ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAY1045

Solar Based Multilevel Inverter for BLDC Motor Drive

K. Dhana Lakshmi[1]
PG Student
Department of Electrical and Electronics Engineering
Visakha Institute of Engineering & Technology
Visakhapatnam, India

Talada Santhosh[2]
Assistant Professor
Department of Electrical and Electronics Engineering
Visakha Institute of Engineering & Technology
Visakhapatnam, India

T. Sreenu[3]
Assistant Professor
Department of Electrical and Electronics Engineering
Visakha Institute of Engineering & Technology
Visakhapatnam, India

Abstract:- The BLDC motor is widely utilized in high power and low voltage applications because to its simple construction, great efficiency, low maintenance requirements, and low cost .Furthermore, considering their size, they have a lot of torque and power output. The BLDC motor is powered by an alternating current source and is operated straight from the AC supply port, despite being a DC motor in this case. The main drawback is that any disruptions in the source will have an impact on the applications that use BLDC motors in the industrial context. So, to avoid this, there should be a converter and an inverter intermediary between the motor and the source. One of three methods can be used to drive the BLDC motor. 1. Two-level inverters based on pulse width modulation (PWM). 2. An multiple-level working inverter. 3. A multilevel inverter with neutral clamping. Using a multicarrier PWM technique, the suggested inverter may lower the output signal's harmonic content. It is capable of generating very good motor currents. In this instance, a three-level diode clamped multilevel inverter can be used to accurately control the speed of a BLDC.

This study's primary goal is to demonstrate how to run a BLDC drive with an inverter to lower harmonics. A diode clamped multi-level inverter is a device that converts voltage to current. An improved version of this strategy is provided by this research. Using the MATLAB Simulink software tool, one can assess the system's overall effectiveness by simulating the neutral clamp multilevel inverter-based drive system's functioning. In the event of a power outage, the entire application will cease to function and generate output. Under order to increase the output and supply reliability of power, renewable energies must be used under these circumstances. There are many renewable energy sources available; however solar photovoltaic systems are the better option because of their benefits over traditional power sources. A diode clamped multi-level inverter was used. A diode clamped multi-level inverter was used to drive the BLDC.

Keywords:- *BLDC, Multi-Level Inverter, Neutral Point Clamped Diode, THD, Multicarrier PWM, Firing Circuit.*

I. INTRODUCTION

There are numerous advantages to using a BLDC motor, such as its high efficiency, low maintenance requirements, reduced weight, and much more compact design. Because of these built-in benefits, BLDC motors have been utilized extensively in a variety of industrial applications for a long time.

These are the most suitable motors for applications requiring rapid dynamic response in speed response due to their high efficiency and ease of regulation across a wide speed range.

The use of motor drive topologies based on Multi-Level Inverter (MLI) technology is growing in the motor drive sector.

Multilevel inverters are used to create sinus voltages from discrete voltage levels. By providing benefit of three-level topologies is that they would be able to create multilayer voltage waveforms using equipment with a lower voltage rating, which would be very beneficial. The purpose of multilevel inverters is to generate sine values using discrete voltage levels, in contrast to the goal of pulse width modulation (PWM) systems, which produce sinusoids with variable voltage and frequency. different gate signals to the MOSFETs, three-phase sinusoids can be produced at a variety of voltages. There are numerous ways that PWM has been developed and applied to inverters. Sine-Triangle PWM (SPWM) and Space Vector PWM (SVPWM) are the two most often used techniques for generating PWM for multilevel inverters (SVPWM).a kind of multilevel sine triangle PW comparing values pulse width modulation. Several prior studies have examined the use of multilayer inverter systems for the speed control of various motors; these studies have all been published. A few of them are members of this organization. The brushless direct current

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAY1045

(BLDC) motor offers a wide range of applications in high-power systems, according to Yousif Ismail Al Mashhad and collaborators [1].

It is inexpensive, easy to build, low maintenance, more effective, and produces a significant amount of electricity in the output unit. An inverter provides electricity to the BLDC motor, which is a direct current motor. The design and modeling of a three-phase, three-level inverter. Techniques for operating a brushless DC motor are presented in this paper. With controls for phase, frequency, and amplitude, it offers a three-phase voltage source. MATLAB Simulink is utilized in this study to simulate the system and demonstrate its operation. An in-depth description of the modular three-phase multilevel inverter system for brushless DC motor control is provided by Devi Kiran and associates [2].When two switches in a single leg conduct simultaneously while the device is operating, the power supply has shorted out and has to be fixed. At the moment, each switch disperses half of the current, resulting in a 50% reduction in the power cell explosion's intensity. This is economical and reduces system expenses while boosting system dependability. The control circuit and the power supply circuit will be the two categories into which the system's components will be separated. A power rectifier and a three-phase inverter make up the power section. A filter capacitor and a multilayer inverter with three phases of diode clamps complete the power section. A servo motor drive connects the motor to the multilayer inverter, enabling it to operate independently of the inverter. Through the use of a capacitor filter, a three-phase diode bridge rectifier converts an input voltage of alternating current (AC) to an output voltage of direct current (DC). diode bridge rectifier converts an alternating current (AC) input voltage into a direct current (DC) output voltage through the use of a capacitor filter, a three-phase ge.A DC output voltage The amount of ripple content that is actually present in the alternative current output voltage is reduced using a device known as a capacitor filter.After the capacitor filter is applied, pure DC electricity is received by the three-phase multilevel inverter and used for operation.

A direct current (DC) input voltage is transformed into an alternating current (AC) output voltage (DC) by means of 12 MOSFET switches operating in parallel. the opto-coupler, gate driver circuit, and microcontroller make comprise the control circuit of the suggested system, in that order. In particular, the microcontroller is in charge of generating the gating signals required to activate the power MOSFET switches included in the multilevel inverter system.

