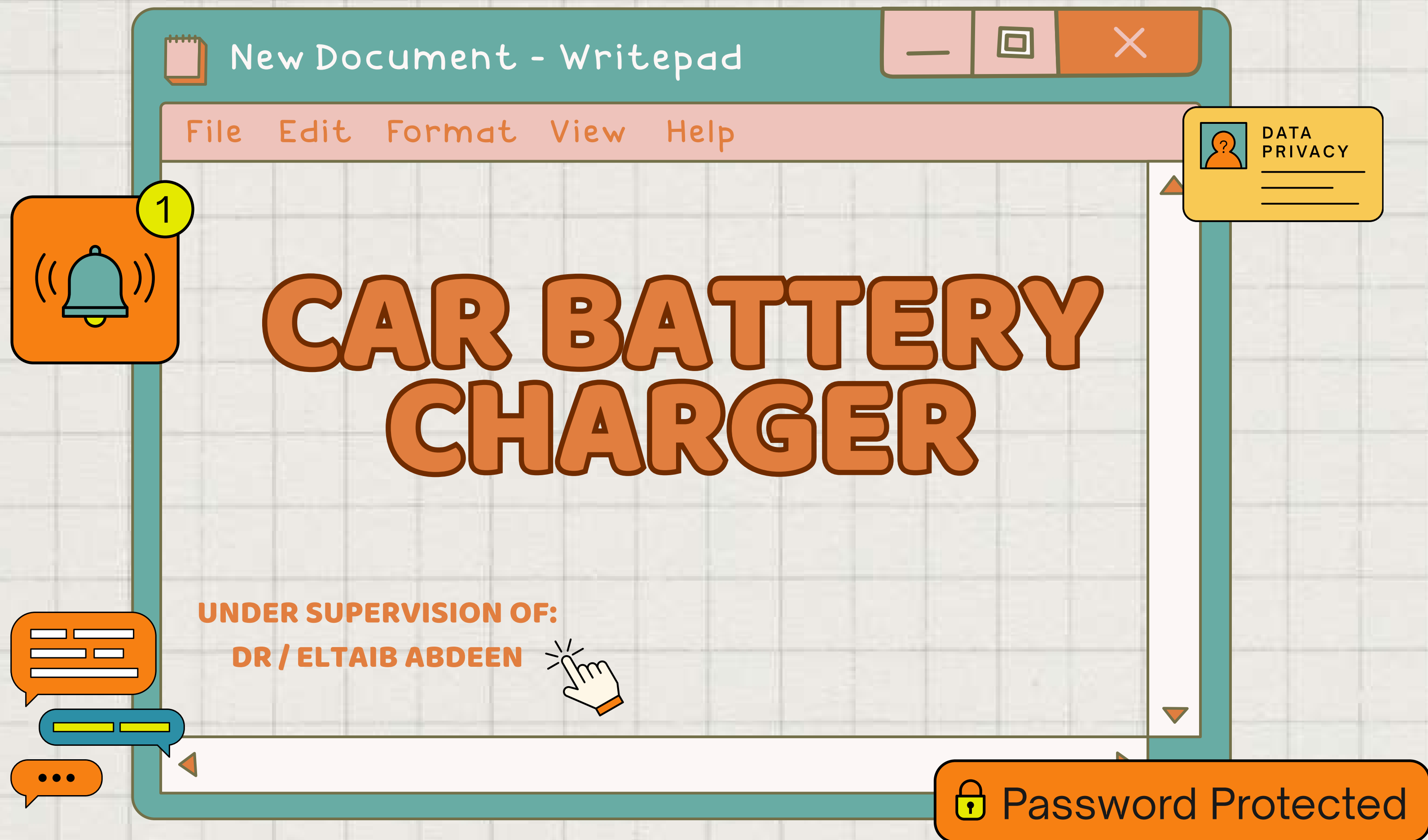




PROJECT OVERVIEW

**Making a device using the Boost
converter to charge the car
battery**





PROJECT GOAL

GOALS

**Using the Boost converter to raise the voltage from 5V input source,
i.e. DC Adapter
to a voltage suitable for
charging a car battery**

CAR BATTERY

First of all, we need to know some information about the car battery

1.

Voltage of the battery

We found that the batteries needs from 12V to 14.4V for recharging

2.

The current of the battery

Most of car battery chargers provide from 8A to 10A output current to the battery, as shown.



