

Solar based User Adjustable Multi-Purpose Frequency Inverter

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Abstract— This paper debriefs about a low energy portable device called portable inverter, The key feature of this inverter is that it can operate on variable frequency defined by user allowing the inverter to work on desired frequency, This system is also compatible with solar panels(10W) whose output is 12V and can also be operated on 12V battery allowing to obtain a 12V supply whose output is passed through MOSFET driver IC whose output goes to step up transformer allowing to operate 230V bulb on a 10 watt solar panel or a 12 volt battery. This system not only upgrades the existing system over variable frequency but also stages advantage oversize and compactness. This is all possible using Ic CD4047 which is low cost highly efficient MOSFET driving IC. This module can operate on a solar PV panel or any 12V supply. This modules compactness is so efficient that it can be seamlessly embedded to existing lamps blubs and fans.

Key Words- User defined Frequency, Inverter, PV panel, MOSFETS, Snubber circuit

1. INTRODUCTION

This system implements a combination of renewable energy and electric power like the battery, variable supply, there are few parameters can be considered during the design and development of inverters for working efficiently. To meet industry expectation this system should be low cost and a compact and be seamlessly connected to any required device. The output power obtained from solar photovoltaic (PV) module depends on solar radiation, in the absence of solar

Radiations the output is not generated from the panel, so inside the system we require a 12V battery to get sustained and efficient output as per the requirement. We produce variable frequency by changing the value of the input capacitor and resistor helping us to achieve variable Output frequency so we can use this inverter any country. By varying the value of resistor and capacitor the output switching of the MOSFETS will be changed and we achieve variable frequency and the MOSFET acts as power switches and gives the input to the step up transformer. [4]. There are several types of energy generation techniques like thermal Power stations, wind mill, hydro power plants, this is some Examples of energy generation system in that 80% of Electric energy can be produced by a thermal power station. In this power plant the coal plays a key role to generate electricity, during this process a huge amount of ash is released in the environment and also harms the surrounding

area. Our system generates electricity from conational energy resource and performing a tremendous role against the side of effects of thermal energy.

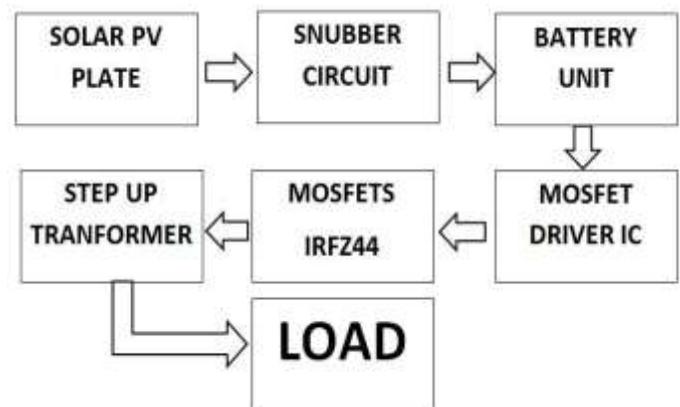


Fig.1: Block diagram representation of photovoltaic system.

2. HARDWARE DESIGN

This prototype system works in three steps, Input comes from the solar panel which converts solar rays into electrical energy it acts as a transducer and we are using a 10W solar panel for the demo purpose output of the solar panel is fed to a battery through snubber circuit.

Snubber circuit protects the system from reverse current.it contains forward bias diode and capacitor, due to forward bias diode current flows from source to load and filter through a capacitor and goes to the battery and charge the battery. When battery is completely charged it acts as a short circuit and current flows from load to source, during this condition diode acts an open switch and does not allow to flow the current from load to source if in any of the condition diode starts conducting the capacitor acts as an open switch because capacitor does not pass dc supply, the system battery provides a continuous supply to the inverter during the absence of sunlight. The battery provides 12V DC supply to work efficiently, the system uses MOSFET driver Ic CD4047 whose output is obtained from pin 10 and 11 they both are inverted to each other. The output frequency depends on the input timing circuit which is a combination of resistors and capacitors, Resistor provides a discharging path to the capacitor through the ground. The discharging period totally depends on the capacitance of the capacitor; this forms the timing circuit which acts as input to the driver IC.

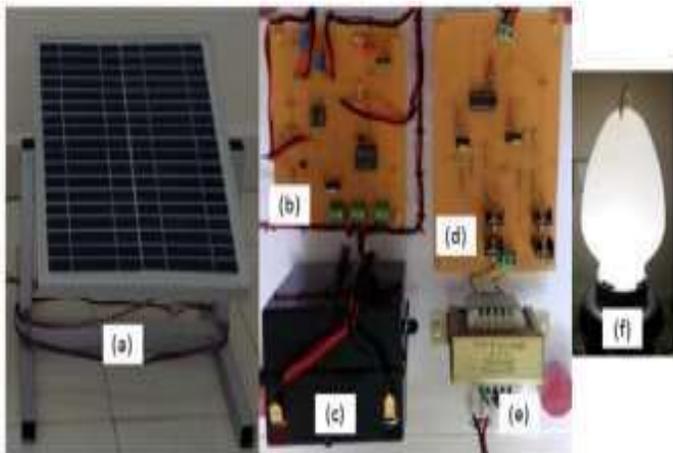


Fig.2 Developed System

This system contains a solar charge controller used for protecting the battery from the damage, there are several types of batteries but our system allows lead Acid battery and Lithium-Ion batteries, while the charging period of battery it requires low current and continuous voltage. The charge controller cut off the battery from the system when the battery is completely charged.

