PHOTOVOLTAIC ARRAY FED INVERTER

Babu Paul[1], Sarath M S[2], Sebastian Jo Thalackal[3], Sharun Vittappan[4], Shonitha Krishnan M[5]

[1]*Assistant professor, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India*
[2]*U G students, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India*
[3]*U G students, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India*
[4]*U G students, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India*
[5]*U G students, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India*

Abstract

Solar energy is the most low cost, competition free, universal source of energy as sun shines throughout. This energy can be converted into useful electrical energy using photovoltaic technology. The steady state reduction of price per peak watt and simplicity with which the installed power can be increased by adding panels are attractive features of pv technology. In this project, a controller to vary the amplitude of the inverter output voltage interposed between the PV array and the load is developed. The detailed modelling of the components of proposed scheme has been taken up. The developed controller varies the pulse-width of a PWM generator, so that that the inverter output voltage varies with irradiation and temperature. The variation of the amplitude is to maximize the power output for a given radiation and temperature. Experimental investigation presented gives the utility of such a control approach.

Keywords: *PV Array, Inverter, PIC16F616 microcontroller, PWM technique*

---***---

1. INTRODUCTION

As the sources of conventional energy are deteriorating fastly with a corresponding rise in cost, considerable attention is being paid to other alternative energy sources. It is well known that non-conventional energy sources are friendly to the environment, sustainable and are attractive alternatives in places where a connection to the utility network is either impossible or unduly expensive. Hence, there is an increasing interest in standalone generating systems based on renewable energy. Among them, solar energy which is free and abundant in most parts of the world has proven to be a challenging source of energy in many developing and developed countries.

Photovoltaic's (PVs) are arrays (combination of cells) that contain a solar voltaic material that converts solar energy into electrical energy. PV cell is a basic device for Photovoltaic Systems. Such systems include multiple components like mechanical and electrical connections and mountings and various means of regulating and (if required) modifying the electrical output. Materials that are used for photovoltaic are mono-crystalline silicon, polycrystalline silicon, microcrystalline silicon, cadmium telluride and copper indium selenide. The current and voltage available at the PV device terminals can be directly used to feed small loads like lighting systems or small DC motors. In order to get constant power output from PV array we have to model photovoltaic array fed inverter. For obtaining required performance suitable control circuit is designed by taking the output of the inverter and comparing with reference value using PIC16F616 microcontroller. It controls and compares the input voltages and provide an output pulse using PWM technique.

2. PROPOSED SCHEME

The block diagram of the proposed scheme is as shown in Fig1. The output variation of PV array in solar power technology depends on the temperature and intensity of sunlight (radiation). The block diagram consists of main block like PV array, inverter unit, filter circuit, step transformer, PWM technique used for pulse generation to MOSFETs of the inverter. Output voltage obtained from PV array is converted to ac using 1-phase, 2-leg inverter. The ripples in the ac voltage obtained from inverter are minimized using LC filter circuit. The ripples free inverter output is stepped-up to 230v using step up transformer.

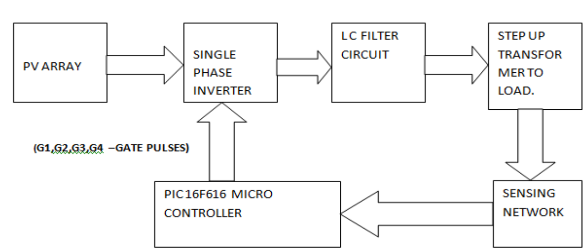


Fig. 1: Block Diagram for proposed scheme

This supply is given to drive the load. The required performance obtained by using PIC 16F616. It controls and compares the input voltages and provide an output pulse using

PWM technique, thereby required performance can be obtained even though there is variation in temperature and radiation parameter.

3. DEVELOPMENT OF CONTROLLER

The circuit diagram for proposed scheme shown in fig 2. A variable DC supply is given as input source to the whole circuit. This variable DC voltage is passed through a diode which provides a unidirectional flow. From the diode it splits into two. One branch is directly given to the centre tapped 12 - 0 – 12 V step-up transformer and the other branch is passed through a voltage regulator for giving supply voltage to both ICs.

The main components of this circuit are PIC 16F616, ULN2003A, LM7805. In this PIC 16F616 provides the basic operation. It controls and compares the input voltages and provides an output pulse using PWM technique. This pulse is of low values. So they are given to a driver circuit consisting of ULN2003A having high current gain. The output of the driver IC has sufficient value to drive the gate of MOSFET to which they are connected.

According to the gate pulses given , their corresponding pair of MOSFETs conducts and it will provides path for variable DC voltage through centre tapped transformer . As a result of this, an output voltage is induced at the secondary. This secondary voltage is used for feedback. For the ease of control, this feedback voltage is given to a step-down transformer and further this AC is converted to DC using bridge rectifier. This DC analog signal is passed through filters and resistors to avoid the response for small variation of output voltage, thus preventing flickering of load. After that , a zener voltage regulator is provided to limit the input voltage to the PIC within 5V.

