Sohag University
Faculty of Engineering

4th year Communication Dept.
Embedded Laboratory

LAB2

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LCD

LCD

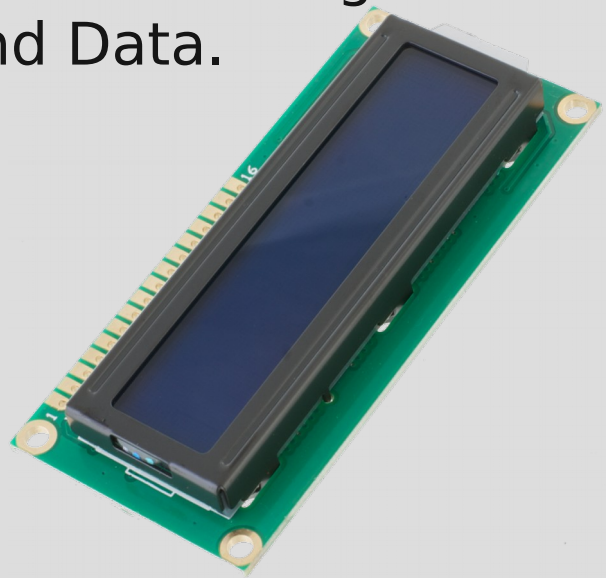
- Liquid Crystal Display

- **16x2 LCD**
  - Find the datasheet here

    What do you think!  find out as much information as possible.

16x2 LCD

- Very basic module and commonly used in various devices and circuits.
- 16X2: 16 characters per line
  2 lines
- Has 16 pins
- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Has two registers, Command and Data.

