LCD Interfacing with PIC16F877A 16×2 LCD

Liquid Crystal Displays (LCDs) like computers, digital watches, and also DVD and CD players. They have become very common and have taken a giant leap in the screen industry by clearly replacing the use of Cathode Ray Tubes (CRT).

CRT draws more power than LCD and is also bigger and heavier. All of us have seen an LCD, but no one knows the exact working of it.

Let us have a look at the working of an LCD. Here we are using an alphanumeric LCD 16×2.

A **16×2 LCD** is a very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi-segment LEDs.

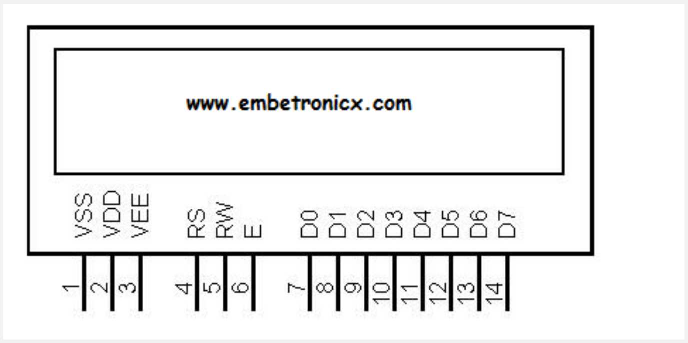
The reasons are that LCDs are economical; easily programmable; and have no limitation of displaying special & even custom characters (unlike in seven segments), animations, and so on.

A 16×2 LCD means it can display 16 characters per line, and there are 2 such lines. In this LCD, each character is displayed in a 5×7 pixel matrix.

This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling the display, etc.

The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.



Pin Description

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high-to-low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

The LCD module requires 3 control lines as well as either 4 or 8 I/O lines for the data bus. The user may select whether the LCD is to operate with a 4-bit data bus or an 8-bit data bus.

If a 4-bit data bus is used, the LCD will require a total of 7 data lines (3 control lines plus the 4 lines for the data bus). If an 8-bit data bus is used, the LCD will require a total of 11 data lines (3 control lines plus the 8 lines for the data bus).

The three control lines are referred to as **EN**, **RS**, and **RW**.

The **EN** line is called “Enable.” This control line is used to tell the LCD that you are sending it data. To send data to the LCD, your program should make sure this line is low (0) and then set the other two control lines and/or put data on the data bus.

When the other lines are completely ready, bring **EN**high (1) and wait for the minimum amount of time required by the LCD datasheet (this varies from LCD to LCD), and end by bringing it low (0) again.

The **RS** line is the “Register Select” line. When RS is low (0), the data is to be treated as a command or special instruction (such as a clear screen, position cursor, etc.).

