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Pv-Fc Systems Fed Multilevel Inverter by Employing Pi Controller

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Abstract: ***This paper presented a seven level Photovoltaic (PV) solar cell system & Fuel cell designed in support of grid connected network by employing Pulse Width Modulation control scheme. The input power source comprises of PV source & Fuel cell. Modified MPPT algorithm (P&O) is use just before take out the maximum control from Photo voltaic system. The structure of the circuit is multi modular towards convert dc input voltages to dc output voltages among low rate devices at low duty cycle. A Proportional Integrate controller is to be implementing for multilevel inverter operating & closed loop analysis is done. One reference signal is to be impossible to tell apart to each other by means of an balance equivalent towards the triangular signal are used to make PWM signals intended for the switch. In the Proposed system will be verified during MATLAB/Simulink. The tentative result is compared among the predictable distinct phase seven level grids connected with Pulse Width Modulation generator.***

Keywords: MPPT (P&O) algorithm, PWM Inverter, PV-FC system, Proportional Integrate current controller.

I. INTRODUCTION

Photovoltaic (PV) causes are new today in numerous presentations when they have upsides-of being support & contamination free. Sun oriented electric-vitality requests have developed reliably by 25%–30% per annum over recent years, which is basically because of the diminishing expense & costs. India is one of rapidly creating countries simultaneously as far off since vitality use. At the present time, it is the fifth greatest shopper of vitality under earth with will turn into the third greatest by 2030 [1]. The country is profoundly subject to fossil wellspring of vitality expected for its interest. Because of current situation of vitality utilization, India is gradually focusing just before sustainable power source capital. Right now interest for power is expanding rapidly so it is diminish to the hole between request & supply, India have producing 20GW of Solar Power by 2025. Photovoltaic (PV) cells be enormous region semiconductor that changes over sunshine into power [2]. PV framework transforms into incredibly appealing course of action due to the vitality emergency & condition issue, for example, contamination & a dangerous atmospheric devotion impact.

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The first challenge in reaping of sun based energy is with the end goal of PV board is a flexible power-source. These are the prime difficulties inside incorporating them through framework [3-5]. It is hypothetically perceived that temperature, wind speed, pneumatic force, high temperature, & sun oriented region & so forth control the result as far as execution.

MPPT calculations are particularly required in PV application since the power extricated from an average sunlight based board shifts among the confinement & temperature. Hence we require utilizing MPPT calculations to secure the most extreme power from sun powered PV source [6-8]. In the present paper, changed P&O_MPPT calculation be utilized for PV framework to follow most extreme power. Also PEM Fuel cell is utilized as another source [9-10]. The vast majority of the examination works utilized regular Boost-converters for increase voltage acquired commencing sources other than at this point Multilevel Boost converters [11-12] are utilized to increase voltage got on or after the sources.

Examination of Boost-Converter & Multilevel Boost Inverter for half & half PV-FC framework is finished [11]. The remainder of the segment is composed an as pursues: in area II about present existing frameworks &segment III presents the proposed frameworks. Displaying of PV unit is clarified in segment IV. Demonstration of fuel is studied in V.

II. EXISITNG SYSTEM

Fig. 1 Shows the PV-FC based multilevel inverter with open loop system. It consists of Fuel cell, PV source, multilevel boost converter & multilevel inverter. The main drawback of this system there is no feedback controller so it cannot be operating automatically.

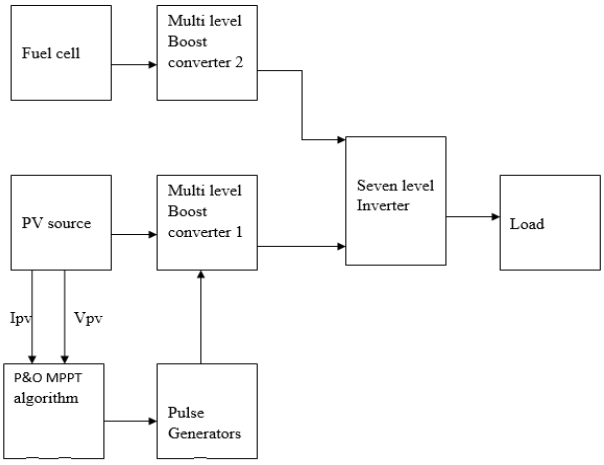


Fig. 1 Circuit Diagram of Existing structure

III. PROPOSED SYSTEM

Fig. 2 shows the proposed PV-FC based multilevel inverter with closed loop controller. The system consists of photovoltaic source, fuel cell, multilevel boost converter, multilevel inverter & load. The closed loop PI controller for operating the multilevel inverter as shown in Fig. 2.

