Simulation based Power Conditioning Unit for off Grid Solar PV System

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***Abstract*: This is, aim to design and simulation of effective Power Conditioning Unit (PCU) with Solar Charge Controller, Inverter and Grid charger for Solar PV system. It provides theoretical studies of photovoltaic systems and modeling techniques using equivalent electric circuits. As, the system employs the Power Conditioning Unit (PCU), it is consists of various modes of operation and control methods. MATLAB simulations verify the Inverter design and hardware implementation. The results validate that PCU can significantly increase the efficiency and the performance of Solar PV system**.

1. Introduction:-Solar Power Conditioning Unit (PCU) is an integrated system consisting of a solar charge controller, inverter and a Grid charger. It provides the facility to charge the battery bank either through Solar or Grid .The PCU continuously monitors the state of Battery Voltage, Solar Power output and the loads. Due to sustained usage of power, when the Battery voltage falls below a preset level, the PCU will automatically transfer the load to the Grid power and also charge.
Once the Batteries are charged to the preset level, the PCU cuts off the Grid power from the system and will restore to feeding the loads from the battery bank and also restore to charging the battery from the available Solar Power. The PCU always gives preference to the Solar Power and will use Grid power only when the Solar Power is insufficient to meet the load requirement. Which consists of following major components?

a) Solar panel

b) Battery

c) Charge Controller

d) AC charger

e) Inverter

2. RELEVANCE:- Companies use to take an contracts of installation of solar PV system for commercial load demand. They face lot of problems in maintenance of inverter, solar charger and grid charger when separately installed .That problem can overcome by using power conditioning unit instead of separate installment. But cost of the PCU in market is much more. So, they want to manufacture their own product of PCU and install at desired price.

3. LITERETURE REVIEW:-

A. Various Types of Charge Controller Using Solar System

Md. AtiqurRahaman, M. A. Matin, ApurbaSarker, Md. Rubaiat Uddin

Construction and implementation of an efficient solar charge controller at low cost. The charge controller is implemented using an inexpensive microcontroller with the help of solar panel and battery.

B. Power Conditioning Unit for solar photovoltaic energy collection system

Prof. G. Beghin

Power Conditioning Unit (PCU) for solar photovoltaic energy collection system. The PCU provides for peak power tracing of the solar array with feeding power to the utility and system protective and interface functions utilizing a microprocessor system

C. Type Of Inverter And Design

Prof.Madhuri R. Patil, Prof. Devidas D. Dighe

In this paper we studied different types of the inverters and there harmonics contains. Square wave, modified sine wave and pure sine wave are single phase inverter techniques and are mainly discussed in this paper and compared for their suitable use.

D. MATLAB Simulation of Inverter Using MOSFET/IGBT

Prof:-Azuan Bin Alias

This project is about modeling and simulation of single phase Pulse Width
Modulation (PWM) inverter. The model was implemented using MATLAB/ Simulink with the SimPowerSystems Block Set.

4. PROPOSED WORK:

A. Solar Panel:

A solar panel is a packaged connected assembly of photovoltaic cells. The solar panel can be used Commercial and residential applications. Solar panels use light energy photon from the sun to generate electricity through the photovoltaic effect.

The advantages of solar panels are,

1. They are the most readily available solar technology.
2. They can last a lifetime.
3. They are required little maintenance.
4. They operate best on bright days with little or no obstruction to incident sunlight.

B. Battery:

Electrical storage batteries are commonly used in PV system. The primary functions of a storage battery in a PV system are:

1) Energy Storage Capacity and Autonomy: To store electrical energy when it is produced by the PV array and to supply energy to electrical loads as needed or on demand.

2) Voltage and Current Stabilization: To supply power to electrical loads at stable voltages and currents, by suppressing or smoothing out transients that may occur in PV system.

