

MODELING AND ANALYSIS OF FIVE LEVEL INVERTER FOR RENEWABLE ENERGY SOURCES

Mr.Durgam Srinivas

Research Scholar, Department of Electrical
& Electronics Engg, Shri Venkateshwara
University, U.P,India
durgamsrinivas247@gmail.com

Dr. Amith Kr.Jain

Professor, Shri Venkateshwara University,
U.P,India

ABSTRACT:

A new solar toughness length device which contains a dc/dc power converter and a new seven-diploma inverter. The dc/dc electricity converter integrates a dc-- dc beautify converter in addition to a transformer to transform the final consequences voltage of the solar cellular choice into impartial voltage assets with numerous connections. This emblem-new seven-degree inverter is configured making use of a capacitor choice circuit and moreover a full-bridge electricity converter, related in cascade. A sun photovoltaic gizmo with dc-dc energy converter in addition to a 9 stage inverter, the nine level inverter geography consists of plenty lots less sort of switches on the identical time as contrasted to traditional cascaded H bridge inverter the output of sunlight PV panel tool will simply be fed to a MPPT set of regulations to fetch a most amount of power from a photograph electric powered gadget. This emblem-new seven level inverter is set up the usage of a capacitor preference circuit similarly to an entire bridge energy converter. The capacitor choice circuit converts the two output voltage resources of dc/dc electric power converter right into a three degree dc voltage, in addition to the complete bridge converter on pinnacle of that transforms this 3 section dc voltage into 7 level voltages. The proposed gadget generates sinusoidal final results present day that remains in section with the software voltage and is fed proper into the electricity.

Keywords: PV Array, MPPT, PV panels, multilevel inverter, 7 level inverter, DC to AC converter.

1. INTRODUCTION

Solar electricity is wearing out being more critical because it generates an awful lot much less air pollutants in

addition to the properly worth of fossil fuel strength is developing, on the identical time as the price of solar arrays is reducing. The electricity conversion interface is essential to grid-related sun stamina technology systems as it converts the dc energy created through a daylight hours cellular variety into air conditioning stamina further to feeds this air conditioner strength into the energy grid. An inverter is vital in the energy conversion client interface to convert the dc energy to ac electric powered powered electricity [1] Given that the output voltage of a sun cellular variety is low, a dc-dc stamina converter is used in a small-capacity solar electric powered electricity era tool to growth the end result voltage, so it'd in form the dc bus voltage of the inverter. The power conversion performance of the power conversion consumer interface is important to ensure that there may be no waste of the power produced via way of the sun mobile variety [2] The massive use nonrenewable fuel sources has resulted within the global

problem of greenhouse discharges. Furthermore, due to the reality the components of nonrenewable gasoline resources are dwindled in the destiny, they will emerge as an increasing number of hundreds greater luxurious [3, 4] Therefore solar energy is turning into introduced crucial because it creates lots a whole lot a lot less pollutants further to the charge of fossil gas power is setting up, moreover due to the truth the price of sun arrays is decreasing. In unique, small-potential gave electricity technology structures the usage of solar strength can be drastically applied in home applications in the close to future. The energy conversion character interface is critical to grid-related solar electricity length structures as it transforms the DC stamina created through using a solar cell desire into AC energy similarly to feeds this Air Conditioner strength into the power grid. An inverter can be very crucial inside the electric powered electricity conversion interface to transform the DC power to Air Conditioner sturdiness. Because the output voltage of a sunlight mobile range is low, a DC-DC power converter is applied in a small-capability solar stamina generation device to enhance the give

up end result voltage so it could healthy the DC bus voltage of the inverter [4] The energy conversion interface is critical to grid applicable sun energy technology structures as it transforms the dc stamina generated via a sun cellular choice right into air con energy and moreover feeds this air con strength into the software program software program grid. An inverter is vital in the electrical strength conversion consumer interface to convert the dc power to ac electricity. Given that the give up result voltage of a sun cell array is low, a dc-- dc power converter is made use of in a small-ability sun stamina generation tool to enhance the give up end result voltage, so it might in shape the dc bus voltage of the inverter. The electricity conversion popular universal overall performance of the energy conversion interface is crucial to insure that there may be no waste of the strength generated the usage of the usage of the sunlight hour's mobile variety. The lively devices and moreover passive gadgets within the inverter generate an electricity loss. The energy losses because of active devices consist of every conduction losses and additionally converting losses. Conduction loss results from the use

of dynamic gadgets, at the same time as the converting loss is symmetrical to the voltage and the cutting-edge adjustments for every and each changing and moreover changing regularity [3] A clean out inductor is applied to technique the switching harmonics of an inverter, so the power loss is symmetrical to the amount of switching harmonics [5, 6, 7].

