iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 3 Issue: XII Month of publication: December 2015

DOI:

Volume 3 Issue XII, December 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

A Multi- Input Single Switch (MISS) Battery Charger

P.Durga Prasad[1], J.Hemasunder[2]
[1] P.G Student, [2] Asst. professor , EEE Department
Gudlavalleru Engineering College, Gudlavalleru, AP, India.

Abstract: - Non conventional power and storage have made DC based domestic distribution an smart choice for future homes. This paper proposes Multi-Input-Single Switch (MISS) battery charger for DC nanogrids, instead of using different dedicated converters. The main aim of this work is to design a single stage boost converter with multiple inputs that can efficiently charge a battery for DC nano grids. The output of the converter is directly connected to a battery to save an additional converter stage for each source. Due to low power rating of the system, it is very important to minimize number of converter stages and use the generated energy efficiently. From various unidirectional renewable energy sources, different dedicated converters used, so this paper proposes a multiple input with a single stage boost converter that can efficiently destroy generated energy to charge a battery, Non conventional energy sources will have profitable value when some of the other sources are not great enough to command a dedicated converter. The converter is called Multi-Input-Single Switch (MISS) converter. The converter varies the duty cycle based on finest operation of the major power source (e.g., MPP in case of solar panel), where as the other smaller unidirectional sources act as slave. PV Module Maximum Power Point Tracker (MPPT) is a photovoltaic system that uses the photovoltaic array as a source of electrical power supply. Every photovoltaic (PV) array has an optimum operating point, called the maximum power point, which varies depending on cell temperature, the insulation level and array voltage. The function of MPPT is needed to operate the PV array at its maximum power point. Here Incremental conductance method can find the MPPT accurately; Incremental conductance method can track the MPPT at changing atmospheric conditions and efficiency also improved. The simulations are performed by using MATLAB/Simulink.
Index Terms -Multi Input Single Switch (MISS), DC grid, Battery Charging, Step-Up Converter, Multi-port, PV Module,MPPT, Incremental Conductance, PV cell, Algorithm.

I. INTRODUCTION

For stability in supply of power with non-conventional renewable energy sources, a storage component is a must. It is useful to make the distribution voltage and battery voltage to be the same in a small power system like nanogrids to recover efficiency of power usage. This will also reduce further stage of conversion between the battery and the DC nanogrids. an additional factor that improves efficiency is: more the distribution voltage (V_d) less is the current for the equal power level. Consequently, a boost stage between the solar panel and distribution bus is advantageous. Solar energy has the compensation of maximum reserve, inexhaustibleness, and is free from environmental restrictions, thus building PV technology a popular research topic.
MPPT or Maximum Power Point Tracking is algorithm that included in charge controllers used for extracting maximum available power from PV module under certain environment. The voltage at which PV module can generate maximum power is called „maximum power point" (or peak power voltage). Maximum power changes with solar radiation, ambient temperature and solar cell temperature. MPPT checks output of PV module, compares it to battery voltage then fixes what is the best power that PV module can produce to charge the battery and converts it to the best voltage to get maximum current into battery. It can also supply power to a DC load, which is connected directly to the battery. MPPT algorithm can be applied to both buck and boost power converter depending on system design. Normally, for battery system voltage is equal or less than 48 V, buck converter is useful. On the other hand, if battery system voltage is greater than 48 V, boost converter should be chosen.
The Maximum Power Point Tracking (MPPT) is generally used as online control strategy to track the maximum output power operating point of the Photovoltaic generation for different operating condition of insolation and temperature of the Photovoltaic generation. The study of developing a PV charging system for Li-ion batteries by integrating MPPT and charging control for the battery is reviewed. The different types of non isolated Dc-Dc converters for the photo voltaic system.Finest operating performances by various converter topologies are one of the main points which can be brief in this research work. It concludes that the best type of

Volume 3 Issue XII, December 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

converter for PV system is the buck-boost Dc/Dc converter.

DC-DC converters can be used as switching mode regulators to convert an unregulated dc voltage to a regulated dc output voltage. The regulation is normally achieved by PWM at a fixed frequency and the switching device is generally BJT, MOSFET or IGBT. There are several types of dc-dc converters, buck, boost, buck-boost topologies, have been developed and reported in the literature to meet variety of application specific demands. The important requirement of any DC–DC converter used in the MPPT scheme is that it should have a low input current ripple. Buck converters will produce ripples on the PV module side currents and thus require a larger value of input Capacitance on the module side.

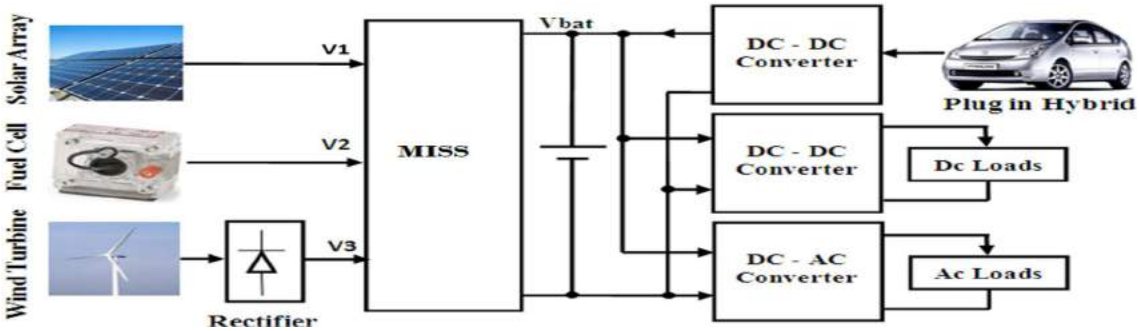


Fig. 1. Multi-Input Single Switch Application

The majority of the researches have addressed the multi-source power utilization trouble by using independently controlled converters. That means, the source and grid have a committed converter between them. This option is quite good for advanced power installations. However, in a nanogrids where the power generation is restricted and the sources have restricted output, these options may not be the most capable ones as more converters will degrade efficiency and reliability.

In the proposed concept looks at an alternate circuit to understand a power electronic interface for nanogrids, with multiple unidirectional input sources and a single output. The converter structure is realized using a single master control with several sources of relatively smaller power rating. The output of the converter is directly connected to a battery to save an additional stage as well as MPPT control. Thus, the battery bus and the DC distribution bus are the same.

II. MULTI-INPUT SINGLE SWITCH (MISS) TOPOLOGY

The overall topology is derived from boost Converter as shown in Fig. 2. There is a Master source S_1 (can be voltage or current source) and N-l slave sources S_2 to Sn are interfaced to the drain of the control switch through dedicated inductors. The converter topology is referred to as Multi Input Single Switch(MISS) due to the fact that the master source is always in control of the duty.

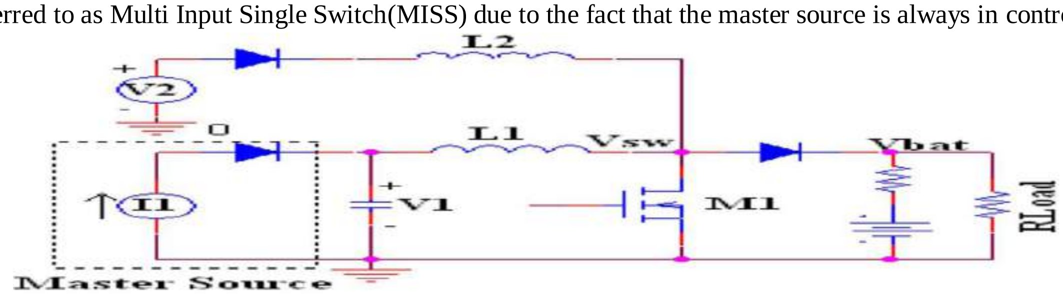


Fig. 2. Multi Input Single Switch (MISS) Boost Converter

The Master Source S $_1$ fixes the duty cycle of switch M_l based on the MPP operating point of the input source, if input is a solar panel. [n this case the current is used to charge the battery as well as supply the loads connected to this bus. In case of a voltage source, the output current of the boost can be controlled. The loads are connected to the battery bus directly or through an interface converter. As the converter topology is based on boost converter output voltage is always greater than input voltage for the operation of the converter.

