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

∵ $V_{in} = 5$ V $V_o = 14.4$ V $I_o = 10$ A

∴ $R_l = V_o/I_o = 1.44\ \Omega$

∵ For the boost converter → ∴ $V_o/V_{in} = 1/(1-D)$

∴ $D = 0.653$
(in percentage = 65.3 %)

∵ $I_c = C * dV/dT$

∵ $V_l = L * dI_l/dT$

∴ $\Delta V_o = (V_o*D)/R_o*C*F_s$

∴ $\Delta I_L = (V_{in}*D)/(L*F_s)$

∵ Let, $\Delta I_L = 30\%\ I_L$ & $\Delta V_o = 1\%\ V_o$ & $F_s = 100$ KHz

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

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

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

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

Components

Element	Value
Resistor	1.44Ω
Inductor	3.3 uH
Capacitor	470 uF

- ## MOSFET "IRFZ44N"

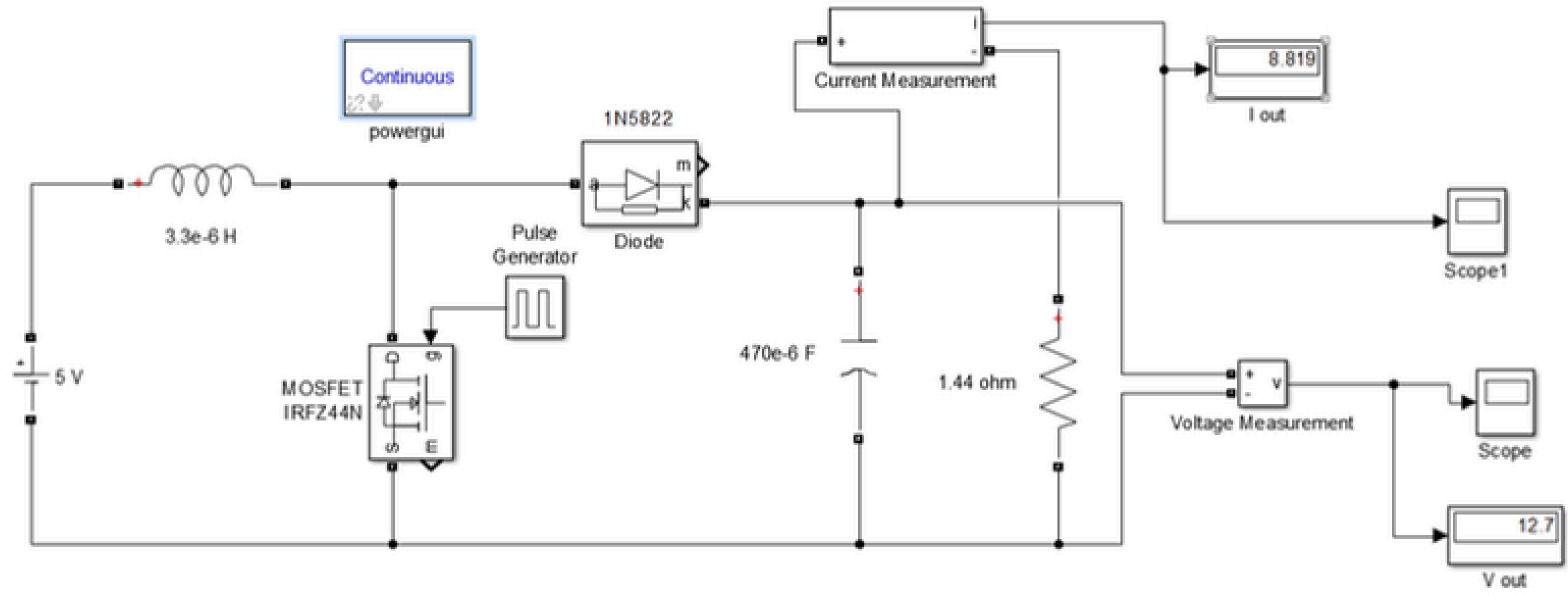
QUICK REFERENCE DATA

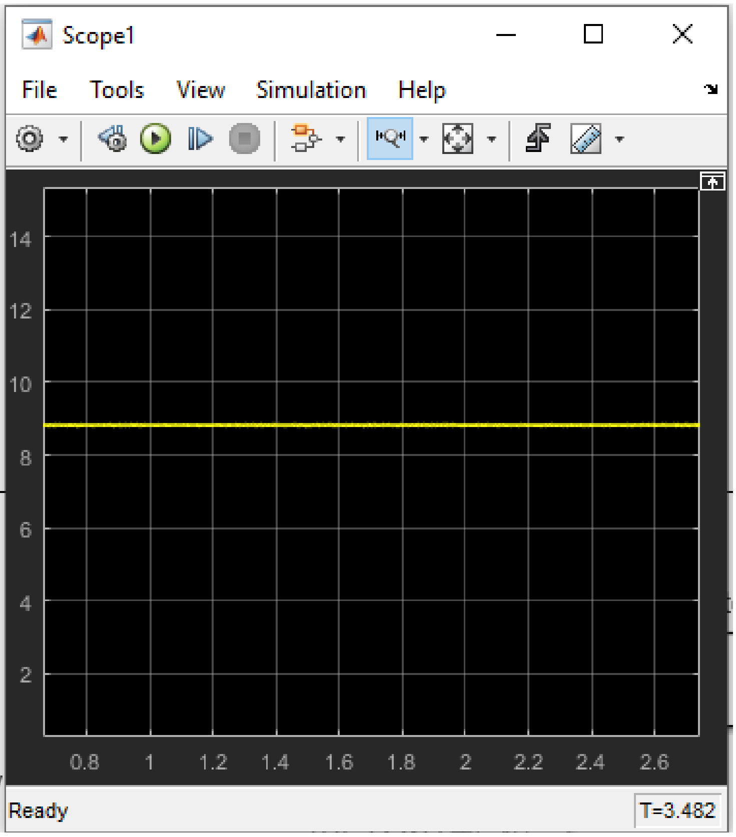
SYMBOL	PARAMETER	MAX.	UNIT
V_{DS}	Drain-source voltage	55	V
I_D	Drain current (DC)	49	A
P_{tot}	Total power dissipation	110	W
T_j	Junction temperature	175	˚C
$R_{DS(ON)}$	Drain-source on-state resistance V_{GS} = 10 V	22	mΩ

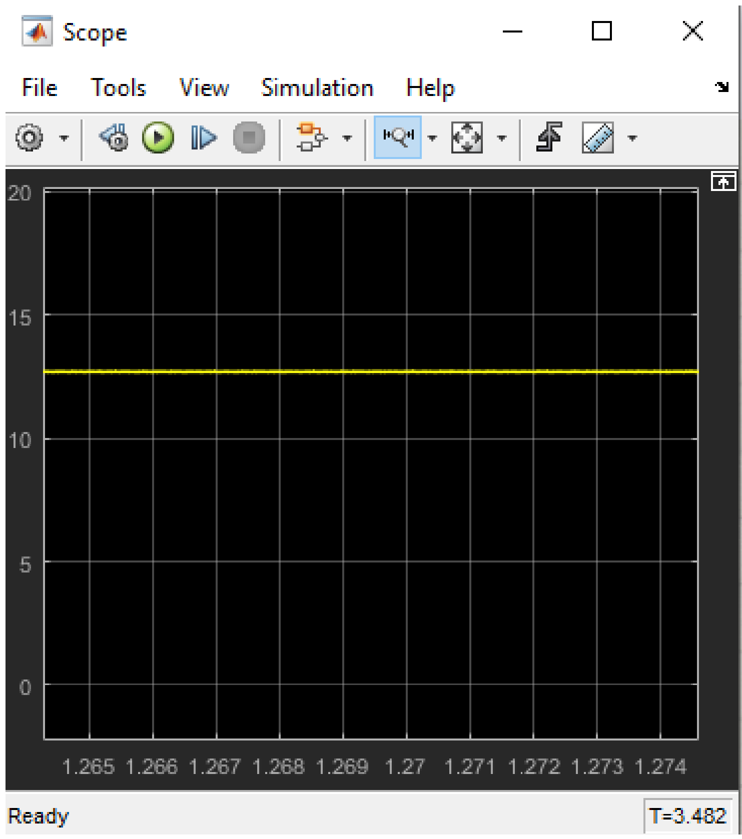
- ## Diode "1N5822"

