PROJECT REPORT

- CAR BATTERY CHARGER
- POWER SUPPLY

Table Of Content

Overview

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

Goals

- **Goal 1**

  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

- **Goal 2**

  Designing a power supply by adding some modifications to the Boost Converter

Calculations

∵ Vin =5 V Vo =14.4 V Io=10 A

∴ Rl = Vo/Io = 1.44 Ω

∵ For the boost converter → ∴ Vo/Vin = 1/(1-D)

∴ D = 0.653
(in percentage = 65.3 %)

∵ Ic = C * dV/dT

∵ Vl = L * dIl/dT

∴ ΔVo = (Vo*D)/Ro*C*Fs

∴ ΔI_L = (Vin*D)/(L*Fs)

∵ Let, ΔI_L = 30% I_L & ΔVo = 1% Vo & Fs = 100KHz

∵ Assume that the voltage is 14.4V and the current is 10A to take the losses in consideration.

∴ $I_L = \dfrac{Vo}{D` * R} = \dfrac{14.4}{0.347 * 1.44} = 28.82\ A$ → ΔI_L= 0.3 * 28.82 = 0.8645

∴ $8.645 = \dfrac{5 * 0.653}{L * 100\ KHz}$ → ∴ L = 3.77 uH
take the standard value = 3.3 uH

∴ $0.144 = \dfrac{14.4 * 0.653}{1.44 * C * 100KHz}$ → ∴ C = 453 uF
take the standard value = 470 uF

Components

Element	Value
Resistor	1.44Ω
Inductor	3.3 uH
Capacitor	470 uF

- ## MOSFET "IRFZ44N"

