Development of a high voltage power supply for detectors using photo-diode

Sharmili Rudra*, Prabir Ghosh, Tejaswita Kumari, Atanu Chowdhury, Soumya Sen

Seacom Engineering College, JL-2: Jaladhulagori (Via Andul Mouri), Sankrail, Howrah-711 302, West Bengal, India

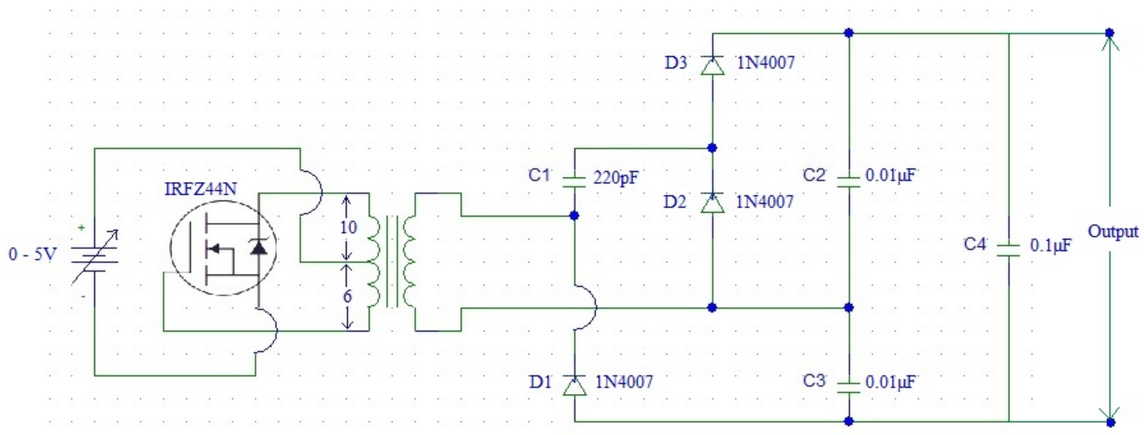
**e-mail: sr.phys@gmail.com*

PM2018 - 14th Pisa Meeting on Advanced Detectors, 27 May- 02 June 2018, La Biodola, Isola d'Elba, Italy

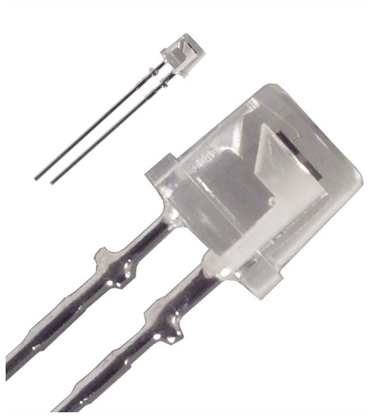
Introduction

In this poster we have discussed about the conversion of DC high voltage from solar energy for powering particle detectors. A typical solar panel is simply a configuration of large number of solar cells connected in series. Here we use the photo-diode as solar panel. When the photons having an energy higher than 1.1 eV incidents on depletion region, electron-hole pairs are created using photoelectric effect. The absorption of photons occurs in active region. The holes move towards the anode and electrons towards the cathode due to the electric field. So a photo current is produced.

