Electronics Workshop - II

Project 2-Portable Mobile Charger with Rectifier Circuit

Group 29

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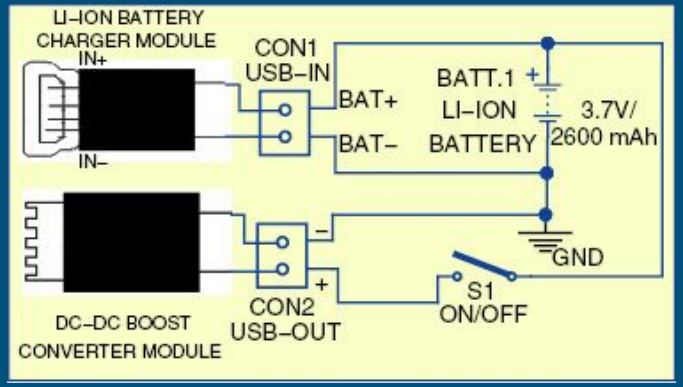
What is a Portable Mobile Charger?

A portable mobile charger, usually called a power bank is a portable device that can supply USB power using stored energy in its built-in batteries. Power Banks are rechargeable. Portable Power banks are comprised of rechargeable batteries in a special case with a special circuit to control power flow. They allow you to store electrical energy(deposit it in the power bank) and then later use it to charge up a mobile device or any other electronic device(withdraw it from the bank).

Power banks are good for almost any USB-charged devices.

The Power Bank Circuit

This is the basic circuit of the Power Bank circuit



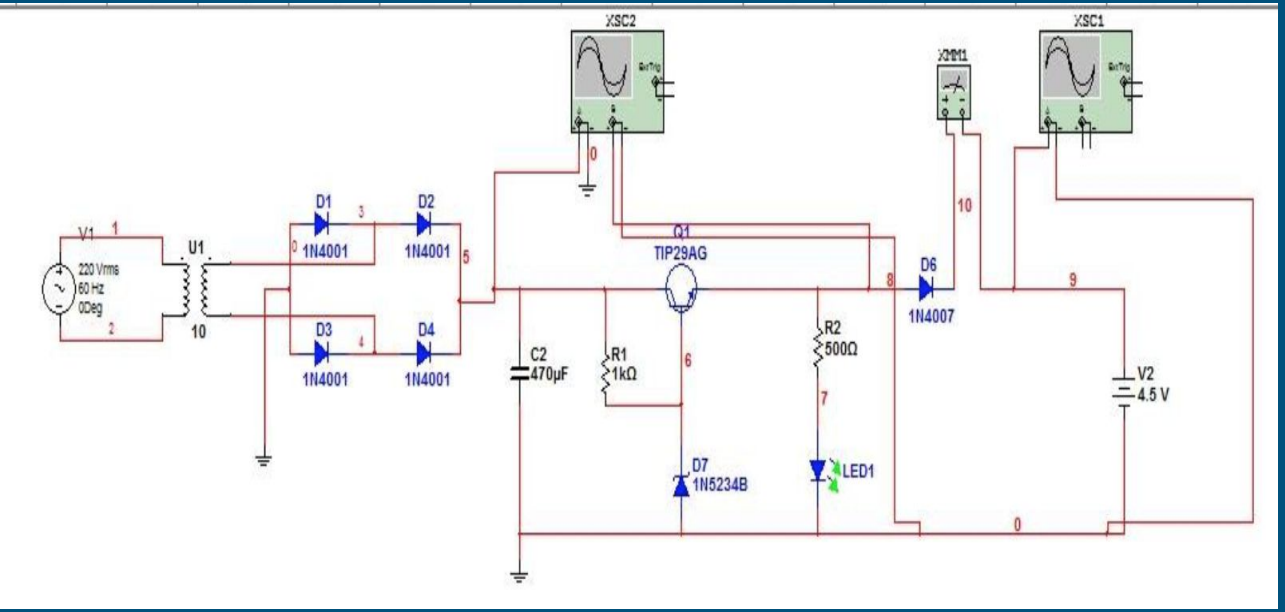
We have also made the rectifier circuit along with the above circuit which acts as the adapter.

