SIMULATION OF AUTOMATED POWER SUPPLY SYSTEM FOR DOMESTIC LIGHTING USING SOLAR BASED SPWM INVERTER AND DIESEL GENERATOR

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ABSTRACT- This paper describes the details of fully automatic system for continuous power supply for domestic load in which solar power, supply mains and diesel generator used as source. System gives output on the predefined priority. First priority is set on solar power, second priority is set on supply mains and last one is on diesel power. For converting solar DC power into AC power, SPWM based voltage source inverter is used. For designing SPWM voltage source inverter, IGBT bridge is used and for generation of SPWM gate pulses, reference sine waves compared with triangular wave. The performance of single phase SPWM inverter fed domestic load is described in detail.

Keywords - SPWM inverter, domestic lighting, Solar power.

1. INTRODUCTION-

Solar power is renewable and environmental pollution free energy source. Solar power battery charged system provides power supply for a day irrespective of bad weather. By adopting the appropriate technology for the concerned geographical location, we can use large amount of power from solar radiations. More over solar energy is expected to be the most promising alternate source of energy. The global search and the rise in the cost of conventional fossil fuel is making supply-demand of electricity product almost impossible especially in some remote areas. Generators can be used as alternative supply source but it can also be used for certain hours of the day and the cost of fueling them is increasing become difficult if they are to be used for commercial purposes. Normally in remote areas domestic lighting is done by either supply mains or by solar power but in bad weather condition solar power is not sufficient for domestic lighting, So other option is supply mains but if both sources are unavailable at a time, so diesel powered generation system is alternative choice.

TABLE - 01. PRIORITY SELECTION FOR LOAD WITH DIFFERENT CASES.

Case	Solar Power	Supply Mains	Diesel Generator	Output Priority
01	0	0	0	No source
02	0	0	1	D/G set
03	0	1	0	Supply mains
04	0	1	1	Supply mains
05	1	0	0	Solar power
06	1	0	1	Solar power
07	1	1	0	Solar power
08	1	1	1	Solar power

Presently domestic lighting system is done by manual system so there is problem with continuous lighting system at remote location. In which load is automatic shifted from one source to another source on the basis of predefined priority and also controlled by battery charging and discharging process. Solar power is first priority for load because it is renewable, non-polluted energy source, second

priority is on supply mains and last priority is on diesel powered generator .Table 01 shows output priority of supply for load within different cases. In this table, '0' represent unavailability of source and '1' represent availability of source. For converting DC power into AC power, output IGBT based SPWM inverter is used.

2. PROPOSED SYSTEM-

2.1 Block diagram of proposed system- Complete block diagram of proposed system is shown in figure2.1.1. In which solar panel is connected to charging current controller. Output of charging current controller is connected to battery voltage controller, which controls battery charging process as battery voltage reaches at preset maximum value so controller automatically turn off battery charging process. For better performance of battery and inverter, charging voltage controller automatically disconnect the load, as battery voltage is low. Battery level indicator also used for indicating the battery voltage level.

