International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 02 | Feb 2020 www.irjet.net p-ISSN: 2395-0072

Analysis and Implementation of Super Capacitors as a Storage Device in Standalone Photovoltaic System

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Abstract- Solar energy is the direct derivative from sun which can be harnessed through photovoltaic(PV) cells.Stand alone PV system make use of batteries as a storage unit.Careful steps are taken in this regard to protect the battery and make its charging effective. One of the best options for storage unit as compared to the batteries is super capacitors. Also its power density is high. It enhances system overall efficiency. Super capacitor have better performance characteristics and less charging time than. This work lucidly explains the analysis and comparative studies between batteries and super capacitors in terms of get charging time considering solar irradiance varying at time and being constant. The load voltage and current are described too. Using the MATLAB/SIMULINK platform the stand alone PV system (300W) is simulated.

Keywords- super capacitors , stand-alone PV , renewable power generating system , Capacitor Fundamental .

I. Introduction-

Energy is one of the most fundamental parts of universe. It is the prime aspect that is required by any functional unit for its sustainability or its proper functioning. The energy resources which can be used again and again and can that can be recycled comes under the category of RES. Sambhar Lake has been selected for the installation of the world's largest Solar plant the
generating capacity of 4000GW is planning stage. In current situation India is progressing in the direction of using more RES. India has about 28.1 GW of total installed renewable energy capacity as of 31 marches 2013.

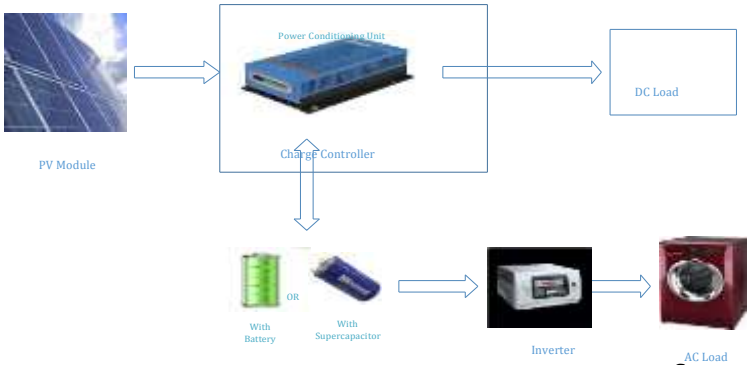


Figure-1 Single Line Diagram of 300W Stand- Alone PV System

With the use of Super capacitors electrical charge can be stored in large amount. It is a type of electronic device. Thus the super capacitors despite of attaining higher energy densities are still able to maintain the characteristic high power density of conventional capacitors. The working principle of super capacitor same as the traditionally used capacitor. The difference lies in the construction effect office of it which is the surface area of the electrodes used is large and the distance between them is less. The cell is considered to be a one of important medium of harnessing solar energy as it can directly converts the solar rays into the useful electrical energy. Hence, it provided us with a long term energy solution. Specifically one PV cell gives a 3W power at 5VDC. To get power in ample amount it must a\be applied in series-parallel combinations. Several numbers of PV cells constitute a PV module. Several PV modules constitute a PV array. The power output obtained from these modules ranges from few watts up to 300W. All this depends upon the type of applications these are employed in. Basically an array of it provides the output of 100W to kW. Also, now a day's MW power can also be obtained from itG

II. MODELLING OF 300W STAND-ALONE PHOTOVOLATIC SYSTEM

The system is comprised of PV arrays arranged in suitable combination. The device used for storing energy in case the generation of power by PV system exceeds the load demand can be either battery or supercapacitors. In case the supply through PV is not enough stored energy in this devices can be utilized. The system is capable of supplying DC as well as AC loads.

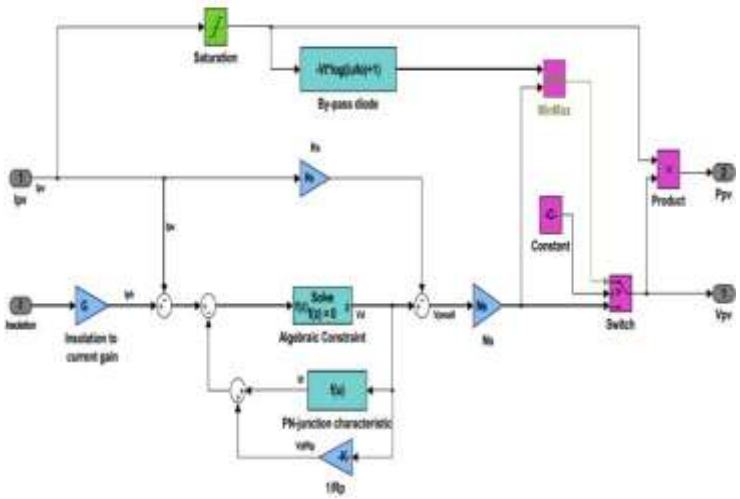


Figure-2 Solar PV cell simulation model

III. The Charge Model of Battery

PV system working in standalone mode has batteries as its central part. Rechargeable batteries types that are popular are represented by parameterized generic dynamic model of battery blocks.

