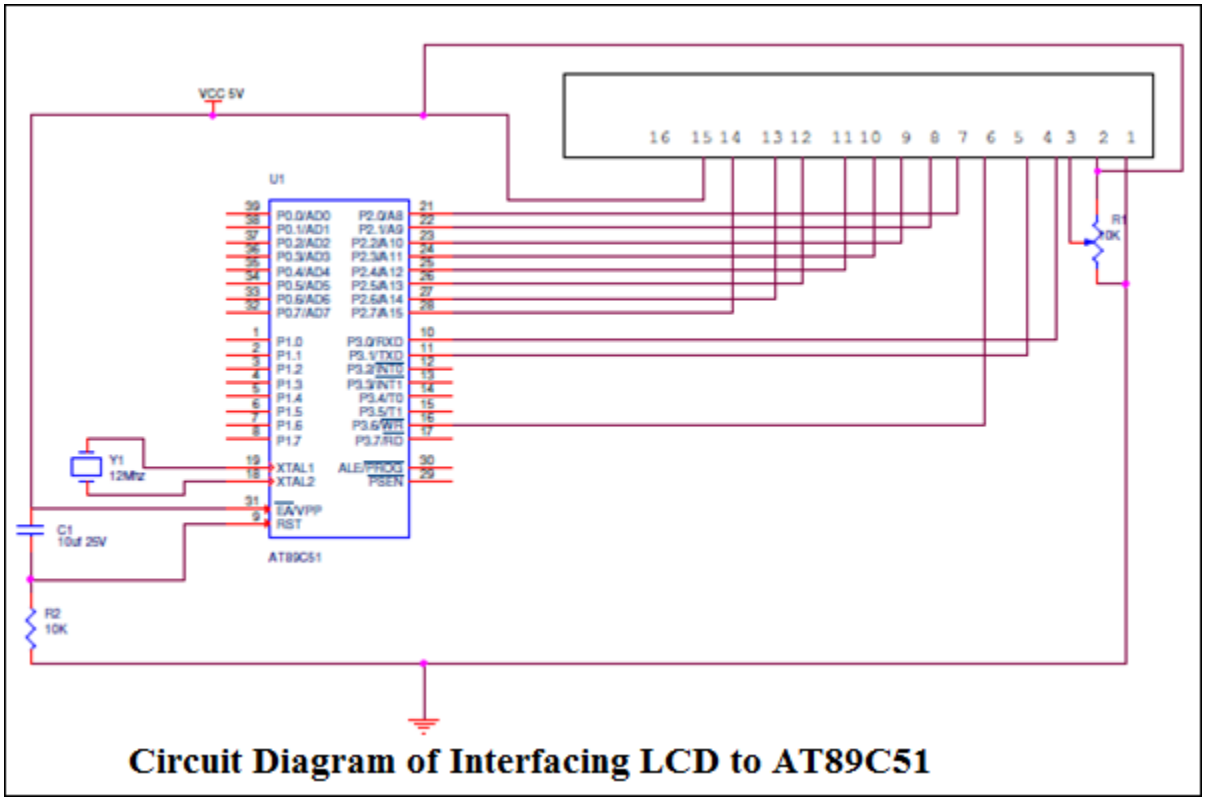
Interfacing 16×2 LCD with 8051

In this session we will have brief discussion on how to interface 16×2 LCD module to AT89C51which is a 8051 family microcontroller. We use LCD display for the messages for more interactive way to operate the system or displaying error messages etc. interfacing LCD to microcontroller is very easy if you understanding the working of LCD, in this session I will not only give the information of LCD and also provide the code in C language which is working fine without any errors.

Interfacing 16×2 LCD with 8051 Circuit Diagram:



Circuit Diagram of Interfacing LCD to AT89C51

Interfacing LCD to AT89C51:

LCD: 16×2 Liquid Crystal Display which will display the 32 characters at a time in two rows (16 characters in one row). Each character in the display of size 5×7 pixel matrix, Although this matrix differs for different 16×2 LCD modules if you take JHD162A this matrix goes to 5×8. This matrix will not be same for all the 16×2 LCD modules. There are 16 pins in the LCD module, the pin configuration us given below

PIN NO	NAME	FUNCTION
1	VSS	Ground pin
2	VCC	Power supply pin of 5V
3	VEE	Used for adjusting the contrast commonly attached to the potentiometer.
4	RS	RS is the register select pin used to write display data to the LCD (characters), this pin has to be high when writing the data to the LCD. During the initializing sequence and other commands this pin should low.
5	R/W	Reading and writing data to the LCD for reading the data R/W pin should be high (R/W=1) to write the data to LCD R/W pin should be low (R/W=0)
6	E	Enable pin is for starting or enabling the module. A high to low pulse of about 450ns pulse is given to this pin.
7	DB0	
8	DB1	
9	DB2	
10	DB3	
11	DB4	DB0-DB7 Data pins for giving data(normal data like numbers characters or command data) which is meant to be displayed
12	DB5	
13	DB6	

PIN NO	NAME	FUNCTION
14	DB7	
15	LED+	Back light of the LCD which should be connected to Vcc
16	LED-	Back light of LCD which should be connected to ground.

So by reading the above table you can get a brief idea how to display a character. For displaying a character you should enable the enable pin (pin 6) by giving a pulse of 450ns, after enabling the pin6 you should select the register select pin (pin4) in write mode. To select the register select pin in write mode you have to make this pin high (RS=1), after selecting the register select you have to configure the R/W to write mode that is R/W should be low (R/W=0).

