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,, inverter, capacitor bank, transformer, single phase grid feeder. A reference grid are taken from the single phase is given to clamper circuit, which is used to detect zero crossing and auxiliary power supply to the Arduino. 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 parts 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 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.

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II. 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).

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).

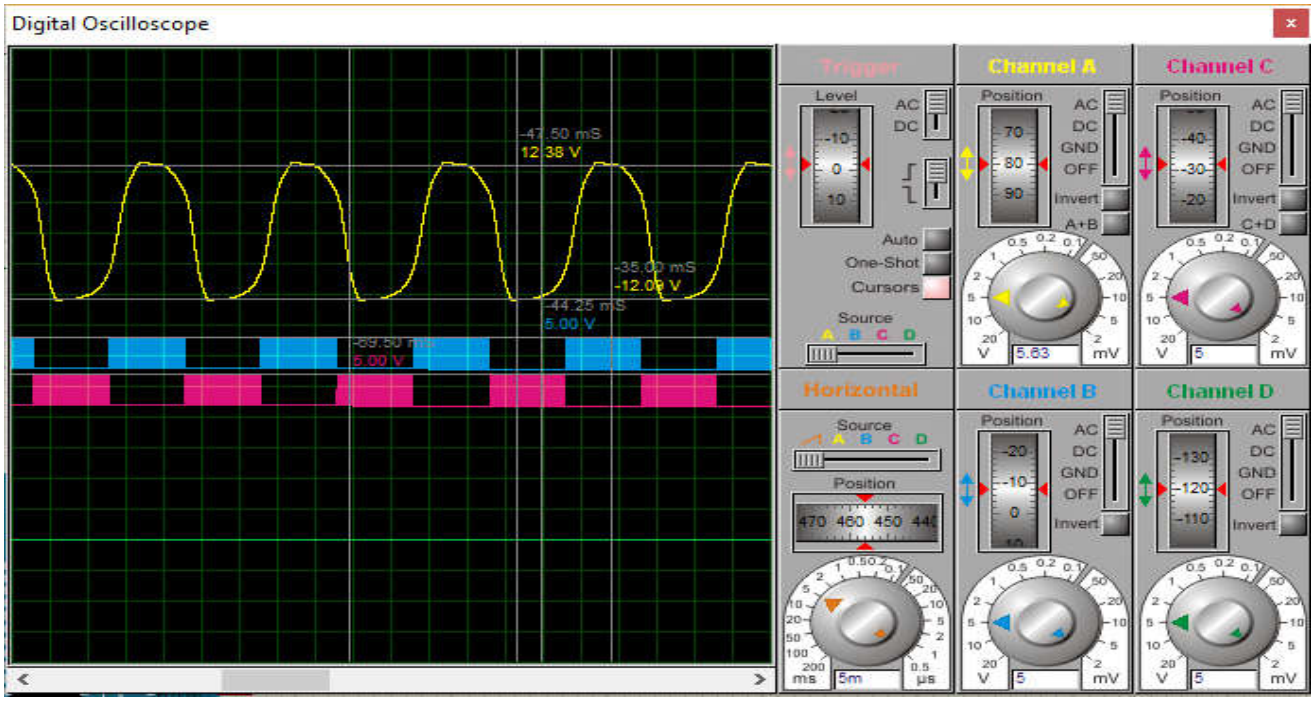

Figure 1: Inverter Output

III. CLAMPER CIRCUIT

A **clamper** is an electronic circuitthat fixes excursions of a signal to a defined value by shifting its DC value. The clamper does not restrict the peak-to-peak excursion of the signal, it moves the whole signal up or down so as to place the peaks at the reference level. A **diode clamp** (a simple, common type) consists of a diode, which conducts electric current in only one direction and prevents the signal exceeding the reference value; and a capacitor, which provides a DC offset from the stored charge. The capacitor forms a time constant with the resistor load, which determines the range of frequencies over which the clamper will be effective either the positive or the negative peak. Here we use the positive clamper.

