iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VII **Month of publication:** July 2021

DOI: https://doi.org/10.22214/ijraset.2021.37189

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

MPPT-Based Single Phase Solar String Inverter

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Abstract: ***A microcontroller primarily based totally method of producing a sine wave from the sun panel output is designed and carried out on this paper the usage of a two-degree topology for a sun string inverter. This paper offers the improvement of a most energy factor tracking (MPPT) and manipulate circuit for a unmarried section inverter the usage of a pulse width modulation (PWM) IC. The elegance of this configuration is the removal of a complicated circuitry to generate oscillation pulses for transistor switches. The controller IC TL494 is capable of generate the vital waveforms to manipulate the frequency of inverter via right use of switching pulse. The DC to AC inversion is correctly completed along the switching signals; the circuit produced inverter output of frequency almost 50 Hz. The major goal of the proposed method is to layout a low cost, low harmonics voltage supply inverter basically targeted upon low energy digital home equipment the usage of variable sun energy as inputs.***

Keywords: AC sun panels, DC-AC converters, MPPT price controllers, PWM inverters.

I. INTRODUCTION

A. Maximum Power Point Tracking (MPPT)

When a solar PV module is applied in a system, its going for walks component is decided via the weight to which it is connected. Also, because of the reality that solar radiation falling on a PV module varies for the duration of the day, the going for walks component of the module moreover modifications for the duration of the day. Ideally under all going for walks conditions, one would like to exchange maximum power from a PV module to the weight. In order to make sure the operation of PV modules for maximum power switch, a completely unique technique called Maximum Power Point Tracking (MPPT) is employed in PV systems where, virtual circuitry is used to make sure that maximum amount of generated power is transferred to the weight. The maximum power component tracking mechanism makes use of a set of regulations and an virtual circuitry. The mechanism is based totally completely on the principle of impedance matching amongst load and PV module this is important for maximum power switch. This impedance matching is performed via the usage of a DC to DC converter via changing the duty cycle (d) of the switch.

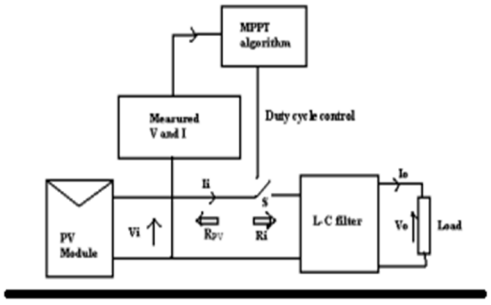


Fig.1 diagram of the MPPT algorithm together with the circuit

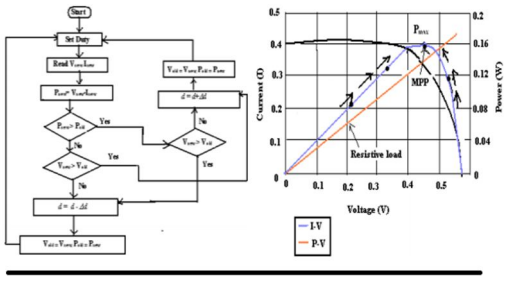


Fig.2 (a) Flow chart of hill climbing method and

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B. Schematic Diagram Demonstrating how the Operating point Moves Towards the Maximum Power point (MPP)

The power from the solar module is calculated by measuring the voltage and therefore the current. This power is an input to the algorithm, which then adjusts the duty cycle of the switch, leading to the adjustment of reflected load impedance consistent with the facility output of PV module. as an example , the relation between the input voltage (Vi) and therefore the output voltage (Vo) and impedance of load (RL) reflected at the input side (Ri) of a buck type DC to DC converter are often given as: Vo = Vi x d Ri = *RL d*2 Where d is that the duty cycle. By adjusting the duty cycle, Ri are often varied which should be same because the impedance of solar PV module (RPV) during a given operating condition for max power transfer. b) Inverter: an influence inverter, is an electric power converter that changes DC (DC) to AC (AC); the converted AC are often at any required voltage and frequency with the utilization of appropriate transformers, switching and control circuits. In an inverter, dc power from the PV array is inverted to ac power via a group of solid state switches—MOSFETs or IGBTs—that essentially flip the dc power back and forth, creating ac power.Fig.3 shows basic H-bridge operation during a single-phase inverter. This solid state switching process is understood as inversion.

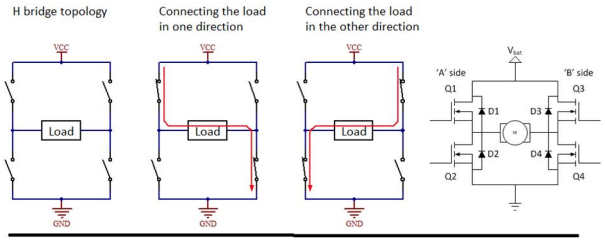


Fig.3 An H-bridge circuit performs the essential conversion from dc to ac power.

