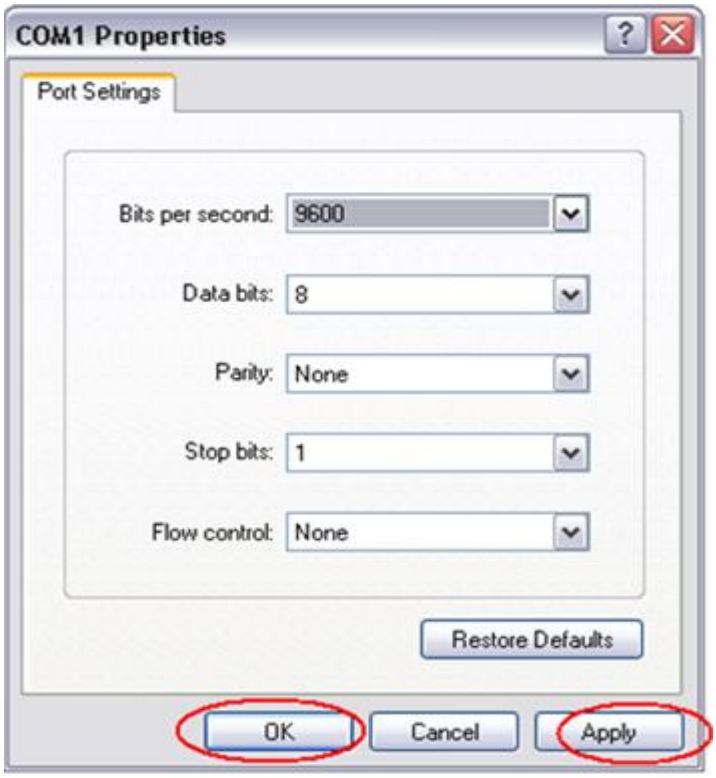
Steps for creating HyperTerminal in PC

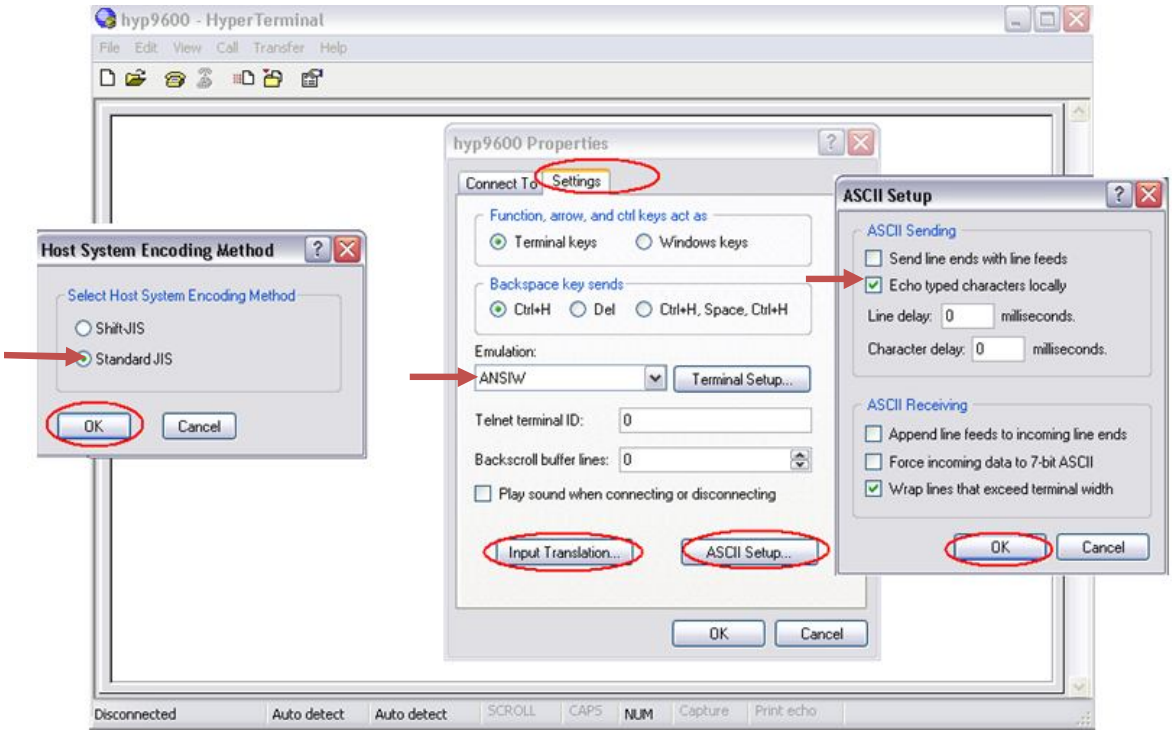
The serial data transmitted through USART can be viewed on a PC using a Windows tool for Serial Port Communication called HyperTerminal.