Parts of the circuit

In our project, we have implemented a full wave rectifier connected to a battery charging module which acts as the adapter to the power bank and converts a 220V AC input to a 7V DC output. It is used for charging the batteries which store energy which is then used for charging the device to be charged.

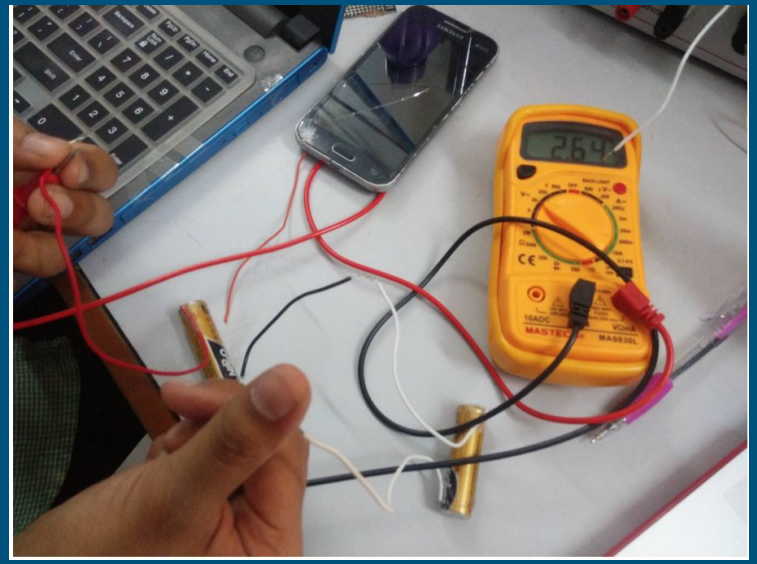
After this come the rechargeable batteries which are charged by the battery charging module and charge the device connected through the Mobile charging module, which is the next part of the circuit.

Rectifier Circuit and Battery Charging Module

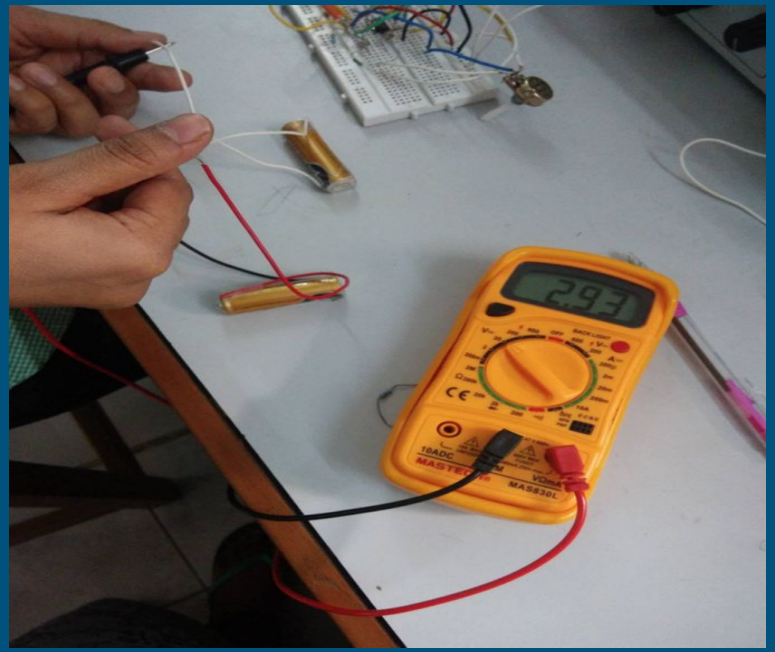


The first part is the full wave rectifier which converts a 220V AC input voltage to a 7V DC output voltage. The other part takes this 7V output and supplies it to the connected rechargeable batteries so that they can get charged.