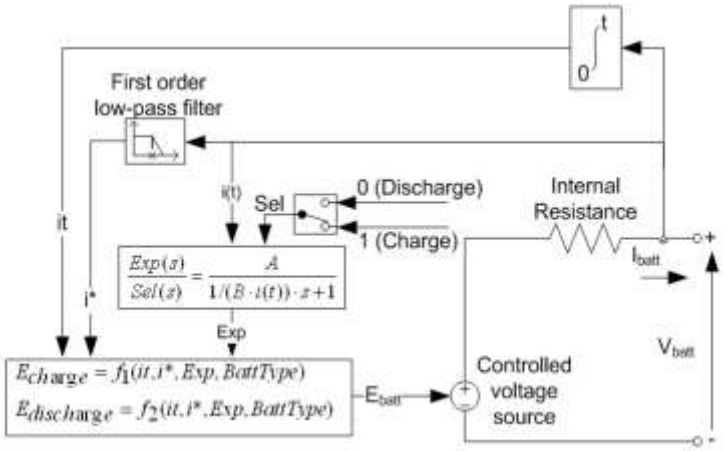


Figure-3 Equivalent Circuit of Battery Model

Single exponential model of PV cell is preferred because of simplicity and fewer complication. Then this chapter addressed an improved and east-to-use battery dynamic model. The charge and discharge battery dynamic model are justify with four batteries types. And also supercapacitor model has deliberated.

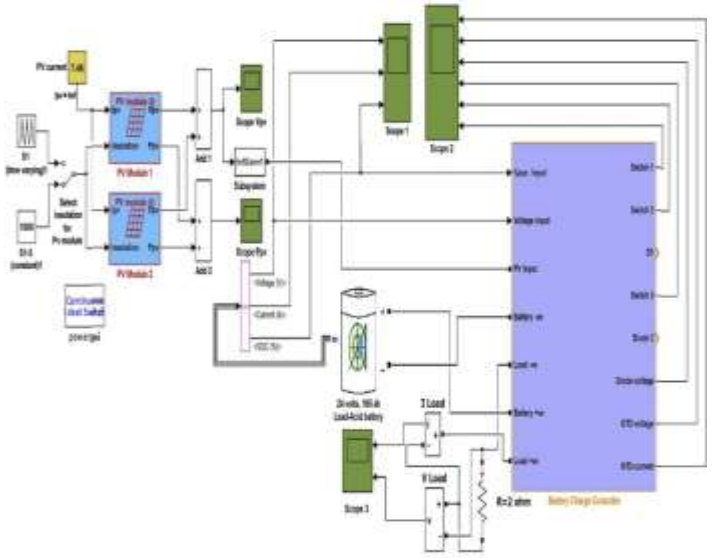


Figure 4- Battery Test Circuit

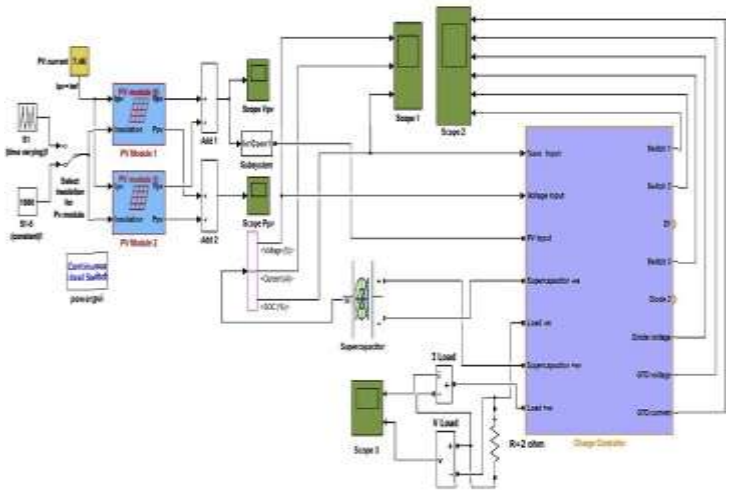


Figure-5 Supercapacitor Test Circuit

IV. SIMULATION RESULT AND ANALYSIS

MATLAB/Simulink is utilized to realize the srandalone PV system and after simulation its results are generated accordingly .Simulation is ran with constant and time varying solar insulation for 100*2000sec.The load connected has (2+j 0.01).

