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Environmental Factors Affecting Solar Panel

Anisha Cotta[1], Pratish Vir[2], Pankaj Singh[3], Ashish Sunoj[4], Sujeet Velip[5]
[1]*Assistant Professor, Dept. of Electronics & Telecommunication Engg., Don Bosco College of Engg., Goa, India*
[2,3,4,5]*Student, Dept. of Electronics & Telecommunication Engineering, Don Bosco College of Engg., Goa, India*

***Abstract*: Energy which comes from natural resources such as sunlight, wind, rain, geothermal heat etc. is called renewable energy. Renewable energy is very important because the non-renewable energy such as petrol, diesel, and fossil fuels are limited. Solar energy is the most easily available source of energy. Most important it is nonconventional source of energy because it is non-polluting, clean etc. The influences of temperature and irradiance variations on the different solar cell parameters are studied. It is useful to understand the effect of temperature and irradiance on the solar cell and module performance, in order to estimate their performance under various conditions. The efficiency of solar module is directly related with the solar parameter and therefore solar parameter changes and affects the efficiency of solar module. In solar energy systems, solar panels absorb sunlight and generate electricity which is supplied in commercial and residential applications, the solar irradiance variations limit the converter's transformation rate for a certain input amount, leaving the rest of the energy unconverted. In order to utilize the maximum energy provided by Photo-Voltaic system we need to minimize the affects of environment. The solar panel also known as solar cell, Photo-Voltaic system, solar module, solar array**

***Keywords*: solar energy, solar panel, temperature, irradiance**

1. Introduction

Today, Photovoltaic (PV) or solar energy represents a small portion of the total generated energy, even though this kind of resource is enormous (the average intensity of light is about 1353W/m2 and the earth receives more energy from the sun in 1h than the global population uses in an entire year). The total energy from sun given to earth every 1hr is more than the energy produced by entire human population in one year. The energy produced from solar has increased by 8 times in the last four years. Solar power plants equipped with battery storage system is used for grid stabilization. The MPPT charge control technique of charging a battery and then obtaining constant output power has greater losses and very bulky apparatus. In applications where the solar energy need not be stored, using ideal DC – DC converters is the optimal method of obtaining constant output power.

2. Basic concept

The output power of a solar panel depends on the amount of light projected on the panel. Time of the day, season, panel position and orientation are the factors behind the output power. The present scenario used to convert variable output current from solar panel to a constant power makes use of MPPT charge control technique coupled to a battery which gives out constant DC power.

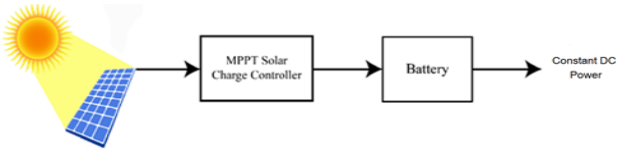

Fig. 1. Block diagram representation of extracting constant power using MPPT charge control technique

The main advantage of the above method lies in the fact that once charged, the battery can supply equipment as and when needed. However, in applications where the solar energy is to be used directly without storing in the battery, DC – DC converters can be used which will convert the variable input to constant output. This will reduce losses and also the cost of setup.

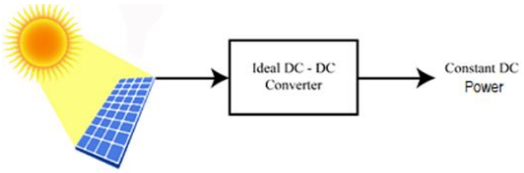

Fig. 2. Block diagram representation of extracting constant output using DC – DC converter

3. Factors affecting solar cell

Major factors are temperature, solar isolation, dust, shading, weather, and soiling.

A. Solar isolation

Solar isolation is the energy in sunlight. The total sunlight received at a site is affected by the interference from the clouds, length of the day, position of the sun, and other interference in the sky. Insolation can be either "direct" or "diffuse". Direct insolation means energy reaches the earth's surface without any interruption. The scattered light which is reflected back from the particles in the atmosphere is called diffuse insolation. Direct insolation can be converted into electricity more effectively than diffuse by the solar panels.

B. Dust / Dirt

Dust and dirt block light to solar panels reducing their output. Horizontal installations are generally avoided, to prevent dust

build up. At the DKASC all PV arrays are given an annual full cleaning to remove dust. The time and dates of this cleaning are posted in the notes on the data section.

C. Shading

Shade blocks direct insolation from the panels. There is a larger impact on the output of the solar panel even by small amount of shade as it changes the flow of electricity through the panel. At the DKASC we aim to ensure that know arrays are subject to shading from trees, buildings or other arrays within the hours of 08:30 and 16:30 each day. Solar panels should be located such that there will never be shadows on them. The cells within a panel are usually all wired in series so the current flow of the whole cell is affected by the shaded cell, but there are some situations where it cannot be avoided, and thus the effects of partial shading should be considered while planning. In such a situation, it is better to avoid wiring panels in series if possible.

