

Analog Operations through Arduino

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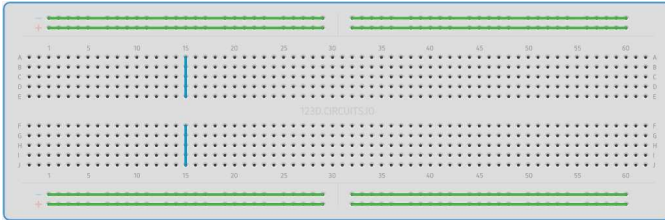


Fig. 1: Breadboard

1 MEASURING THE RESISTANCE

Problem 1. Connect the 5V pin of the Arduino to an extreme pin of the Breadboard shown in Fig. 1. Let this pin be V_{cc} .

Problem 2. Connect the GND pin of the Arduino to the opposite extreme pin of the Breadboard.

Problem 3. Let R_1 be the known resistor and R_2 be the unknown resistor. Connect R_1 and R_2 in series such that R_1 is connected to GND and R_2 is connected to V_{cc} . Refer to Fig. 10

Problem 4. Connect the junction between the two resistors to the A0 pin on the Arduino.

Problem 5. Connect the arduino to the computer so that it is powered.

Problem 6. Open the Arduino IDE and type the following code. Open the *serial monitor* to view the output.

```
// Declarations
int V_out_q=0;
//V_out_q is the quantized voltage
float V_in = 5,V_out;
//V_in = V_cc
float R1=220,R2;
//R1 is known resistance
//R2 is unknown resistance
```

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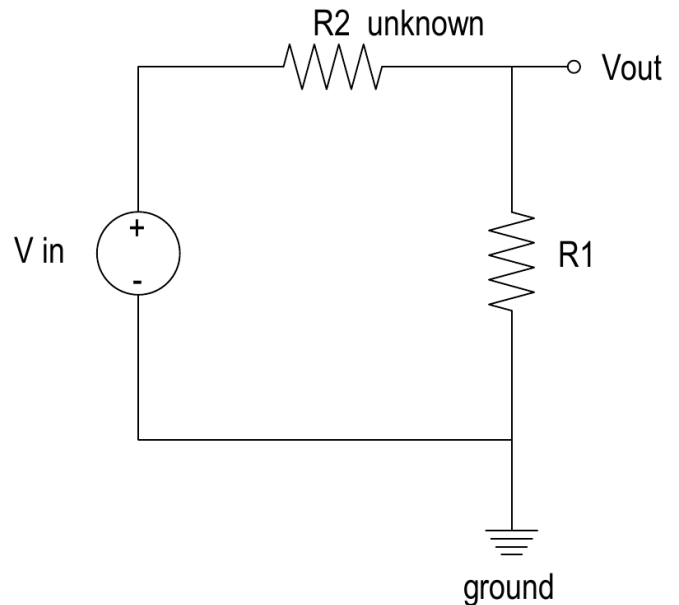


Fig. 3: Voltage Divider

```
void setup()
{
  //Get the result onto the serial
  //monitor
  Serial.begin(9600);
}

void loop()
{
  //V_out_q is an integer between 0
  //to 1023
  V_out_q=analogRead(0); //reading
  //from A0

  //V_out is the actual voltage at
  //the junction of R1 and R2
  V_out = V_in*V_out_q/1024;

  R2 = R1*((V_in)/(V_out) - 1.0);
  delay(3000);
  Serial.println(R2);
}
```

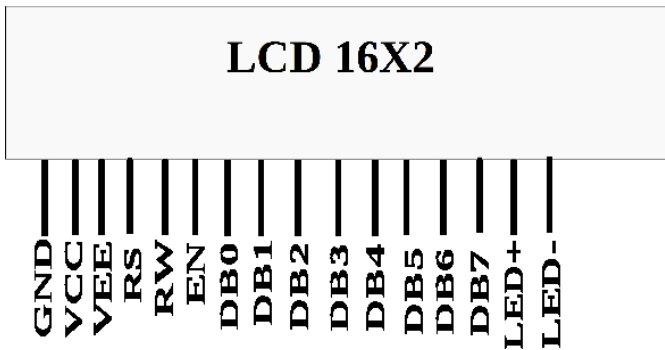


Fig. 7: lcd

TABLE I: Arduino to LCD Pin Connection.

| Arduino Pins | LCD Pins | LCD Pin Label | LCD Pin Description |
|--------------|----------|---------------|---------------------|
| GND | 1 | GND | |
| 5V | 2 | Vcc | |
| GND | 3 | Vee | Contrast |
| D12 | 4 | RS | Register Select |
| GND | 5 | R/W | Read/Write |
| D11 | 6 | EN | Enable |
| D5 | 11 | DB4 | Serial Connection |
| D4 | 12 | DB5 | Serial Connection |
| D3 | 13 | DB6 | Serial Connection |
| D2 | 14 | DB7 | Serial Connection |
| 5V | 15 | LED+ | Backlight |
| GND | 16 | LED- | Backlight |

2 DISPLAY RESISTANCE ON LCD

Problem 7. Plug the LCD in Fig. 7 to the breadboard.

Problem 8. Connect the 220Ω resistance from V_{cc} to pin 15 (Led+) of the LCD.

Problem 9. Connect the Arduino pins to LCD pins as per Table I.

Problem 10. Include the instructions for the LCD in the code for measuring the resistance.

Solution:

```

#include <LiquidCrystal.h>
LiquidCrystal lcd(12,11,5,4,3,2);
    //arduino pins connected to LCD
//Declarations
int V_out_q=0;
//V_out_q is the quantized voltage
float V_in = 5,V_out;
//V_in = V_cc
float R1=220,R2;
//R1 is known resistance
//R2 is unknown resistance

void setup()
{
    //Get the result onto the serial
    monitor
    lcd.begin(16,2);
    lcd.setCursor(0,0);
    lcd.print("----OHM_METER----");
    Serial.begin(9600);
}

void loop()
{
    //V_out_q is an integer between 0
    to 1023
    V_out_q=analogRead(0); //reading
    from A0

    //V_out is the actual voltage at
    the junction of R1 and R2
    V_out = V_in*V_out_q/1024;

    R2 = R1*((V_in)/(V_out) -1.0);
    delay(3000);
    Serial.println(R2);
    lcd.setCursor(0,1);
    lcd.print("R_=_");
    lcd.print(R2);
    lcd.print("Ohm");
}

```

3 EXPLANATION

- 1) We create a variable called `analogPin` and assign it to 0. This is because the voltage value we are going to read is connected to `analogPin A0`.
- 2) The 10-bit ADC can differentiate 1024 discrete voltage levels, 5 volt is applied to 2 resistors and the voltage sample is taken in between the resistors. The value which we get from `analogPin` can be between 0 and 1023. 0 would represent 0 volts falls across the unknown resistor. A value of 1023 would mean that practically all 5 volts falls across the unknown resistor.
- 3) V_{out} represents the divided voltage that falls across the unknown resistor.
- 4) The Ohm meter in this manual works on the principle of the voltage divider shown in Fig. 10.

$$V_{out} = \frac{R_1}{R_1 + R_2} V_{in} \quad (10.1)$$

$$\Rightarrow R_2 = R_1 \left(\frac{V_{in}}{V_{out}} - 1 \right) \quad (10.2)$$

In the above, $V_{in} = 5\text{V}$, $R_1 = 220\Omega$.