Standalone Universal Solar Based DC Power House

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***Abstract*— Most of the circuits in the physics laboratory runs on fixed or adjustable regulated DC power supplies. For example TTL based gates runs on 5V, Transistor based & 555 timer based circuits can easily run on 15 V regulated supply, Op-Amp based circuit's needs ± 15V supply and so on. However, all these supplies are based on the same concept. 220 V AC utility is reduced to lower value of AC voltage using step down transformer which in turn is converted to regulated DC voltage.**

In this research work we have entirely different approach, we store the energy from the photovoltaic solar panels to a 12 V 9 Ah battery and in turn run all the electronic circuits may be TTL based, transistorized based, 555 timer based or may be Op-Amp based, all are running on the Solar Based DC Supplies.

Index Terms: **Photovoltaic, Buck converter, Boost converter, Battery, Charge Controller.**

INTRODUCTION

Why not to use the DC voltage obtained from solar panels to run the various circuits in the physics / electronics laboratory, rather than converting the solar panels' DC into 220 V AC using inverter (appreciable loss in conversion) and then converting higher voltage AC into lower voltage AC employing a step down transformer (again having heat losses in conversion) and then converting AC into regulated DC using Rectification, Filtration and Regulation (each stage & at every interface there is appreciable loss of energy) and so on.

Direct Current (DC) electric power is an emerging disruptive technological area that has the potential to stimulate economic growth, inspire innovation, increase research and development opportunities, create jobs and simultaneously advance environmental sustainability.

This research work is an outcome of pure experimentation. The innovation in this paper is, a 80 W portable solar panel provides 12V DC @ 7 amps current. Wattage & Current is huge, we can run various loads, however, we need 5V (for TTL circuits, 15V (for 555 Timer based circuits, 18V (for Transistorized Circuits) & ±15V (for Op-Amp based circuits). The problem was resolved by using appropriate buck and boost circuits. In addition to resourcing various voltages the power house provides an additional facility of a constant current source providing 1mA/10mA constant current. In addition the power house provides a facility of mobile charging point, 18W DC fan and an LED lamp of 10 Watts. For troubleshooting circuits and to study waveforms a battery operated digital storage oscilloscope is also provided which is charged using solar energy.

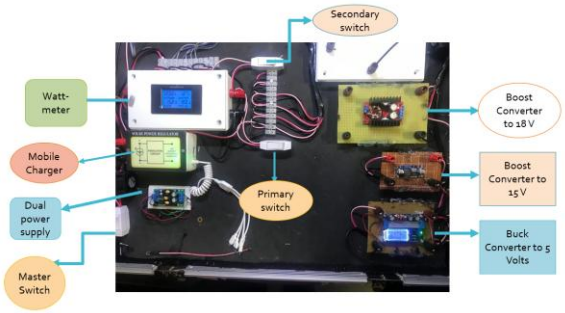
The complete system includes:

1. 5 V
2. 15 V
3. 18 V
4. $\pm$ 15 V
5. 1 Amps / 10 mA CCS
6. DC Fan &LED illumination
7. Mobile Charger &Power Meter
8. Digital Storage Oscilloscope (DSO)

Solar Panels: Two 40 watts solar panels connected in parallel are used to generate electrical energy. Panels are mounted with stainless steel frame with a movable arrangement so that it can be carried anywhere and can be use in all weather conditions. Energy is first stored in the solar battery so that fluctuations in the current and voltage produced due to sun's movement can be eliminated. Advance batteries come with in-built charge controller which prevents battery from overcharging and over discharging thereby increasing its life.

80 Watt Portable Solar Panel

Portable Power Box:

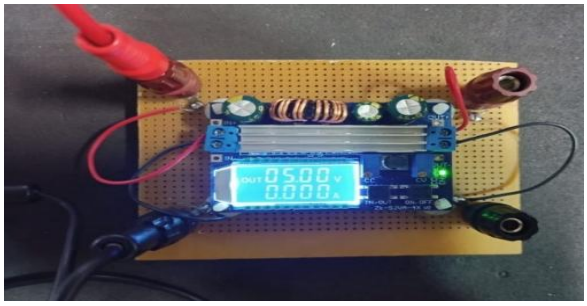


DC Power Meter: Multidisplay meter give details of voltage of the battery connected to solar panel. It also displays current , power and electrical energy being consumed by the loads.

