**LCD – connections and explanation**

**How Does the LCD Work in 4-bit Mode?**

**The LCD can work in 8-bit or 4-bit mode:**

1. **8-bit mode: Uses all 8 data pins (D0-D7) → Faster but requires more connections.**
2. **4-bit mode (we are using this):** 
   * **Uses only D4-D7 for data.**
   * **Saves Arduino pins.**
   * **LCD splits data into two 4-bit chunks to process.**

**Why use 4-bit mode?**

* **Saves pins (Arduino has limited digital pins).**
* **Easier wiring and less complexity.**

**🛠 Wiring the 1602 LCD (Without I2C)**

**🔌 Pin Mapping**

| **LCD Pin** | **Function** | **Arduino Uno Pin** |
| --- | --- | --- |
| VSS | GND | GND |
| VDD | Power | 5V |
| V0 | Contrast Adjust | Potentiometer (Middle Pin) |
| RS | Register Select | D7 |
| RW | Read/Write | GND |
| E | Enable | D6 |
| D4 | Data Bit 4 | D5 |
| D5 | Data Bit 5 | D4 |
| D6 | Data Bit 6 | D3 |
| D7 | Data Bit 7 | D2 |
| A | LED Backlight + | 5V |
| K | LED Backlight - | GND |

Code –

#include <LiquidCrystal.h>

// Define LCD Pins

LiquidCrystal lcd(7, 6, 5, 4, 3, 2); // (RS, E, D4, D5, D6, D7)

void setup() {

lcd.begin(16, 2); // Initialize LCD (16 columns, 2 rows)

lcd.print("Hello, World!"); // Print message on first row

}

void loop() {

// No need to add anything here

}

**📜 Code: Display "Hello, World!" on LCD**

cpp

#include <LiquidCrystal.h>

**📌 What is this?**

* This **includes the LiquidCrystal library**, which allows Arduino to control an LCD without an I2C module.
* The **LiquidCrystal library** is **built-in**, so you **don’t need to install it manually**.

cpp

LiquidCrystal lcd(7, 6, 5, 4, 3, 2); // (RS, E, D4, D5, D6, D7)

**📌 What does this do?**

* This **creates an LCD object** named lcd.
* The numbers (7, 6, 5, 4, 3, 2) **tell the Arduino which pins are connected to the LCD**.
* It uses **only 6 pins** (instead of 8) because we are using it in **4-bit mode** (more on this later).

**Pin Mapping Explained:**

| **LCD Pin** | **Function** | **Connected to Arduino** |
| --- | --- | --- |
| RS | Register Select | 7 |
| E | Enable | 6 |
| D4 | Data Pin 4 | 5 |
| D5 | Data Pin 5 | 4 |
| D6 | Data Pin 6 | 3 |
| D7 | Data Pin 7 | 2 |

cpp

void setup() {

lcd.begin(16, 2);

**📌 What does this do?**

* lcd.begin(16, 2); **initializes the LCD screen**.
* 16, 2 means **16 columns and 2 rows**.
  + **16 columns → Can fit 16 characters per row.**
  + **2 rows → Supports 2 lines of text.**

cpp

lcd.print("Hello, World!");

**📌 What does this do?**

* This prints "Hello, World!" on the LCD.
* The cursor **automatically starts at position (0,0)** → **First row, first column.**
* The text will stay on the screen unless updated or cleared.

cpp

void loop() {

// No need to add anything here

}

**📌 What does this do?**

* Since we only need to print text **once**, we **don’t need anything in loop()**.
* setup() runs **only once**, which is enough for this basic example.