

PROJECT REPORT

- CAR BATTERY
CHARGER
 - POWER SUPPLY
- 
- The background features a large, abstract geometric design. A large black triangle points upwards from the bottom left. Overlapping this is a large purple triangle pointing downwards from the top right. A smaller, blue-to-purple gradient triangle is positioned at the top right, partially overlapping the black triangle. The overall composition is modern and minimalist.

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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

$$\therefore V_{in} = 5 \text{ V} \quad V_o = 14.4 \text{ V} \quad I_o = 10 \text{ A}$$

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

$$\therefore \text{For the boost converter} \rightarrow \therefore V_o / V_{in} = 1 / (1 - D)$$

$$\therefore D = 0.653$$

(in percentage = 65.3 %)

$$\therefore I_c = C * dV/dT$$

$$\therefore V_l = L * dI_l/dT$$

$$\therefore \Delta V_o = (V_o * D) / R_o * C * F_s$$

$$\therefore \Delta I_L = (V_{in} * D) / (L * F_s)$$

$$\therefore \text{Let, } \Delta I_L = 30\% I_L \text{ \& } \Delta V_o = 1\% V_o \text{ \& } F_s = 100 \text{ KHz}$$

$$\therefore \text{Assume that the voltage is 14.4V and the current is 10A to take the losses in consideration.}$$

$$\therefore I_L = \frac{V_o}{D * R} = \frac{14.4}{0.347 * 1.44} = 28.82 \text{ A} \rightarrow \Delta I_L = 0.3 * 28.82 = 0.8645$$

$$\therefore 0.8645 = \frac{5 * 0.653}{L * 100 \text{ KHz}} \rightarrow \therefore L = 3.77 \mu\text{H}$$

take the standard value = 3.3 μH

$$\therefore 0.144 = \frac{14.4 * 0.653}{1.44 * C * 100 \text{ KHz}} \rightarrow \therefore C = 453 \mu\text{F}$$