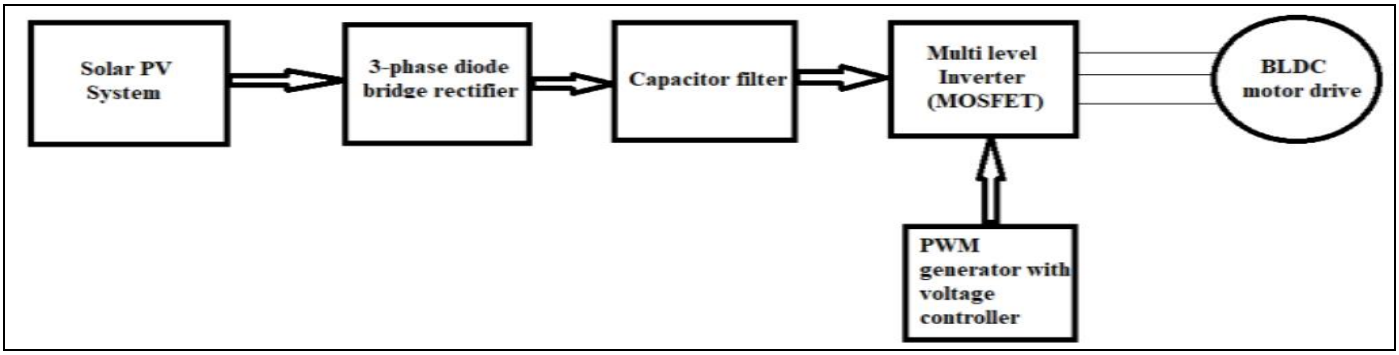

Fig.1 Block Diagram of BLDC Motor

II. MODELLING OF SYSTEM MODEL

➢ *Modelling of System Model*

With an induction motor driver circuit make up the model of a BLDC drive with a multi-level inverter. This Vabc and Iabc represent the output voltages and currents of the inverter.

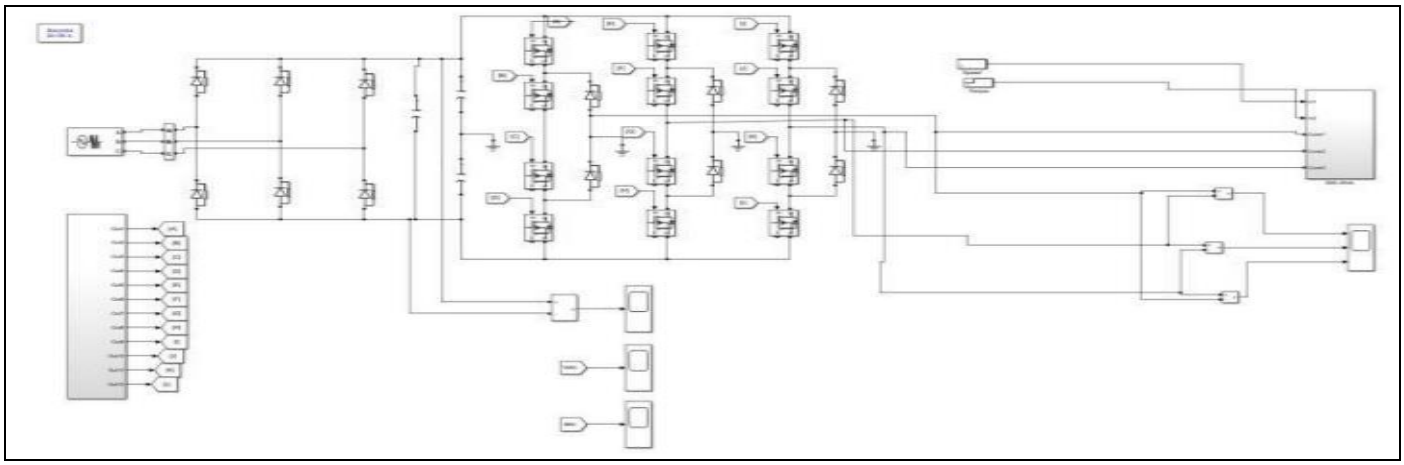

Fig 2 Simulink Model for Multi-Level BLDC Drive Inverter Type

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAY1045

➢ *BLDC Drive Circuit*

The AC7 block from the Specialized Power Systems library has been altered for use in this circuit. For a single 3 HP motor, this model shows a sensor-free DC motor drive with brake chopper. A TAC7 is no longer dependent on hall or speed sensors. A back-EMF observer uses the voltages and currents at the motor's terminals to determine the motor's location and speed. Every 60 electrical degrees, the rotor position produces commutations signals, which are equivalent to hall effect signals.through the use of a Universal Bridge Block, a PWM voltage source inverter powers a trapezoidal back-EMF synchronous motor. The torque benchmark for the current control block is generated by a PI regulator within the speed control loop.

When the torque reference is found, a three-phase current regulator is utilized to supply the motor with the three reference motor line currents in cycle with the back electromotive forces. The block's output terminals give users access to the motor's torque, actual and predicted speed, and current.