SO WE CAN SAY THAT

$$V_{in} = 5 \text{ V}$$

$$V_o = 14.4 \text{ V}$$

$$I_o = 10 \text{ A}$$

$$\rightarrow R_l = V_o / I_o = 1.44 \Omega$$

Some important assumptions:

$$\Delta I_L = 30\% I_L$$

$$\Delta V_o = 1\% V_o$$

→ Switching frequency = 100KHz

Which is suitable for most of the components

Notice that, we assume that the voltage is 14.4V and the current is 10A to take the losses in consideration.

CALCULATIONS

- For boost converter

$$V_o/V_{in} = 1/(1-D) \rightarrow D = 0.653 \text{ (in percentage = 65.3 \%)}$$

$$\Delta V_o = (V_o * D) / R_o * C * F_s \rightarrow C = 453 \text{ uF}$$

take the standard value = 470uF

$$\Delta I_L = (V_{in} * D) / (L * F_s) \rightarrow L = 3.77 \text{ uH}$$

take the standard value = 3.3 uH

COMPENENTS USED

- **MOSFET**

We used the **IRFZAAN** MOSFET for:

- (1) It`s maximum drain current $I_d = 50\text{ A}$
- (2) It has $R_{ds(on)} = 0.0175\ \Omega$

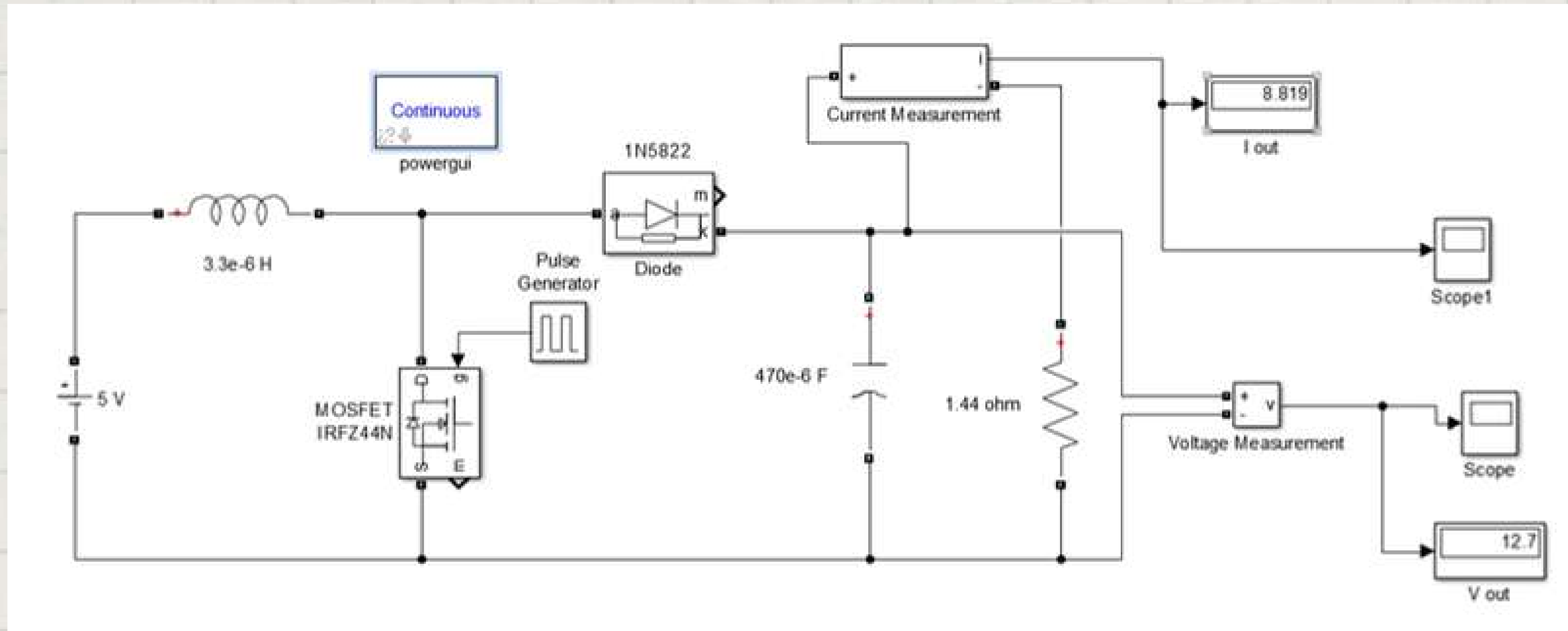
Element	Value
Inductor	3.3 μH
Capacitor	470 μF
Resistor	1.44 Ω