C. Charge Controller:

A charge controller or charge regulator limits the rate at which electric current is added to or drawn from electric batteries. It prevents overcharging and may prevent against overvoltage, which can reduce battery performance or lifespan, and may pose a safety risk. It may also prevent completely draining ("deep discharging") a battery, or perform controlled discharges, depending on the battery technology, to protect battery life

D. Grid Charger:

It consist step down transformer, rectifier and filter circuit. Step down transformer used to reduces the voltage level desirable to rectifier input. Rectifier converts alternating current (AC) in to direct current (DC), which flow only one direction. Electronic filters are circuits which perform signal processing function specially to remove unwanted frequency component from the output of rectifiers a component of a larger photovoltaic system to generate and supply electricity in

E. PWM Inverter:

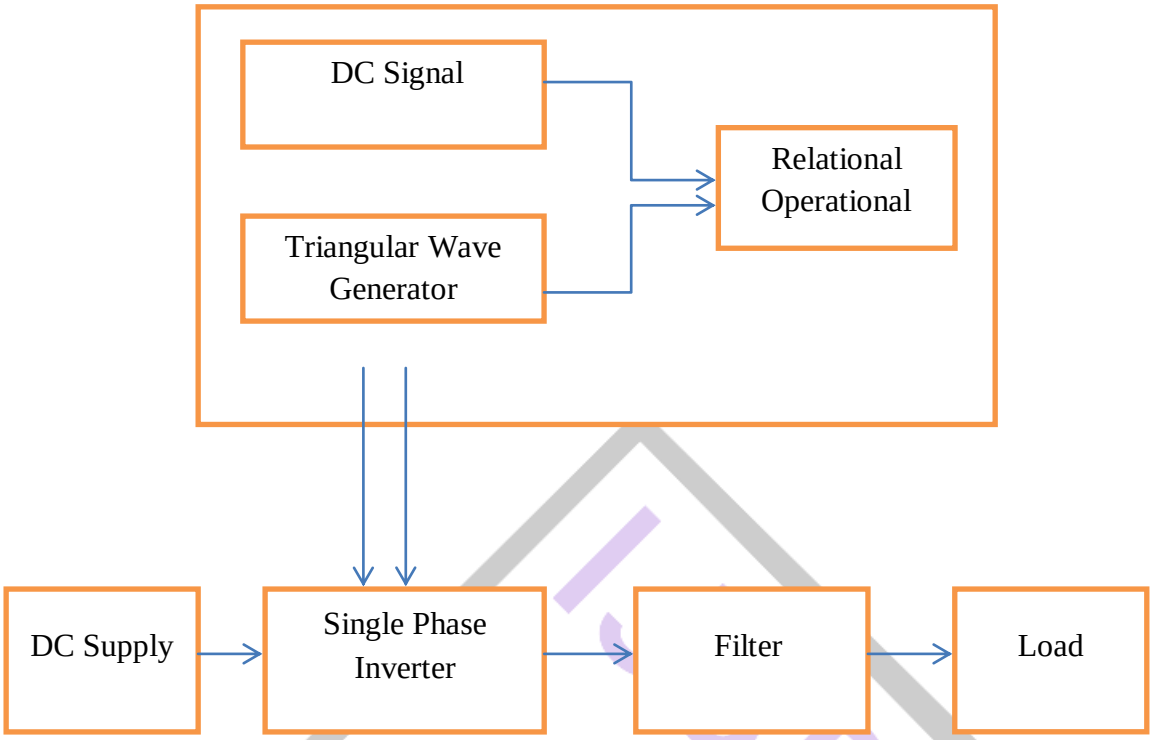

Fig 1. PWM Inverter.

Fig.1 shows PWM Inverter convert DC supply to AC supply and generation of PWM signal with the help of DC Wave and Triangular wave.it gives to switching device for operation.

PWM:-

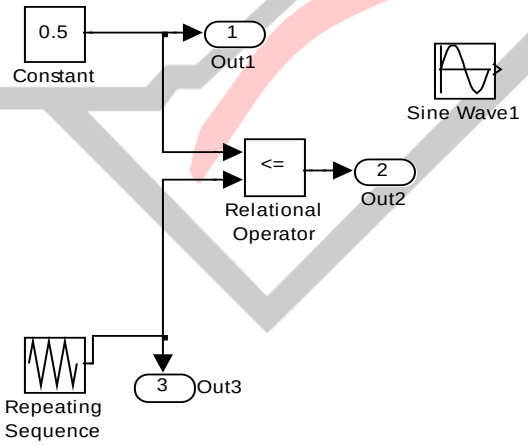

Fig.2 PWM Generation

Above fig shows the Simulink Model for SPWM Pulses generation. The pulse-width modulation (PWM) technique produces a DC waveformcompared with triangular waveform .Where DC waveformassumed as the reference waveform. The desired output voltage is achieved by varying the frequency and amplitude of a reference or modulating voltage. The variations in the amplitude and frequency of the reference voltage change the pulse-width patterns of the output voltage but keep the modulation.

