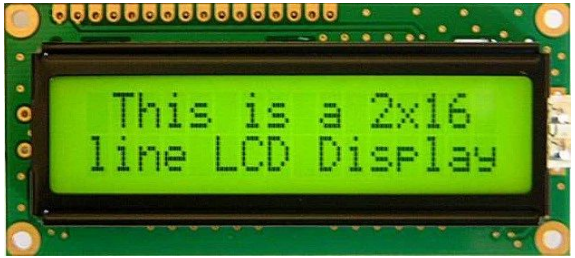
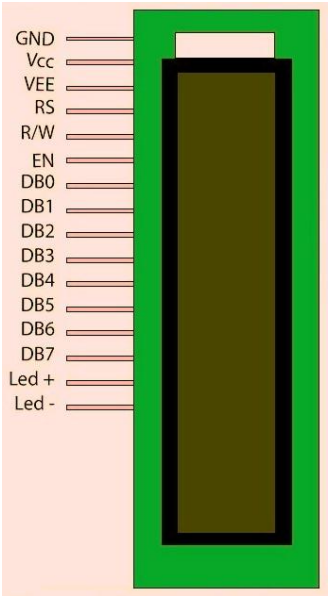
LCD

AVR Session

What is an LCD?





PIN No	Name	Function
1	VSS	Ground voltage
2	VCC	+5V
3	VEE	Contrast voltage
4	RS	Register Select 0 = Instruction Register 1 = Data Register
5	R/W	Read/ Write, to choose write or read mode 0 = write mode 1 = read mode
6	E	Enable 0 = start to latch data to LCD character 1= disable
7	DB0	Data bit 0 (LSB)
8	DB1	Data bit 1
9	DB2	Data bit 2
10	DB3	Data bit 3
11	DB4	Data bit 4
12	DB5	Data bit 5
13	DB6	Data bit 6
14	DB7	Data bit 7 (MSB)
15	BPL	Back Plane Light +5V or lower (Optional)
16	GND	Ground voltage (Optional)

The Instruction Set

Instruction	Code RS	R/$\overline{W}$	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description	Execution Time (max) (when f_{cp} or f_{osc} is 270 kHz)
Clear display	0	0	0	0	0	0	0	0	0	1	Clears entire display and sets DDRAM address 0 in address counter.	
Return home	0	0	0	0	0	0	0	0	1	—	Sets DDRAM address 0 in address counter. Also returns display from being shifted to original position. DDRAM contents remain unchanged.	1.52 ms
Entry mode set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies display shift. These operations are performed during data write and read.	37 s
Display on/off control	0	0	0	0	0	0	1	D	C	B	Sets entire display (D) on/off, cursor on/off (C), and blinking of cursor position character (B).	37 s
Cursor or display shift	0	0	0	0	0	1	S/C	R/L	—	—	Moves cursor and shifts display without changing DDRAM contents.	37 s
Function set	0	0	0	0	1	DL	N	F	—	—	Sets interface data length (DL), number of display lines (N), and character font (F).	37 s
Set CGRAM address	0	0	0	1	ACG	ACG	ACG	ACG	ACG	ACG	Sets CGRAM address. CGRAM data is sent and received after this setting.	37 s
Set DDRAM address	0	0	1	ADD	ADD	ADD	ADD	ADD	ADD	ADD	Sets DDRAM address. DDRAM data is sent and received after this setting.	37 s
Read busy flag & address	0	1	BF	AC	AC	AC	AC	AC	AC	AC	Reads busy flag (BF) indicating internal operation is being performed and reads address counter contents.	0 s

How to control LCD

The uC sends commands to the LCD by setting RS, RW, and DB0...DB7 to specific values

What data to send for each command is given in the Instruction Set.

Fortunately people have mapped each instruction to a C function and provided it in a header file, so we don’t have to remember the instruction code or keep referring to the instruction set.

So, we will be using this header file “lcd.h”

Example Code:

```
#include <avr/io.h>
#include <avr/delay.h>

#include “lcd.h”

int main(){
      LCD_init();

      LCD_write(“Hello AVR”); // You can write strings
      LCD_putchar(“!”);       // You can also write single characters

      _delay_ms(3000);        // Display text for 3s

      LCD_wait();             // Waits until any previous command finishes, LCD is free
      LCD_command(0x01);      // This is how you send commands
                              // This command will clear the screen
                              // Look it up in the Instruction Set

      LCD_write(“Elec Club rocks!”);

      while(1);

return 0;
}
```

We can implement functions of our own too!

```
.
.
.

void LCD_clrscr(){
      LCD_wait();
      LCD_command(0x01);
}

int main(){
      ...

      LCD_clrscr();   // Now you don't need to remember 0x01 represents clear screen! :D

      ...
}
```

This is essentially what "**lcd.h**" does. Open the file and see its contents! Try to understand the various functions by seeing what command they send and looking up the Instruction Sheet!

Let’s implement a function by looking up the Instruction Sheet now!

lcd.h does not have an important function which moves cursor to a position (x,y). We will try to implement that. Each block in the LCD which displays a character is represented by a DDRAM block. Hence to set the cursor position we need to set the DDRAM address.

Lets look at the Instruction Sheet.

Instruction	Code RS	R/$\overline{W}$	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description	(max) (when f_{cp} or f_{osc} is 270 kHz)
address											received after this setting.	
Set DDRAM address	0	0	1	ADD	ADD	ADD	ADD	ADD	ADD	ADD	Sets DDRAM address. DDRAM data is sent and received after this setting.	37 s

We need to set DB7 to 1 and DB6...DB0 to the address we want.

The addresses of 16x2 LCD are 0...15 for the first line and 64...79 for the second line. 16 characters per line. So lets write our function.

```
void LCD_cursor_goto(int x, int y){
      char addr = 0x80;              // Set DB7 to 1
      if(y==1)
            addr = addr + 0x40;      // Start counting from 64(0x40) for line 2
      addr = addr + x;         // Finally add x position to get address

      LCD_wait();                    // wait until any previous command finishes
      LCD_command(addr);             // Send command to LCD
}
```