Synchronization of PV System With Power Grid

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Abstract : Creating electrical power from solar based vitality is extremely well known. There are numerous studies going for expanding the effectiveness and planning less difficult system. Electrical power produced by PV cells depend upon solar based irradiances, ambient temperatures and electrical load. To exchange most extreme accessible power from PV cells to the grid, Maximum Power Point Tracking (MPPT) calculations have been produced and actualized. In this examination, a less difficult single-stage single-phase grid connected system has been planned and observed. The proposed circuit does not require complex hardware and regulation strategies. Under various environmental conditions, the control unit forces the framework to work at the most extreme accessible power.

Index Terms—Maximum Power Point Tracking (MPPT), PV system, single stage, solar energy, MATLAB SIMULINK.

I. INTRODUCTION

Interest for energy is expanding each day. Finding new energy sources is very important factor. Among them, sustainable ones, for example, wind and sun based power, are well known and they are ecological cordial energy sources. For a few areas which get enough solar based irradiance, PV panels can be favoured for creating electrical power. The efficiency of the PV panels is around 25 %. At the point when the converter and different misfortunes are considering, the efficiency can be down to 16 % .
maximum available power from PV cells to the grid.

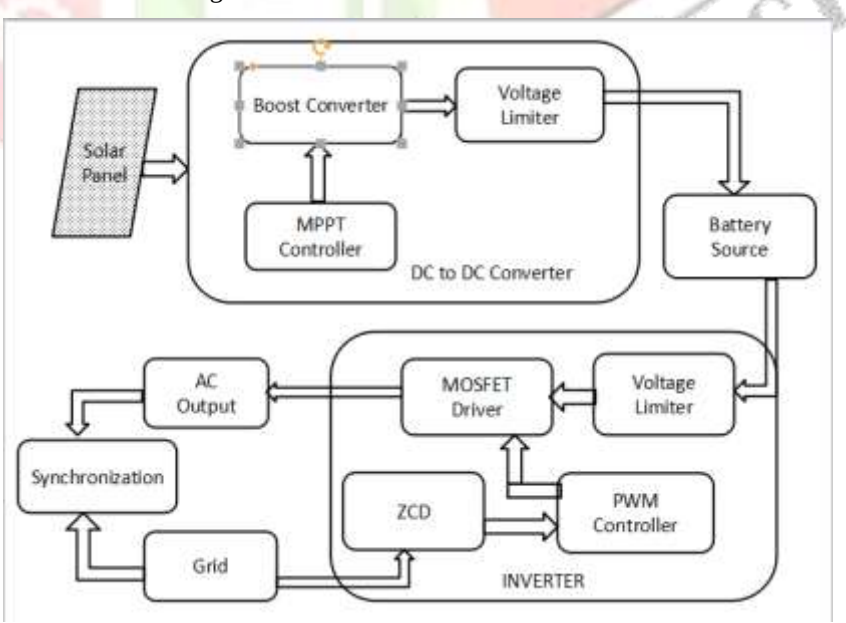

Figure 1. block diagram of the PV cell inverter system

Initial investment of PV frameworks is high. Keeping in mind the end goal to pay back itself inside a shorter time, the effectiveness should be expanded. First goal is to ensure the PV module is operated at the maximum power point (MPP)with the aid of the DC/DC

converter and MPPT. Second goal is to inject a sinusoidal current into the utility grid through the DC/AC inverter[1]. A typical PV framework comprises of dc/dc converter, voltage controller, inverter and batteries. Therefore, overall effectiveness progresses toward becoming lower. To increase the effectiveness and declines the initial capital, grid associated frameworks without batteries are favoured. PV cells can create distinctive power depending upon electrical loads at the same environmental condition. Hence, the generation of the greatest accessible power isn't ensured under every electrical load. To exchange greatest energy to the grid from PV cells, Maximum Power Point Tracking (MPPT) algorithms, for example, Incremental Conductance, Constant Voltage and Current are created. In this examination, a solitary stage system, which does not require complex hardware and modulation strategies, is presented. It is less complex than existing ones and furthermore it is capable for exchanging maximum available power from PV cells to the grid.