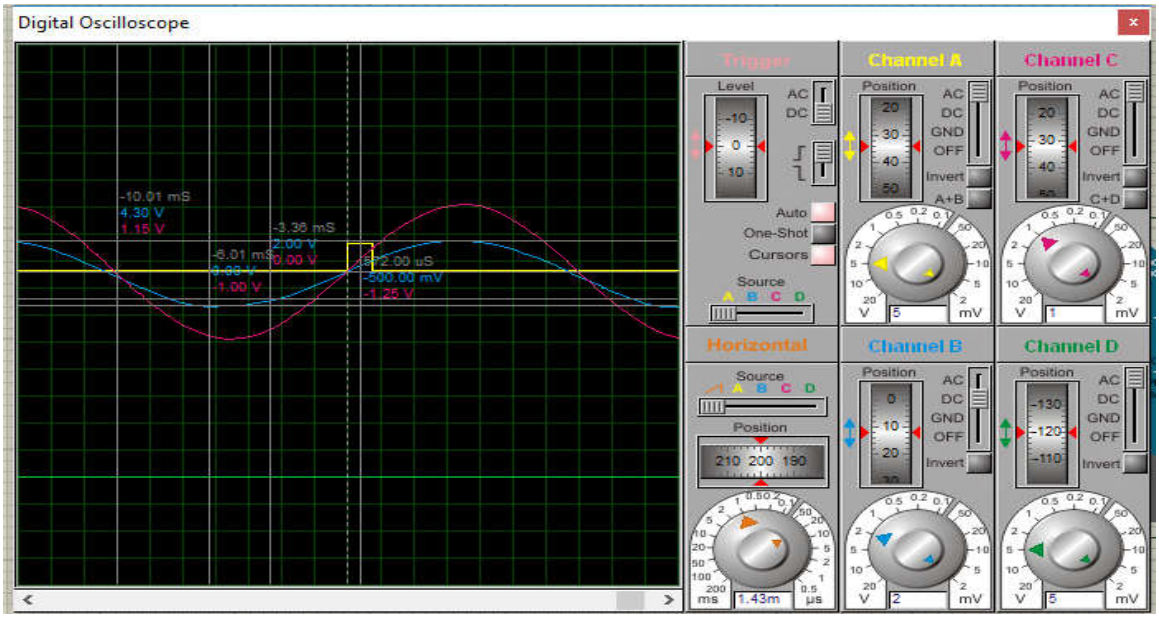

Figure 2: CLAMPER OUTPUT

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 up transformer not the step down transformer. Here we step up a 12V ac into 230V 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. 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).

V. ARDUINO

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world.

The *UNO* is the most used and documented board of the whole *Arduino* family. ... *Arduino Uno* is a microcontroller board based on the below specification

- Microcontroller:ATmega328
- Operating voltage: 5V
- Input voltage (recommended):7-12V
- Input voltage (limits):6-20v
- Digital I/O PINS: 14 (OF WHICH 6 PROVIDE PWM)
- Analog input pins: 6
- Dc current per i/o pin: 40 mA
- Dc current for 3.3v pin: 50mA
- Flash memory: 32 KB (ATmega328) of which 0.5KB used by bootloader
- SRAM: 2 KB (ATmega328)

- EEPROM: 1 KB (ATmega328)
- Clock Speed: 16MHz

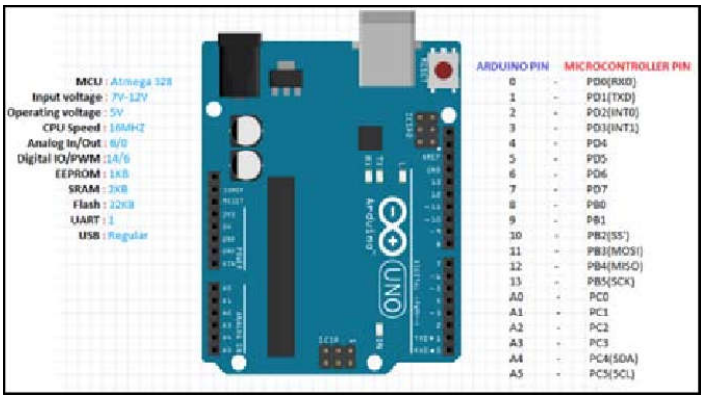

Figure 3: Arduino

VI. DRIVER IC IR2112

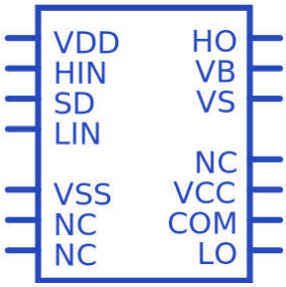

Figure 4: DRIVER IC IR2112

The IR2112 is a high voltage, high speed power MOSFET and IGBT driver with independent high and low side referenced output channels. Proprietary HVIC and latch immune CMOS technologies enable ruggedized monolithic construction. Logic inputs are compatible with standard CMOS or LSTTL outputs. The output drivers feature a high pulse current buffer stage designed for minimum driver cross-conduction. Propagation delays are matched to simplify use in high frequency applications. The floating channel can be used to drive an N-channel power MOSFET or IGBT in the high side configuration which operates up to 600 volts.