	Symbols	IN 5820	IN 5821	IN 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

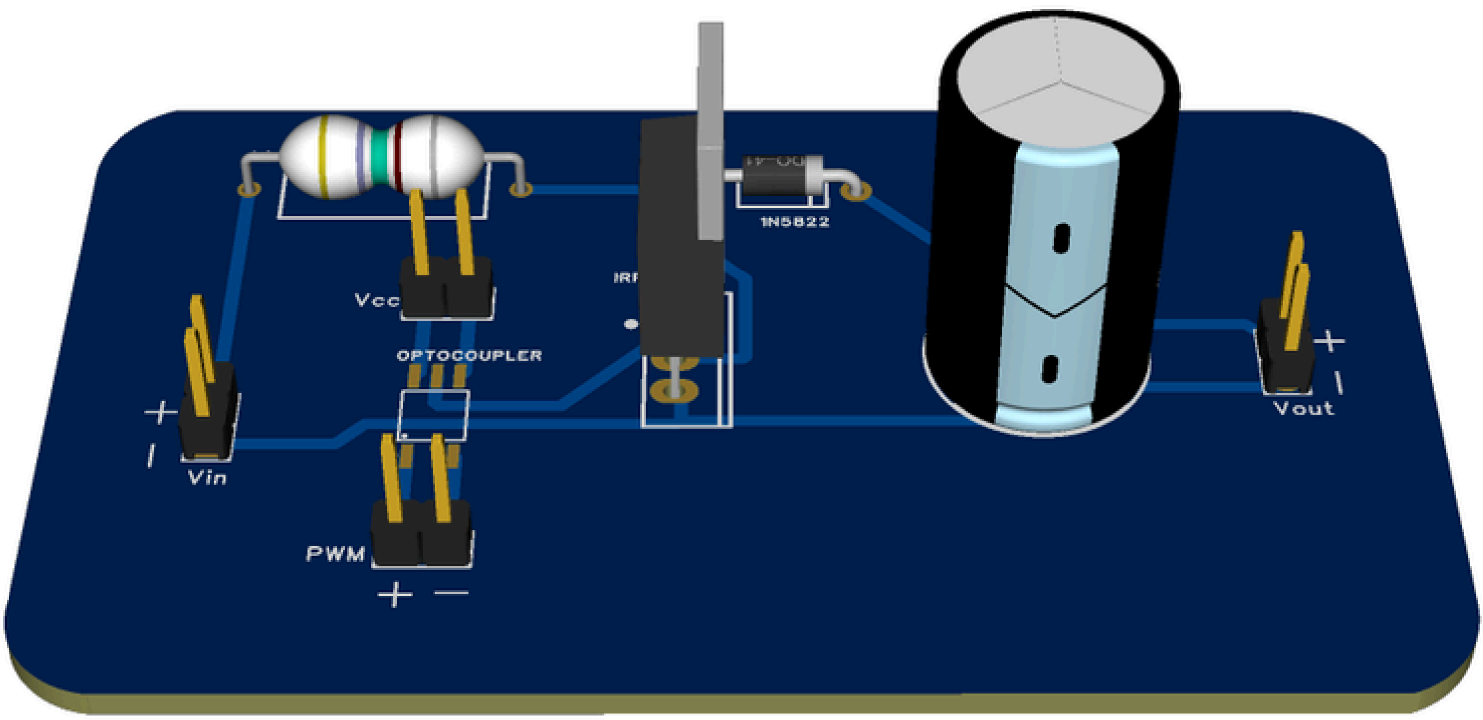
Simulation result



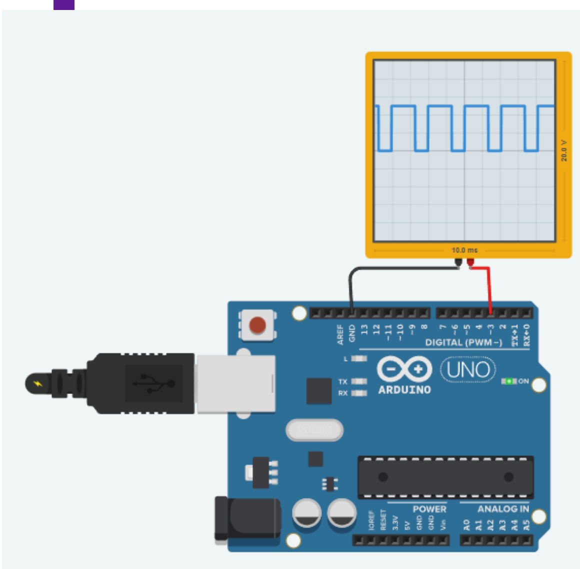




PCB Design



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.

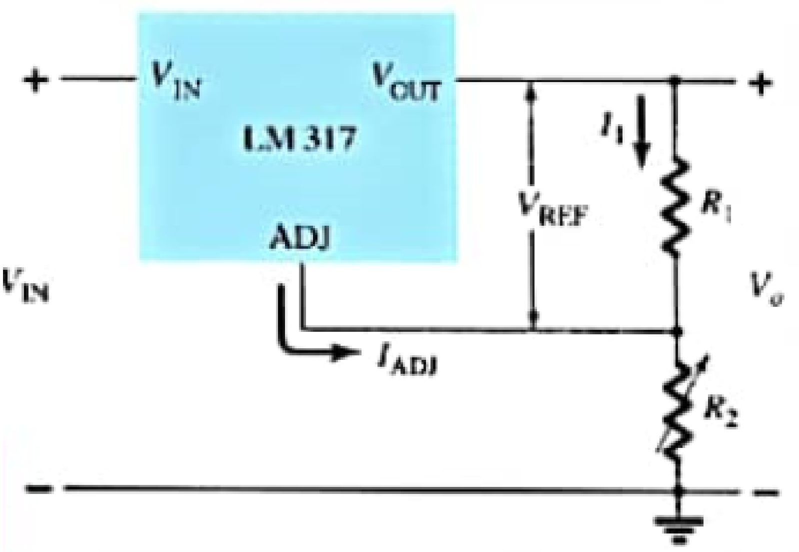