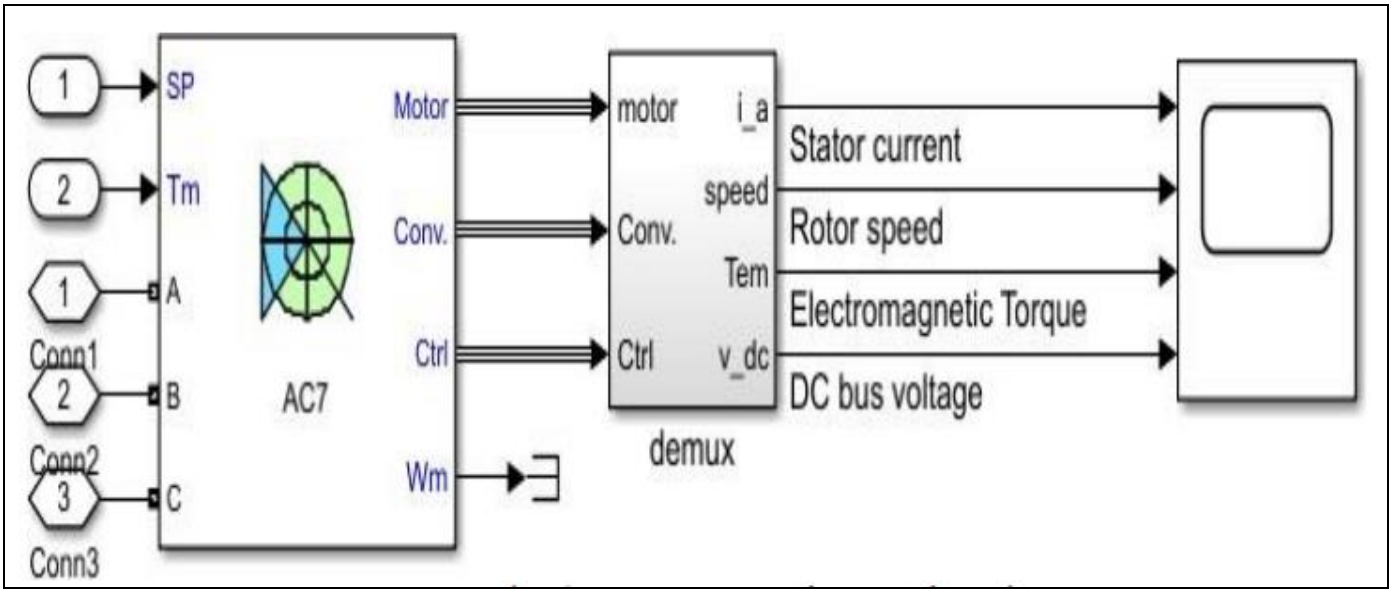

Fig 3 BLDC Driver Circuit

➢ *Multi- Level Inverter*

Multilevel inverter-fed BLDC motors are shown in this work. Powering the diode clamped inverter, which generates several voltage levels, is a bank of consecutive capacitors. Just 50% of the DC bus voltage may be seen across the switches. The voltage source inverter's power rating is nearly quadrupled by these features. Multicarrier PWM may be used by the proposed inverter to reduce harmonic content. It generates superior motor currents. A BLDC's speed is accurately controlled by a three-level diode clamp multilevel inverter.

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

➢ *Multilevel Inverter Simulation*

The three-level neutral point-clamped source for the voltage inverter is depicted in the above figure. It has a total of 12 active unidirectional switches and 6 neutral point clamp diodes. In this figure, "n," the neutrality point between the two capacitors, could be set. Because each switch only needs to block half of the voltage (Vdc/2) this layout offers significant advantages .Their ratings are same. When a switch is not in use, similar-type diodes are employed to clamp the same reference voltage across it or to distribute the voltage equally. .To produce three levels, two switches from each phase leg must always be turned on simultaneously. The dc bus voltage is split into three levels by connecting two bulk capacitors, Ca and Cb, in seri. The switch experiences significantly less voltage stress as a result.

III. SIMULATION RESULTS

A. Results Without Solar PV System Based Multi-Level Inverter

➢ *BLDC Drive Circuit Results*

Given a 250-line voltage input supply source with a 50 Hz frequency, the multilevel inverter's output, which serves as the BLDC motor's input stator current, has a 10A output and with that magnitude, as seen in Figure 4, the motor's torque will be 20 N-M, its stator speed will be 1500 rpm, and its output DC-bus voltage will be 330 volts. (The features of BLDC drives).

