

# Lesson 19 Thermometer

## Introduction

In this lesson, you will learn how to use an LCD display to show the temperature.

## Hardware Required

- ✓ 1 \* RexQualis Mega 2560
- ✓ 1 \* LCD1602 module
- ✓ 1 \* 10k ohm Resistor
- ✓ 1 \* Thermistor
- ✓ 1 \* Potentiometer
- ✓ 1 \* Breadboard
- ✓ 18 \* M-M Jumper Wires

## Principle

### Thermistor

Thermistor is a type of resistor whose resistance is dependent on temperature and have a electric resistance value for each absolute temperature.

Thermistor widely used to control temperature in electronics devices such as alarms, thermometers, "clocks", electronic circuit temperature compensation, heat sinks, air conditioning. There are two basic types of thermistors: a PTC thermistor (Positive Temperature coefficient) which substantially increases its electrical resistance with increased temperature, and the thermistor NTC (Negative Temperature coefficient), which substantially lowers its electrical resistance with increased temperature. The thermistor is not electrically

polarized. The most common thermistor in electronics store is the NTC type, so I will be using this for the application.

The major problem NTC thermistor is the calibration, that is, to establish a function between electrical resistance and temperature. The variation in its electrical resistance with temperature is non-linear it may be seen as an exponential function according to equation Steinhart-Hart

## Code interpretation

```
#include <LiquidCrystal.h>
```

```
int tempPin = 0;
```

```
// BS E D4 D5 D6 D7
```

```
LiquidCrystal lcd(7, 8, 9, 10, 11, 12);
```

```
void setup()
```

```
{
```

```
    lcd.begin(16, 2);
```

```
}
```

```
void loop()
```

```
{
```

```
    int tempReading = analogRead(tempPin);
```

```
// This is OK
```

```
    double tempK = log(10000.0 * ((1024.0 / tempReading - 1)));
```

```
    tempK = 1 / (0.001129148 + (0.000234125 + (0.0000000876741 * tempK *  
tempK )) * tempK ); // Temp Kelvin
```

```
    float tempC = tempK - 273.15; // Convert Kelvin to Celcius
```

```
float tempF = (tempC * 9.0) / 5.0 + 32.0; // Convert Celcius to Fahrenheit
```

```
/* replaced
```

```
float tempVolts = tempReading * 5.0 / 1024.0;
```

```
float tempC = (tempVolts - 0.5) * 10.0;
```

```
float tempF = tempC * 9.0 / 5.0 + 32.0;
```

```
*/
```

```
// Display Temperature in C
```

```
lcd.setCursor(0, 0);
```

```
lcd.print("Temp      C  ");
```

```
// Display Temperature in F
```

```
//lcd.print("Temp      F  ");
```

```
lcd.setCursor(6, 0);
```

```
// Display Temperature in C
```

```
lcd.print(tempC);
```

```
// Display Temperature in F
```

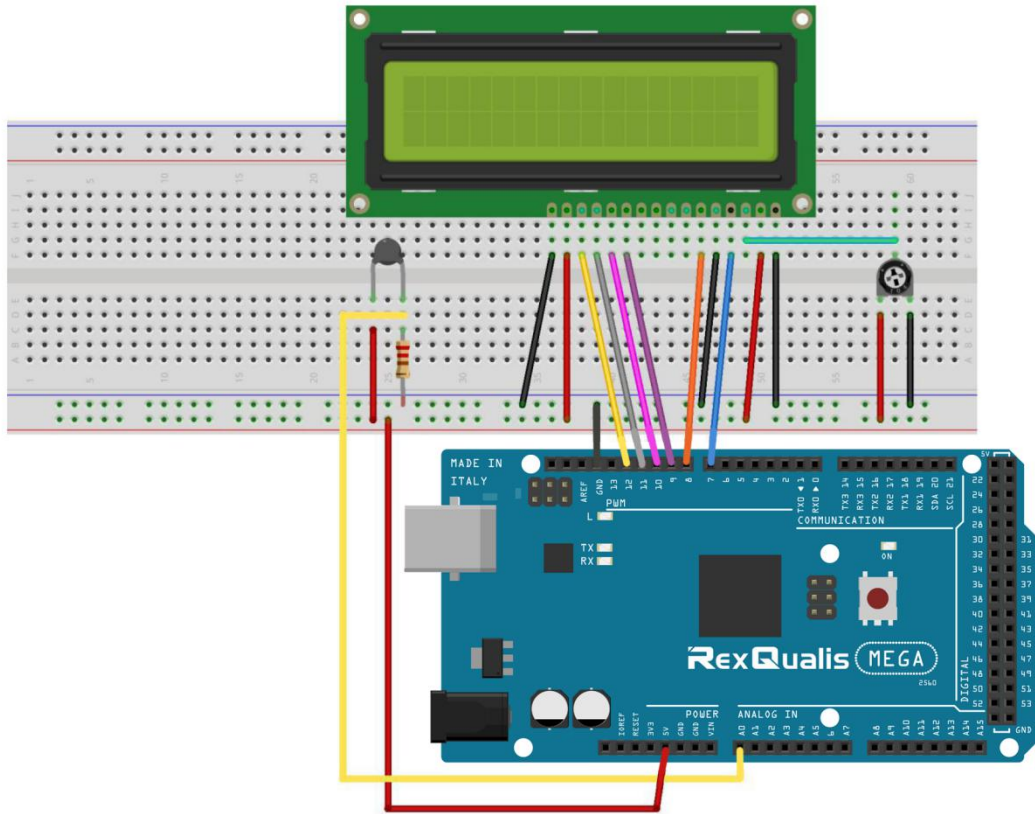
```
//lcd.print(tempF);
```

```
delay(500);
```