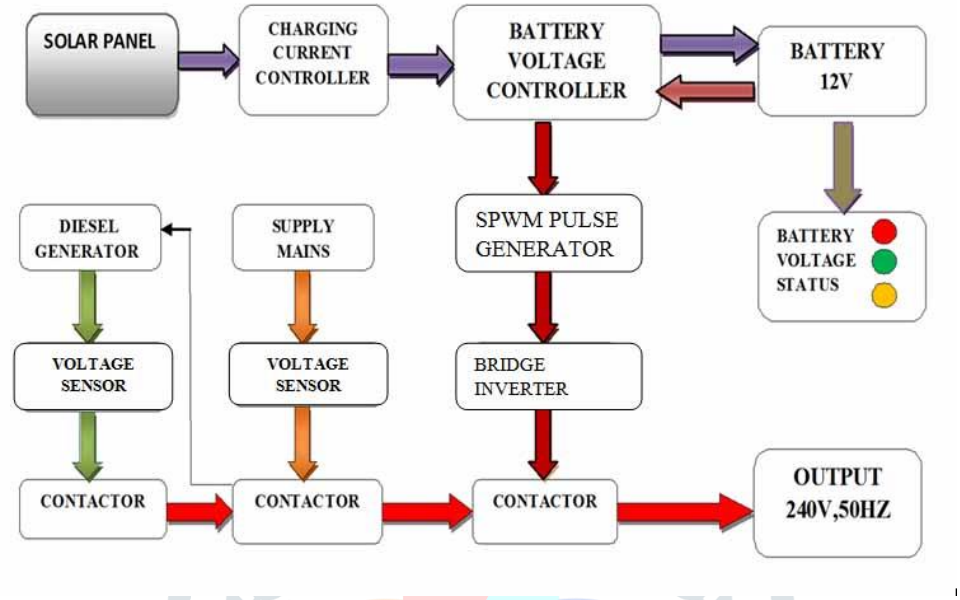

Fig.- 2.1.1 Block diagram of the system

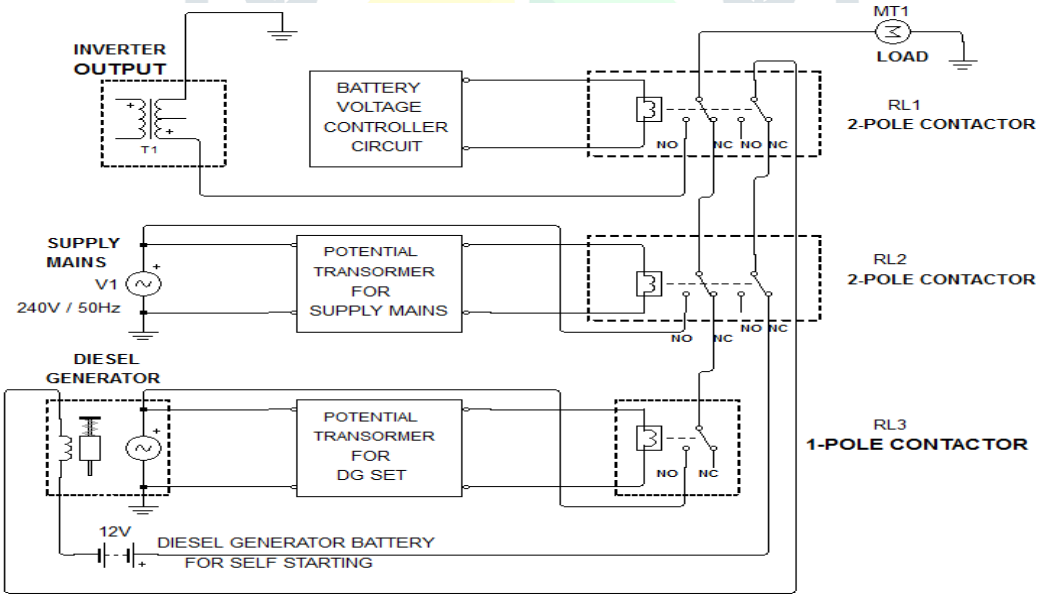

Fig.- 2.1.2 Contactor connection for priority selection

Main function of system is to maintain continuity of output supply. For continuous power supply 3 different electrical sources are used. These sources are solar panel, supply mains and diesel generator. With the help of switching setting of contactors first priority set on solar based SPWM inverter, second priority set on supply main and last priority set on diesel generator. IGBT based voltage inverter gated through SPWM gate pulses, The gating signals are produced by comparing a sinusoidal reference wave with a high frequency triangular signal.

The rms ac output voltage

$$V_o = V_s\sqrt{\frac{p\delta}{\pi}} \rightarrow V_s\sqrt{\sum_{m=1}^{pn}\frac{\delta_m}{\pi}}$$

Where,
p = number of pulses
δ= pulse width

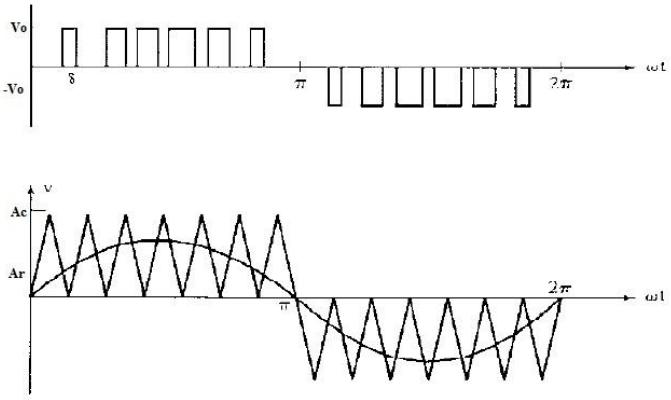

Fig.- 2.1.3 Sinusoidal Pulse Width Modulation

voltage sensor are used for sensing voltage level of supply mains and diesel generator, as the voltage comes is in normal range (200-240). So, contactor is operated on the basis of priority setting source when connected to domestic load system.

For inverter and supply mains system DPDT contactor is used , one part of contactor used for priority selection and other part of contactor is used for diesel generator operation, supply mains and inverter side contactor are connected to each other with particular setting for automatic turn on/off diesel generator.