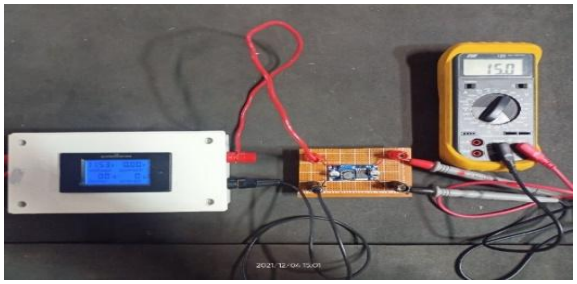
Constant Voltage Sources (CVS):

For various experiments in UG electronics laboratory there is a requirement of different voltage sources like 5V, 12 V and 18 V. Here all the needs gets fulfilled by using appropriate buck and boost converter.

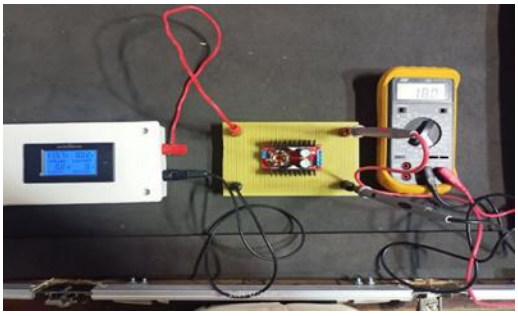
1. Buck Converter – 5V



2. Boost Converter – 15 V

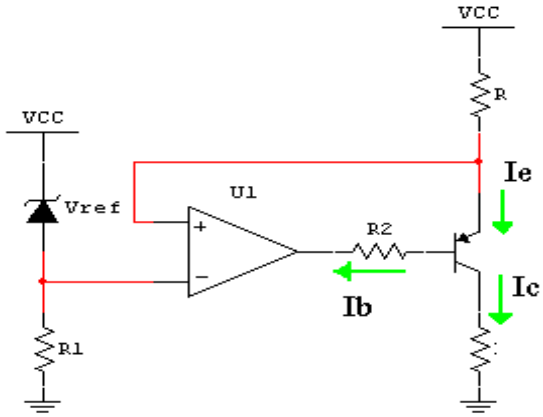


3. Boost Converter – 18 V



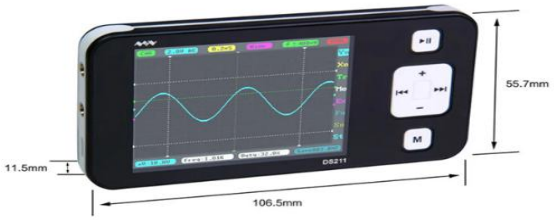
Constant Current Sources – 1mA /10 mA

To provide constant current for experiments we can generate it using OP-AMP IC 741 and pnp transistor. Here OP-AMP works on 5V produced using buck converter.



Digital Oscilloscope (DSO)

The DSO DS211 oscilloscope is an Open Hardware pocket-size compatible 32bit digital storage oscilloscope, it based on ARM -M3, equipped with 320 x 240 colour display, SD card, USB port and recharging function. Its compact, simple to operate; meets the basic demands of school lab, electric furniture repairment and electric engineering.



Other Useful Loads:

Light and Fan is of also important for us in the lab. So in case of power failure or in any other emergency

we have DC Fan and DC LED lamps which runs on solar energy.

CONCLUSION

We have run all the voltage sources, current sources, fan and light simulataneously without any problem during our testing of the kits. So we can efficiently use solar energy to run our undergraduate electronics lab and dependency on the grid electricity will be reduced resulting in cost saving and environment friendly option.

ACKNOWLEDGEMENTS:

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