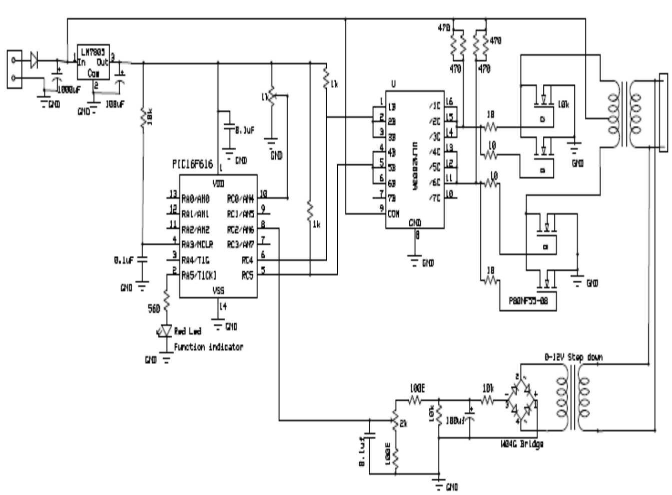
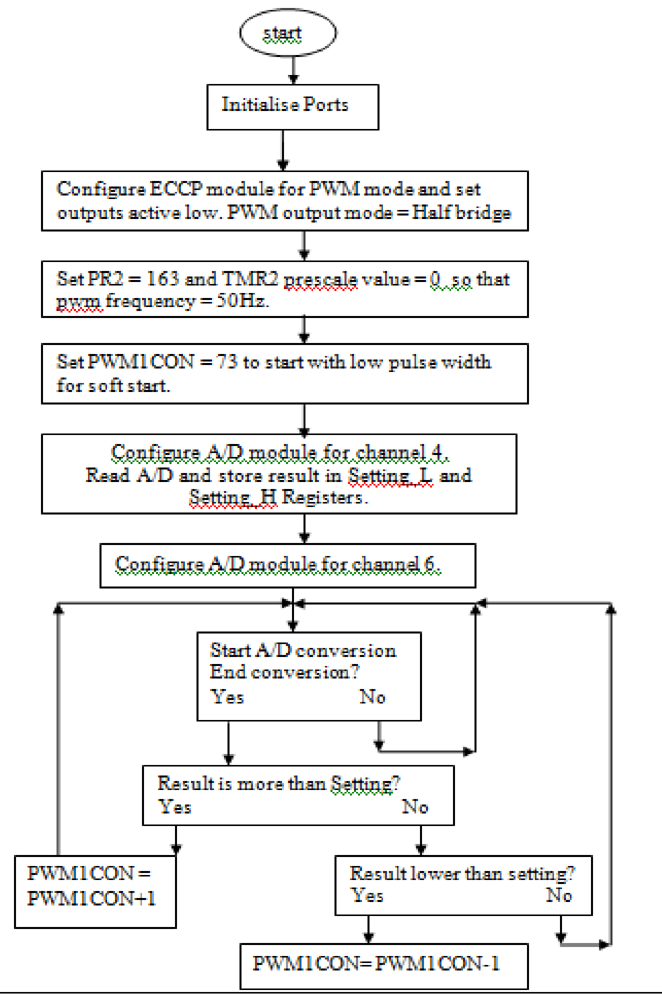


Fig 2: circuit diagram

The input signal to PIC is given through pin 8. This pin converts the DC analog signal to digital signal. A reference signal to IC is given through a potential divider at pin 10 . So PIC compares this input signal with reference value. According to the error bits formed, the sine wave is modified using PWM technique. As a result of this, pulse width of output varies which will in turn varies the gate pulses to MOSFETs. In this circuit, PIC is configured at half bridge PWM ie., there are two outputs and one is complement of other provided with a small dead delay .

4. FLOW CHART



5. RESULT AND DISCUSSION

The experimental model was constructed using a 30V variable DC supply instead of PV array. The proposed scheme is tested with R load (20 W lamp load). By varying the supply voltage from 11 to 22 V, a nearly constant voltage of 200 V can be measured using a voltmeter connected across the load. The results thus obtained are tabulated as shown below:

Table 1: Table of analysis

SOURCE VOLTAGE (V)	OUTPUT VOLTAGE (V)
11	199
12	200
13	201
15	199
18	200
20	198
22	200

Fig 3: Hardware model

6. CONCLUSIONS

The system described here is a PV system for low load applications, using a single phase PWM inverter. The control technique is easy to implement economically with analog and digital components. The required performance can thus be successfully obtained by using pic16F616.

The future work includes improving the stability of the system and also to study various instability in PWM inverter with harmonic analysis and ways to eliminate it. The circuit can be further modified to provide protection against short circuits and over current by adding additional features to the controller PIC16F616.

ACKNOWLEDGEMENTS

This work was supported by Electrical and Electronics Engineering Department, Mar Athanasius College of Engineering, Kothamangalam.

REFERENCES

[1]. Arul Daniel's, Santhoshkumar.B, and H. HabeebullaSait "Analog controller for photovoltaic array fed inverter driven Single phase induction motor" IEEE Conference 2009.

[2]. Dr. P.S Bimbra, Power Electronics,fiffth ed,New Delhi publications,2012.

[3]. Raju. A. B, S. Ramesh Karnik and RohiniJyoti."Maximum Efficiency Operation of A Single Stage Inverter Fed Induction Motor PV Water Pumping System", First International Conference on Emerging Trends in Engineering and Technology

[4]. VarinVongmanee. "The photovoltaic pumping system using a variable speed single phase induction motor drive controlled by field oriented principle", The 2004 IEEE Asia-Pacific Conference on Circuits and Systems, December 6-9,2004.

[5]. Ms SunithaUndrajavarapu, M Srinivasa Rao, Mr L Udav Kiran "Photoyoltaic array fed Boost Spwm InverterDriven Single-Phase Induction Motor", The International JournalOf Engineering Research and Applications (IJERA) ISSN: 2248-9622 vol.2, issue 4, July August 2012, pp. 2136-2141