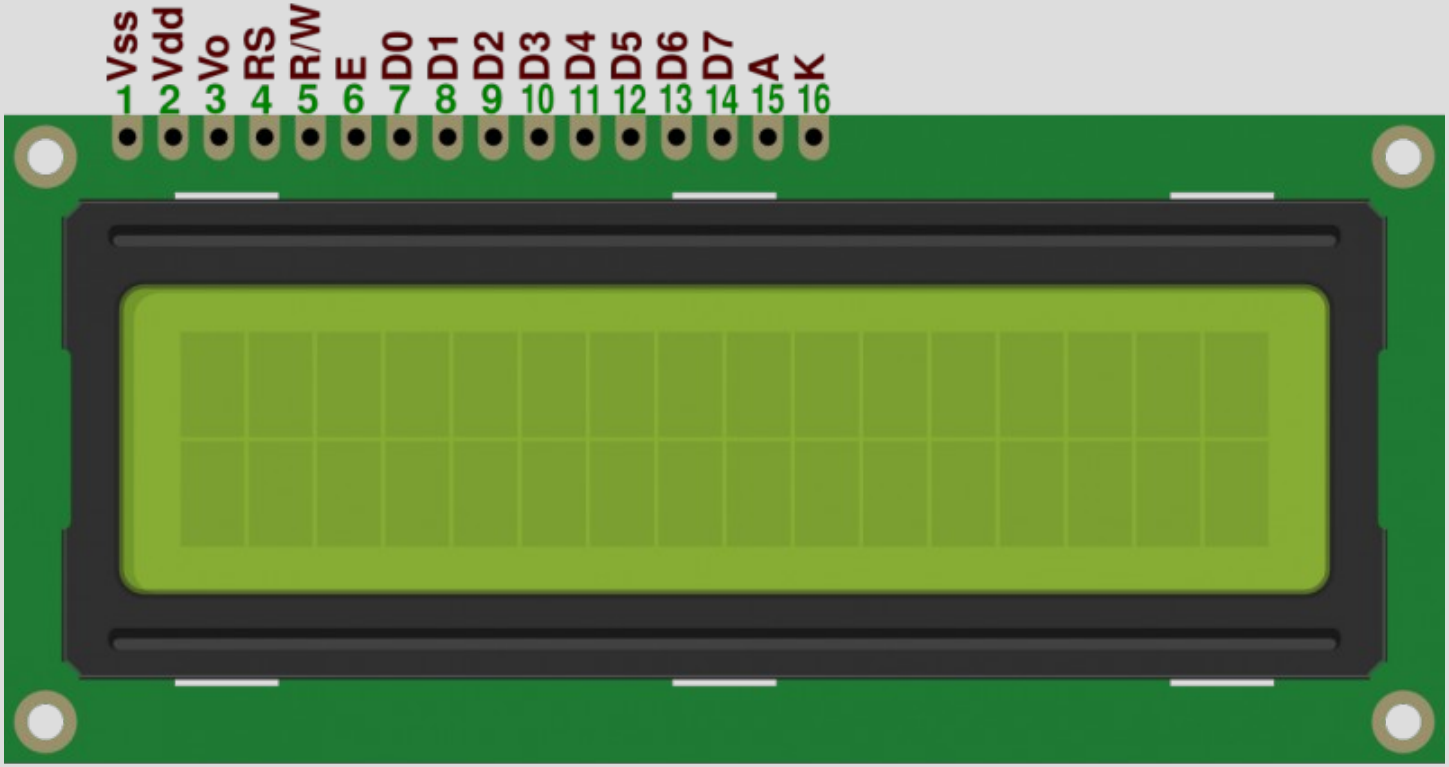


Registers

- Command Register:
  - an instruction given to LCD to do a predefined task
  - initializing , clearing screen, setting the cursor position, controlling display … etc.

- Data Register:
  - the data to be displayed on the LCD
  - the data is the ASCII value of the character to be displayed on the LCD

Pins Description:



From datasheet:

LCD-016M002B

Vishay

16 x 2 Character LCD

PIN NUMBER	SYMBOL	FUNCTION
1	Vss	GND
2	Vdd	+ 3V or + 5V
3	Vo	Contrast Adjustment
4	RS	H/L Register Select Signal
5	$R/\overline{W}$	H/L Read/Write Signal
6	E	H →L Enable Signal
7	DB0	H/L Data Bus Line
8	DB1	H/L Data Bus Line
9	DB2	H/L Data Bus Line
10	DB3	H/L Data Bus Line
11	DB4	H/L Data Bus Line
12	DB5	H/L Data Bus Line
13	DB6	H/L Data Bus Line
14	DB7	H/L Data Bus Line
15	A/Vee	+ 4.2V for LED/Negative Voltage Output
16	K	Power Supply for B/L (OV)

- VSS : Ground (0V)
- Vdd: Supply voltage, 5V (4.7V – 5.3V)
- Vo: Contrast adjustment

  grounded to get maximum contrast.
- RS: Register Select.

  Low → command register

  High → data register
-
-

- R/W: Read/Write data.
  - Low → write to the register
  - High → read from the register
- E: toggled between 1 and 0 for data acknowledgment
  - Must be held high to perform Read/Write Operation.
- DB0-DB7: Data Bus Line
  - send Command or data to the LCD
- A: Backlight VCC (5V) Led+
- K: Backlight Ground (0V) Led-

Lcd Library

void Lcd_Init();

- Initializes Lcd module.
- Requires:

  LCD_D7: Data bit 7
  LCD_D6: Data bit 6
  LCD_D5: Data bit 5
  LCD_D4: Data bit 4
  LCD_RS: Register Select (data/instruction) signal pin
  LCD_EN: Enable signal pin

  LCD_D7_Direction: Direction of the Data 7 pin
  LCD_D6_Direction: Direction of the Data 6 pin
  LCD_D5_Direction: Direction of the Data 5 pin
  LCD_D4_Direction: Direction of the Data 4 pin
  LCD_RS_Direction: Direction of the Register Select pin
  LCD_EN_Direction: Direction of the Enable signal pin

Example:

```
// Lcd pinout settings
sbit LCD_RS at RB4_bit;
sbit LCD_EN at RB5_bit;
sbit LCD_D7 at RB3_bit;
sbit LCD_D6 at RB2_bit;
sbit LCD_D5 at RB1_bit;
sbit LCD_D4 at RB0_bit;


// Pin direction
sbit LCD_RS_Direction at TRISB4_bit;
sbit LCD_EN_Direction at TRISB5_bit;
sbit LCD_D7_Direction at TRISB3_bit;
sbit LCD_D6_Direction at TRISB2_bit;
sbit LCD_D5_Direction at TRISB1_bit;
sbit LCD_D4_Direction at TRISB0_bit;
...


Lcd_Init();
```

void Lcd_Out(char row, char column, char *text);