2.2 Model of Complete System-

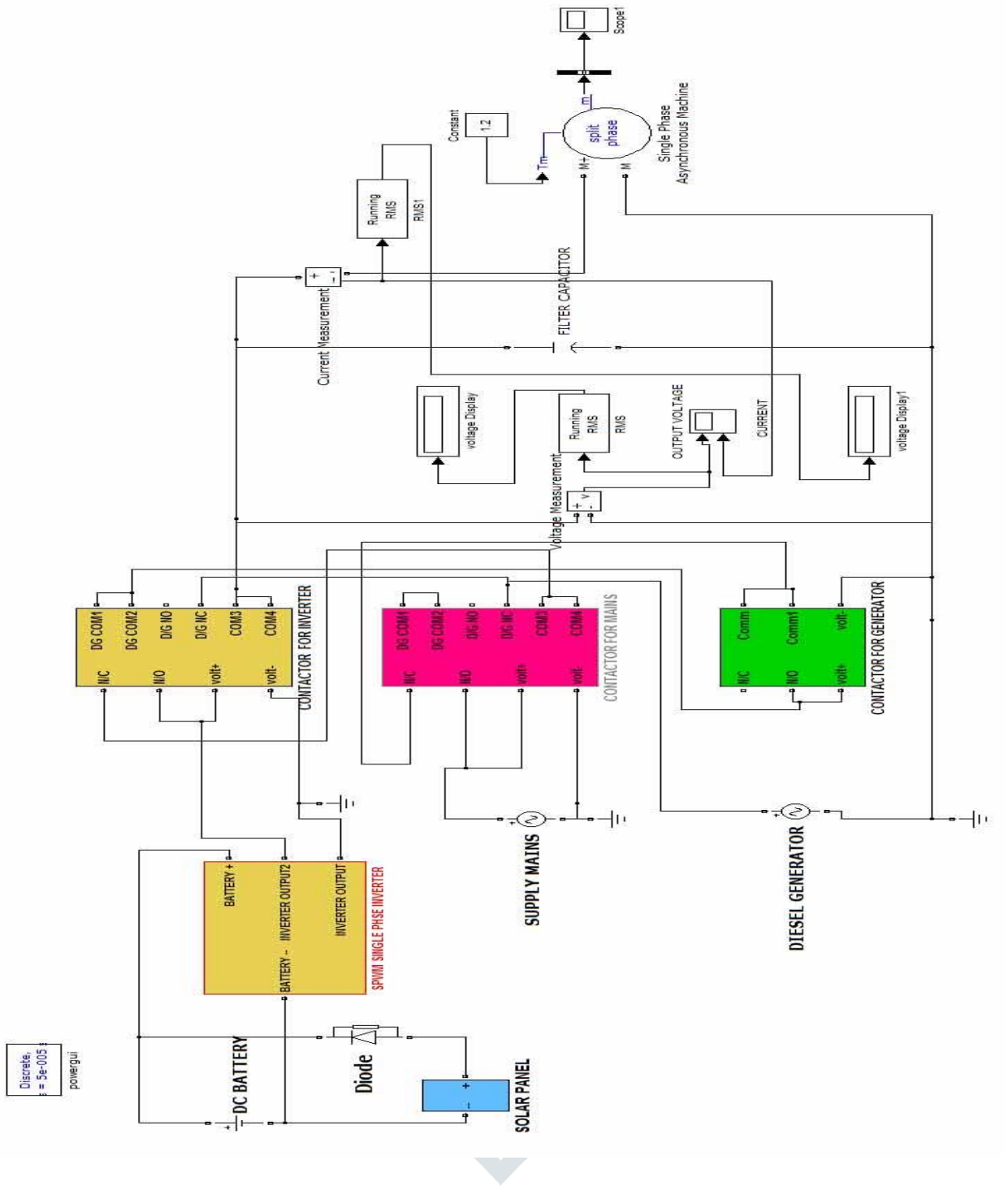

Fig.- 2.2.1 Model of complete system

Main model of system shows in figure 2.2.1, it consist of solar panel for charging battery bank. Battery bank DC Supply is connected to SPWM based voltage source inverter and inverter output connected to the inverter side DPDT contactor. Solar based SPWM inverter have first priority and next one is supply mains. Supply is connected to DPDT supply mains contactor through voltage comparator system , in which supply mains voltage is compared with preset voltage level. As the voltage comes in normal range so, contactor coil is activated and contactor is turn on. Similarly diesel generator supply is connected to D-G side SPDT contactor through voltage comparator system, in which D-G voltage is compared with preset voltage level, as the voltage comes in normal range so contactor coil is activated and contactor is turn on. Single phase split phase type induction motor is used as a load, motor output parameters like speed, stator current, torque can be shown in scope 1 and for load variation constant block is used.

