INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Literature Survey on Topologies & various Control Techniques of Multilevel Converter

Amit Sadhak[1], Mr. Satyadharma Bharti[2], Juli Singh Sadhak[3]

[1, 2]M.Tech Scholar, Department of Electrical Engineering, RCET Bhilai Chhattisgarh, India

[3]Phd Scholar BIT, Department of Electrical Engineering, Durg Chhattisgarh, India

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Abstract: In this study, the most common structure converter topologies and management schemes are reviewed. Structure converter topologies (MLIs) square measure increasingly being used in medium and high power applications as a result of their many advantages like low power dissipation on power switches, low harmonic contents and low magnetic attraction interference (EMI) outputs. The chosen amendment technique to manage the converter can have an honest role on harmonic elimination whereas generating the most effective output voltage. Intensive studies are performed on carrier-based, sinusoidal, space vector and letter of the alphabet delta PWM ways that in open loop management of inverters. The selection of topology and management techniques would possibly vary according to power demands of the converter.
Keywords: Multilevel inverters; classical topologies; PWM.

I. INTRODUCTION

The foremost common initial application of construction converters has been in traction, each in locomotives and track-side static converters [1]. More modern applications are for power grid converters for power unit compensation and stability sweetening [2], Active Filtering [3], High-Voltage motor drive [4], High-voltage DC transmission [5], and last for medium voltage Induction motor variable speed drives [6]. The previous approaches transmitted the good thing about well-known circuit structures and management strategies. However, the newer semiconductors area unit costlier, and by going higher in power, different power-quality needs ought to be consummated, introducing the necessity of power filters. The new approach uses the well-known and cheaper semiconductors; however, the additional advanced circuit structures came at the side of many challenges for implementation and management. Nonetheless, these challenges turned apace into new opportunities, since the additional advanced circuit structures enabled additional management degrees of freedom that might be wont to improve.

II. CLASSIFICATION OF MULTILEVEL INVERTER

1) Diode clamped multilevel inverter (Neutral Point Clamped Inverter).
2) Flying Capacitor Multilevel Inverter (Capacitor Clamped Inverter).
3) Cascaded H-bridge Multilevel Inverter.

A. Diode Clamped Multilevel Inverter [10-12]

Fig.1 Shows a Three level diode clamped electrical converter during which the 2 series connected capacitors C1 and C2 divide the dc voltage into three output voltage levels Van :Vdc/2, 0 and -Vdc/2 by the change combination as shown in Table 1.The change state one implies the switch is ON whereas state zero implies that it's OFF. The two diodes D1 and D2 clamp the voltage across the switch to once each S1 and S2 square measure turned ON, the voltage across point „ a‟ and „zero‟ is Va0 = Vdc. S1‟ blocks the voltage across C1 and S2‟ blocks the voltage across C2, D1‟ balances the voltage sharing between S1‟ and S2‟. The voltage Van is ac whereas voltage Va0 is dc. If the output is found between point „a‟ and „zero‟, then it's a dc-dc converter that has three output voltage levels: Vdc, Vdc/2 and zero.

Table-1 State Combination of Diode Clamped Converter

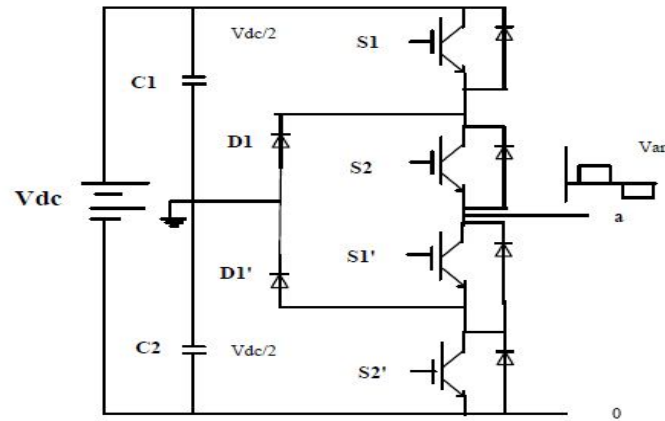| Voltage (Van)	S1	S2	S1'	S2'
$V_{dc}/2$	1	1	0	0
0	0	1	1	0
$-V_{dc}/2$	0	0	1	1

