International Journal of Electrical and Electronics Engineers
Vol. No. 9, Issue No. 01, January-June 2017
ISSN (O) 2321-2055
ISSN (P) 2321-2045

GRID SYNCHRONISED PV-SYSTEM ANALYSIS &CHARACTERISTICS FORNON LINEAR LOADS AND ANALOMOUS SITUATIONS

R. Hothri[1], G.V. Prasanna Anjaneyulu [2]

[1] Asst. Professor, [2] Assoc. Professor, EEE Department, Tirumala Engineering College, Narasaraopet, Guntur District, A.P., (India)

ABSTRACT

This work manages a solitary stage single stage multifunctional framework interfaced sun powered photovoltaic (SPV) framework. The single stage topology used in the network associated PV framework has the upsides of high productivity and ease contrasted and the two phase topology the essential capacity of the lattice associated inverter in a solitary stage SPV framework is to supply dynamic power into load and matrix. A slope climbing MPPT controller is utilized for following the most extreme power from photovoltaic exhibit under framework anomalous conditions. The PV cluster is associated with voltage source converter (VSC) through DC connect. The MPPT controller gauges reference PV voltage and relating PV control. A PLL-less control is utilized for control of multifunctional VSC. The voltage source converter (VSC) controller utilizes the heap and PV forward terms for quick element reaction. The execution of the SPV framework is investigated under matrix anomalous conditions (sudden hang and swell). The recreation studies are performed on MATLAB/SIMULINK.

Keywords— *Photo Voltaic, PLL, Solar PV system, MPPT, VSC.*

I. INTRODUCTION

Present days the cost of sun based vitality diminished and the cost of fossil energizes expanded. Along these lines, the world's moved towards the sun powered photograph voltaic (SPV) vitality framework. The utilization of renewable vitality Sources are expanding step by step. These sources are perfect, contamination free, and unlimited.Notwithstanding, effective use of sun oriented vitality is extremely testing issue amid framework associated mode and islanding mode. By utilizing MPPT controller, to remove the greatest use of force from PV exhibit amid network associated mode and islanding mode. Distinctive MPPT controllers have been proposed by the numerous analysts. Annoy and watch, incremental conductance strategies are for the most part utilized in light of utilizations. In this work slope climbing MPPT controller [10] is utilized, to gauge the most extreme voltage and greatest power. It is the mix of annoy and watch strategy and incremental conductance technique.

International Journal of Electrical and Electronics Engineers
Vol. No. 9, Issue No. 01, January-June 2017
ISSN (O) 2321-2055
ISSN (P) 2321-2045

Thus, the structure of circulation framework is changes step by step. On the off chance that directs loads, voltage control and circulation misfortunes are the fundamental concerns. Be that as it may, expanding power converters in the dissemination framework are bringing about the genuine power quality issues [8].

Routinely, two phase PV framework is utilized to associate PV exhibit to circulated control framework. To start with stage DC to DC converter is utilized, to control the greatest power purpose of PV exhibit by utilizing MPPT controller and to exchange vitality to second stage converter. The second stage DC to AC converter is utilized, to create a yield current in stage with matrix voltage and to acquire a solidarity control calculate. The principle favorable position of this topology is less demanding controller is plan and two converters have autonomous control objectives. Be that as it may, this framework has a poor proficiency, because of countless, exorbitant size, substantial hold up and high cost. In any case, this work manages a solitary stage single stage multifunctional network interfaced sun oriented photovoltaic framework under matrix strange conditions [1].

II. CONFIGURATION OF SPV& CONTROL

Synchronized Grid SPV framework appeared in Fig 1. SPV framework comprises of photovoltaic (PV) exhibit, a solitary stage H-connect VSC, an interfacing inductor, a swell channel, single stage network and load. PV exhibit creates the power when it is presented to light. PV cluster yield is encouraged to the VSC. The H-connect VSC bolsters the SPV vitality into network and load. Interfacing inductor retains voltage contrast between the VSC yield and matrix. Swell channel is associated parallel to the lattice. It retains the exchanging music at purpose of normal coupling (PCC).