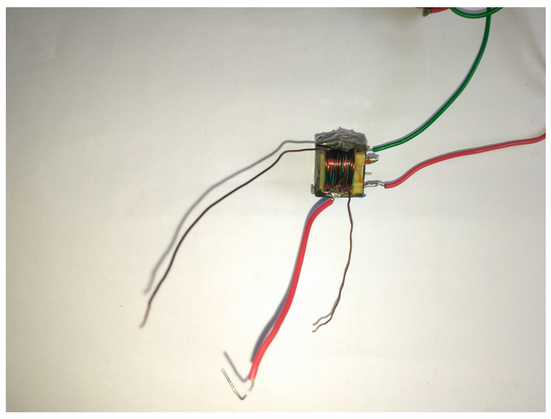
Circuit diagram



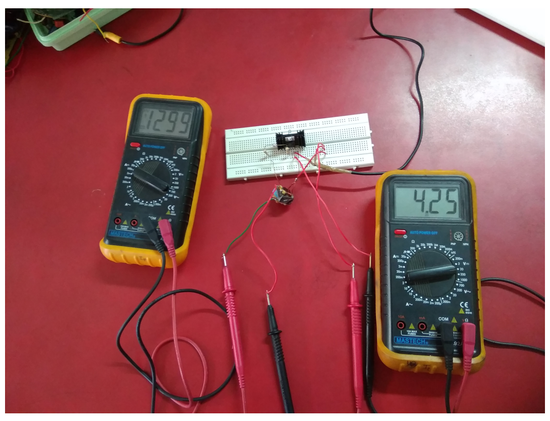
Components and experimental set-up

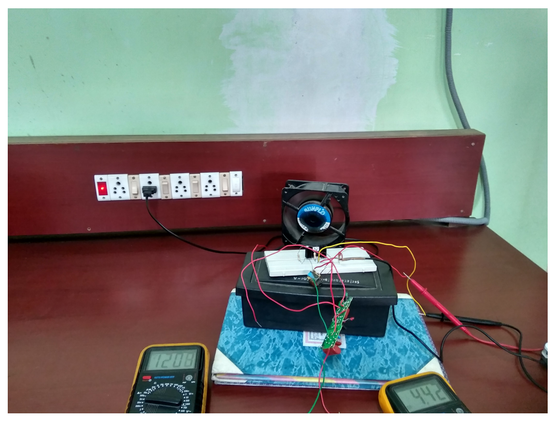


IR Photo diode



Mini power transformer



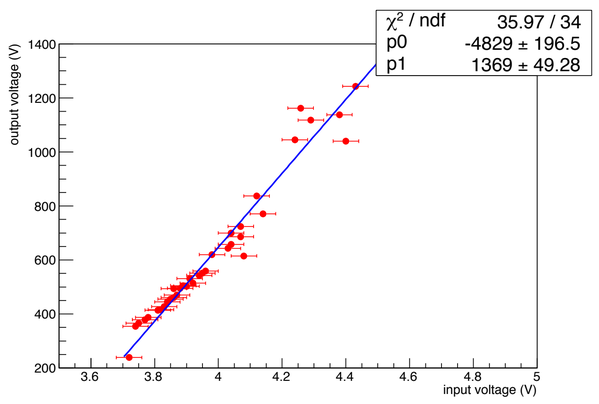


Experimental set-up

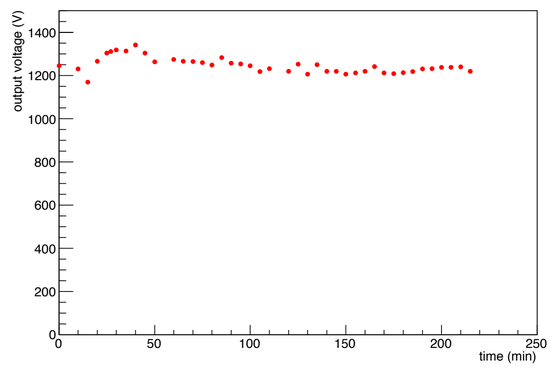
Experimental methods

- Photo-diode has three different modes of operation, photo-voltaic, photo-conductive and avalanche diode.
- In this work we used the photo-voltaic mode.
- At the start of the measurement the voltage produced by a single photo-diode is around 1.7 V. Its output current is very low.
- So that in the present set-up, photodiodes (5x5) are used in proper combination to produce the voltage of 5 V. This is referred as input voltage in the result section. Photodiodes are used here to convert solar energy to electrical energy.
- This is fed to a transformer through a IRFZ44N MOSFET.
- IRFZ44N and a small resistor are used as switching device.
- The mini power transformer is used to convert this low voltage into high voltage AC.
- Output of the transformer is put to a rectifier consist of diodes and capacitors. In this method so far a stable 1200V DC is achieved.
- In this method air cooling is used.

Results



Input voltage to the transformer is varied using a pot and the output voltage is measured. The output voltage increases linearly with the input voltage. In this set-up a voltage up-to 1250 V is achieved.



To check the stability of the system the input is kept constant and the output is measured with time. In a measurement of 200 minutes the output voltage remains almost constant at 1250 V within a RMS fluctuation of 2.9%.

Summary and outlooks

A circuit is designed using photo-diode in photo-voltaic mode to convert solar energy into electrical energy. Using 25 photo-diodes a voltage up to 1250 V is achieved. The output voltage varies linearly with the input voltage. In a continuous test of 200 minutes the output voltage remains almost constant at 1250 V within a RMS fluctuation of 2.9%. The output voltage will be used to power PMT of scintillator detector and the result will be reported in future.

Acknowledgements

We would like to thank Seacom Engineering College for providing the infrastructure of this work. We would also like to thank Dr. Saikat Biswas of Bose Institute, Kolkata for the valuable suggestions in the course of this work.

References

[1] Pulsed solar panel light current-voltage characterization based on Zener diode.
Victor C. H. Lim, Cheow Siu Leong, Kamaruzzaman Sopian, Saleem H. Zaidi.
IEEE: Systems, Process and Control (ICSPC), IEEE Conference on 16-18 Dec. 2016, Bandar Hilir, Malaysia.
[2] Voltage field generated by a single photodiode in a volume conductor: simulation and measurements.
Bernhard Steindl, Reinhard Enne, Stefan Schidl, Horst Zimmermann.
IEEE: Engineering in Medicine and Biology Society, 2003. Proceedings of the 25th Annual International Conference of the IEEE on 17-21 Sept. 2003.