The new circuit provides two output ports

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

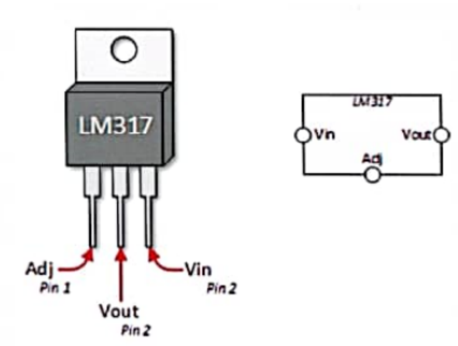
∴12.7 = 1.25 (1 + (R\`/220KΩ) ) ➡ ∴R\` = 2.015 KΩ

∵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

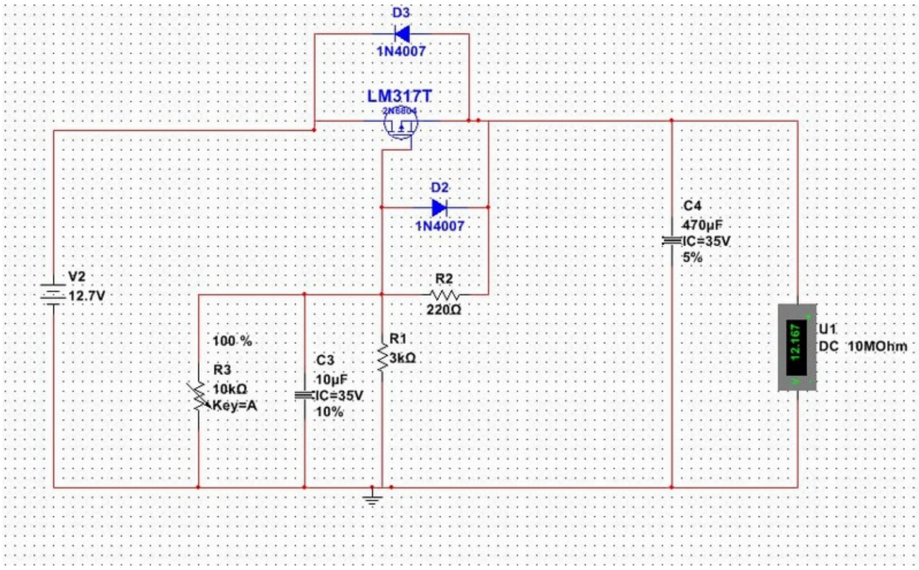
- ## Diode “1N4007”