Volume 3 Issue XII, December 2015
ISSN: 2321-9653

Depending upon the characteristics of the sources connected to the converter it can be classified either as a voltage or a current source. The possible combinations for a two input MISC Converter with current and voltage sources are as shown in Fig. 4.It is important to note that all the common renewable sources are unidirectional in nature and should be interfaced with a diode. When a current source is interfaced to the converter, a capacitor is used at the input terminal as can be seen from Fig. 4. This capacitor is required to meet the ripple requirements of the converter input current. When the source has a voltage source property, an input capacitor is avoided as it will invariably force the capacitor voltage to become equal to the master source terminal voltage due to duty constraint.

III. MODES OF OPERATION

The different modes of operation of MISS converter is as outlined in Table I.

TABLE.I
Modes of Operation

Modes	Modes of Operation	
	Master Source	Slave Source
MODE 1(CSVS)	Current Source(CS)	Voltage Source(VS)
MODE 2 (CSCS)	Current Source(CS)	Current Source(CS)

All the modes given in fig. 4 and fig.5 are valid if the basic constraint of output voltage being greater than input voltage is satisfied. Note that the output of the converter is connected to a battery in parallel to a resistive load. The resistive load represents the load on the DC bus. All the operating modes explained below are very much dependent on the design of input inductor.

A. Mode 1

Current Source and Voltage Source (CSVS) as shown in Fig. 3, when a current source is the master source and voltage source acts as a slave source there are two operating scenarios possible which is explained below as two sub-modes. The duty ratio for these modes is fixed by the current source.

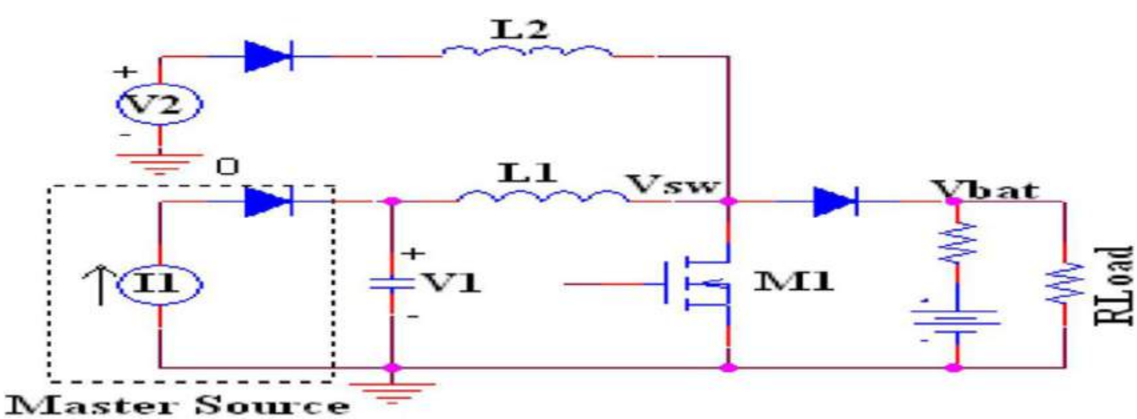


Fig. 3. Mode.(1)Current and Voltage Source Inputs Source (CSVS)

1)Sub-Mode l(A): $V_1 > V_2$: When the input voltage of the master source is greater than that of the slave sources there will be 3 operating intervals for MISC converter, as shown in Fig. 5 (a), Fig. 5 (b), and Fig. 5 (c).

Volume 3 Issue XII, December 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

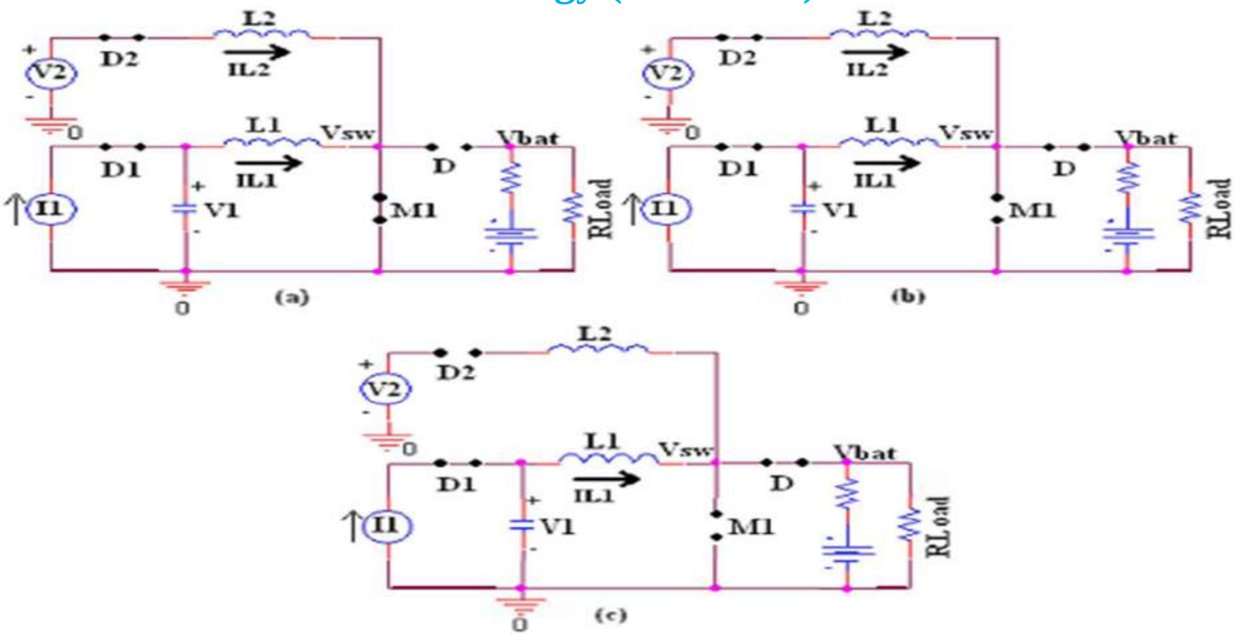


Fig.4. Operating Intervals when Current and Voltage Sources are used: (a) When Ml is on,(b) when Diode D is on, and (c) Input Diode D_2 is off

For a properly designed inductor, the current through the inductor (L_l) of master source will be in CCM. Therefore, for a similar or smaller value of inductor (L_2), the current from voltage source is forced to be in DCM. Assuming the L_2 to be smaller is reasonable as the power rating of the slave source is not high. The inductor Current waveforms IL_l and IL_2 are as shown in Fig. 5 (a).

2) Sub-Mode l(B): V_1 :s $V_{2:}$ When the master source terminal voltage is equal to that of the slave source, both the input currents are ideally in CCM. However, this may not be possible all the time, as the second source is assumed smaller.

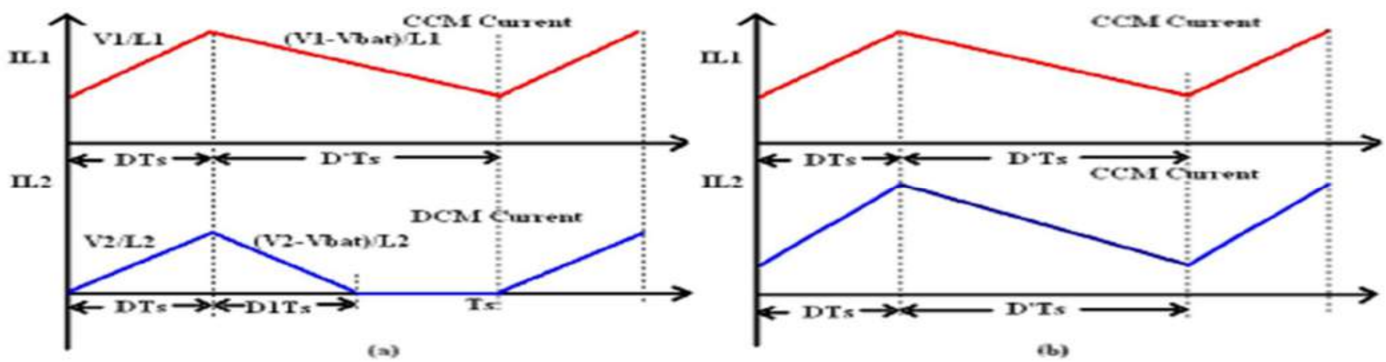


Fig.5. Inductor current Waveforms (a) Sub-Mode I(A), and (b) Sub-Mode 1(B).