Follow these simple steps for displaying a character or data

- E=1; enable pin should be high
- RS=1; Register select should be high
- R/W=0; Read/Write pin should be low.

To send a command to the LCD just follows these steps:

- E=1; enable pin should be high
- RS=0; Register select should be low
- R/W=1; Read/Write pin should be high.

Commands: There are some preset commands which will do a specific task in the LCD. These commands are very important for displaying data in LCD. The list of commands given below:

Command	Function
0F	For switching on LCD, blinking the cursor.
1	Clearing the screen

Command	Function
2	Return home.
4	Decrement cursor
6	Increment cursor
E	Display on and also cursor on
80	Force cursor to beginning of the first line
C0	Force cursor to beginning of second line
38	Use two lines and 5x7 matrix
83	Cursor line 1 position 3
3C	Activate second line
0C3	Jump to second line position 3
0C1	Jump to second line position1

Circuit Explanation:

The crystal oscillator is connected to XTAL1 and XTAL2 which will provide the system clock to the microcontroller the data pins and remaining pins are connected to the microcontroller as shown in the circuit. The potentiometer is used to adjust the contrast of the LCD. You can connect data pins to any port. If you are connecting to port0 then you have to use pull up registers. The enable, R/W and RS pins are should be connected to the 10, 11 and 16 (P3.3, P3.4 and P3.5).

Programming LCD to 8051:

Coming to the programming you should follow these steps:

- STEP1: Initialization of LCD.
- STEP2: Sending command to LCD.
- STEP3: Writing the data to LCD.

Initializing LCD: To initialize LCD to the 8051 the following instruction and commands are to be embed in to the functions

- 0×38 is used for 8-bit data initialization.
- 0xFH for making LCD on and initializing the cursor.
- 0X6H for incrementing the cursor which will help to display another character in the LCD
- 0x1H for clearing the LCD.

Sending data to the LCD:

- E=1; enable pin should be high
- RS=1; Register select should be high for writing the data
- Placing the data on the data registers
- R/W=0; Read/Write pin should be low for writing the data.

The program given below will use above functions and display the complete string which is given by the programmer to display the data. You have provided two demo codes working properly and easy to understand.

```
#include <REGX51.H>
#include <string.h>
#include <stdio.h>

sfr  LCD=0xa0;
sbit EN=P3^6;
sbit RS=P3^7;

voidnop(void);
void delay_1s(unsigned char t);
voidinitial_lcd(void);
void delay(void);
voidstring_to_lcd(unsigned char *s);
voidwrite_lcd(unsigned char dat,unsignedint com);
void delay_50ms(unsigned char x);
```

```
void main()
{

P0=0xff;
P1=0xff;
P3=0xff;
delay_50ms(4);
initial_lcd();
write_lcd(0×80,0);
string_to_lcd(“   WELCOME TO   “);
write_lcd(0xc0,0);
string_to_lcd(“INNOVATE ENG SOL”);

}

voidnop(void)
{

unsigned char n;
for(n=0;n<20;n++);

}

//……delay routine……..//

void delay_1s(unsigned char t)
{

unsigned char i,j;
for(i=0;i<t;i++)

{

for(j=0;j<20;j++)

{
```

```
TMOD=0×01;
TH0=0x3c;             //for 12MHz   (12/12MHZ)=1u>per cycle operation
TL0=0xb0;           //50ms delay get (50m/1u)=50000;
TR0=1;               //Load value is =65536-50000=15536(=3cb0H)

while(TF0!=1);  //wait for overflow flag
TF0=0;

}

}

}

voidinitial_lcd(void)
{

write_lcd(0×38,0);
write_lcd(0x0c,0);
write_lcd(0×01,0);

}

voidwrite_lcd(unsigned char dat,unsignedint com)
{

RS=com;
LCD=dat;nop();
EN=1;nop();
EN=0;
nop();

}

voidstring_to_lcd(unsigned char *s)

{
```

```
unsigned char i,l;
l=strlen(s);
for(i=0;i<l;i++)

{

write_lcd(*s,1);delay_50ms(1);
s++;

}

}

void delay_50ms(unsigned char x)
{

unsigned char i;
for(i=0;i<x;i++)

{

TMOD=0×01;
TH0=0x3c;
TL0=0xb0;
TR0=1;
while(!TF0);
TF0=0;
TR0=0;

}

}
```

********** SECOND DEMO CODE**********

```
#include<reg51.h>
#define cmdport P3
```

```
#define dataport P2
#define q 100

sbitrs = cmdport^0;        //register select pin
sbitrw = cmdport^1;         //read write pin
sbit e = cmdport^6;        //enable pin

void delay(unsigned intmsec)    //Function to provide time delay in msec.

{

inti,j ;
for(i=0;i<msec;i++)
for(j=0;j<1275;j++);

}

voidlcdcmd(unsigned char item)    //Function to send command to LCD

{

dataport = item;
rs= 0;
rw=0;
e=1;
delay(1);
e=0;

}

voidlcddata(unsigned char item)    //Function to send data to LCD

{

dataport = item;
rs= 1;
rw=0;
```

```
e=1;
delay(1);
e=0;

}

void main()

{

lcdcmd(0×38);    //for using 8-bit 2 row mode of LCD
delay(100);
lcdcmd(0x0E);    //turn display ON for cursor blinking
delay(100);
lcdcmd(0×01);    //clear screen
delay(100);
lcdcmd(0×06);    //display ON
delay(100);
lcdcmd(0×86);    //bring cursor to position 6 of line 1
delay(100);
lcddata('A');

}
```

Source: www.electronicshub.org/interfacing-16x2-lcd-8051/