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

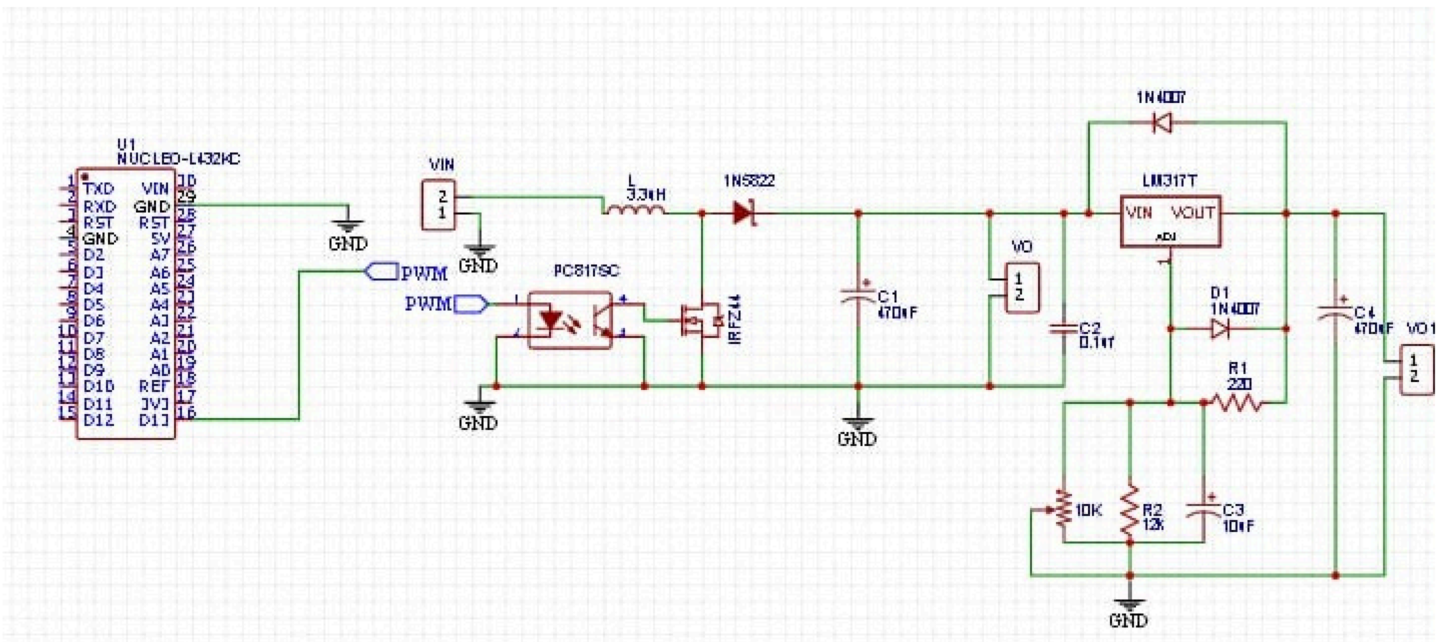
Single phase, half wave, 60Hz, resistive or inductive load.
For capacitive load, derate current by 20%.