2.2.1 Model Of SPWM Inverter Sub- System-

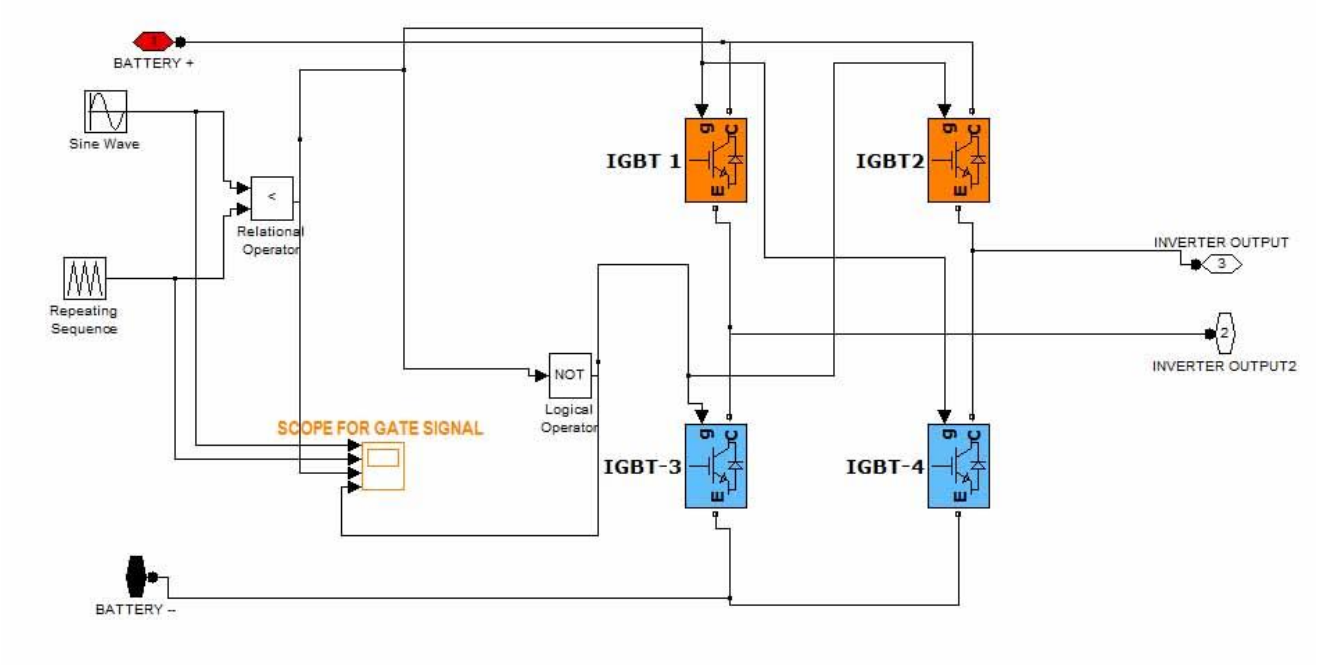

Fig.- 2.2.1.1 Model Of SPWM Inverter

Fig. 2.2.1.1 shows sub system of SPWM inverter block diagram, in which gating signals are produced by comparing a sinusoidal reference wave with a high frequency triangular signal with the help of relational operator block, 4 IGBT with feedback diode are used for Bridge inverter, IGBT-1 & IGBT-4 works at same time and IGBT-2 & IGBT-3 works for next cycle. IGBT output of inverter collect from the terminal no. 2 and 3.

3. RESULTS AND DISCUSSION

Results are obtained with solar powered SPWM single phase 1000VA MOSFET based inverter with 230V battery bank , which is connected to 4 different loads for analysis of various electrical parameters.

