IJECEC INTERNATIONAL JOURNAL OF ELECTRICAL AND COMPUTER COMMUNICATION ENGINEERING
ISSN(Online):2533-8945
VOLUME 4 ISSUE 3

NEW THREE-PHASE SYMMETRICAL MULTILEVEL VOLTAGE SOURCE INVERTER

[#1] LOKESH PATLAVATH , P.G SCHOLAR

[#2] K SUDHARSHAN , ASSOCIATE PROFESSOR

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

KHADER MEMORIAL COLLEGE OF ENGINEERING AND TECHNOLOGY, DEVARAKONDA(M), NALGONDA,T.S-508248

ABSTRACT: This paper offers a brand new design and implementation of a 3-section multilevel inverter for distributed power generation approach utilizing low frequency modulation and sinusoidal pulse width modulation as well. It's a modular form and it can be expanded for extra quantity of output voltage stages by way of including extra modular stages. The effect of the proposed topology is its skillability to maximize the quantity of voltage phases making use of a diminished number of isolated dc voltage sources and digital switches.Moreover, this paper proposes a colossal factor, which is developed to define the number of the required accessories per pole voltage stage. A designated assessment headquartered on is furnished with the intention to categorize the exceptional topologies of the s addressed in the literature. Additionally, a prototype has been developed and demonstrated for quite a lot of modulation indexes to verify the manage method and efficiency of the topology. Experimental outcome exhibit a good-matching and good similarity with the simulation results.

1.INTRODUCTION

Just lately, multi-degree inverters first-rate attention as a single stage inverter. Even though, they have got bought want high number of add-ons, however because of their advantages reminiscent of generating output voltage with extremely low distortion factor , low dv/dt, small output filter dimension, low electromagnetic interface , and low whole harmonic distortion , still have quality attention [1]–[6]. Virtually, all of those advantages appear strongly because the quantity of dc-energy sources extended as in the case of renewable power programs.

The final proposal of is to make use of remoted dc sources or a bank of sequence capacitors to produce ac voltage waveforms with larger amplitude and close sinusoidal waveform. There are three conventional forms of named as impartial point diode clamped [7], flying capacitor [8], and cascaded H-Bridge [9]. Practically all of them are affected by elevated accessories number per stage, and tricky control structure [9].

Among the many exclusive topologies for, they are able to be categorized into two principal categories: 1) single dc-supply inverter akin to, and inverters; 2) multi-dc sources inverters equivalent to inverter [10]. At the same time, multi-dc sources inverter is split into symmetrical and nonsymmetrical topologies. Mainly, nonsymmetrical topologies produce more voltage stages in comparison with

symmetrical topologies. Just about all of those topologies can be expanded for extra voltage stages through increasing the number of the primary configuration (common cellphone).

Many topologies were provided in the final decade specializing in minimizing the fundamental multilevel topologies drawbacks. The writer in [11] offered a topology named multilevel dc link. It contains a group of general cells linked in sequence configuration. Each mobile produces or 0 voltage throughout the linked cells, there may be an H-bridge to change the polarity of the synthesized voltage. The required number of energetic switches for output voltage phases is for the inverters. Nevertheless, this topology requires increased quantity of components in comparison with the conventional topologies, and excessive voltage stresses.

Nonetheless, in [12], the authors awarded a topology named transistor-clamped H-bridge . The principal mobilephone can produce 5-phases per pole within the output voltage. Nonetheless, it suffers additionally from the increased add-ons counts, requisites of electrolytic capacitors, problematic manage methodology.

Alternatively, in [13], the authors provided three-segment asymmetrical multi-stage cascade inverter. The output voltage phases synthesized by way of series linked cells like in [11]. For two cells configuration, it produces 4 stages per pole . However, as an alternative of utilising H-bridge to getting the reverse voltage polarities as in [11], it uses conveniently the phase shift relationship between the three legs, through subtracts every leg's voltage with the neighboring one to produce the road voltage, the equal subtraction idea was presented in [14].