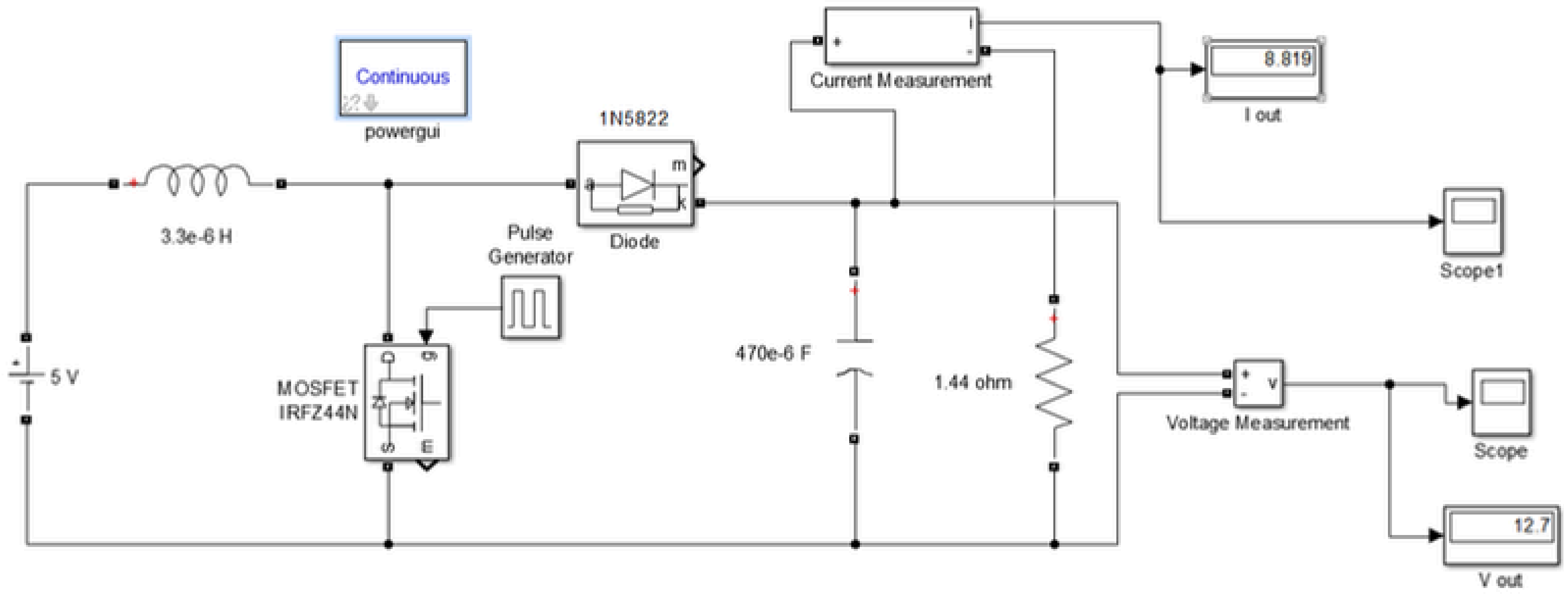
QUICK REFERENCE DATA

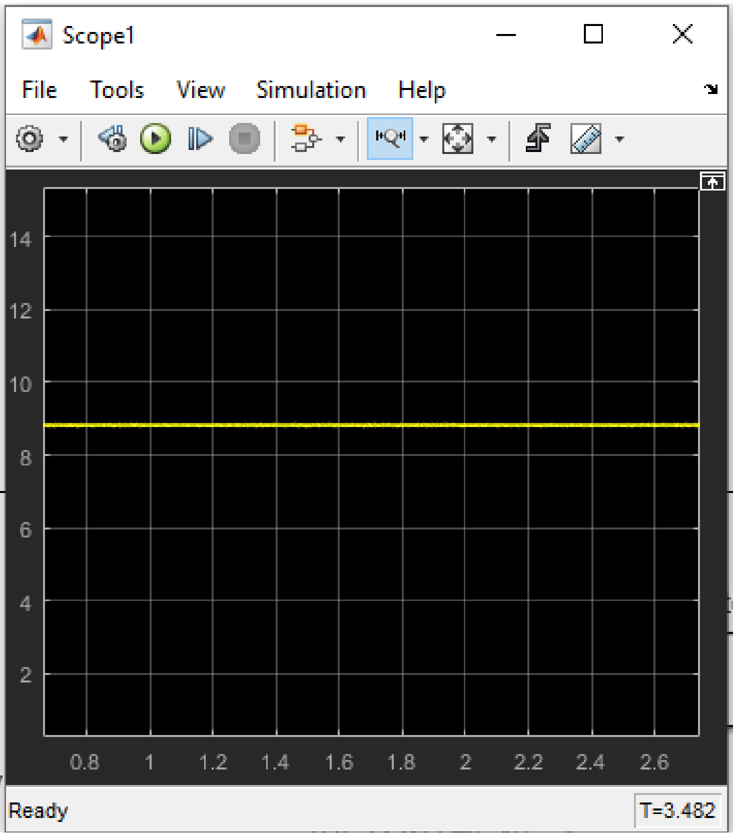
SYMBOL	PARAMETER	MAX.	UNIT
V_{DS}	Drain-source voltage	55	V
I_D	Drain current (DC)	49	A
P_{tot}	Total power dissipation	110	W
T_j	Junction temperature	175	˚C
$R_{DS(ON)}$	Drain-source on-state resistance V_{GS} = 10 V	22	mΩ