Objective of the System:

The substantial use of fossil fuels has actually resulted within the global headache of greenhouse exhausts. Moreover, as the products of fossil fuels are depleted in the fate, they will certainly expand to be progressively steeply-priced. Hence, sun power is coming to be higher vital since it produces a horrible whole lot much less pollutants and also the cost of fossil fuel strength are growing, while the price of sunlight varieties is decreasing. In certain, small ability allocated stamina generation frameworks the use of sunlight electricity may be generally made use of in residential applications inside the future. The power conversion user interface is essential to grid related solar power era structures due to the fact that it transforms the dc electrical power generated by way of a sunlight

cellular variety right into air conditioning power as well as feeds this a/c energy in to the software grid An inverter is important within the power conversion interface to transform the dc strength to air conditioner strength. Given that the output voltage of a solar cell array is reduced, a dc-- dc strength converter is applied in a small-functionality solar electrical energy age tool to enhance the outcome voltage, so it can inform the dc bus voltage of the inverter. The toughness conversion efficiency of the strength conversion interface is crucial to guarantee that there might be no waste of the power generated with the help of the sunlight mobile selection. The dynamic tools as well as passive gadgets in the inverter generate a power loss. The energy losses due to active gadgets incorporate both transmission losses and changing losses. Transmission loss effects from utilizing energetic devices, at the same time as the changing loss are symmetrical to the voltage and also the current adjustments for every changing and changing frequency [1] A clear out inductor is used to gadget the changing harmonics of an inverter, so the stamina loss is symmetrical to the amount of switching harmonics [2].

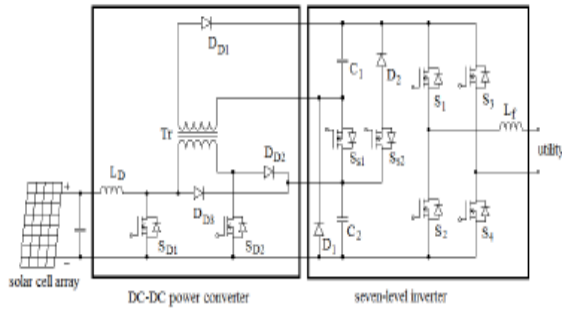


Fig.1.1. Model block diagram.

2. LITERATURE SURVEY

Single Phase Seven Level Inverter with Less Number of Components for grid connection:

Authors: M.E.H. Benbouzid and A. Kheloui

A logo-new geography for plunged seven diploma converters with pulse width inflection (PWM) and additionally reduced quantity of buttons for grid connection is offered in this paper. By enhancing the sort of voltage stages on the output in multilevel converters the energy immoderate wonderful is advanced. The advised topology decreases the wide style of switches and lowers THD with growth in output voltage degrees. Reduction in kind of switches and moreover wide style of voltage resources reduces losses, fee and moreover intricacy of the converter. Switching method and

moreover operation primary of recommended 7 diploma cascaded multilevel converters are furnished. The proposed inverter has truly been compared to the 5-stage PWM inverter. The effectiveness of the proposed inverter evaluated using MATLAB/SIMULINK simulation utility [3]

A 7-Level Single DC Source Cascaded H-Bridge Multilevel Inverters Control Using Hybrid Modulation:

AUTHORS: F. Khoucha, A. Ales, A. Khoudiri

This paper offers a brand new hybrid cascaded Hbridge multilevel inverter (HCMLI) motor energy DTC control scheme for electric cars or hybrid electric powered vehicles wherein every phase of the inverter may be applied the use of best an unmarried DC source. Traditionally, each section of the inverter require n DC deliver for $2n + 1$ output voltage tiers. In this paper, a scheme is proposed that permits the use of a unmarried DC deliver as the first DC supply which could be to be had from batteries or fuel cells, with the final $(n - 1)$ DC resources being capacitors. This scheme can simultaneously hold the DC voltage degree of the capacitors,

produce a almost sinusoidal output voltage due to its excessive quantity of output stages and consequently a immoderate overall performance and moreover green torque and flux controller is received, permitting a DTC answer for hybrid multilevel inverter powered motor drives.