VII. OVERALL BLOCK DIAGRAM

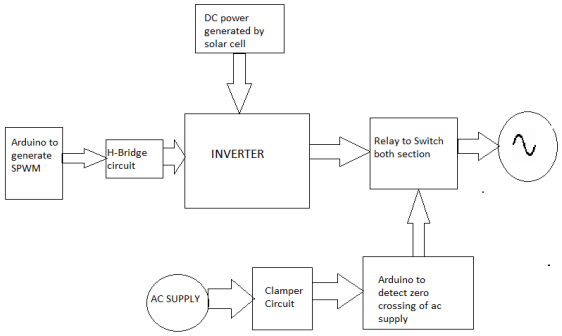

Figure 5: overall block diagram

Voltage from solar panel is stored in a 12V battery is been given to the inverter. The driver circuit is used to switch ON & OFF the MOSFET. Arduino is used to synchronize solar frequency with grid frequency. Step-up transformer 12V to 230V. Auxiliary power supply of 230V is given to the clamper circuit 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 Expected synchronized output shown in the fig 6.

The Digital Storage Oscilloscope was used to show the output results.

VIII. OUTPUT

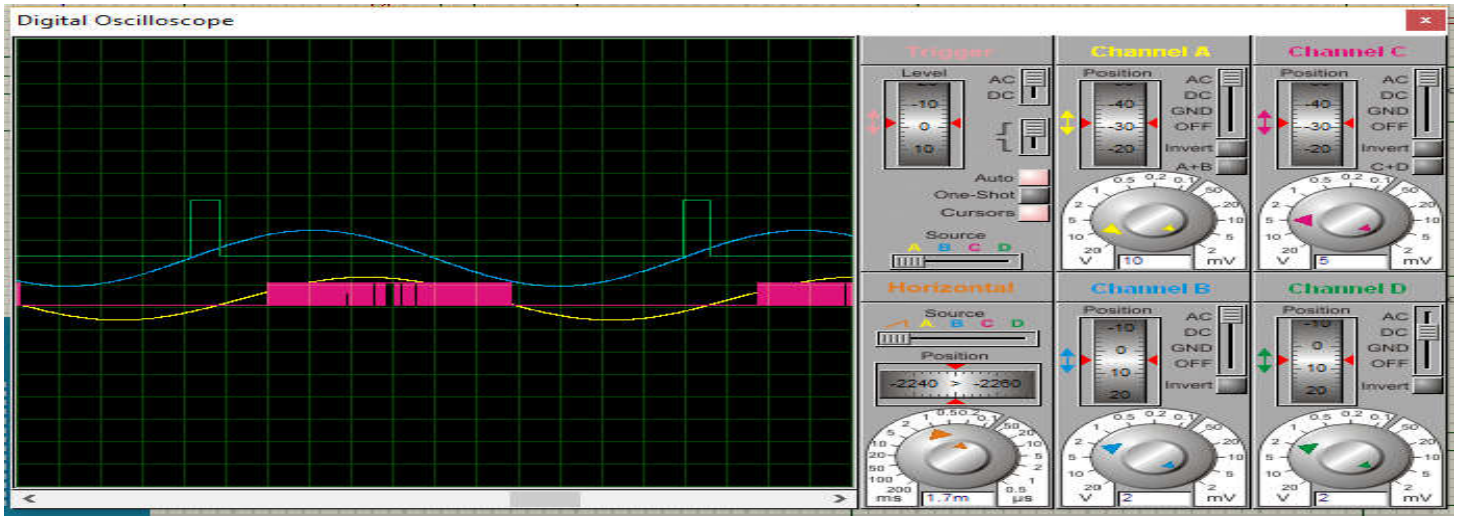

Figure 6: Synchronized wave form

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. Arduino is used to check the frequency of grid and solar. And also detects zero crossing of the sine wave to drive the circuit Un fluctuated load with synchronized frequency is been delivered to the grid.

