ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

*An ISO 3297: 2007 Certified Organization* *Vol. 4, Special Issue 1, March 2015*

National Conference on Recent Advances in Electrical & Electronics Engineering (NCREEE 2015)

Organized by

Dept. of EEE, Mar Baselios Institute of Technology & Science (MBITS), Kothamangalam, Kerala-686693, India

On 26th & 27th March 2015

# Solar Powered Mobile Charger Using Buck Converter

Aleena Theresa [1], Reeba Stephen[2], Neetha Baby M.[3], Anna Geethu Paul[4], Kishna S.[5], Neeba Sabu [6]

UG Student, Dept. of EEE, MBITS, Nellimattom, Kerala, India [1,2,3,4,5]

Assistant Professor, Dept. of EEE, MBITS, Nellimattom, Kerala, India [6]

**ABSTRACT**: The proposed system, solar powered charger (SPC) plays an important role in mobile charging during travelling. The sun is the ultimate power source and solar energy is renewable energy source. The SPC system is ecofriendly and user friendly. The solar panel used is of 12v rating. The voltage must be suitably step down. The simplest way to reduce the voltage of a DC supply is to use a linear regulator (such as a 7805), but linear regulators waste energy as they operate by dissipating excess power as heat. Buck converters, on the other hand, can be remarkably efficient (95% or higher for integrated circuits), making them useful for tasks such as converting the main voltage in a computer (4-5V in mobile phones, 12 V in a desktop, 12-24 V in a laptop) down to the 0.8-1.8 volts needed by the processor. The basic operation of the buck converter has the current in an inductor controlled by two switches (usually a transistor and a diode). In the idealized converter, all the components are considered to be perfect. Specifically, the switch and the diode have zero voltage drop when on and zero current flow when off and the inductor has zero series resistance. Further, it is assumed that the input and output voltages do not change over the course of a cycle. The gate pulse for the buck converter is generated from PIC microcontroller. Capture Compare PWM (CCP) modules are available with a number of PIC microcontrollers which can be used to generate gate pulses.

**KEYWORDS:** Buck Converter, Photovoltaic Cell

## I.INTRODUCTION

Solar power is the ultimate power source which is abundantly available in the universe. Solar Powered Mobile charger (SPC) can plays an important role in mobile phone charging. SPC utilizes the abundant solar energy for charging mobile phones and is eco-friendly. It employs Maximum Power Point Tracking (MPPT) technology to confirm maximum utilization of trapped solar energy in the solar panel. MPPT mechanism makes use of an algorithm and an electronic circuitry, so that maximum amount of generated power is transferred to the load. This is based on the principle of impedance matching between load and PV array. As a 12 V solar panel is used SPC consists of a buck converter for stepping down the voltage level which is suitable for charging mobile phones. Micro-controller is the main part of the SPC system. It is coded to generate a PWM wave, which controls the duty cycle of the MOSFET switch. The switching of MOSFET switch produces a continuous voltage at the output .The regulated voltage at the output of buck converter is used to charge a 5V battery. Silicon diodes are used to make the voltage to a desired value. Users (PUs).

## II.BLOCK DIAGRAM AND EXPLANATION

The block diagram of SPC system contains a solar panel, buck converter, microcontroller, and battery. The solar panel is used to convert the solar energy to electrical energy .The normal voltage rating of the solar panel used is 12V.The principle used is PHOTOELECTRIC EFFECT for the conversion of solar energy to electrical energy .When light is incident upon a material surface; the electrons present in the valence band absorb energy and get excited. They jump to the conduction band and become free. Some reach a junction where they are accelerated into a different material by a Galvani potential. This generates an electromotive force, and thus electric energy. Buck converter is a dc-dc converter, which comprises of MOSFET switch (IRF250N), inductor, capacitor and diode. Buck converter reduces the input voltage to desirable voltage of charging. Switching of the converters provided by the PIC microcontroller. Battery is charged from this output of buck converter.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

*An ISO 3297: 2007 Certified Organization* *Vol. 4, Special Issue 1, March 2015*

National Conference on Recent Advances in Electrical & Electronics Engineering (NCREEE 2015)

Organized by

Dept. of EEE, Mar Baselios Institute of Technology & Science (MBITS), Kothamangalam, Kerala-686693, India

