Experiment – 2

Title: LCD interfacing to PIC Microcontroller.

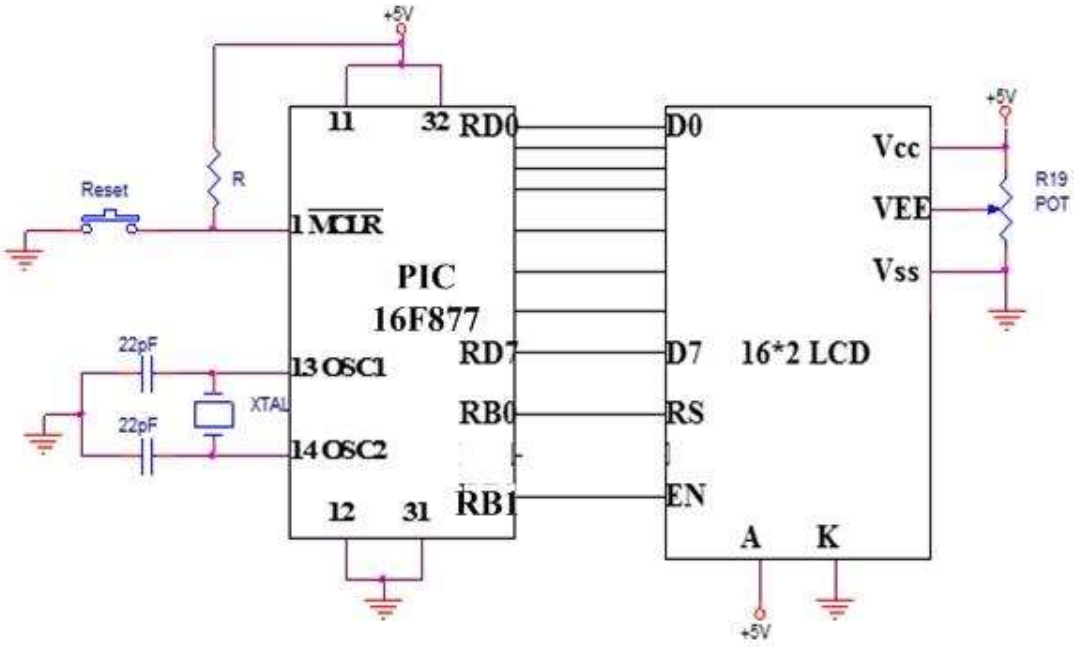
Aim: To interface 16*2 LCD display to PIC and display message on LCD.

Objectives:

- To study concept of LCD.
- To study MPLAB IDE software.
- To study LCD interfacing to PIC, flowcharts & programs.

Software Used: MPLAB IDE

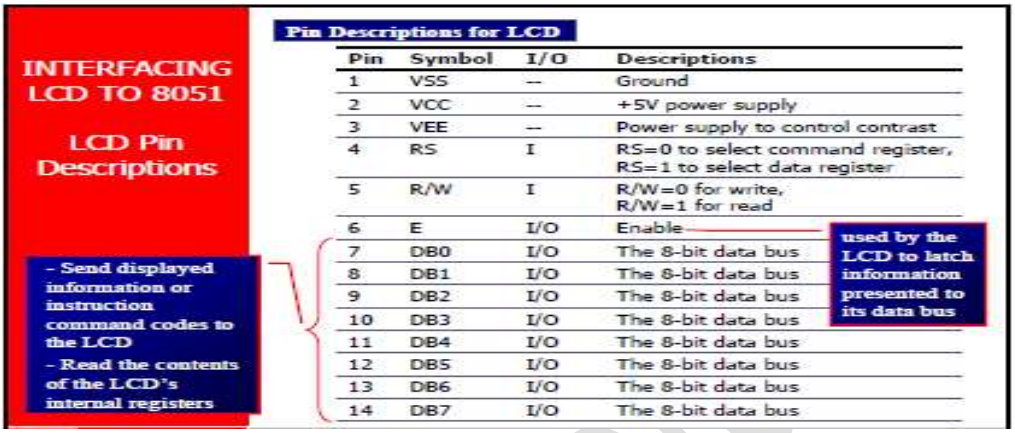
Block Diagram:



Theory:

LCD: A liquid crystal display (LCD) is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). They are used in a wide range of applications including: computer monitors, television, instrument panels, aircraft, cockpit display, signage, etc. It is an electronically modulated device made up of any number of pixels filled with liquid crystals. LCD has become very popular option for displaying in Embedded Applications. Since they are very cheap and easy to interface with microcontrollers, they are widely found in devices like telephones, vending machines, washing machines, toys etc. LCD comes in several varieties i.e. 16*2, 20*2, 20*4 etc. These different LCD varieties can display different number of characters i.e. 16*2 can display 32 characters at a time. The 16*2 model has 2 lines and 16 columns of display blocks. Each block can be used to display 1 character. So there are total 32 such blocks. One block has 8*5 pixels. Depending on which pixel is ON and which is OFF we can display several Alpha-Numeric characters. LCD also has a backlight,

which helps us to see the display even in dark. In reality this module consists of a controller chip, a segment driver chip, LCD display and some passive components. There are total 16 pins in the LCD module. While using LCD, we can think a simple analogy for its operation. Each of the 32 blocks is a memory, as soon as we write an ASCII number into one of these 32 memory locations the corresponding character is displayed on that block. The function of displaying the character after decoding the data is done by an onboard controller chip. The following table shows the LCD pin diagram, LCD commands.