3.1 SPWM Gate Pulse Wave Form

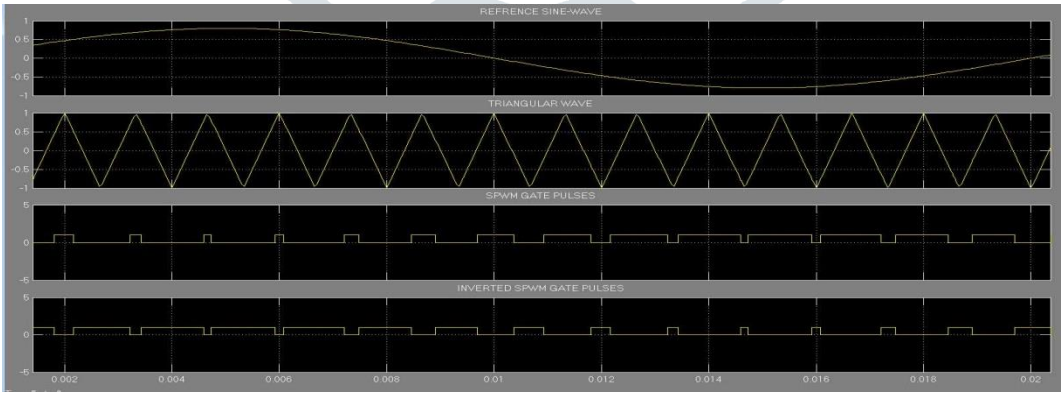

Fig .- 3.1.1 SPWM Gate Pulse Wave Form For 1 Cycle

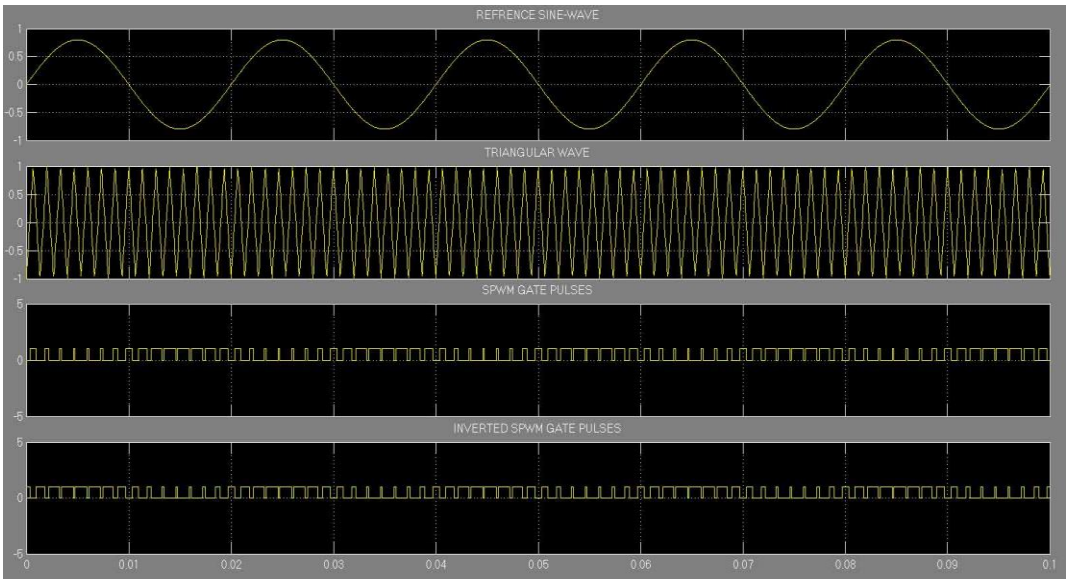

Fig. -3.1.2 SPWM Gate Pulse Wave Form in 0.1sec

CASE 1-40 ohms pure resistive load connected to inverter

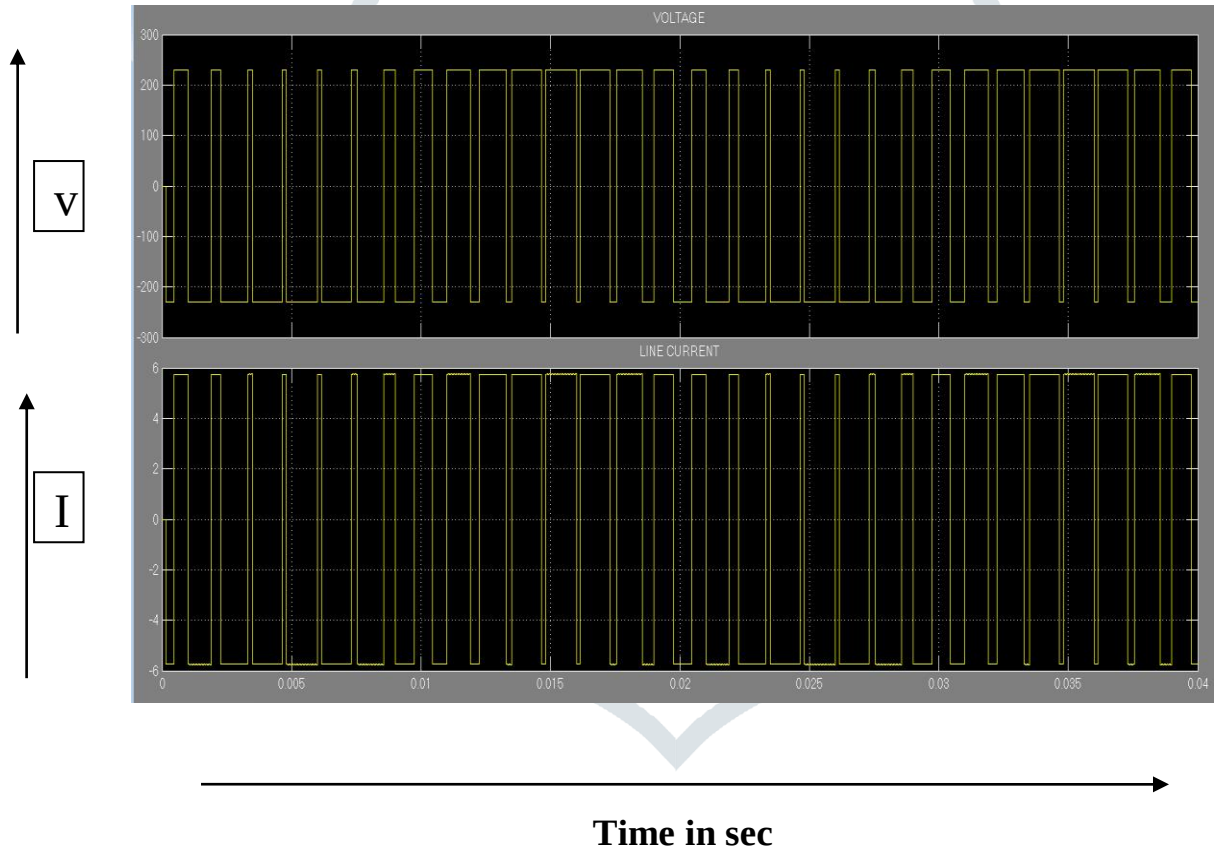

Fig.- 3.1.3 voltage and current wave form under 40 ohm resistive load

Table- 3.1.1 Output Parameter under 40 ohm resistive load

S.NO.	PARAMETER	VALUE
1	V_{dc}	230V
2	V_{ac}	229.8 V
3	I_{ac}	5.745 Amp
4	LOAD	40 ohm

Case- 2 0.25 HP, 230 volt induction motor connected to inverter with 1.2 Newton meter load.