On 26th & 27th March 2015

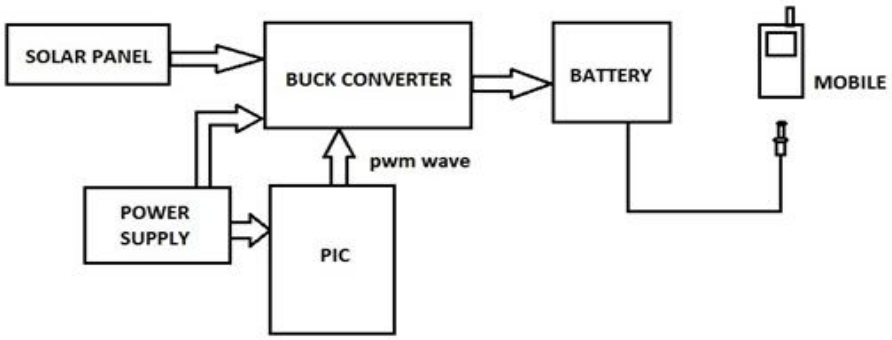


Fig. 1 block diagram of solar powered mobile charger

**BUCK CONVERTER**

`It is a dc to dc step-down converter. The simplest way to reduce the voltage of a DC supply is to use a linear regulator (such as a 7805), but linear regulators waste energy as they operate by dissipating excess power as heat. Buck converters, on the other hand, can be remarkably efficient (95% or higher for integrated circuits). It utilizes a MOSFET switch (IRFP250N), a diode, inductor and a capacitor. Few resistors also are used in the circuit for the protection of the main components. When the MOSFET switch is 'ON' current rises through inductor, capacitor and load. Inductor stores energy. When switch is 'OFF' the energy in the inductor circulates current through inductor, capacitor freewheeling diode and load. The output voltage will be less than or equal to the input voltage. The output voltage of a buck converter is given by the equation (2.1)

$$V_0 = D\,V_{in} \qquad \text{.....(2.1)}$$

Where D is the duty ratio of the MOSFET switch D is given by the equation (2.2)

$$D = \frac{T_{on}}{T_{on}+T_{off}} \qquad \text{.....(2.2)}$$

$$0 \leq D \leq 1 \qquad \text{.....(2.3)}$$

Fig. 2 shows the working of a buck converter (with its switch in on position and off position respectively) pictorially.

The red line shows the path of current.

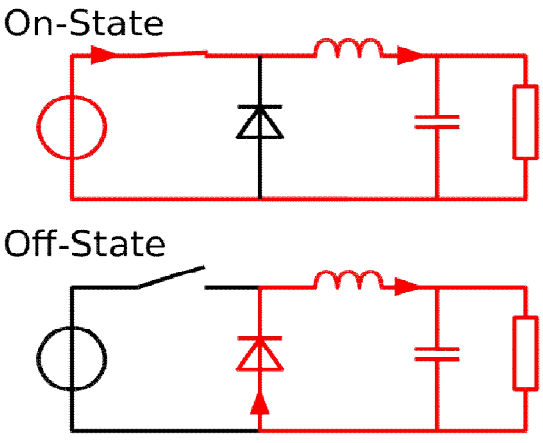


Fig. 2 schematic of working of buck converter

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

*An ISO 3297: 2007 Certified Organization* *Vol. 4, Special Issue 1, March 2015*

National Conference on Recent Advances in Electrical & Electronics Engineering (NCREEE 2015)

Organized by

Dept. of EEE, Mar Baselios Institute of Technology & Science (MBITS), Kothamangalam, Kerala-686693, India

On 26th & 27th March 2015

## III. CIRCUIT DIAGRAM AND EXPLANATION

Solar panel converts solar energy to electrical energy. The panel is of the rating 12V.The output from the solar panel is fed to buck converter, which step down the voltage input. Buck converter converts the output voltage of panel to voltage range (6V) suitable for charging the battery. The buck converter consist of MOSFET switch, inductor, capacitor, resister and diode. The voltage conversion is made possible by controlling the duty cycle of MOSFET switch(12V to 6V).The duty cycle is varied by the PWM from the PIC microcontroller.PIC is coded to produce PWM of 5 V. The PWM output is given to optocoupler (TIP250). Optocoupler is used to provide isolation and protection. The optocoupler is a voltage shifting IC. The voltage is shifted to 3.5V.This input PWM provides the on/off conditions for MOSFET. During on condition inductor and capacitor gets charged from incoming voltage. During off condition, inductor discharges and thus the circuit is complete. The voltage at the output of buck converter charges the 6V battery. The diode in the circuit is to make the voltage suitable for charging the equipment.