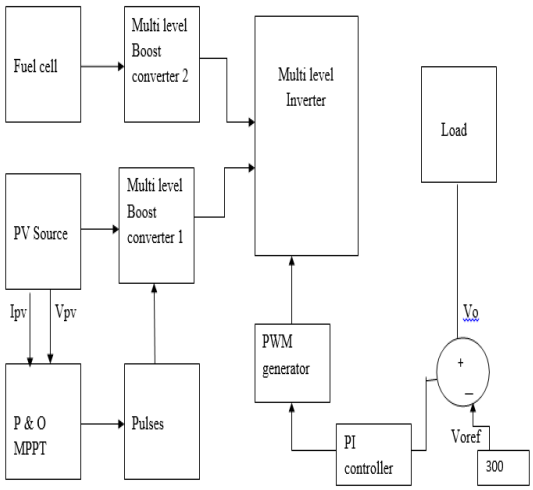


Fig. 2 Circuit diagram of the proposed MLBC-MLI framework

The output of PV-FC in variable DC is converted by constant dc with step up voltage by employing multilevel boost converter. The multilevel boost converter Output is input of multilevel inverter. Here multilevel inverter converts the constant DC into AC with multilevel i.e., 7 levels. The load voltage is subtracted with the reference voltage & it is passes through the PI controller & after that the signal is goes through the PWM generator. PWM generator generates the pulse to the inverter for controlling.

IV. DISPLAYING PV UNIT

Fig. 3 illustrate Photo voltaic cell model circuit, it consists of shunt & series resistances as shows in figure. The PV cell is device which converter solar energy into to electricity i.e., variable DC supply.

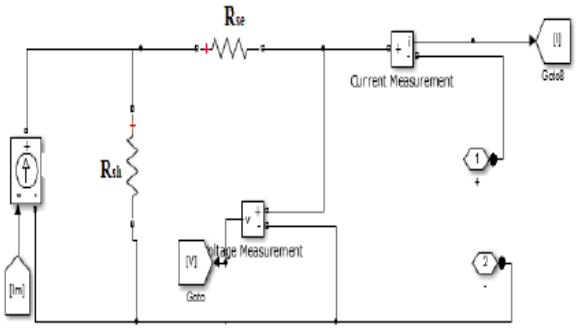


Fig. 3 Photo Voltaic Model Circuit

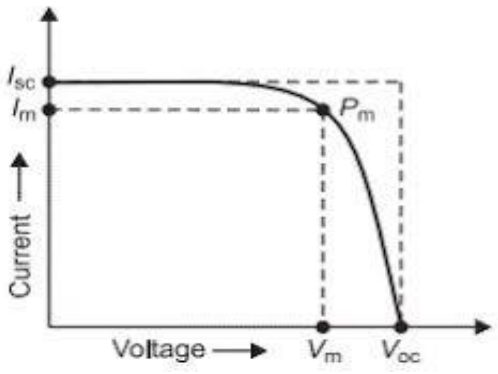


Fig. 4(a) P-V Characteristics of PV Cell

By seeing V-I characteristics of PV cell, the overall current as

$$I = I_{PV.CELL} - I_{o.CELL}\left[\exp\left(\frac{qV}{akT}\right) - 1\right] \quad \text{----(1)}$$

In PV system series connected cells & parallel connected cells are represented depending upon the current & voltage. If increases the voltage cells are associated in series & if increases the current cells are associated in parallel. So overall current written as below,

$$I = I_{PV} - I_o\left[\exp\left(\frac{V + R_s I}{V_t a}\right) - 1\right] - \frac{V + R_s I}{R_p} \quad \text{----(2)}$$