TABLE 3.1.2Induction Motor Parameter

Nominal power, voltage, and frequency [Pn(VA), Vn(Vrms), f(HZ)]
[.25*746 230 50]
Main winding stator [Rs(ohm), Lls(H)]
[2.02 7.4e-3]
Main winding rotor [Rr'(ohm), Llr'(H)]
[4.12 5.6e-3]
Main winding mutual inductance Lms(H)
0.1772
Auxiliary winding stator [RS(ohm), LlS(H)]
[7.14 8.5e-3]
Inertia, friction factor, pole pairs, turn ratio(aux/main) [J(kg.m^2), F(N.m.s), p, NS/Ns]
[0.0146 0 2 1.18]
Disconnection speed wc (% synchronous speed)
75
Initial speed w0 (% synchronous speed)
0

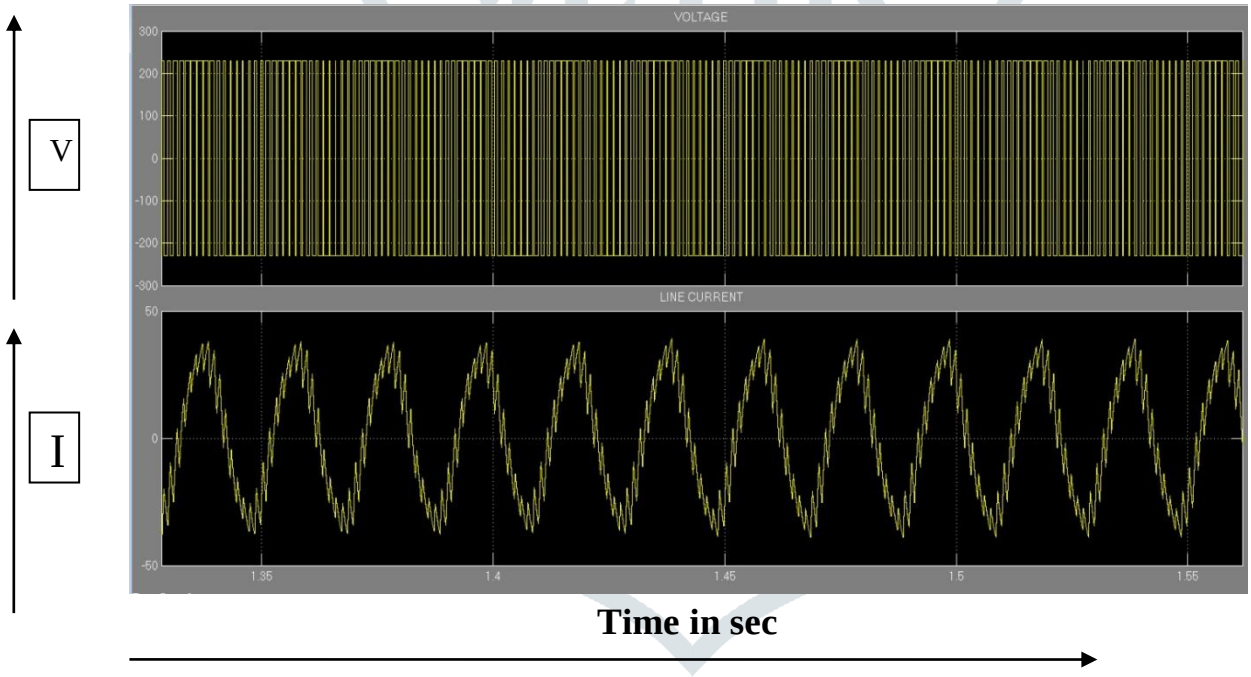

Fig.-3.1.4 voltage and current wave of induction motor connected to inverter with 1.2 Newton-meter load.