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAY1045

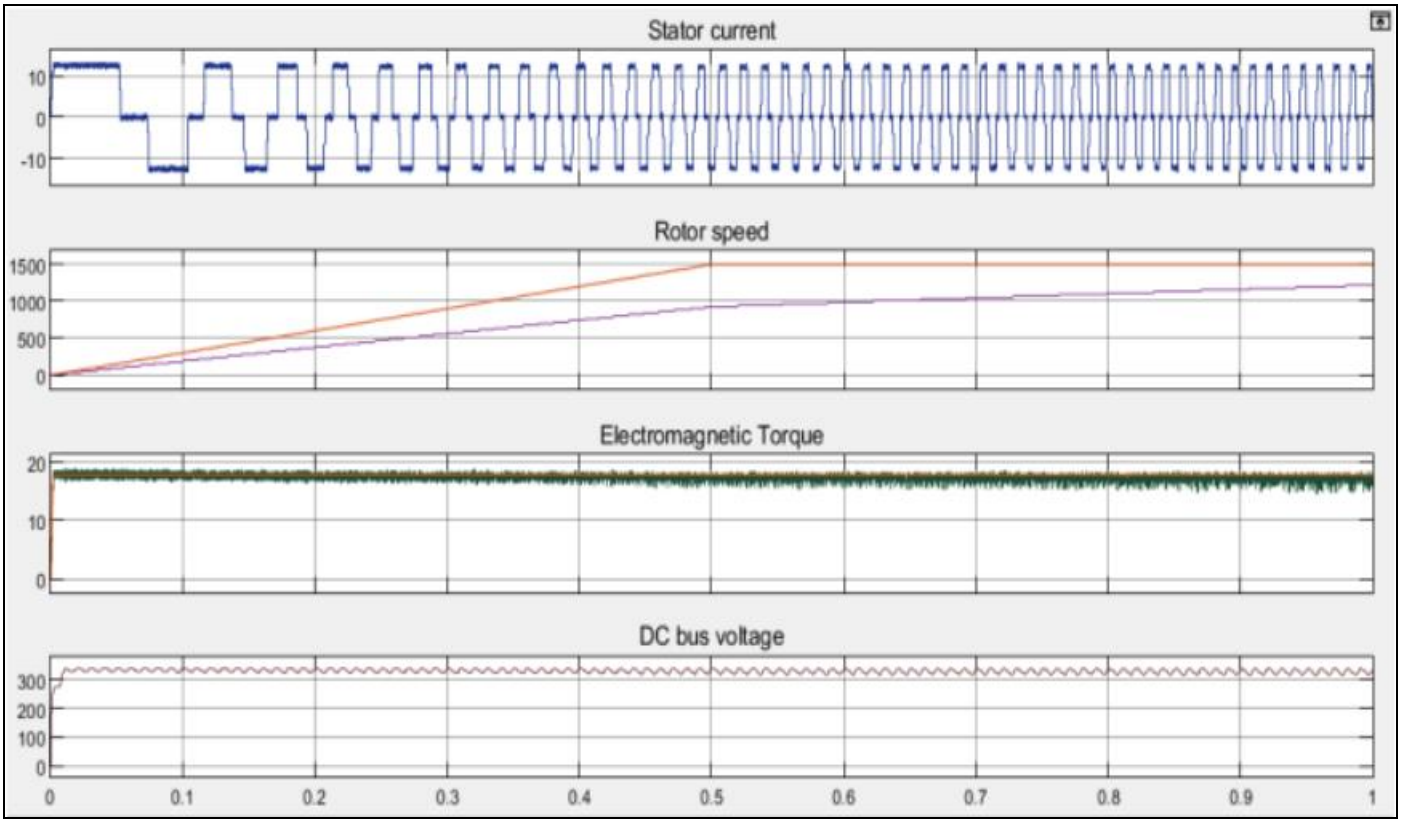

Fig 4 BLDC Drive Characteristics

➢ *Inverter Results*

These are the line-to-line voltages (Vab, Vbc, and Vca) of the inverter output voltages displayed in Figure 5. Figure 6 shows the output DC bus voltage, while Figure 7 shows the output converter voltage.

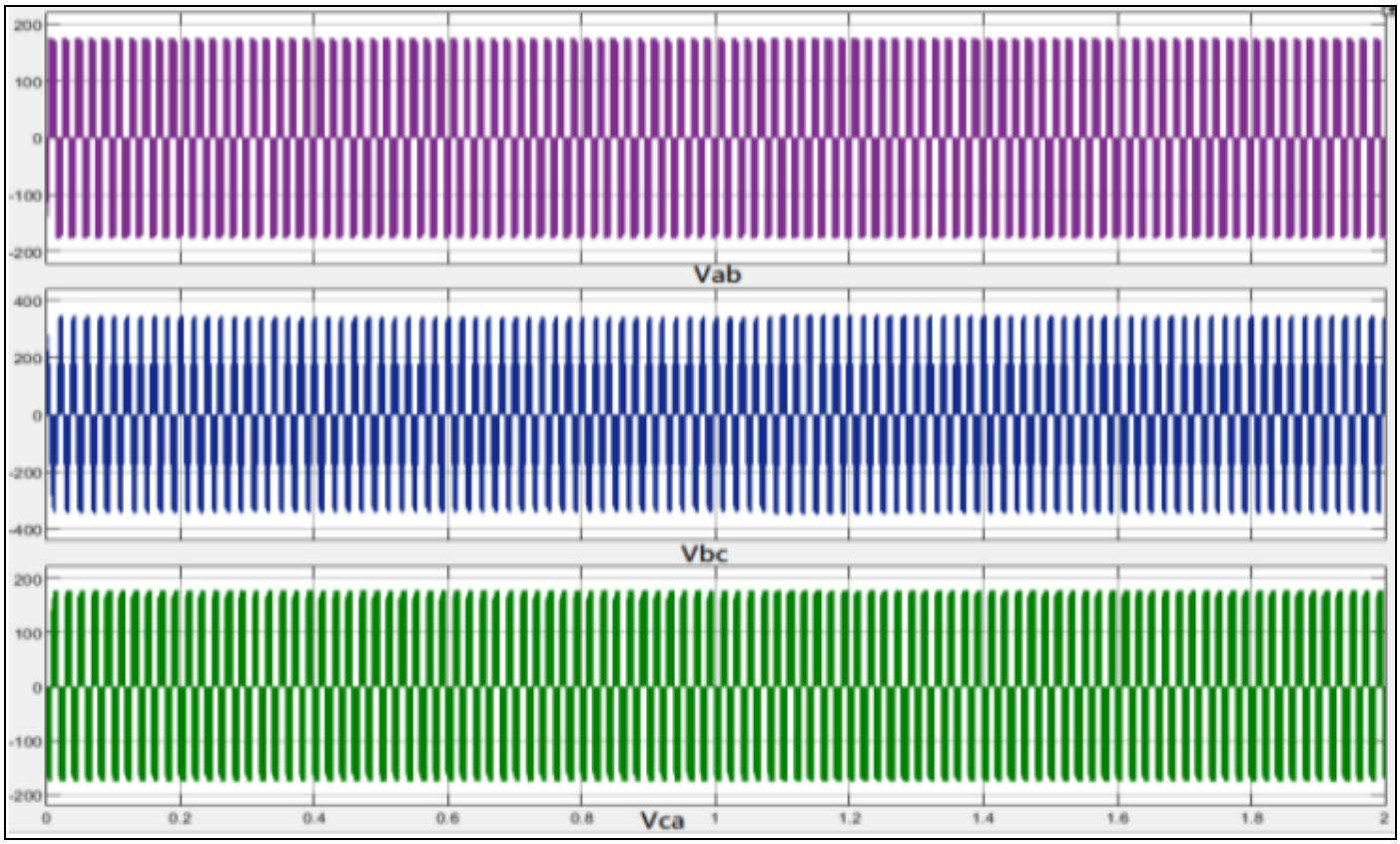

Fig 5 Inverter Output Voltages of Line-to-Line Voltages Vab, Vbc, Vca.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAY1045