- **Diode**

We used the **IN5822** Diode Bec, its $I_{fsm} = 80\text{ A}$, in duration = 8.3 ms

$$\rightarrow \frac{1}{F_s} = \frac{1}{100\text{KHz}} = 10^{-5}\text{ s} < 8.3\text{ms}$$

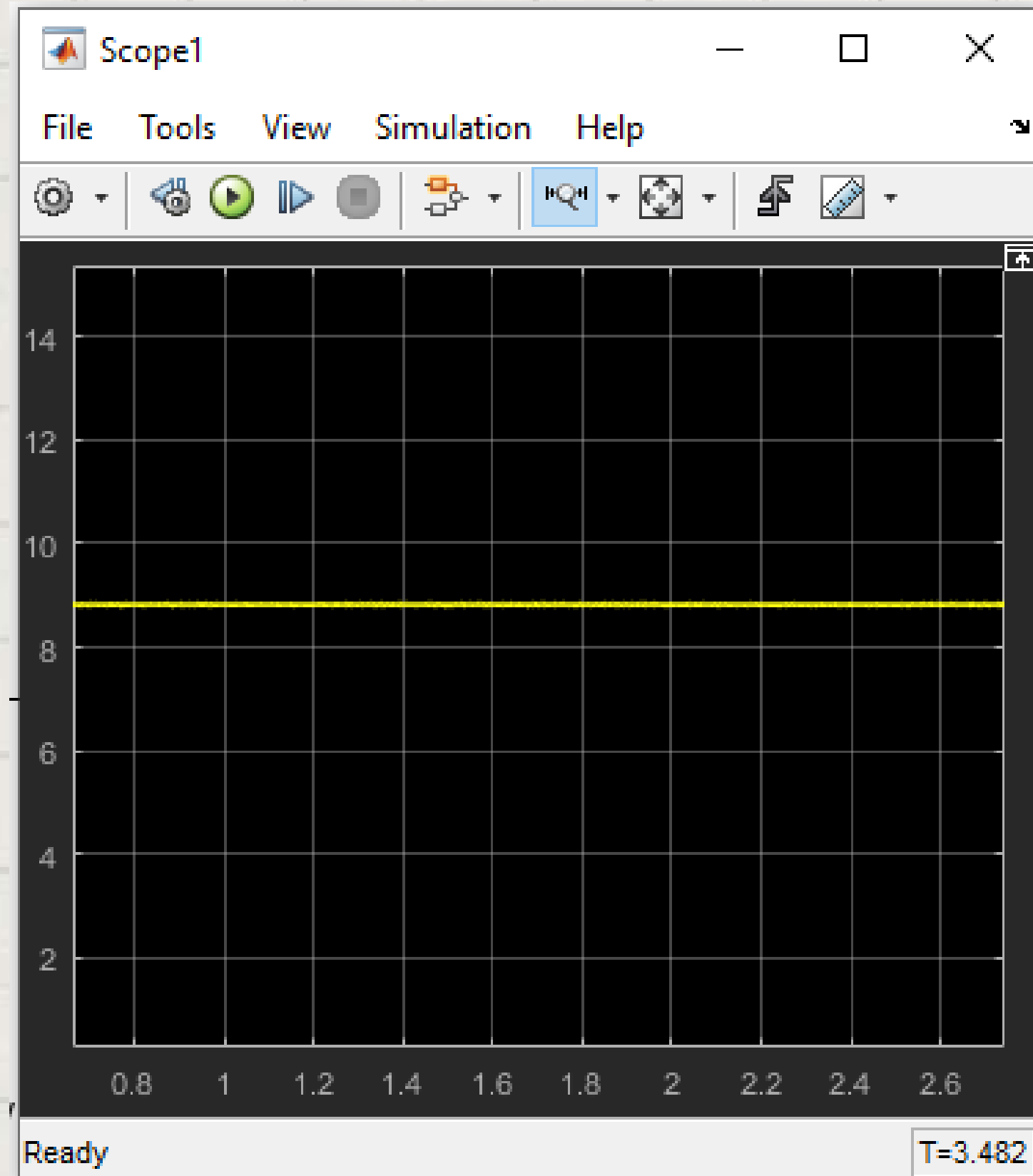
SIMULATION RESULT



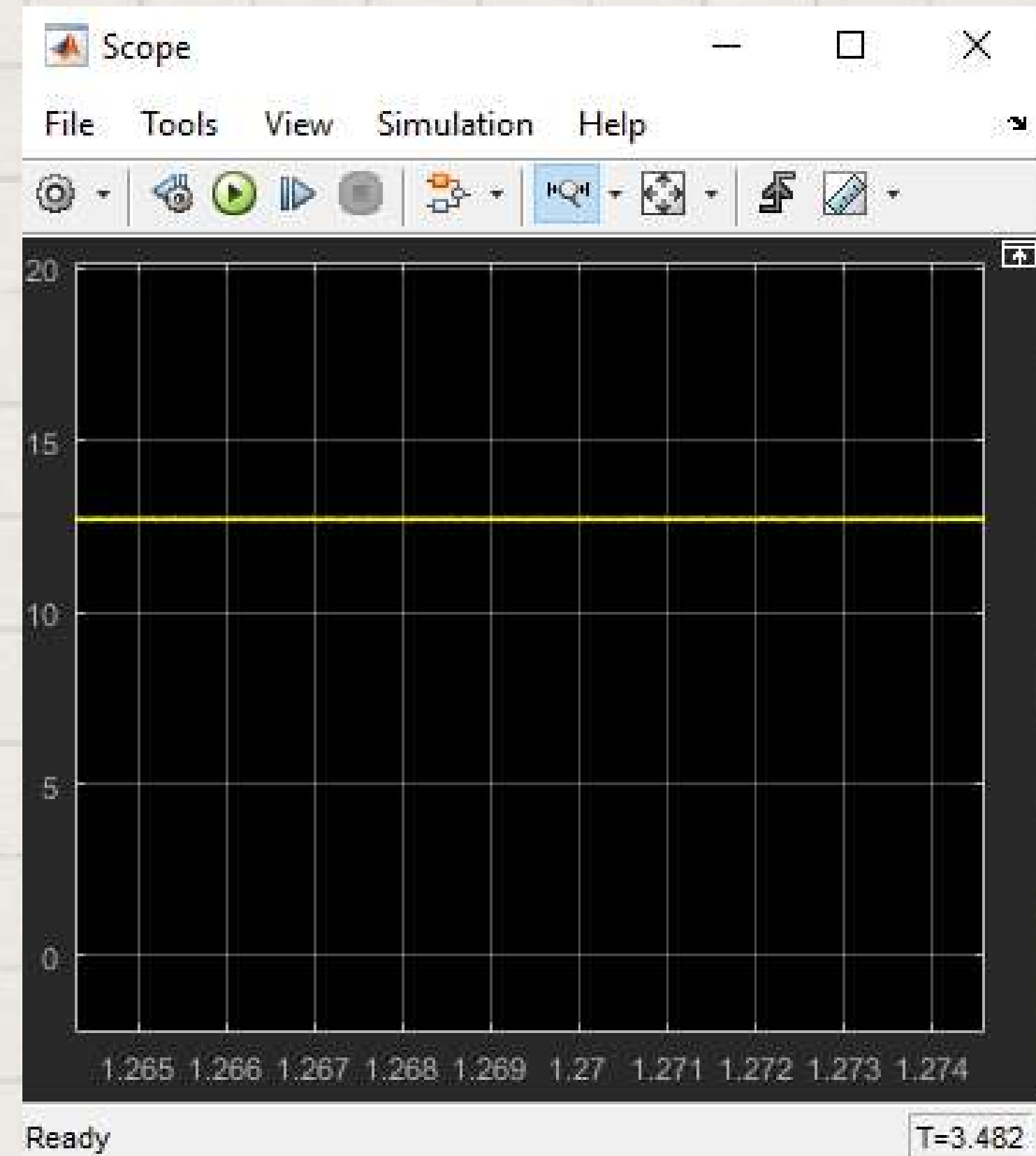
$V_o = 12.7\text{ V} \checkmark$
 $I_o = 8.819\text{ A} \checkmark$