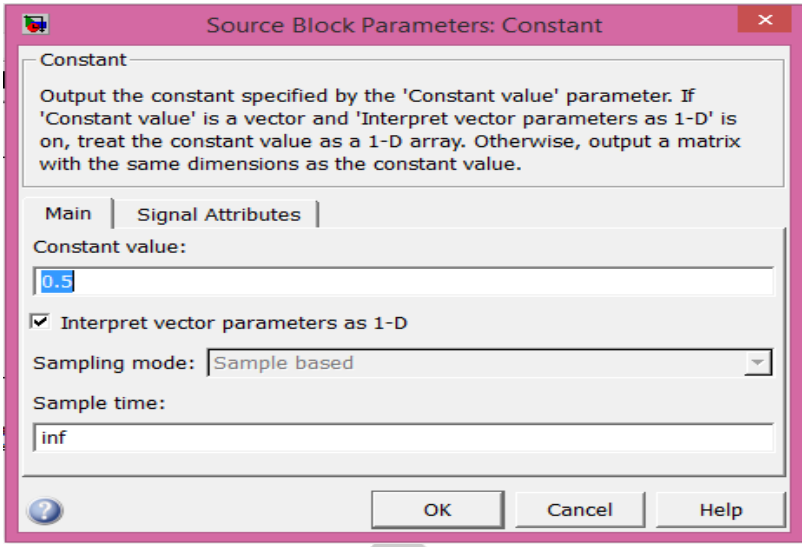

Fig3. Selection Parameter For DC Wave.

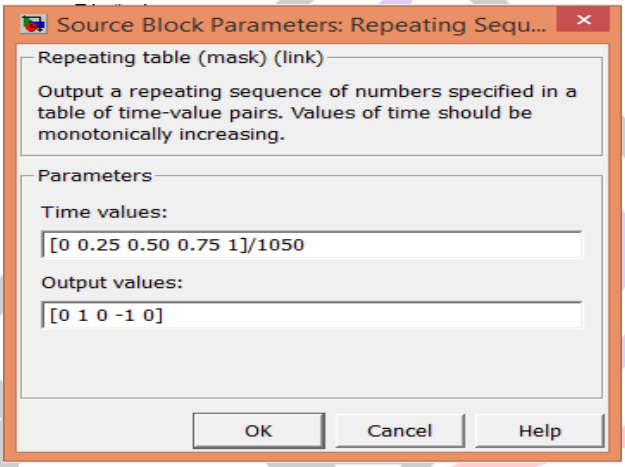

Fig 4. Selection Parameter For Triangular Wave.

