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DESIGN AND IMPLEMENTATION OF SOLAR ENERGY WITH GRID INTERFACING

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***Abstract:* This paper proposes a grid interfaced solar photovoltaic power generating system consisting of photovoltaic cell, DC-DC boost converter, Inverter, Capacitor bank, transformer, single phase grid feeder. A reference grid current are taken from the single phase is given to microcontroller, which is used to detect zero crossing and auxiliary power supply to the microcontroller. Here we interface solar energy with grid taking frequency into consideration. We are using solar energy since it is one of the most renewable forms of energy which is found to be abundance in all part of the world. During peak hours voltage fluctuation problems occurs in the transmission line, at this condition the load get damaged. To avoid this battery is connected parallel to the solar panel.**

Key words: Energy Efficiency, Photovoltaic System, Renewable Energy

I. INTRODUCTION

Renewable energy systems such as photovoltaic power generation, wind power generation and fuel cells are receiving a huge attention globally. Eco friendly power generation is the best feature of renewable energy systems. Renewable energy systems emit no pollution into the atmosphere when they generate electricity. However, most power plants such as thermal power generation and nuclear power generation plants have produced most of the power supply. But, Thermal and nuclear plant establish a danger impacts in the world.. On the other hand, renewable energy systems are very clean on a large-scale from the perspective of return of investment. In this paper, we propose a management system to maximize the efficiency of a photovoltaic power system in application's aspect.

The combination of element technologies of renewable energy with commercial electricity result in high efficiency and positive results as described above.

However, while research on the element technologies have been studied well, studies on energy management with renewable energy are not relatively developed. In case of on-grid photovoltaic systems connected to commercial electricity grids directly through Inverters like in figure 1, power consumption can be decreased in buildings or homes, but there could also be energy loss when power consumption is very low or electricity price are cheap, and vice versa.

We are interfacing solar energy with grid. There are many types of renewable energy such as solar, wind, tidal etc., In our project we proposes solar energy since it is convenience for us.

The paper is organized as follows: Section 2 explains the boost converter section. Section 3 discusses the inverter section. Section 4 explains the transformer section. Microcontroller and grid section discussed in Section 5,6. In section 7 discusses the over all block diagram and explanation. Output and conclusions in Section 8 and 9.

II. BOOST CONVERTER SECTION

A DC-to-DC is an electronic circuit which converts a one level of voltage value to the other level voltage values. It is one type of power converters in power Electronics. DC to DC converters are important converter in the field of electrical, and it is used for various electronic devices. Such electronic devices contain several sub-circuits, each with its own voltage level requirement different from that supplied by the battery or an

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external supply (sometimes higher or lower than the supply voltage).

Additionally, the battery voltage declines as its stored power is drained. Compare than partially lowered battery, Switched DC to DC converters offer to increase voltage levels. At the same time saving space is another advantage, instead of using multiple batteries to accomplish the same thing.

In this project the converter helps to increase voltage levels from 12V to 24.6V

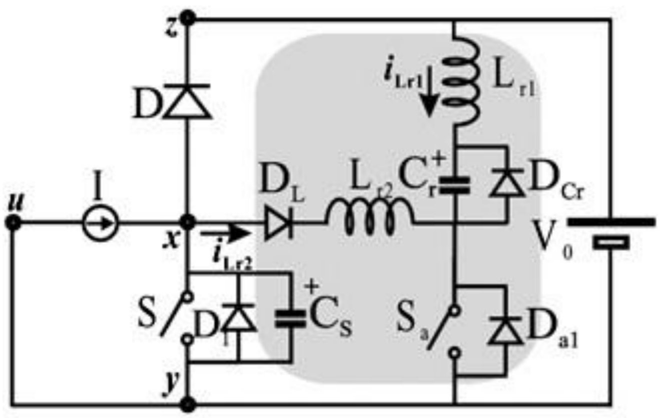


Figure 1: Boost Converter

III. INVERTER

In renewable systems (solar cell) the output is DC.It is modified to Ac by use of inverters. The output level of AC magnitude is small. For that, we are used transformer to increase the magnitude level.

The inverter usage will start from small level (like computers) to higher level (high voltages direct current transmissions).

Figure 2: Inverter

Here, the use of inverter is same to convert from DC to AC. The output of solar section is DC. This DC quantity is converted into AC. The output of the AC is interfaced with grid power (AC).