This may lead to the second source working under current limit. Similarly, if slave source voltage is larger, for same duty cycle as the master, its current will invariably reach current limit. Therefore, all that can be said about this mode is that, in a practical scenerio, the slave source works under current limit. (b) Indicates the state of operation before the source current reaches its limit. When the slave source reaches current limit the inductor current waveform depend on the characteristics of source such as type of source, source impedance etc.

B. Mode 2: Current Source and Current Source(CSCS) in this mode both inputs of the two input MISC converter are connected to current sources (shown in Fig. 6.The terminal voltages V_1 and V_2 will be forced to become equal by the duty ratio of the switch controlled by master source. The equivalent circuits under this mode of operation are as shown in Fig. 7(a) and Fig. 7 (b). The normal operation of the converter is valid when input inductors and capacitors are selected properly.

Volume 3 Issue XII, December 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

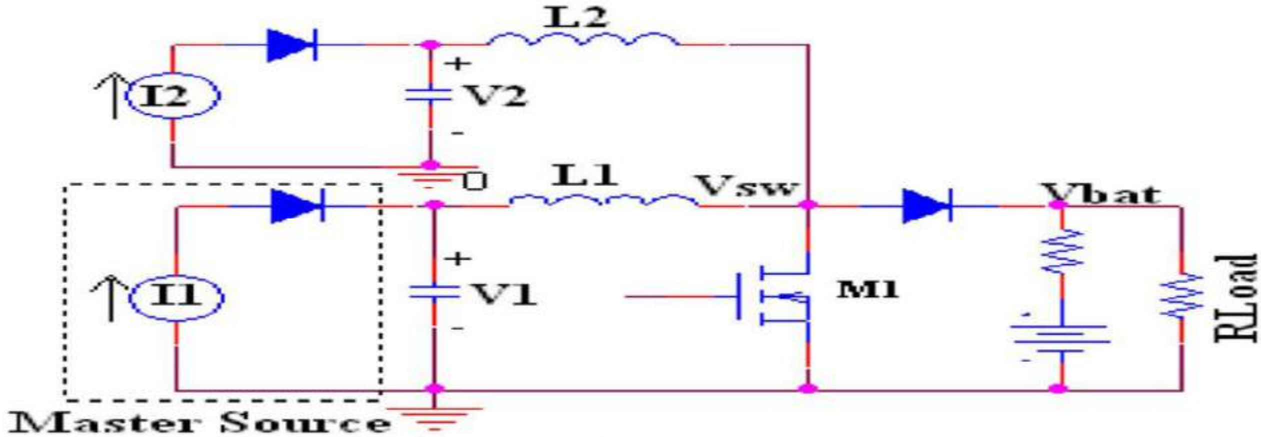


Fig. 6. Mode.(2) Current and Current Source Inputs,

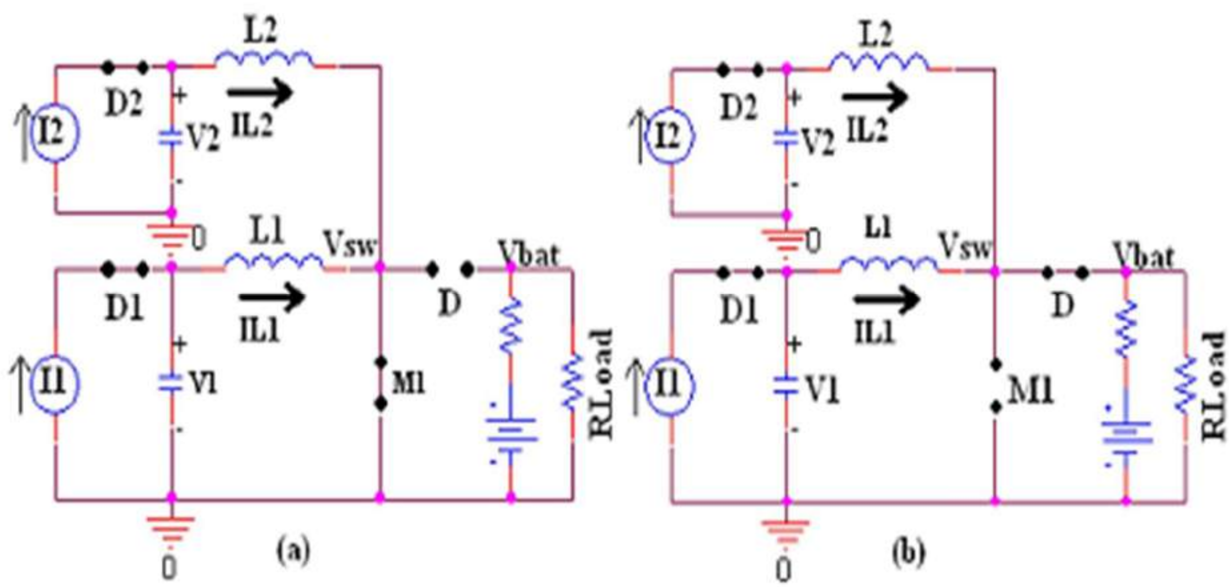


Fig. 7.Operating Intervals when both inputs are current sources: (a) whenMl is on, and (b) when Diode D is on.

The average current drawn from the current source 12 is positive but the negative portion of the current indicates that inductor current I_{Ll} is charging the input capacitor of slave source 12 every switching cycle.

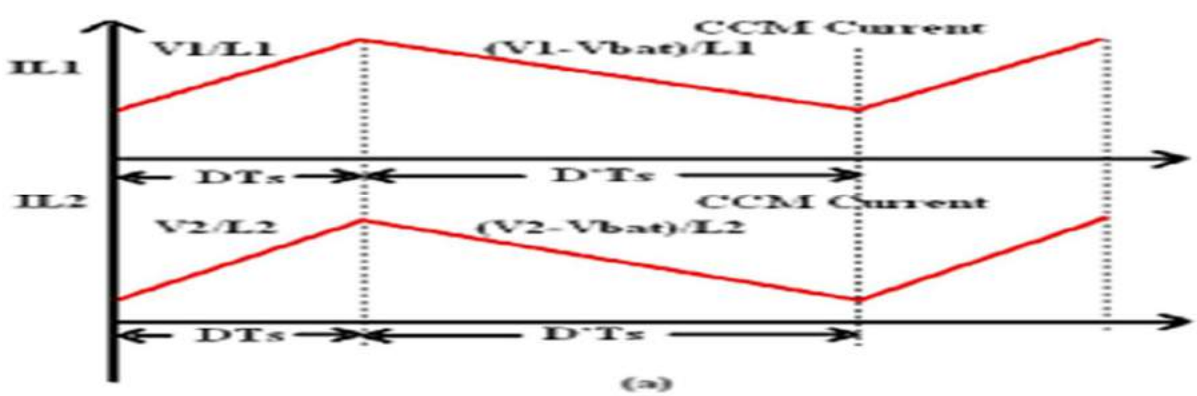


Fig. 8. Inductor Current waveforms

Ideally current I_{Ll} drawn from the source should be transferred only to the output battery and therefore this operating scenario is not

Volume 3 Issue XII, December 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

efficient. To prevent this mode of operation the proper selection of Inductance and capacitance value is mandatory.