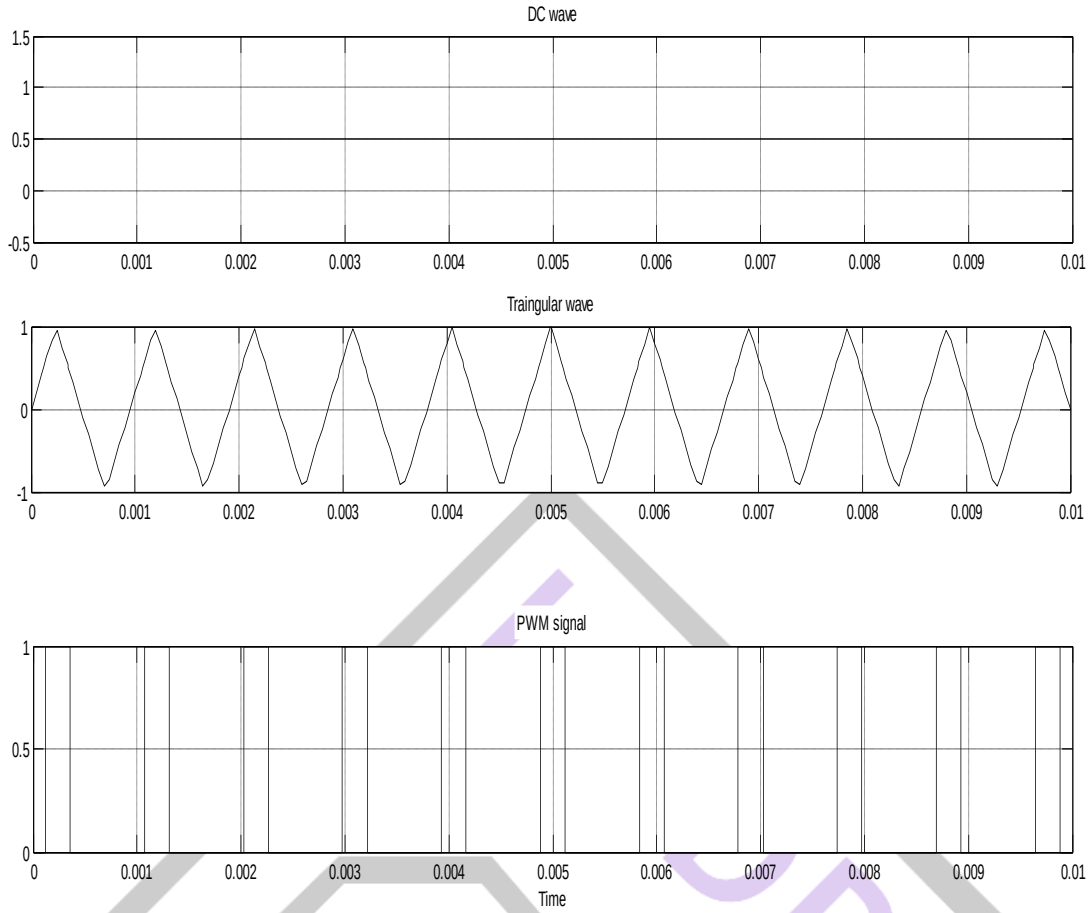

Fig.5 Output of PWM generation

Inverter Model

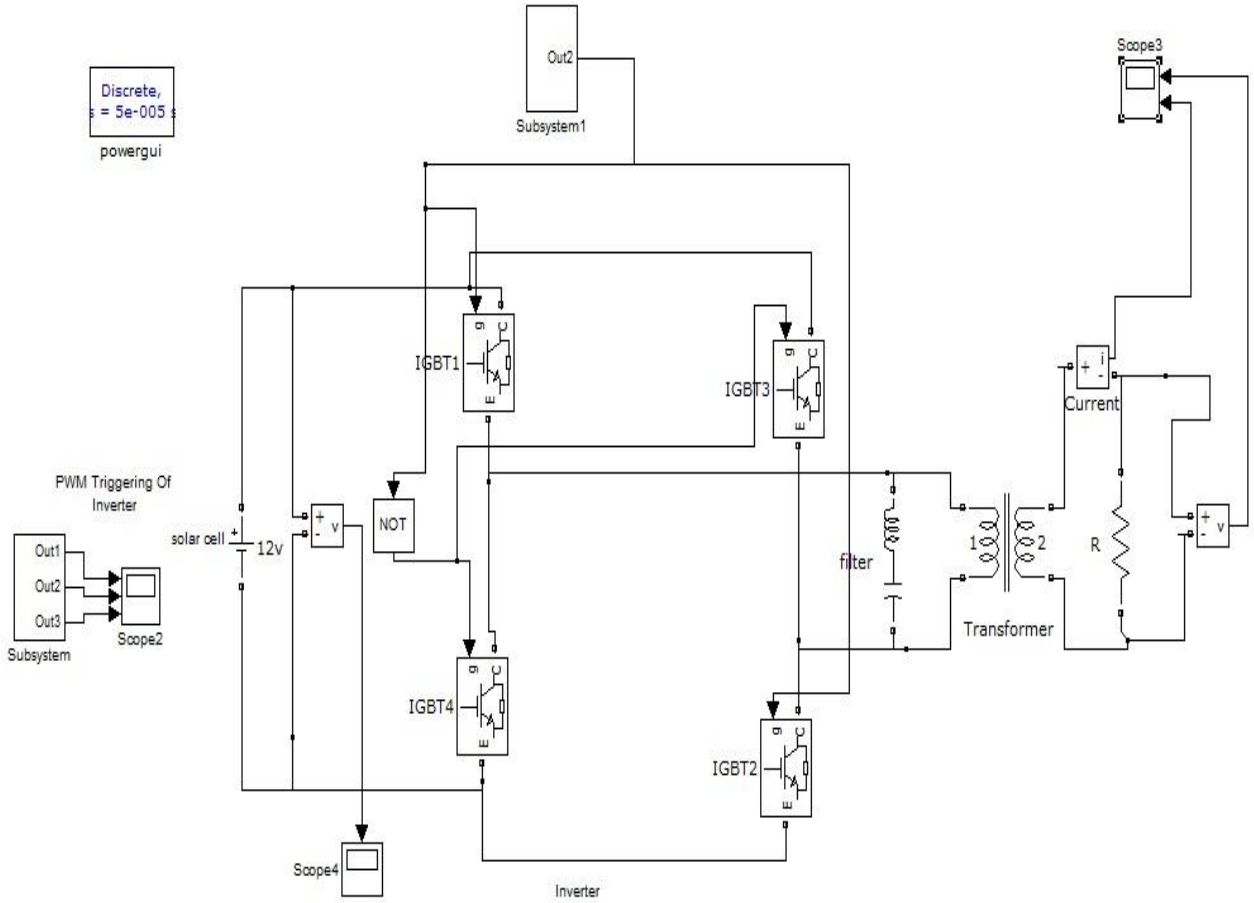

Fig.6

Simulation of Inverter

Fig shows simulation of inverter using four switching device and PWM method

Output of inverter not sinusoidal but using filter it is possible

Total Output Of Inverter.

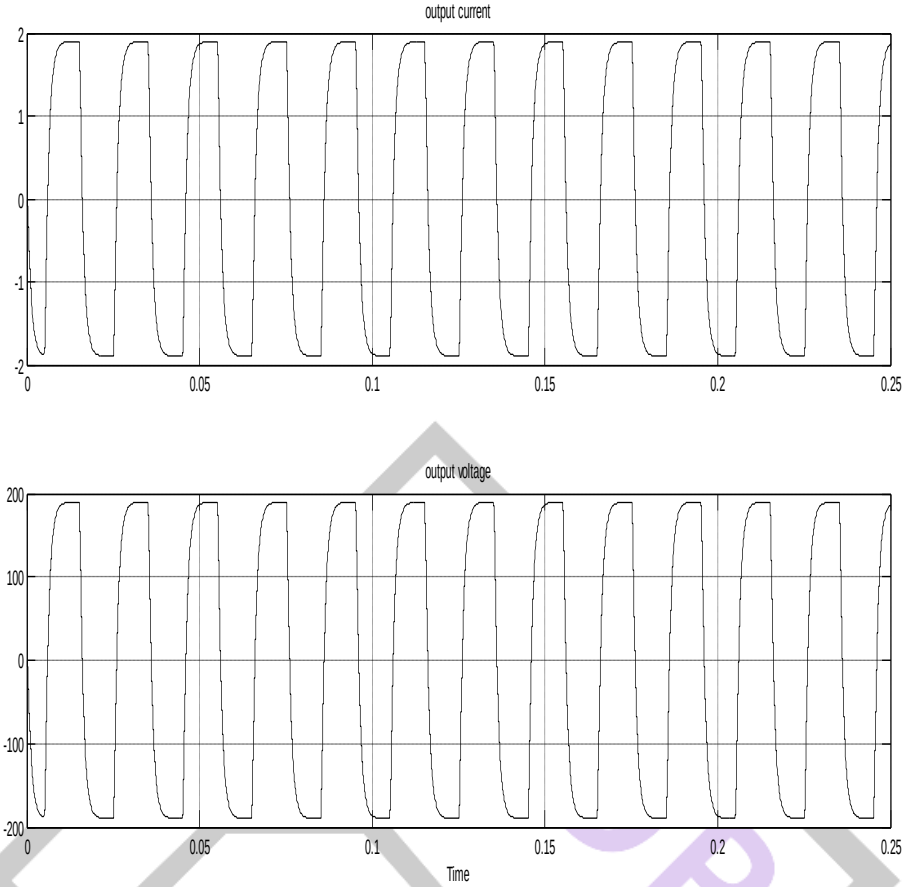

Fig.7 Output waveform of Inverter

5. Conclusion: - solar power while charging the battery. It senses the availability of solar power, grid power and gives charging preference to the solar power charge and only switches to the grid when the solar power is not available. It isdesigned to give maximum benefit from the sun and minimize your electricity bill.

6. Reference:-

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