Add an LCD to your projects and visualize measurements, parameters, data, messages, etc...

Features
• for Hitachi HD44780 or compatible LCD’s
• requires 1 Arduino UNO™ (not included)
• stackable design: the shield can be stacked with other shields

Specifications
• supplied with 20 character / 4 lines display with white backlight
• contrast adjust trimmer
• backlight on/off switch
• reset button
• 3 user configurable pushbuttons (3 digital inputs / 1 analog input)
• dimensions: 68 x 53mm / 2.67 x 2.08”
1. **Assembly (Skipping this can lead to troubles !)**
   Ok, so we have your attention. These hints will help you to make this project successful. Read them carefully.

1.1 **Make sure you have the right tools:**
   - A good quality soldering iron (25-40W) with a small tip.
   - Wipe it often on a wet sponge or cloth, to keep it clean; then apply solder to the tip, to give it a wet look. This is called ‘thinning’ and will protect the tip, and enables you to make good connections. When solder rolls off the tip, it needs cleaning.
   - Thin raisin-core solder. Do not use any flux or grease.
   - A diagonal cutter to trim excess wires. To avoid injury when cutting excess leads, hold the lead so they cannot fly towards the eyes.
   - Needle nose pliers, for bending leads, or to hold components in place.
   - Small blade and Phillips screwdrivers. A basic range is fine.

   For some projects, a basic multi-meter is required, or might be handy.

1.2 **Assembly Hints :**
   - Make sure the skill level matches your experience, to avoid disappointments.
   - Follow the instructions carefully. Read and understand the entire step before you perform each operation.
   - Perform the assembly in the correct order as stated in this manual.
   - Position all parts on the PCB (Printed Circuit Board) as shown on the drawings.
   - Values on the circuit diagram are subject to changes, the values in this assembly guide are correct*.
   - Use the check-boxes to mark your progress.
   - Please read the included information on safety and customer service.

* Typographical inaccuracies excluded. Always look for possible last minute manual updates, indicated as ‘NOTE’ on a separate leaflet.

1.3 **Soldering Hints :**

1. Mount the component against the PCB surface and carefully solder the leads.

2. Make sure the solder joints are cone-shaped and shiny.

3. Trim excess leads as close as possible to the solder joint.
DO NOT BLINDLY FOLLOW THE ORDER OF THE COMPONENTS ON THE TAPE. ALWAYS CHECK THEIR VALUE ON THE PARTS LIST!

REMOVE THEM FROM THE TAPE ONE AT A TIME!
1 **CONSTRUCTION**

1 **Resistors**
- R1: 4K7 (4 - 7 - 2 - B)
- R2: 470 (4 - 7 - 1 - B)
- R3: 22 (2 - 2 - 0 - B)
- R4: 4K7 (4 - 7 - 2 - B)
- R5: 2K2 (2 - 2 - 2 - B)
- R6: 6K8 (6 - 8 - 2 - B)

2 **Ceramic capacitor on tape**
- C1: 100nF (104)

3 **Female headers**
- LCD1: 2 x 8p
- LCD2: 2 x 8p
- LCD3: 2 x 8p

4 **Trimmer**
- VR1: 10K (Contrast)

5 **Switch**
- SW5: Backlight

6 **Push buttons**
- Digital inputs
  - SW1
  - SW2
  - SW3
- Reset
  - SW4

7 **Male headers**
- Selection analog / digital interface
- JP1
- JP2
- JP3
- JP4
- JP5
- JP6
- JP7

- Do not cut the connector pins!
8 Female headers

Do not cut the connector pins!

1. SK6: 2 x 3p

2. 2 x 8p

3. 2 x 6p

Solder
Follow these steps if the supplied LCD is not provided with a male header connector.
II CONNECTION DIAGRAM

1. LCD

HITACHI HD44780 or compatible LCD's

2. Selection analog / digital interface

3. (de)activate the backlight

4. Input data

<table>
<thead>
<tr>
<th>DIGITAL</th>
<th>ANALOG</th>
</tr>
</thead>
<tbody>
<tr>
<td>10101101011001...</td>
<td>10101101011001...</td>
</tr>
<tr>
<td>10101101011001...</td>
<td>10101101011001...</td>
</tr>
<tr>
<td>10101101011001...</td>
<td>10101101011001...</td>
</tr>
</tbody>
</table>

5. Contrast

6. Reset
III GENERAL INFORMATION

All displays based on the HD44780 have the same interface, regardless of the connector type or the pin arrangement. This interface consists of eight data lines, three control lines, a power supply, a GND and a line for contrast setting. The arrangement of these lines varies from model to model, so you will have to refer to the data sheet. Some models feature a built-in backlight connected via two lines.

