

LCD Interfacing

sarwan@NIELIT Chandigarh

LCD Interfacing

- ▶ Liquid Crystal Displays (LCDs)
- ▶ **cheap** and **easy** way to display text
- ▶ Various configurations (1 line by 20 X char upto 8 lines X 80).
- ▶ Integrated controller
- ▶ The display has two register
 - ▶ **command** register
 - ▶ **data** register
- ▶ By **RS** you can select register
- ▶ Data lines (DB7-DB0) used to transfer data and commands

Alphanumeric LCD Interfacing

Microcontroller

▶ Pinout

- ▶ 8 data pins D7:D0
- ▶ RS: Data or Command Register Select
- ▶ R/W: Read or Write
- ▶ E: Enable (Latch data)

▶ RS – Register Select

- ▶ RS = 0 → Command Register
- ▶ RS = 1 → Data Register

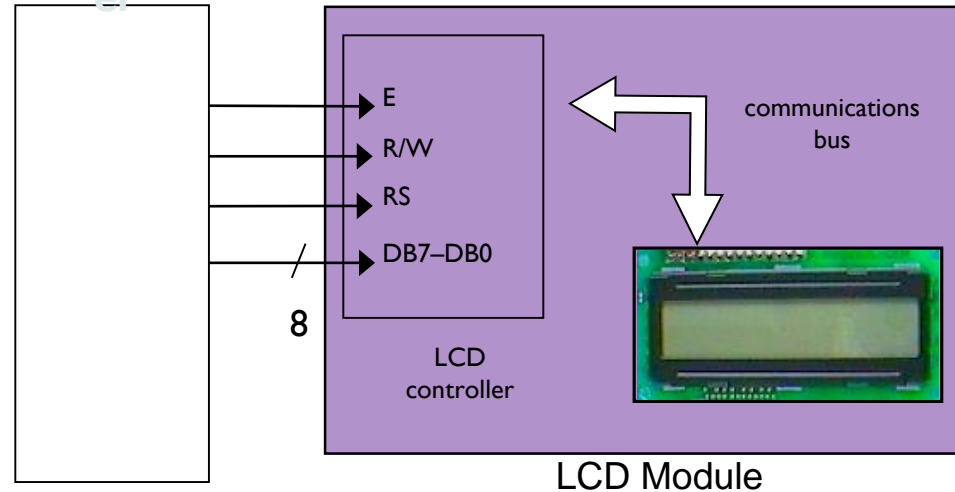
▶ R/W = 0 → Write , R/W = 1 → Read

▶ E – Enable

- ▶ Used to latch the data present on the data pins.

▶ D0 – D7

- ▶ Bi-directional data/command pins.
- ▶ Alphanumeric characters are sent in ASCII format.



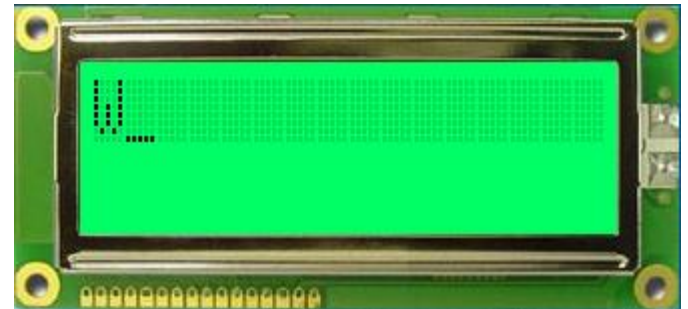
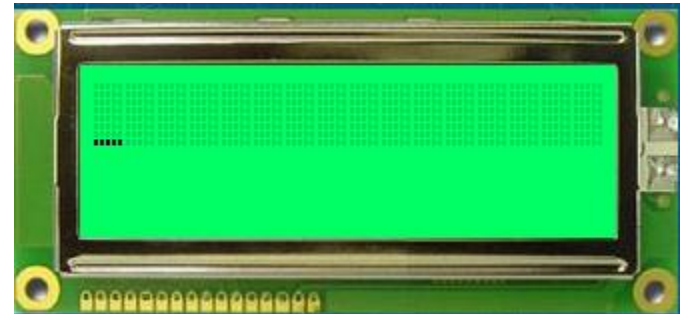
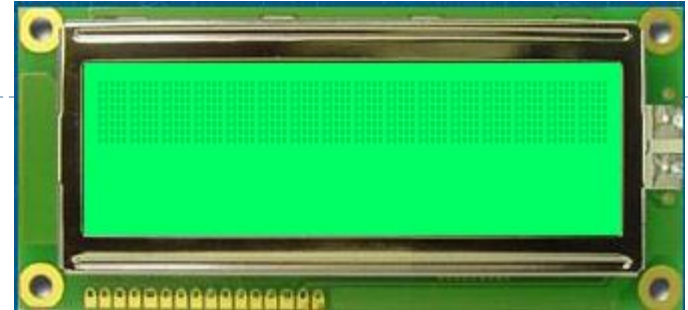
LCD Working

```
instr ( 0x0F );
```

```
instr ( int i ) {  
    RS = 1;  
    Enable = 1 ;  
    P1 = i ;  
    Enable = 0 ;  
}
```

```
data ( 'W' );
```

```
data ( int i ) {  
    RS = 0;  
    Enable = 1 ;  
    P1 = i ;  
    Enable = 0 ;  
}
```