IV. INCREMENTAL-CONDUCTANCEMPPT ALGORITHM

MPPT or Maximum Power Point Tracking is algorithm that built-in in charge controllers used for extracting maximum accessible power from PV module under definite conditions. The drawback of the perturb and observe method to track the peak power under fast varying atmospheric condition is overcome by IC method. The IC can find out that the MPPT has reached the MPP and stop perturbing the operating point. If this condition is not met, the direction in which the MPPT operating point must be perturbed can be calculated using the relationship between dl/dV and –I/V This relationship is derived from the fact that dP/dV is negative when the MPPT is to the right of the MPP and positive when it is to the left of the MPP.

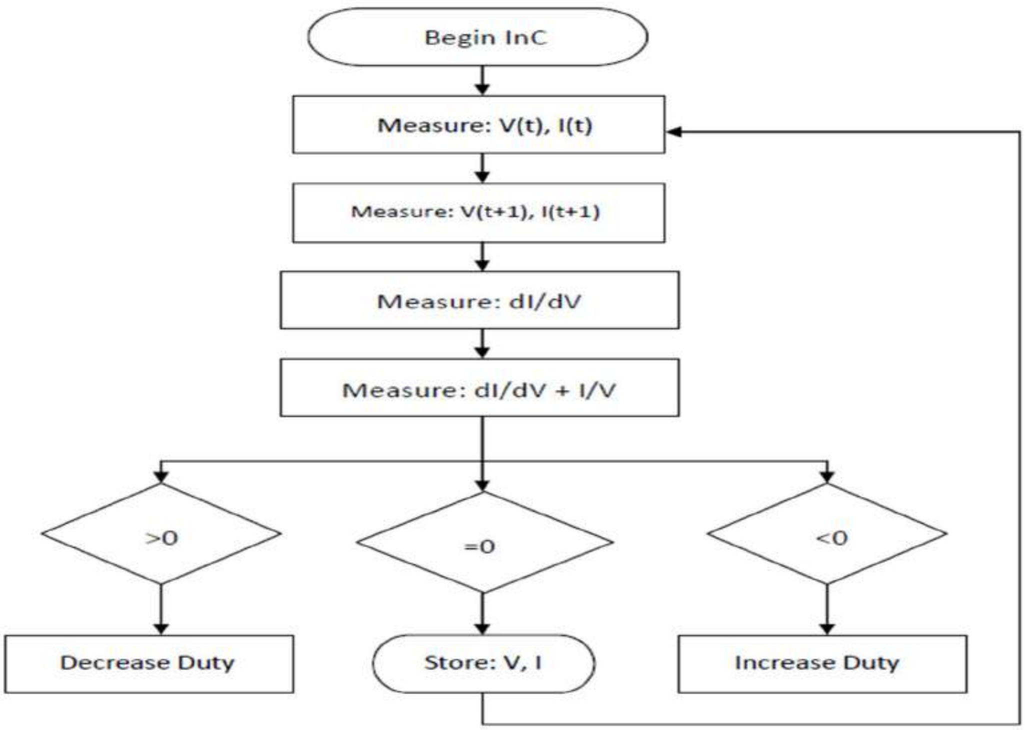


Fig.9. Incremental-Conductance MPPT Algorithm Flow Chart

This algorithm has advantages over P&O in that it can determine when the MPPT has reached the MPP, where P&O oscillates around the MPP. Also, incremental conductance can track rapidly increasing and decreasing irradiance conditions with higher accuracy than P and O. In incremental conductance method the array terminal voltage is always adjusted according to the MPP voltage it is based on the incremental and instantaneous conductance of the PV module. The basic concept of Incremental conductance on a PV curve of a solar module. The slope of the P-V module power curve is zero at The MPP, increasing on the left of the MPP and decreasing on the Right hand side of the MPP. The basic equations of this method are as follows.

$$dP/dV=0 \quad \text{at MPP}$$

$$dP/dV>0 \quad \text{left of MPP}$$

$$dP/dV<0 \quad \text{right of MPP}$$

$$dP/dV= d(VI)/d(V)= I + V*dI/dV$$

The dP/dVis defined as Maximum power point identifier factor. By utilizing this factor, the IC method is proposed to effectively

Volume 3 Issue XII, December 2015
ISSN: 2321-9653

track the MPP of PV array. The following definitions are considered to track the MPP.

$$\Delta I/\Delta V = -I/V \text{ at MPP}, \Delta Vn = 0.$$

V. RESULTS AND DISCUSSION

The simulation results of the Multi Input Single Switch(MISS) Battery Charger are developed using MATLAB/ SIMULINK R2010.