The inverter will acquire enter of 12 V dc from the controller circuit and it's getting to convert this to 230 V ac. The inverter circuit designed as an H bridge inverter with an IC which incorporates PWM method and converts, with the assist of a 12V/230 V transformer, the received 12V dc from MPPT circuit, to the output 230V ac to be used.

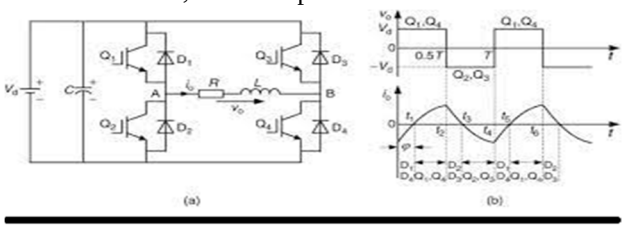


Fig. 4 Full bridge single phase inverter

The complete bridge (unmarried phase) inverter is constructed from 1/2 of bridges linked to shape what's called a complete bridge or H-bridge inverter. Its association is proven in discern four. It incorporates of DC voltage source, four strength switches (typically bipolar junction transistors-BJTs, metal-oxide semiconductor discipline impact transistors-MOSFETs, insulated gate bipolar transistors- IGBTs or gate became on transistors-GTOs) and the burden. To create a square-wave output voltage, the tool pairs Q1Q3 and Q2Q4 are switched as a substitute at a put off of one hundred eighty degrees. When Q1 and Q3 are ON with Q2Q4 OFF for a length t, additionally with Q2Q4 ON and Q1Q3 OFF at t. assuming there may be a sinusoidal load current, the burden will soak up strength while Q1Q3 and Q2Q4 pairs are carrying out as a substitute while feed backing happens while the diode pairs are carrying out.

II. METHODOLOGY

The block diagram for the circuit is as shown.

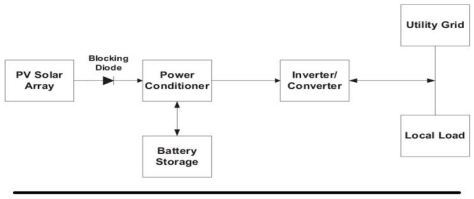


Fig.5 Block diagram for a solar power system

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1) *MPPT Circuit:* The subsequent step is to layout and take a look at the MPPT circuit. The voltage and the modern-day output from the panel array should be measured and the most electricity needs to be furnished to the battery

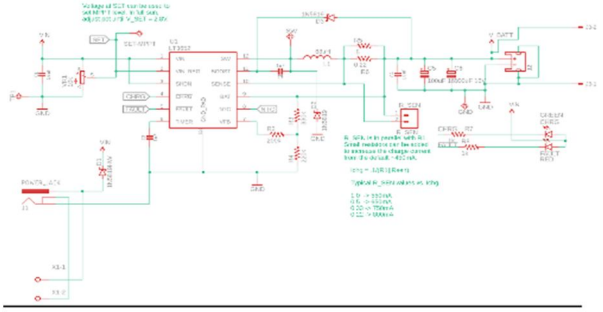


Fig.6 Schematic diagram for MPPT circuit

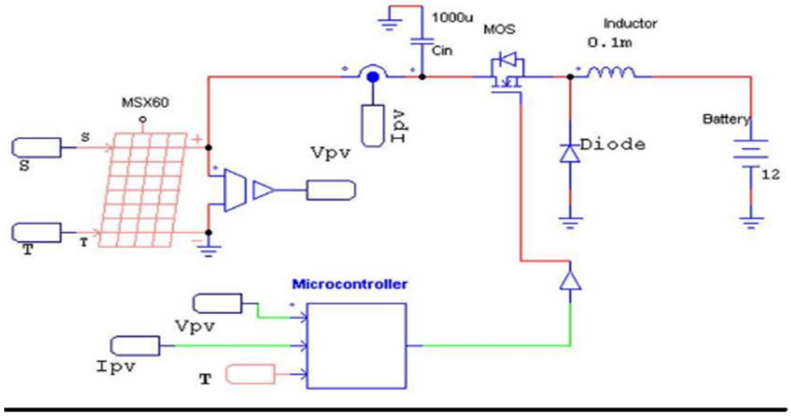


Fig.7 MPPT circuit.