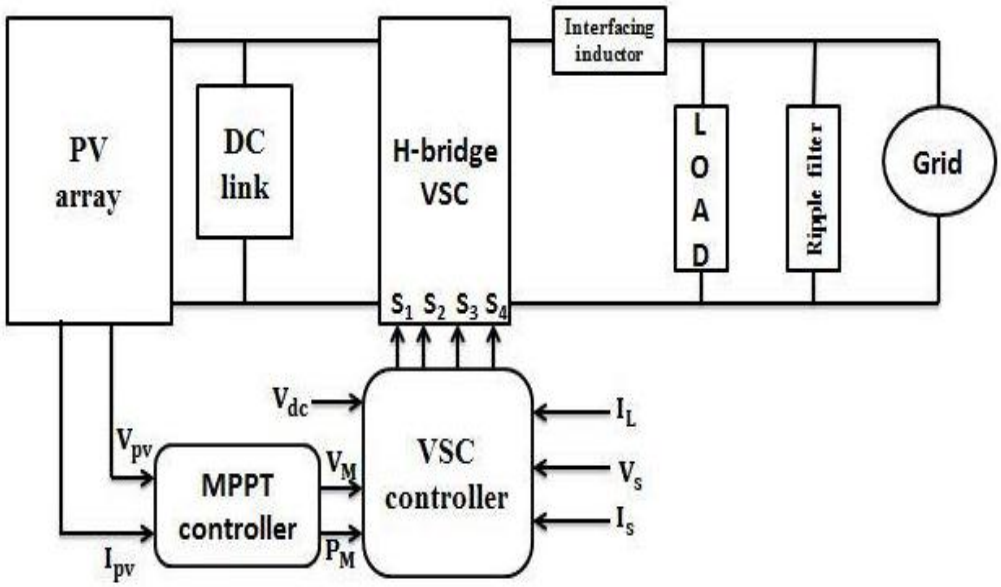

Figure 1. Grid Synchronized SPV System

2.1. SPV CONTROL

Grid Synchronized SPV framework comprises of a two control calculation. One is MPPT controller and another is VSC controller. A slope climbing MPPT controller is utilized to separate the most extreme power and voltage

International Journal of Electrical and Electronics Engineers
Vol. No. 9, Issue No. 01, January-June 2017
ISSN (O) 2321-2055
ISSN (P) 2321-2045

from PV exhibit. It is clarified in area A. A PLL less control is utilized to control the multifunctional VSC. VSC control is clarified in area B.

2.1.1. Most extreme Power Point Tracking Controller

In this work, a slope climbing MPPT controller is utilized for the effortlessness. When all is said in done, all the MPPT controllers apprise the obligation cycle for concentrate the most extreme working point. In this MPPT controller evaluate the greatest power and most extreme voltage from PV exhibit.

In the event that the power yield of PV cluster is expanded then the working point is irritated in same bearing and if the power yield of PV exhibit is diminished then the working point is annoyed backward course. The greatest power point (MPP) is separated by keeping the SPV string voltage to (voltage relating to most extreme power point). The yield of MPPT controller is the reference PV cluster voltage. PV exhibit voltage set to reference voltage with the assistance of PI (relative essential) controller. PV exhibit is straightforwardly associated with the VSC through DC connect appeared in Fig.1. Hence reference PV cluster voltage additionally equivalent to DC interface voltage. The reference DC voltage persistently balanced as for surrounding conditions. The reference DC-connect voltage is equivalent to under enduring state conditions.The MPPT controller estimates the reference PV array voltage (or DC link voltage) which is then given to the VSC control algorithm.

2.1.2. VSC Controller

A PLL less control is utilized to control the multifunctional VSC and is shown in Fig.3.

