

Solar Based Power Bench for Physics Laboratory

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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 $\pm 15V$ supply and so on. However, all these supplies are derived on the same concept. 220 V AC utility is reduced to lower value of AC voltage using 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 26Ah battery and in turn run all the electronic circuits may be TTL based, may be transistorized based, may be 555 timer based or may be Op-Amp based all are running on the Solar Based DC Supplies.

Keywords: Photovoltaic, Buck, Boost, Battery, Charge Controller

1. 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 400 W solar panel provides 12V DC [at] 32 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) & $\pm 15V$ (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 5mA/20mA constant current. In addition the power house provides a facility of mobile charging point, 18W DC fan and an illumination of 10 Watts.

Solar based Universal DC Power Supply

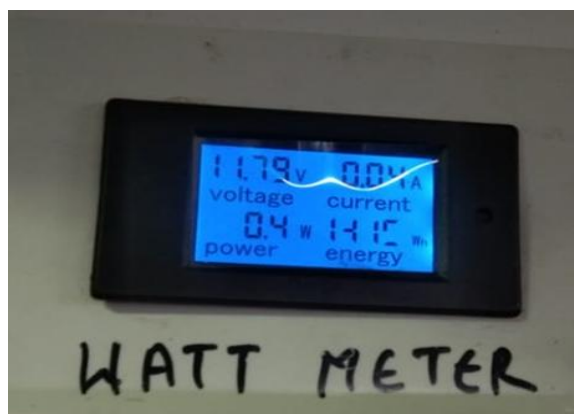
The complete system includes:

1. 5 V
2. 15 V
3. 18 V
4. ± 15 V Dual Supply
5. 5 Amps / 20 Amps CCS
6. DSO
7. DC Fan & LED illumination

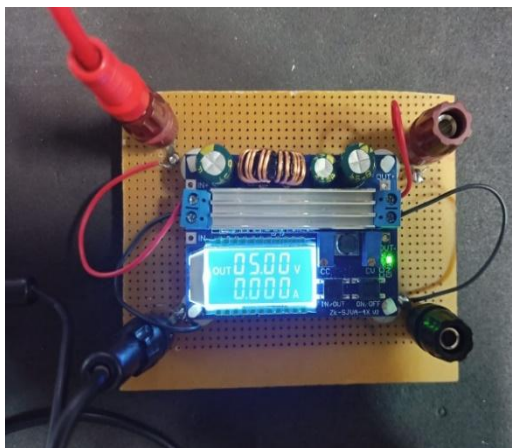
8. Mobile Charger & Power Meter



390 Watt Solar Panel Mounted on College Terraces



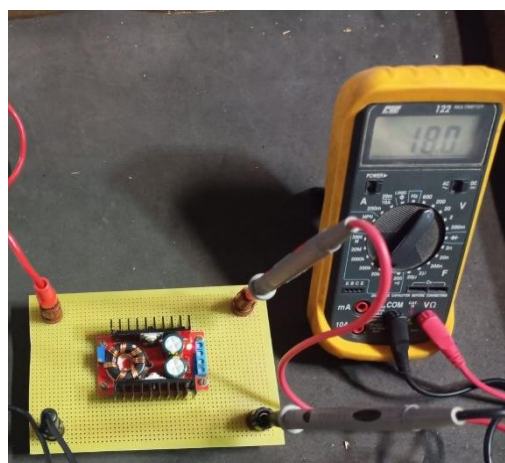
DC Power Meter



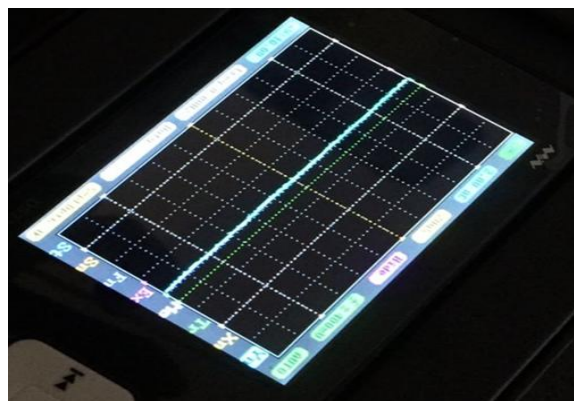
12 V Solar Battery BUCKED to 5V for TTL Circuits