LCD Commands

- ▶ The LCD's internal controller can accept several commands and modify the display accordingly. These commands would be things like:
 - ▶ Clear screen
 - ▶ Return home
 - ▶ Decrement/Increment cursor
- ▶ After writing to the LCD, it **takes some time** for it to complete its internal operations. During this time, it will not accept any new commands or data.
 - ▶ We need to insert time **delay** between any two commands or data sent to LCD

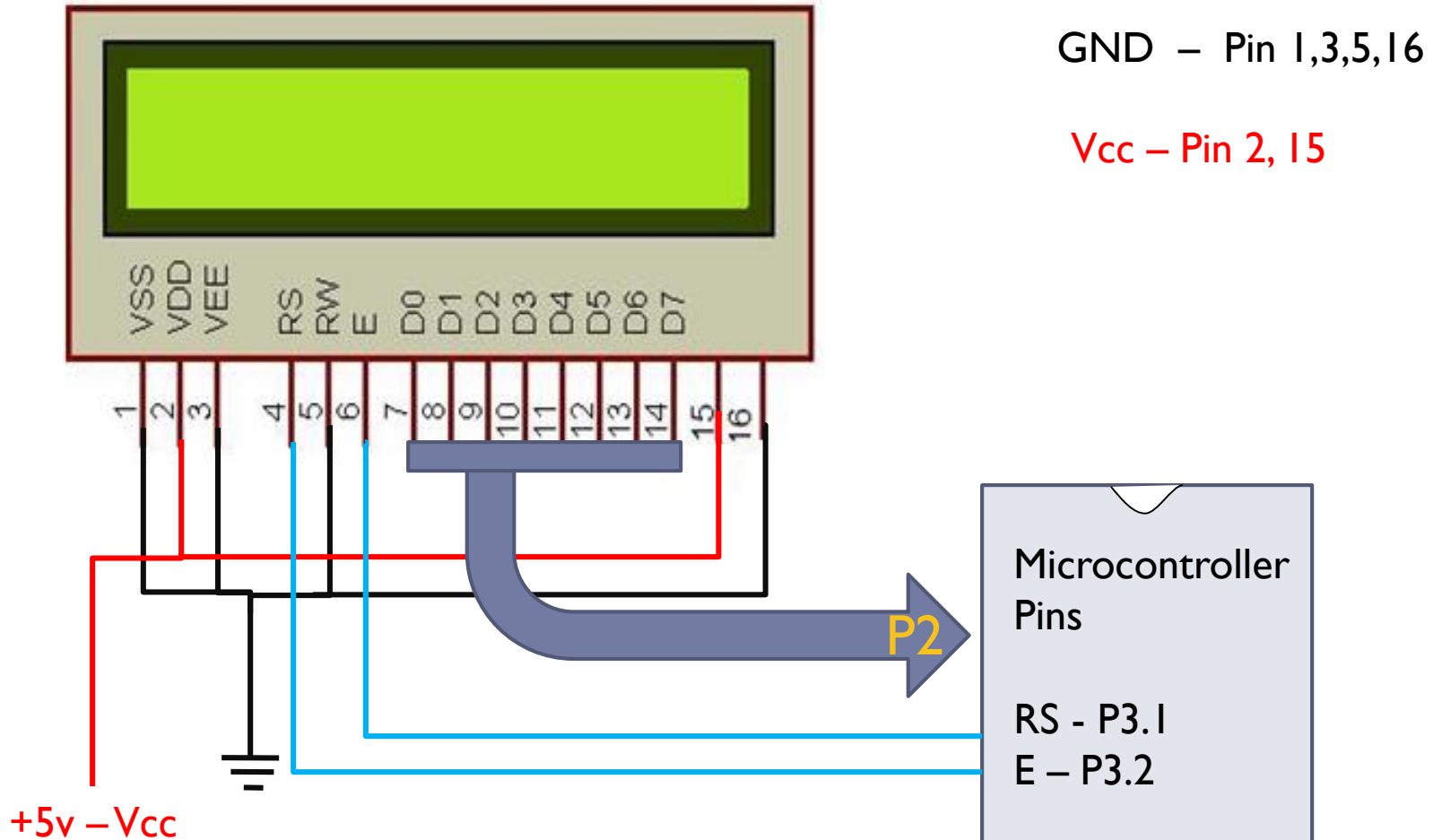
Pin Diagram

Pin No.	Name	Input / Output	Description
Pin no. 1	V_{SS}	-	Power supply (GND)
Pin no. 2	V_{CC}	-	Power supply (+5V)
Pin no. 3	V_{EE}	-	Power supply to control Contrast
Pin no. 4	RS	Input	0 = Instruction input 1 = Data input
Pin no. 5	R/W	Input	0 = Write to LCD module 1 = Read from LCD module
Pin no. 6	EN	Input / Output	Enable signal
Pin no. 7	D0	Input / Output	Data bus line 0 (LSB)
Pin no. 8	D1	Input / Output	Data bus line 1
Pin no. 9	D2	Input / Output	Data bus line 2
Pin no. 10	D3	Input / Output	Data bus line 3
Pin no. 11	D4	Input / Output	Data bus line 4
Pin no. 12	D5	Input / Output	Data bus line 5
Pin no. 13	D6	Input / Output	Data bus line 6
Pin no. 14	D7	Input / Output	Data bus line 7 (MSB)