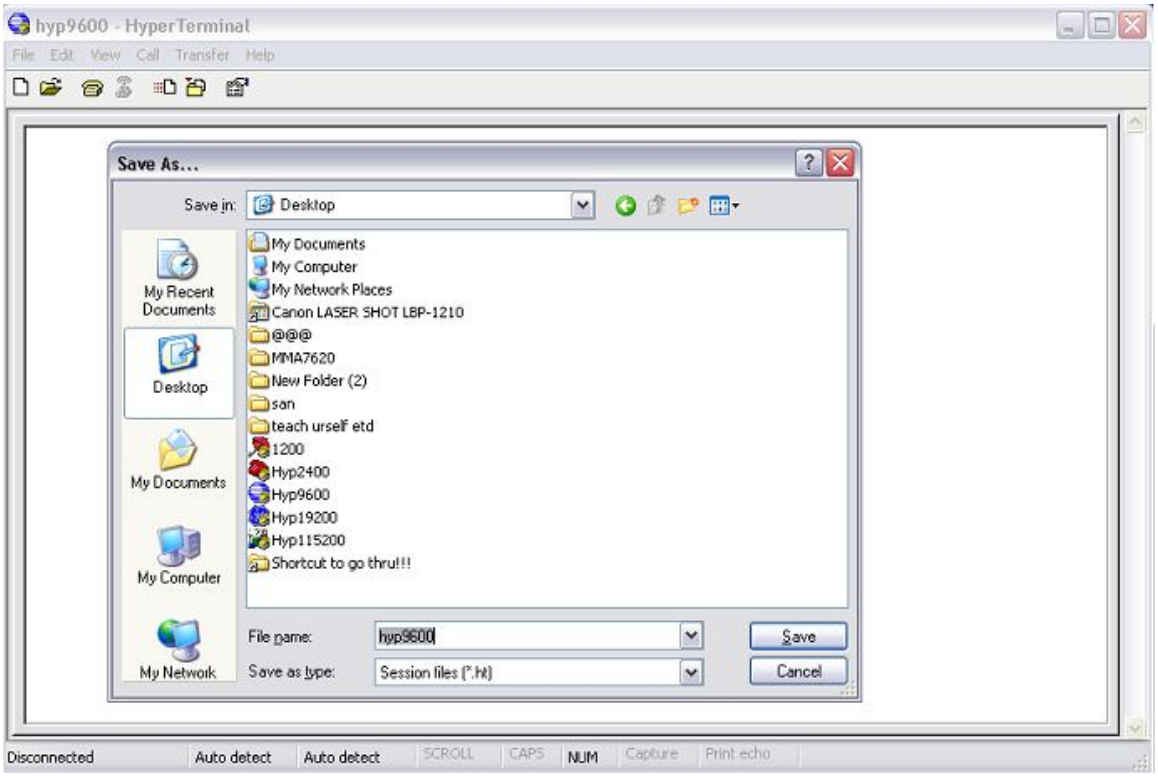

New Connection - HyperTerminal
File Edit View Call Transfer Help
Connection Description
New Connection
Enter a name and choose an icon for the connection:
Name:
hyp9600
Icon:
OK
Cancel
Disconnected
Auto detect
Auto detect
SCROLL
CAPS
NUM
Capture
Print echo

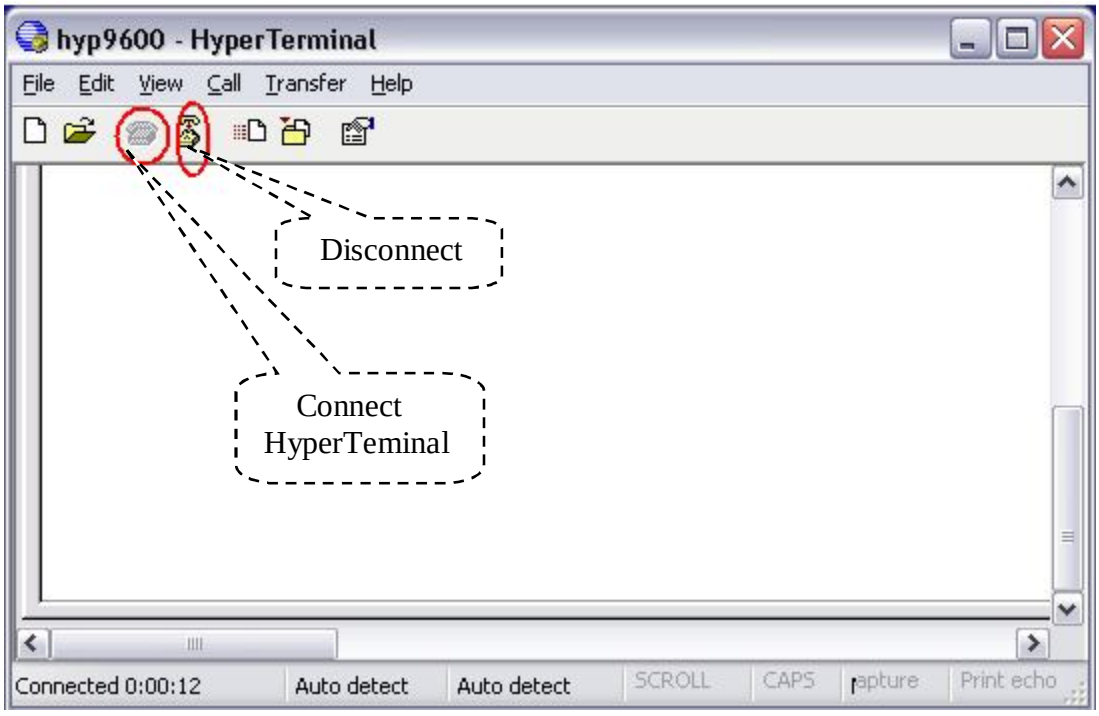

Connect To
hyp9600
Enter details for the phone number that you want to dial:
Country/region:
United States (1)
Area code:
688
Phone number:
Connect using:
COM1
OK
Cancel


COM1 Properties
Port Settings
Bits per second: 9600
Data bits: 8
Parity: None
Stop bits: 1
Flow control: None
Restore Defaults
OK
Cancel
Apply


hyp9600 - HyperTerminal
File Edit View Call Transfer Help
hyp9600 Properties
Connect To
Settings
Function, arrow, and ctrl keys act as
Terminal keys
Windows keys
Backspace key sends
Ctrl+H
Del
Ctrl+H, Space, Ctrl+H
Emulation:
ANSIW
Terminal Setup...
Telnet terminal ID:
Backscroll buffer lines:
Play sound when connecting or disconnecting
Input Translation...
ASCII Setup...
OK
Cancel
Host System Encoding Method
Select Host System Encoding Method
Shift-JIS
Standard JIS
OK
Cancel
ASCII Setup
ASCII Sending
Send line ends with line feeds
Echo typed characters locally
Line delay:
milliseconds.
Character delay:
milliseconds.
ASCII Receiving
Append line feeds to incoming line ends
Force incoming data to 7-bit ASCII
Wrap lines that exceed terminal width
OK
Cancel
Disconnected
Auto detect
Auto detect
SCROLL
CAPS
NUM
Capture
Print echo