Before charging



After charging



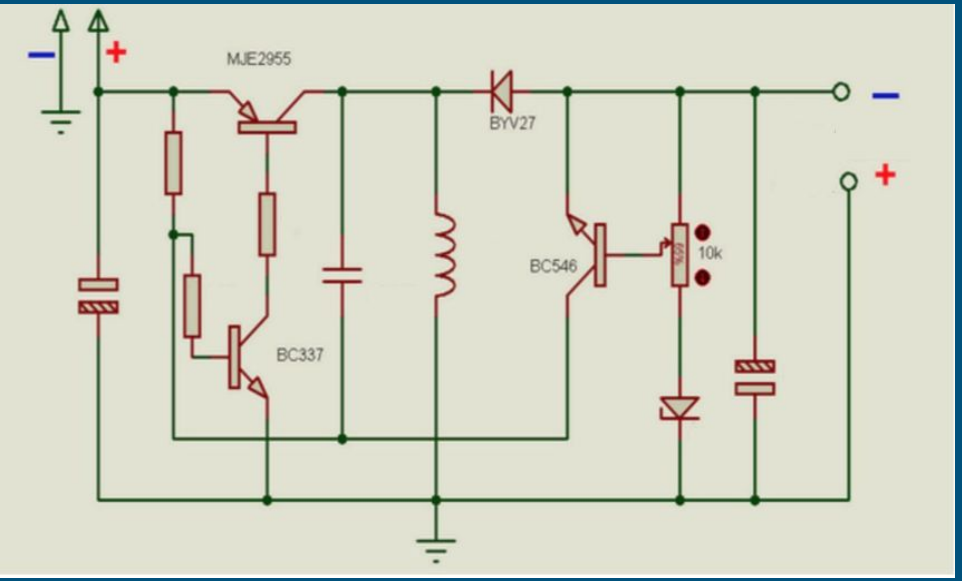
Initial testing of the circuit for 3V batteries

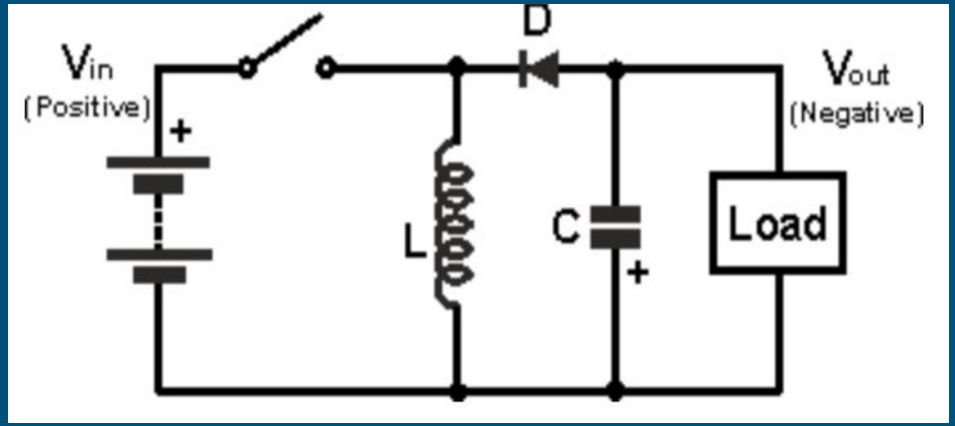
Parts of the circuit

The Mobile Charging Module is basically a DC-DC converter. As the batteries charge the device connected, the voltage across them will decrease but the voltage supplied to the the device must remain same, for that we need to maintain a constant output voltage for a given range of input voltage. Hence this charging module gives the required 5V output to charge the connected device over a 3.6V to 6V range.

We have also included a battery level indicator circuit which will indicate the voltage left in the rechargeable batteries.