Pin Descriptions for LCD

Pin	Symbol	I/O	Descriptions
1	VSS	--	Ground
2	VCC	--	+5V power supply
3	VEE	--	Power supply to control contrast
4	RS	I	RS=0 to select command register, RS=1 to select data register
5	R/W	I	R/W=0 for write, R/W=1 for read
6	E	I/O	Enable
7	DB0	I/O	The 8-bit data bus
8	DB1	I/O	The 8-bit data bus
9	DB2	I/O	The 8-bit data bus
10	DB3	I/O	The 8-bit data bus
11	DB4	I/O	The 8-bit data bus
12	DB5	I/O	The 8-bit data bus
13	DB6	I/O	The 8-bit data bus
14	DB7	I/O	The 8-bit data bus

Figure: LCD pin diagram

COMMAND	COMMAND CODE										COMMAND CODE	E-CYCLE f_{osc}=250KHz
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
SCREEN CLEAR	0	0	0	0	0	0	0	0	0	1	Screen Clear, Set AC to 0 Cursor Reposition	1.64ms
CURSOR RETURN	0	0	0	0	0	0	0	0	1	*	DDRAM AD=0, Return, Content Changeless	1.64ms
INPUT SET	0	0	0	0	0	0	0	1	I/D	S	Set moving direction of cursor, Appoint if move	40us
DISPLAY SWITCH	0	0	0	0	0	0	1	D	C	B	Set display on/off,cursor on/off, blink on/off	40us
SHIFT	0	0	0	0	0	1	S/C	R/L	*	*	Remove cursor and whole display,DDRAM changeless	40us
FUNCTION SET	0	0	0	0	1	DL	N	F	*	*	Set DL,display line,font	40us
CGRAM AD SET	0	0	0	1	ACG						Set CGRAM AD, send receive data	40us
DDRAM AD SET	0	0	1	ADD							Set DDRAM AD, send receive data	40us
BUSY/AD READ CT	0	1	BF	AC							Executing internal function, reading AD of CT	40us
CGRAM/ DDRAM DATA WRITE	1	0	DATA WRITE								Write data from CGRAM or DDRAM	40us
CGRAM/ DDRAM DATA READ	1	1	DATA READ								Read data from CGRAM or DDRAM	40us
	I/D=1: Increment Mode; I/D=0: Decrement Mode S=1: Shift S/C=1: Display Shift; S/C=0: Cursor Shift R/L=1: Right Shift; R/L=0: Left Shift DL=1: 8D DL=0: 4D N=1: 2R N=0: 1R F=1: 5x10 Style; F=0: 5x7 Style BF=1: Execute Internal Function; BF=0: Command Received										DDRAM: Display data RAM CGRAM: Character Generator RAM ACG: CGRAM AD ADD: DDRAM AD & Cursor AD AC: Address counter for DDRAM & CGRAM	E-cycle changing with main frequency. Example: If fcp or f_{osc}=270KHz 40us x 250/270 =37us

Figure: LCD commands

Procedure:

- Make necessary connections to connect the LCD to PIC target board. Connect PORTD to the data pins of LCD and PORTB to the control pins.
- Switch on the power.
- Start MPLAB IDE software PC and write a program to display message on LCD.
- Perform the configuration settings and build it.

- Connect the PICKit3 programmer to the Target board.
- Program the .hex file into the PIC.
- Reset the microcontroller and observe the output on LCD.

Program:

```
#define _XTAL_FREQ 16000000
#include <xc.h>
#define RS PORTBbits.RB0
#define EN PORTBbits.RB1
void LCD_init(void);
void lcd_cmd(unsigned char value);
void lcd_data(unsigned char value1);

void main(void)
{
LCD_init();
lcd_data('H');
lcd_data('e');
lcd_data('l');
lcd_data('l');
lcd_data('o');
while(1);
}
void LCD_init(void)
{
TRISD=0X00;                                    //make PORTD o/p
TRISB=0X00;                                    //make PORTD o/p
__delay_ms(100);                               //delay
EN=1;
__delay_us(2);
EN=0;
__delay_ms(3);                                 //2ms delay
lcd_cmd(0x38);
lcd_cmd(0x0E);
lcd_cmd(0x01);
__delay_ms(2);                                 //2ms delay
```

```
lcd_cmd(0x06);
lcd_cmd(0x80);
}

void lcd_cmd(unsigned char value)
{
PORTD=value;
RS=0;
EN=1;
__delay_us(2);
EN=0;
__delay_ms(3);                                  //2ms delay
}

void lcd_data(unsigned char value1)
{
PORTD=value1;
RS=1;                                           //Select data reg
EN=1;
__delay_us(2);
EN=0;
__delay_ms(3);                                  //2ms delay
}
```

Applications: (Write applications of LCD here)

Result: Interfacing of 16*2 LCD with PIC microcontroller is studied successfully and observed the message displayed on LCD.

Teacher's Sign

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