Design and Testing of a 3.7V to 30V DC-DC Boost Converter for Two 12V Cooling Fans Connected in Series.

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1 Introduction

Power electronics is the technique of converting one form of electricity to another. For example, computer that consumes dc power of say 19.5V and the power that is available at home or the office is 230 Vrms AC. Thus, there should be a way that the AC power can be converted to DC for the computer to use. Again, in the case of the mobile phone, a battery of say 4.2V would have to be stepped-down to a lower voltage for a circuit board which requires about 3V or less to function properly. Lastly, given a renewable energy source, for example a solar panel which outputs about 30V dc and power needs to be transferred to the power grid of 230Vrms AC, there is a need for a DC-AC inverter. In essence, whenever the source and load are not well-matched with each other, in terms of amplitude, type of the signal (dc or ac), or frequency a power electronic converter comes to play.

Power electronic converters can be classified into;

- DC-DC Converters
- AC-DC Rectifiers
- DC-AC Inverters
- AC-AC Converters

In this design project, a dc-dc converter which is called the boost converter (step-up) is considered. As the name implies, the converter boosts up smaller voltages for applications that require higher voltages. Applications of this converter type includes the flashlights in our digital cameras, power supply circuits and many more.

2 Project Objectives

Overall Objective: To design, build and test a 3.7V to 30V DC-DC boost converter with two(2) 12V cooling fans connected in series at the output.

- Use the Eagle software to design the schematic diagram and then layout the PCB design based on the schematic.
- Test the circuit on a breadboard.
- Solder the components on the printed circuit board.

3 Project Description

The two (2) TIP41C NPN transistors are used for switching in the converter circuit. The 18650 battery outputs about 2-3 amps to the base of the TIP41 transistors. The current begins to flow from the base to the emitter until the transistor is 'ON'.

The 'ON' and 'OFF' operation of the TIP41 transistors causes current to flow through the 24-0-24 toroidal inductor. At this point, the inductor stores energy in its magnetic field. When the TIP41 transistor is in its 'OFF' state, there is a sudden drop of the inductor current and this change in inductor current produces a back emf in addition to the supply voltage which forward bias the 1N5400 diode and charges up the 3300μF capacitor minus a small voltage drop across the 1N5400 diode.

This voltage is supplied to the two (2) 12V cooling fans connected in series. The 3300μF capacitor is recharged each time the transistors are 'OFF' thus maintaining a steady output voltage across the loads.

4 Circuit Diagram

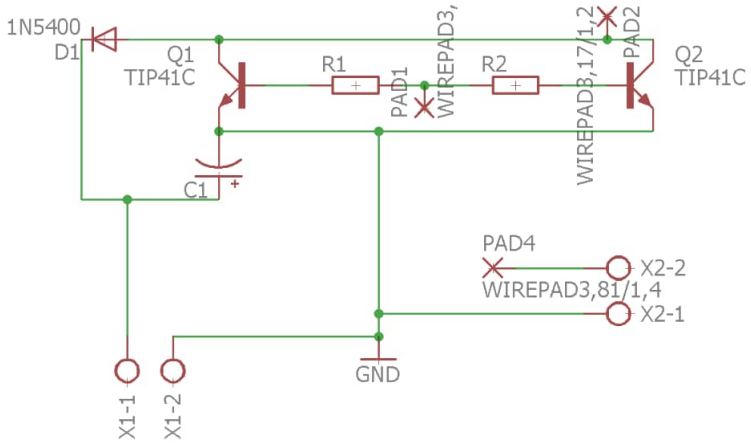

Figure 1: Shows the schematic diagram of the 3.7V to 30V DC-DC boost converter circuit developed with Eagle

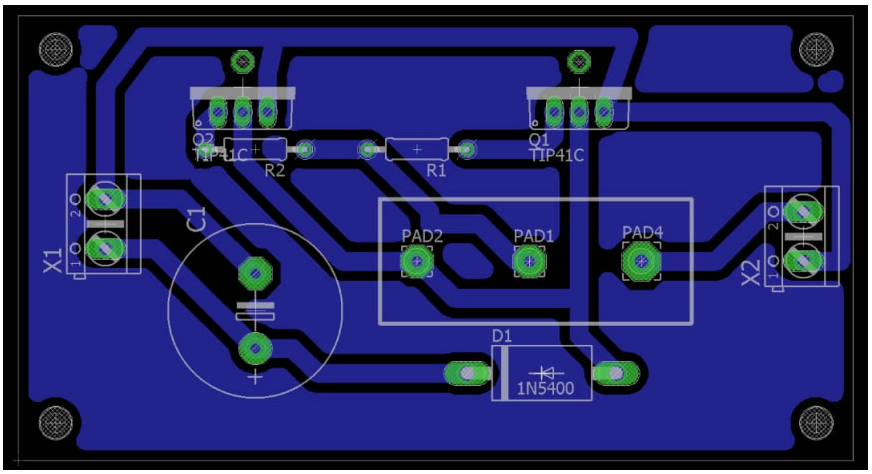

Figure 2: Shows the PCB layout with the component placement of the circuit developed with Eagle