II. METHODOLOGY

A) SOLAR CELL MODELING

Solar cells made of a p-n junction fabricated in thin layer of semiconductors, whose electrical characteristics differ very little from a diode represented by the equation of Shockley. Thus the simplest equivalent circuit of a solar cell is a current source in parallel with a diode as shown in Fig. 2. So the process of modeling this solar cell can be developed based on Equation.[2]

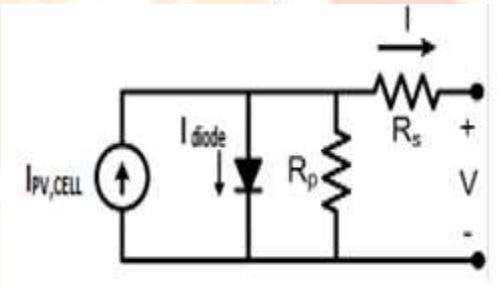

Figure 2: Equivalent Model of Solar Cell

$$I = I_{PV,CELL} - I_{DIODE} \quad (1)$$

$$I = I_{PV,CELL} - I_{O,CELL}[\exp\left(\frac{q+v}{\alpha+k+T}\right) - 1] \quad (2)$$

Where:

IP V ;CELL = Current generated by the incident light

IDIODE = Shockley diode

Io;CELL = Reverse Saturation or leakage current

q = Electron charge (1.6021*10-19)

k = Boltzmann constant (1.3805*10-23)

T = Temperature of the PN junction diode

α= Ideally constant (between 1 to 2)

B) Maximum Power Point Tracking (MPPT)

At the point when a solar based PV module is utilized as a part of a framework, its working point is chosen by the load to which it is connected. Also, since solar powered radiation falling on a PV module fluctuates for the duration of the day, the operating time of the module also changes for the duration of the day. Ideally under every single working condition, one might want to exchange

maximum power from a PV module to the load. Keeping in mind the end goal to guarantee the task of PV modules for maximum power transfer, an extraordinary technique called Maximum Power Point Tracking (MPPT) is utilized in PV system where, electronic hardware is utilized to ensure that most extreme measure of created power is exchanged to the load. The maximum power point tracking system makes utilization of an algorithm and an electronic circuitry. The mechanism depends on the guideline of impedance matching amongst load and PV module which is vital for maximum power transfer.

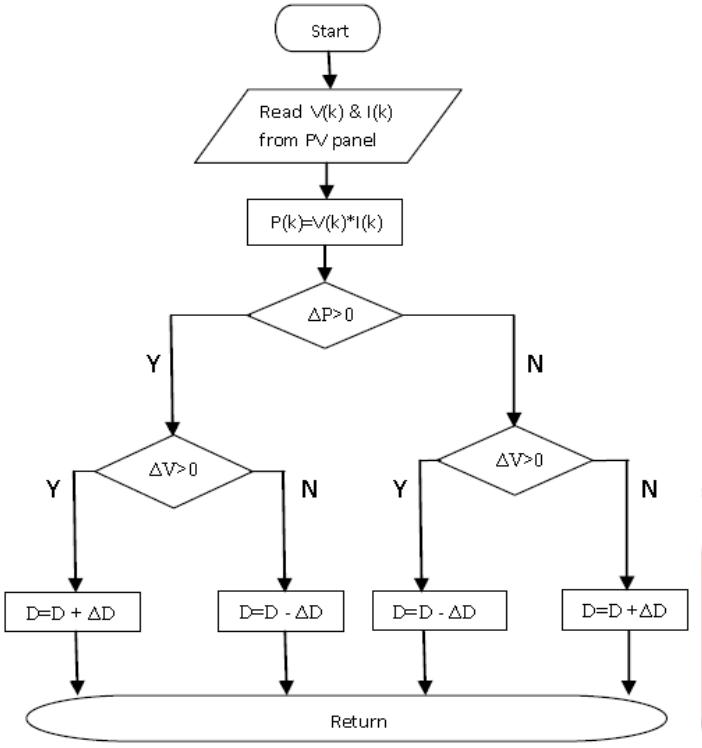

Figure 2: Flow Chart of MPPT

C) Inverter

Here the sine wave is 50hz it is our reference flag which is contrasted with a high recurrence saw tooth wave. With the goal that the yield state of PWM inverter is given:

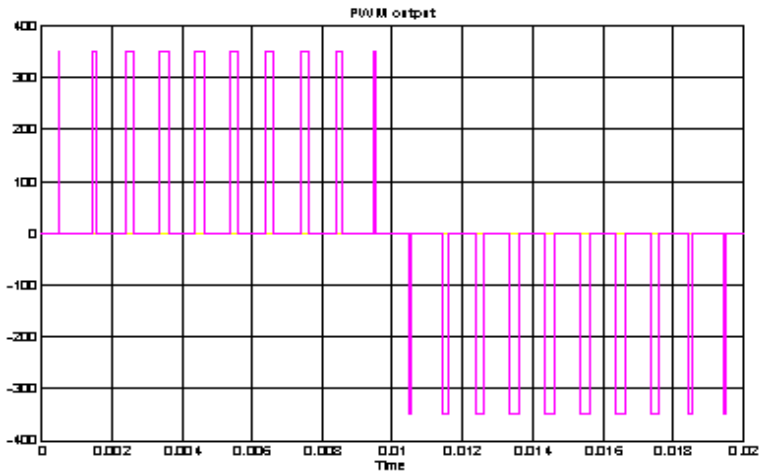

Fig. 5: PWM Inverter Output

Because of the fluctuating plenty fullness of the reference flag, the widths of the yield beats of PWM inverter is changed too, bringing about heartbeat widths that are relative to the adequacy of the reference flag wave. The PWM based voltage source dc to air conditioning inverter in MTALAB [SIMULINK] display.