- Prints text on LCD starting from specified position..
- Requires:
  The Lcd module needs to be initialized

Example:

```
// Write text "Hello!" on Lcd starting from row 1, column 3:
Lcd_Out(1, 3, "Hello!");
```

void Lcd_Out_Cp(char *text);

- Prints text on Lcd at current cursor position
- Requires:
  The LCD module needs to be initialized

Example:

```
// Write text "Here!" at current cursor position:
Lcd_Out_Cp("Here!");
```

void Lcd_Chr(char row, char column, char out_char);

- Prints character on Lcd at specified position.
- Requires:
  - The LCD module needs to be initialized

Example:

```
// Write character "i" at row 2, column 3:
Lcd_Chr(2, 3, 'i');
```

void Lcd_Chr_Cp(char out_char);

- Prints character on Lcd at current cursor position.
- Requires:
  The LCD module needs to be initialized

Example:

```
// Write character "e" at current cursor position:
Lcd_Chr_Cp('e');
```

void Lcd_Cmd(char out_char);

- Sends command to Lcd.
- Requires:
  The LCD module needs to be initialized

Example:

```
// Clear Lcd display:
Lcd_Cmd(_LCD_CLEAR);
```

Lcd Commands:

_LCD_FIRST_ROW → Move cursor to the 1st row

_LCD_SECOND_ROW → Move cursor to the 2nd row

_LCD_THIRD_ROW → Move cursor to the 3rd row

_LCD_FOURTH_ROW → Move cursor to the 4th row

_LCD_CLEAR → Clear display

_LCD_RETURN_HOME → Return cursor to home position, returns a shifted display to its original position.

_LCD_CURSOR_OFF → Turn off cursor

_LCD_SHIFT_RIGHT → This function is used for shifting on the right hand side.

_LCD_SHIFT_LEFT → This function is used for shifting on the left hand side.