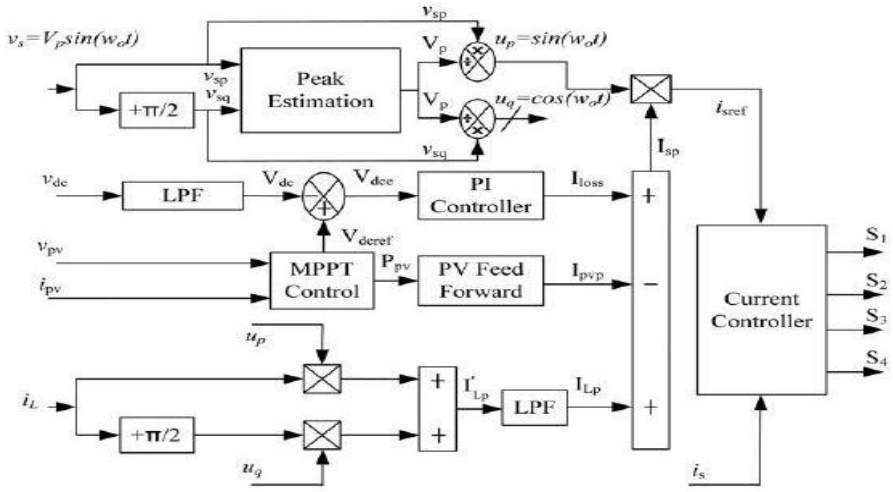

Figure.2: PLL Less VSC control Scheme

Multifunctional VSC supporting a few capacities, for example, keeping up DC connect voltage equivalent to MPPT evaluated voltage, repay the responsive power, moderation of music and bolstering SPV vitality into framework at solidarity control considerAn aggregate of six amounts are measured which are network voltage, lattice current, stack current, PV exhibit voltage, PV cluster current and DC interface voltage. Network voltage is part into two amounts with 90^0phase lead.

International Journal of Electrical and Electronics Engineers
Vol. No. 9, Issue No. 01, January-June 2017
ISSN (O) 2321-2055
ISSN (P) 2321-2045

III. SIMULATION RESULTS

The framework associated SPV framework is recreated in MATLAB Simulink. The execution of matrix associated SPV framework is examined under various working conditions and distinctive stacking conditions (straight and nonlinear). In the event of straight loads, the voltage source converter (VSC) conveyances the responsive power required for the heap and dynamic power from PV cluster. If there should arise an occurrence of non-straight loads, the VSC supplies all sounds required by the heap and VSC nourishes the dynamic power from PV cluster. The execution of SPV framework broke down under various burdens and irradiance changes alongside matrix anomalous conditions (voltage sag/swell).

3.1. Performance of SPV system under linear loads

Fig.3(a-b) Shows the harmonic analysis of grid current for linear loads& nonlinear loads respectively for same rating.