➢ ***Select File - - > Save As - - > Desktop***



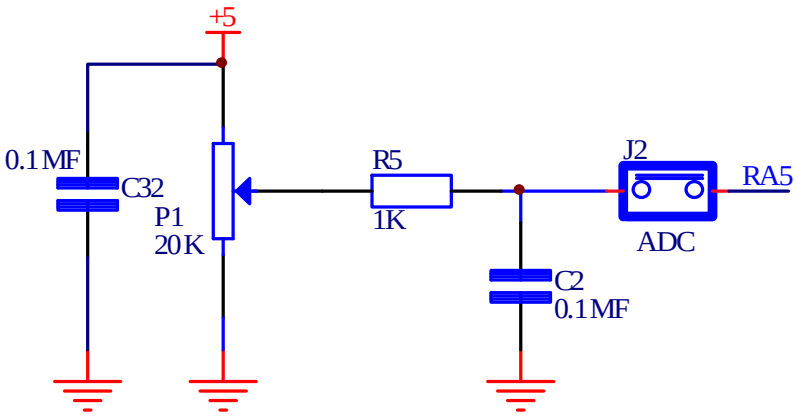


ANALOG TO DIGITAL CONVERTER (ADC) MODULE

a) Analog pin RA5 connected to a potentiometer

A potentiometer in an electrical circuit allows reducing the voltage level from the circuit maximum to ground, or zero level. In order to measure and control the action of the potentiometer, we need to quantify its action by producing a digital value within the physical range of the circuit; that is, we need to convert an *analog* quantity that varies continuously between 0 and 5 volts, to a discrete *digital* value range. If, in this case, the voltage range of the potentiometer is from 5 to 0 volts, we can digitize its action into a numeric range of 0 to 1023 units. The device that performs either conversion is called an A/D or *analog-to-digital converter*.

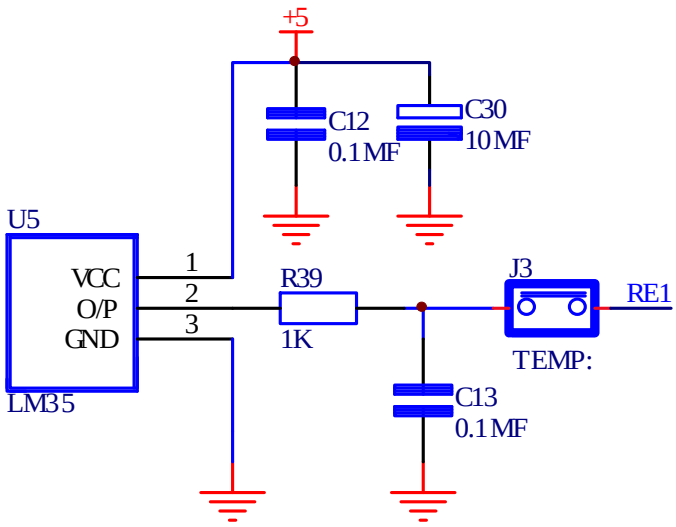
It's connected to PORTA 5th pin (RA5) analog channel four.



NOTE: For the module to work, jumper J2 must be placed (short access).

b) Analog pin RE1 interfaced to a Temperature sensor

LM35 temperature sensor can be used to measure environment temperature, in the range of -55C to 150C. It's connected to PORTE 1st pin (RE1) analog channel six.

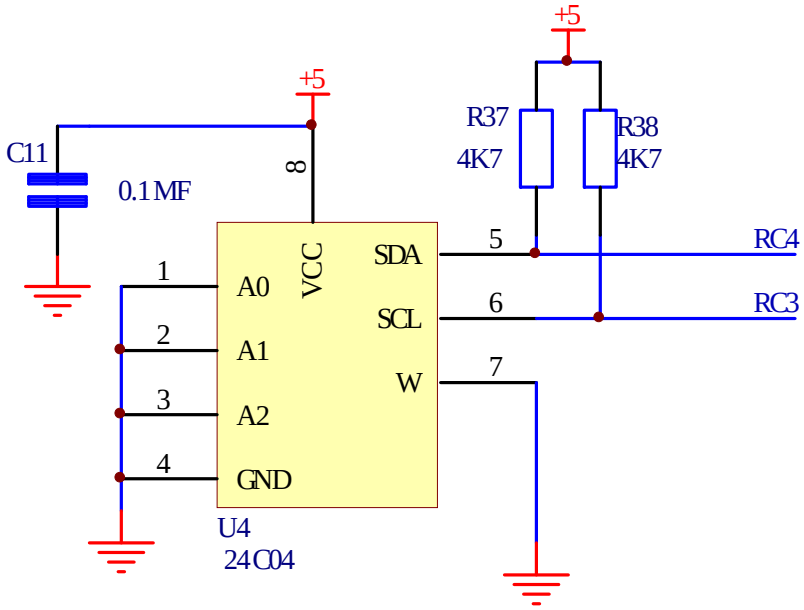


NOTE: For the module to work, jumper J3 must be placed (short access)

EEPROM & RTC INTERFACING (I^2C PROTOCOL IMPLEMENTATION)