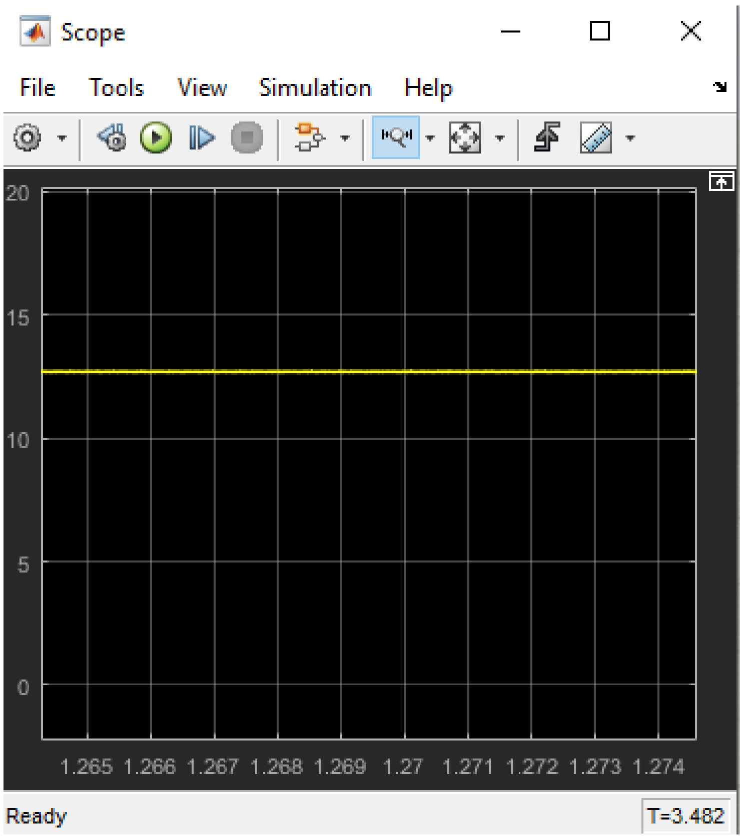
- ## Diode "1N5822"

	Symbols	1N 5820	1N 5821	1N 5822	Units
Maximum repetitive peak reverse voltage	V_{RRM}	20	30	40	Volts
Maximum RMS voltage	V_{RMS}	14	21	28	Volts
Maximum DC blocking voltage	V_{DC}	20	30	40	Volts
Maximum average forward rectified current 0.375"(9.5mm)lead length at T_L=95˚C	$I_{(AV)}$	3.0			Amps
Peak forward surge current 8.3ms single half sine-wave superimposed on rated load (JEDEC method) at T_L=75˚C	I_{FSM}	80.0			Amps
Maximum instantaneous forward voltage at 3.0 A(Note 1)	V_F	0.475	0.500	0.525	Volts
Maximum instantaneous forward voltage at 9.4 A(Note 1)	V_F	0.850	0.900	0.950	Volts