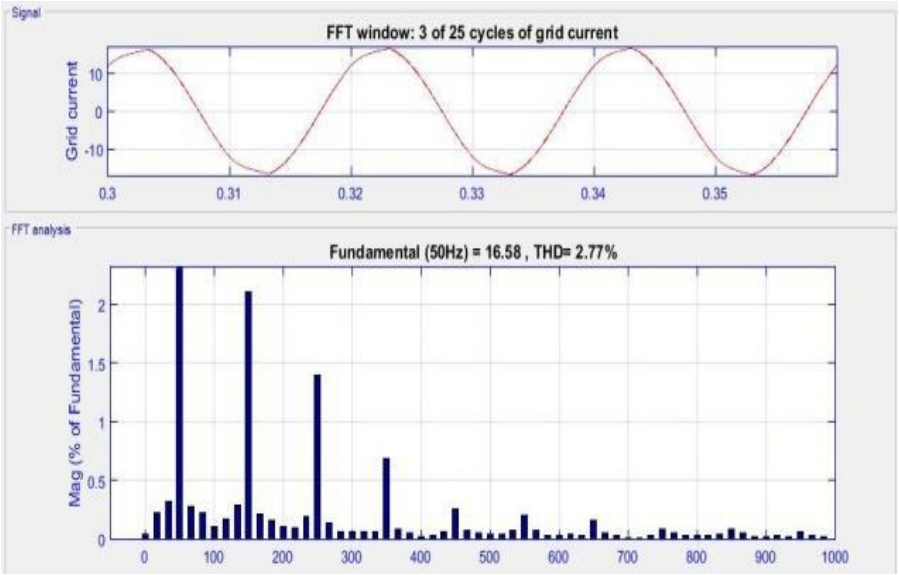

Figure.3.a. Grid current THD Analysis for linear loads

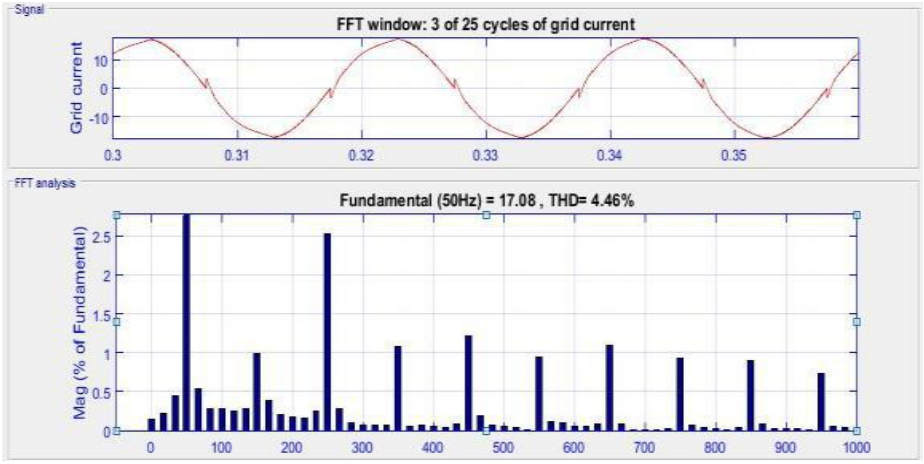

Figure.3.b. Grid current THD Analysis for non- linear loads

International Journal of Electrical and Electronics Engineers
Vol. No. 9, Issue No. 01, January-June 2017
ISSN (O) 2321-2055
ISSN (P) 2321-2045

Fig. 4(a) shows the grid voltage & currentfor linear loads. Fig. 4. (b). shows grid voltage & current for nonlinear loads.