IV. TRANSFORMER

A transformer is an electrical device used to convert AC power at a certain voltage level to AC power at a different voltage, but at the same frequency. The transformer is based on the working principle of "Faradays Law of Electromagnetic induction". In this project, we used only the step down transformer not the step up transformer. Here we step down a 230V ac into 12V ac.

The supply is given to the primary of the transformer. The voltage induced in the secondary due to induction. In the secondary coil voltage is related with primary coil voltage with turns ratio. For example, if the primary coil have 100 turns and c 480 volts and a secondary coil is 25 turns, the secondary voltage is calculated by using the below relations.
Secondary voltage = (480 volts) * 0.25 = 120 volts

Figure 3: Transformer

Energy losses in transformers are due to a number of factors: these are copper losses in the coils themselves due to material resistance, core losses due to hysteresis eddy current (the reluctance of the material's magnetic domains to reverse during each electrical cycle).Step-down transformer form one phase is taken to give auxiliary supply to microcontroller and also to detect zero crossing to synchronize solar frequency with gridfrequency step up transformer is used to increase the voltage.

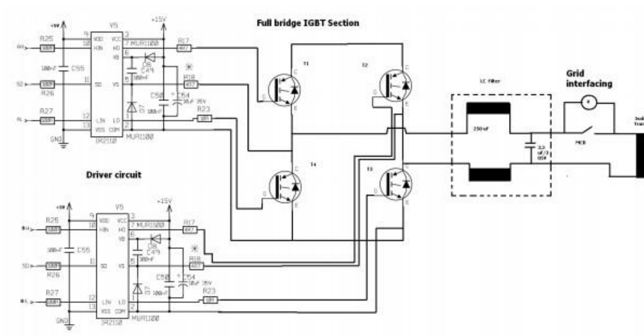


Figure 4: Transformer connection with the system

V. MICROCONTROLLER

In this project, the output is to synchronize the solar output and grid output. It is done by using the zero crossing method. The output of the microcontroller section is our required synchronization result. The comparison procedure is developed by coding and stored the microcontroller. The ATmega8L is a low-power CMOS 8-bit microcontroller is used in this project. A reference grid current are taken from the single phase is given to microcontroller, which is used to detect zero crossing and auxiliary power supply to the microcontroller.

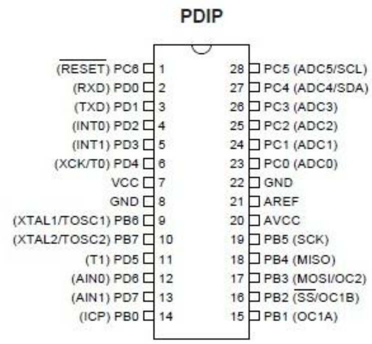


Figure 5: Microcontroller pin diagram

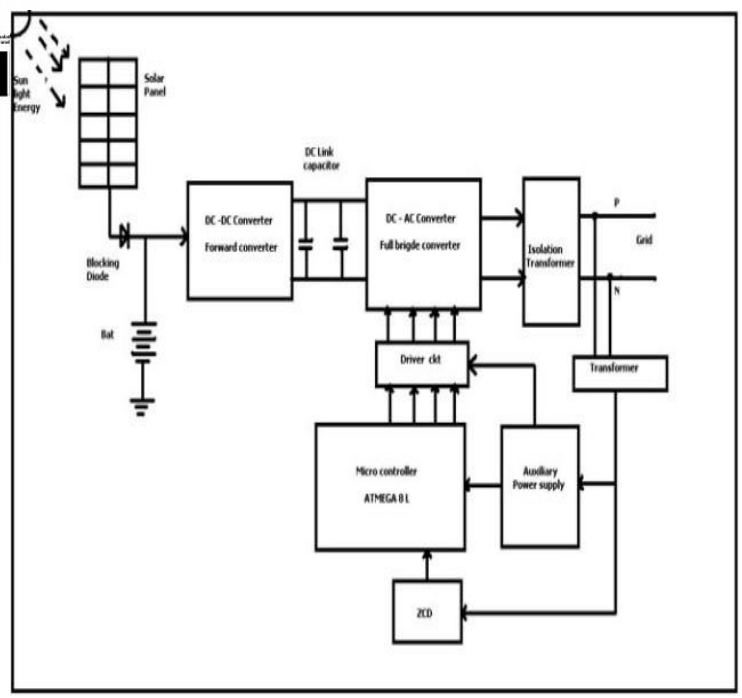
VI. GRID

Generally grid means interconnected substations. It is the junction between the two sub stations. If any one substation voltage value gets damaged due to some interrupted conditions, it give the same value without interruption.