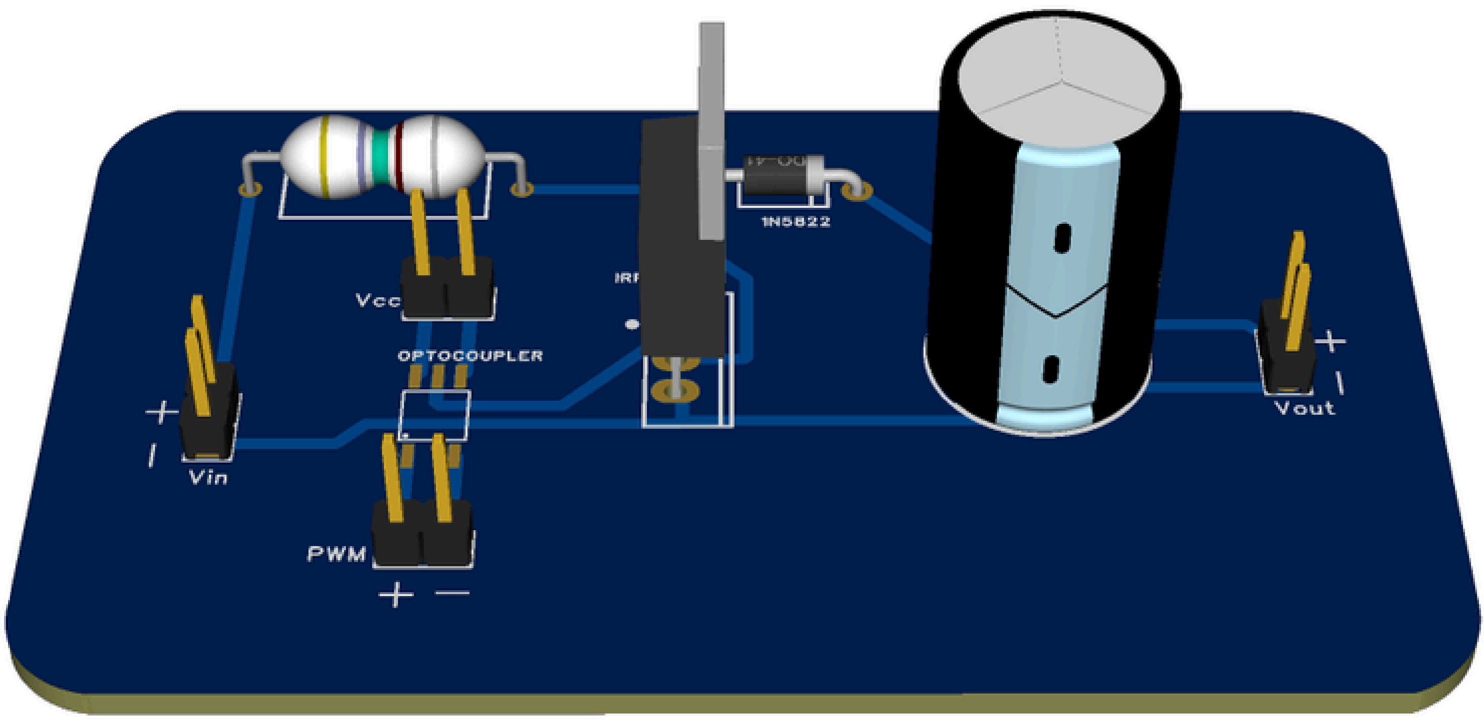
Simulation result



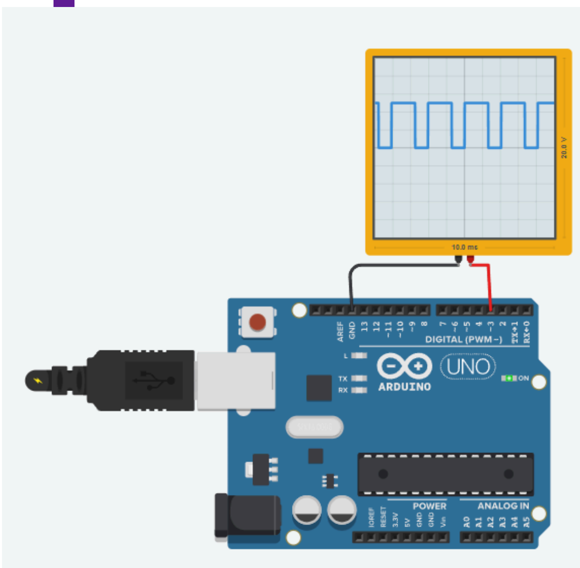




PCB Design



Arduino Code




```
void setup()
{
  pinMode(3, OUTPUT);
}

void loop()
{
 analogWrite(3,0.653*255);
  while (true);
}
```

Power Supply

We can obtain a power supply by using the output voltage of the previous circuit as an input to another circuit.

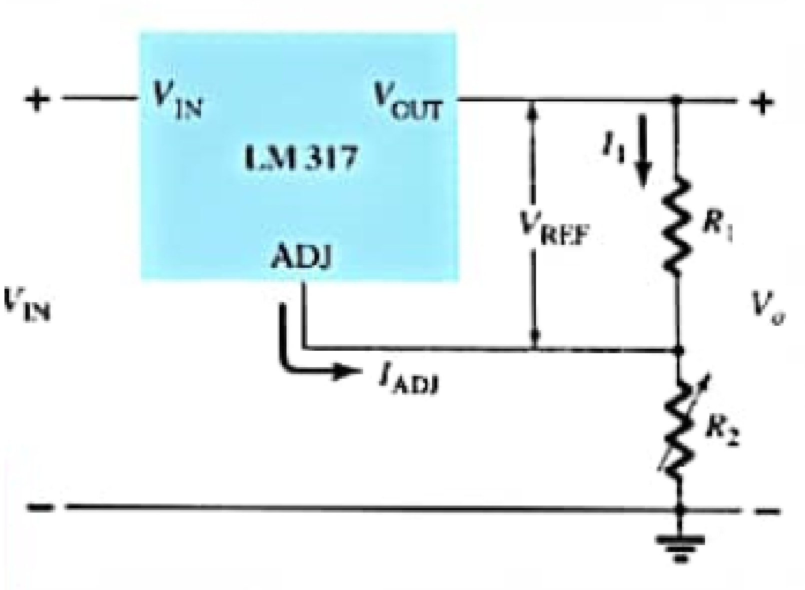
The new circuit provides two output ports

1. One of them is a constant DC voltage equals to the input voltage “12.7 V”.
2. The other is a DC voltage can be adjusted from 1.2 V to a value approximately equal the input voltage “12.7 in this case” by a variable resistance.

