A Review Paper on Solar Based SMPS Using Microcontroller

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Abstract **-** To overcome the electricity problem where energy crises occur frequently, implementation of non-conventional energy sources plays important role. The simplest way to collect non-conventional energy is solar energy. Solar energy can be stored in battery through maximum power point tracking charge controller unit. This energy can be converted into required form using switch mode power supply converter. This includes the design of the photovoltaic system and the energy management by seeking the Maximum Power Point (MPP).

Keyword **-** Maximum Power Point Tracking, Perturb and Observe, DC-DC Converters, Photovoltaic System.

I. INTRODUCTION

Basic requirement of switch mode power supply is efficiency, small size and low cost this can be achieved by using photovoltaic type of solar panel. But characteristics of solar panel such as voltage and current or IV curve are depending upon temperature and irradiance level. Therefore, the operating current and voltage which maximize power output will change with environmental conditions, as in Figure 1.1. [1]

There are a number of maximum power point tracking (MPPT) algorithms which track the optimal current and voltage in a changing environment. MPPT technology is used as a benefit in varying environmental conditions because of the different angles and exposure to the sun. These limitations make it important to transfer all power using MPPT technology. It is used to obtain the most power possible from the PV solar module. PV solar modules do not have a linear voltage and current relationship [2].

A. Photovoltaic Generation

Photovoltaic conversion is the direct conversion of sunlight into electricity without any heat engine to interfere. Photovoltaic devices are rugged and simple in design requiring very little maintenance and their biggest advantage being their construction as stand-alone systems to give outputs from microwatts to megawatts. Hence they are used for power source, water pumping, remote buildings, solar home systems, communications, satellites and space vehicles, reverse osmosis plants, and for even megawatt scale power plants. With such a vast array of applications, the demand for photovoltaic is increasing every year [3].

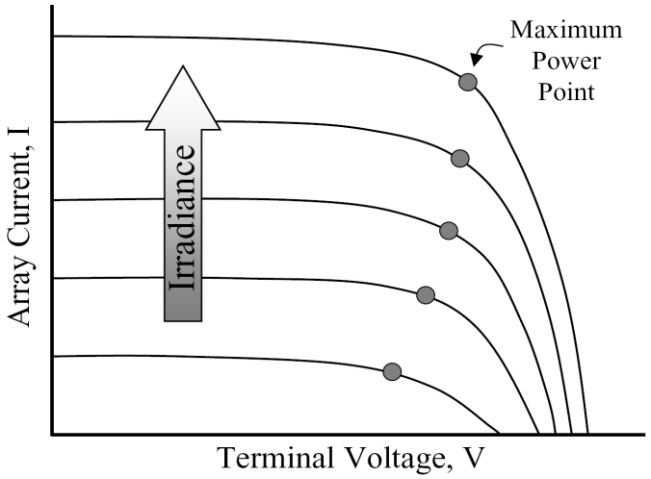

Fig: 1.1 IV Curves at various irradiance

A photovoltaic power generation system consists of multiple components like cells, mechanical and electrical connections and mountings and means of regulating and/or modifying the electrical output. These systems are rated in peak kilowatts (kWp) which is an amount of electrical power that a system is expected to deliver when the sun is directly overhead on a clear day [3].

The main technical requirements in developing a practical PV system include an optimal control that can extract the maximum output power from the PV arrays under all operating and weather conditions, and a high performance-to-cost ratio to facilitate commercialization of developed PV technologies. Since the PV array has a highly nonlinear characteristic, and its performance changes with operating conditions such as insolation or ambient temperature, it is technically challenging to develop a PV system that can meet these technical requirements [4].

II. METHODS OF IMPLEMENTATION

A. Solar Charging

The primary source used to charge the lead acid battery is the energy obtained from the solar cell. Since solar energy is a

very promising renewable energy source, it is wise to utilize the same. Solar Panels hence produce a photocurrent on being exposed to the solar radiation. Not only are the solar cells a major source to harness renewable energy, but are also portable power sources. Since the intensity of radiation is variable, the circuit should work with a broad range of voltages above and below the desired voltage. The method to provide alternate and reliable maximum tracking performance even under a rapid changing irradiance condition [5].

B. Switch mode Power Supply (SMPS)

DC-DC power converters are employed in a variety of applications, including power supplies for personal computers, office equipment, spacecraft power systems, laptop computers, and telecommunications equipment, as well as dc motor drives. The input to a dc-dc converter is an unregulated DC voltage. The converter produces a regulated output voltage V, having a magnitude (and possibly polarity) that differs. A basic dc-dc converter circuit known as the buck converter which provides decreased output as per our requirement.