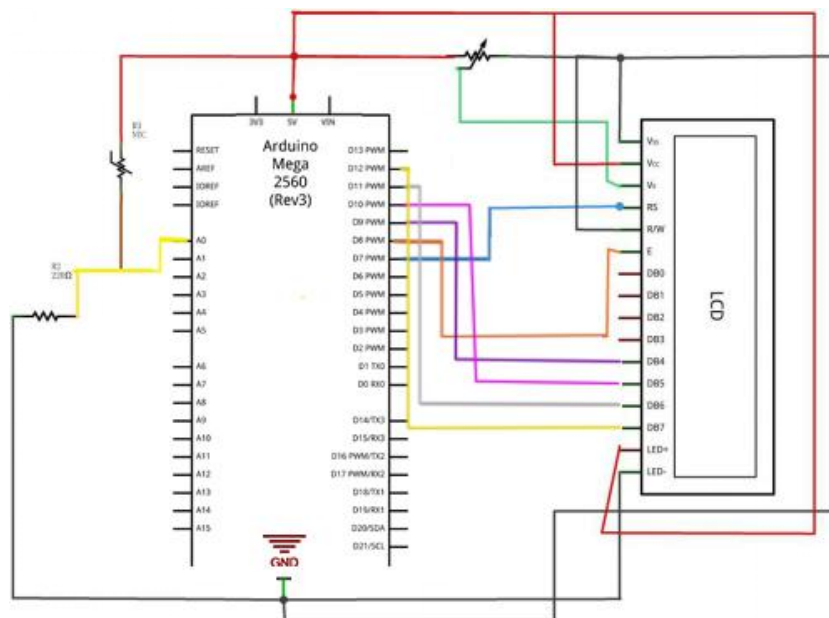
```
}
```

## Experimental Procedures

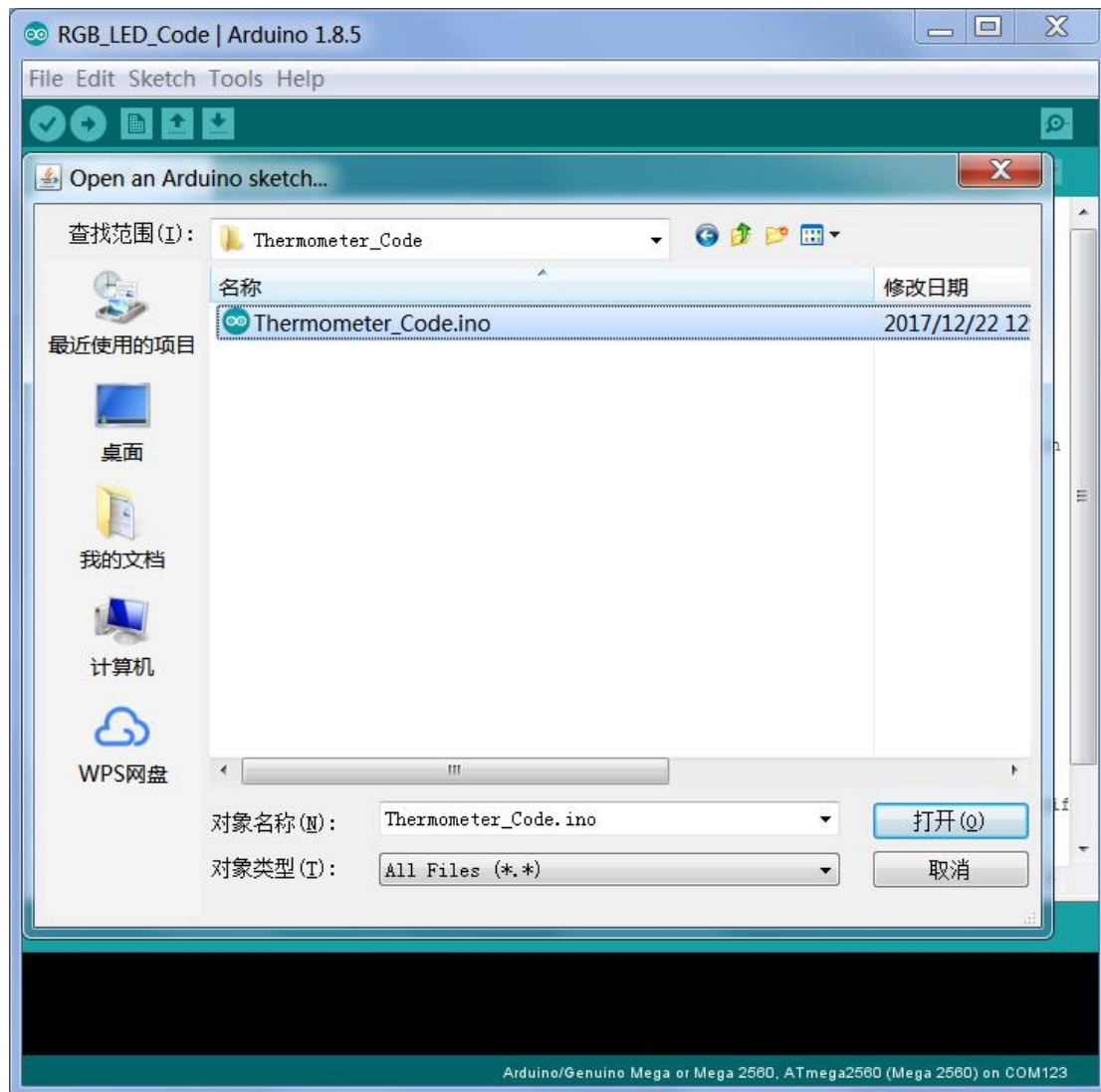
### Step 1: Build the circuit



## Schematic Diagram

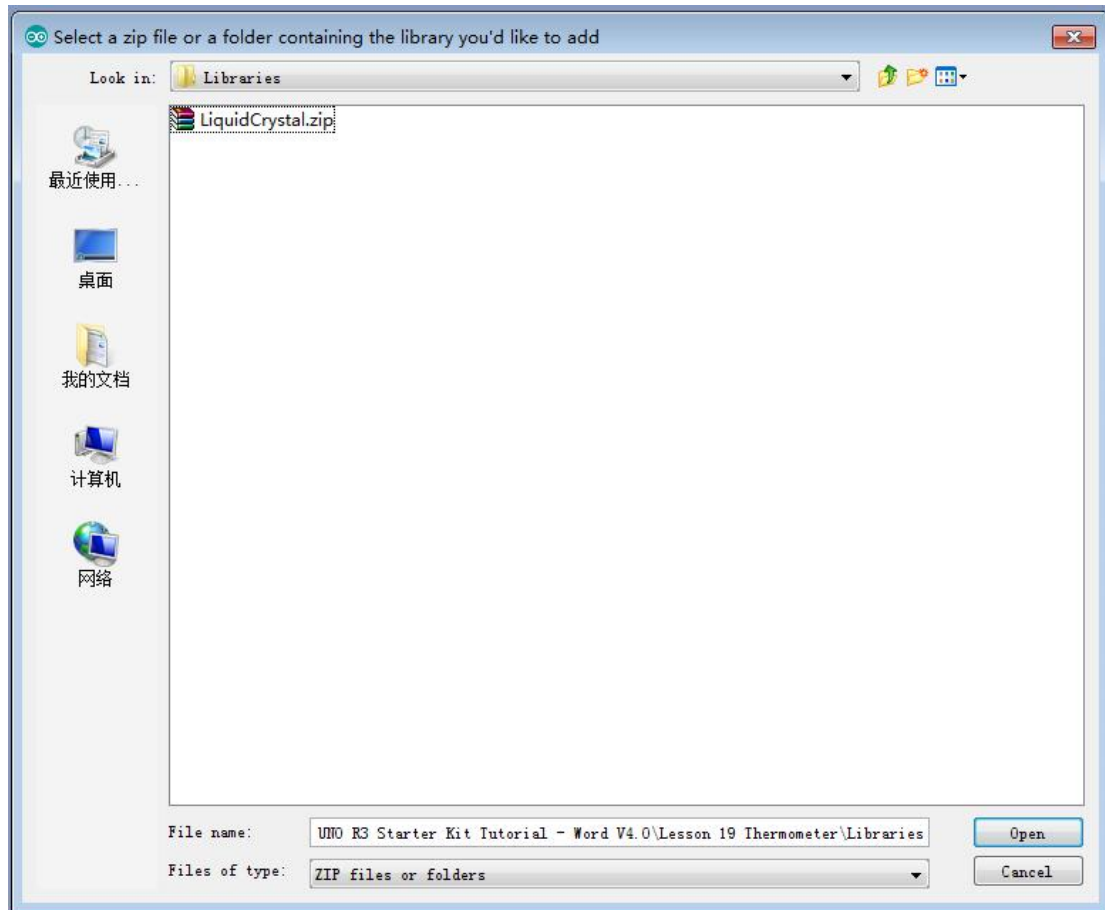


## Step 2: Open the code: `Thermometer_Code`



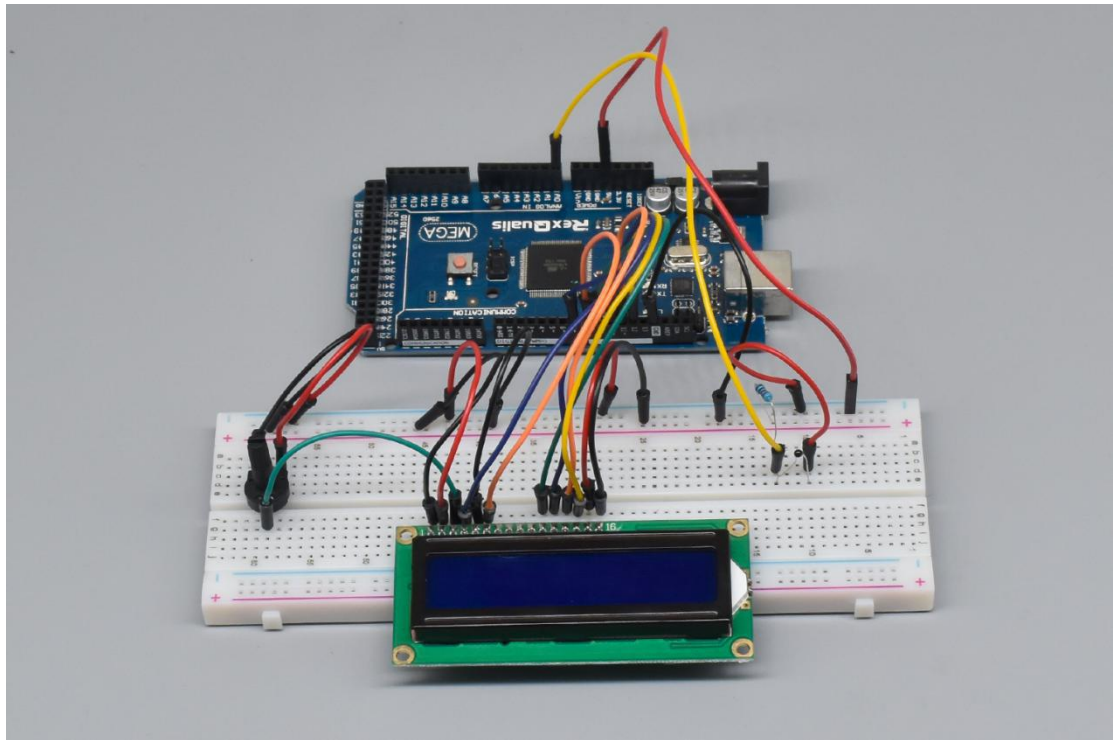
**Step 3:** Attach Arduino Mega 2560 board to your computer via USB cable and check that the '**Board Type**' and '**Serial Port**' are set correctly.

**Step 4:** Load the Library: LiquidCrystal



**Step 5: Upload the code to the RexQualis Mega 2560 board.**

**Then, you can see the temperature on the LCD display. As you change the temperature of the thermistor, the temperature displayed on the LCD display will change accordingly.**



You can see the video of the experiment results on YouTube:

<https://youtu.be/IQojLn1nIIQ>

**If it isn't working, make sure you have assembled the circuit correctly, verified and uploaded the code to your board. For how to upload the code and install the library, check Lesson 0 Preface.**