While, the authors in [15] offered a new single dc-hyperlink vigour provide topology, the awarded topology generates seventeen voltage stages (0,E/sixteen ,E/8 ,3E/16 ,E/four ,5E/sixteen ,3E/8 ,7E/sixteen ,E/2 ,9E/sixteen ,5E/eight ,11E/sixteen ,3E/four ,13E/16 ,7E/8 ,15E/16 and E) on the output voltage through utilisingthreelevel flying capacitor inverter and cascades H-bridge. However, this topology makes use of a single dc-power supply. It uses increased quantity of electrolytic capacitors as floating dc-vigor supplies. The authors in [16] presented a double sub-module circuit. The presented mobile generates a 3 output voltage phases throughout its terminals utilizing eight switches and two capacitors. It increased the voltage balancing over capacitors at low switching frequencies; nevertheless further add-ons when compared with the an identical half bridge modules required.

2.LOW FREQUENCY MODULATION

FM Basics:

Frequency modulation is a form of analog attitude modulation where the baseband knowledge carrying sign, usually called the message or know-how sign m(t), varies the frequency of a carrier wave. Audio signals transmitted with the aid of FM radio communications are the most normal. Nevertheless, FM radio may additionally transmit digital information with the low bandwidth digital know-how often called Radio data approach (RDS) in Europe and Radio Broadcast data method (RBDS) in the U.S. The simplest strategy to producing FM indicators is to use the message signal straight to a

voltage-managed oscillator (VCO) as proven in determine 1.

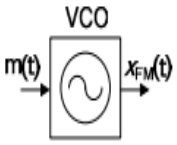


Figure 1. FM Generation with a VCO

A voltage message signal, m(t), is applied to the control voltage of the VCO, and the output sign, xFM(t), is a constant amplitude sinusoidal carrier wave whose frequency is ideally a linear operate of its manipulate voltage. When there is no message or the message sign is zero, the carrier wave is at its core frequency, fc. When a message sign exists, the instantaneous frequency of the output sign varies above and below the middle frequency and is

$$f_i(t) = f_c + K_{VCO}m(t)$$

expressed by

The place KVCO is the voltage-to-frequency obtain of the VCO expressed in models of Hz/V, and the wide variety, KVCO*m(t), is the instantaneous frequency deviation. The instantaneous phase of the output signal is equal to 2π improved through the essential of the instantaneous frequency as shown beneath

$$\theta_i(t) = 2\pi f_c t + 2\pi K_{VCO}\int_0^t m(t)dt$$

Where the preliminary of the section is believed to be zero for simplicity. Consequently, the FM output signal, xFM(t), is given by using the following equation

$$x_{FM}(t) = A_c \cos\left[2\pi f_c t + 2\pi K_{VCO}\int_0^t m(t)dt\right]$$

A number of observations can also be constructed from the FM output sign. First, the amplitude of an FM sign is consistent regardless of the message signal, giving it a regular envelope property with an output power equal to 2 2 Ac into a 1 Ω resistor. 2d, the frequency-modulated output, xFM(t), has a nonlinear dependence to the message signal, m(t), making it complicated to research the properties of an FM signal. To estimate the bandwidth of an FM signal, a single tone message sign is used as shown below

$$m(t) = A_m \cos(2\pi f_m t)$$

The place Am is the amplitude of the message signal and fm is the frequency of the message sign. Substituting this message sign into the above formulation, we find

$$x_{FM}(t) = A_c \cos\left(2\pi f_c t + \frac{K_{VCO}A_m}{f_m}\sin(2\pi f_m t)\right)$$

$$= A_c \cos\left(2\pi f_c t + \frac{\Delta f}{f_m}\sin(2\pi f_m t)\right)$$

$$x_{FM}(t) = A_c \cos(2\pi f_c t + \beta \sin(2\pi f_m t))$$

The quantity =Δ AKfmVCO represents the height frequency deviation of the FM sign from the center frequency and is immediately proportional to the amplitude of the message sign and the gain of the VCO. This wide variety, Δf , is referred to as the highest instantaneous frequency deviation. The ratio of the frequency deviation, Δf , to the message sign frequency, fm, is known as the modulation index, β. For a single tone message sign, the quantity of gigantic sidebands within the output spectrum is a operate of the modulation index. This can also be obvious by using first writing the FM output sign in

ISSN(Online):2533-8945
VOLUME 4 ISSUE 3

phrases of nth order Bessel functions of the primary type [2, 3].