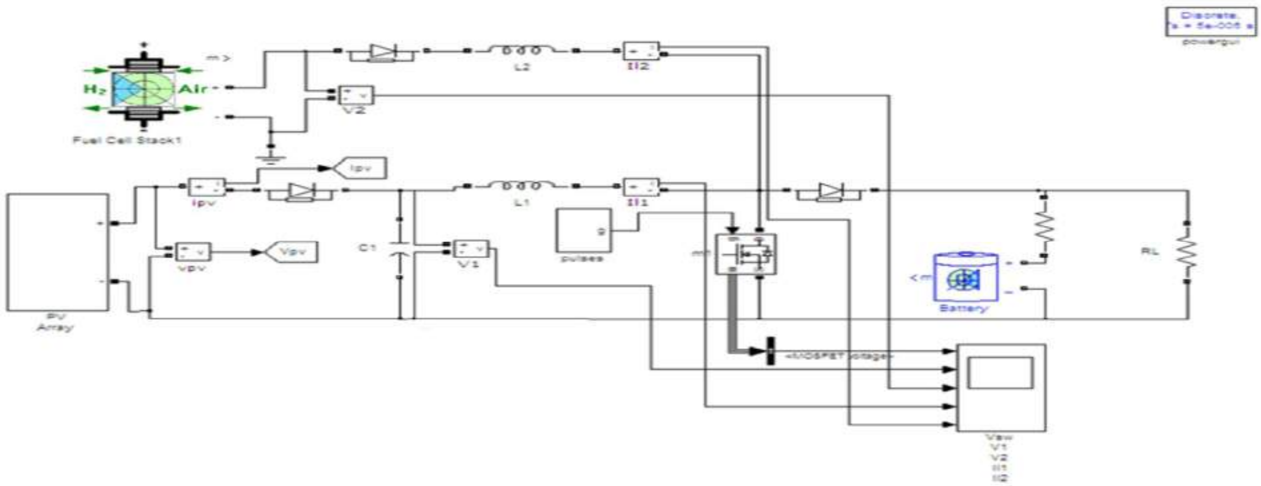


Fig. 10.Simulink Block Diagram of Conventional System in Mode-1

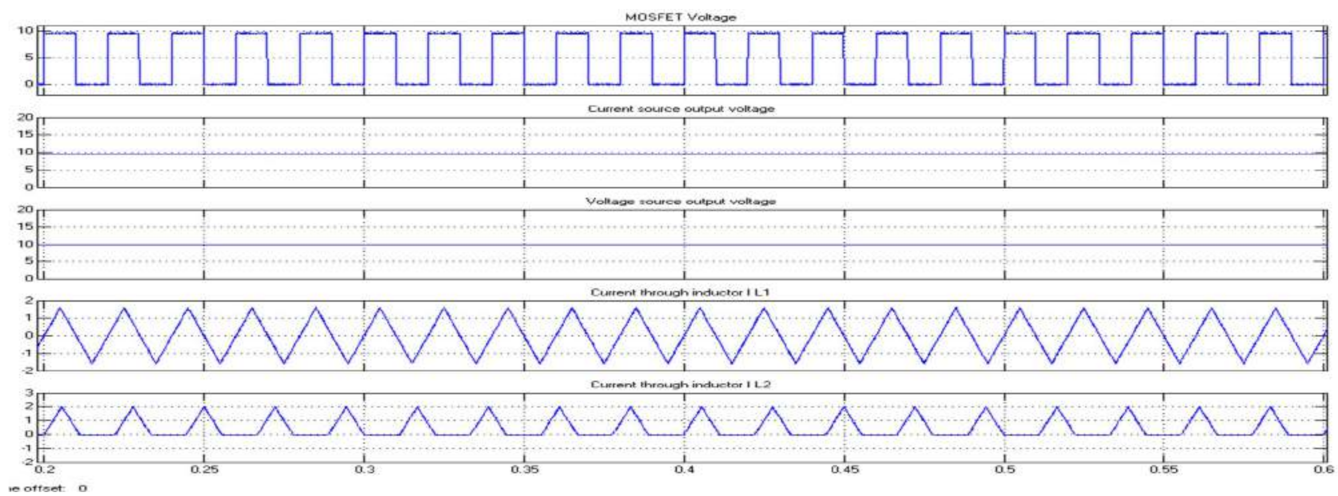


Fig 11.Mode-1 simulated wave forms

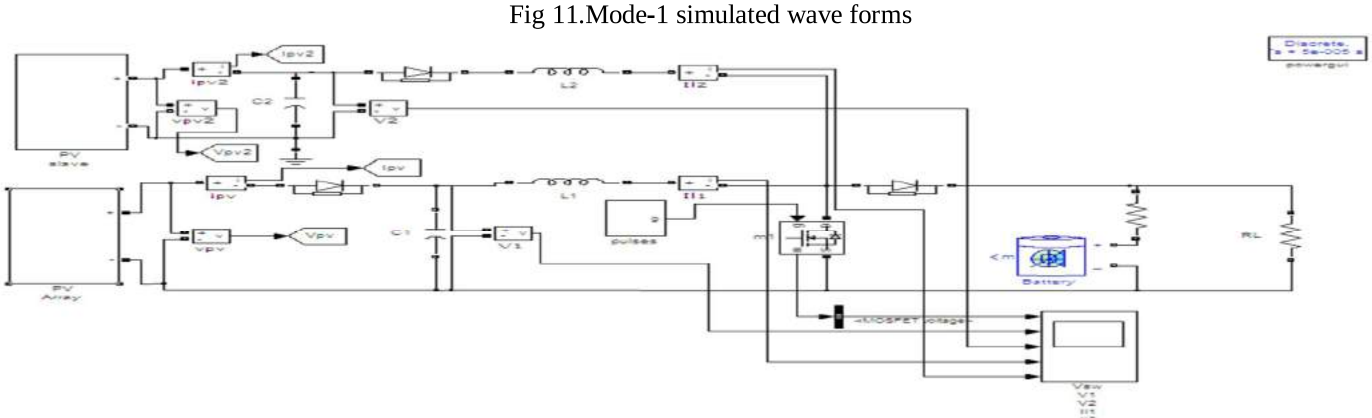


Fig. 12.Simulink Block Diagram of Conventional System in Mode-2

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

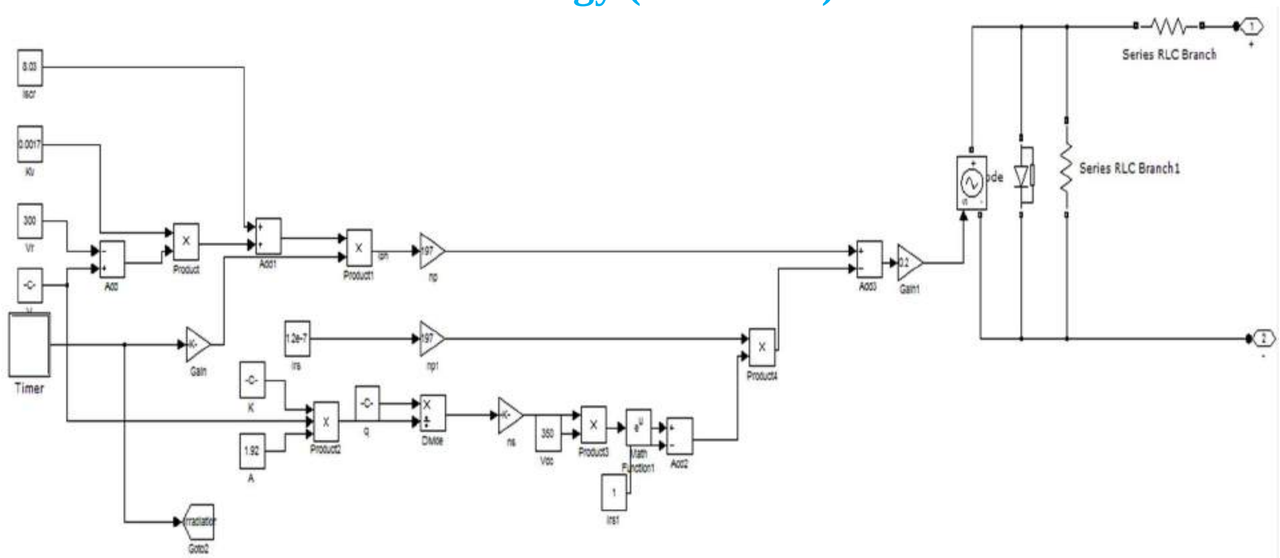


Fig. 13.Simulink Diagram of PV panel

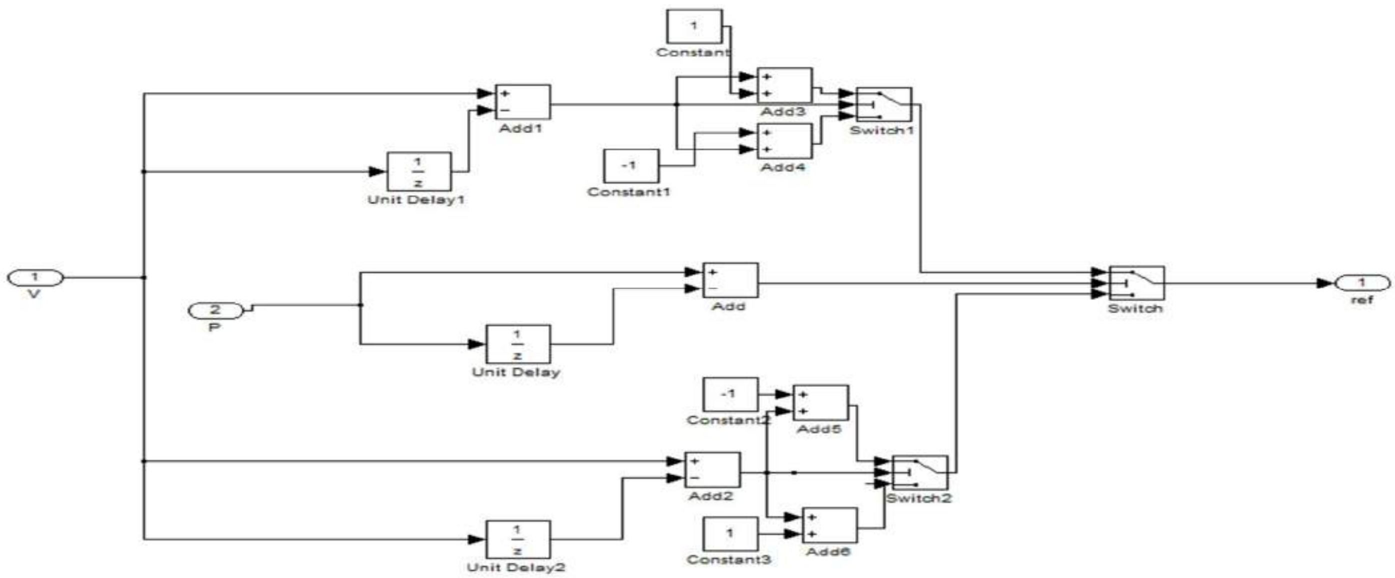


Fig. 14.Simulink Diagram of P &O algorithm

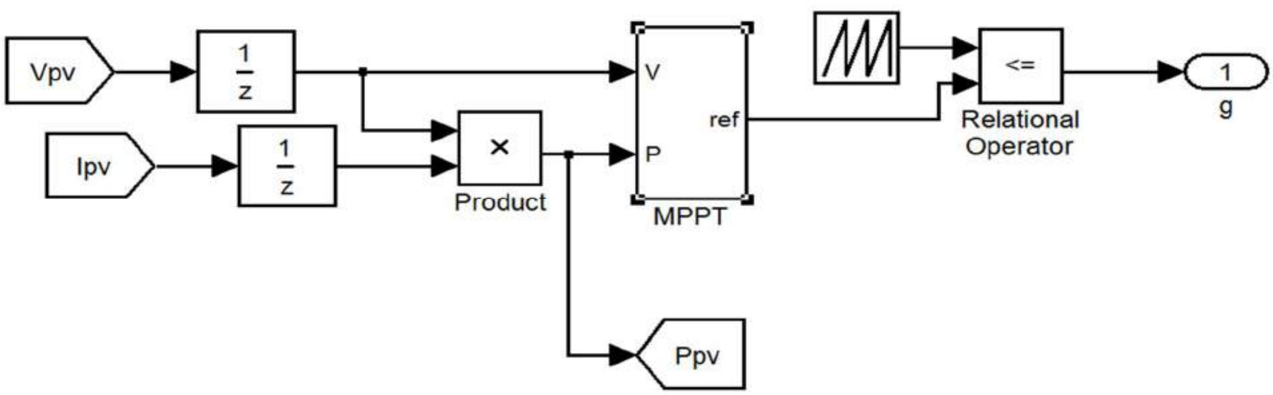


Fig. 15.Simulink Diagram of Pulse generation

Volume 3 Issue XII, December 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