In some conditions R_{sh} is high &R_{se} is low. So the diode overload current is written as

$$I_o = (I_{sc.n} + Ki\,\Delta T) / (\exp(V_{oc.n} + Kv\,\Delta T)/ \alpha T)) \quad \text{-----(3)}$$

V. FUEL CELL

A Fuel cell is an device which changes chemical-energy into electrical energy i.e., DC supply. The operation is depending upon the electrochemical reaction of H_2fuel with O_2. Fuel cell consists of anode, cathode & electrolyte. Provisionally electrolyte there are many types of Fuel cell. Compared to conventional fuel cell proton conversation membrane fuel cell is best device due to its high efficiency & response time was fast. In this project Proton Exchange Membrane is use for better improvement

VI. P & O ALGORITHM

The MPPT (maximum power point-tracking) is very difficult task because the PV I-V curve depends on together instance power & working high temperature. Many methods have existed but The P & o MPPT algorithm is simple& direct control algorithm compare to another algorithms. The below figure.4 shows the characteristics of P &O algorithm with PV curve.

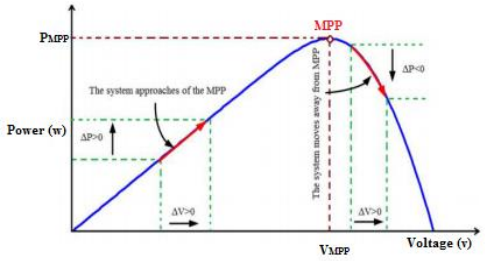


Fig. 4(b) P-V Characteristics of PV Cell

This algorithm depends upon the voltage & power variables as shown in flow chart. Firstly measure the Power & Old Power, when the measured power or output power increases the process will continues otherwise perturbation reverses. Here the total process depending upon the voltage & power only. When the voltage increases & decreases, immodestly check the power increases & decreases. If voltage increases it indicates to that increases power, in this case working point of the PV section is left of the MPP. & if voltage decreases it indicates to the decreases the power, i.e., the working point of a PV section is right of MPP. If increases voltage it indicates to decreases the power in this condition the working point is right of the MPP. & if decreases the voltage it indicate to increases the power i.e. The working point of the PV section in left of MPP. The process of P & O Algorithm is indicating in below Fig. 5.

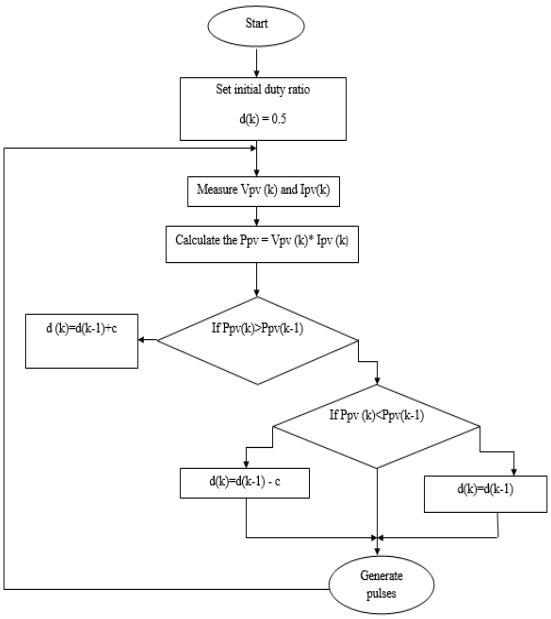


Fig. 5 P & O MPPT Algorithm flow chart

VII. RESULTS ANALYSIS

The Table - 1 indicates the Solar PV parameters which are used in this simulation.

Table - 1 indicates the Solar PV system parameters

Parameters of SPV system	Specifications
Voc	20V
Isc	3.2A
Voltage at MPP	55.16V
Current at MPP	15.5A
Temperature	298K
Irradiance Level	1000 W/m^2

The Fig. 6 indicates MATLAB/SIMULINK diagram of suggested PV-FC based multilevel boost converter with PI controller, Fig. 7 indicates the PV module subsystem, Fig. 8 shows the fuel cell, Fig. 9 indicates the boost converter, Fig. 10 indicates the multilevel inverter & Fig. 11 shows the closed loop PI controller. Fig. 6 contains PV, fuel cell, multilevel boost converter & multilevel inverter.