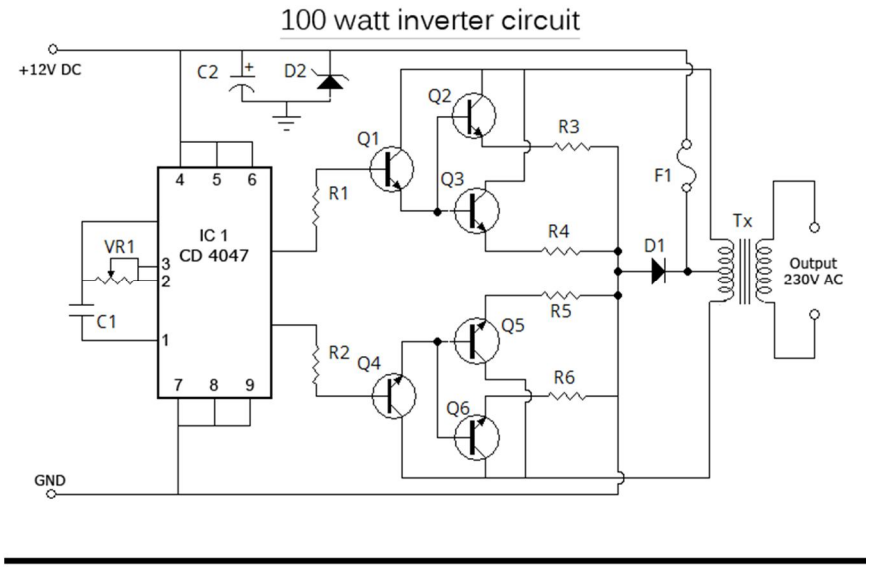


Fig.8 Inverter circuit.

Inverter Circuit: Next is that the circuit for the inverter part. For the inverter the IC TL494 is employed. The four MOSFETs IR740 are arranged during a bridge network and can be switched on two at a time alternately by the 2 switching MOSFETs IRF50N06 in order that two will conduct at a time. The timing is about by using RC network and IC TL494 controls the waveform. The output to 230 V a.c which is converted by transformer.

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III. MODELING AND ANALYSIS

The MPPT and Inverter circuit: The circuit of the MPPT is first examined with the assist of a D.C. electricity supply. It is checked whether or not the voltage is surpassed to the battery to price it. Finding it to paintings as required, it's miles then examined with sun panels. The regulator is likewise checked with the aid of using various the d.c. voltage. It indicates the predicted readings at the display.

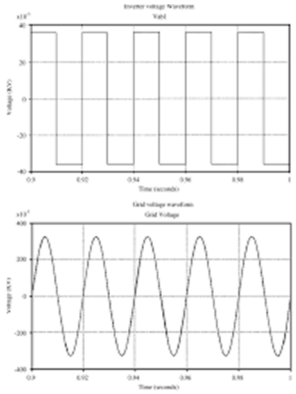


Fig.9 Waveform of inverter output.

The performance of the MPPT circuit is examined and discovered to be round 80%. It will increase with the boom in intensity. The performance of the inverter is examined and discovered to be as a good deal as 90%. It will increase with boom in load.

IV. RESULTS AND DISCUSSION

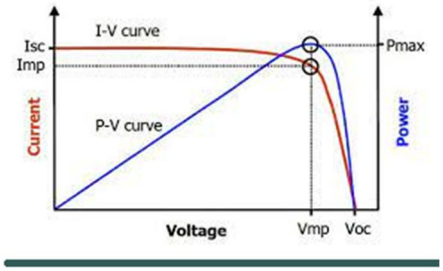


Fig.10 Efficiency of Mppt

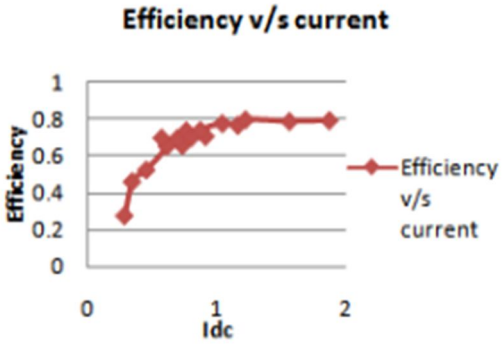


Fig.11 Efficiency v/s current of inverter circuit

The time required to fee the battery is tested. This is completed first the usage of an SMPS after which with the 2 sun panels. The efficiencies of the MPPT and inverter circuits are located to be round 90% and 79.9% respectively.

