

XMUT202 Digital Electronics

Tutorial 8: Liquid Crystal Display (LCD) (Solution)

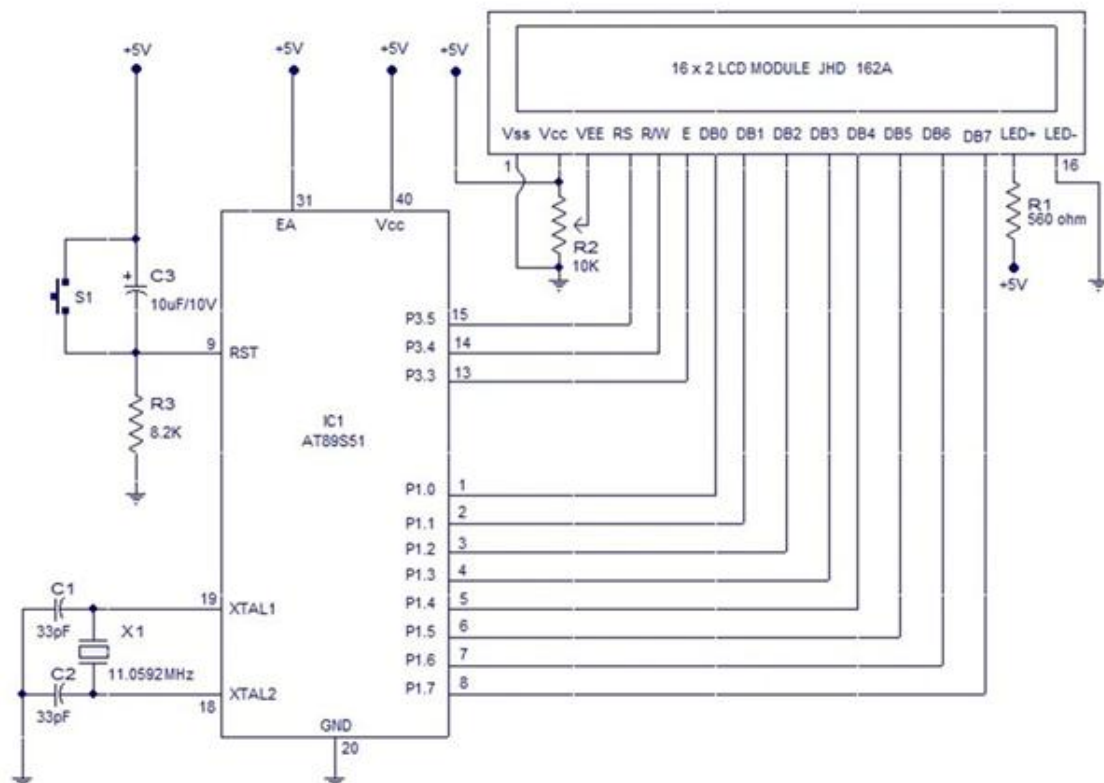
A. Liquid Crystal Display (LCD)

1. Describe common electronic circuit that provides interfacing between the 8051 microcontrollers with the LCD. [10 marks]

Answer

The circuit diagram given above shows how to interface a 16x2 LCD module with AT89S1 microcontroller.

- Capacitor C3, resistor R3 and push button switch S1 forms the reset circuitry.
- Ceramic capacitors C1, C2 and crystal X1 is related to the clock circuitry which produces the system clock frequency.
- P1.0 to P1.7 pins of the microcontroller is connected to the DB0 to DB7 pins of the module respectively and through this route the data goes to the LCD module.
- P3.3, P3.4 and P3.5 are connected to the E, R/W, RS pins of the microcontroller and through this route the control signals are transferred to the LCD module.
- Resistor R1 limits the current through the back light LED and so do the back light intensity. POT R2 is used for adjusting the contrast of the display.



2. Write a generic pseudocode for initialising the LCD from the 8051 microcontrollers.

[4 marks]

Answer

The steps that must be done for initialising the LCD display is given below, and these steps are common for almost all applications.

- Send 38H to the 8-bit data line for initialization
- Send 0FH for making LCD ON, cursor ON and cursor blinking ON.
- Send 06H for incrementing cursor position.
- Send 01H for clearing the display and return the cursor.

3. Write a generic pseudocode for sending data to the LCD from the 8051 microcontrollers.

[5 marks]

Answer

The steps for sending data to the LCD module is given below. The LCD module has pins namely RS, R/W and E. It is the logic state of these pins that make the module to determine whether a given data input is a command or data to be displayed.

- Make R/W low.
- Make RS=0 if data byte is a command and make RS=1 if the data byte is a data to be displayed.
- Place data byte on the data register.
- Pulse E from high-to-low.
- Repeat above steps for sending another data.