Low-Modulation-Index Operation of a Five-Level Diode-Clamped PWM Inverter with a DC-Voltage-Balancing Circuit for a Motor Drive

Authors: Kazunori Hasegawa.

This paper offers a five-degree diode-clamped pulse width-modulated (PWM) inverter meant for a medium-voltage motor drive with a consistent-torque plenty however no regenerative preventing. It applies to piercing rigs, extruders, and rubber mixers. The strength conversion system includes a 3-segment six-pulse diode rectifier, a 5-degree diode-clamped PWM inverter, and additionally a dc-voltage-balancing circuit such as a solitary coupled inductor. The five-diploma inverter is recognized through injecting an fashionable 9th-harmonic 0-series voltage on each of the 3-section reference voltages in a low-modulation-index area. This injection adds not in reality to assuaging magnetic-flux exchange of

the coupled inductor but likewise to growing uniform the strength losses generated with the aid of eight insulated-gate bipolar transistor additives in line with leg. In addition, the dc-voltage-balancing circuit introduces a manage method with the capacity of reducing amplitude of magnetic flux of the coupled inductor. The combination of this manages method as well as the 9th-harmonic zero-series voltage injection continues the height value of the magnetic change within its advanced really worth.

3. RELATED STUDY

Multilevel inverters are in particular classified into three: Diode Clamped, Capacitor Clamped and Cascaded H-Bridge. Diode secured and additionally flying capacitor multilevel inverters couldn't have unequal voltage geography. Asymmetric voltage geography way that it generates even greater voltage quotes with a lousy good deal lots much less quantity of semiconductors and additionally therefore will growth output conventional performance in addition to tool integrity. Disadvantages of diode clamped inverter are constrained very last results voltage and additionally

disruption in rate security for greater than three stages. In capacitor clamped multilevel inverter, capacitor call for to be pre-charged. In principle this geography uses in constrained tiers but because of low-cost traumatic conditions gives perfect 6 prices of voltage. Drawback of this technique is that pre-charging of capacitors is vital in addition to difficult. In this example the arm cells have specific impact at the final results voltage. Variety of levels is predicated upon on form of dc resources related to it. It does now not want diodes and capacitors for securing. It has choppy voltage geography. Recommended geography makes use of best 6 energy virtual buttons and a couple of capacitors. This decreases converting loss and boosts electric strength conversion efficiency [1, 2, 3, 4, as well as 5]

The DC-- DC energy converter includes a boom converter and moreover an existing day-fed earlier converter. The growth converter includes an inductor LD, a power digital button SD1, and a diode, DD3. The raising converter prices capacitor C2 of the seven-degree inverter. The current-fed in advance converter incorporates an inductor LD, power virtual switches SD1 andSD2, a

transformer, and also diodes DD1 in addition to DD2. The contemporary-fed forward converter prices capacitor C1 of the seven-diploma inverter. The inductor LD and moreover the power virtual switchSD1 of the contemporary-day-day-fed ahead converter are moreover used in the beautify converter. Fig 1.1. Reveals the going for walks circuit of the dc--dc energy converter whilst SD1 is activated. The sun cell range factors power to the inductor LD. When SD1 is came to be OFF and additionally SD2 is switched on, its walking circuit is examined in Fig 1.1. Accordingly, capacitor C1is associated with capacitor C2 in parallel thru the transformer, so the strength of inductor LD and the sun cellular variety fee capacitorC2 via DD3 and charge capacitor C1 with the transformer and also DD1 during the off kingdom of SD1. Given that capacitorsC1 andC2 are charged in parallel with way of using the transformer, the voltage percentage of capacitors C1and C2 coincides as the turn percentage (2:1) of the transformer.

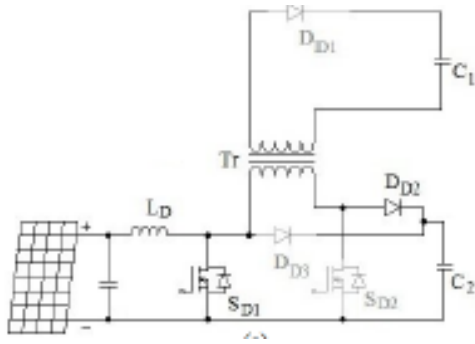


Fig.3.1.Operation of DC-DC power converter with SD1 switch on condition.