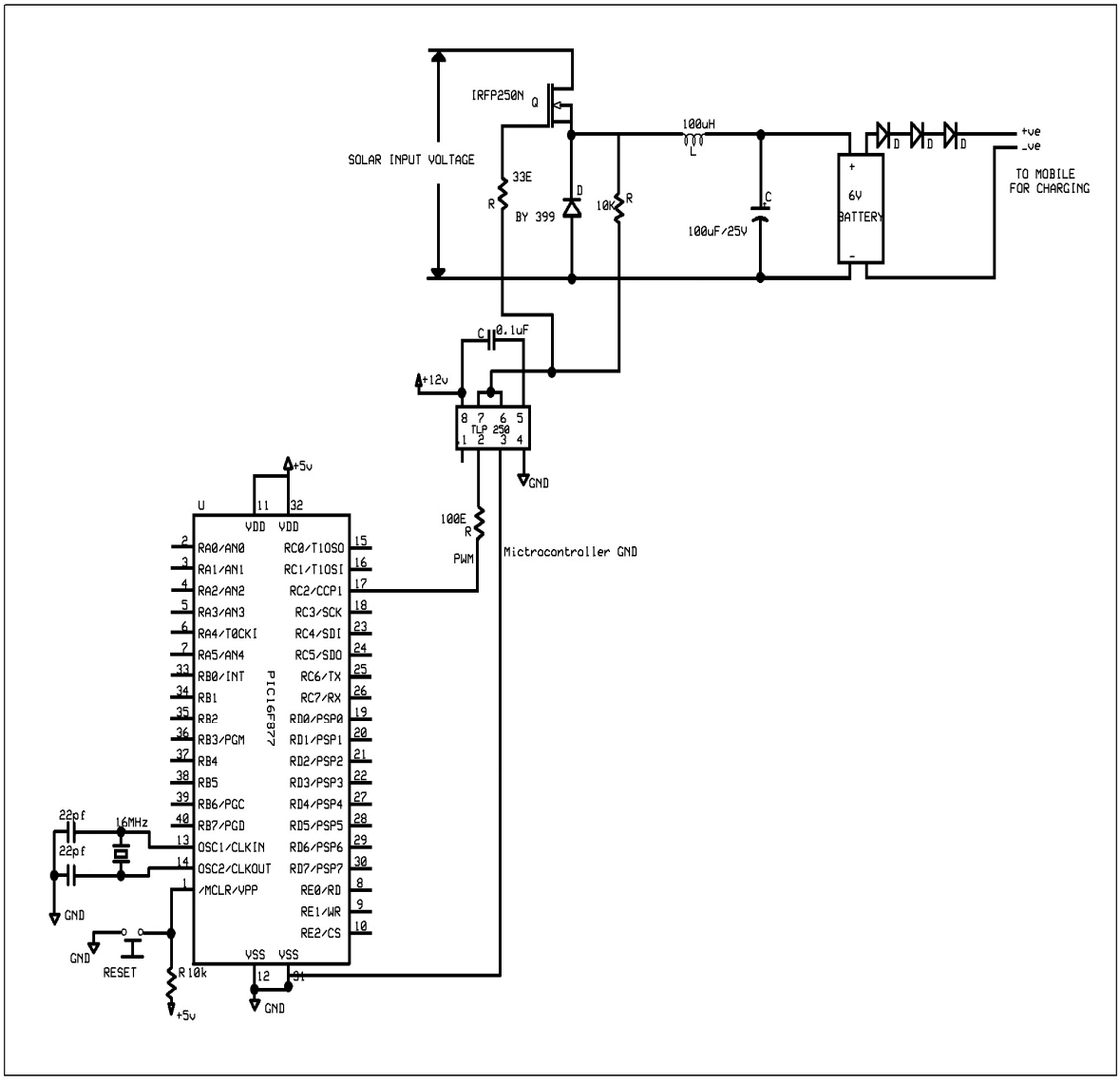


Fig. 3 Circuit diagram of solar powered mobile charger.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

*An ISO 3297: 2007 Certified Organization* *Vol. 4, Special Issue 1, March 2015*

National Conference on Recent Advances in Electrical & Electronics Engineering (NCREEE 2015)

Organized by

Dept. of EEE, Mar Baselios Institute of Technology & Science (MBITS), Kothamangalam, Kerala-686693, India

On 26th & 27th March 2015

## IV. RESULT AND DISCUSSION

Solar panel used is having 12V rating and KWh. A graph is plotted between voltage variation and time of day. We know that the solar energy received from the sun to earth varies whole day. From fig. 3 it is clear that maximum solar energy falls on earth at midday and hence the maximum voltage output is obtained at the same.

