

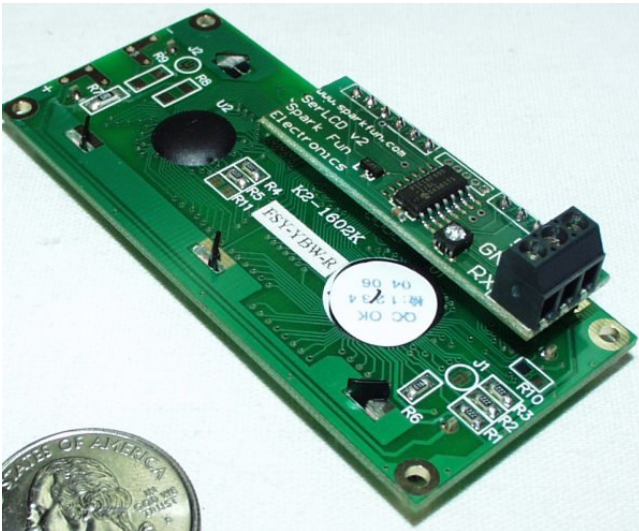
SerLCD v2.5

Serial Enabled LCD

7/5/2006

1 Overview

The SerLCD v2.5 is a simple and cost effective solution for interfacing to Liquid Crystal Displays (LCDs) based on the HD44780 controller. The SerLCD module takes incoming 9600bps TTL level signals and displays those characters on the LCD screen. Only three wires - 5V, GND, and Signal - are needed to interface to the LCD.



Please report typos, inaccuracies, and especially unclear explanations to us at spark@sparkfun.com. Suggestions for improvements are welcome and greatly valued.

1.1 Features in Version 2.5

SerLCD v2.5 has some new features that make the SerLCD even more powerful and economical:

- New PIC 16F688 utilizes onboard UART for greater communication accuracy
- Adjustable baud rates of 2400, 4800, 9600 (default), 14400, 19200 and 38400
- Operational backspace
- Greater processing speed at 8MHz
- Incoming buffer stores up to 80 characters
- Backlight transistor can handle up to 1A
- Pulse width modulation of backlight allows direct control of backlight brightness and current consumption
- All surface mount design allows a backpack that is half the size of the original
- Faster boot-up time
- Boot-up display can be turned on/off via firmware
- User definable Splash Screen

2 Interface Specifications

Default communications occur at 9600bps with 8 bits of data, 1 start bit, 1 stop bit, and no parity.

The SerLCD is controlled using actual ASCII characters. This means that if you pass the ASCII character 'r' to the module, an 'r' will be displayed on the LCD at the next cursor position. There are only two exceptions to this. These are the command characters decimal 254 (0xFE) and 124 (0x7C).

3 Configuration

All settings are stored on onboard EEPROM and loaded during power up.

SerLCD

| Backlight Brightness | |
|----------------------|------------|
| Value | Brightness |
| 128 | Off |
| 140 | 40% On |
| 150 | 73% On |
| 157 | Fully On |
| 158 | Not Valid |

3.1 Backlight

The SerLCD v2.5 Pulse Width Modulates the backlight via a 1A BJT transistor. This allows the user to set 1 of 30 different brightness settings.

By sending the special command character **0x7C** (decimal 124) followed by a number 128-157, the backlight PWM value will be set. This is handy when power consumption of the unit must be minimized. By reducing the brightness, the overall backlight current consumption is reduced.

3.2 LCD Type Setup

The SerLCD v2.5 firmware includes settings to interface to the following types of LCDs : 2x16, 2x20, 4x16, and 4x20.

If you purchased the SerLCD soldered to an LCD, it has already been configured to work with that specific LCD. You should not have to configure anything.

| LCD Type | |
|---------------------------|---|
| 20 Characters Wide | 3 |
| 16 Characters Wide | 4 |
| 4 Lines | 5 |
| 2 Lines | 6 |

If you purchased the SerLCD module by itself, you will have to tell the module what type of LCD it is going to be, or is currently, attached to.

To control what type of LCD the SerLCD module is attached to, transmit the special command - 124

(0x7C). Follow this command with either 3, 4, 5, or 6. These commands set the LCD character width and number of lines. These settings are used to correctly wrap the cursor to keep it within the viewable screen. The type of LCD is saved to EEPROM after each change.