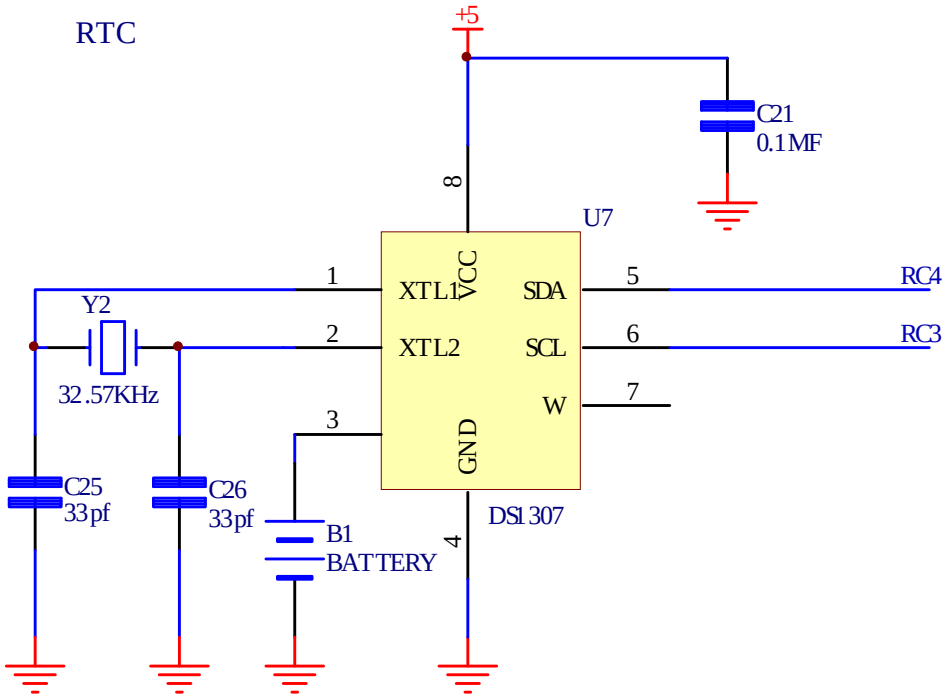
a) External EEPROM Interfacing

The eCee PIC18F4520 development board has 4K SERIAL EEPROM interfacing. It is internally organized with 256 pages comprising of 2-byte locations each. 4K requires an 9-bit data word address for random word addressing with data transfer rate 100 kbits/s. Also it is to be noted that an external EEPROM (AT24C04) is the slave device to be communicated with the microcontroller, via I^2C protocol.



b) ***RTC Interfacing***

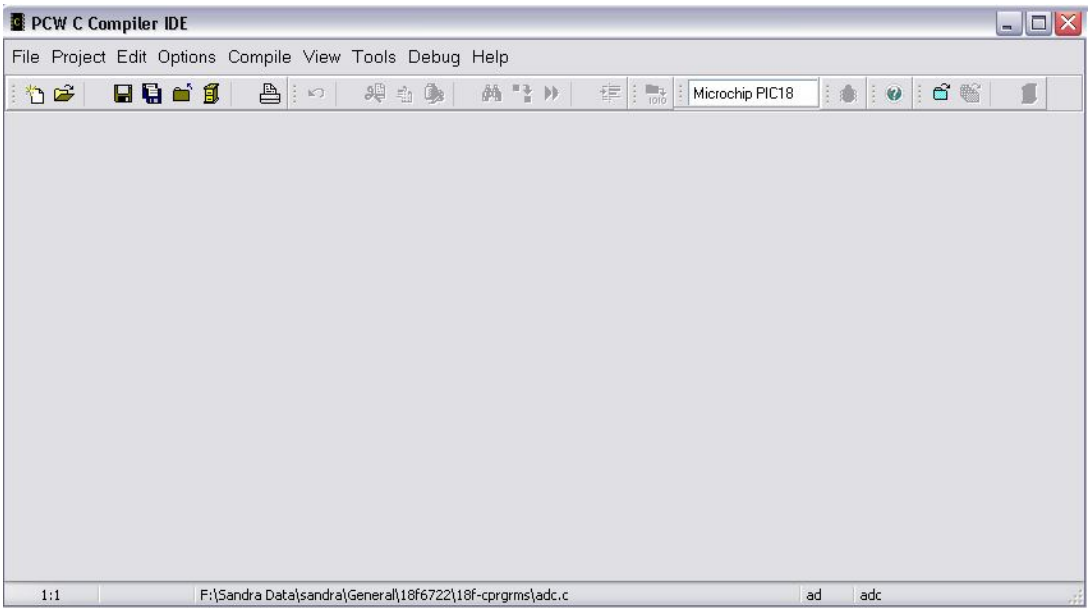
The DS1307 serial real-time clock (RTC) is a low-power, full binary-coded decimal (BCD) clock/calendar plus 56 bytes of NV SRAM. Address and data are transferred serially through an I2C, bidirectional bus. The clock/calendar provides seconds, minutes, hours, day, date, month, and year information. The clock operates in either the 24-hour or 12-hour format with AM/PM indicator. The DS1307 has a built-in power-sense circuit that detects power failures and automatically switches to the battery supply.