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

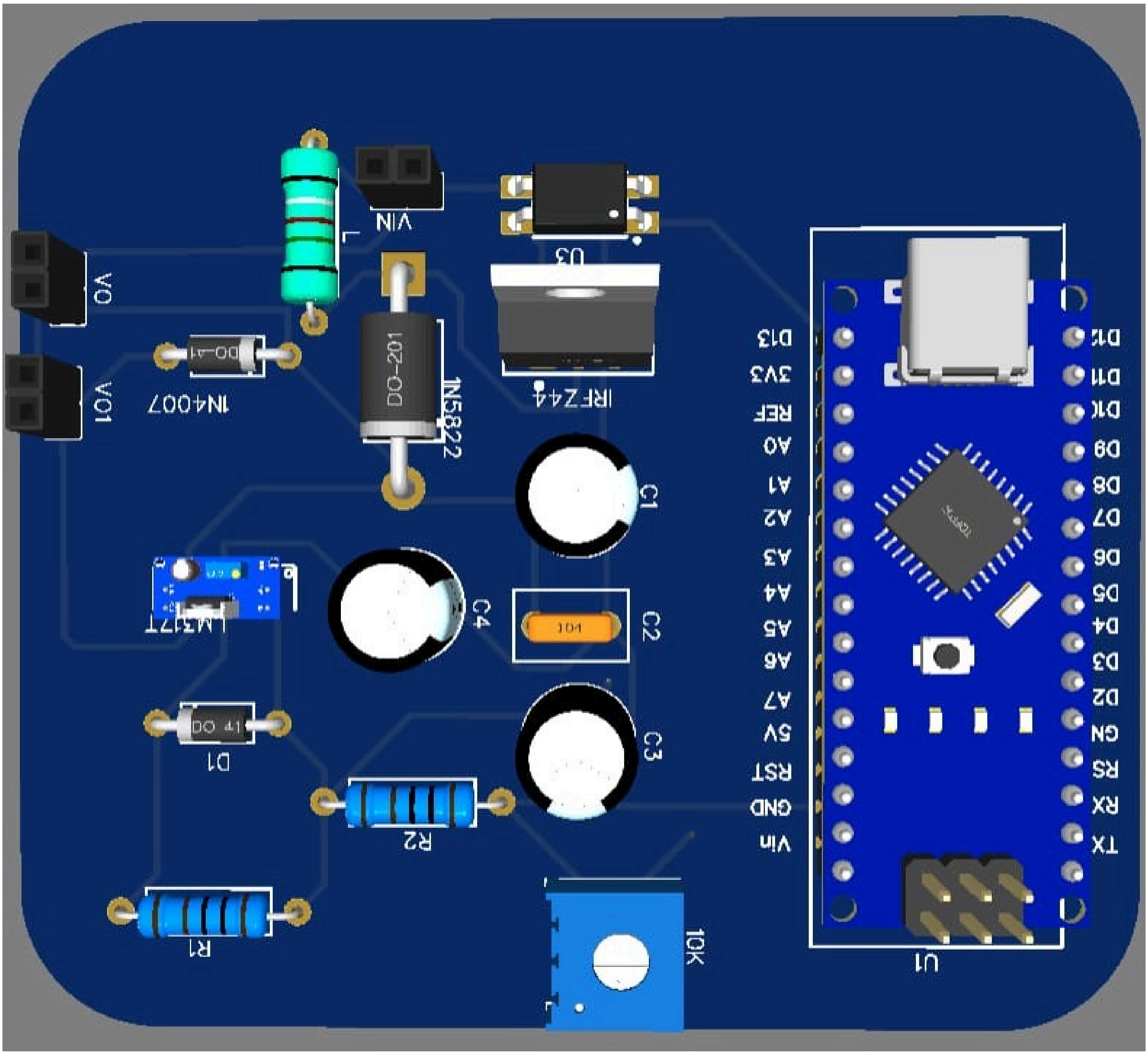
Simulation Result



Full Connections



PCB Design


VIN
U3
IRFZ44
DO-201
1N5822
1N4007
VO
VO1
LM317T
C1
C2
C3
C4
D1
R1
R2
10K
U1
D13
3V3
REF
A0
A1
A2
A3
A4
A5
A6
A7
5V
RST
GND
Vin
D12
D11
D10
D9
D8
D7
D6
D5
D4
D3
D2
RX
TX