Calculations

$$V_O = V_{REF}\left(1+\frac{R_2}{R_1}\right) + I_{ADJ}R_2$$

$I_{ADJ} = 100\,\mu A$ and $V_{REF} = 1.25\,V$



∵Vo = 1.25(1+(R` / R2))

∵Vo=12.7 V

∵assume R=220 KΩ

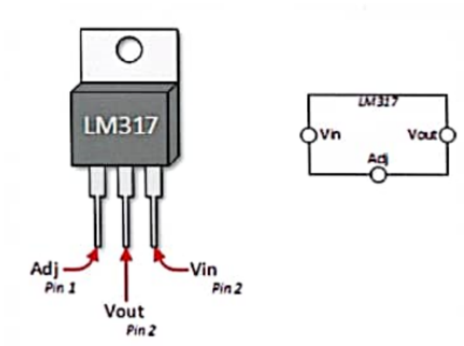
∴12.7 = 1.25 (1 + (R`/220KΩ) ) ➞ ∴R` = 2.015 KΩ

∵R` = R1 // R3

∴assume R1 = 3KΩ ➞ ∴R3 = 10 KΩ

Components

- **MOSFET “LM317”**



Maximum Ratings Ratings at 25°C ambient temperature unless otherwise specified.

Parameter		Symbol	Value	Unit
Input-Output Voltage Differential		V_I-V_O	40	Vdc
Junction-to-Case Thermal Resistance	TO-220 TO-263	$R_{\theta JC}$	3.0 3.0	°C
Power Dissipation, 25°C Case Temperature		P_D	15	W
Operating Junction Temperature Range		T_J	0 to +125	°C
Storage Junction Temperature Range		T_{stg}	–65 to +150	°C

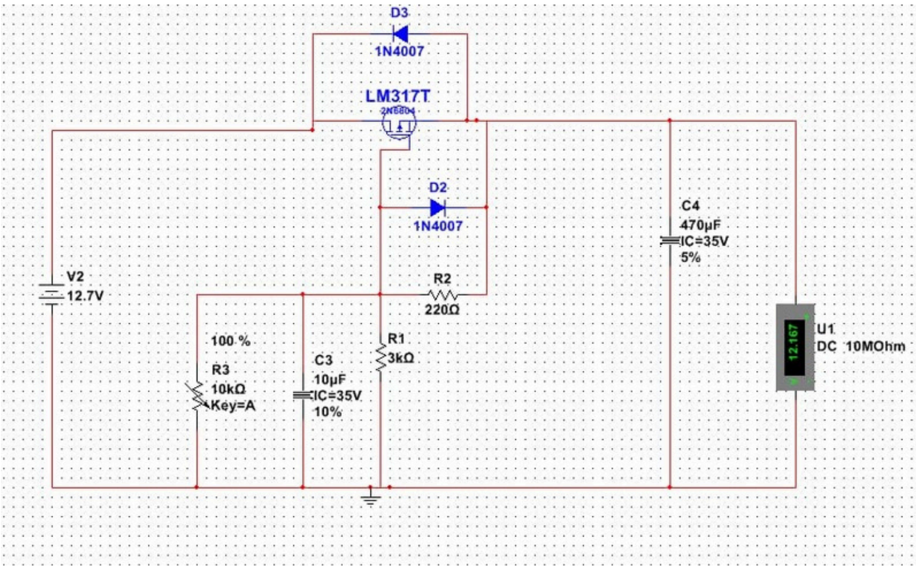
- **Diode “1N4007”**

Maximum Ratings and Electrical Characteristics @ T_A = 25°C unless otherwise specified