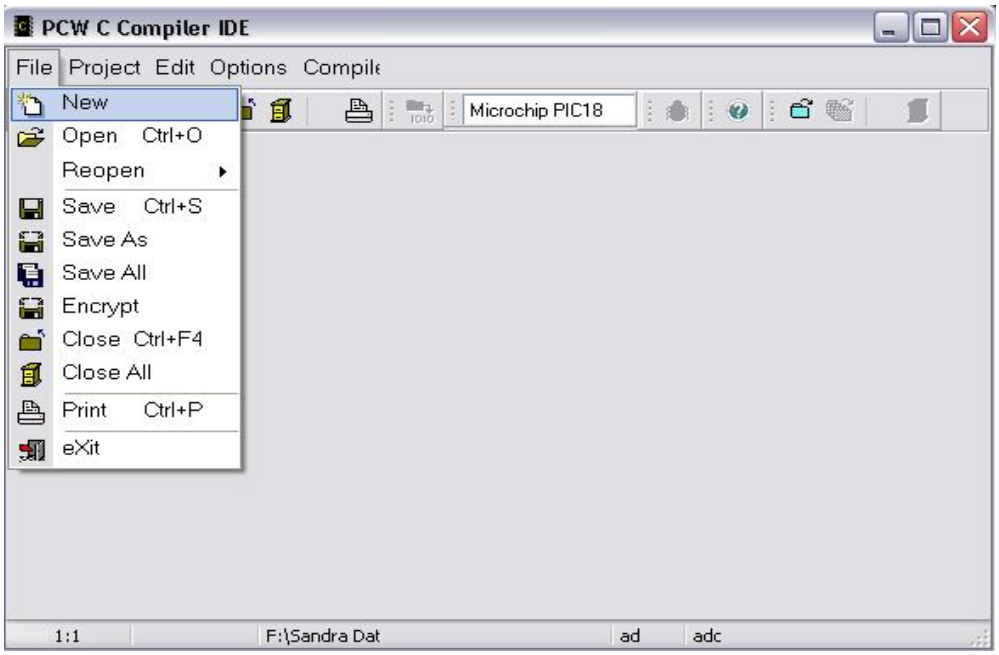
CHAPTER-3 :
SOFTWARE DEVELOPMENT

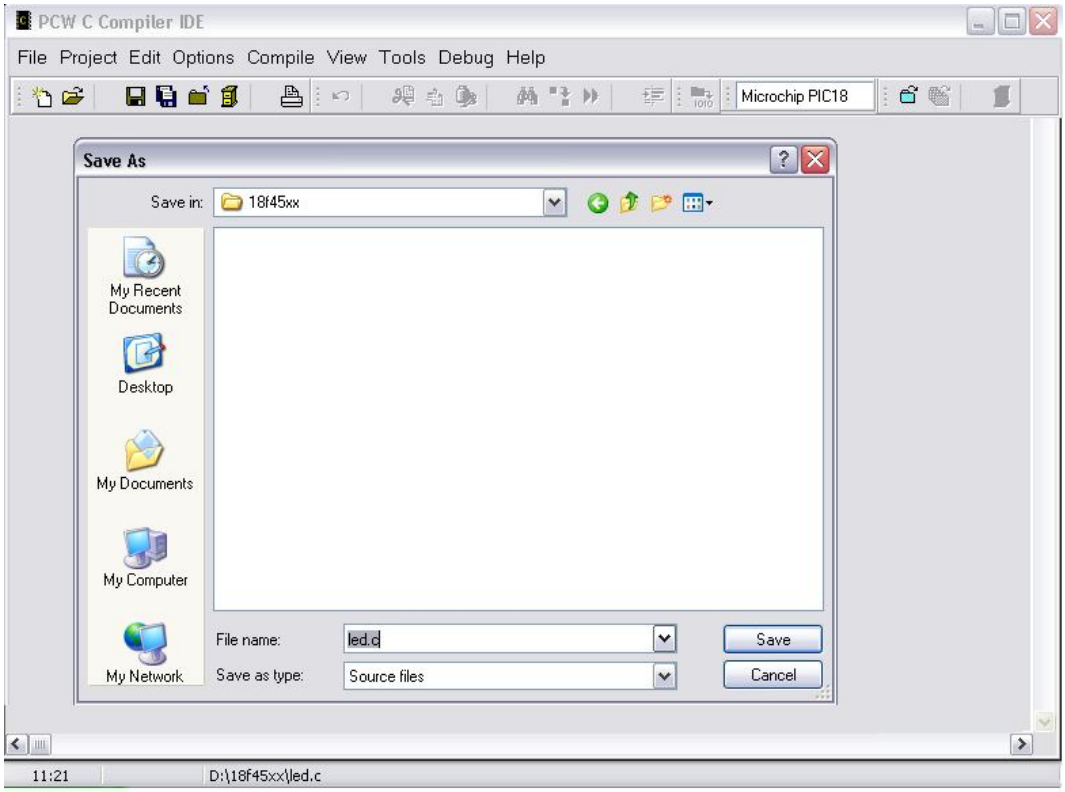
CCS provides complete, low cost, embedded software tools designed for Microchip PIC MCU and dsPIC DSC devices. The CCS C Compiler is comprised of Standard C operators and built-in libraries that are specific to PIC MCU registers, and access to hardware features from C. The CCS C compiler supports the Microchip PIC12x, PIC16x, PIC18x, and dsPIC devices. The compiler is very close to being 100% ANSI compatible. It supports everything a PIC compiler needs. It also supports the necessary superset of ANSI C to work with embedded micros, such as fuse and interrupt level support.