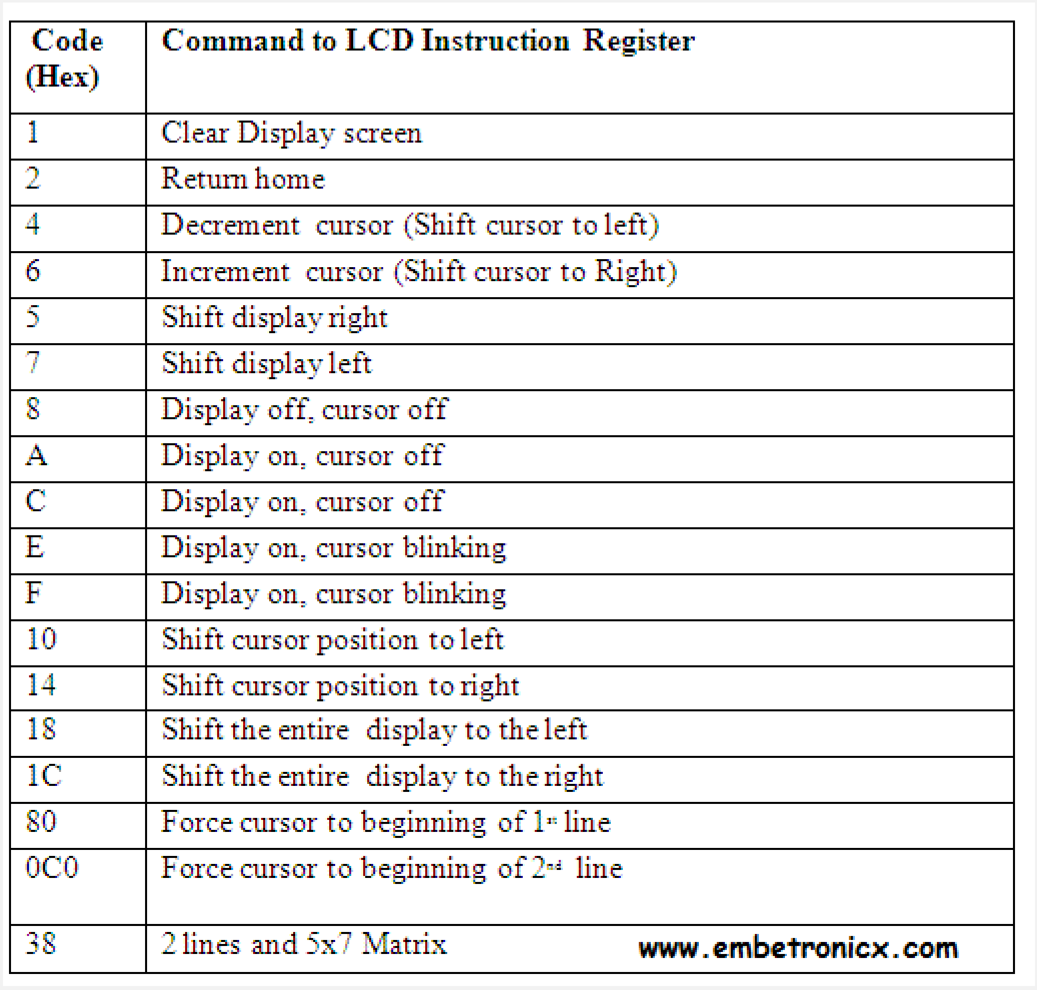
When RS is high (1), the data being sent is text data which should be displayed on the screen. For example, to display the letter “T” on the screen, you would set RS high.

The **RW** line is the “Read/Write” control line. When RW is low (0), the information on the data bus is being written to the LCD. When RW is high (1), the program is effectively querying (or reading) the LCD. Only one instruction (“Get LCD status”) is a read command.

All others are write commands–so RW will almost always be low.

Finally, the data bus consists of 4 or 8 lines (depending on the mode of operation selected by the user). In the case of an 8-bit data bus, the lines are referred to as DB0, DB1, DB2, DB3, DB4, DB5, DB6, and DB7.