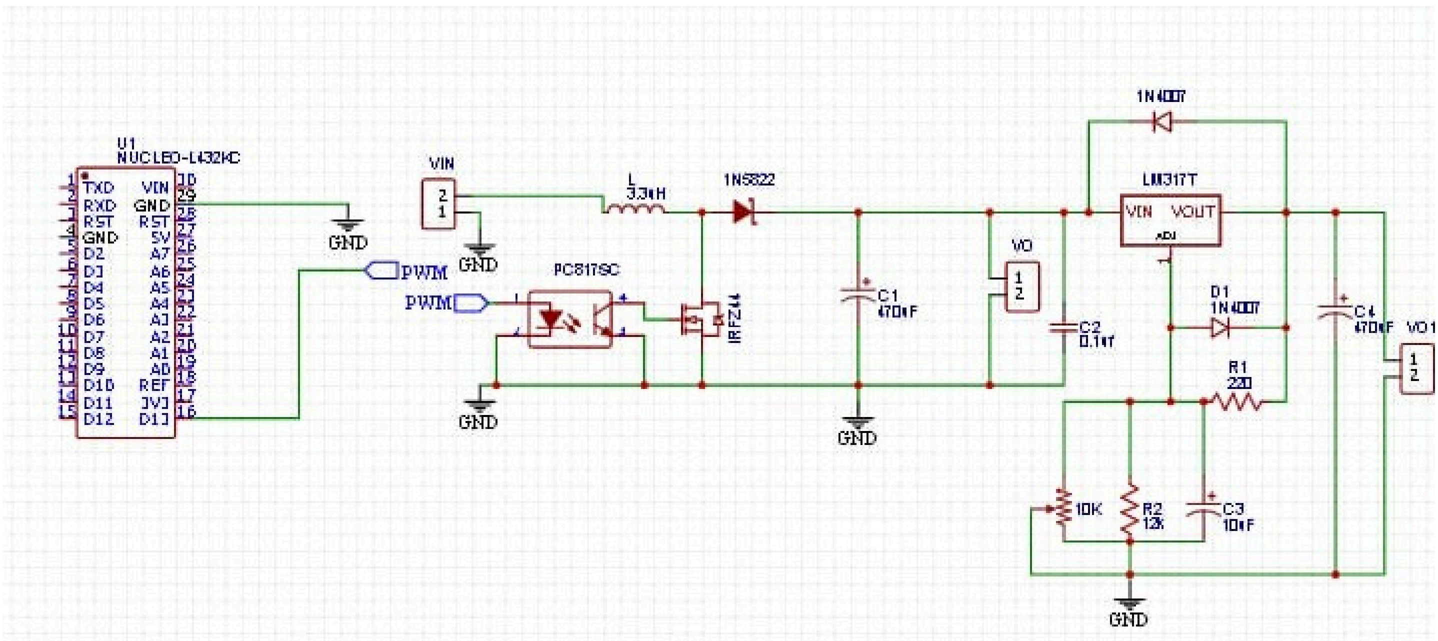
Single phase, half wave, 60Hz, resistive or inductive load.
For capacitive load, derate current by 20%.

Characteristic		Symbol	1N 4001/L	1N 4002/L	1N 4003/L	1N 4004/L	1N 4005/L	1N 4006/L	1N 4007/L	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	V
RMS Reverse Voltage		$V_{R(RMS)}$	35	70	140	280	420	560	700	V
Average Rectified Output Current (Note 1)	@ T_A = 75°C	I_O	1.0							A
Non-Repetitive Peak Forward Surge Current 8.3ms single half sine-wave superimposed on rated load (JEDEC Method)		I_{FSM}	30							A
Forward Voltage	@ I_F = 1.0A	V_{FM}	1.0							V
Peak Reverse Current at Rated DC Blocking Voltage	@ T_A = 25°C @ T_A = 100°C	I_{RM}	5.0 50							µA