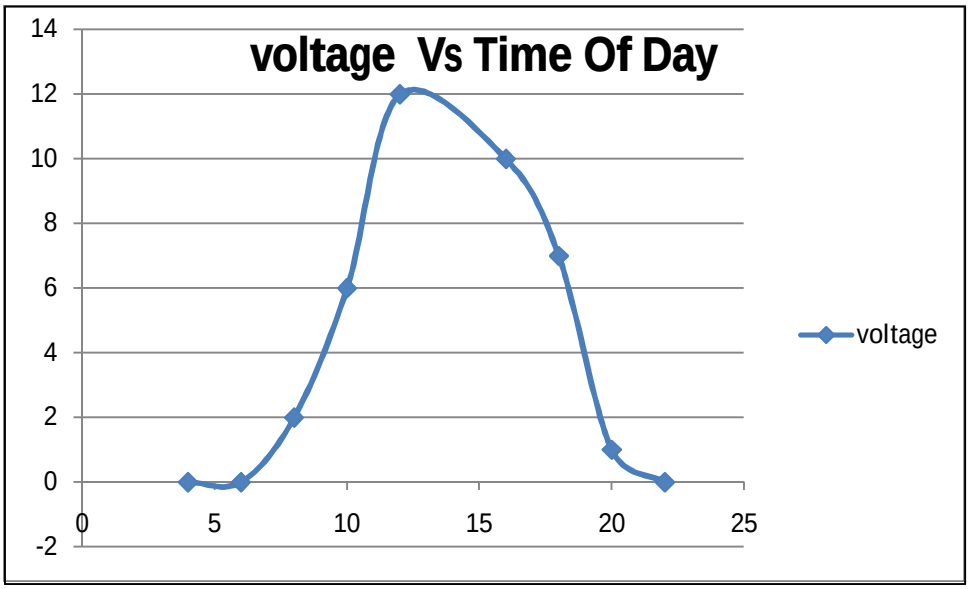


Fig. 4 Voltage Vs Time of day

The buck converter along with the battery storage system makes the input to the mobile phone a constant.

## V.CONCLUSION

Solar powered cell phone chargers can be a better alternative to electrical cell phone chargers. It will make the running cost of mobile phone reduced. For that purpose designed an eco-friendly solar powered charger (SPC) for mobile charging which utilizes an effective converter topology and microcontroller to ensure effective utilization of solar energy. An SPC can accommodate almost any model cell phone. It can use the sun's energy to recharge a cell phone. The system can be modified for multicharger.

## REFERENCES

**[1]** R. A. MASTROMAURO, M. LISERRE, AND A. DELL 'AQUILA, "CONTROL ISSUES IN SINGLE-STAGE PHOTOVOLTAIC SYSTEMS: MPPT, CURRENT AND VOLTAGE CONTROL," *IEEE TRANS. IND. INFORMAT., VOL. 8, NO. 2, PP. 241–254, MAY. 2012.*

[2] Z. Zhao, M. Xu,Q. Chen, J. S. Jason Lai, and Y. H. Cho, "Derivation, analysis, and implementation of a boost–buck converter-based high-efficiency pv inverter," *IEEE Trans. Power Electron., vol. 27, no. 3, pp. 1304–1313,* Mar. 2012.

[3] M. Hanif, M. Basu, and K. Gaughan, "Understanding the operation of a Z-source inverter for photovoltaic application with a design example, *IET Power Electron., vol. 4, no. 3, pp. 278–287, 2011.*

[4] J.-M. Shen, H. L. Jou, and J. C. Wu, "Novel transformer-less grid connected power converter with negative grounding for photovoltaic generation system," *IEEE Trans. Power Electron., vol. 27, no. 4, pp. 1818–* 1829, Apr. 2012.

[5] Mohammed O Badawy, Ahmet S Yilmaz, Yilmaz Sozer, Iqbal Husain. Parallel Power Processing Topology for Solar PV Applications. IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS, VOL. 50, NO. 2, MARCH/APRIL 2014