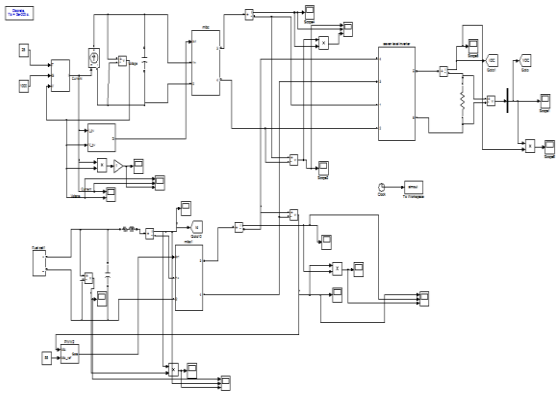


Fig. 6 MATLAB/SIMULINK Illustration of projected structure

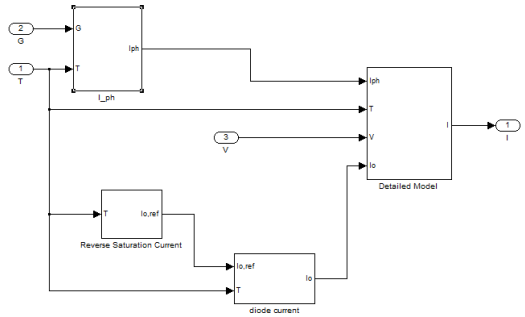


Fig. 7 PV module subsystem

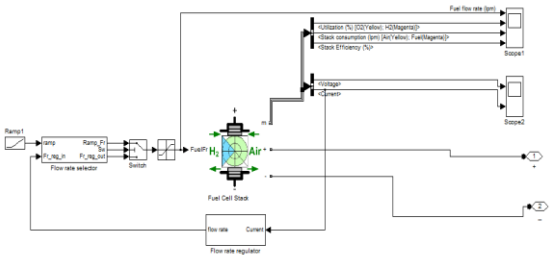


Fig. 8 Fuel cell

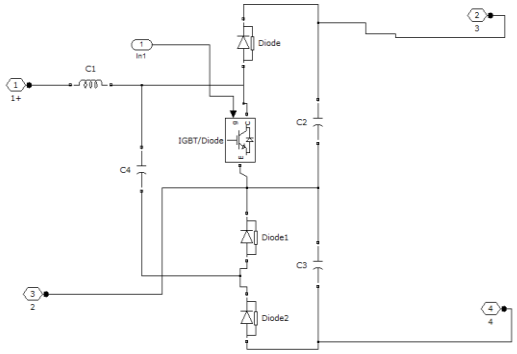


Fig. 9 Boost converter

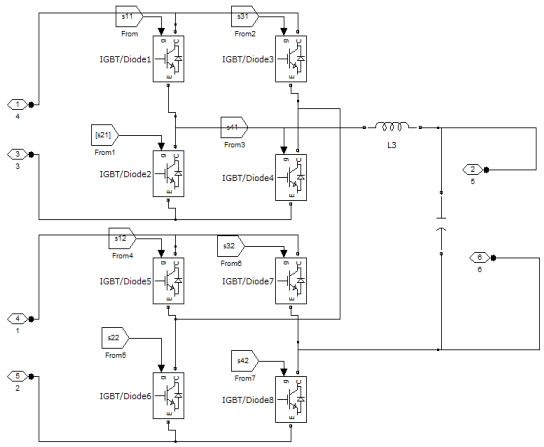


Fig. 10 Multilevel inverter

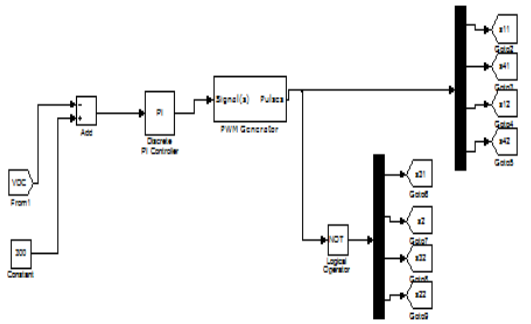
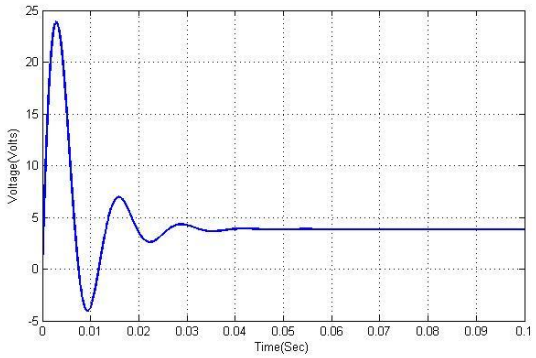


Fig. 11 Closed loop pi controller

Fig. 12 appearances PV Voltage, PV Current & PV Power, Fig. 13 express Fuel cell voltage, Fuel cell current & Fuel