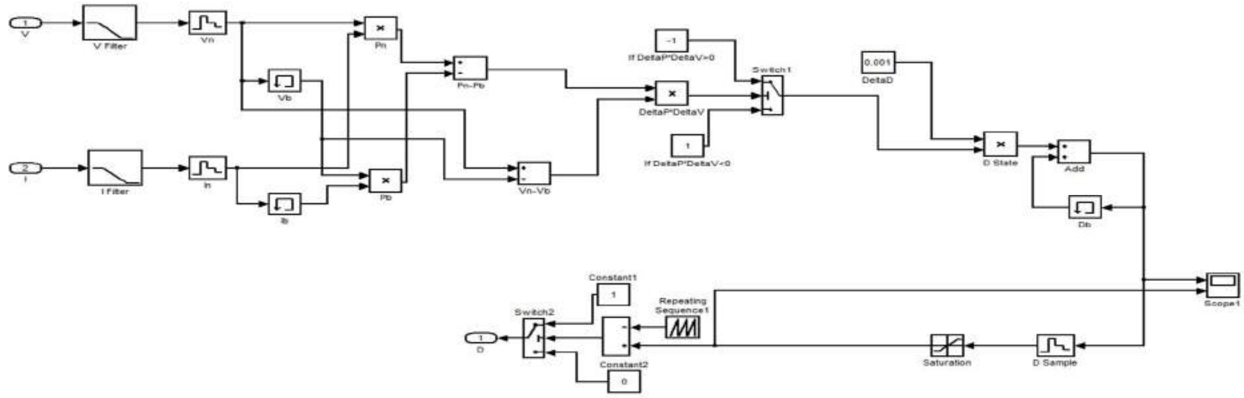


Fig. 16.SimulinkDiagram of proposed Incremental Conductance algorithm

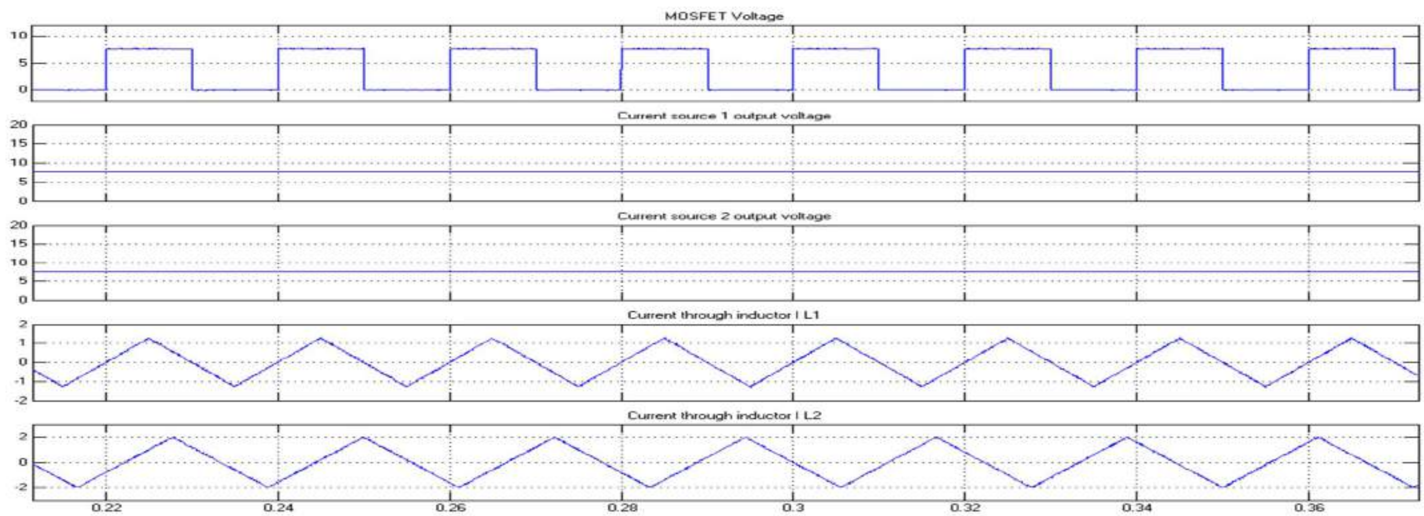


Fig 17.Mode-2 simulated wave forms

Incremental conductance method can find the MPPT accurately; Incremental conductance method can track the MPPT at changing atmospheric conditions and efficiency also improved .The proposed circuits with output waveforms are shown below from fig.18 to fig.21.

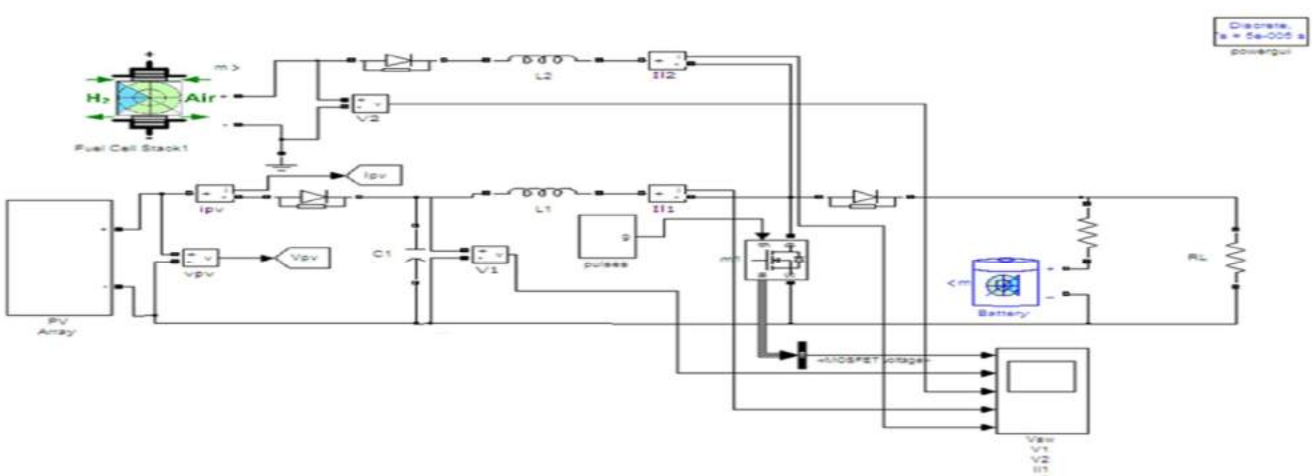


Fig. 18.SimulinkDiagram of proposed circuit in Mode-1

Volume 3 Issue XII, December 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