take the standard value = 470 μF

Components

Element	Value
Resistor	1.44Ω
Inductor	3.3 uH
Capacitor	470 uF

- MOSFET “IRFZ44N”**

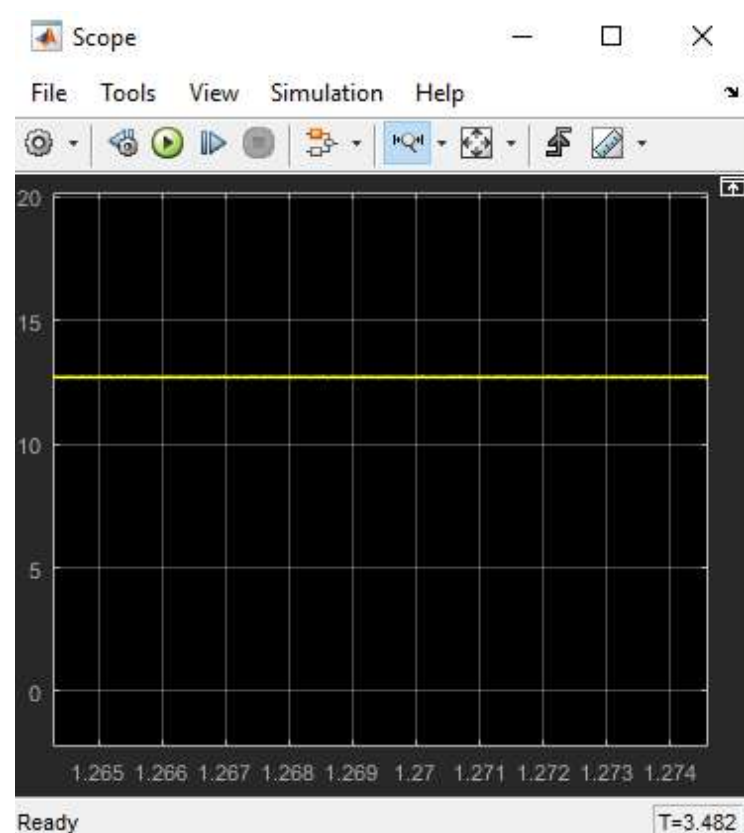
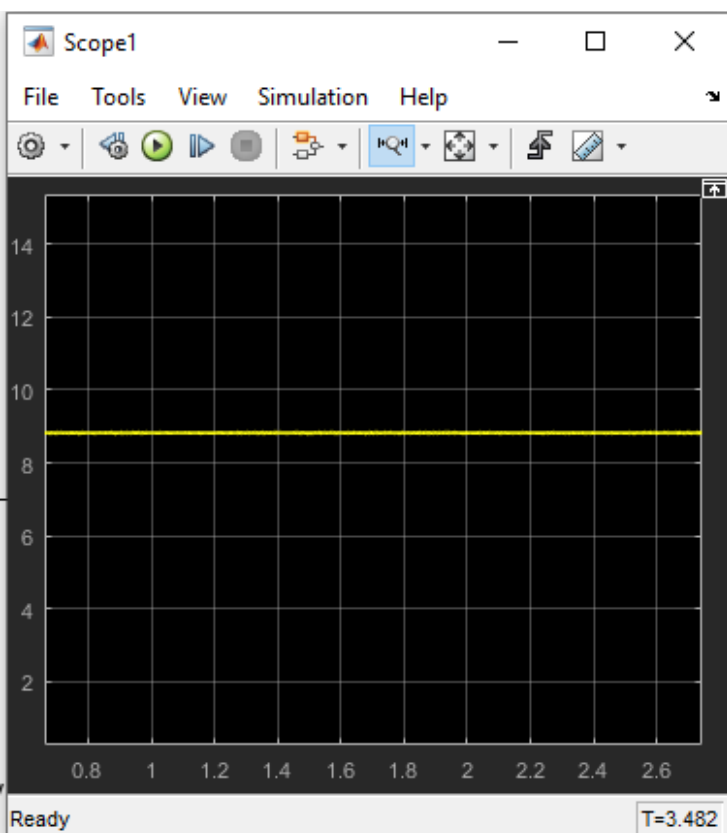
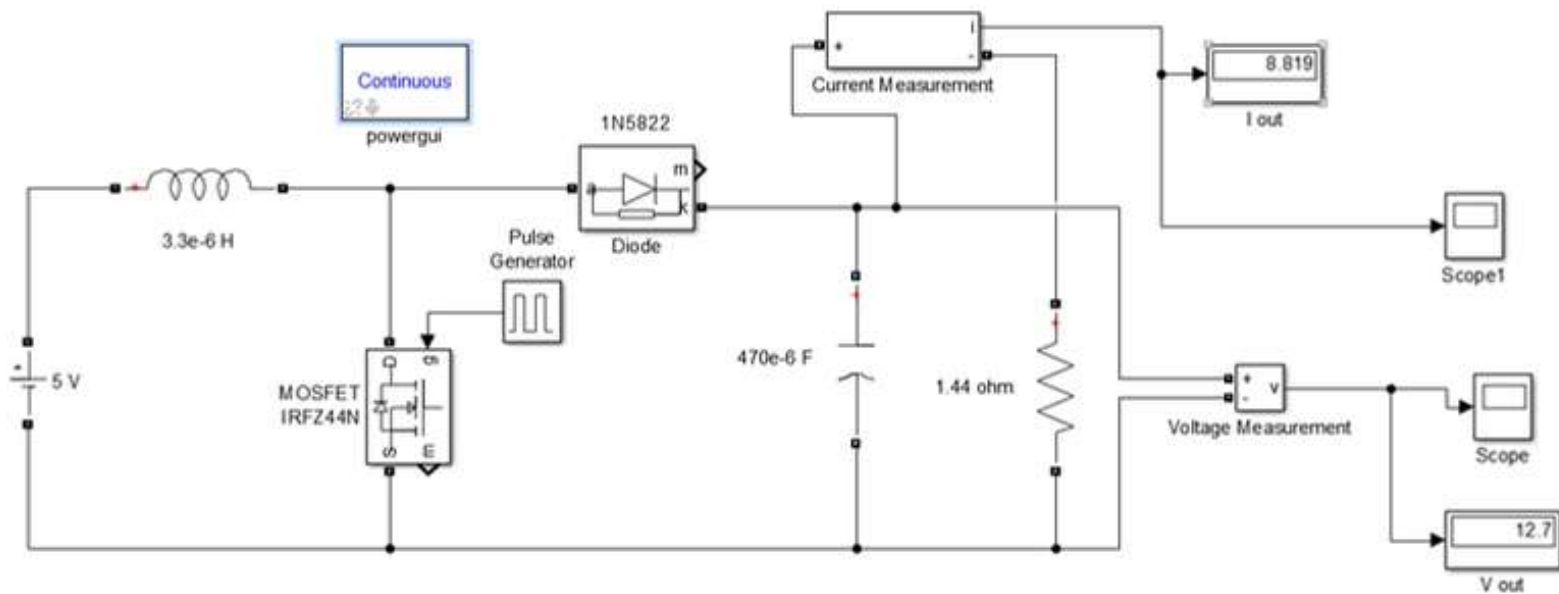
QUICK REFERENCE DATA