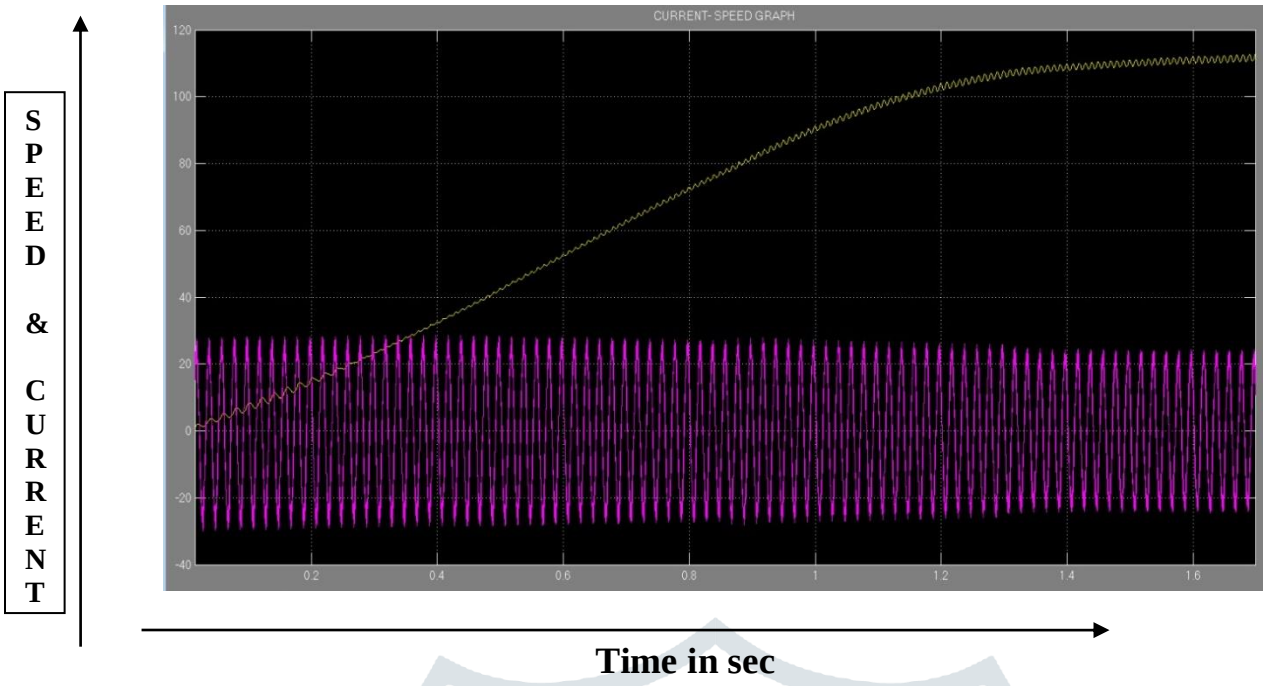

Fig.-3.1.5 speed (rps) and current wave of induction motor connected to inverter with 1.2 Newton-meter load

Table 3.1.3 Output Parameter of 1-phase induction motor under 1.2 N-m load.

S.No.	PARAMETER	VALUE
1	V_{dc}	230V
2	V_{ac}	229.8 V
3	I_{ac}	24.65 Amp
4	LOAD	1.2 Nm
5	SPEED	114.1 rps

Case -3 1 HP, 230 volt induction motor connected to inverter with 1 .5 Newton-meter load.

TABLE-3.1.4 Induction Motor Parameter

Nominal power, voltage, and frequency [Pn(VA), Vn(Vrms), f(HZ)]
[1*746 230 50]
Main winding stator [Rs(ohm), Lls(H)]
[2.02 7.4e-3]
Main winding rotor [Rr'(ohm), Llr'(H)]
[4.12 5.6e-3]
Main winding mutual inductance Lms(H)
0.1772
Auxiliary winding stator [RS(ohm), LlS(H)]
[7.14 8.5e-3]
Inertia, friction factor, pole pairs, turn ratio(aux/main) [J(kg.m^2), F(N.m.s), p, NS/Ns]
[0.0146 0 2 1.18]
Disconnection speed wc (% synchronous speed)
75
Initial speed w0 (% synchronous speed)
0

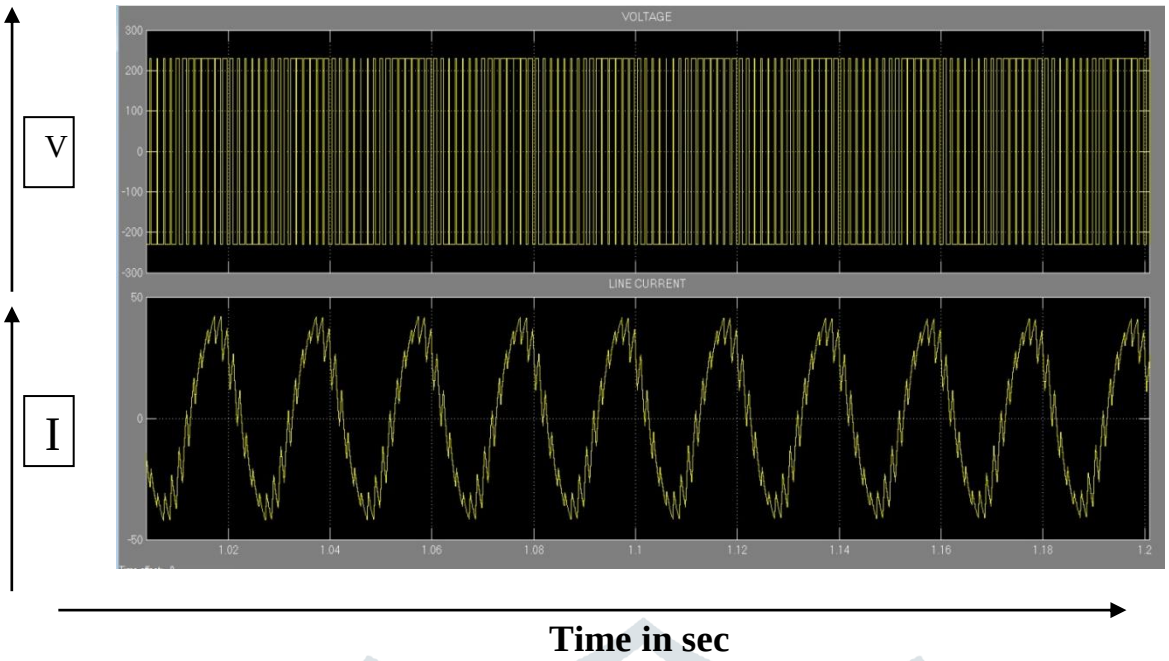

Fig.-3.1.6 voltage and current wave of induction motor connected to inverter with 1.2 Newton - meter load.