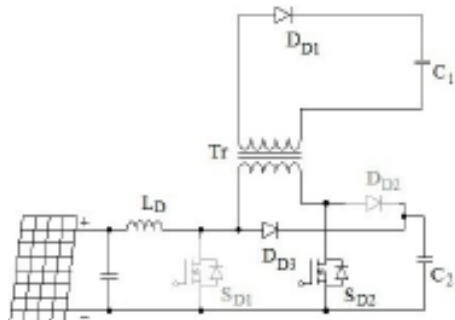


Fig.3.2.Operation of DC-DC power converter with SD2 switch on condition.

The voltage of capacitor C1 can be represented as (2) it should be precise that the contemporary of the captivating inductance of the transformer will decrease when SD2 is in the ON country. Conventionally, the ahead converter desires a 3rd demagnetizing winding so that it will release the strength saved in the attractive inductance went lower back to the power deliver. However, inside the encouraged dc-- dc electric powered energy converter, the power stored in the magnetizing inductance is contributed to capacitor C2 through

DD2 and SD1 on the identical time as SD2 is having in reality ended up being OFF. Considering that the electricity stored inside the magnetizing inductance is transferred beforehand to the output capacitor C2 and additionally no longer lower once more to the dc supply, the energy common efficiency is superior. On top of that, the power circuit is streamlined due to the truth the charging circuits for capacitors C1 and C2 are incorporated. Capacitors C1 and C2 are butted in parallel with the supply of the usage of the transformer, so their voltages automatically have a couple of relationships. The manage circuit is likewise simplified [9, 10, 11, and 12].

4. PROPOSED SEVEN-LEVEL INVERTER

Conventional multilevel inverter geographies consist of the diode clamped, the flying -capacitor, and additionally the waterfall H bridge sorts. Diode-clamped and flying capacitor multilevel inverters employ capacitors to enlarge numerous voltage ranges. Yet it is tough to regulate the voltage of those capacitors. Given that it's miles difficult to provide an unequal voltage

era in every the diode-clamped in addition to the flying capacitor geographies, the electricity circuit is made complicated via the use of the increase within the voltage stages that is important for a multilevel inverter. For a single-section seven-degree inverter, 12 strength virtual switches are required in every the diode-clamped and also the flying-capacitor topologies. Asymmetric voltage generation is made use of in the waterfall H-bridge multilevel inverter to permit extra degrees of outcome voltage, so the cascade H-bridge multilevel inverter is suitable for applications with expanded voltage levels.

As visible in Fig. Four.1, the seven-diploma inverter includes a capacitor choice circuit and an entire-bridge electricity converter that is most possibly attached in waterfall. Operation of the seven-degree inverter may be divided into the enormously wonderful half of cycle and the dreadful fifty percent cycle of the electricity. For simplicity of evaluation, the electricity virtual switches in addition to diodes are notion to be ideal, at the identical time as the voltages of every capacitor C1 and also C2 inside the capacitor want circuit correspond in addition to equal

to $V_{dc}/3$ and $2V_{dc}/three$, respectively. Since the outcome present day-day of the sun strength era tool will clearly be sorted to be sinusoidal as well as in level with the software program voltage, the final results cutting-edge day of the seven- degree inverter is also super within the extremely good half of cycle of the utility. The approach of the seven-diploma inverter inside the extraordinary half of cycle of the power may be in a comparable way divided right into four settings, as confirmed in Fig.4.1.

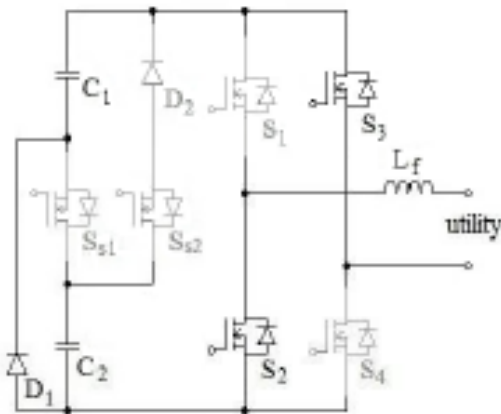


Fig.4.1. operation of seven-level inverter in the negative half cycle mode 1.