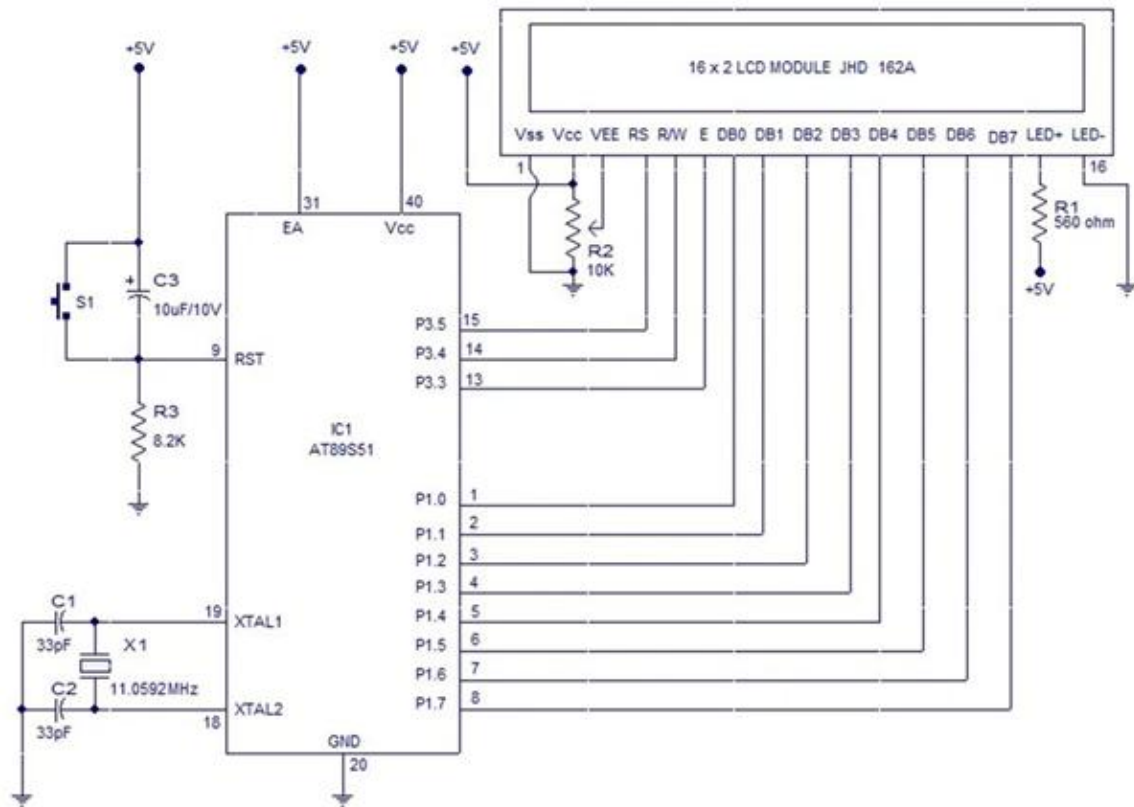
B. LCD Programming

1. Write an assembly language program for 8051 microcontroller that will interface with the LCD as shown in the figure below.

[32 marks]

Design specification of the program is outlined as follows:

- LCD mode uses 2 lines and 5x7 matrix.
- When LCD is ON, the cursor ON and cursor blinking is also ON.
- Apply command, read, and write subroutines to help you better structure your program.
- Implement best practices in embedded system development with respect to the signal configuration, use of delay between instructions, etc.
- Write a character on the first line and another character on the second line for testing.



Solution

Program for interfacing LCD to 8051 microcontroller is shown below.

Subroutine CMND sets the logic of the RS, R/W, E pins of the LCD module so that the module recognizes the input data (given to DB0 to DB7) as a command.

Subroutine DISP sets the logic of the RS, R/W, E pins of the module so that the module recognizes the input data as a data to be displayed.

Program:

```
;Initialise of the LCD
MOV A, #38H           ;Use 2 lines and 5x7 matrix
ACALL CMND
MOV A, #0FH           ;LCD ON, cursor ON, cursor blinking ON
ACALL CMND
MOV A, #01H           ;Clear screen
ACALL CMND
MOV A, #06H           ;Increment cursor
ACALL CMND
MOV A, #82H           ;Cursor line one, position 2
ACALL CMND
```

```

MOV A, #3CH           ;Activate second line
ACALL CMND

;Write a character on the first line
MOV A, #49D
ACALL DISP

;Change from first line to second line
MOV A, #0C1H          ;Jump to second line, position 1
ACALL CMND

;Write a character on the second line
MOV A, #67D
ACALL DISP

;Infinite loop
HERE:
SJMP HERE

;Send commands to the LCD
CMND:
MOV P1, A
CLR P3.5
CLR P3.4
SETB P3.3
CLR P3.3
ACALL DELAY
RET

;Display characters on the LCD
DISP:
MOV P1, A
SETB P3.5
CLR P3.4
SETB P3.3
CLR P3.3
ACALL DELAY

```

```
RET

;Delay execution of program
DELAY:
CLR P3.3
CLR P3.5
SETB P3.4
MOV P1, #0FFh
SETB P3.3
MOV A, P1
JB ACC.7, DELAY

;Clear the LCD
CLR P3.3
CLR P3.4
RET

END
```