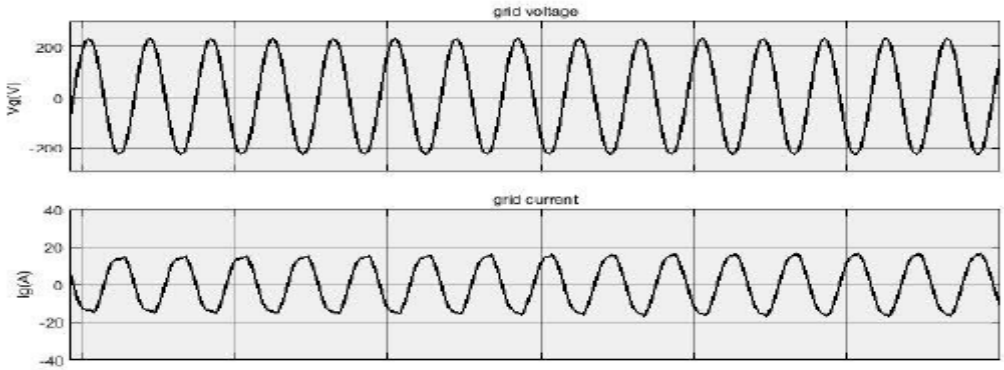

Figure.4.a. Grid voltage & current for linear loads

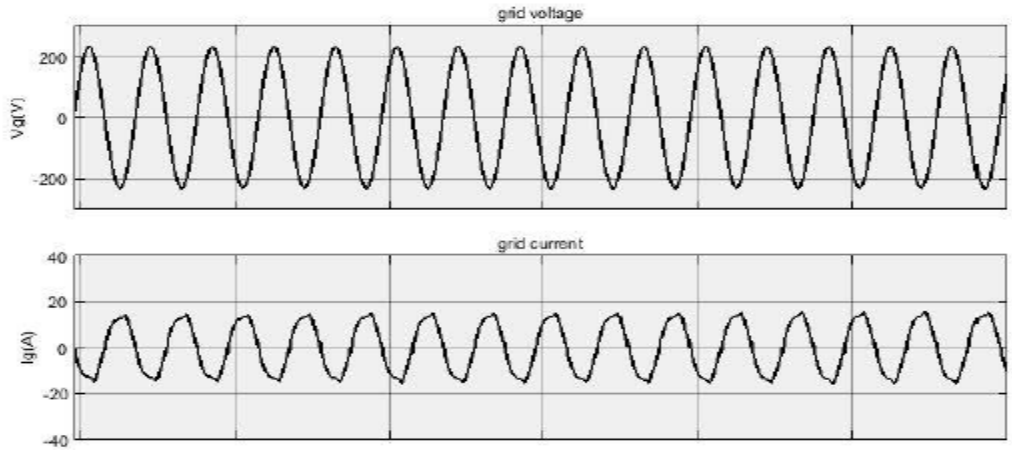

Figure.4.b. Grid voltage & current fornonlinear loads

Fig. 5-a shows Grid voltage & current under sudden voltage sag. Fig. 5-b shows Grid voltage & current under sudden voltage swell.

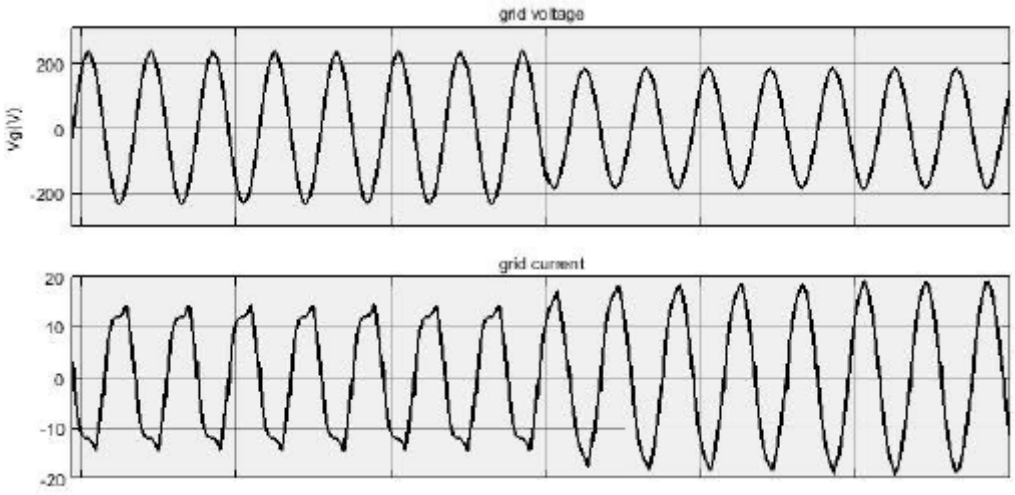

Figure.5.a. Grid voltage & current under sudden voltage sag

International Journal of Electrical and Electronics Engineers
Vol. No. 9, Issue No. 01, January-June 2017
ISSN (O) 2321-2055
ISSN (P) 2321-2045