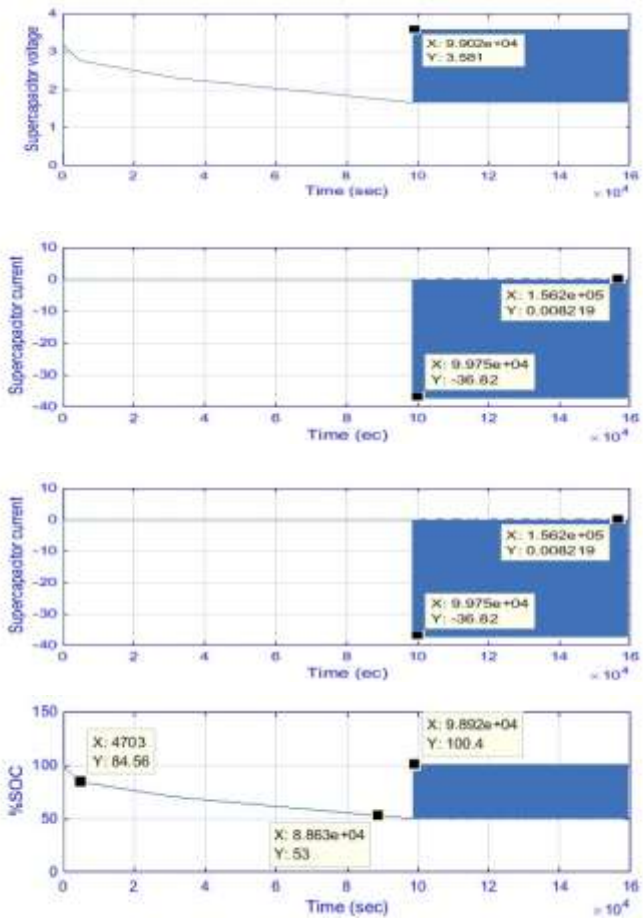
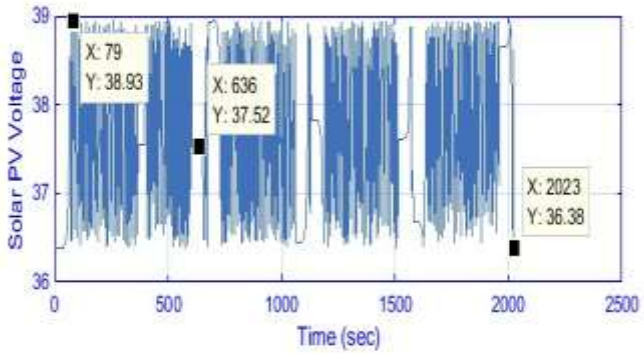


Figure- 6 Supercapacitor Voltage & Current with Charging-Discharging Waveforms

Here the solar insolation is varying time hence the simulation is processed accordingly and same is true for the output result. This is near to real situation. The Fig. presents the momentary increasing-decreasing of V_{PV}& P_{PV}.



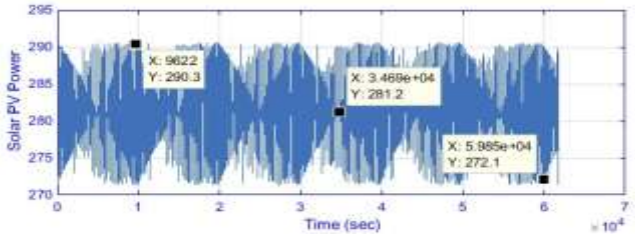


Figure-7 V_{PV}& P_{PV}

V. WITH SUPER CAPACITOR

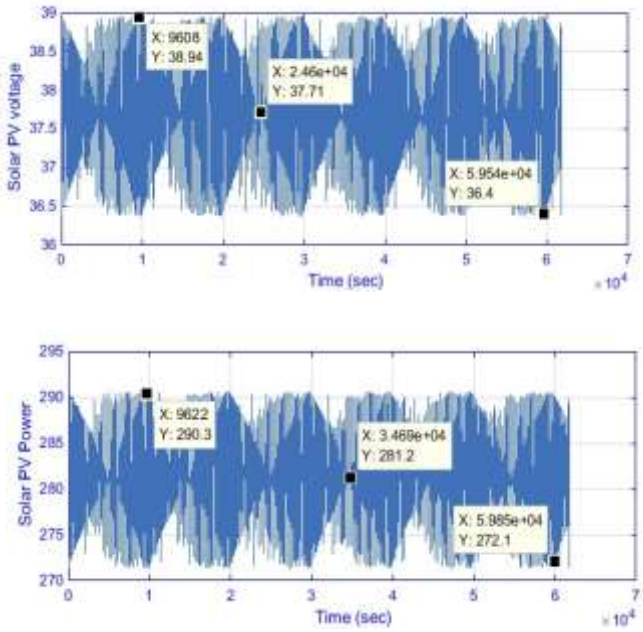


Figure- 8 V_{PV} and P_{PV}(Time Varying Insolation)

VI. CONCLUSIONS

The given thesis price present step towards the solution of scarcity to be seen in upcoming future for energy. Explain the use of energy storage unit and presented the use of Li-Ion battery which has less charging time when compared to the conventionally used batteries. In the future we can design the Solar PV system with the Maximum Power Point Algorithm (MPPT) by which we will be able to track the maximum power from solar panels to battery and supercapacitor or load without depending on the level of solar insolation. It is also a major

challenge towards the renewable power generating system that to increase the level of generated voltage as direct input AC grid after inversion.

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