Here, the output of solar panel DC is converted into AC .The output AC is interfaced with grid. The frequency matching is very important for solar grid interfacing. This is done by using the microcontroller.

In this project, 230Volts (AC) normal supply is considered for grid system.

VII. OVERALL BLOCK DIAGRAM



Voltage from solar panel is stored in a 12V battery is been given to the DC-DC boost converter. In the boost converter PTC coil is placed to avoid over voltage. The heat sink is provided for the MOSFET to avoid overheating. The driver circuit is used to switch ON & OFF the MOSFET. The output of the boost converter is 24.6V. The output of the boost converter is given to the Inverter through the capacitor bank. Microcontroller is used to synchronize solar frequency with grid frequency. Step-down transformer 230V to 12V is given to microcontroller for auxiliary power supply and for the detection of zero crossing. Output of the inverter is given to Step-up transformer to a manual breaker. This step-up transformer gives the output of 230V which is fed to the grid.

The overall developed circuit model is shown in the figure (6). The Expected synchronized output shown in the figure (7) also un synchronized waveform is shown in figure (8).The Digital Storage Oscilloscope was used to show the output results.

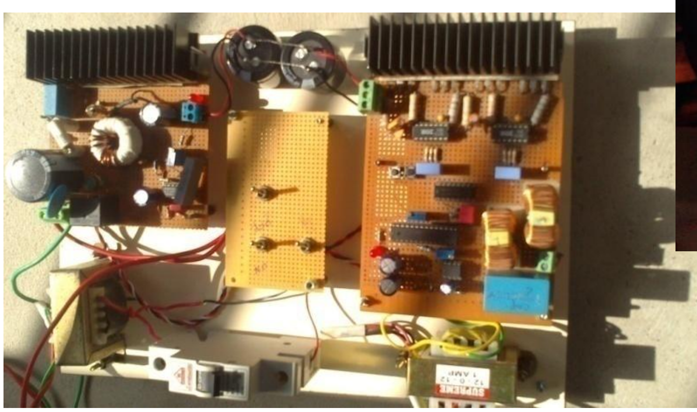


Figure 6: Overall circuit diagram

VIII. OUTPUT

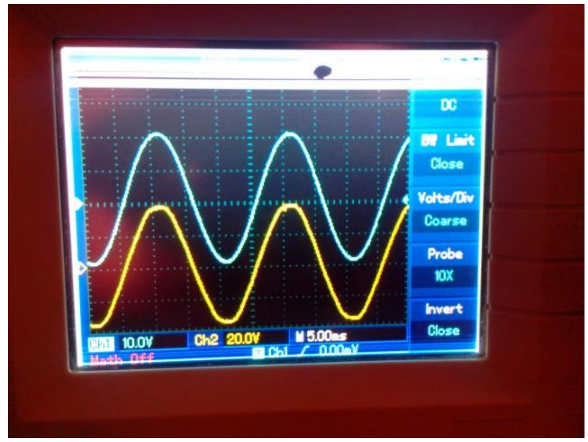


Figure 7: Synchronized wave form

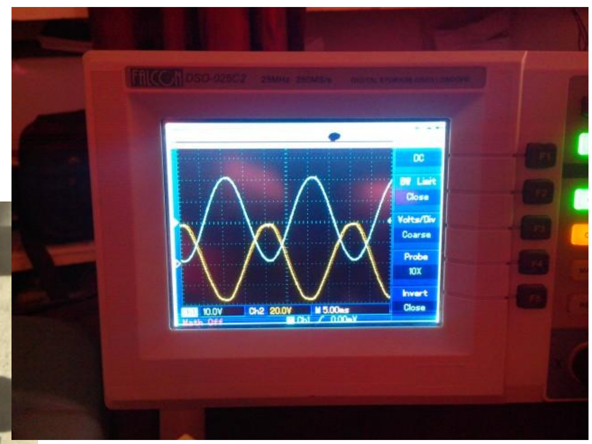


Figure 8: Unsynchronized wave form

IX. CONCLUSION

This paper presents that the interfacing of solar power with grid taking frequency into consideration. Synchronization is achieved for solar output frequency and gird frequency. Power is delivered to the grid by manual breaker. Microcontroller is used to check the frequency of grid and solar. And also detects zero crossing of the sine wave to drive the circuit.Unfluctuated load with synchronized frequency is been delivered to the grid.

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