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 $V_{GS} = 10\text{ V}$	22	mΩ

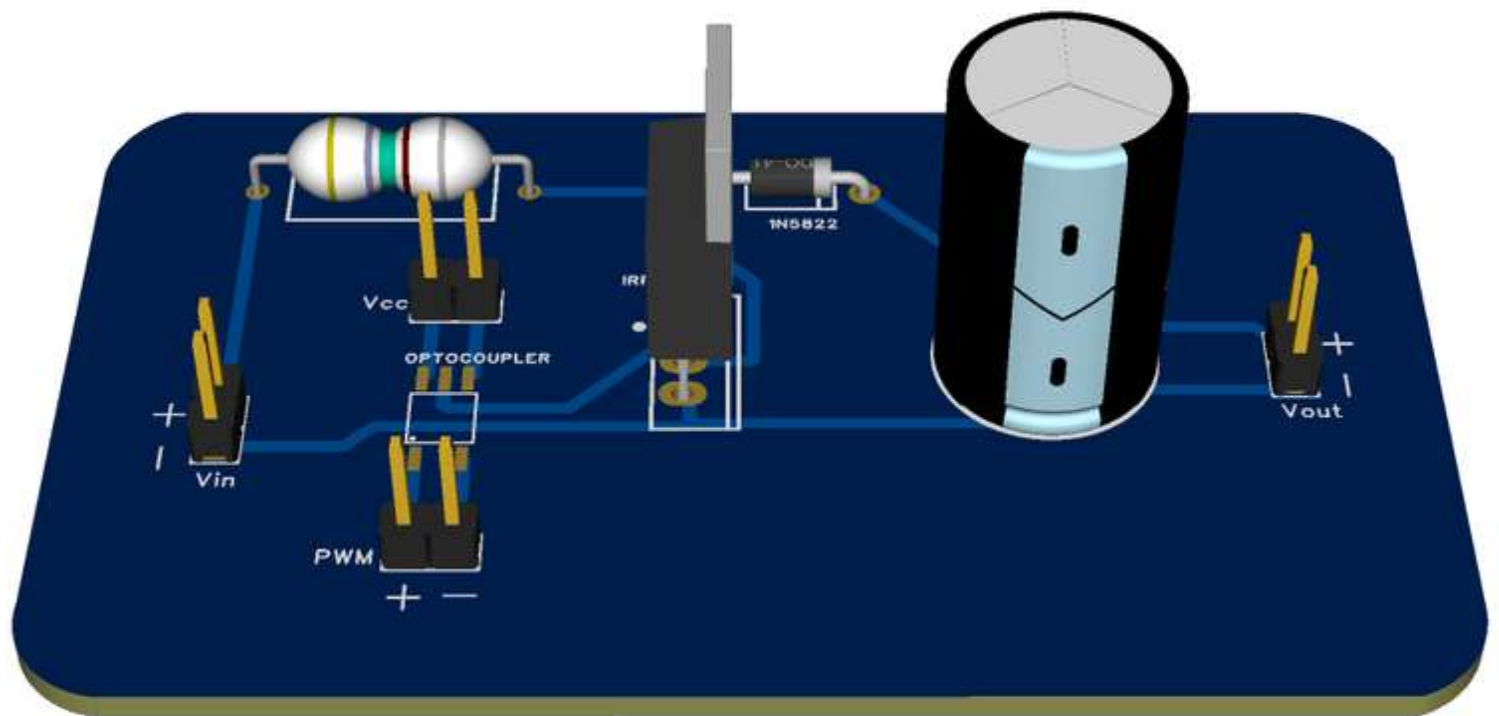
- Diode “1N5822”**

	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 $T_L=95^\circ\text{C}$	$I_{(AV)}$	3.0			Amps
Peak forward surge current 8.3ms single half sine-wave superimposed on rated load (JEDEC method) at $T_L=75^\circ\text{C}$	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