Figure-1 Three Level Diode Clamped Converter

B. Capacitor Clamped Multilevel Inverter [13-15]

Fig.2 shows a 3 level electrical device clamped electrical converter. Here rather than diodes, electrical devices square measure wantto clamp the device voltage to at least one capacitor voltage level. The voltage across „a‟ and „zero‟ Van has 3 voltage levels Van: Vdc/2 , 0, -Vdc/2 by the change combination as shown in Table 2.The change state „1‟ denotes that switch is ON and state „0‟ denotes that switch is OFF. There square measure 2 attainable mixtures to get the voltage level.
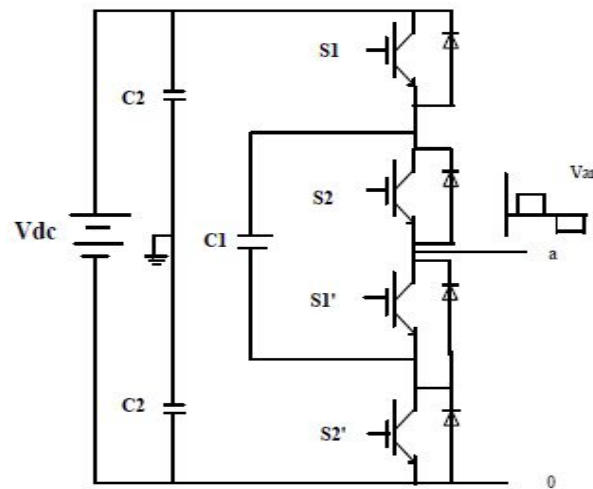

Figure-2 Capacitor Clamped Converter

Table-2 State Combination of Capacitor Clamped Converter

Voltage (Van)	S1	S2	S1'	S2'
$V_{dc}/2$	1	1	0	0
0	0	0	1	1
$- V_{dc}/2$	1	0	1	0
	0	1	0	1

C. Cascaded H-Bridge Multilevel Inverter [16-18]

Fig. 3 shows a section leg of a five-level cascaded electrical converter. It consists of 2 H-Bridge electrical converter units with 2 isolated and equal DC sources. once switches S11, S21 and switches S12, S22 conduct, the output voltage of the H Bridges H1 and H2 is VH1 + VH2 = E and also the resultant electrical converter section voltage is VAN=VH1+VH2=2E.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
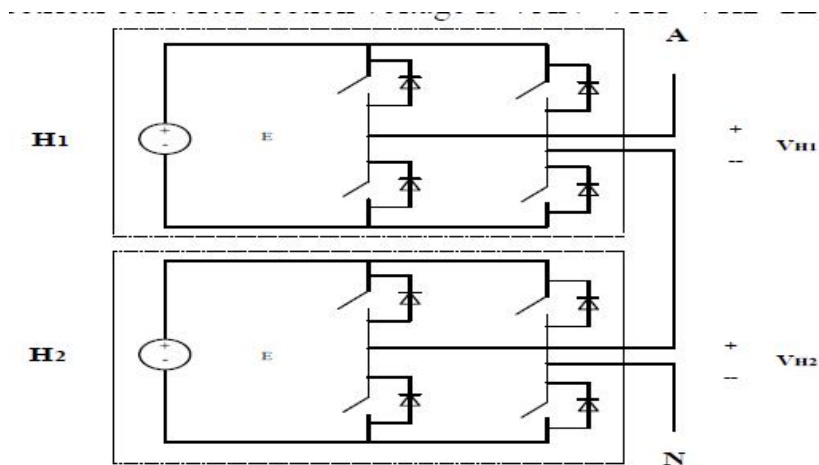*Volume 7 Issue VI, June 2019- Available at www.ijraset.com*

Figure-3 Cascade H Bridge Converter

III.MODULATION TECHNIQUES OF MULTILEVEL INVERTER

Switching frequency, modulation techniques are broadly divided into 2 parts as fundamental switching frequency and high switching frequency pulse width modulation (PWM).