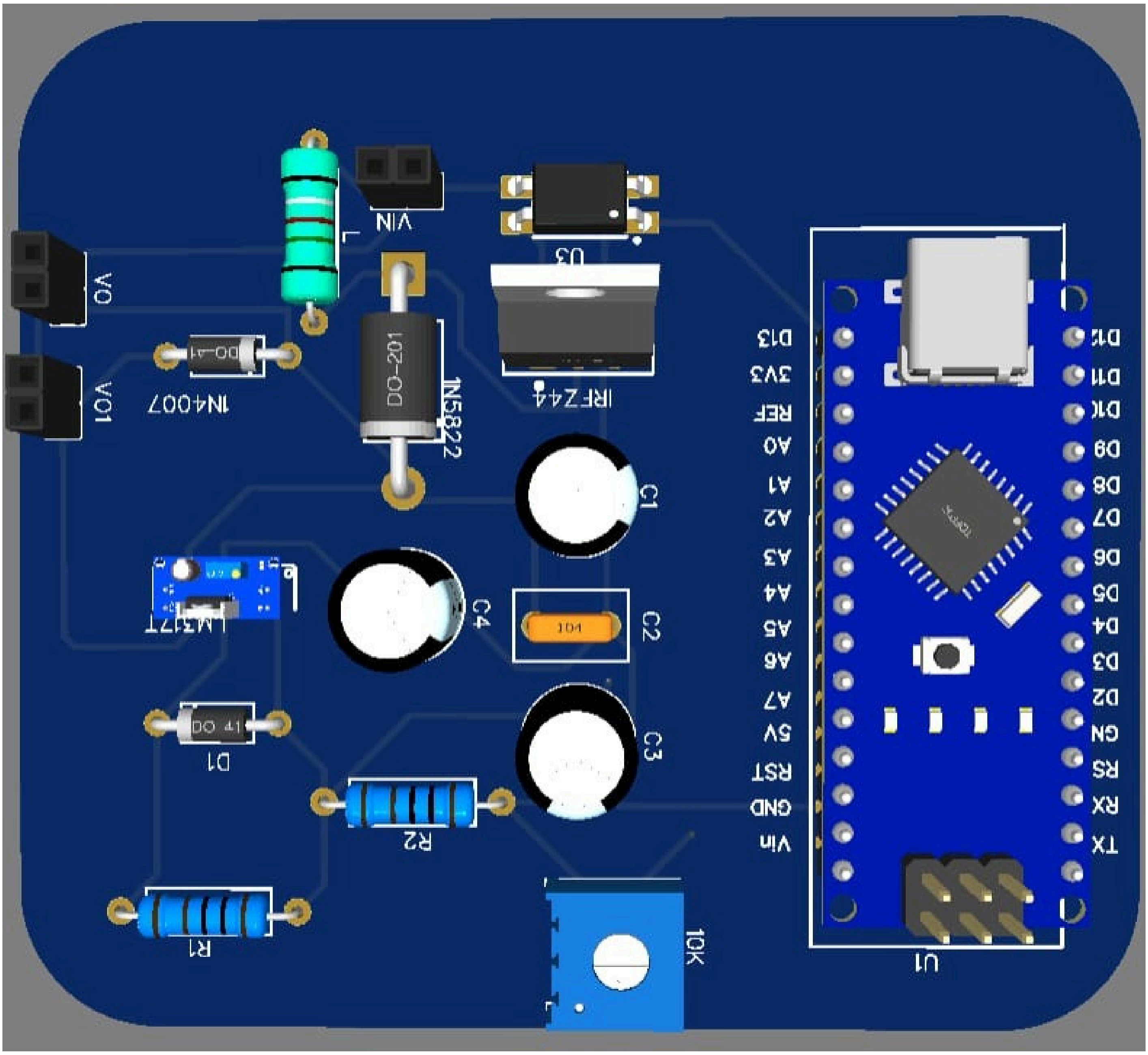
Simulation Result



Full Connections



PCB Design


VIN
U3
IRFZ44
DO-201
1N5822
1N4007
VO
VO1
LM317T
C1
C2
C3
C4
D1
R1
R2
10K
U1