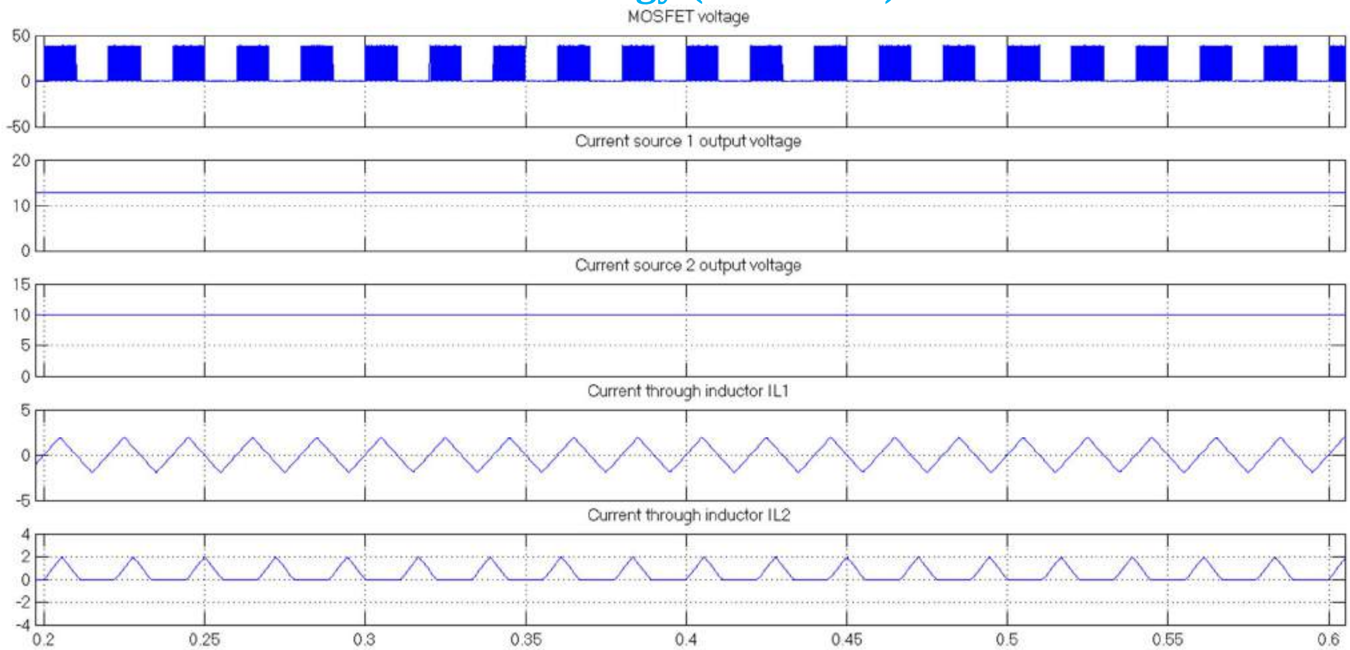


Fig 19.Proposed circuit simulated mode 1(incremental conductance) wave forms

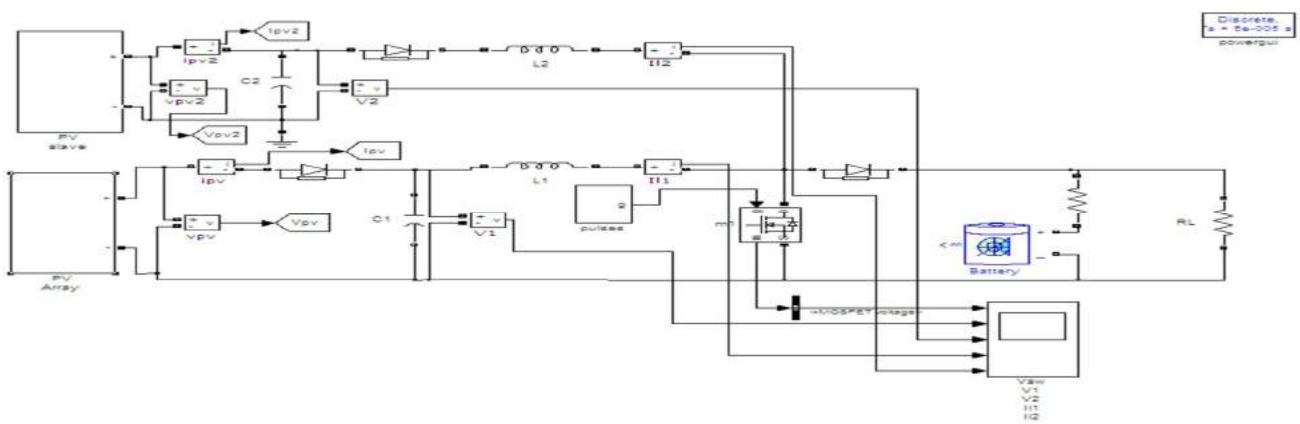


Fig. 20.SimulinkDiagram of proposed circuit in Mode-11

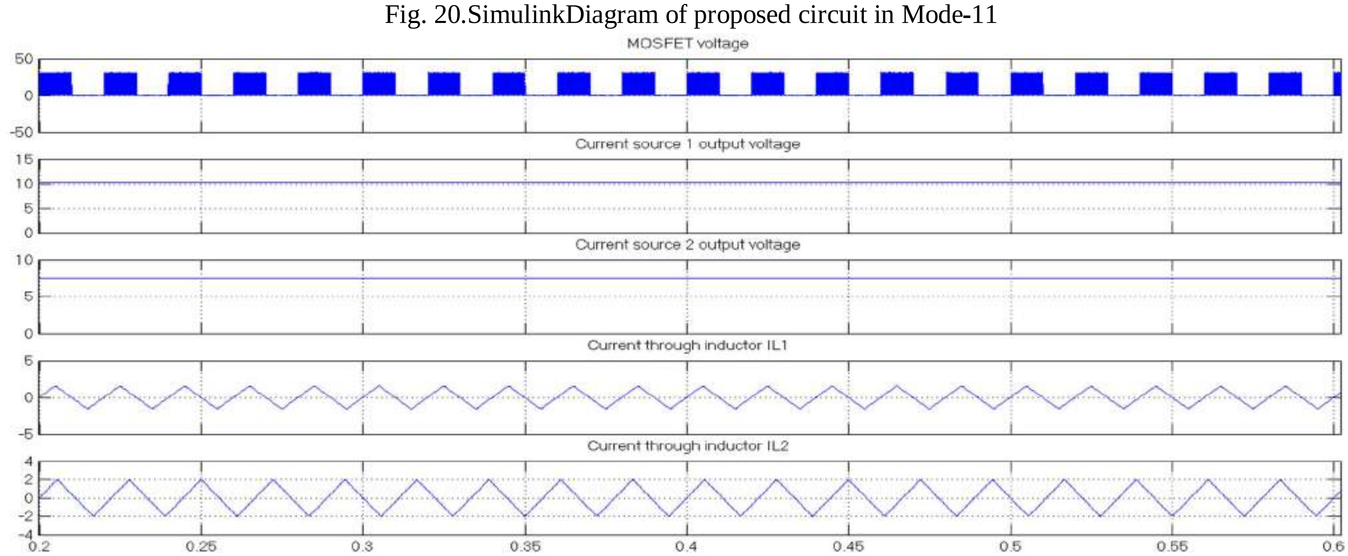


Fig 21.Proposed circuit simulated mode 2(incremental conductance) wave forms

Volume 3 Issue XII, December 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

VI. CONCLUSION

This paper proposed a simple Incremental conductance algorithm in MPPT. This method computes the maximum power point in solar panel and controls directly the Multi-Input-Single Switch (MISS) converter. It accepts multiple inputs and boosts the voltage to charge a battery using a single switch control and it offers different advantages which are: good tracking efficiency, response in high and well control for the extracted power. A fixed duty cycle based on the highest power source (Master source) characteristics is used to control the circuit. Depending upon the interfaced source characteristics different modes of operations are possible.By this experimental work, the simulation of the PV system with Incremental conductance MPPT algorithm has been successfully implemented in the Matlab/Simulink.

