Analog Operations through Arduino

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***Abstract*—This manual shows how to use an arduino for measuring an unknown resistance by interfacing with a simple voltage divider circuit. This helps understand how to use the analog pins of the arduino. The principle can be readily applied for reading sensor data.**

1 Components

Component	Value	Quantity
Resistor	220 Ohm	1
	1K	1
Arduino	Uno	1
Jumper Wires		20

TABLE I

2 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}.

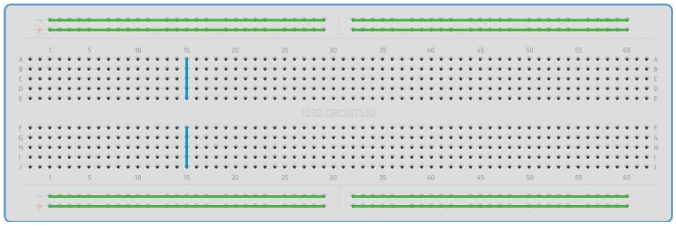

Fig. 1: Breadboard

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. 3

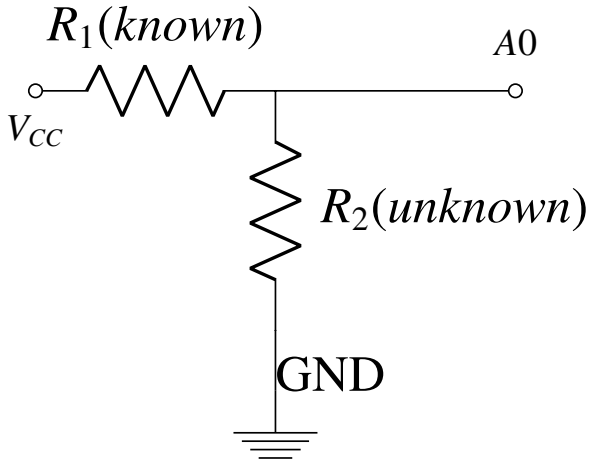

Fig. 3: Voltage Divider

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.

```
//Code released under GNU GPL.
   Free to use for anything.
//Remove the following  line if
   you are using the Arduino IDE
#include "Arduino.h"

//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;
```

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```
//R1 is known resistance
//R2 is unknown resistance

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

void loop()
{
//V_0ut_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);
}
```

Problem 7. Now keep $R_1 = 1K$ and $R_2 = 220\Omega$ and verify by modifying the above code.

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. 3.

$$V_{out} = \frac{R_1}{R_1 + R_2} V_{in} \tag{7.1}$$

$$\Rightarrow R_2 = R_1 \left(\frac{V_{in}}{V_{out}} - 1 \right) \tag{7.2}$$

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