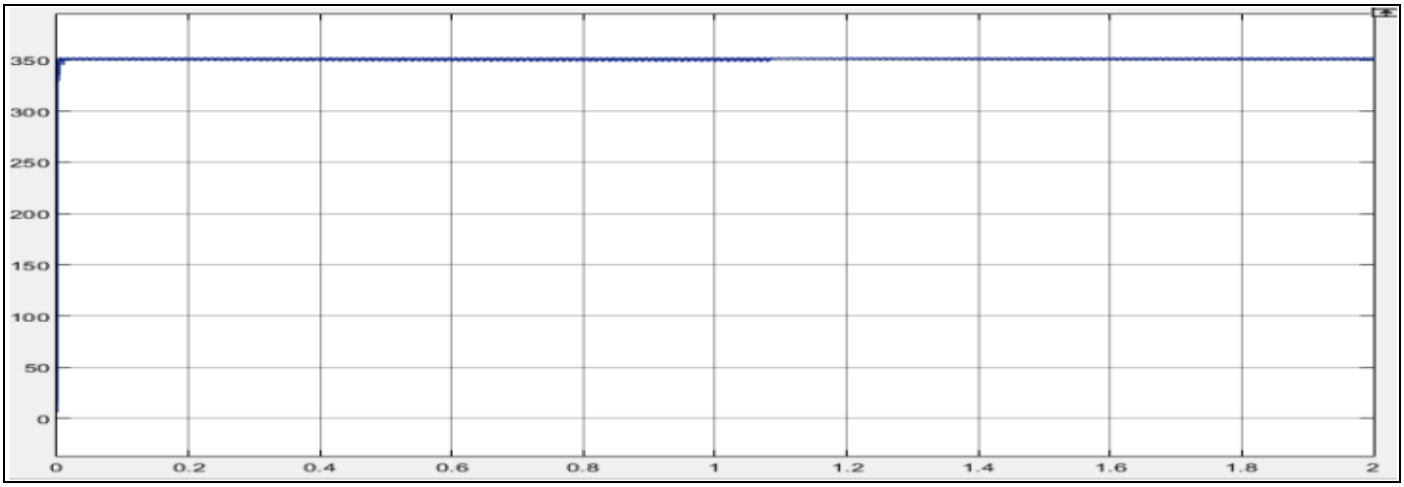

Fig 6 DC Bus Voltage

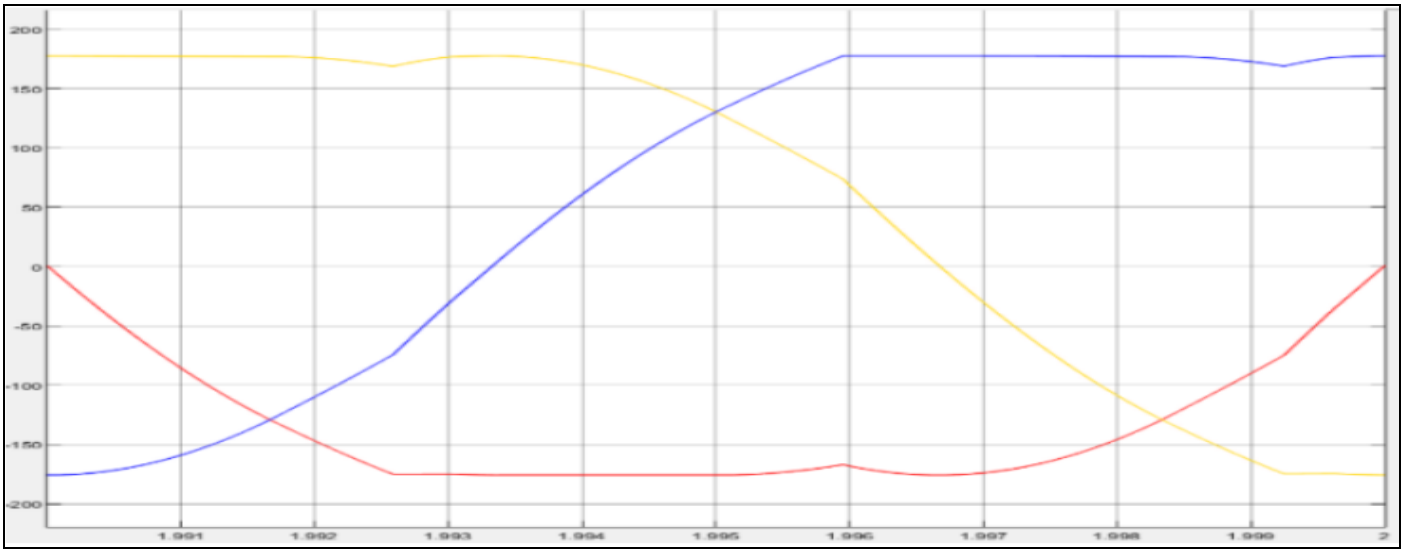

Fig 7 Converter Output Voltage

B. Results with Solar PV System Based Multi-Level Inverter

Constant inputs: solar temperature (25 degrees Figure 8 depicts a solar PV system model with two Celsius) and solar irradiance (1000) These values supplied to a solar panel that has ten parallel strings, each of which has 1000 series-connected modules. The result is an output voltage of about 800 volts and an output current of 80 amps, which is supplied to a BLDC motor drive.