C. Maximum Power Point Tracking

The Maximum Power Point Tracking (MPPT) is a technique used in power electronic circuits to extract maximum energy from the Photovoltaic (PV) Systems. In the recent decades, photovoltaic power generation has become more important due its many benefits such as needs a few maintenance and environmental advantages and fuel free. However, there are two major barriers for the use of PV systems, low energy conversion efficiency and high initial cost. To improve the energy efficiency, it is important to work PV system always at its maximum power point. So far, many researches are conducted and many papers were published and suggested different methods for extracting maximum power point. The control algorithm suggested by Joe Antonio Barros Vieira ,extreme the perturb and observe(P&O) maximum power tracking function to transfer maximum energy generated by photovoltaic panel to the battery[6].

D. Photovoltaic Cell

Photovoltaic generators are neither fixed current sources nor voltage sources but can be approximated as current generators with dependent voltage sources. During darkness, the solar cell is not an active device. It produces neither a current nor a voltage. A solar panel cell essential is a p-n semiconductor junction. When exposed to the light, a current is generated (DC current).The generated current change linearly with the solar irradiance. The equivalent electrical circuit of an ideal solar cell is given in fig.2[7].

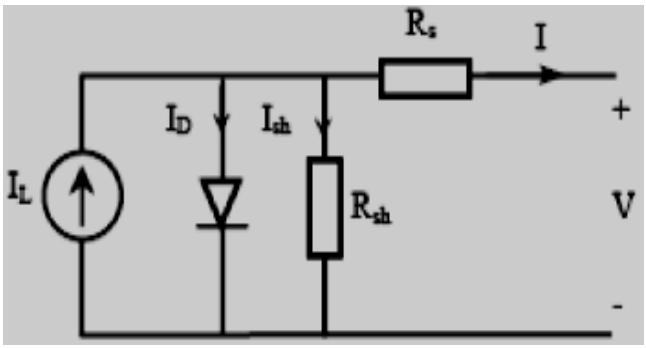

Fig.2: Equivalent circuit of Solar cell

The I-V characteristics of the solar cell circuit can be sets by the following equations. The
current through diode is given by:

$ID = IO [\exp (q (V + I RS)/KT)) – 1]$

While, the solar cell output current:

$I = IL – ID – I sh$

$I = IL – IO [\exp (q(V + I RS)/KT)) – 1] – (V + IRS)/ Rsh$

Where,

I : Solar cell current (A)
IL : Light generated current (A)
IO : Diode saturation current (A)
q : Electron charge (1.6×10-19 C)
K : Boltzman constant (1.38×10-23 J/K)
T : Cell temperature in Kelvin (K)
V : solar cell output voltage (V)
Rs: Solar cell series resistance (Ω)
Rsh: Solar cell shunt resistance (Ω)

III. DC-DC CONVERTER ANALYSIS

A. Buck Converter

A buck converter or voltage regulator is also called a step down regulator since the output voltage is lower than the input voltage. In a simple example of a buck converter, a diode is connected in parallel with the input voltage source, a capacitor, and the load, which represents output voltage. A switch is connected between the input voltage source and the diode.A inductor is connected between the diode and the capacitor [7], shown in Figure 3 .

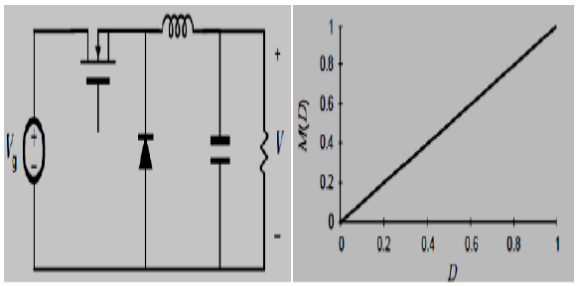

Fig:3 Buck Converter and its conversion graph

IV. CONCLUSION

Solar panels are as good as power supplies of an average of 17.5V in bright sunlight. The only problem is unregulated voltage due to variation in intensity of light. MPPT regulating the output voltage but it again makes the system less efficient because of some unexpected conditions. Solar charger circuits need voltage regulators so as to charge the batteries at constant voltage. The battery charging process should be stopped once it is fully charged and this is ensured using a zener which will start conducting at the cut off voltage. Solar based SMPS should be able to collect maximum energy under rapid change in irradiance. The charger circuit should a simple, ready to use lead acid battery charger and is a good way to tap sun's energy on the go.

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