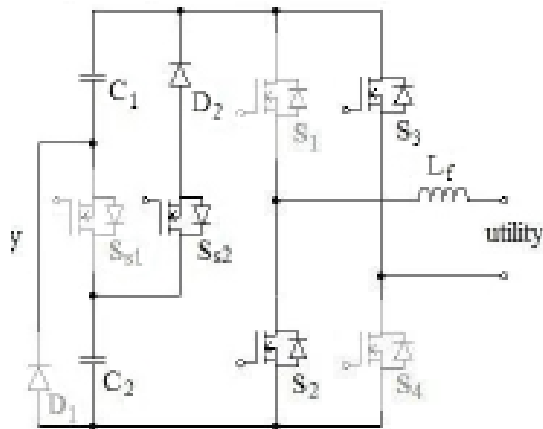


Fig.4.2. operation of seven-level inverter in the negative half cycle mode 2.

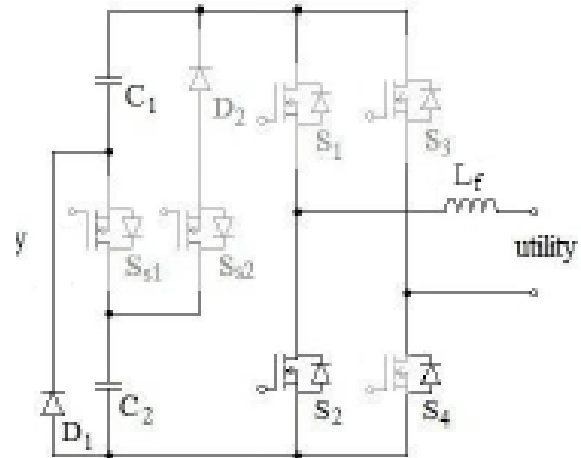


Fig.4.4. operation of seven-level inverter in the positive half cycle mode 1.

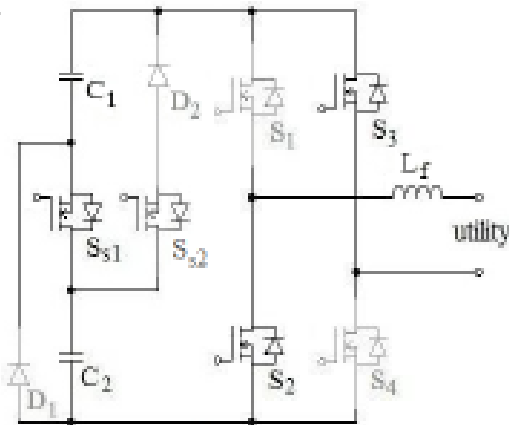


Fig.4.3. operation of seven-level inverter in the positive half cycle mode 1.

For that reason, the surge voltages in C1 and C2 need to be blocked by the use of the dc-- dc power converter to give stepped forward MPPT. Appropriately, double control loops, an external voltage control loop as well as an inner cutting-edge control loop, are utilized to manipulate the dc-- dc electricity converter. Because the output voltages of the DC-DC strength converter integrates the voltages of C1 and C2, which are managed with the helpful resource of the seven-degree inverter, the external voltage manage loophole is made use of to alter the output voltage of the solar mobile array. The inner current control loop controls the inductor modern so that it methods a routine cutting-edge and blocks the ripple voltages in C1 as well as C2. The

perturbation and also statement strategy is used to give MPPT. The result voltage of the solar mobile variety as well as the inductor modern are detected and also despatched to a MPPT inverter to establish the favoured outcome voltage for the solar cellular range. Then the discovered result voltage and also the prominent output voltage of the solar cell range are sent out to a deduct or as well as the difference is despatched to a PI inverter. The output of the PI inverter is the referral indication of the internal contemporary control loop. The reference signal as well as the discovered inductor current are despatched to a deduct or and also the distinction is despatched to an amplifier to complete the inner existing day manipulate loophole. The outcome of the amplifier is despatched to the PWM circuit. The PWM circuit generates a repaired of corresponding signs that take care of the power electronic switches of the dc-- dc toughness converter.