I. SIMULATION SYSTEM

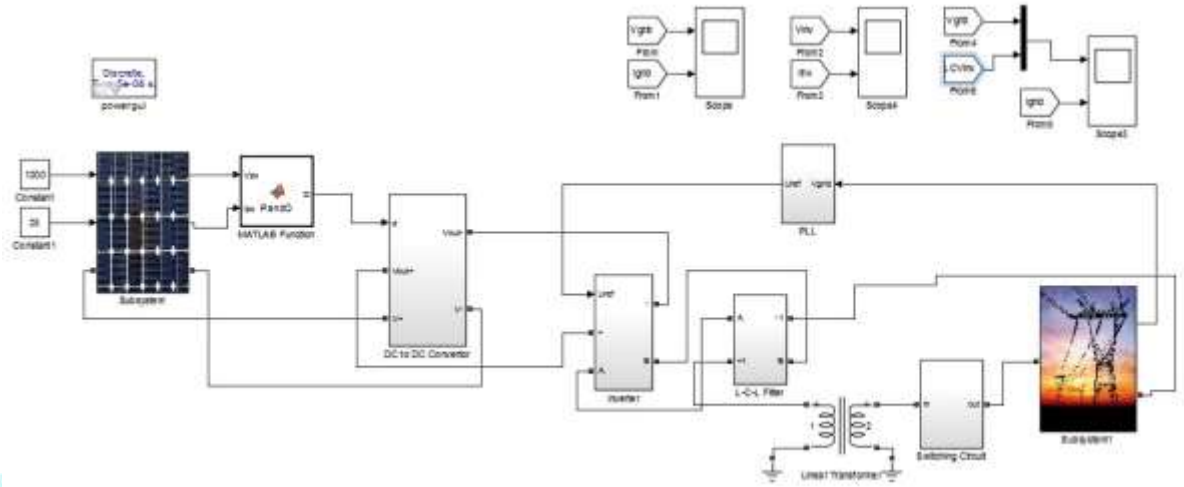

Fig. 7: Simulation of Solar Cell Inverter Synchronization with Grid

II. RESULT

In this model photovoltaic system using single phase inverter synchronization with utility grid on the use of PLL algorithm. On the voltage and current synchronization with the frequency on MATLAB Simulink. as well as same system are develop on hardware, in the hardware single phase inverter output is square wave signal this is not a pure sinusoidal, the pure sinusoidal waveform are develop using LC filter this output wave form of single phase inverter tie with grid this because of ZCD this is result of that system.

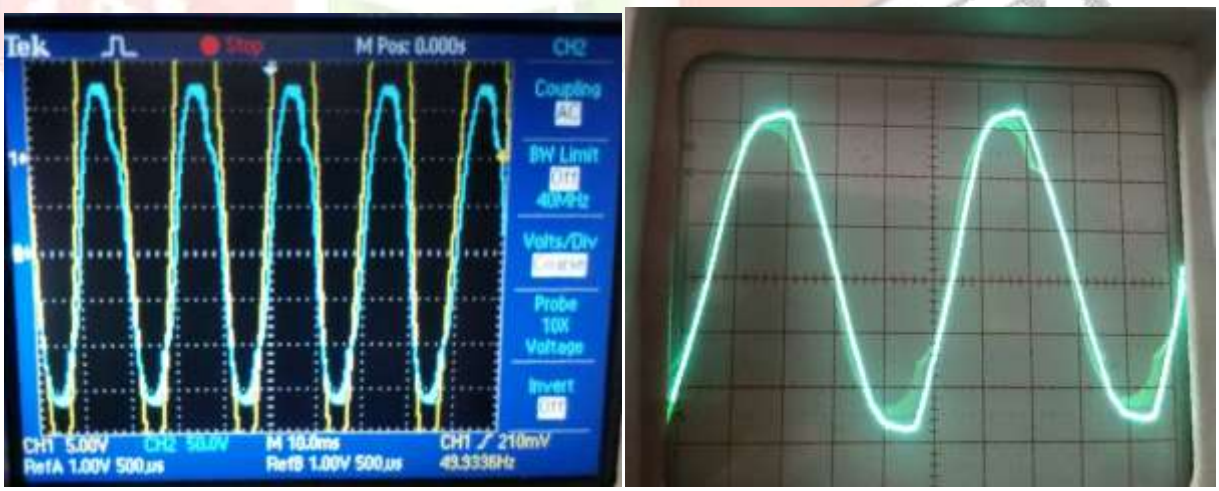

Figure 4. System output results on CRO

III. CONCLUSIONS

A single phase inverter with DC-DC boost converter for solar powered PV framework with wide input voltage range is designed and modeled in MATLAB/SIMULINK condition and actualized as an equipment in PCB. The simulation result demonstrates that the DC-