REFERENCES

[1] ArunSankar U. Student Member, IEEE, SoumyaShubhra Nag, Student Member, IEEE, and Santanu K. Mishra, Senior Member, IEEE 978-1-4799-0482-2/13 ©2013 IEEE.

[2] D. Dong, I. Cvetkovic, D. Boroyevich, W. Zhang, R. Wang, P. Mattavelli, "Grid-Interface Bidirectional Converter for Residential DC Distribution Systems-Part One: High-Density Two-Stage Topology ",IEEE Trans. Power Electron., Vol. : 28, no. 4, pp. 1655 - 1666, April 2013.

[3] R. Adda, O. Ray, S. K. Mishra, A. Joshi, "Synchronous-Reference-FrameBased Control of Switched Boost Inverter for Standalone DC Nanogrid Applications ", IEEE Trans. Power Electron., vol. 28, no. 3, pp. 1219 - 1233, Mar. 2013.

[4] R. Adda, O. Ray, S. K. Mishra, A. Joshi, "Implementation and Control of Switched Boost Inverter for DC Nanogrid Applications," in Proc. IEEEEnergy Conversion Congress and Exposition (ECCE) 2012, Raleigh, NC, Sept. 2012. pp. 3811-3818.

[5] R. Adda, O. Ray, S. K. Mishra, A. Joshi, "DSP based PWM control of Switched Boost Inverter for DC Nanogrid applications," in Proc. 381h Annual 310 Conference of Industrial Electronics Society (I ECON) 2012, Montreal, Canada, Oct. 2012, pp. 5285-5290.

[6] X. Li, A. Bhat, "Multi-Cell Operation of a High-Frequency Isolated DC/AC Converter for Grid-Connected Wind Generation Applications" , Proc. of IEEE Int. Con! on Industrial and Information Systems (ICIIS), Dec. 2009, pp. 169 - 174.

[7] S. Poshtkouhi, O. Trescases, "Multi-input Single-inductor DC-DC Converter for MPPT in Parallel-Connected Photovoltaic Applications ", Proc. of 26th Annual IEEE Applied Power Electronics Conference and Exposition (APEC), Mar. 2011, pp. 41 - 47.

[8] C.Wang, M. H.Nehrir, S.R.Shaw,"Dynamic Models and Model Validation for PEM Fuel Cells Using Electrical Circuits", IEEE Trans.EnergyConver., vol. 20, no.2, pp. 442 - 451, lun. 2005.

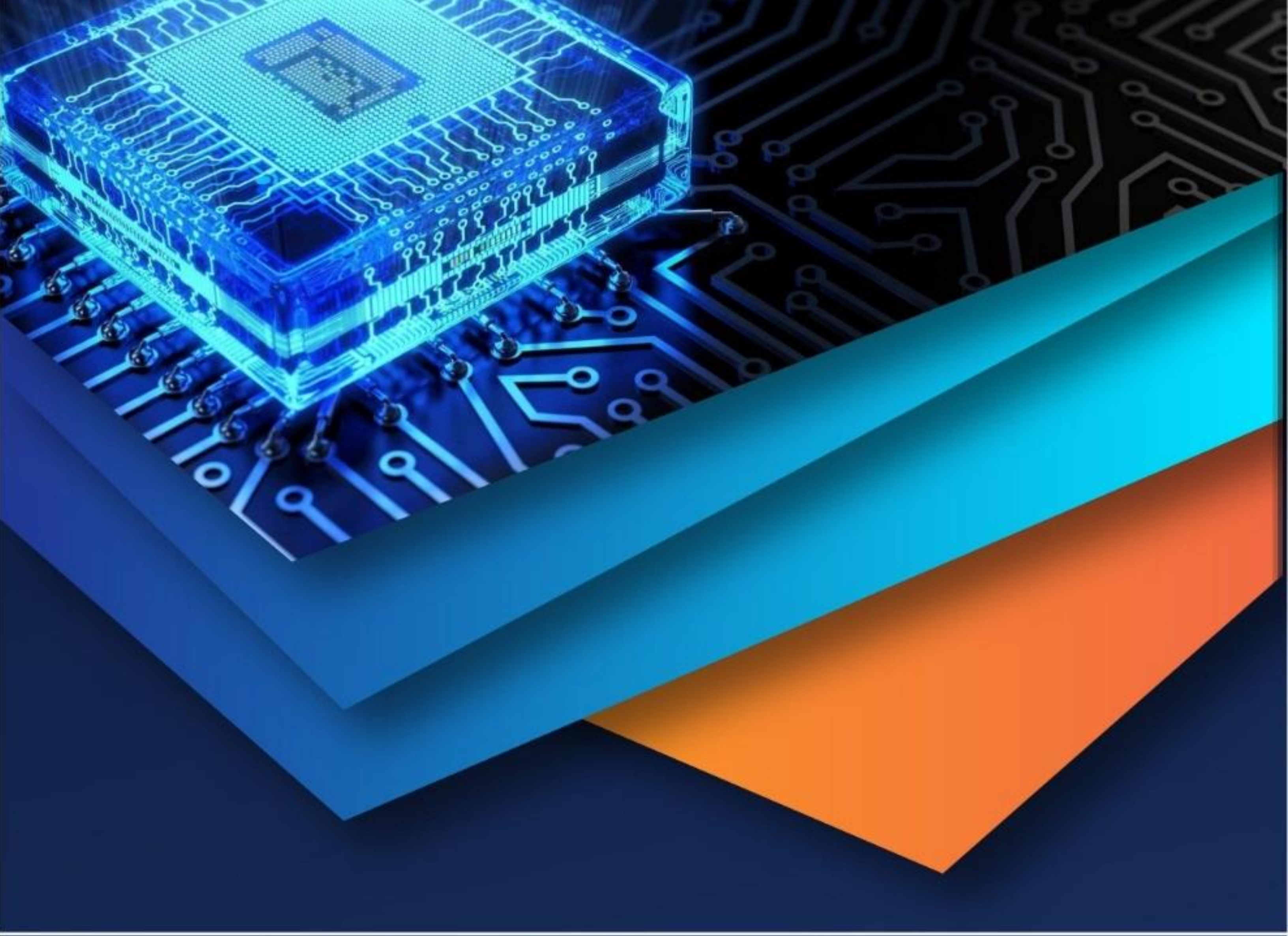
[9] Jiang Wei, B. Fahimi, "Multiport Power Electronic Interface-Concept, Modeling, and Design", IEEE Trans. Power Electron . . vol. 26, no. 7, pp. 1890 - 1900 , .luI. 2011.

[10] WaiRong-long, Lin Chung-You, Liawlun-lie, Chang Yung-Ruei, "Newly Designed ZVS Multi-Input Converter", IEEE Trans. Indust. Electron., vol. 58, no. 2, pp. 555 - 566, Feb. 2011.

[11] H. Krishnaswami, N. Mohan, "Three-Port Series-Resonant DC-DC Converter to Interface Renewable Energy Sources With Bidirectional Load and Energy Storage Ports", IEEE Trans. Power Electron., vol. 24, no. 10, pp. 2289 - 2297 , Oct. 2009.

Durga prasad P Received his B.Tech degree in Electrical and Electronics Engineering from QIS college of Engineering& Technology, Ongole, affiliated to JNTU, Kakinada in 2012. He is pursuing M.Tech in the department of Electrical and Electronics Engineering with specialization in Power Electronics and Electric Drives in Gudlavalleru Engineering College, Gudlavalleru, A.P, India. His research interests include Power Electronic Converters and Drives.

.



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY