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MULTILEVEL INVERTER TOPOLOGY

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Abstract— In recent days, more attention has been given to multilevel-inverter because of their reliability, modularity and multi-level output waveform which is less harmonic distortion of voltage. In recent times multilevel-inverters are extensively used in many high power use. They get more attention in industrial purpose, like as drives motor, renewable energy systems and static VAR compensators and so forth. The goal of this research work is the execution of multi-level inverter because of its better power factor, less electromagnetic distortion and reduced electromagnetic interference. This multilevel inverter generates a stepped output voltage. To generate smoothly stepped waveforms, the level of multilevel inverter requires a large number of semiconducting devices (switches), it is the only disadvantage of the multilevel inverter topology. It not only raises cost of inverter but also affect the reliability of multilevel inverter system. Although the researchers bring in hundreds of multilevel inverters, still it is not achieved so far. It is the incentive for this dissertation In this Paper This research work comparative study the performances of cascaded sub multilevel inverter. a power electronic device that is used for high voltage and high power applications of low switching stresses and lower total harmonic distortion, hence reduces the size and bulk of passive filters. This new topology is based on a combination of conventional diode clamped and H-bridge topologies. The proposed idea has not only achieves high power ratings

Index Terms— multilevel-inverter, cascaded, multilevel inverter topology, cost, voltage, total harmonic distortion, diode clamped

1 INTRODUCTION

THIS Multilevel inverter provides a suitable solution for medium and high power systems to synthesize an output voltage which allows a reduction of harmonic content in voltage and current waveforms. Renewable energy power supplied into the utility grid has been paid much attention due to increase in fossil fuel prices, environmental pollution and energy demand boom. Among various renewable energy resources such as solar, wind, tidal, geothermal, biomass etc., the solar photovoltaic system being more attractive and promising green resource. The solar photovoltaic (PV) modules directly converts the light energy into the electrical energy, but energy obtained from the PV module acts as low voltage DC source and has relatively low conversion efficiency. In order to improve the efficiency and convert low voltage DC source into usable AC source, the power electronics converters are used to transform DC into AC. The simulation results presented in this paper verifies the operation of proposed MMC topology

2 INVERTER:

In current years, industries and utilities have demanded high power alternating current equipment, such as AC drive, STATCOM, UPS & FACTS, and so forth, whose rating reaches to megawatts ranges. Adjustable AC drives which operate in high power variety are connected to the average voltage system. Due to the limitation of semiconductor switches to operate in high current and voltage ratings, it is not to be likely to connect a semiconductor switch straight at average voltage networks [35]. The consistent development in the worldwide vitality interest connected with societies expanding attention to natural effects from the vast usage of fossil fuels has prompted the exploration of renewable energy resources, for example, photovoltaic (PV) innovation. Inverter is an electronic device that changes DC source to AC source. The input voltage, output voltage and the overall power handling depend on the design of specific circuitry. The inverter does not produce any power, the power is provided by the DC source.it is widely used in industrial and domestic application When all is done a remarkable on the V-I or P-V characteristic call MPP at which whole PV framework works with most extreme effectiveness and produces its maximum output power

3 MULTILEVAL INVERTER STRUCTURE

In the multi-level topologies, a voltage level of 3 measures the minimum number. Due to the bidirectional switch, the multistage voltage source converter can operate in rectifier mode and inverter mode. That is why we mostly talk about inverters instead of inverters. A multilevel converter can change its input or output nodes between various voltage or current levels (more than two). When the number of levels rises to infinity, THD of the total output approaches zero [29] However, the many of voltage levels is achieved by voltage imbalance issues, voltage blocking supplies, the circuit configuration and circuitry limitations, control complexity, and, of course, ener-

gy costs[23], investment and maintenance
The more significant number of semiconductor switches in multi-level inverters has a negative impact on reliability and performance. On the other hand, the use of inverters with a small number of semiconductor switches need extensive and expensive L-C filters to limit the insulation loads of motors winding [24], or it can be applied to motors that withstand these limitations. , In industrial applications three large multi-level inverters structures have been used, such as the cascaded H-bridge inverter with separate direct current sources, the diode-locked inverters and the flying-capacitor inverter.

3.1 DIODE CLAMPED TOPOLOGY:
This topology was first proposed in1981.They are also known as neutral point. As the name suggest , and unlike cascaded H-bridge inverters ,they need clamping devices. Diodes are used as clamping devices. Three phase diode clamped multilevel inverter have three legs with a common DC bus. This Dc voltage is subdivided into switches via capacitors. For n-levels, n-1 switches are required .For nlevels, n-1 capacitors are required for clamping Dc voltages. If one switch is turned on ,the other one from the pair should be necessarily off. Each diode has to block the voltage equal to number of switches above it times the supplied DC voltage.

3.2 H-BRIDGE TOPOLOGY:

The term H bridge is derived from the typical graphical representation of such a circuit. An H bridge is built with four switches(solid-state or mechanical).One of the basic and well known topologies among all multilevel inverter is cascaded H-bridge multilevel inverter. It can be used for both single and three phase conversion
With single bus all the are connected which minimize the capcity requre for drive [20] such as a continuous high voltage sequence between associations or an adaptive frequency converter

3.3 **Flying capacitor Multi-level inverter**

In 1992, the first flying capacitor inverter from FONCH and MEYNARD was proposed [28]. The flying capacitor inverter is also referred to as a capacitor clamped inverter. As the name implies, the flying capacitor inverter, as in the DCMLI, uses inverter topology capacitors instead of a diode for the lock. The inverter with the flying capacitor is similar in structure to the inverter with the diode for clamping. It uses the capacitors instead of the diodes for clamping. The flywheel capacitor inverter also has series-coupled, switch cells, and this FCI has a ladder-type structure for the DC side capacitors, each capacitor being identical to that of the subsequent capacitor. The voltage change between the two branches of the capacitors has a waveform output [28].

3.4 Cascade Multi-level inverter

The third type of MLI is the cascaded multilevel inverter, or Cascaded multilevel inverter was invented entirely by the researchers 'LIA' and 'PENG' in the year 1975. Lia and Peng then analyzed and applied the cascaded multilevel inverter and its advantages in the year 1997 [30]. Since 1997 cascaded multilevel inverter was widely used in many applications. The cascaded multilevel inverter is modular and flexible in nature, and hence it has been used in higher power applications as well, main they are used in the FACTS controllers which are series and shunt connected controllers. Cascaded multilevel inverter generates a nearly exact sinusoidal waveform at the output. As H-Bridge inverters are associated in series, if the H-bridge converters increased by connecting in series, Van can be increased without again designing the power stage. If there is a failure in H-Bridge cell occurs, then the redundancy which is built in will realise the failure In the symmetric MLI topology voltage provided to every full bridge, the network is the same. The symmetric topology is nothing but the topology where all the values of the Direct voltage source are the same. This feature of the symmetric topology gives very good modularity. But as the number of levels at the output raises the switching devices [21] will also get increased hence increasing the complexity.

But unlike in the symmetric topology, voltage level in the asymmetric topology is different for all the full bridge networks. To get the maximum level of output with reduced harmonics the values of the direct voltage sources are chosen to b different, these different values of the DC voltages are referred to the asymmetric topology.

4 CONCLUSIONS:

A multilevel inverter with individual dc sources has been proposed for use in large electric drives. Simulation and experimental results have shown that with a control strategy operates the switches at the fundamental frequency, these converters have low output voltage THD and high efficiency. In summery the main advantages of using multilevel converters for large electric drives include the following,

1. They are suitable for large volt-ampere rated and /or high voltage motor drives.

2. These multilevel converters systems have higher efficiency because the devices can be switched at minimum frequency.

3. No EMI problem or common mode voltage/current problem exists.

4. No charge unbalance problem results when the converters are in higher charge mode or drive mode.

REFERENCES

[1] J.S. Bridle, "Probabilistic Interpretation of Feedforward Classification Network Outputs, with Relationships to Statistical Pattern Recognition," *Neurocomputing – Algorithms, Architectures and Applications,* F. Fogelman-Soulie and J. Herault, eds., NATO ASI Series F68, Berlin: Springer-Verlag, pp. 227-236, 1989.

(Book style with paper title and editor)

[2] J. Hema Latha, Basava Raja Bakara "Modeling and Analysis of 21 Level Cascade Model Multilevel Inverter "Proceedings of the Second International Conference on Inventive Systems and Control ISBN:978-1-5386-0807-4; 2018IEEE

[3] MarifDaulaSiddique, Asif Mustafa, AdilSarwar, SaadMekhilef, Noraisyah-Binti Mohamed Shah "Single Phase Symmetrical and Asymmetrical Design of Multilevel Inverter Topology with Reduced Number of Switches" 2018 IEEMA Engineer Infinite Conference (eTechNxT):978-1-5386-1138-82;2018 IEEE

[4] FatihEroglu, Ali Osman Arslan, Mehmet Kurtoglu, Ahmet Mete Vural. "Generalized adaptive phase-shifted PWM for single-phase seven-level cascaded H-bridge multilevel inverters",2018 5th International Conference on Electrical and Electronic Engineering (ICEEE), 2018

[5] Torkaman, Ali Mosallanejad. "Minimizing switching losses in cascaded multilevel inverters by proper switching array selection", 2018 9th Annual Power Electronics, Drives Systems and Technologies Conference (PEDSTC), 2018.