cell Power, Fig. 14 indicates the MLBC-1 Voltage, Current &Power, Fig. 15 shows MLBC-2 Voltage, Current& Power.

By observing analysis the PV voltage is variable 4volts dc & current is 300amps & power is 1220 watts. The PV source is connected to multilevel boost converter - 1. The multilevel boost converter converted 4volts into 230 volts as indicate in Fig. 14. As well as the fuel cell voltage is 36 volts dc, it is connected to multilevel boost converter - 2, it is converted into 120 volts as indicate in Fig. 15.



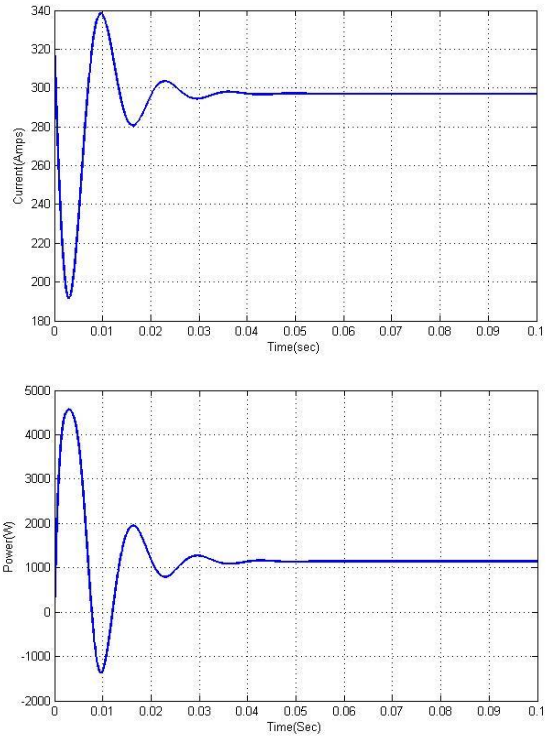
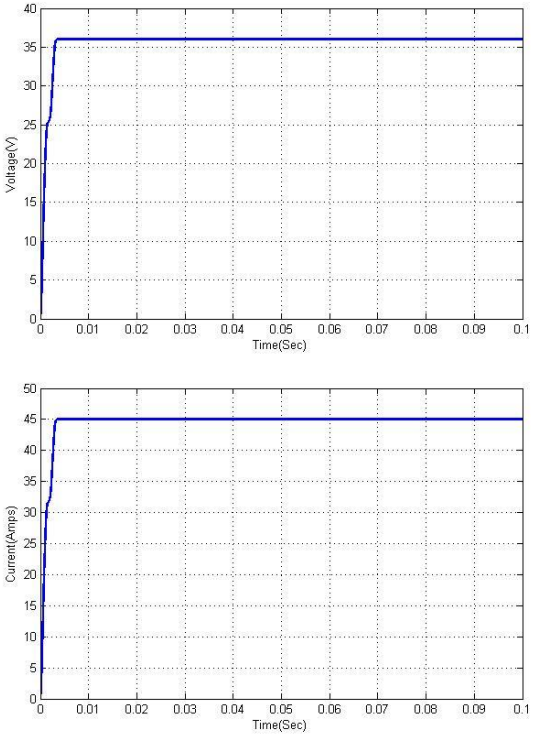