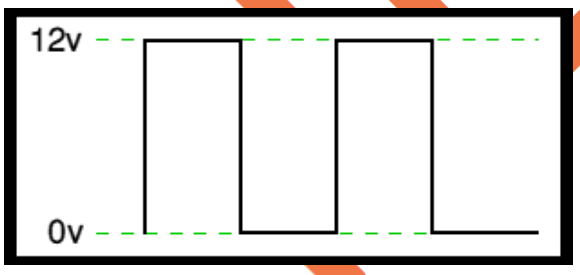
$$x_{FM}(t) = A_c \sum_{n=-\infty}^{\infty} J_n(\beta)\cos(2\pi(f_c + nf_m)t)$$

3.PULSE WIDTH MODULATION

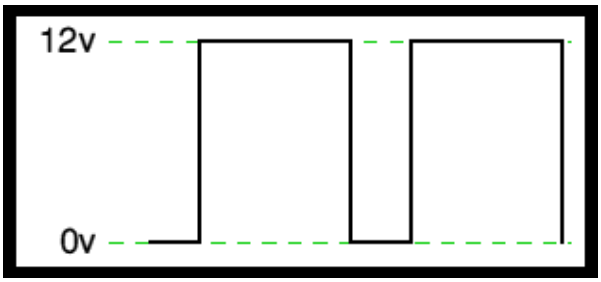
3.1What is PWM?

Pulse Width Modulation (PWM) is the most amazing method to gain steady voltage battery charging through switching the solar approach controller's vigour instruments. When in PWM legislation, the present from the solar arraytapers consistent with the battery's condition and recharging needsconsider a waveform similar to this: it's a voltage switching between 0v and 12v. It is really apparent that, when you consider that the voltage is at 12v for precisely as long as it's at 0v, then a 'compatible device' connected to its output will see the usual voltage and feel it is being fed 6v - precisely half of of 12v. So by using varying the width of the constructive pulse - we will differ the 'natural' voltage

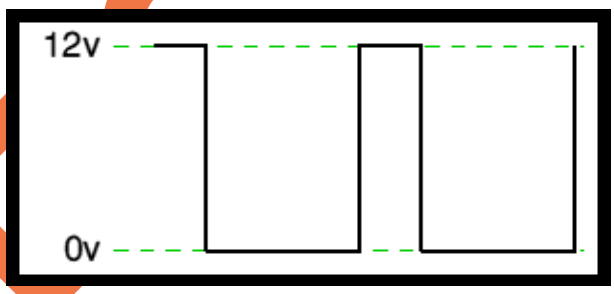
.



Similarly, if the switches keep the voltage at 12 for 3 times as long as at 0v, the average will be 3/4 of 12v - or 9v, as shown below.



and if the output pulse of 12v lasts only 25% of the overall time, then the average is

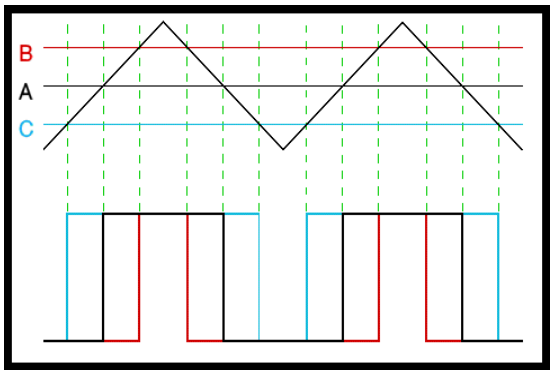


By way of varying - or 'modulating' - the time that the output is at 12v (i.E. The width of the constructive pulse) we can alter the usual voltage. So we are doing 'pulse width modulation'. I mentioned previous that the output had to feed 'a suitable gadget'. A radio would now not work from this: the radio would see 12v then 0v, and would mostly not work properly.Nonetheless a device corresponding to a motor will respond to the usual, so PWM is a traditional for motor manipulate.