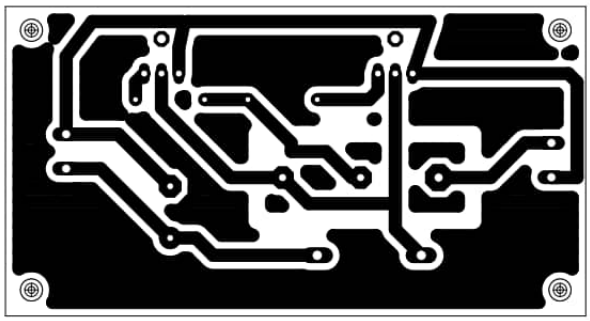

Figure 3: Shows the PCB etching revealing the desired circuit pattern.

5 Item List

ITEM	QUANTITY
TIP41C NPN Transistor	2
Heat Sink	2
2 Pin Terminal Block	2
18650 Battery	1
220R	2
1N5400 Diode	1
3300muF 50V Capacitor	1
Toroid Inductor	1

Table 1: List of electronic components for the circuit

6 Testing

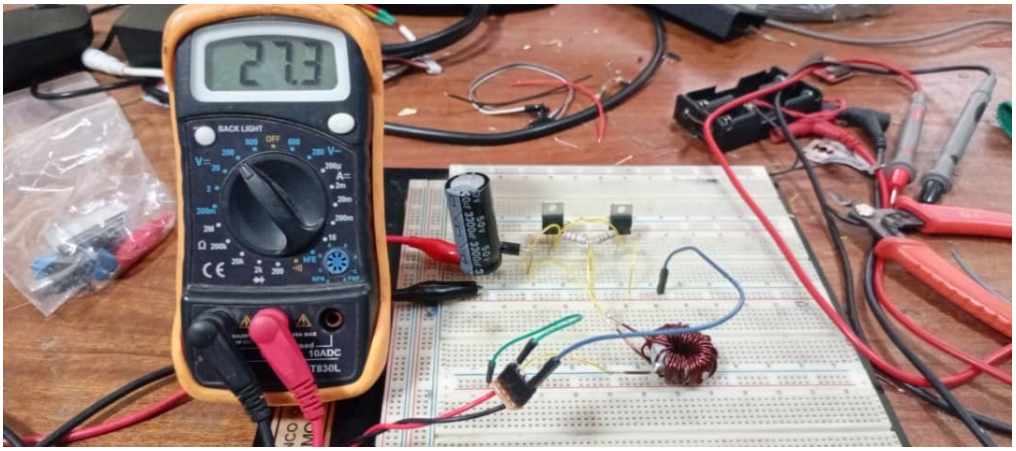

Figure 4: Shows the breadboard arrangement of each of the components of the converter circuit. An output voltage of 27.3V was recorded accounting for the conversion losses as a result of voltage drops.

7 Prototype

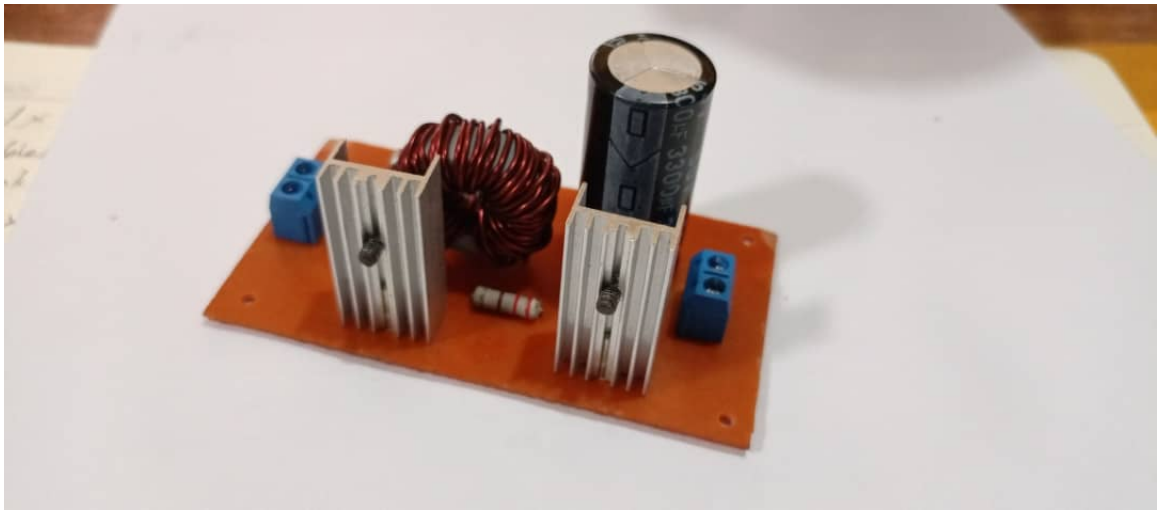

Figure 5: Shows the 3.7V to 30V DC-DC boost converter prototype circuit