DC boost converter could manage the variable supply. The DC input voltage from the solar oriented PV and keep up it at DC voltage regardless of supply voltage varieties. The inverter arrangement effectively changes over the DC voltage to AC voltage. The circuit is actualized as a hardware on a PCB board and the output waveforms are confirmed on a CRO. The hardware result demonstrates that the DC-DC boost converter could support DC input voltage. The inverter stages effectively changes over the DC voltage to AC voltage. pure sinusoidal wave was gotten by passing the output through a filter.

IV. REFERENCES

[1] Adel A. Elbaset, Hamdi Ali And Montaser Abd El SattarDesign And Performance Of Single-Phase Grid Inverter PhotovoltaicSystem For Residential Applications With MaximumPower Point Tracking 2016 IEE.

[2] Akash Khokhariya, Mayur Rana, Nisarg Patel, HirenJariwala Utilization Of Solar Energy With Linear Load-Volume 7 Issue No. 2 2017 IJESC

[3] Preethi, L. And Ramya Rani, N. Solar PV And BatteryStorage Integration Using Three-Level NPC Inverter InternationalJournal Of Innovation Sciences And Research Vol.5,No, 04, Pp.714-718, April- 2016.

[4] Lenos Hadjidemetriou, Elias Kyriakides, YonghengYang and Frede Blaabjerg ”A Synchronization Method forSingle-Phase Grid-Tied Inverters” IEEE TRANSACTIONSON POWER ELECTRONICS, VOL. 31, NO. 3, MARCH2016.

[5]Frede Blaabjerg, Remus Teodorescu, Marco Liserre andAdrian V. Timbus ”Overview of Control and Grid Synchronizationfor Distributed Power Generation Systems” IEEETRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL.53, NO. 5, OCTOBER 2006.

[6] Bidyadhar Subudhi and Raseswari Pradhan ”A ComparativeStudy on Maximum Power Point Tracking Techniquesfor Photovoltaic Power Systems” IEEE TRANSACTIONS ONSUSTAINABLE ENERGY, VOL. 4, NO. 1, JANUARY 2013.

[7] R. Geetha And V. Jayachitra Simplified Reactive PowerControl For Grid-Connected Photovoltaic Inverters IndianJournal Of Science And Technology, Vol 8(13), July 2015.

[8] S. Surendra Babu1, Md. Shariff Modeling And SimulationOf Renewable Energy Source Fed Isolated Full-BridgeConverter Issn 2319-8885 Vol.04,Issue.36, September-2015.

[9] Lenos Hadjidemetrious,EliasKyriakides,Yonghang Yangand Frede Blaabjerg ASynchronizationM”

[10] Natarajan Pandiarajan, Ramabadran Ramaprabha, AndRanganathmuthu Application Of Circuitmodel For PhotovoltaicEnergy Conversion System Hindawi Publishing CorporationInternational Journal Of Photoenergy Volume 2012,Article ID 410401.

[11] Atul Gupta, Anurag Porippireddi, Venu Uppuluri Srinivasa,Akash Sharma, Mangesh Kadam Comparative StudyOf Single Phase PLL Algorithms For Grid SynchronizationApplications IJECT Vol. 3, Issue 4, Oct - Dec 2012.

[12] Uday B.Mujumdar , D.R.Tutakne Pll For Grid SynchronizationOf Single Phase Distributed Generation SystemE-Issn:2278-1676,P-Issn: 2320-3331, Volume 11, Issue 5 Ver.Iii (Sep - Oct 2016).

[13] S.M.A.Faisal Model Of Grid Connected PhotovoltaicSystem Using Matlab/Simulink Journal Of Electrical Engineering.

[14] A.Shanmughapriya, P.Saranya, S. Angeline Sreeja SynchronizationOf Power From Grid And Pv System With MpptBased On Incremental Conductance Technique Volume: 03Special Issue: 07 — May-2014.

[15] Alias Khamis, Azah Mohamed, Hussain Shareef, AfidaAyob, Mohd Shahrieel Mohd Aras Modelling And Simulation of A Single Phase Grid Connected Using PhotovoltaicAnd Battery Based Power Generation 978-1-4799-2578-0/1331:002013.

[16] Mayur Rana, Nisarg Patel, Hiren Jariwala Single PhaseGrid-Connected Photovoltaic System With Maximum PowerPoint Tracking Vol-3 Issue-4 2017.