} *Acceptable values*

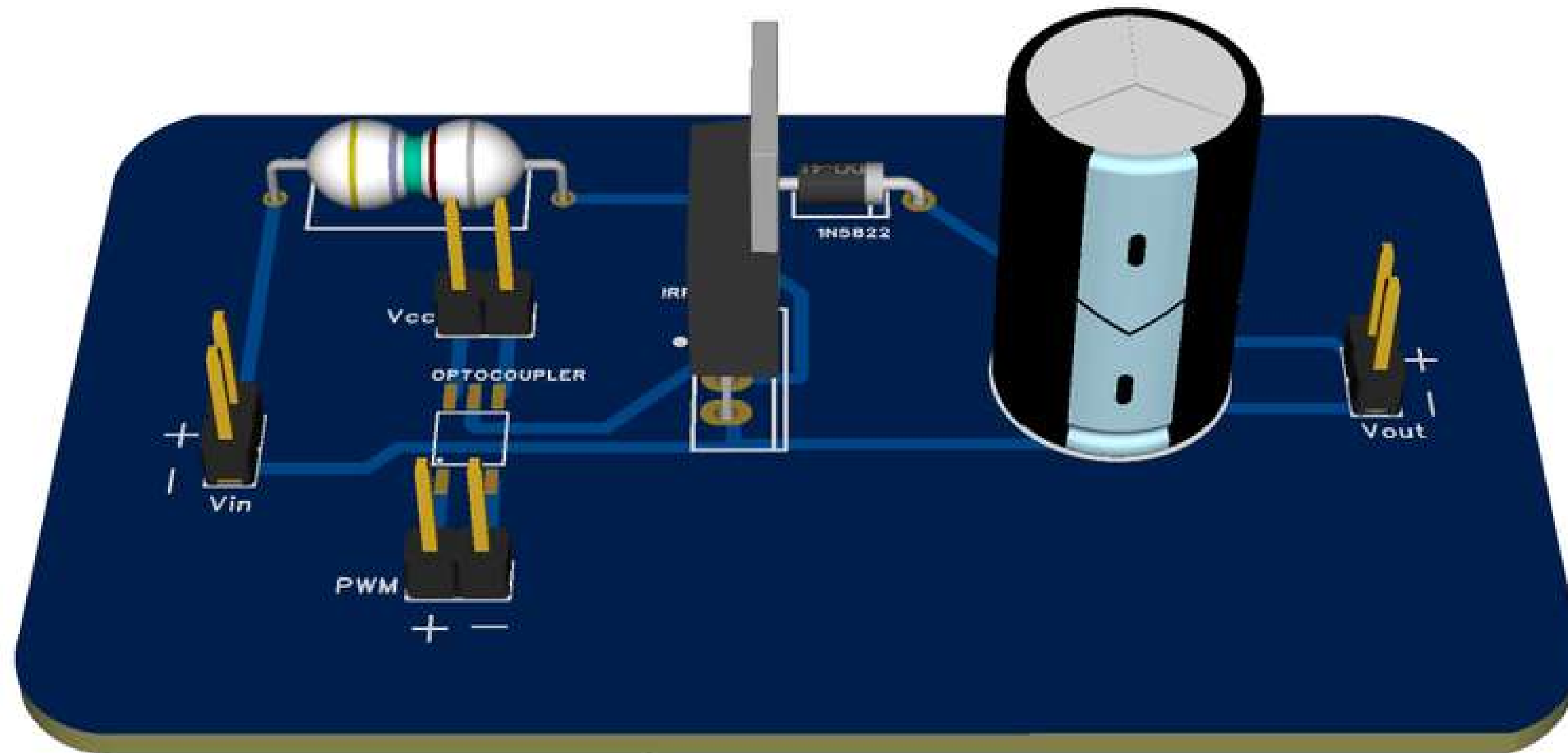
OUTPUT CURRENT WAVEFORM



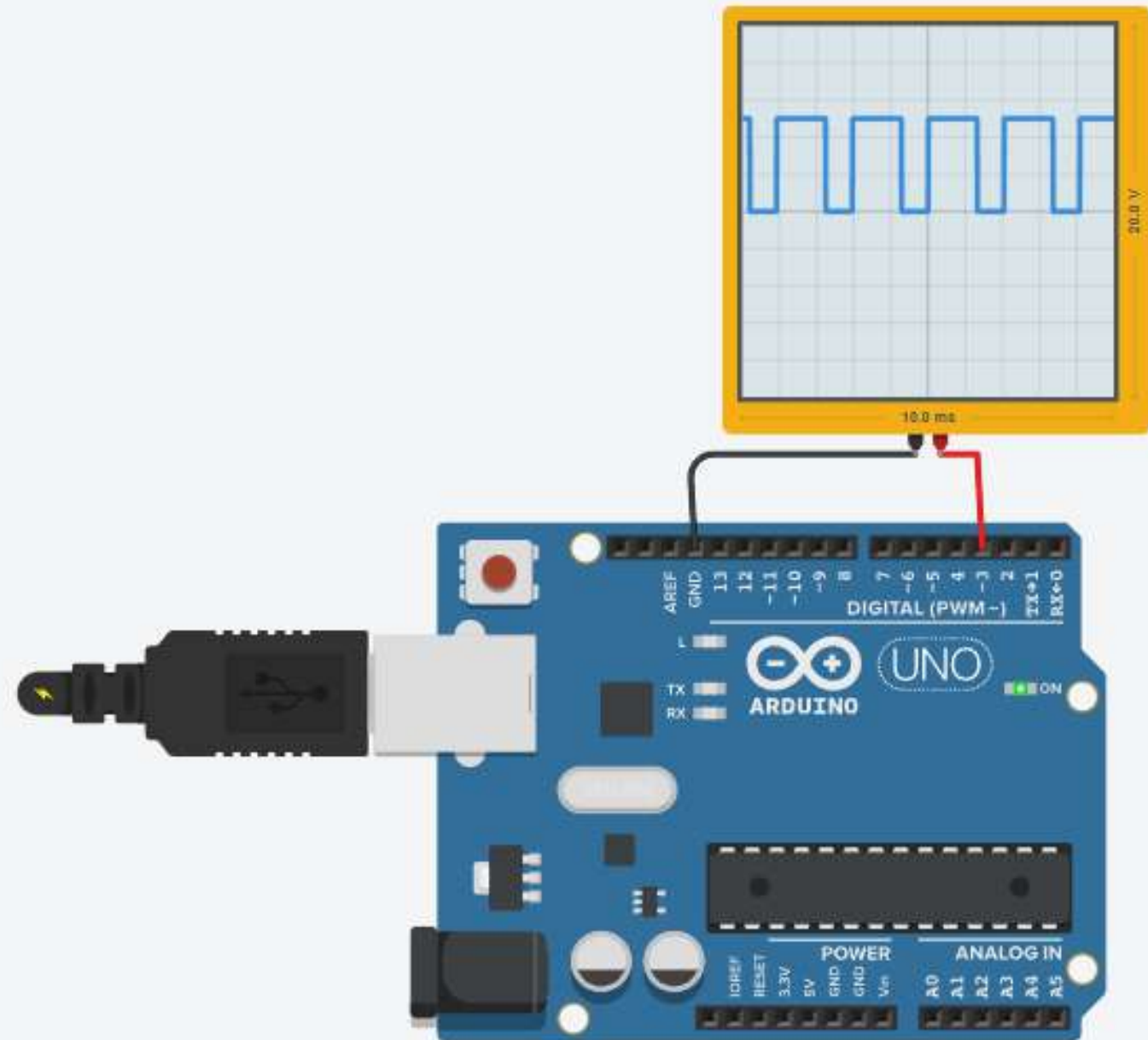
OUTPUT VOLTAGE WAVEFORM



PCB DESIGN

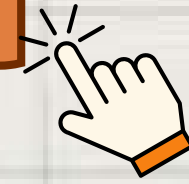


ARDUINO CODE



```
3 void setup()
4 {
5     pinMode(3, OUTPUT);
6 }
7
8 void loop()
9 {
10    analogWrite(3, 0.653*255);
11    while (true);
12 }
```

OBTAINING A POWER SUPPLY BY USING THE SAME CIRCUIT



- We can obtain a power supply by using the output voltage of the previous as an input to another circuit.
- The new circuit provides me two output ports one of them is a constant DC voltage equals to the input voltage “12.7 V” and the other is a DC voltage can be adjusted by a variable resistance from 1.2 V to approximately equal the input voltage “12.7 in this case”.