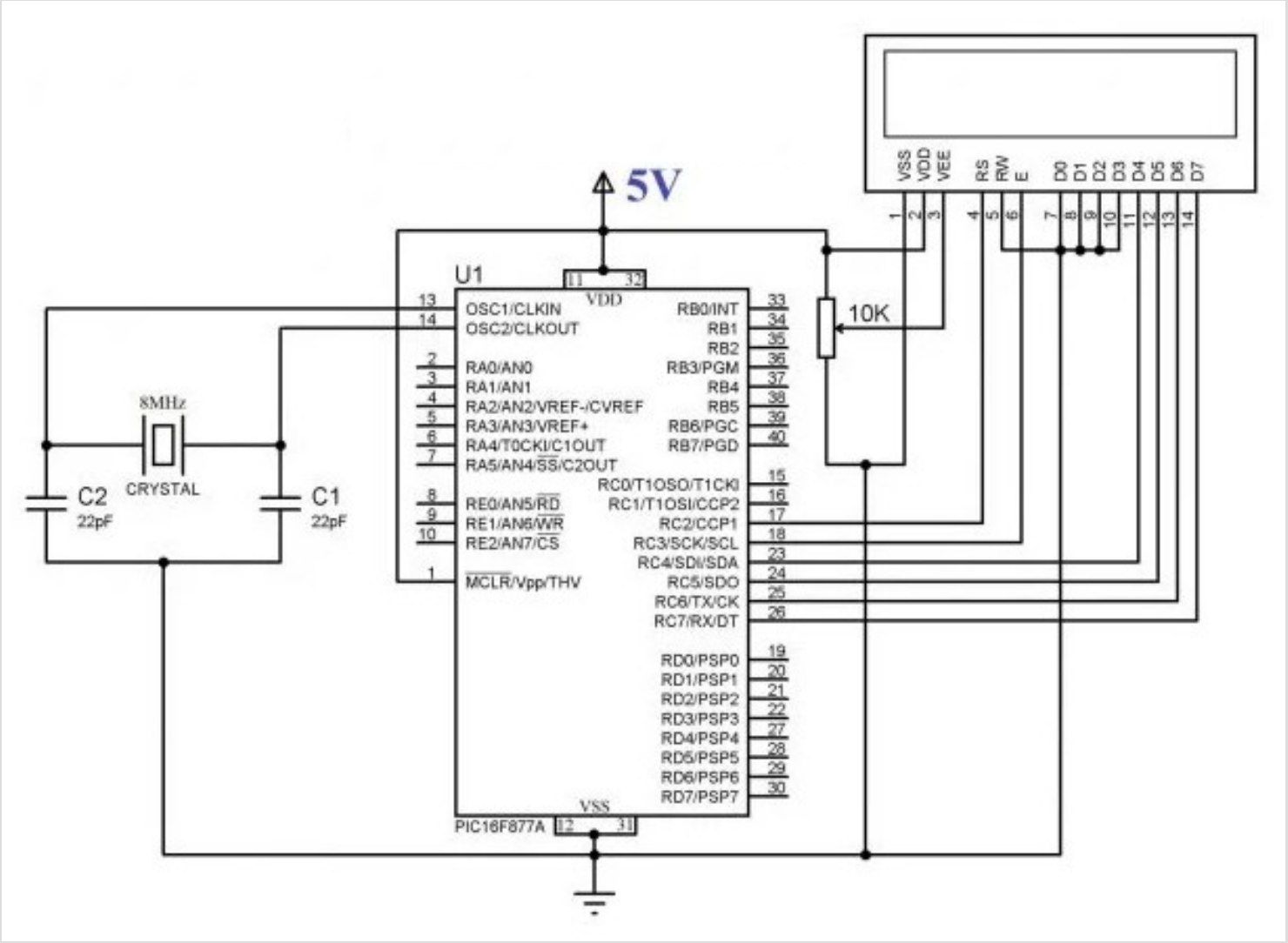
_LCD_TURN_ON → Turn Lcd display on

_LCD_TURN_OFF → Turn Lcd display off

Example:

MikroC Pro Code

```
// LCD module connections
sbit LCD_RS at RC2_bit;
sbit LCD_EN at RC3_bit;
sbit LCD_D4 at RC4_bit;
sbit LCD_D5 at RC5_bit;
sbit LCD_D6 at RC6_bit;
sbit LCD_D7 at RC7_bit;
sbit LCD_RS_Direction at TRISC2_bit;
sbit LCD_EN_Direction at TRISC3_bit;
sbit LCD_D4_Direction at TRISC4_bit;
sbit LCD_D5_Direction at TRISC5_bit;
sbit LCD_D6_Direction at TRISC6_bit;
sbit LCD_D7_Direction at TRISC7_bit;
// End LCD module connections
void main()
{
 Lcd_Init(); // Initialize LCD
 Lcd_Cmd(_LCD_CLEAR); // Clear display
 Lcd_Cmd(_LCD_CURSOR_OFF); // Cursor off
 Lcd_Out(1,1,"Hello World");//Write text'Hello World' in first row
}
```


5V
U1
VDD
VSS
PIC16F877A
OSC1/CLKIN
OSC2/CLKOUT
RA0/AN0
RA1/AN1
RA2/AN2/VREF-/CVREF
RA3/AN3/VREF+
RA4/T0CKI/C1OUT
RA5/AN4/SS/C2OUT
RE0/AN5/RD
RE1/AN6/WR
RE2/AN7/CS
MCLR/Vpp/THV
RB0/INT
RB1
RB2
RB3/PGM
RB4
RB5
RB6/PGC
RB7/PGD
RC0/T1OSO/T1CKI
RC1/T1OSI/CCP2
RC2/CCP1
RC3/SCK/SCL
RC4/SDI/SDA
RC5/SDO
RC6/TX/CK
RC7/RX/DT
RD0/PSP0
RD1/PSP1
RD2/PSP2
RD3/PSP3
RD4/PSP4
RD5/PSP5
RD6/PSP6
RD7/PSP7
8MHz
CRYSTAL
C2
22pF
C1
22pF
10K
VSS
VDD
VEE
RS
RW
E
D0
D1
D2
D3
D4
D5
D6
D7

To Do:

1. Hello World! .
2. moving text
3. up-Down counter using push buttons