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V. CONCLUSION

The experiments and observations suggests that MPPT primarily based totally rate controllers are pleasant appropriate for sun structures as they song the most strength in case of strength fluctuations on the enter aspect because of environmental situation variation. Hence its miles advocated to apply the MPPT primarily based totally rate controllers. Use of microcontroller primarily based totally structures offer large computational functionality and discount with inside the hardware. Microcontroller is a mini pc and brings a good deal greater accuracy with inside manipulate of MOSFET and IGBT. It is suggested to apply an unmarried section PWM inverter with H Bridge the usage of IRF740B N-channel MOSFETs and the TL494 strength deliver controller. The TL494 carries all of the features required with inside the creation of a pulse-width-modulation (PWM) manipulate circuit on an unmarried chip. Designed mainly for power supply manipulate, this tool gives the ability to tailor the strength-deliver manipulate circuitry to a particular application. Several remarkable functions of the advanced Sinusoidal PWM inverter are: fewer harmonic, low cost, easy and compact

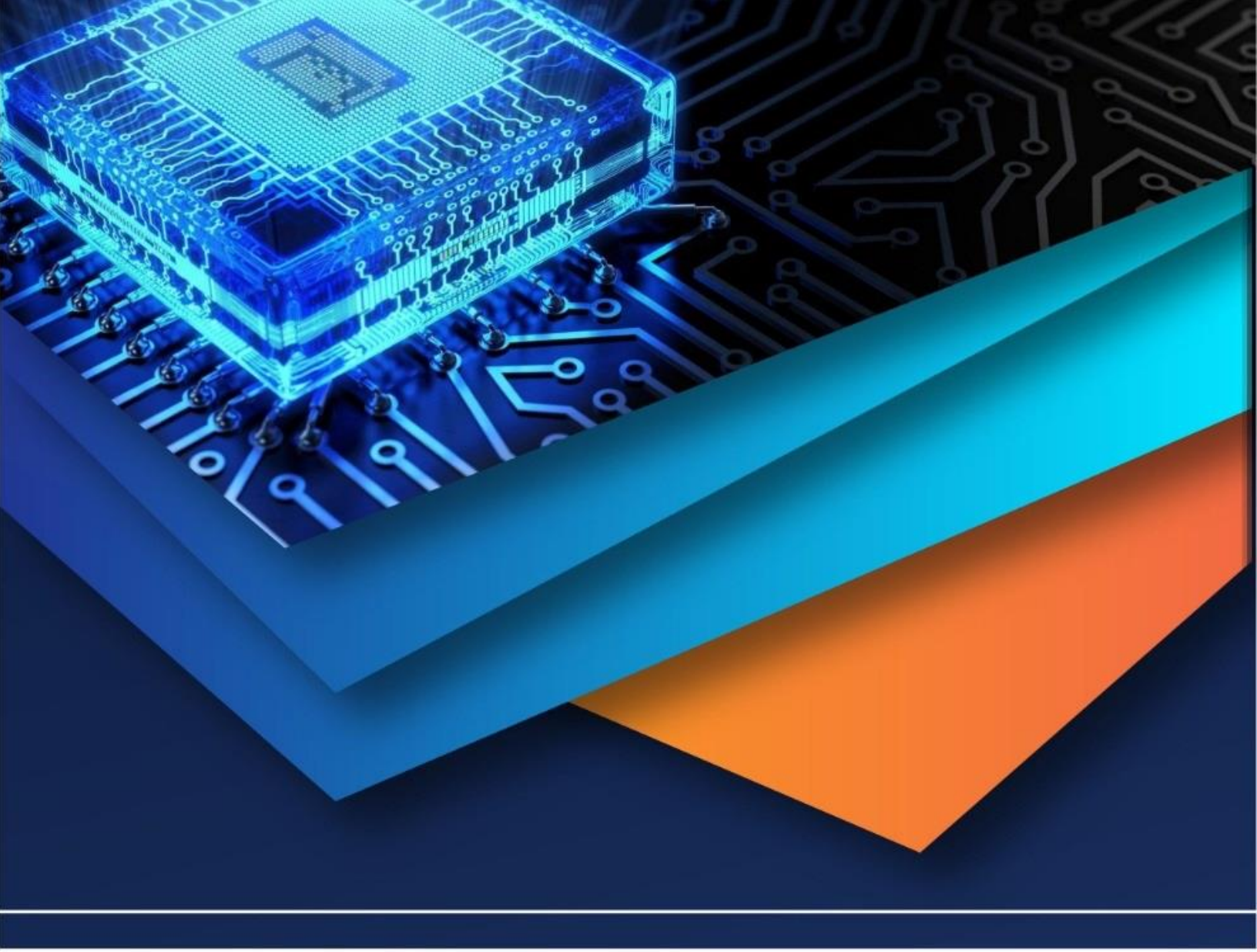
VI. ACKNOWLEDGEMENTS

This project is accomplished based on the knowledge gained during pandemic infused lockdown by the authors under the guidance of a Dr. S. Ravichandran. The authors do not claim any right to the algorithms, codes, data, formulas used, approach as their property. They only used their intellect to compile the results and obtain the optimal values for accuracy and also formatting it in the IEEE format.

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