# Liquid Crystal Displays (LCD) with Arduino

Find out how to wire an LCD to an Arduino, and how to use the LiquidCrystal library through a set of useful examples.

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> *This article was revised on 2021/11/18 by Karl Söderby.*

The LiquidCrystal library allows you to control LCD displays that are compatible with the Hitachi HD44780 driver. There are many of them out there, and you can usually tell them by the 16-pin interface.


Output of the sketch on a 16x2 LCD

The LCDs have a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display. The interface consists of the following pins:

- A **register select (RS) pin** that controls where

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You can select either the data register, which holds what goes on the screen, or an instruction register, which is where the LCD's controller looks for instructions on what to do next.

- A **Read/Write (R/W) pin** that selects reading mode or writing mode
- An **Enable pin** that enables writing to the registers
- 8 **data pins (D0 -D7)**. The states of these pins (high or low) are the bits that you're writing to a register when you write, or the values you're reading when you read.

There's also a **display contrast pin (Vo)**, **power supply pins (+5V and GND)** and **LED Backlight (Bklt+ and BKlt-)** pins that you can use to power the LCD, control the display contrast, and turn on and off the LED backlight, respectively.

The process of controlling the display involves putting the data that form the image of what you want to display into the data registers, then putting instructions in the instruction register. The **LiquidCrystal Library** simplifies this for you so you don't need to know the low-level instructions.

The Hitachi-compatible LCDs can be controlled in two modes: 4-bit or 8-bit. The 4-bit mode requires seven I/O

pins. For displaying text on the screen, you can do most everything in 4-bit mode, so example shows how to control a 16x2 LCD in 4-bit mode.

## Hardware Required

- Arduino Board
- LCD Screen (compatible with Hitachi HD44780 driver)
- pin headers to solder to the LCD display pins
- 10k ohm potentiometer
- 220 ohm resistor
- hook-up wires
- breadboard

## Circuit

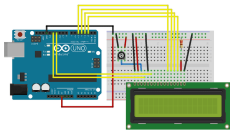
Note that this circuit was originally designed for the Arduino UNO. As the Arduino is communicating with the display using **SPI**, pin 11 & 12 will change depending on what board you are using. For example, on a MKR WiFi 1010, the SPI bus is attached to pin 8 & 11.

Before wiring the LCD screen to your Arduino board we suggest to solder a pin header strip to the 14 (or 16) pin count connector of the

To wire your LCD screen to your board, connect the following pins:

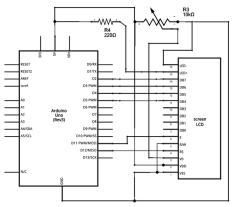
- LCD RS pin to digital pin 12
- LCD Enable pin to digital pin 11
- LCD D4 pin to digital pin 5
- LCD D5 pin to digital pin 4
- LCD D6 pin to digital pin 3
- LCD D7 pin to digital pin 2
- LCD R/W pin to GND
- LCD VSS pin to GND
- LCD VCC pin to 5V
- LCD LED+ to 5V through a 220 ohm resistor
- LCD LED- to GND

Additionally, wire a 10k potentiometer to +5V and GND, with it's wiper (output) to LCD screens VO pin (pin3).



The circuit (made using Fritzing).

## Schematic



The schematic (made using Fritzing).

## Hello World Example

This example sketch prints `Hello World!` to the LCD and shows the time in seconds since the Arduino was reset.

```
36
37   This example cod
38
39   https://docs.ard
40
41 */
42
43 // include the li
44 #include <LiquidC
45
46 // initialize the
47 // with the ardui
48 const int rs = 12
49 LiquidCrystal lcd
50
51 void setup() {
52   // set up the L
53   lcd.begin(16, 2
54   // Print a mess
55   lcd.print("hell
56 }
57
58 void loop() {
59   // set the curs
60   // (note: line
61   lcd.setCursor(0
62   // print the nu
63   lcd.print(milli
64 }
```

## Autoscroll Example

This example sketch shows how to use the `autoscroll()` and `noAutoscroll()` methods to move all the text on the display left or right.