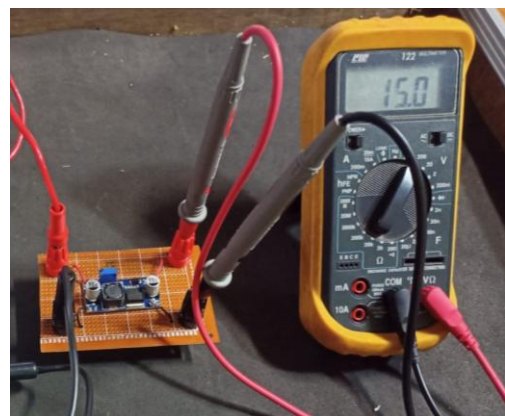
18 W 12 V DC Fan Running on 12 V Solar Battery



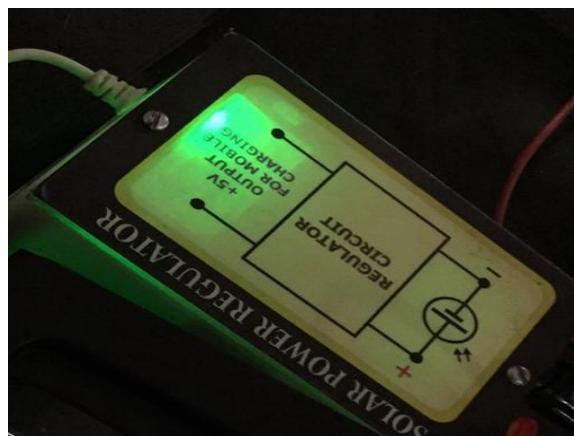
12 V Solar Battery BOOSTED to 18V for Transistors



Battery Based DSO



12 V Solar Battery BOOSTED to 15V for Timer 555

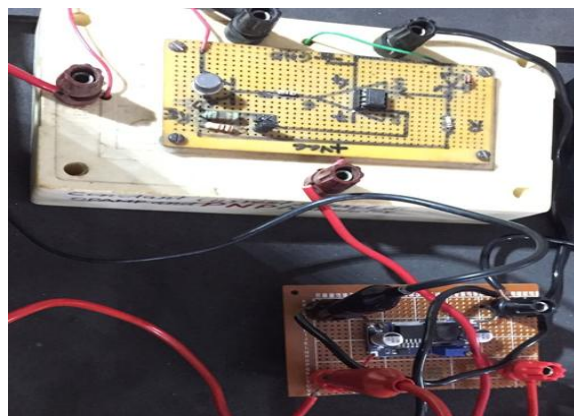


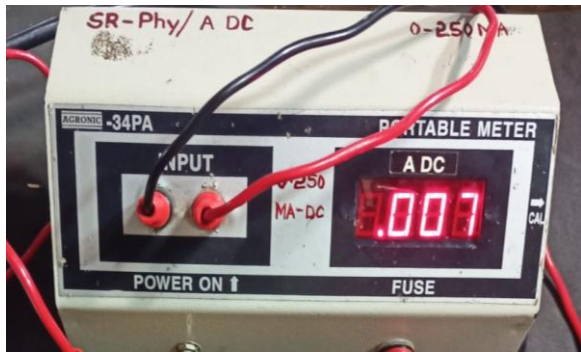
Solar Based Mobile Charger

2. Applications



TTL Circuit Running on 5V Supply





Op-Amp 741 Based CCS for 7mA



Acknowledgement

I am thankful to my college and my principal for providing a fully equipped lab & a free hand to install solar panels at any preferred location of the college. Thanks to Google available with infinite amount of information and addresses of economical electronic component vendors offline as well as online.

References

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Author Profile



The author at present is Head, Department of Physics at Guru Nanak Khalsa College Matunga, Mumbai. Guiding research students in the field of Renewable Energy since last 8 years. An author of various books and published research paper at national and international level.



All Units Working Simultaneous



On Solar Based Power Supplies

18 Point Mobile Charging Station totally running on Solar Power

NO ELECTRICITY, NO ADAPTOR. . . .

Only USB cable is required