Fig. 12 PV Voltage in Volts, Current in Amps, Power in watts



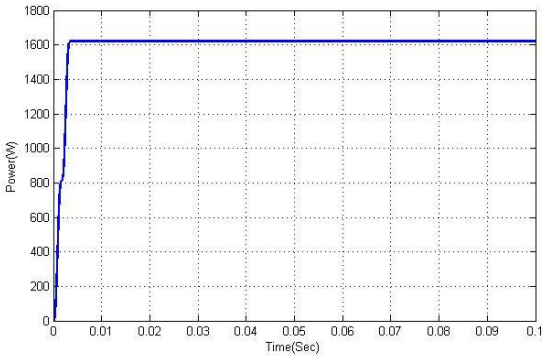


Fig. 13 Fuel Cell Voltage, Current & Power

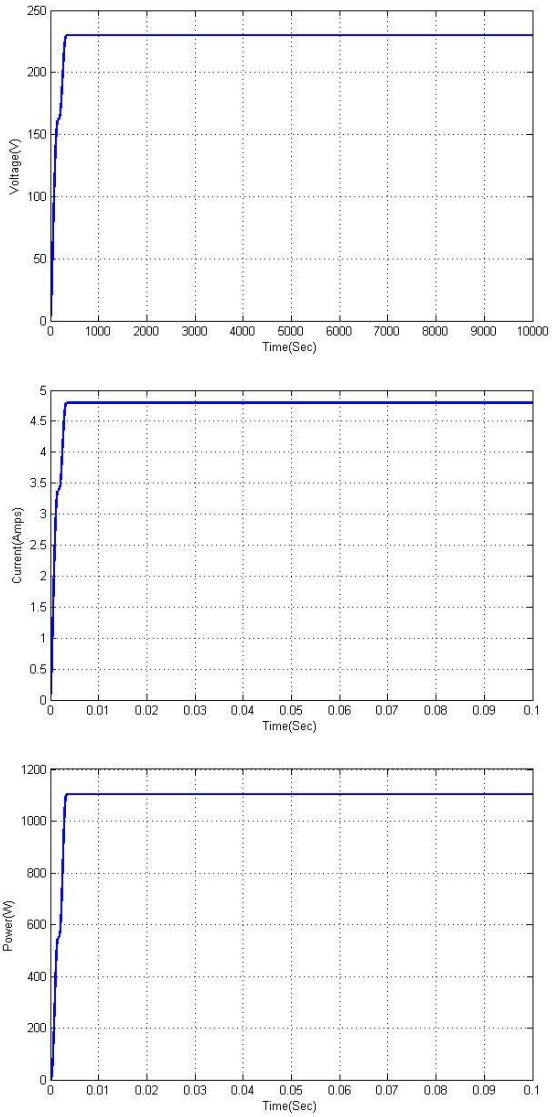


Fig. 14 MLBC-1 Output Voltage (V), Current (A) & Power (W)