- `autoscroll()` moves all the text one space to the left each time a

- `noAutoscroll()` turns scrolling off

This sketch prints the characters `0` to `9` with autoscroll off, then moves the cursor to the bottom right, turns autoscroll on, and prints them again.

```
/*

  LiquidCrystal

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 library works w

 Hitachi HD44780

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 and noAutoscrol

 The circuit:

 * LCD RS pin to

 * LCD Enable pi

 * LCD D4 pin to

 * LCD D5 pin to

 * LCD D6 pin to
```

## Blink Example

This example sketch shows how to use the `blink()` and `noBlink()` methods to blink a block-style cursor.

```
/*

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  Hitachi HD44780

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  This sketch prin

  cursor block bli

  The circuit:

  * LCD RS pin to

  * LCD Enable pin

  * LCD D4 pin to

  * LCD D5 pin to

  * LCD D6 pin to
```

## Cursor

This example sketch shows how to use the `cursor()` and `noCursor()` methods to control an underscore-style cursor.

```
/*

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 library works w

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 uses the cursor

 on and off the

 The circuit:

 * LCD RS pin to

 * LCD Enable pi

 * LCD D4 pin to

 * LCD D5 pin to

 * LCD D6 pin to
```

## Display Example

This example sketch shows how to use the `display()` and `noDisplay()` methods to turn on and off the display. The text to be displayed will still be preserved when you use noDisplay() so it's a quick way to blank the display without losing everything on it.

```
/*
  LiquidCrystal L

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 the display.

 The circuit:
 * LCD RS pin to
 * LCD Enable pin
 * LCD D4 pin to
 * LCD D5 pin to
 * LCD D6 pin to
 * LCD D7 pin to
 * LCD R/W pin to
 * 10K resistor:
 * ends to +5V an
 * wiper to LCD V

 Library original
 by David A. Mell
 library modified
 by Limor Fried (
```

## Scroll Example

This example sketch shows how to use the `scrollDisplayLeft()` and `scrollDisplayRight()` methods to reverse the direction the text is flowing. It prints "Hello World!", scrolls it offscreen to the left, then offscreen to the right, then back to home.

```
/*
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  The circuit:
 * LCD RS pin to
 * LCD Enable pin
 * LCD D4 pin to
 * LCD D5 pin to
 * LCD D6 pin to
 * LCD D7 pin to
 * LCD R/W pin to
 * 10K resistor:
 * ends to +5V an
 * wiper to LCD V

 Library original
 by David A. Mell
 library modified
 by Limor Fried (
```

## Serial to Display Example

This example sketch accepts serial input from a host computer and displays it on the LCD. To use it, upload the sketch, then open the Serial Monitor and type some characters and click Send. The text will appear on your LCD.

```
// include the li
#include <LiquidC

// initialize the
// with the ardui
const int rs = 12
LiquidCrystal lcd

void setup() {
  // set up the L
  lcd.begin(16, 2
  // initialize t
  Serial.begin(96
}

void loop() {
  // when charact
  if (Serial.avai
    // wait a bit
    delay(100);
    // clear the
    lcd.clear();
    // read all t
    while (Serial
      // display
      lcd.write(S
    }
  }
}
```

## Set Cursor Example

This example sketch shows how to use the `setCursor()` method to reposition the cursor. To move the cursor, just call `setCursor()` with a row and column position. For example, for a 2x16 display:

```
lcd.setCursor(0, 0)
lcd.setCursor(15, 0
lcd.setCursor(0, 1)
lcd.setCursor(15, 1
```

Here is the full example:

```
/*

  LiquidCrystal

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 setCursor() met

  The circuit:

 * LCD RS pin to

 * LCD Enable pi

 * LCD D4 pin to

 * LCD D5 pin to

 * LCD D6 pin to
```

## Text Direction Example

This example sketch shows how to use the `leftToRight()` and `rightToLeft()` methods. These methods control which way text flows from the cursor.

- `rightToLeft()` causes text to flow to the left from the cursor, as if the display is right-justified.
- `leftToRight()` causes text to flow to the right from the cursor, as if the display is left-justified.

`m` through `r` left to right, then `s` through `z` right to left again.

```
/*

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 The circuit:

  * LCD RS pin t

  * LCD Enable p

  * LCD D4 pin t

  * LCD D5 pin t

  * LCD D6 pin t

  * LCD D7 pin t
```

## Custom Character

This example demonstrates how to add custom characters on an LCD display.

Note that this example requires an additional potentiometer:

- Outer pins connected to 5V and GND.
- Inner pin (wiper) connected to A0.

This potentiometer controls

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```
/*
  LiquidCrystal

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  The circuit:
 * LCD RS pin to
 * LCD Enable pi
 * LCD D4 pin to
 * LCD D5 pin to
 * LCD D6 pin to
 * LCD D7 pin to
 * LCD R/W pin t
 * 10K potentiom
 * ends to +5V a
 * wiper to LCD
 * 10K poterntio

 created 21 Mar
 by Tom Igoe
 modified 11 Nov
 by Scott Fitzge
```

### Suggest changes

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