<table>
<thead>
<tr>
<th>Pin LCD</th>
<th>function</th>
<th>Pin Arduino UNO</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD</td>
<td>+5 V Power supply</td>
<td>+5 V</td>
</tr>
<tr>
<td>Vss</td>
<td>GND</td>
<td>GND</td>
</tr>
<tr>
<td>Vo</td>
<td>contrast voltage</td>
<td>Trimmer</td>
</tr>
<tr>
<td>RS</td>
<td>Selection: write data or commands</td>
<td>8</td>
</tr>
<tr>
<td>R / W</td>
<td>Selection: writing or reading</td>
<td>GND</td>
</tr>
<tr>
<td>Enable</td>
<td>'Enable'-line</td>
<td>9</td>
</tr>
<tr>
<td>DB0</td>
<td>Data line 0</td>
<td>Not used</td>
</tr>
<tr>
<td>DB1</td>
<td>Data line 1</td>
<td>Not used</td>
</tr>
<tr>
<td>DB2</td>
<td>Data line 2</td>
<td>Not used</td>
</tr>
<tr>
<td>DB3</td>
<td>Data line 3</td>
<td>Not used</td>
</tr>
<tr>
<td>DB4</td>
<td>Data line 4</td>
<td>4</td>
</tr>
<tr>
<td>DB5</td>
<td>Data Line 5</td>
<td>5</td>
</tr>
<tr>
<td>DB6</td>
<td>Data Line 6</td>
<td>6</td>
</tr>
<tr>
<td>DB7</td>
<td>Data Line 7</td>
<td>7</td>
</tr>
<tr>
<td>BL +</td>
<td>LED Backlight +</td>
<td>+5 V</td>
</tr>
<tr>
<td>BL -</td>
<td>LED Backlight -</td>
<td>GND</td>
</tr>
</tbody>
</table>

UNO Connections Assigned to the Buttons

<table>
<thead>
<tr>
<th>Push button</th>
<th>Arduino connection (digital mode)</th>
<th>Arduino PIN (analogue mode)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>10</td>
<td>AN3</td>
</tr>
<tr>
<td>S2</td>
<td>11</td>
<td>AN3</td>
</tr>
<tr>
<td>S3</td>
<td>12</td>
<td>AN3</td>
</tr>
</tbody>
</table>

The shield has three different connector types and is thus compatible with a large array of displays.

The connectors are arranged so as to leave room for the three push buttons and the reset button.

To work properly, each LCD requires a small voltage to adjust the contrast. This voltage is obtained from the +5 V through a trimmer.
Three push buttons are provided for your own applications. For maximum flexibility, we provide two ways to interface with these buttons. The first is the classic way, which makes use of three digital Arduino lines, specifically pins 10, 11 and 12. In this case, the available digital lines are 0, 1, 2, 3 and 13. Activate this mode by shortcutting jumpers JP4, JP5 and JP6.

To use the push buttons with the digital inputs, activate the internal pull-up resistors via your firmware. Do this for each push button with following code: pinMode (buttonPin, INPUT_PULLUP). The push buttons will work in negative logic, i.e. the value at rest is 1, the value at pressed push button is 0 (zero).

A second way involves the use of one analogue line, pin A3. In this case, the digital lines remain free for other purposes. Activate this mode by shortcutting jumpers JP1, JP2, JP3 and JP7.

How does it work? Study the diagram and in particular the network formed by R4, R5 and R6. These resistors, in series, form a voltage divider.

When no button is pressed, the AN3 line is at +5 V as there is no current flowing. If we press S1, AN3 will be shorted to GND and the voltage is zeroed.

If we press S2, the node between R5 and R6 is grounded, so that line AN3 reaches 1.6 V. If we press S3, the node at R6 is grounded so AN3 goes to 3.3 V.

This means that, for each button, the Arduino ADC converter will get a different voltage. The analogRead(A3) function will provide a different value according to which push button is pressed (see table).

<table>
<thead>
<tr>
<th>Push button</th>
<th>AN3 voltage</th>
<th>ADC value</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>5v</td>
<td>1024</td>
</tr>
<tr>
<td>P1</td>
<td>0v</td>
<td>0</td>
</tr>
<tr>
<td>P2</td>
<td>1.6v</td>
<td>328</td>
</tr>
<tr>
<td>P3</td>
<td>3.3v</td>
<td>676</td>
</tr>
</tbody>
</table>

Analog mode of reading of the buttons.

IV PROGRAMMING

Programming via the Arduino IDE is straightforward, as it does not require no additional library. The system library LiquidCrystal already includes all necessary functions.

A programming code is available on www.velleman.eu.
Leds and how to use them

Leds feature a specific voltage drop, depending on type and colour. Check the datasheet for exact voltage drop and rated current!

**How to Calculate the series resistor:**
Example: operate a red led (1.7V) on a 9Vdc source.
Required led current for full brightness: 5mA (this can be found in the datasheet of the led)

\[
\text{Supply voltage (V) - led voltage (V)} \div \text{required current (A)} = \text{series resistance (ohms)}
\]

\[
\frac{9V - 1.7V}{0.005A} = 1460 \text{ ohm}
\]

Closest value: use a 1k5 resistor

Required resistor power handling=
voltage over resistor x current passed trough resistor

\[
(9V - 1.7V) \times 0.005A = 0.036W
\]

A standard 1/4W resistor will do the job

**LEDs in series:**
Example: 3 x red led (1.7V) on 9V battery
Required led current for full brightness: 5mA (this can be found in the datasheet of the led)

\[
\text{Supply voltage (V) - (number of leds x led voltage (V))} \div \text{required current (A)} = \text{series resistance (ohms)}
\]

\[
\frac{9V - (3 \times 1.7V)}{0.005A} = 780 \text{ ohm}
\]

Use an 820 ohm resistor

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**open collector outputs**

An open collector output can be compared to a switch which switches to ground when operated

Example: How to switch an LED by means of an open collector output

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**Never connect leds in parallel**
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