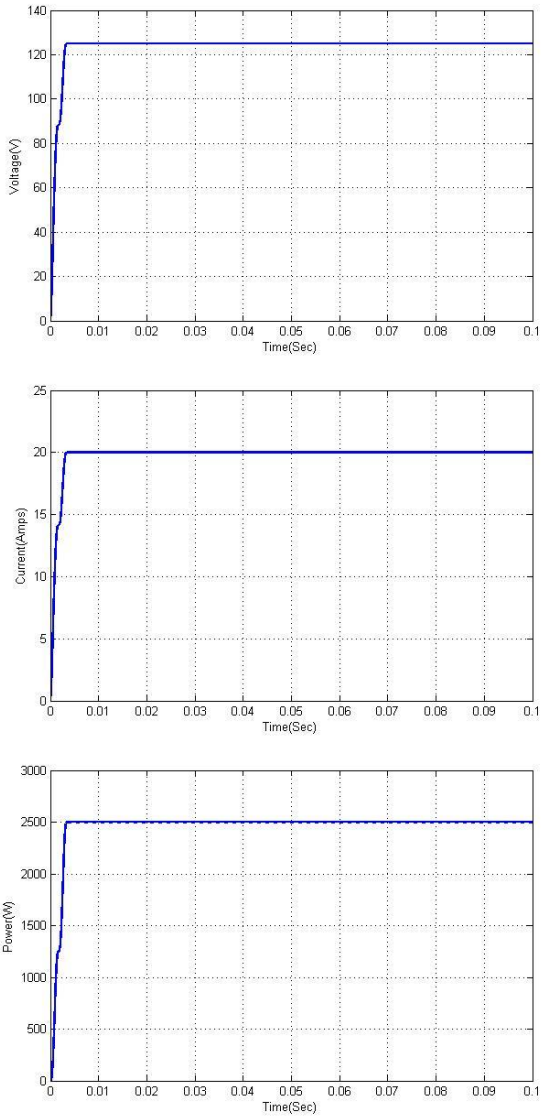


Fig. 15 MLBC-2 output-voltage (V), current (A) & Power (W)

When the multilevel boost converters are integrated & connect to the multilevel inverter. The multilevel inverter consists of h bridges with IGBTs as shown in Fig. 10. Here Fig.16 shows the multilevel inverter Output voltage 350 volts, Fig. 17 shows the Output current & Fig. 18 shows the Output power is 2550 watts.

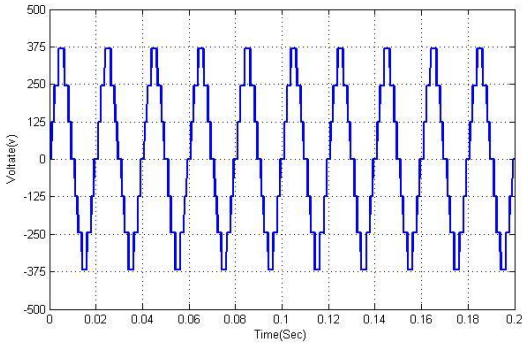


Fig. 16 Output Voltage

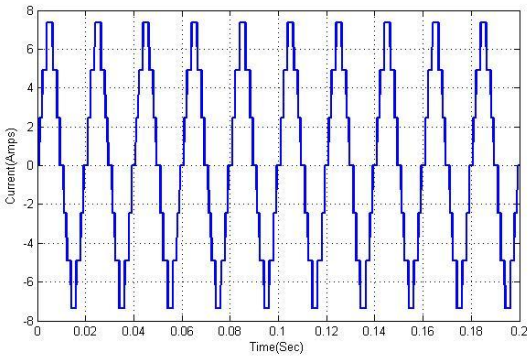


Fig. 17 Output Current

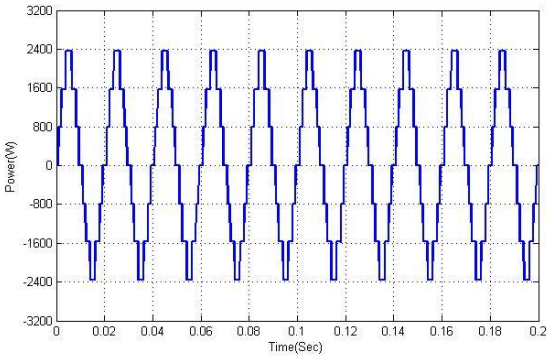


Fig. 18 Output Power

The Table-2 indicates the output specifications of the PV, FC, LBC-1, MLBC-1 & MLI, and Table 3 shows the Output values of Multilevel Inverter.

Table – 2 Input &Output values of the PV, FC, MLBC-1, MLBC - 1

	PV MLBC-1	FC MLBC-2
Output Voltage in volts	240	120

Table - 3 MLI Output values

Output Voltage in volts	350
Output Current in amps	7
Output Power in watts	2550

VIII. CONCLUSION

The Proposed Seven Level Photo Voltaic (PV) Solar Cell system designed in support of grid connected Photovoltaic system through generates with the Pulse Width Modulation control scheme. The current effort is created on closed loop PI controller. The benefits of the recommended framework is high output voltage for similar input voltage to converters commencing sources (PV-FC). Simulation results are studied by MATLAB/SIMULINK environment. In future the proposed system is done for FOPI based - MLI systems.

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