Pulse Width modulator

So, how will we generate a PWM waveform? It can be actually very convenient; there are circuits to be had within the TEC website. First you generate a triangle waveform as proven in the diagram beneath. You compare this with a dc voltage, which you regulate to control the ratio of on to off time that you simply require. When the triangle is above the

'demand' voltage, the output goes excessive. When the triangle is below the demand voltage, the



When the demand velocity it within the core (A) you get a 50:50 output, as in black. Half of the time the output is high and half of the time it's low. Fortunately, there is an IC (built-in circuit) referred to as a comparator: these come usually4 sections in a single bundle. One can be utilized as the oscillator to provide the triangular waveform and yet another to do the comparing, so a whole oscillator and modulator may also be carried out with half an IC and possibly 7 other bits.

4.SIMULATION RESULTS

The proposed topology has been simulated making use of MATLAB/ PSIM program package deal tools. A single cellphone has been chosen to provide 5 phases per line-to-line load voltages according to (three). Nonetheless, the proposed topology can be multiplied to cells. The prototype of the proposed is carried out and setup utilizing the steel–oxide–semiconductor field-outcomes transistor (MOSFET) as switching devices and symmetrical dc-vigour supplies. For implementation, the switching frequency is chosen to be kHz.

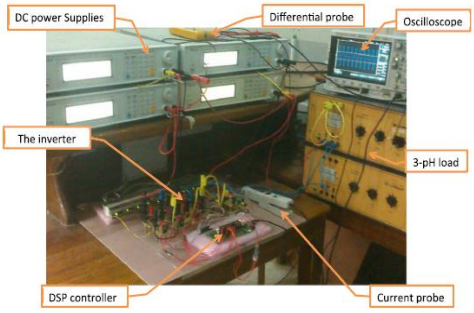


Fig. 2. Experimental setup of the proposed MLI.

The proposed prototype has been experimentally established and when compared with the simulation results. The of form TMS320F28335 is used to generate the switching alerts. Fig. 6 indicates the prototype setup used for the proposed, which involves four dc-vigor presents, switching contraptions, size tools, the controller and three-segment resistive load. This part demonstrates the control flexibility of the proposed headquartered on low frequency modulation technique and the defined beforehand without lack of modularity.

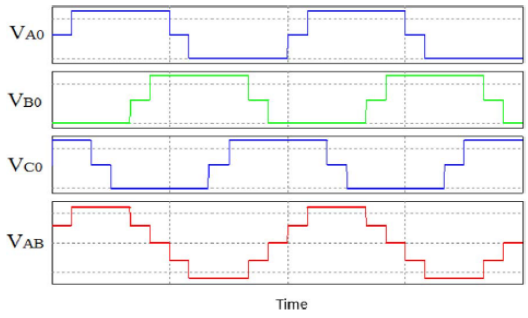
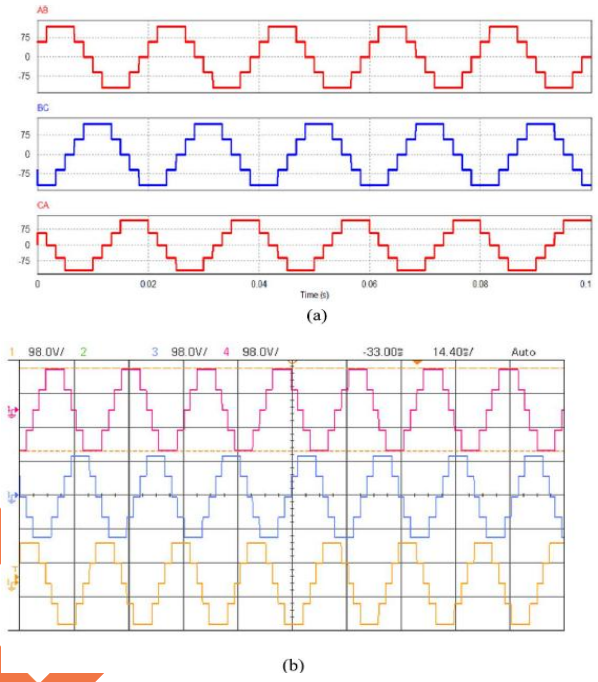


Fig. 3. Pole voltages and line-to-line voltage (VAB) with low frequency modulation technique.