- *Open up **PCW C Compiler** by selecting the tool icon **pcw** from your desktop or start-up.*

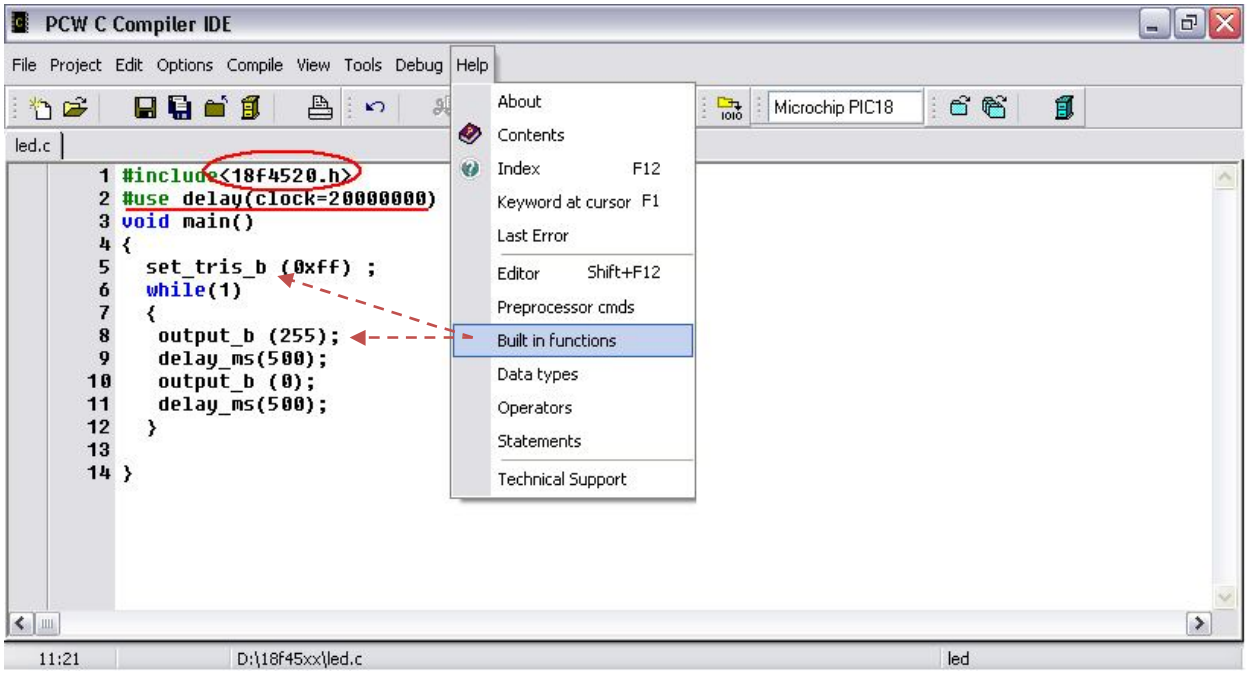


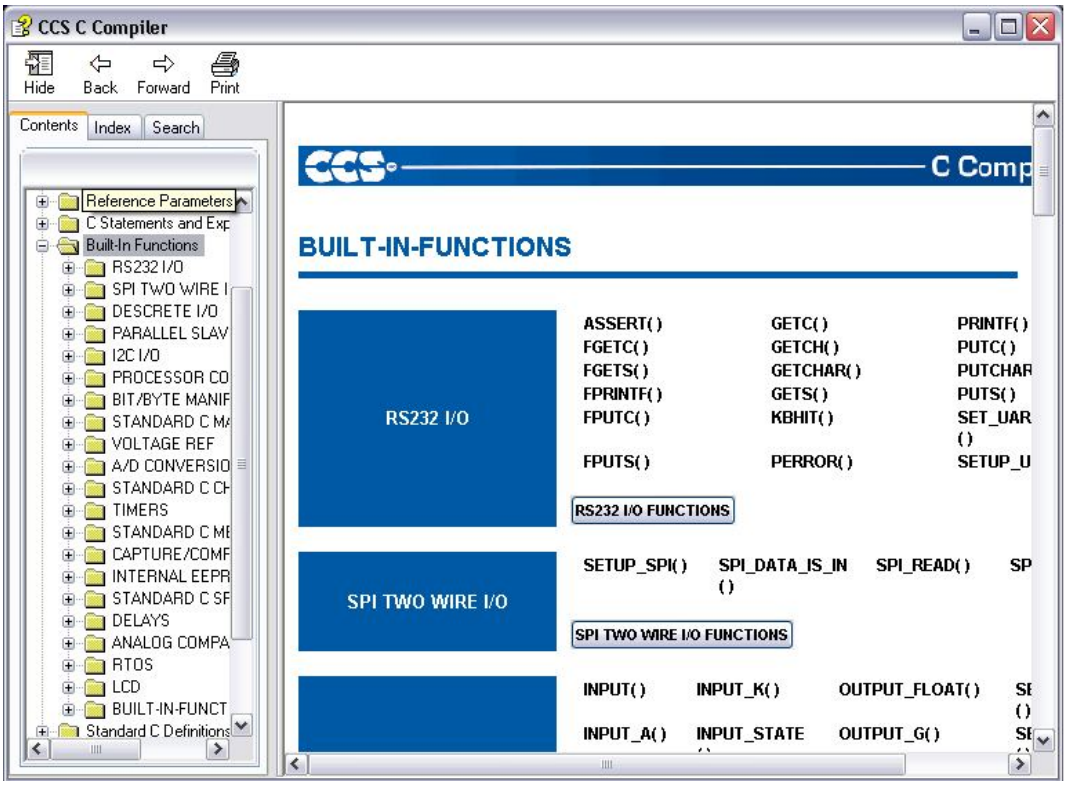
- *Create a new code file by taking option New from the File menu.*
- *Save the created file to your folder created mentioning the extension say .c*