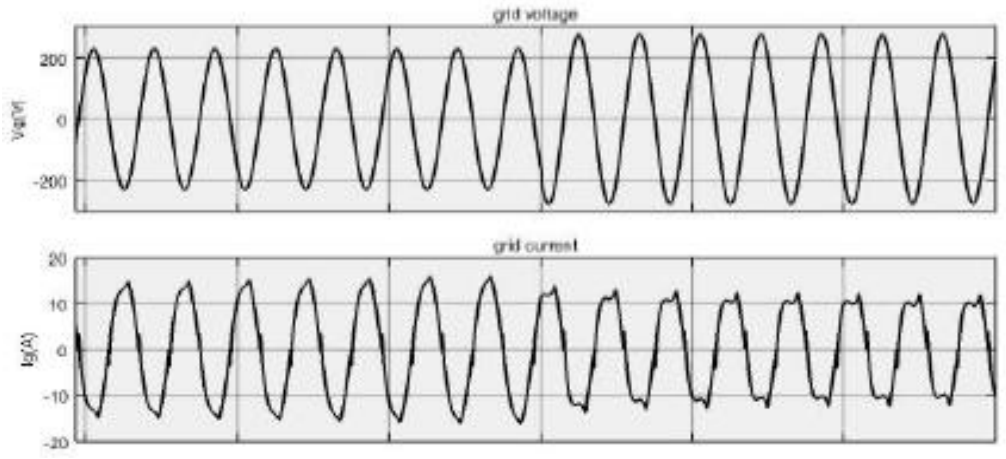

Figure.5.b. Grid voltage & current under sudden voltage swell

IV. CONCLUSIONS

A solitary stage single-stage multifunctional matrix interfaced SPV framework is reproduced for nourishing sun oriented PV vitality into the circulation arrange, which helps in lessening the dissemination line misfortunes. A PLL-less control is reenacted for control of multifunctional VSC which is recreated under anomalous matrix conditions (voltage droop/swell).Multifunctional VSC likewise enhanced the receptive power pay and consonant relief. The matrix current THD is seen beneath 5% (as indicated by IEEE-519 standard) even with nonlinear burdens at purpose of normal coupling (PCC). The execution of matrix interfaced SPV framework is reenacted on MATLAB based stage.THD analysis under linear and nonlinear loads is shown in the following Table. 1.

	%THD – Linear Loads	**%THD – Non Linear Loads**
Grid Current	2.72	4.46

APPENDIX

Simulation parameters: Single-phase grid voltage = 230V, frequency= 50Hz, supply inductance=2.42 mH and supply resistance=0.76Ω, interfacing inductance= 3.5 mH, Ripple filter R=5Ω, C=5μF, Kp=0.5, Ki=0.1, open circuit voltage=450V, short circuit current=10A, Peak power=4.15KW.

REFERENCES

[1]. Chinmay Jain, Bhimsingh, "Single-phase single-stage multifunctional grid interfaced solar photo-voltaic system under abnormal grid conditions," IET Gener. Trans. Distr., vol. 9, Issue. 10, pp. 886-894, 2015.

[2]. Alajmi.B.N, Ahmed.K.H, Adam.G.P, Williams.B.W, "Single-phase single-stage transformer less grid-connected PV system," IEEE Trans. Power Electron., vol. 28, no. 6, pp. 2664–2676, 2013.

[3]. SagarDeo, Chinmay Jain, Bhim Singh, "A PLL-Less Scheme for Single-Phase Grid Interfaced Load Compensating Solar PV Generation System," IEEE Trans. on Industrial Informatices, vol. 11, no. 3, June 2015.

[4]. Singh, B., Jain, C., Goel, S, "ILST control algorithm of single-stage dual purpose grid connected solar PV system," IEEE Trans. Power Electron., vol. 29, no. 10, pp. 5347–5357, 2014.

[5]. Popescu, M., Bitoleanu, A., Suru, V.: „A DSP-based implementation of the p-qtheory in active power filtering under nonideal voltage conditions" , IEEE Trans.Ind. Inf., vol. 9, no. 2, pp. 880–889, 2013.

[6]. Kumar, C., Mishra, M.K.: „A multifunctional DSTATCOM operating under stiff source" , IEEE Trans. Ind. Electron., vol. 61, no. 7, pp. 3131–3136, 2014.

[7]. Geury, T., Pinto, S., Gyselinck, J.: „Three-phase power controlled PV current source inverter with incorporated active power filtering" . Proc. of Industrial Electronics Society (IECON)., pp. 1374–1379, 2013.

[8]. Kim, J.-H., Lee, S.-w., Lee, S.-R., Lee, T.-W., Won, C.-Y, "Power quality control using the Goertzel algorithm for grid-connected system," Proc. Of Telecommunications Energy Conf. (INTELEC)., pp. 1–3, 2009.