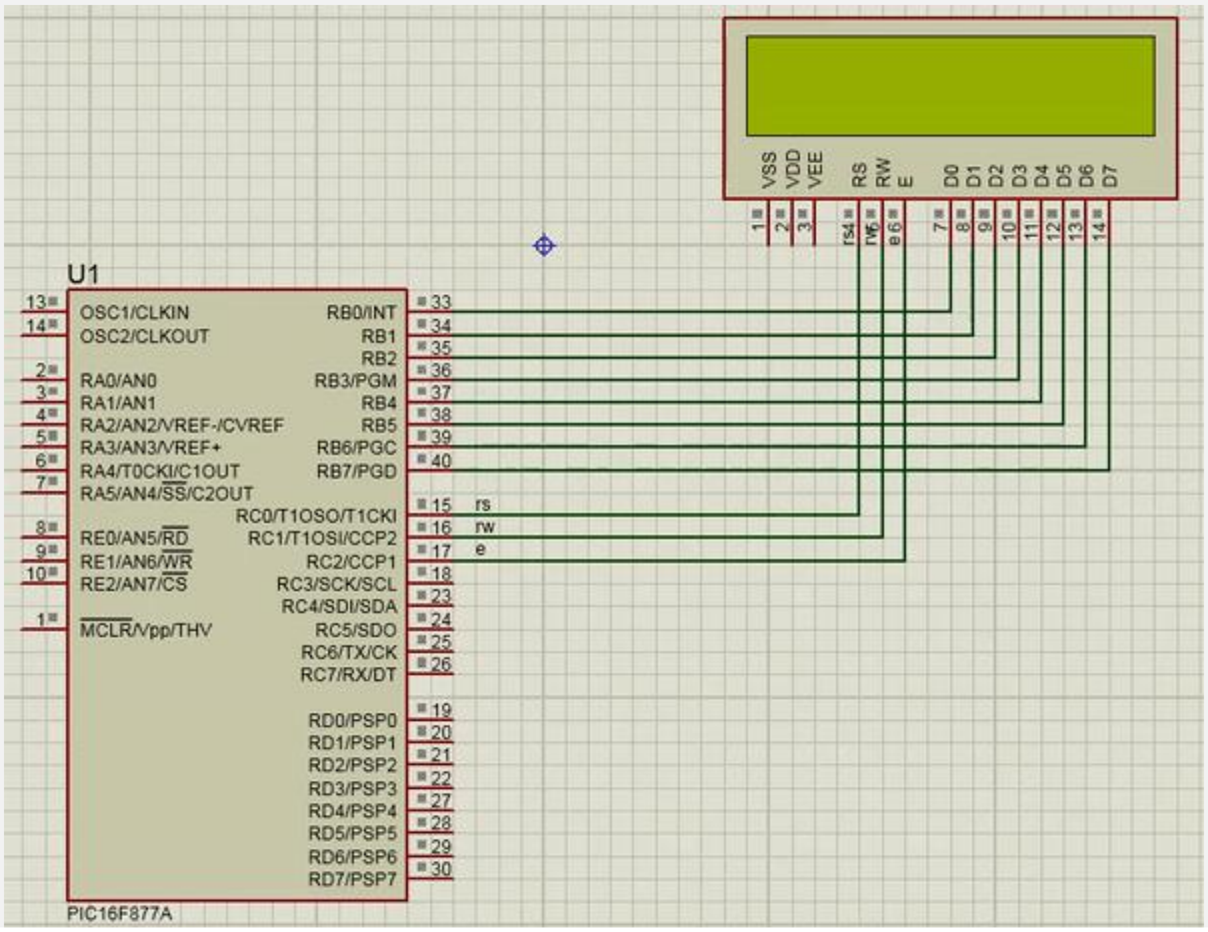
LCD COMMANDS



Code (Hex)	Command to LCD Instruction Register
1	Clear Display screen
2	Return home
4	Decrement cursor (Shift cursor to left)
6	Increment cursor (Shift cursor to Right)
5	Shift display right
7	Shift display left
8	Display off, cursor off
A	Display on, cursor off
C	Display on, cursor off
E	Display on, cursor blinking
F	Display on, cursor blinking
10	Shift cursor position to left
14	Shift cursor position to right
18	Shift the entire display to the left
1C	Shift the entire display to the right
80	Force cursor to beginning of 1st line
0C0	Force cursor to beginning of 2nd line
38	2 lines and 5x7 Matrix www.embetronicx.com

Now let’s move to programming.

LCD Interfacing with PIC16F877A – Circuit



- **RS** – Port C .0 (RC0)
- **RW** – Port C.1 (RC1)
- **EN** – Port C.2 (RC2)
- **Data lines** – Port B

```
#include<pic.h>
#define rs RC0
#define rw RC1
#define en RC2
#define delay for(j=0;j<1000;j++)
int j;
void lcd_init();
void cmd(unsigned char a);
void dat(unsigned char b);
void show(unsigned char *s);
```

```
__CONFIG( FOSC_HS & WDTE_OFF & PWRTE_OFF & CP_OFF & BOREN_ON & LVP_OFF &
CPD_OFF & WRT_OFF & DEBUG_OFF);
void main()
{
unsigned int i;
TRISB=TRISC0=TRISC1=TRISC2=0;
lcd_init();
cmd(0x8A); //forcing the cursor at 0x8A position
show("WELCOME TO EmbeTronicX");
while(1) {
for(i=0;i<15000;i++);
cmd(0x18);
for(i=0;i<15000;i++);
}
}
void lcd_init()
{
cmd(0x38);
cmd(0x0c);
cmd(0x06);
cmd(0x80);
}
void cmd(unsigned char a)
{
PORTB=a;
rs=0;
rw=0;
en=1;
delay;
en=0;
}
void dat(unsigned char b)
{
```

```
PORTB=b;
rs=1;
rw=0;
en=1;
delay;
en=0;
}
void show(unsigned char *s)
{
while(*s) {
dat(*s++);
}
}
```