Battery Charging Module

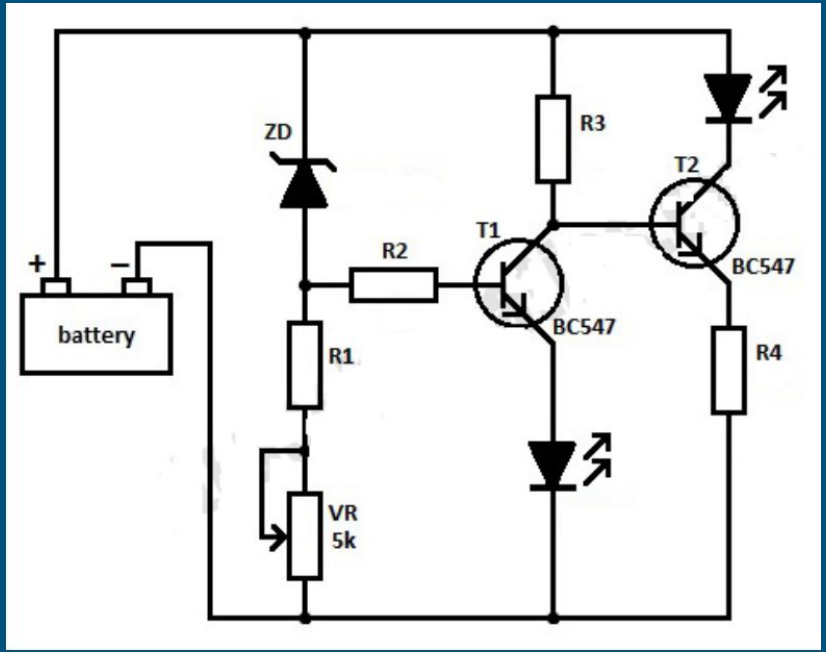




The Battery charging Module is basically an inverting DC-DC Buck-Boost converter which converts an input from range of 3.8V to 6V to a constant output voltage of 5V.

Battery Level Indicator Circuit

As the name suggests, the battery level indicator shows how much charging i.e. voltage the rechargeable batteries have in them. This is done by designing a circuit such that different LEDs glow at different voltage levels. In the relatively simple circuit that we have designed, the green LED glows in a 2.5V-5V range while both the LEDs glow if the charge is above 5V.



Parts of the circuit

We implemented a switch using CMOS between the Battery Charging module and the Mobile charging module such that the battery connections can be easily interchanged among both the circuits depending on which circuit is being used. At a time only one circuit can be ON. We added switch to prevent pass through charging. According to which recharging and discharging of the batteries at same time can cause batteries to damage because of the heat generated.