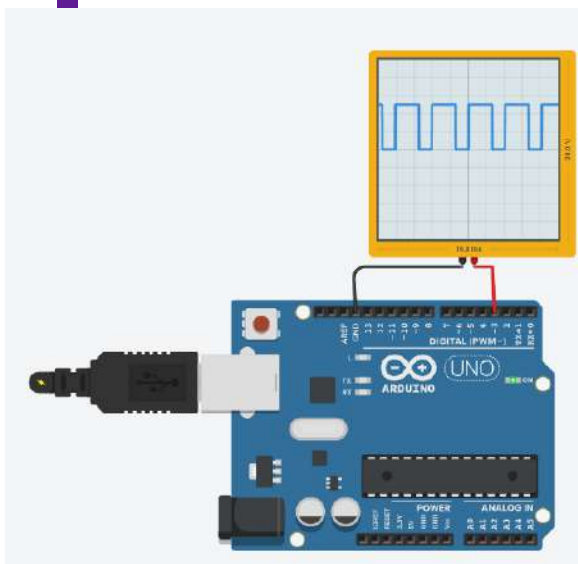
Simulation result



PCB Design



Arduino Code



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

Power Supply

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

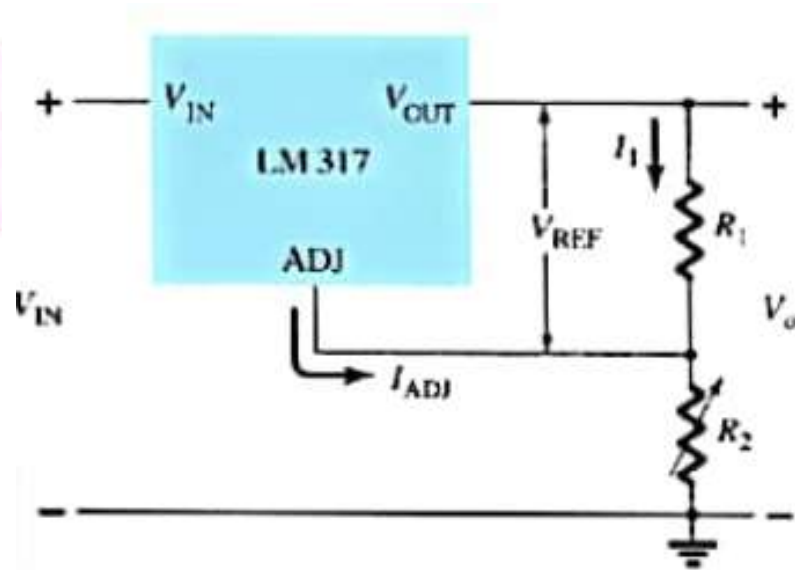
The new circuit provides two output ports

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

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

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



$$\therefore V_O = 1.25 (1 + (R' / R_2))$$

$$\therefore V_O = 12.7 V$$

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

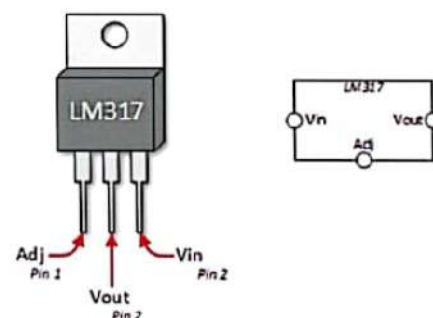
$$\therefore 12.7 = 1.25 (1 + (R' / 220 K\Omega)) \longrightarrow \therefore R' = 2.015 K\Omega$$

$$\therefore R' = R_1 // R_3$$

$$\therefore \text{assume } R_1 = 3 K\Omega \longrightarrow \therefore R_3 = 10 K\Omega$$

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	$R_{\theta JC}$	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

@ $T_A = 25^\circ\text{C}$ 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	V_{RRM}	50	100	200	400	600	800	1000	V
Working Peak Reverse Voltage	V_{RWM}								
DC Blocking Voltage	V_R								
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	560	700	V
Average Rectified Output Current (Note 1) @ $T_A = 75^\circ\text{C}$	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 @ $I_F = 1.0\text{A}$	V_{FM}	1.0							V
Peak Reverse Current @ $T_A = 25^\circ\text{C}$ @ $T_A = 100^\circ\text{C}$	I_{RM}	5.0 50							μA