The important thing aspect within the generation of the output voltages waveforms is the pole voltages (, , and). Every one among them is shifted via a hundred and twenty with a view to generate balanced three phase sinusoidal output voltages. The three pole

voltages are proven in Fig. 7. The nonzero phase determines the number of the utilized sources. Conventionally, producing the poor parts in the output voltage wants an H-bridge and as a direct outcomes, the number of the used switches is expanded. Nonetheless,the proposed topology benefits from the zero section in the pole voltages waveform to provide the positive and bad parts in the output voltages waveforms. It finished through subtracts every pole voltage with the neighboring one to provide the road voltage (as an instance:) as in [13], [14],and [28].

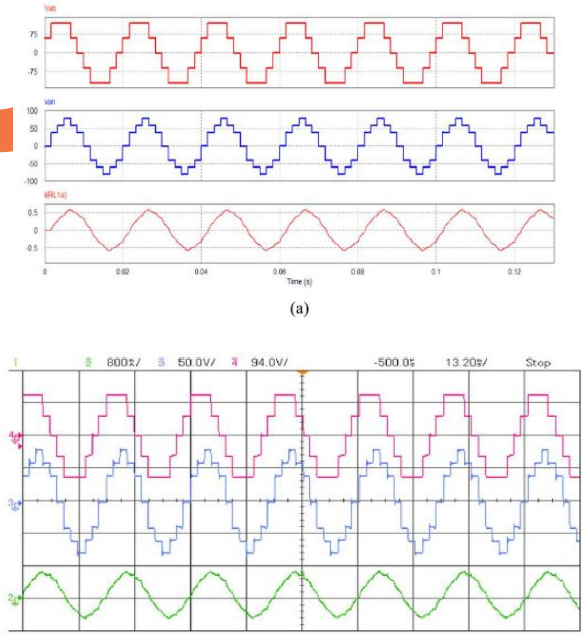
The pole voltages waveform to provide the confident and terrible elements in the output voltages as in [13], [14] and [28].In step with switching states offered in table III, the recommended produces three section balancing line voltages as shown in Fig. Eight, each line voltage has five phases and has a segment shift of a hundred and twenty between each other. Also, as the pole voltages have three voltage stages (0,volts), the output line-to-line voltages have 5 voltages degree (volts). The section voltages are deduced from the pole voltages: they produce seven levels on the output segment voltages i.E.,(volts). The simulation and experimental outcome of the output phase voltage are proven in Fig. 9. With a purpose to scan the performance of the proposed with low switching frequency, Fig. 10 indicates the weight line-to-line voltage, phase voltage and the section current of the proposed when loaded through load (,) additionally, the efficiency of the proposed has been validated utilizing SPWM headquartered on schemes I and II. Figs. Eleven, 12, and thirteen display the pole voltage, output line-to-line voltages, and output phase voltage utilising Scheme I.



(a)

(b)

Fig. 4. Output phase voltages (, , and) with low frequency modulation technique. (a) Simulation. (b) Experimental.



(a)

(b)

Fig.5. Inverter outputs with load with low frequency modulation technique. (a) Simulation. (b) Experimental.

5.CONCLUSION

A new modular multilevel inverter topology utilising two modulation control tactics is awarded. The proposed has a couple of advantages when compared with current topologies. A slash quantity of add-ons rely reminiscent of remoted dc-vigour provides, switching devices, electrolyte capacitors, and energy diodes are required. So it exhibits the deserves of excessive efficiency, decrease rate, simplified manipulate algorithm, smaller inverter's foot print and extended the total method reliability. Due to the modularity of the awarded topology, it may be improved to better levels number results in a excellent performance issues comparable to low, low, and low and doing away with the output filter shall be received. Beside the low frequency modulation, two schemes are effectually utilized to control the urged. This paper additionally suggests a huge element, which defines the desired accessories to generate one voltage level throughout the output pole terminals.