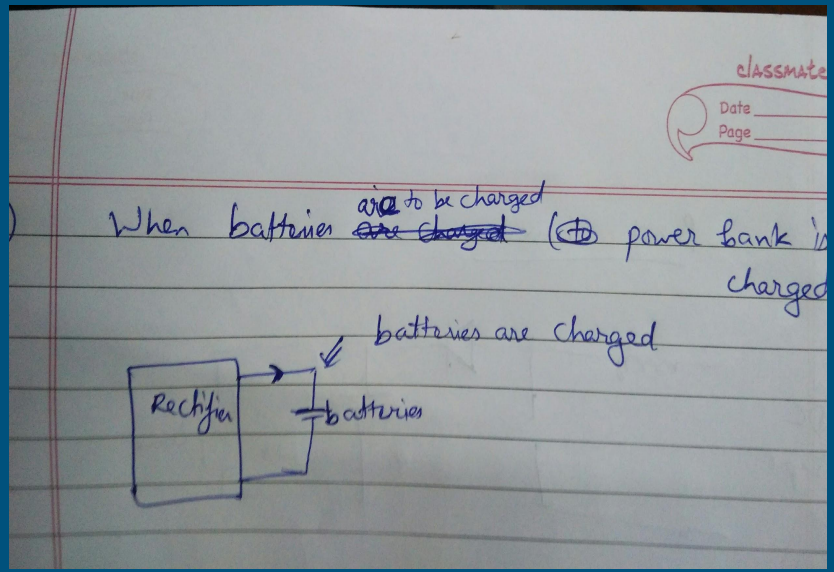
Switch

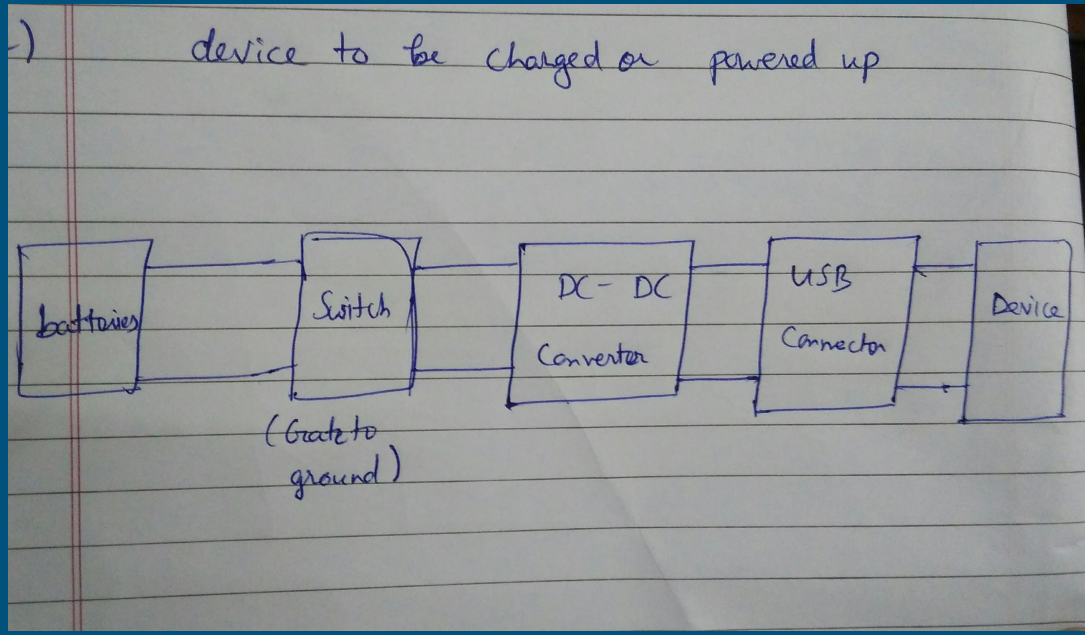
While making the power bank, we realized that an important feature of a regular power bank is that it charges only the batteries and not the device connected when both the power bank and the device are connected at the same time. Hence we have made a switch using CMOS technology such that the DC-DC Buck-Boost Converter turns off when the transformer of the Rectifier circuit is turned on and only the batteries are charged.

We connected the switch to avoid *Pass Through Charging.