X.REFERENCES

[1] P. Sung-Yeul, L. Jih-Sheng, and L. Woo-Cheol, "An easy, simple, and flexible control scheme for a three-phase grid-tie inverter system," in*Energy Conversion Congress and Exposition (ECCE), 2010 IEEE*, 2010, pp. 599-603.

[2] M. M. Amin and O. A. Mohammed, "Development of High- Performance Grid-Connected Wind Energy Conversion System for Optimum Utilization of Variable Speed Wind Turbines," *Sustainable Energy, IEEE Transactions on,* vol. 2, pp. 235-245, 2011.

[3] M. B. Nissen, "High performance development as distributed generation," *Potentials, IEEE,* vol. 28, pp. 25-31, 2009.

[4] J. Lee, B. Han, and K. Choi, "High-efficiency grid-tied power conditioning system for fuel cell power generation," in *Power Electronics and ECCE Asia (ICPE & ECCE), 2011 IEEE 8th International Conference on*, 2011, pp. 1492-1497.

[5] K. Touafek, M. Haddadi, and A. Malek, "Modeling and Experimental Validation of New Hybrid Photovoltaic Thermal Collector," *Energy Conversion, IEEE Transactions on,* vo. 26, pp. 176-183, 2011.

[6] A. O. Converse, "Seasonal Energy Storage in a Renewable Energy System," *Procedings of the IEEE,* vol. 100, pp. 401-409, 2012.

[7] X. Q. Guo and W. Y. Wu, "Improved current regulation of three-phase grid-connected voltage- source inverters for distributed generation systems," *Renewable Power Generation, IET,* vol. 4, pp. 101-115, 2010.

[8] S. Teleke, M. E. Baran, S. Bhattacharya, and A. Q. Huang, "Optimal Control of Battery Energy Storage for wind Farm Dispatching," *Energy Conversion, IEEE Transactions on,* vol. 25, pp. 787-794, 2010.

[9] H. C. Chiang, T. T. Ma, Y. H. Cheng, J. M. Chang, and W. N. Chang,"Design and implementation of a hybrid regenerative power systemcombining grid-tie and uninterruptible power supply functions,"*Renewable Power Generation, IET,* vol. 4, pp. 85-99, 2010.

[10] L. Zhigang, G. Rong, L. Jun, and A. Q. Huang, "A High-Efficiency PVModule-Integrated DC/DC Converter for PV Energy Harvest inFREEDM Systems," *Power Electronics, IEEE Transactions on,* vol. 26,pp. 897-909, 2011.

[11] Y. Zhilei, X. Lan, and Y. Yangguang, "Seamless Transfer of Single-Phase Grid-Interactive Inverters Between Grid-Connected and Stand-Alone Modes," *Power Electronics, IEEE Transactions on,* vol. 25, pp.1597-1603, 2010.

[12] S. Dasgupta, S. K. Sahoo, and S. K. Panda, "Single-Phase InverterControl Techniques for Interfacing Renewable Energy Sources WithMicrogrid--Part I: Parallel-Connected Inverter Topology With Activeand Reactive Power Flow Control Along With Grid Current Shaping,"*Power Electronics, IEEE Transactions on,* vol. 26, pp. 717-731, 2011.

[13] R. Bojoi, L. R. Limongi, D. Roiu, and A. Tenconi, "Enhanced powerquality control strategy for single-phase inverters in distributedgeneration systems," in *Industrial Electronics (ISIE), 2010 IEEEInternational Symposium on*, 2010, pp. 2727-2732.

[14] C. Yang and K. Smedley, "Three-Phase Boost-Type Grid-ConnectedInverter," *Power Electronics, IEEE Transactions on,* vol. 23, pp. 2301-2309, 2008.

[15] S. M. Alghuwainem, "Performance analysis of a PV powered DC motordriving a 3-phase self-excited induction generator," *Energy Conversion,IEEE Transactions on,* vol. 11, pp. 155-161, 1996.

[16] B. M. T. Ho, H. S. H. Chung, and W. L. Lo, "Use of system oscillationto locate the MPP of PV panels," *Power Electronics Letters, IEEE,* vol.2, pp. 1-5, 2004.

[17] H. Insung and P. Sehyun, "Flexible structural power monitoring devicewith clamp type CT sensors," in *Consumer Electronics (ICCE), 2011IEEE International Conference on*, 2011, pp. 311-312.