CALCULATIONS

$$V_o = 12.5(1 + (R' / R_2)) \quad \curvearrowright$$

$$V_o = 12.7 \text{ V}$$

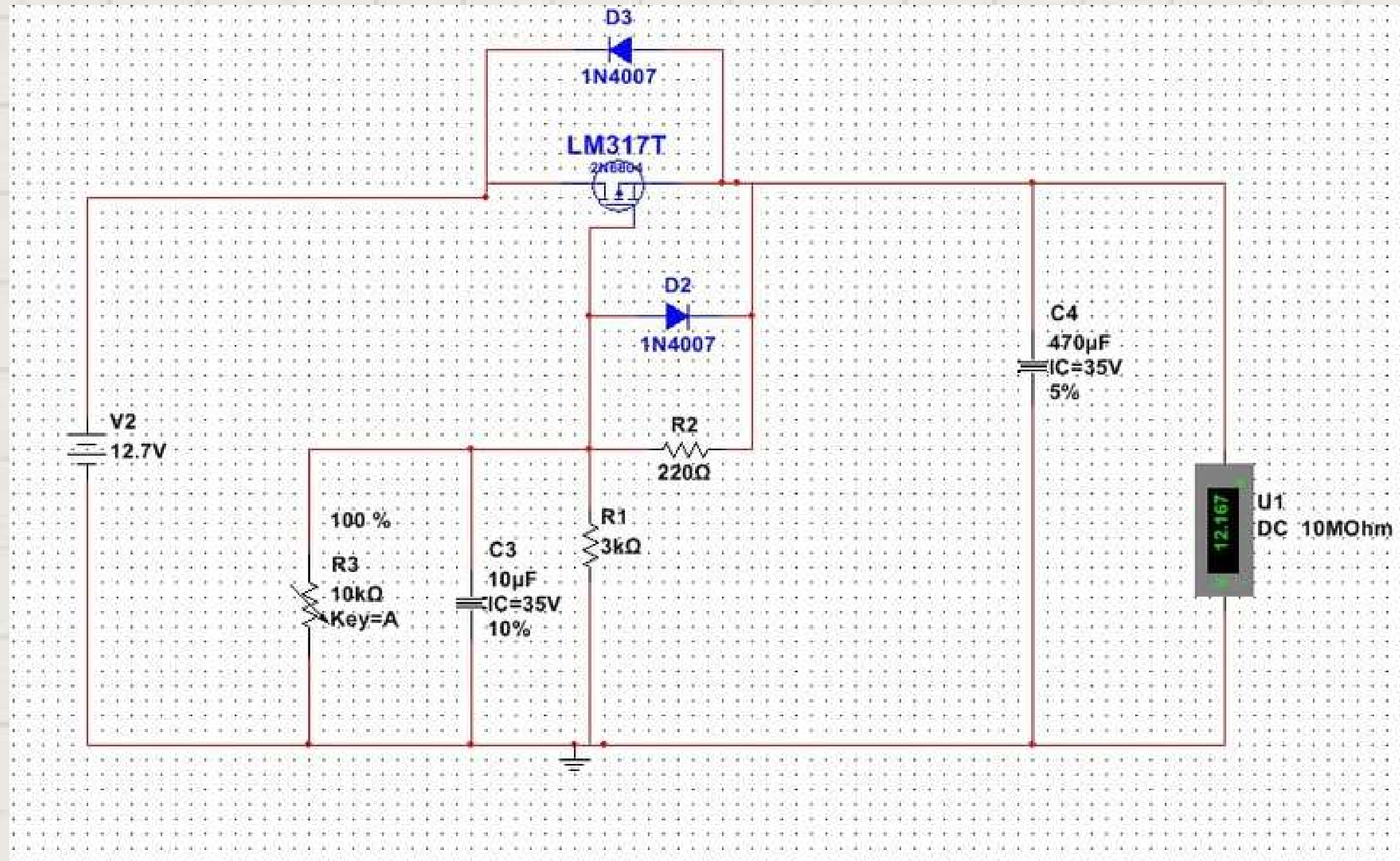
assume $R = 220 \text{ K}\Omega$

$$12.7 = 1.25(1 + (R' / 220 \text{ K}\Omega)) \quad \rightsquigarrow \rightarrow R' = 2.015 \text{ K}\Omega$$