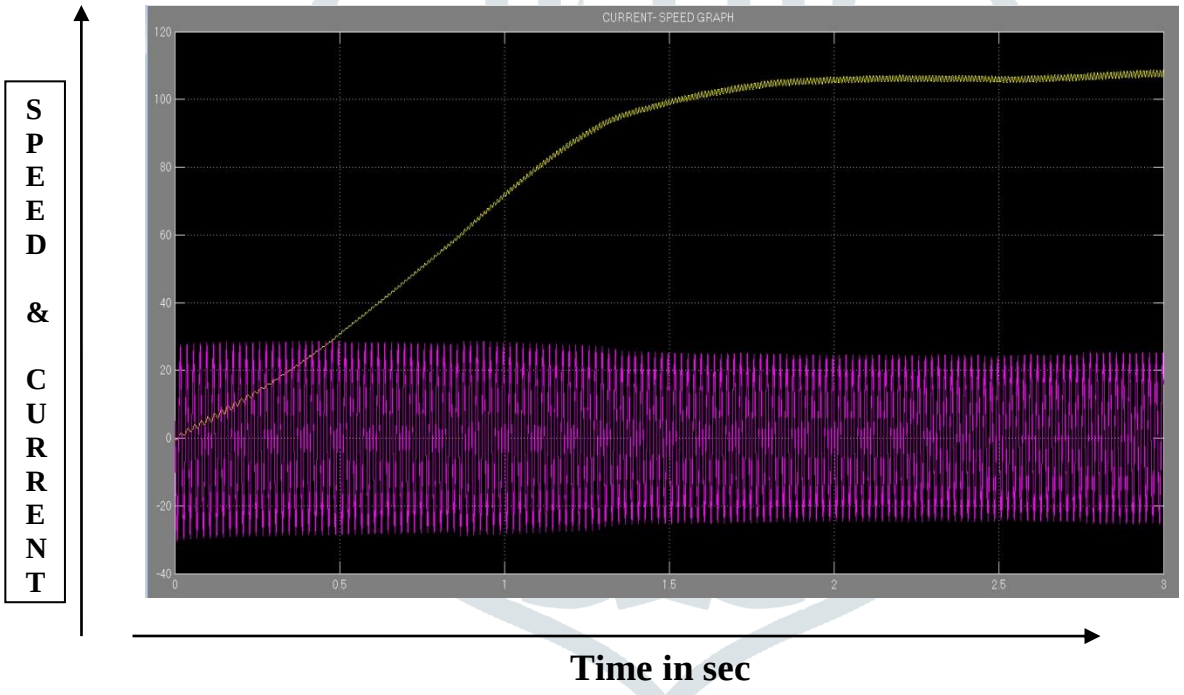

Fig.-3.1.7 speed (rps) and current wave of induction motor connected to inverter with 1.2 Newton- meter load

Table- 3.1.5 Output Parameter of 1-phase induction motor under 1.5 N-m load.

S.No.	PARAMETER	VALUE
1	V_{dc}	230V
2	V_{ac}	229.8 V
3	I_{ac}	25.25 Amp
4	LOAD	1.5 Nm
5	SPEED	108.7 rps

4. CONCLUSION-

As per my research problem "**Implementation of Continuous Power Supply System for Domestic load Using Solar Based SPWM Inverter And Diesel Generator**" has been design in MATLAB 2010. First source priority set on solar power next one is on supply mains and last one is on diesel generator. SPWM inverter produces sine wave output, which reduces harmonics content and power losses

at load side. It is found that the complete designed system working well and giving desired output results. The novelty of designed system is that, batteries are directly charged from the solar panel. So, DC power is available throughout 24 hours. Apart from irrigation some light sources can be used in night. By implementing this type system there are various benefits for the government and the farmers. For the government a solution for energy crisis is proposed. The excess energy produced using solar panels can also be feedback to the grid with small modifications in the system circuit, which can be a source of the revenue for the farmer, thus encouraging farming in India and same time giving a solution for energy crisis.

5. SCOPE OF FUTURE WORK-

This is one of the emerging fields in which lot of researchers interested to work and it has a sufficient scope to extend the work in the following area as**:**

1. This system can also be implemented for three phase system.
2. With the help of moisture sensor, water pump can be automatic turn on and off.
3. In this system 3 input source are used on the priority basis i.e. solar power, supply mains and diesel generator but wind power also can be used as 4^{th} input source.
4. By using GSM module system can be start and stop from the remote location .
5. By using GSM module system sent periodically live status to any particular number.

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