D. Temperature

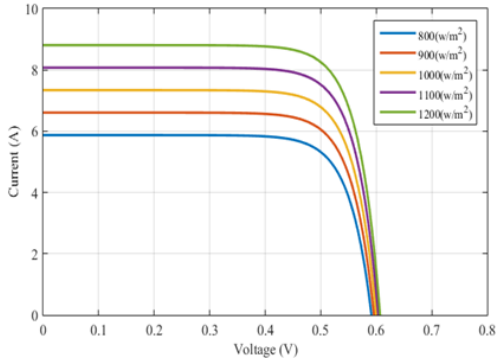

Fig. 3. Output Current change with Irradiance

The output current gets affected more by Solar Irradiance as compared to output voltage as shown in figure 3.

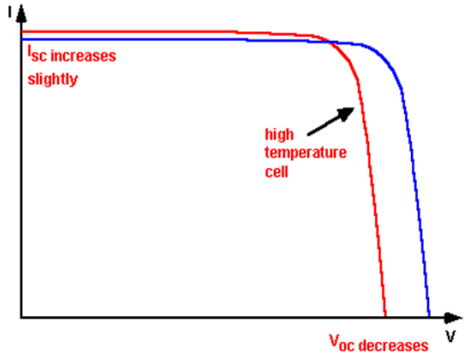

Fig. 4. V-I Graph for Solar Panel Exposed to Temperature Change

When the solar panel is exposed to temperature change, the output voltage is affected more compared to the output current as shown in Figure 4.

As the temperature increases, the output of the solar panel decreases. High surrounding temperatures limit the amount of electricity a panel can produce. Heat is produced by the solar panels as they produce electricity. The warmer solar cells get, the less efficient they are same goes for those little electrons. The hotter the cell material is, the more resistance there is and the slower the electrons can move through it. This means that production goes down because not as many electrons can get through the circuitry in the same amount of time as before. This is another situation where quality matters. In extreme heat high quality panels are designed to maintain performance level while lower quality panels lose efficiency and produce less energy. What a bummer. We can't imagine making a huge investment only to watch it under perform on a Summer afternoon when it should be creating lots of free electricity. Solar cells perform better in cold rather than in hot climate, panels are rated at 25˚C which can be significantly different from the real outdoor situation. For each degree rise in temperature above 25˚C the panel output decays by about 0.25% for amorphous cells and about 0.4-0.5% for crystalline cells thus, in hot summer days panel temperature can easily reach 70˚C or more. Thus a 100W panel will produce only 75W in May/June in most parts of India where temperatures reach 45˚C and beyond in summer and electricity demand is high.

Solar panels are tested under laboratory conditions, called STC (Standard Test Conditions): at an Irradiance (light) level of 1000W/m^2 with a temperature of 25˚C, but in the real world these conditions are constantly changing so the panel output is different from the lab conditions. So, other specifications are reported, called NOCT (Nominal Operating Cell Temperature). It is the temperature reached by open circuit cells in a module under the following conditions: Irradiance (light) falling on the solar panel at 800W/m^2; Air temperature of 20ºC; Wind speed at 1m/s; and the panel is mounted with an open back (air can circulate behind panel).

Most good quality panels available today in India have NOCT values of 47±2˚C. Lower the NOCT the better it is expected to perform in hotter climates. Moser Baer panels have NOCT of 47±2˚C and temperature coefficient of rated power -0.43% per K for panels up to 125W$_p$; their higher power panels have NOCT of 45±2˚C and temperature coefficient of rated power -0.45% per K.

4. Conclusions

It was observed that solar panel when exposed to various environmental conditions such as temperature changes and solar irradiance, i.e. the variation in the amount of solar energy received by the panel due to weather changes, dust accumulation on the panel, shade falling on panel etc. leads to variation in the input power, which in turn causes fluctuations or variations in the desired output power. In order to find a solution to this problem a DC-DC Boost Converters are designed.

References

[1] Aguillon-Garcia Jacobo and Banuelos-Sanchez Pedro, "High-Efficiency DC-DC Converter for Large Input-Voltage Fluctuations in Solar

Applications, Chinese Journal of Electronics, Vol. 24, No.3, pp. 502-507, 07 2015.
[2] M. I. Khan, M. R. Islam, M. Z. Mozumder and K. M. Rahman, Photovoltaic maximum power point tracking battery charge controller, 2009 1st International Conference on the Developements in Renewable Energy Technology (ICDRET), Dhaka, pp. 1-5, 2009.
[3] S.C.W. Krauter, Solar Electric Power Generation – Photovoltaic Energy Systems, The Netherlands: Springer-Verlag, 2006.
[4] Ned Mohan, Tore M. Undeland, William P. Robbins. Power Electronics: Converters, Applications and Designs, Third Edition, Wiley, 2003.
[5] M. Jain, M. Daniele and P.K. Jain, A bidirectional DC-DC converter topology for low power application, IEEE Trans. Power Elect., Vol. 15, No.4, pp. 595–606, 2005.