The hindrance concerning the cost of every used component is out of scope of this paper. The approach simulation mannequin and its manage algorithm are developed utilizing PSIM and MATLAB program package instruments to validate the proposed topology. A laboratory prototype has been developed and proven for quite a lot of modulation indexes to confirm the manage procedures and performance of the topology, the similarity between the simulation and bought experimental outcome used to be demonstrated.

6.REFERENCES

[1] S. J. Park, F. S. Kang, M. H. Lee, and C. U. Kim, "A new unmarried-phasefive-level PWM inverter using a deadbeat manipulate scheme," IEEETrans. Power Electron., vol. 18, no. 3, pp. 831–843, May 2003.

[2] V. G. Agelidis, D. M. Baker, W. B. Lawrance, and C. V. Nayar, "Amultilevel PWM inverter topology for photovoltaic packages," inProc. Int. Symp. Ind. Electron., Jul. 1997, vol. 2, pp. 589–594.

[3] G. J. Su, "Multilevel DC-link inverter," IEEE Trans. Ind. Appl., vol.Forty one, no. 3, pp. 848–854, May–Jun. 2005.

[4] M. Calais, L. J. Borle, and V. G. Agelidis, "Analysis of multicarrierPWM methods for a single-phase five degree inverter," in Proc. PowerElectron. Specialists Conf., 2001, vol. Three, pp. 1351–1356.

[5] C. T. Pan, C. M. Lai, and Y. L. Juan, "Output cutting-edge ripple-unfastened PWMinverters," IEEE Trans. Circuits Syst. II, Exp. Briefs., vol. Fifty seven, no. 10,pp. 823–827, Oct. 2010.

[6] T. C. Neugebauer, D. J. Perreault, J. H. Lang, and C. Livermore, "Asix-segment multilevel inverter for MEMS electrostatic induction micromotors,"IEEE Trans. Circuits Syst. II, Exp. Briefs, vol. Fifty one, no. 2, pp.Forty nine–fifty six, Feb. 2004.

[7] A. Nabae, I. Takahashi, and H. Akagi, "A new impartial-point-clampedPWM inverter," IEEE Trans. Ind. Appl., vol. IA-17, no. 5, pp. 518–523,Sep. 1981.

[8] M. F. Escalante, J. C. Vannier, and A. Arzandé, "Flying capacitor multilevelinverters and DTC motor drive packages," IEEE Trans. Ind.Electron., vol. 49, no. Four, pp. 809–815, Aug. 2002.

[9] M. Malinowski, K. Gopakumar, J. Rodriguez, and M. A. Pérez, "Asurvey on cascaded multilevel inverters," IEEE Trans. Ind. Electron.,vol. 57, no. 7, pp. 2197–2206, Jul. 2010.

[10] M. A. Pérez, S. Bernet, J. Rodriguez, S. Kouro, and R. Lizana, "Circuittopologies, modeling, manage schemes, and applications of modularmultilevel

converters," IEEE Trans. Power Electron., vol. 30, no. 1,pp. 4–17, Jan. 2015.

[11] S. N. Rao, D. V. A. Kumar, and C. S. Babu, "New multilevel invertertopology with decreased wide variety of switches the use of advanced modulationstrategies," in Proc. Int. Conf. Power, Energy Control, Feb. 2013, pp.693–699.

[12] N. A. Rahim, M. F. M. Elias, and W. P. Hew, "Transistor-clampedH-bridge primarily based cascaded multilevel inverter with new approach of capacitorvoltagebalancing," IEEE Trans. Ind. Electron., vol. 60, no. 8,pp. 2943–2956, Aug. 2013.

AUTHOR'S PROFILE :

[1]. LOKESH PATLAVATH, M.Tech Student, EEE Dept, Khader Memorial College Of Engineering & Technology, Nalgonda, T.S.,India.

[2].K.SUDHARSHAN, working as Associate Professor in EEE department, Khader Memorial College Of Engineering & Technology, Nalgonda, T.S.,India.