Pin no. 15	Backlight	Input	+5v for LED backlight (+5V)
Pin no. 16	Backlight	Input	Ground for LED backlight (GND)

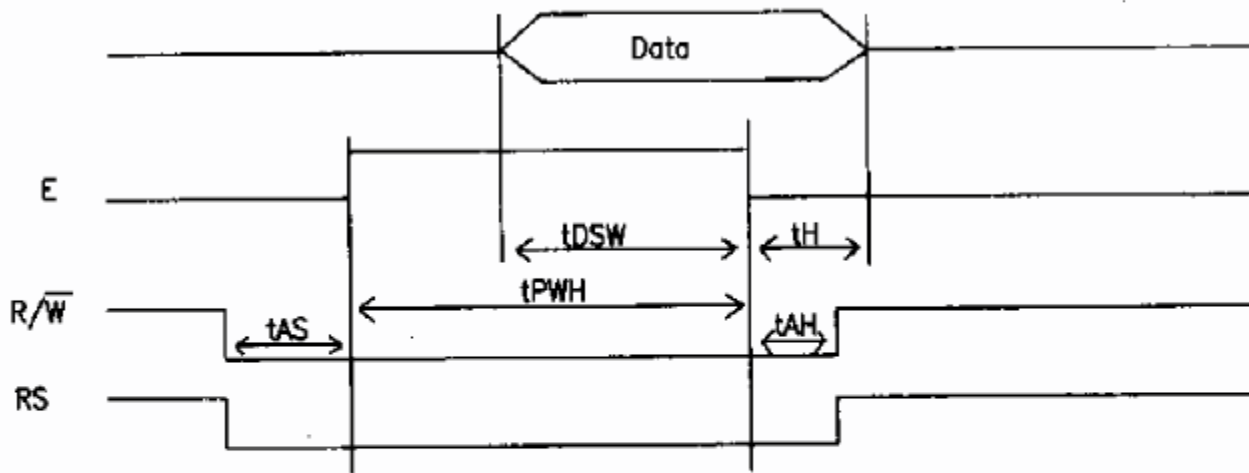
LCD Commands

Code (Decimal)	Code (Hex)	Command to LCD Instruction Register
1	0x01	Clear display screen
2	0x02	Return Home
4	0x04	Decrement cursor (shift cursor to left)
6	0x05	Increment cursor (shift cursor to right)
6	0x06	shift display right
7	0x07	shift display left
8	0x08	Display off, cursor off
10	0x0A	Display off, cursor on
12	0x0C	Display on, cursor off
14	0x0E	Display on, cursor on
15	0x0F	Display on, cursor blinking
16	0x10	Shift cursor position to left
20	0x14	Shift cursor position to right
24	0x18	Shift the entire display to the left
30	0x1C	Shift the entire display to the right
128	0x80	Force cursor to the beginning of 1st line
192	0xC0	Force cursor to the beginning of 2nd line
56	0x38	2 lines and 5 x 7 matrix

Circuit Diagram



LCD Timing



t_{PWH} = Enable pulse width = 450 ns (minimum)
 t_{DSW} = Data set up time = 195 ns (minimum)
 t_H = Data hold time = 10 ns (minimum)
 t_{AS} = Set up time prior to E (going high) for both RS and R/W = 140 ns (minimum)
 t_{AH} = Hold time after E has come down for both RS and R/W = 10 ns (minimum)

Figure 4-37. LCD Timing