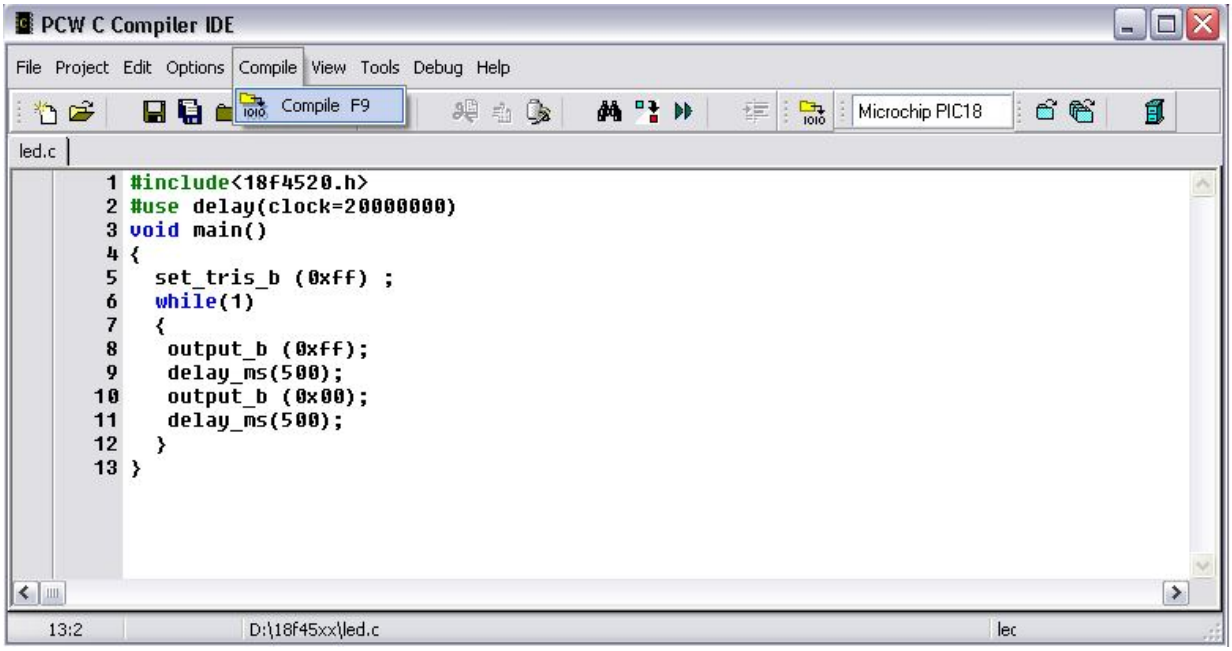


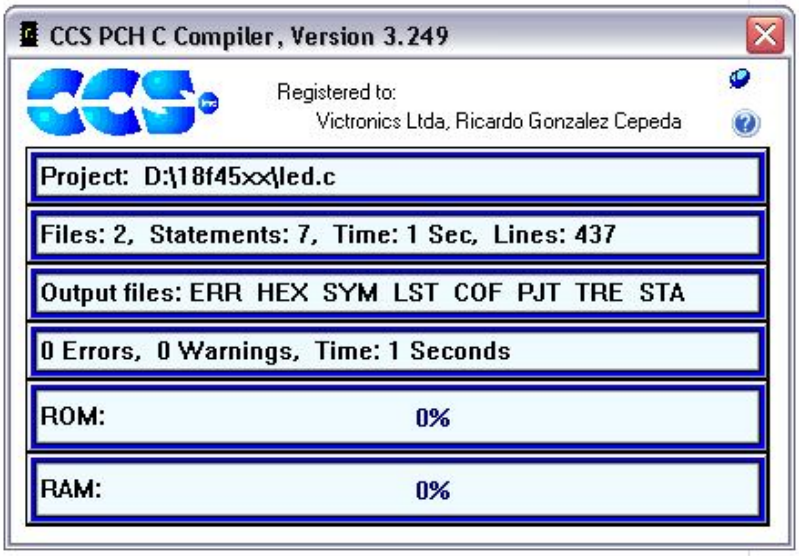
CCS compiler supports many built-in functions which makes easy program coding.
To access the built-in functions select Help from the menu and click on the option -Built in functions at the pull down menu list.



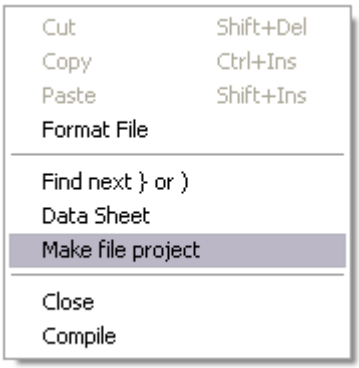


➢ *When you are done with the program code, the next step is compiling process. To compile your code click Compile - > Compile F9 from the menu bar. There should be no errors on any step up and if so a hex file corresponding to your code will be created in your project folder in result to build succeeded.*



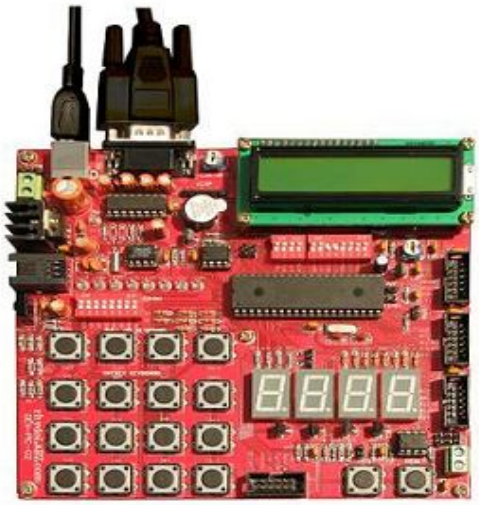


➢ *For the compilation to be complete and to get the corresponding hex file select right click of the mouse and you will find an option list as shown below, where Make file project has to be clicked.*