SIMULATION ANALYSIS:

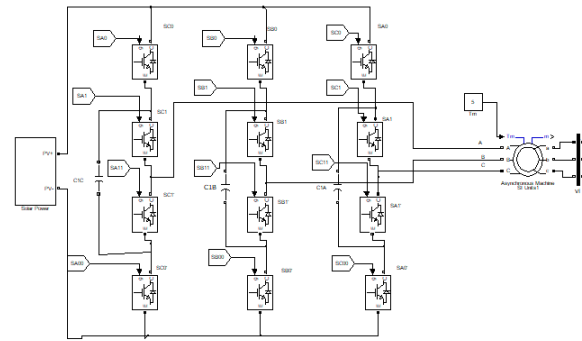


Fig.4.5. Simulation model of PV with Multi level circuit.

The splendid use of nonrenewable gasoline resources has surely resulted inside the worldwide issue of greenhouse emissions. In addition, due to the truth the materials of nonrenewable gas assets are faded in the destiny, they may emerge as grade by grade extra highly-priced. Hence, sun power is developing into even more crucial because it creates a super deal less pollution and the fee of fossil gasoline electric energy is growing, on the same time as the rate of sun arrays is reducing. In information, tiny capability distributed strength era structures the usage of sun electricity may be considerably utilized in belongings applications inside the close to future.

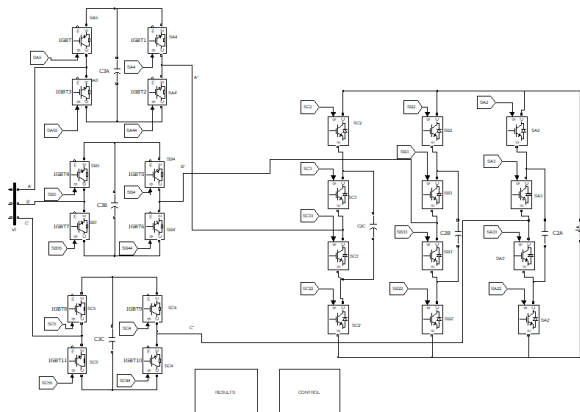


Fig.4.6. Seven level inverter circuit.

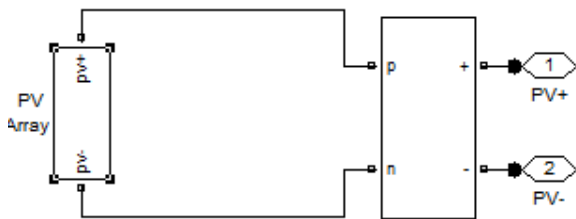


Fig.4.7. PV Array with DC to DC converter.

The seven-degree inverter adjustments over the dc power into fantastic zircon energy as well as reinforces it right into the application and handles the voltages of capacitors C1 as well as C2 The handle item of the seven-level inverter is its yield present, which should be sinusoidal as well as in level with the software application voltage. The dc-- dc electricity converter compounds two loose voltage sources with numerous connections as well as carries out optimum severe force factor complying with so that it will certainly concentrate the greatest

return electrical energy from solar based entirely mobile range.

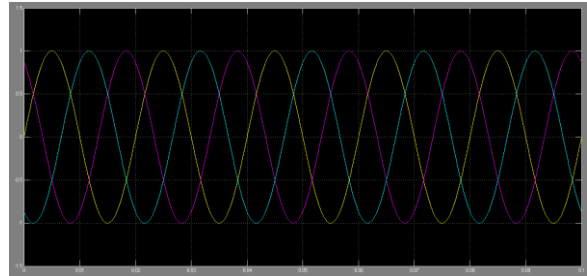


Fig.4.8. Three phase currents at output.

Right here currents are identical there may be no degrees due to the fact y because of the reality that Multi diploma inverter final results is voltage degree in keeping with our fashion.

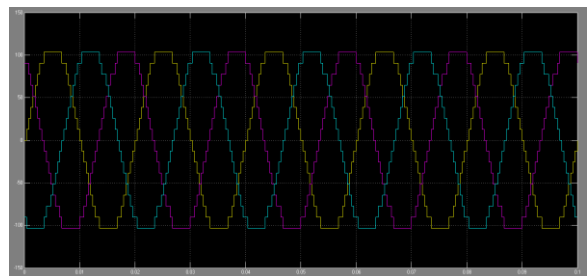


Fig.4.9. Three phase voltage with 7 levels.