3.3 Extended LCD Commands

| HD44780 Commands | |
|--------------------------------|---------------|
| Clear Display | 0x01 |
| Move cursor right one | 0x14 |
| Move cursor left one | 0x10 |
| Scroll right | 0x1C |
| Scroll left | 0x18 |
| Turn visual display on | 0x0C |
| Turn visual display off | 0x08 |
| Underline cursor on | 0x0E |
| Underline cursor off | 0x0C |
| Blinking box cursor on | 0x0D |
| Blinking box cursor off | 0x0C |
| Set cursor position | 0x80 + |

The HD44780 LCD controller is very common. The extended commands for this chip include but are not limited to:

Please refer to the [HD44780 datasheet](#) for more information.

Clear display and set cursor position are the two commands that affect the SerLCD the most. By sending these commands to the SerLCD the cursor position gets changed. This change is tracked by the firmware and cursor wrapping is performed normally. A cursor move to outside the viewable area is possible and the cursor position variable will be updated accurately.

16 Character Displays

| Line Number | Viewable Cursor Positions |
|-------------|---------------------------|
| 1 | 0-15 |
| 2 | 64-79 |
| 3 | 16-31 |
| 4 | 80-95 |

20 Character Displays

| Line Number | Viewable Cursor Position |
|-------------|--------------------------|
| 1 | 0-19 |
| 2 | 64-83 |
| 3 | 20-39 |
| 4 | 84-103 |

The viewable area cursor positions are as follows for almost all HD44780 based LCDs:

To perform a cursor move, a series of steps must occur:

1. You will need to determine the correct decimal position to move to. For example, the viewable position three on the second line of a 16 character display is 66.
2. Set bit 7 (the highest bit) of that decimal number to '1'. Position $66 + 128 = 194$.
3. Now transmit the special character 254 to tell the SerLCD you want to send a command.
4. Finally, transmit the number 194. The cursor is now sitting in the third position of the second line.

3.4 Splash Screen

The SerLCD v2.5 displays a splash screen by default. This splash screen ("Sparkfun.com SerLCD v2") verifies that the unit is powered,

working correctly, and that the connection to the LCD is correct.

The splash screen is displayed for 500ms during boot-up and may be turned off if desired.

A new addition to the V2.5 firmware is the ability for the user to set their own splash screen (2 lines). To do this, just set up the top 2 lines as you would like them to appear, then send special character 124 followed by "<control>j" to save it to memory. To test, just cycle power.

To disable the splash screen, send the 'special command' **0x7C** (decimal 124) to the unit followed by decimal 9. Every time this command is sent to the unit, the Splash Screen Display option will toggle. That is, if the splash screen is currently being displayed, sending the **0x7C 0x09** command will disable the splash screen during the next boot. Sending the **0x7C 0x09** command again will enable the splash screen.

3.4 Changing the Baud Rate

The Serial LCD V2.5 defaults to 9600 baud, but can be set to a variety of baud rates. To change the baud rate, first enter the special command character 124, then:

- 2400 baud, enter "<control>k"
- 4800 baud, enter "<control>l"
- 9600 baud, enter "<control>m"
- 14400 baud, enter "<control>n"
- 19200 baud, enter "<control>o"
- 38400 baud, enter "<control>p"

If the Serial LCD gets into an unknown state, or you otherwise can't communicate with it at the baud rate to which it is set, enter "<control>r" at 9600 baud while the splash screen is active and the unit will reset to 9600 baud.

4 Hardware

4.1 Vcc and Current Draw

The SerLCD v2.5 should only be powered by 5V DC. Higher than 5.5V will cause damage to the PIC, LCD, and backlight (if attached).

The SerLCD uses 3mA with the backlight turned off and ~60mA with the backlight activated.

4.2 Contrast Control

The SerLCD v2.5 comes equipped with a 10k potentiometer to control the contrast of the LCD. This is set by during assembly and testing but may need correcting for your specific LCD module. Temperature and supply voltage can effect the contrast of the LCD.

4.3 Hi-Current Control Pin

The SerLCD v2.5 uses a general purpose, 1000mA NPN transistor to control the Backlight. If you purchased the SerLCD module, you may use this pin as a general purpose, high power control pin. If you issue the backlight on/off command to the SerLCD, pin 15 (next to the last pin) will turn on/off. Pin 16 (last pin above 'www.sparkfun.com') is connected to ground.

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