Charge controller contains cut off circuitry which is made up of OP-AMP circuit, OP-AMP is used in Schmitt trigger mode in this mode inverting terminal is connected to the VCC as a reference value to the OP-AMP and non-inverting terminal is connected to the positive terminal of the battery.

When both the value of inverting and non-inverting terminal of OP-AMP are the same that means the battery is completely charged. At this point, OP-AMP generates a signal which is provided to the transistor for working in cut off mode. Due to this battery is protected from getting overcharged.

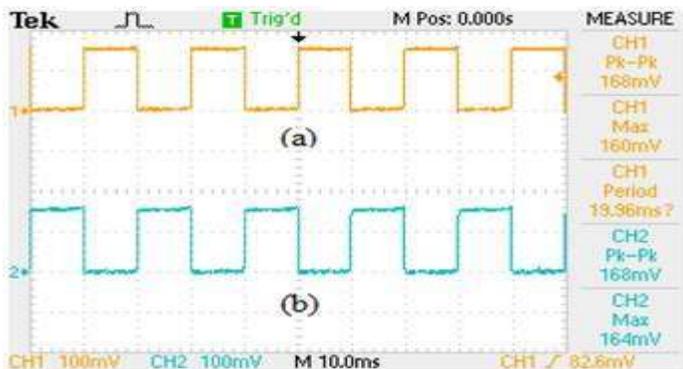


Fig 3: (a) Pin #10 output (b) pin #11 output of CD4047 Ic

Above figure shows the output of pin number 10 and 11 of CD4047 Ic with the help of digital oscilloscope (DCO) we measure the output frequency which is set up by input timing circuitry which is decided by RC circuit, above figure

shows 50 Hz frequency that means it has 50 % duty cycle. This output of Ic CD4047 is given to the IRFZ44 MOSFETS, which acts as input to the MOSFET and start switching at 50 Hz frequency, That is it switches 50 times on and off in one second. As shown in Fig. 3, the output of the MOSFETs is given to the center-tapped step-up transformer.

3. INVERTER EFFICIENCY

The efficiency of the system can be indicated by a ratio of its output power to input power, after concluding the observation we can state that increasing the Watts of load increase the overall efficiency as shown in table I. The Equation (1) is used to calculate the efficiency of the system.

$$\text{Efficiency, } \eta = \frac{\text{Output Power, } P_{out}}{\text{Input Power, } P_{in}} \times 100\%$$

Equation (1)

Load	Input Voltage	Input Current	Output Voltage (Before Transformer)	Output Current (Before Transformer)	Output Voltage (After Transformer)	Output Current (After Transformer)	Inverter Efficiency
No load	12.20 V	0.254A	13.33V	0.213A	230.0V	-	-
3W	12.02 V	0.795A	12.85V	0.486A	227.0V	27.88mA	66.23%
18W	11.86 V	1.385A	12.27V	0.768A	203.1V	74.90mA	92.61%
21W	11.76 V	1.758A	11.94V	0.815A	198.4V	100.90mA	96.83%

Table I Practical Observation

As shown in Table I, is the efficiency of the CD4047 inverter we connect a 3W LED lamp as a load then the observed efficiency is 66.23%, resulting in lesser efficiency whereas, when the load is changed from 3 W to 18W the efficiency boosts up to 90.23%.further increasing the load value to 21W the efficiency obtain is 96.23 % According to observation result we can conclude that this inverter is suitable for 20W-25W Since in this range it operates at the highest efficiency.

Nominal Voltage (V)	Operating Hours						
	1	2	3	4	5	6	7
12.41	12.13	11.90	11.59	11.06	9.11	2.57	-
12.65	12.41	12.13	11.67	11.13	8.41	2.27	-
12.69	12.45	12.17	11.56	11.12	7.98	3.05	-

Table II Voltage Reading for 7 hours.

4. CONCLUSION

In this paper, we present a Solar Based User-defined variable frequency inverter. This inverter gives variable frequency by changing input resistance value in the RC circuit this system works efficiently between 20W-25W loads also this system can operate continuously 4 hours without solar energy as we reduce the load in wattage the backup time increase for 5 w load it works for 15 hours. This kind of system can also an emergency

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Pravin R Nawate, is R&D Engineer at Eco Sense Pvt Ltd and his project has received the Best Idea award at IMechE Process Division Event held at IIT Bombay on 2018. He is an Co-founder at Technical Studios, also a technical consultant at Desire Automation, Former Lecturer at Govt. Polytechnic Aurangabad, Awarded his B-Tech from National institute of electronics and Information technology (NILELIT), Former PCB Designer at CBROZ training & Research center.

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