[6] SubhashreeChoudhury, SamikhyaNayak, Tara Prasanna Dash, PK Rout. "A comparative analysis of five level diode clamped and cascaded H-bridge multilevel inverter for harmonics reduction", 2018 Technologies for Smart-City Energy Security and Power (ICSESP), 2018

[7] Junfeng Liu, Jialei Wu, Jun Zeng. "Symmetric/Asymmetric Hybrid Multilevel Inverters Integrating Switched-Capacitor Techniques", IEEE Journal of Emerging and Selected Topics in Power Electronics, IEEE 2018.

[8] MasoudBarmala, DaryoushNazarpour, SajjadGolshannavaz, Reza Choupan. "A new structure for multilevel inverters intended to increase the operational reliability", 2018 9th Annual Power Electronics, Drives Systems and Technologies Conference (PEDSTC), 2018.

[9] AmirhoseinGohari, EbrahimAfjei, HosseinTorkaman, Ali Mosallanejad. "Minimizing switching losses in cascaded multilevel inverters by proper switching array selection",9th Annual Power Electronics, Drives Systems and Technologies Conference (PEDSTC), 2018

[10] Richard Castillo, Bill Diong, Preston Biggers. "Single-phase hybrid cascaded H-bridge and diode-clamped multilevel inverter with capacitor voltage balancing", IET Power Electronics,2017

[11] Himansu N Chaudhari " Comparison of symmetrical and asymmetrical cascaded current source multilevel inverter" International Journal of Research in Engineering and Technology, 2013

[12] Sabari Nathan, L., S. Karthik, and S. Ravi Krishna. "The 27-level multilevel inverter for solar PV applications", IEEE 5th India International Conference on Power Electronics (IICPE), 2012.

[13] Elsheikh, Maha G., Mahrous E. Ahmed, EmadAbdelkarem, and Mohamed Orabi. "Single phase five-level inverter with less number of power elements", 2011 IEEE 33rd International Telecommunications Energy Conference (INTELEC), 2011

[14] M. Chithra, S.G. BharathiDasan. "Analysis of cascaded H bridge multilevel inverters with photovoltaic arrays", 2011 International Conference on Emerging Trends in Electrical and Computer Technology, 2011

[15] G. P. Adam, O. Anaya-Lara, G. M. Burt, D. Telford, B. W. Williams, and J. R. McDonald, "Modular multilevel inverter: pulse width modulation and capacitor balancing technique," IET Power Electron., vol. 3, no. 5, pp. 702–715, 2010

[16] M. Manjrekar and T. A. Lipo, "A hybrid multilevel inverter topology for drive application," in Proc. Appl. Power Electron. Conf., 1998, vol. 2, pp. 523–529

[17] FaridKhoucha, MounaSoumiaLagoun, AbdelazizKheloui, and Mohamed El HachemiBenbouzid, "A Comparison of Symmetrical and Asymmetrical Three-Phase H-Bridge Multilevel Inverter for DTC Induction Motor Drives"IEEE TRANSACTIONS ON ENERGY CONVERSION, VOL. 26, NO. 1, MARCH 2011

[18] C.kamalakannan, L.pdmasuresh, subhran susekhar dash" power Electronics and renewable systems" proceedings of ICRERES,2014

[19] P Mamatha, ChallaVenkatesh," Performance Improved Multilevel Inverter with Selective Harmonic Elimination"International Conference on Recent Trends in Electrical, Electronics and Computing Technologies, 978-1-5090-6266-9/17 2017 IEEE

[20] Nupur Mittal, Bindeshwar Singh, S.P Singh, Rahul Dixit, and Dasharath Kumar" Multilevel Inverters: A Literature Survey on Topologies and Control Strategies" 2nd International Conference on Power, Control and Embedded Systems, 978-1-4673-1049-9/12 2012 IEEE

[21] Jih-Sheng L a, Fang ZhengPeng" MultilevecloNverters- A Newb Reedo F Power Converters"ConJRec. Ieee, 0-7803-3008-0195,1995 IEEE

[22] T.Poompava, A.Chitra, C.Srinivas, K.Giridharan"Meticulous Analysis of Induction motor drive fed from a Nine-level Cascade H-Bridge inverter with a level shifted Multicarrier PWM"2013 International Conference on Smart Structures & Systems (CSS-2013), March 28 - 29,2013, Chennai, India,978-1-4673-6240-5/02 2013 IE

[23] L.padnasuresh, surbhran susekhar dash, bijayaketan panigrahi "artificial intelligence and evolutionary algorithms in engineering system" proceeding of ICAEES 2014, volume 1

[24] Anshuman Shukla, Arindam Ghosh, Avinash Joshi" Flying Capacitor Multilevel Inverter and its Applications in Series Compensation of Transmission Lines" IEEE Power Engineering Society General Meeting, IEEE 2004