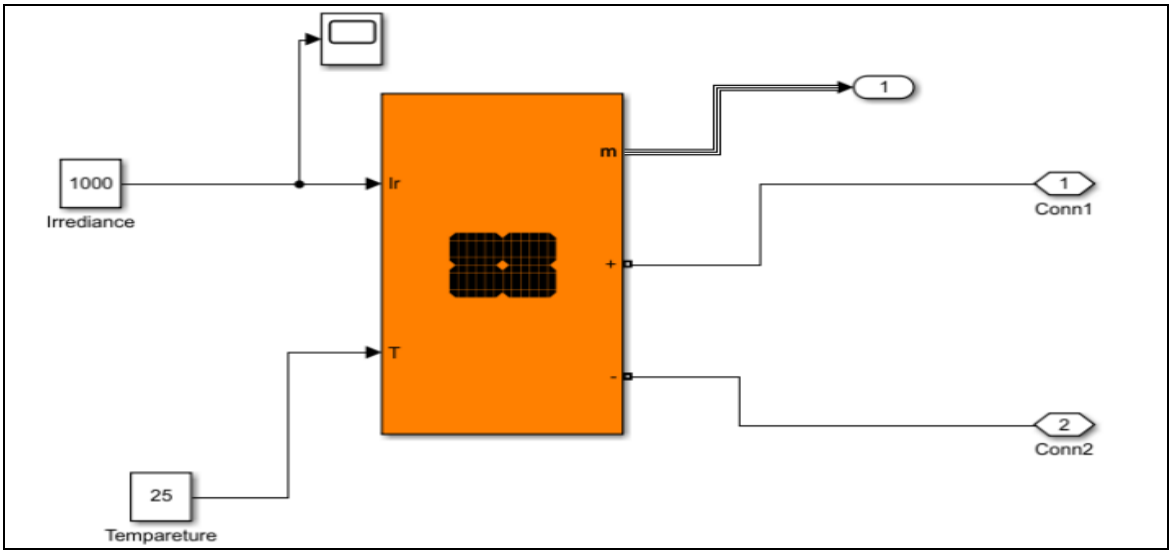

Fig 8 Solar PV System

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAY1045

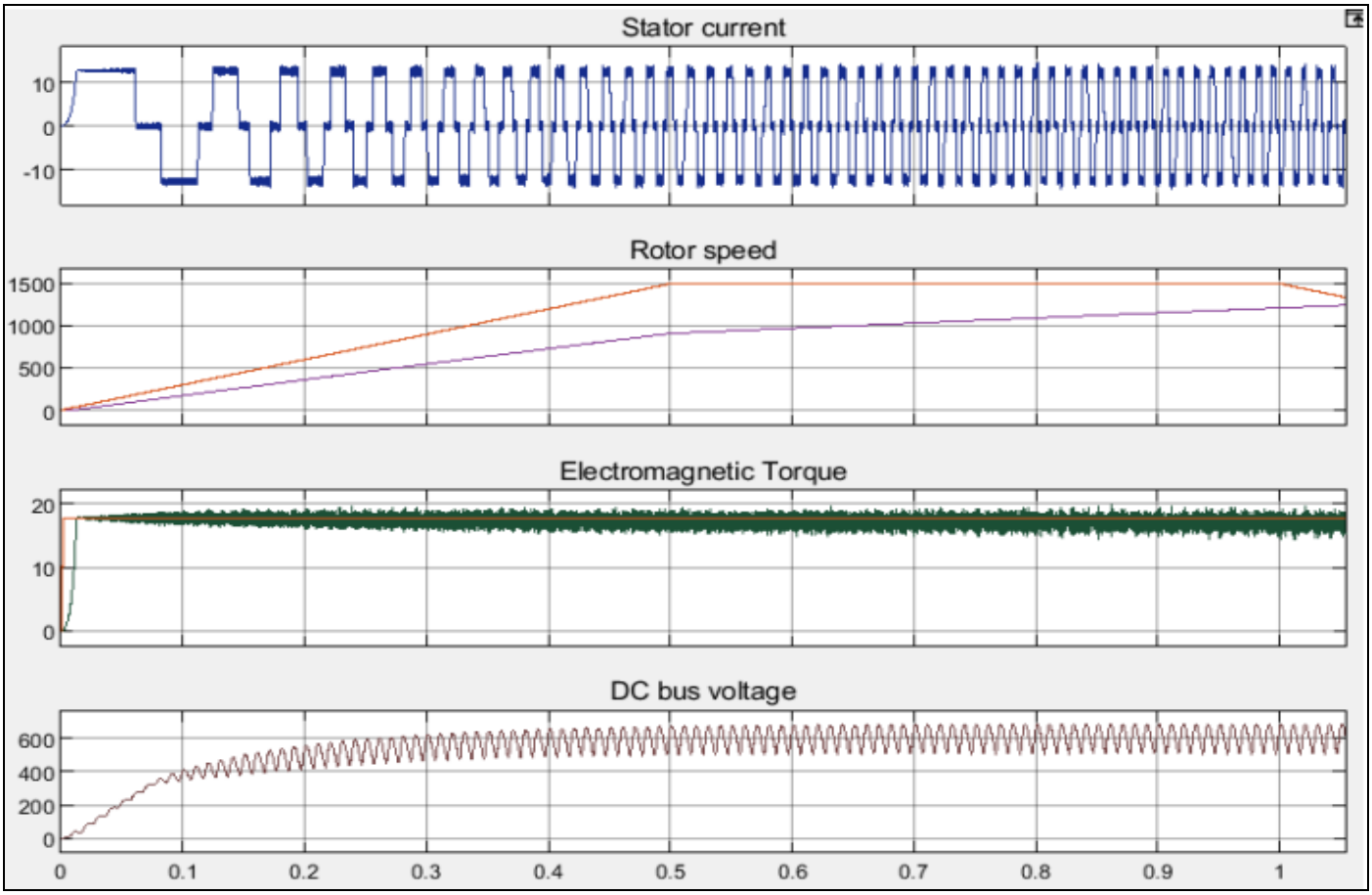

Fig 9 BLDC Characteristics with Solar PV System

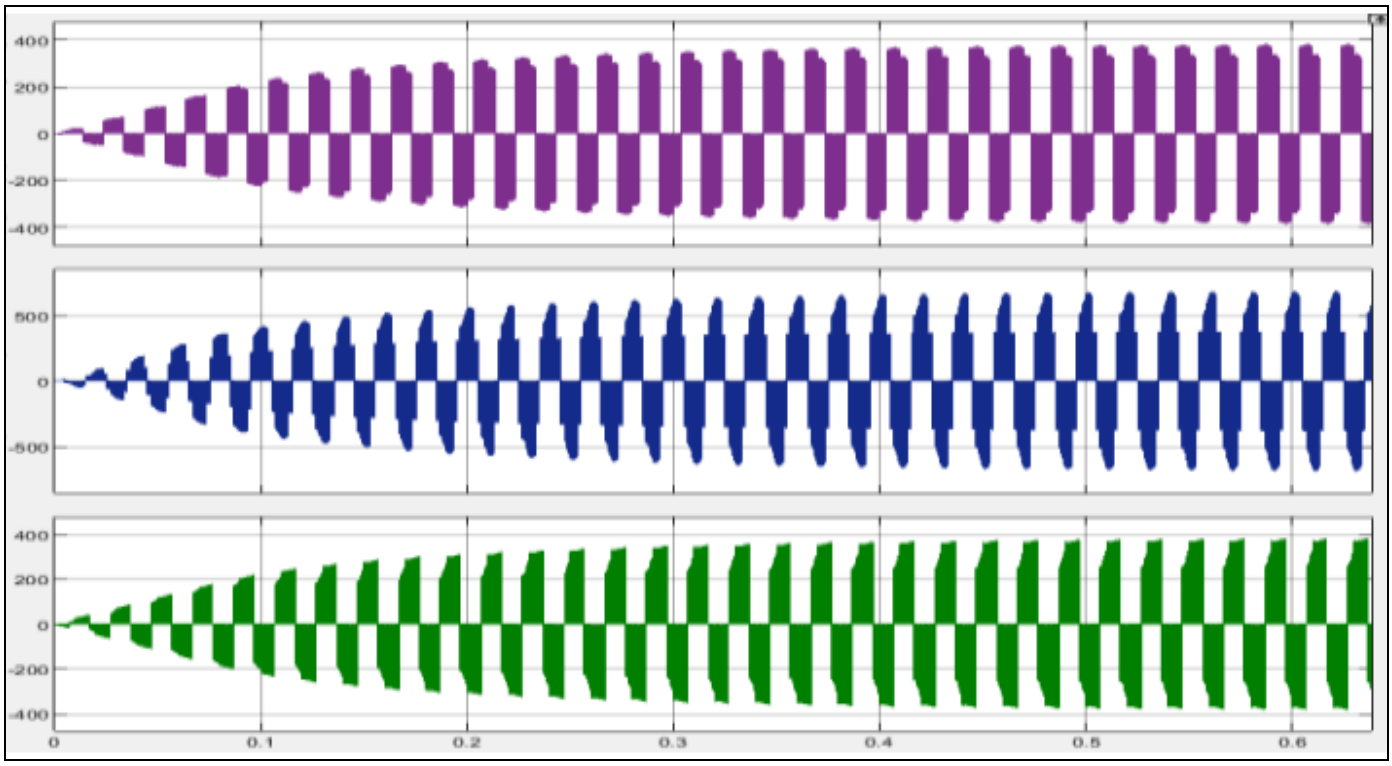

Fig 10 Inverter Output Voltage with Solar PV System as Energy Source

As a result, we can conclude that the solar PV system can be used as a conventional energy source in place of the readily available AC source, as illustrated in Figures 9 and 10. BLDC drive characteristics with solar PV system as input source having same characteristics without any variation.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAY1045