SETTING UP eCee PIC18F4520

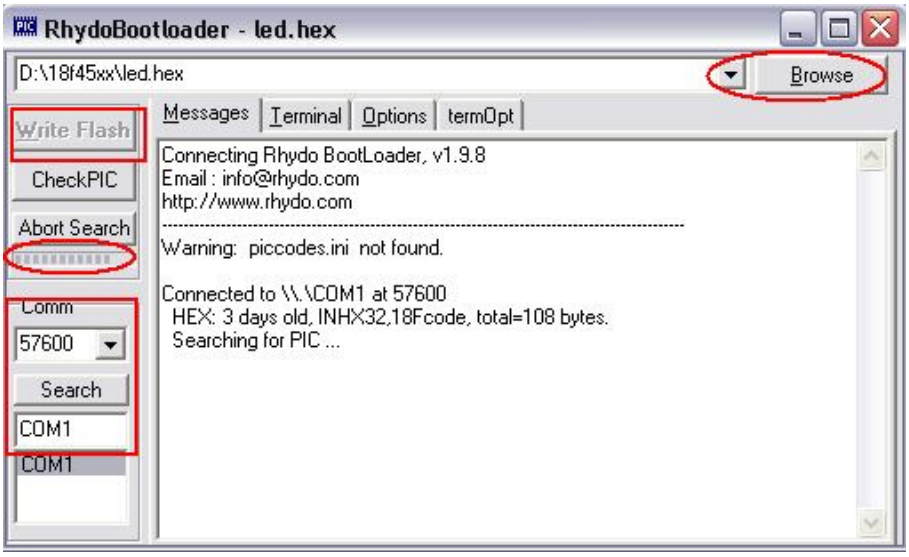
- Power the development board with a USB Cable.
- Make sure that the Power-On LED is ON and the jumper is in proper position.
- Connect the RS-232 Cable to the COM port of your computer.
- Connect the other end to the Serial Port of your Demo Kit.



PROGRAMMING STEPS

The PIC18F4520 Demo Kit is preloaded with Boot loader firmware. This allows the user to program the microcontroller without using separate programmer.

1. Setup Rhydo Boot Loader.
2. Select COM port and set Baud rate as 57600 bps.
3. Browse your Hex files.
4. Ensure RS-232 connection and power connection.
5. Click the Write Flash button.
6. Reset PIC using the Reset button while Boot loader searches for PIC.



Note: *The microcontroller is preloaded with boot-loader software. Programming with other devices/programmers or removing the microcontroller from the development board could damage the boot-loader. In this case, the company won't be liable for the damages caused and no replacement/refunding/reloading is entertained.*

CHAPTER- 4: I/O DISTRIBUTION

The Pin Distribution of PIC18F4520 Development Board

PIC18F4520 Pin No:	Name	Type	The I/O assign of PIC18F4520 Development Board
1	$\overline{MCLR}$/VPP/RE3	-	Reset Key
2	RA0/AN0	I/O	7-Segment Module Select
3	RA1/AN1	I/O	7-Segment Module Select
4	RA2/AN2/$VREF^-$/CVREF	I/O	7-Segment Module Select
5	RA3/AN3/$VREF^+$	I/O	7-Segment Module Select
6	RA4/T0CKI/C1OUT	-	-
7	RA5/AN4/$\overline{SS}$/LVDIN/C2OUT	I/O	ADC Input (potentiometer)
8	RE0/$\overline{RD}$/AN5	I/O	BUZZER
9	RE1/$\overline{WR}$/AN6	I/O	ADC Input (Temperature Sensor)
10	RE2/$\overline{CS}$/AN7	I/O	N/C
11	VDD	-	5V (Vcc)
12	VSS	-	GND
13	OSC1/CLKIN/RA7	-	-
14	OSC2/CLKOUT/RA6	-	-
15	RC0/T1OSO/T13CKI	I/O	LCD/Pull-Up Key
16	RC1/T1OSI/CCP2	I/O	LCD/Pull-Up Key
17	RC2/CCP1/P1A	I/O	PWM Terminal
18	RC3/SCK/SCL	I/O	SCL
19	RD0/PSP0	I/O	LCD/7-Segment Module
20	RD1/PSP1	I/O	LCD/7-Segment Module
21	RD2/PSP2	I/O	LCD/7-Segment Module
22	RD3/PSP3	I/O	LCD/7-Segment Module

23	RC4/SDI/SDA	I/O	SDA
24	RC5/SDO	I/O	LCD
25	RC6/TX/CK	I/O	TXD
26	RC7/RX/DT	I/O	RXD
27	RD4/PSP4	I/O	LCD/7-Segment Module
28	RD5/PSP5/P1B	I/O	LCD/7-Segment Module
29	RD6/PSP6/P1C	I/O	LCD/7-Segment Module
30	RD7/PSP7/P1D	I/O	LCD/7-Segment Module
31	VSS		GND
32	VDD		5V (Vcc)
33	RB0/INT0/AN12/FLT0	I/O	External Interrupt Key (INT)/LED
34	RB1/ INT1/AN10	I/O	Matrix Keyboard/LED
35	RB2/INT2/AN8	I/O	Matrix Keyboard/LED
36	RB3/ AN9/CCP2	I/O	Matrix Keyboard/LED/ICSP
37	RB4/KBI0/AN11	I/O	Matrix Keyboard/LED
38	RB5/KBI1/PGM	I/O	Matrix Keyboard/LED
39	RB6/KBI2/PGC	I/O	Matrix Keyboard/LED/ICSP
40	RB7/KBI3/PGD	I/O	Matrix Keyboard/LED/ICSP

TECHNICAL SUPPORT

If you are experiencing a problem that is not described in this manual, please contact us. Our phone lines are open from 9:00 AM – 5.00 PM (*Indian Standard Time*) Monday through Saturday excluding holidays. Email can be sent to *support@rhydolabz.com*

LIMITATIONS AND WARRANTEES

This product is intended for personal or lab experimental purpose and in no case should be used where it harmfully effect human and nature. No liability will be accepted by the publisher for any consequence of its use. Use of the product software and or hardware is with the understanding that any outcome whatsoever is at the users own risk. All products are tested for their best performance before shipping, still rhydoLABZ is offering One year Free service warranty (Components cost + Shipping cost will be charged from Customer)

DISCLAIMER

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