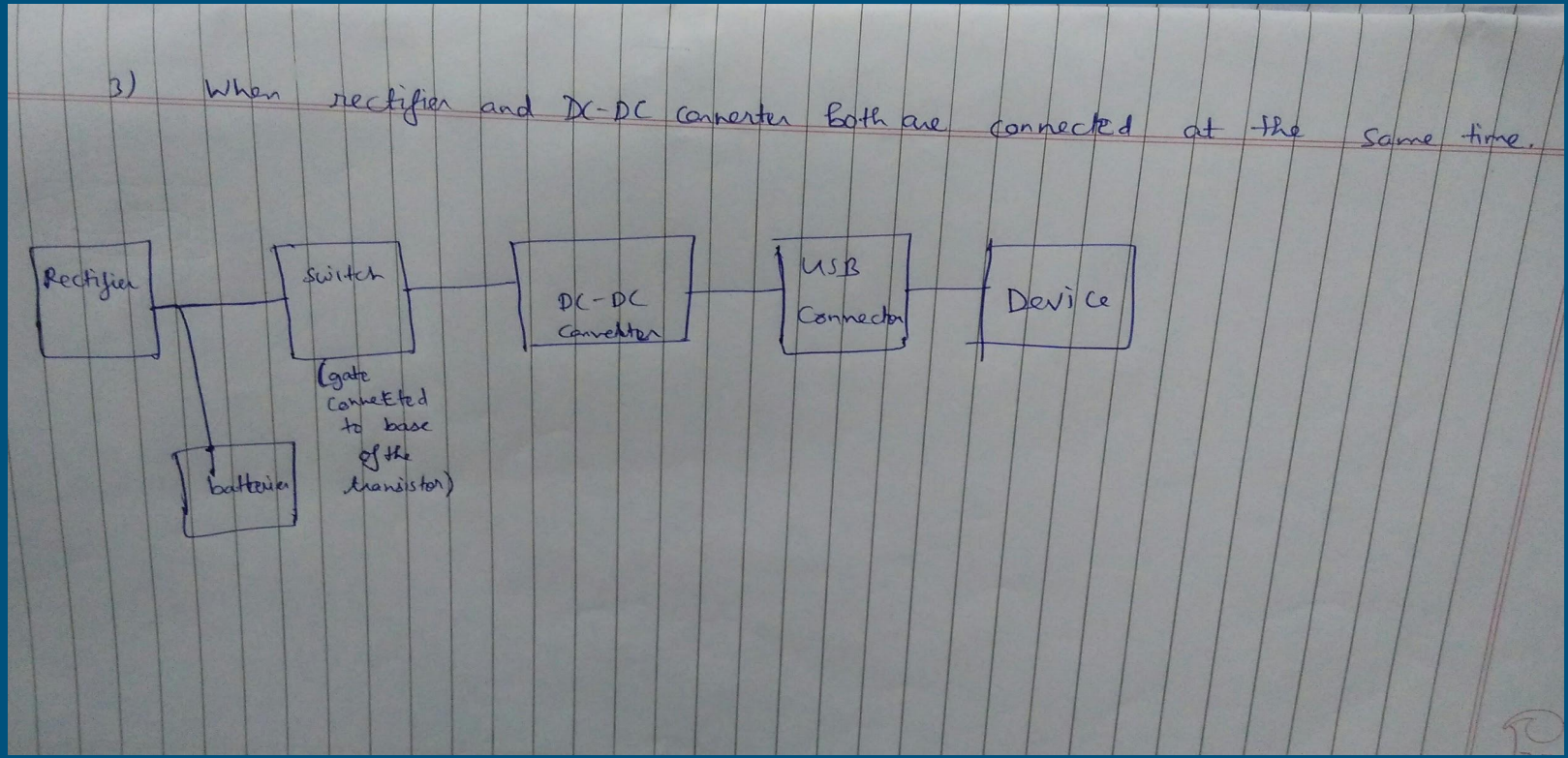
*Pass through charging is when a power bank has the ability to charge itself and charge devices at the same time.

Power Bank in three different conditions





Power Bank in three different conditions



Results obtained after combined implementation of all the circuits together

We have designed the power bank to charge 6V batteries and give a constant output of 5V.

The rectifier circuit gives an output of 7V DC voltage and the battery charging module charges the 6V batteries with nearly 160mA current.

The Mobile Charging Module takes the varying voltage of the batteries as input, gives a constant output of about 5V and charges the device connected with nearly 120mA current.

Challenges faced

- Due to the output capacitor placed after the full wave rectifier which was not getting discharged fast enough, it was negatively affecting the switch hence we connected a resistor across the capacitor thus implementing an RC circuit.
- Due to the internal resistance of the batteries, there is an instant drop of voltage across the batteries after connecting the device to be charged.
- We initially tried to make the switch with individual pMOS and nMOS but then due to the characteristics of the MOSFETS, we were not able to get the required voltage to drive the connected circuit, hence we used CMOS.

Improvising Power banks

Power Banks are used so as to provide energy to chargeable devices, usually in areas where it is difficult to access electricity. Hence it would be more efficient if we could charge the power banks using natural resources like sunlight.

THANK YOU !!