$$R' = R_1 // R_2$$

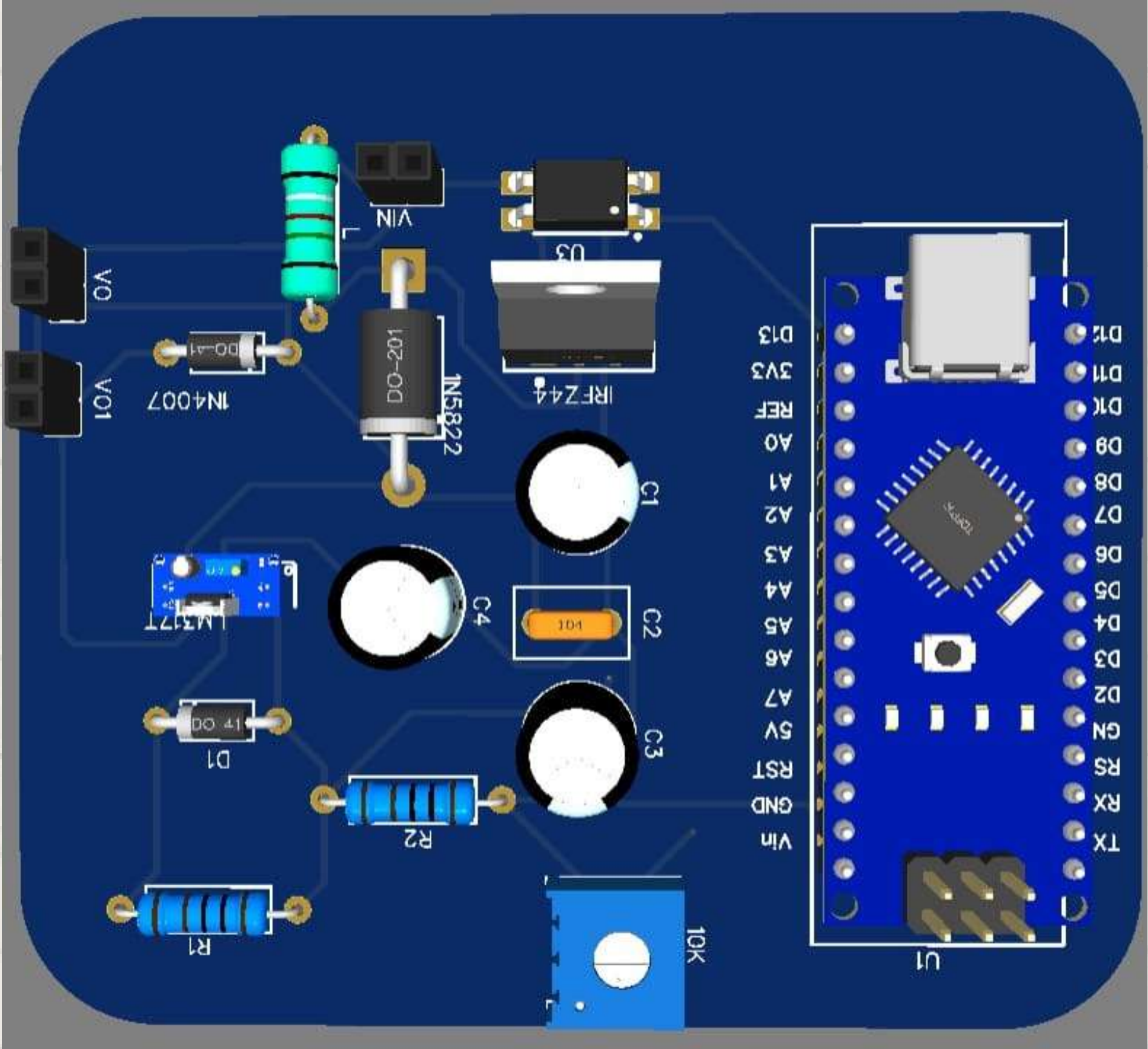
$$\text{assume } R_1 = 3 \text{ K}\Omega \quad \rightsquigarrow \rightarrow R_3 = 10 \text{ K}\Omega$$

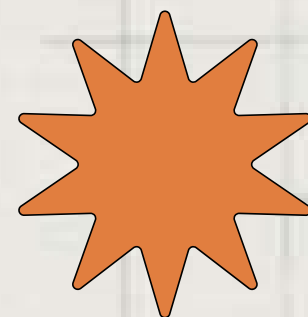
SIMULATION RESULT



$V_o = 12.167 \text{ V}$ ✓

PCB DESIGN





**THANK
YOU!**