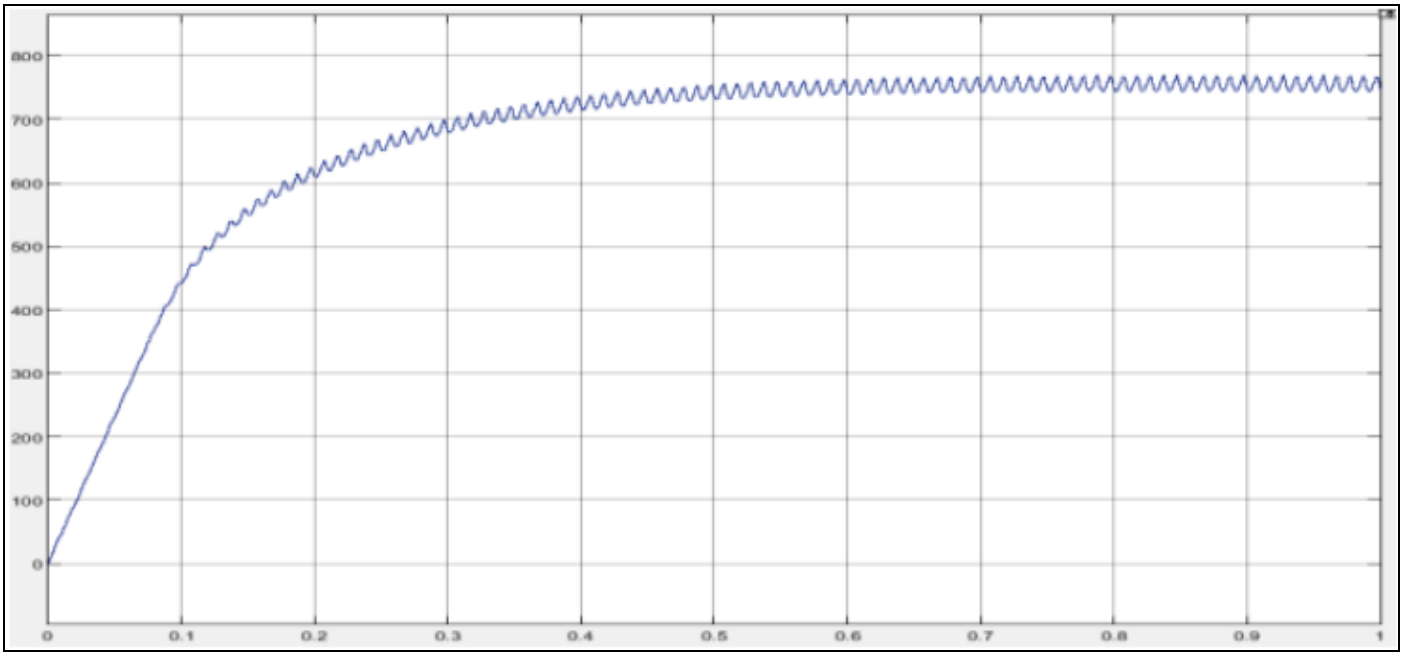

Fig 11 DC Voltage Output with Solar PV System.

IV. CONCLUSION

This study illustrates the use of a multilayer inverter in conjunction with a diode clamp for BLDC motor regulating applications. Utilizing the multicarrier PWM technique yields a high output power with low harmonic distortion and the lowest possible output harmonic distortion. Simulink was used in the design and simulation of a three-level BLDC motor drive. Comparing the overall harmonic distortion to a conventional inverter, it is very low. At different times during the trial, it was found that the BLDC motor could attain speeds of 600 to 900 rpm. Businesses that require variable speed drives can employ an inverter system, which has the potential to save a substantial amount of energy due to its lower harmonic losses. The number of levels may also be raised in order to further restrict the amount of harmonic distortion produced. Based on the observation that BLDC drive characteristics with solar PV system as input source have the same characteristics without any variation, we may infer that the solar PV system can be used as a conventional energy source instead of the available AC source. MATLAB was used to create the circuit for the simulated implementation. The most typical speeds were found to be between 600 and 900 rpm. The three-level multilevel inverter system's outputs and the PWM waveform were also simulated. Using a PWM.

REFERENCES

[1]. Yousif Ismail Al Mashhadany , “High-performance multilevel inverter drive of brushless DC motor”, International Journal of Sustainable and Green Energy, Vol. 4, pp 1-7, October 2014

[2]. P. Devi Kiran, M. Ramachandra Rao, “Two Level and Five Level Fed BLDC Motor Drive”, International Journal of Electrical and Electronics, Vol. 3, Issue 3, pp 71-82, August 2013

[3]. Purna Chandra Rao,Y.P. Obulesh, Ch. Sai Babu, ”High Performance Cascaded Multilevel Inverter fed BLDC Motor Drive”, International Journal of Engineering Sciences and Emerging Technologies, Vol. 5, Issue 2, pp: 88-96, June 2013

[4]. S.Flora Viji Rose1, Mr.B.V.Manikandan , “Simulation and Implementation of Multilevel Inverter Based Induction Motor Drive”, International conference on control automation and energy conservation, Chennai 4-6 June 2009

[5]. Jose, Steffen Sernet, Bin Wu, Jorge and Samir Kouro, “ Multilevel Voltage Source - Converter Topologies for Industrial Medium - Voltage Drives” , IEEE Trans on Industrial Electronics, Vol.54, Issue 6, December 2007t

[6]. P.Thirumuraugan, R.Preethi, “ Closed Loop Control of Multilevel InverterUsing SVPWM”, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 2, Issue 4,pp 1561-1572, April 2013

[7]. Yadav, J. Kumar, “Harmonic Reduction in Cascaded Multilevel Inverter”, International Journal of Recent Technology and Engineering, Vol.2, Iss. 2, pp 147-149, May 2013

[8]. G. Real, E. V. Sánchez, J. G. Gil, “Position and Speed Control of Brushless DC Motors Using Sensorless Techniques and Application Trends”, Sensors, pp 6901- 6964, 2010

[9]. M. Rajshekar, V. G. Swamy, T.A. Kumar, ““Modeling and \simulation of discontinues current mode inverter fee permanent magnet synchronous motor derive”, Journal of Theoretical and Apply.

[10]. G. Eason, B. Noble, and I.N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529-551, April 1955. (*references*)

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAY1045

[11]. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68-73.
[12]. I.S. Jacobs and C.P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G.T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271-350.
[13]. K. Elissa, "Title of paper if known," unpublished.
[14]. R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press.
[15]. Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," IEEE Transl. J. Magn. Japan, vol. 2, pp. 740-741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].
[16]. M. Young, The Technical Writer's Handbook. Mill Valley, CA: UniversityScience,1989.