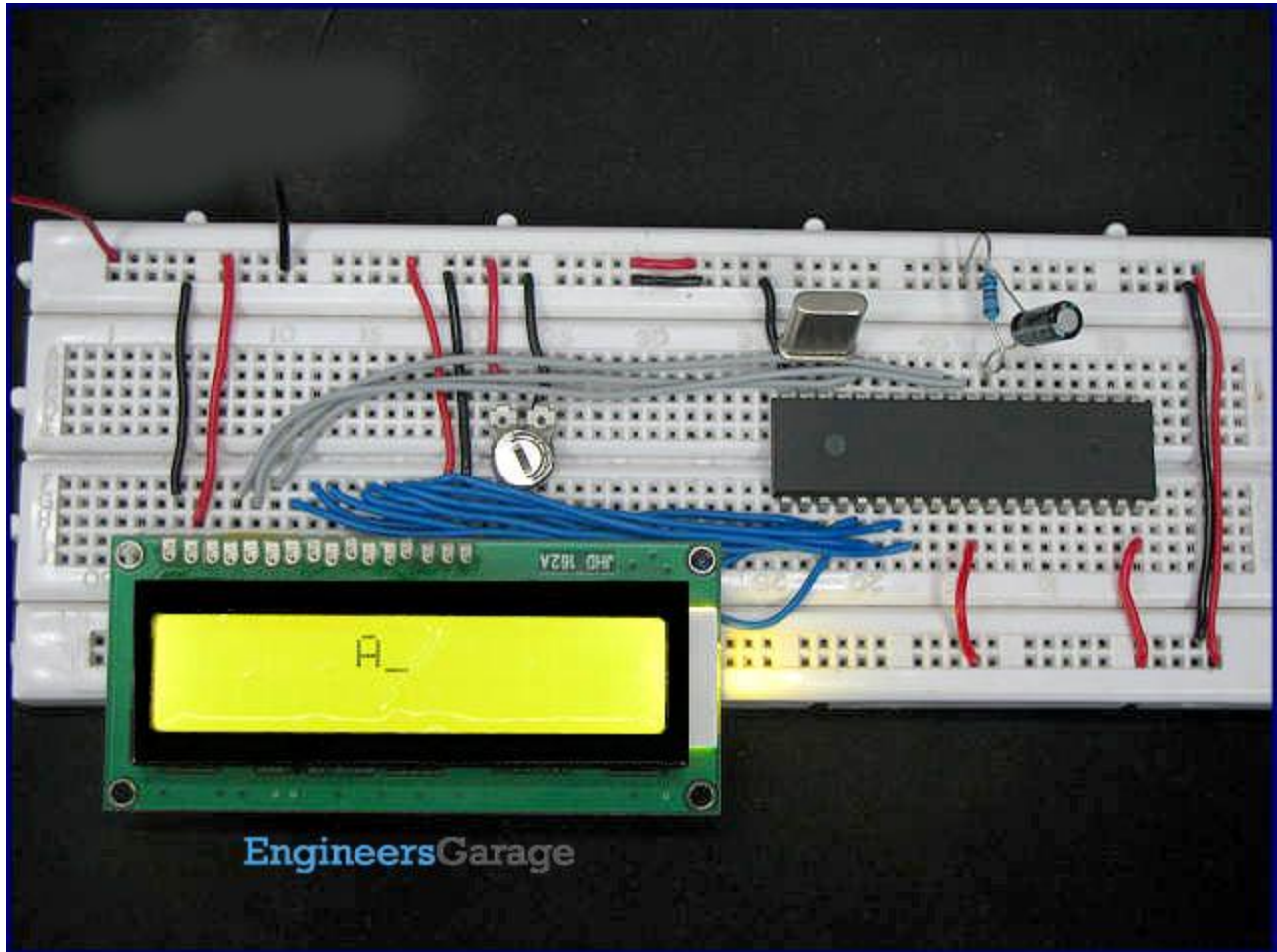


LCD INTERFACING WITH 8051

It is very important to keep a track of the working of almost all the automated and semi-automated devices, be it a washing machine, an autonomous robot or anything else. This is achieved by displaying their status on a small display module. [LCD](#) (Liquid Crystal Display) screen is such a display module and a 16x2 LCD module is very commonly used. These modules are replacing [seven segments](#) and other multi segment LEDs for these purposes. The reasons being: LCDs are economical, easily programmable, have no limitation of displaying special & even [custom characters](#) (unlike in seven segments), [animations](#) and so on. LCD can be easily interfaced with a microcontroller to display a message or status of a device. This topic explains the basics of a 16x2 LCD and how it can be interfaced with [AT89C51](#) to display a character.



16x2 [LCD](#) means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers.

1. **Command/Instruction Register** - stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing, clearing the screen, setting the cursor position, controlling display etc.

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2. **Data Register** - stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

Commonly used LCD Command codes:

Hex Code	Command to LCD Instruction Register
1	Clear screen display
2	Return home
4	Decrement cursor
6	Increment cursor
E	Display ON, Cursor ON
80	Force the cursor to the beginning of the 1 st line
C0	Force cursor to the beginning of the 2 nd line
38	Use 2 lines and 5x7 matrix

The pin description of this module is given below.

Pin configuration:

Pin	Symbol	Description	
1	V _{SS}	Ground	0 V
2	V _{CC}	Main power supply	+5 V
3	V _{EE}	Power supply to control contrast	Contrast adjustment by providing a variable resistor through V _{CC}
4	RS	Register Select	RS=0 to select Command Register RS=1 to select Data Register
5	R/W	Read/write	R/W=0 to write to the register R/W=1 to read from the register
6	EN	Enable	A high to low pulse (minimum 450ns wide) is given when data is sent to data pins
7	DB0	To display letters or numbers, their ASCII codes are sent to data pins (with RS=1). Also <u>instruction command codes</u> are sent to these pins.	
8	DB1		
9	DB2		
10	DB3		8-bit data pins
11	DB4		
12	DB5		
13	DB6		
14	DB7		

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15	Led+	Backlight V_{cc}	+5 V
16	Led-	Backlight Ground	0 V

Programming the LCD:

1. Data pin8 (DB7) of the LCD is busy flag and is read when $R/W = 1$ & $RS = 0$. When busy flag=1, it means that LCD is not ready to accept data since it is busy with the internal operations. Therefore before passing any data to LCD, its command register should be read and busy flag should be checked.
2. To send data on the LCD, data is first written to the data pins with $R/W = 0$ (to specify the write operation) and $RS = 1$ (to select the data register). A high to low pulse is given at EN pin when data is sent. Each write operation is performed on the positive edge of the Enable signal.
3. To send a command on the LCD, a particular command is first specified to the data pins with $R/W = 0$ (to specify the write operation) and $RS = 0$ (to select the command register). A high to low pulse is given at EN pin when data is sent.

Displaying single character 'A' on LCD

The LCD is interfaced with microcontroller ([AT89C51](#)). This microcontroller has 40 pins with four 8-bit ports (P_0 , P_1 , P_2 , and P_3). Here P_1 is used as output port which is connected to data pins of the LCD. The control pins (pin 4-6) are controlled by pins 2-4 of P_0 port. Pin 3 is connected to a preset of 10k to adjust the contrast on LCD screen. This program uses the above concepts of interfacing the LCD with controller by displaying the character 'A' on it.