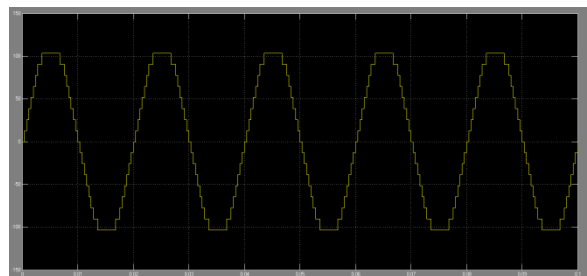


Fig.4.10. Phase A 7 level output voltage.

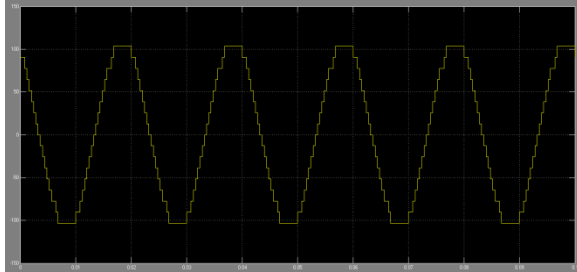


Fig.4.11. Phase B 7 level output voltage.

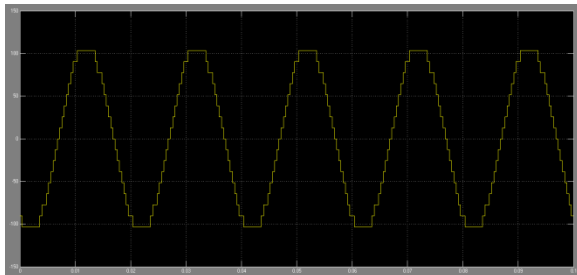


Fig.4.12. Phase C 7 level output voltage.

Succeeding to the return voltages of the DC-DC stamina converter consists of the voltages of C1 in addition to C2, that is maximum possibly managed thru the seven-degree inverter, the external voltage manage circle is used to direct the cross back voltage of the daylight particularly based mobile cluster. The internal current manipulate circle manages the inductor modern with the motive that it strategies a regular present as well as prevents the swell voltages in C1 and also C2.

5. CONCLUSION

The proposed technique has multiple features such as it lowers the price of the entire maker, small period

similarly to an extended efficiency. With the help of decline large choice of switches, seven-diploma of output voltages are produced similarly to a give up end result it minimizes the changing loss in addition to transmission losses. The THD of seven-diploma inverter this paper recommends a solar stamina innovation gizmo to convert the dc stamina created with the useful resource of a solar mobile variety proper into air conditioner stamina that is fed into the software application. The cautioned solar durability technology device carries a dc-- dc strength converter and a 9 degree inverter. The nine diploma inverter includes hundreds an entire lot masses a good deal less energy digital buttons, which streamlines the circuit setup. This reduces the converting electric powered energy loss in addition to boosts the strength fashionable performance. Experimental outcomes display that the proposed solar sturdiness modern generation tool generates a nine-degree output voltage as well as outputs a sinusoidal current this stays in diploma with the energy voltage, producing a strength difficulty of concord. In addition, the recommended sun durability era tool

can successfully trace the maximum stamina of solar cell array.

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authored eight books, co-authored four books and co-edited 15 conference proceedings. He has delivered Invited lectures in more than 30 Technical and Management Workshop / Conferences programs in India and abroad. He has organized 45 plus Conference, Workshop, Faculty Development Program and attend more than 18 Advance courses for Academics and Executive Development Program w.r.t latest Technologies.

ABOUT AUTHORS

Mr. Durgam Srinivas is a Research Scholar, Department of Electrical & Electronics Engg, Shri Venkateshwara University, U.P, India so far has successfully guided many post graduate students in the fields of Power electronics & electrical drives, Electrical power system while several other students are being supervised by him in a wide variety of other fields, in addition to this he supervised many electrical and other disciplinary engineering students .He served as an academic supervisor many Bachelor Degree dissertations towards the award of Undergraduate Degree. He shared his research experience more than many podiums like conferences, workshops, seminars and symposia. He has experience in the teaching and research field.

SUPERVISOR

Dr. Amit Kr. Jain Professor, Shri Venkateshwara University, U.P He has had an outstanding academic record and is a product of prestigious system throughout.

He has published more than 81 Research Papers in reputed Journals and Proceedings of International and National Conferences. He has