[25] Bhuvaneswari, Hari Kumar" Flying Capacitor Multilevel Inverter and its Applications in Series Compensation of Transmission Lines" IEEE Power Engineering Society General Meeting, IEEE 2004,10.1109/ICGCCEE.2014.6922440

[26] A. Reddiprasanna1, P. Chandrasekhar2, G. Jayakrishna"A Novel Seven Level Multilevel Inverter With Photovoltaic Cell ", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 2, Issue 10, October 2013

[27] Leon M. Tolbert, FangZhengPeng, Thomas G. Habetler"Multilevel Converters for Large Electric Drives "; Ieee Transactions On Industry Applications, Vol. 35, No. 1, January/February 1999,0093–9994/99 1999 IEEE

[28] Shweta Gautam, Rajesh Gupta" Generalized Hysteresis Current Controller for Three-level Inverter Topologies ', IEEE International Symposium on Industrial Electronics, 978-1-4673-0158-9/12/2012 IEEE

[29]

[30] Won-Kyo Lee, Soo-Yeon Kim, Jong-Su Yoon, Doo-Hyun Baek"A Comparison of the Carrier-based PWM techniques for Voltage Balance of Flying Capacitor in the Flying Capacitor Multilevel Inverter ", IEEE Transactions on Industrial Electronics Volume: 65, Issue: 4, April 2018,

[31] DasareddyMohanreddya and TenapalliGowriManoharb"Harmonics Mitigation and Switching loss reduction using Cascaded Multilevel Based Half Bridge and Full Bridge Inverter System"International Journal of Current Engineering and Technology ISSN 2277 – 410 6, Vol.3, No.2 (June 2013)

[32] Himanshu N Chaudhari, Dhaval A Patel, Dhrupa M Patel, Maulik A Chaudhari" Comparison Of Symmetrical And Asymmetrical Cascaded Current Source Multilevel Inverter ", Ijret: International Journal of Research in Engineering and Technology, Volume: 02 Issue: 09 Sep-2013

[33] JanardhanKavaliArvind Mittal"Analysis of various control schemes for minimal Total Harmonic Distortion in cascaded H-bridge multilevel inverter"Journal of Electrical Systems and Information Technology, Volume 3, Issue 3, December 2016, Pages 428-441

[34] A. Reddiprasann a, P. Chandrasekhar, G. Jayakrishna"A Novel Seven Level Multilevel Inverter With Photovoltaic Cell ", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 2, Issue 10, October 2013

[35] RadhaSree. K, Sivapathi.K, Vardhaman.V, Dr.R.Seyezhai"A Comparative Study of Fixed Frequency and Variable Frequency Phase Shift PWM Technique for Cascaded Multilevel Inverter"Engineering Research and Applica-

tions (IJERA) ISSN: 2248-9622, Vol. 2, Issue4, July-August 2012, pp.2025-2030

[36] MasoudBarmala, DaryoushNazarpour, SajjadGolshannavaz and Reza Choupan"A New Structure for Multilevel Inverters Intended to Increase the Operation Reliability"2018 9th Annual Power Electronics, Drives Systems and Technologies Conference,978-1-5386-4699-1/18/2018 IEEE

[37] Marcelo Pérez, José Rodríguez, Jorge Pontt, Samir Kouro" Power Distribution in Hybrid Multi-cell Converter with Nearest Level Modulation" IEEE International Symposium on Industrial Electronics,1-4244-0755-9/07/2007 IEEE

[38] SenthilkumarArumugam, Sathish Kumar Shanmugam, AnbarasuLoganathan"A novel bridged-insert cascaded five-level inverter topology"Journal of Measurements in Engineering, Vol. 6, Issue 4, 2018, p. 297-310.

[39] J. Rodriguez, J. S. Lai, and F. Z. Peng, "Multilevel inverters: A survey of topologies, controls, and applications," IEEE Trans. Ind. Electron., vol. 49, no. 4, pp. 724–738, Aug. 2002.

[40] A. A. Boora, A. Nami, F. Zare, A. Ghosh, and F. Blaabjerg, "Voltagesharing-converter to supply single-phase asymmetrical four-level diode-clamped inverter with high power factor loads," IEEE Trans. PowerElectron., vol. 25, no. 10, pp. 2507–2520, Oct. 2010.

[41] M. Manjrekar and T. A. Lipo, "A hybrid multilevel inverter topology fordrive application," in Proc. Appl. Power Electron. Conf., 1998, vol. 2, pp. 523–529

[42] J. I. Leon, S. Kouro, S. Vazquez, R. Portillo, L. G. Franquelo, J. M.Carrasco, and J. Rodriguez, "Multidimensional modulation technique for cascaded multilevel converters," IEEE Trans. Ind. Electron., vol. 58, no. 2, pp. 412–420, Feb. 2011