1) *In Phase Disposition (IPD):* In this modulation technique, all the carriers are in phase and reference wave is a3-phase sinusoidal wave.
2) *Phase Opposition Disposition (POD):* In this type of modulation technique, the carriers above the sinusoidal reference zero points are in phase, but shifted by 180° out of phase with those below the zero reference point.
3) *Alternative Phase Opposition Disposition (APOD):* In this type of modulation technique, each carrier is phase shifted by 180o from it*s* adjacent carrier.
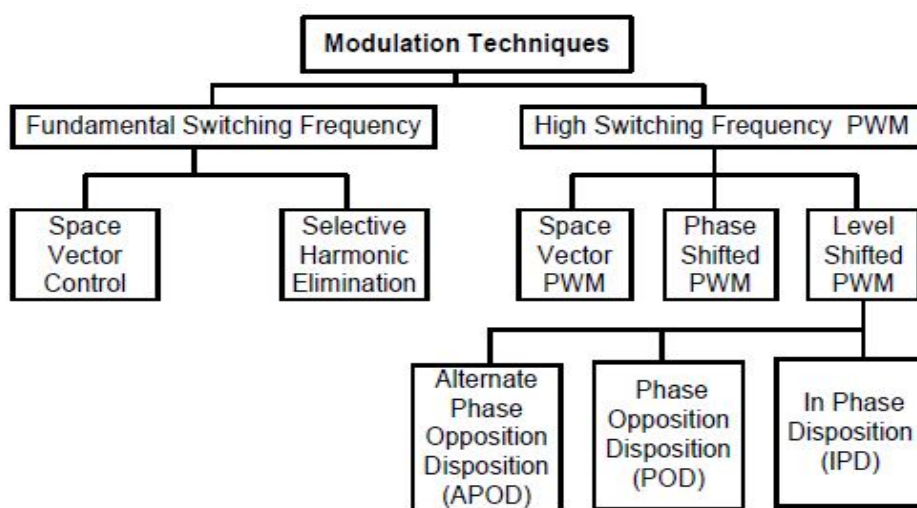

Figure-4 Classification of Modulation Techniques

Table-3 Comparison of Component Required

Converter Type	Diode Clamped	Flying Capacitor	Cascaded H-Bridge
Main Switching Devices	(m-1)*2	(m-1)*2	(m-1)*2
Main Diodes	(m-1)*2	(m-1)*2	(m-1)*2
Clamping Diodes	(m-1)*(m-2)	0	0
DC Bus Capacitors	(m-1)	(m-1)	(m-1)/2
Balancing Capacitors	0	(m-1)*(m-2)/2	0

IV. CONCLUSION

Based on the survey of conventional converter topologies given within the previous sections, several new hybrid topologies will be designed through the mixtures of three main MLI topologies described. Besides the mix of topologies, the trade-offs in MLI structures will be dealt with discrimination AH-MLIs that's shaped discrimination completely different DC supply levels in electrical converter cells. Yet, standard PWM methods that generate switching frequency at fundamental don't seem to be acceptable for MLIs, thanks to switching devices of the upper voltage modules would get to operate at high frequencies solely throughout some inverting instants.

REFERENCES

[1] H. Stemmler. Power electronics in electric traction applications. IEEE conference on Industrial Electronics, Control and Instrumentation, IECON"93, 1993.

[2] H. Fujita, S. Tominaga, and H. Akagi. Analysis and design of an advanced static VAR compensator using quad-series voltage-source inverters. IEEE Industry Apps Meeting, 3:2565–2572, 1995.

[3] Y. Yoshioka, S. Konishi, N. Eguchi, M. Yamamoto, K. Endo, K. Maruyama, and K. Hino. Self-commutated static flicker compensator for arc furnaces. In IEEE Applied Power Electronics Conference, volume 2, , 1996.

[4] L L. Gyugyi, "Power electronics in electric utilities: static var compensators" Proc. IEEE, vol.76,, 1987.

[5] Peter W. Hammond. A new approach to enhance power quality for medium voltage AC drives. IEEE Trans. Industry Applications, 33(1):202–208, January 1997.

[6] L. M. Tolbert, F. Z. Peng, and T. G. Habetler, "Multilevel converters for large electric drives," IEEE Trans. Ind. Application, vol. 35, pp. 36-44, 1999.

[7] M. F. Escalante, J. C. Vannier, and A. Arzande "Flying Capacitor Multilevel Inverters and DTC Motor Drive Applications," IEEE Transactions on Industry Electronics, vol. 49, no. 4,Aug. 2002.

[8] L. M. Tolbert, F. Z. Peng, "Multilevel Converters as a Utility Interface for Renewable Energy Systems," in Proceedings of 2000 IEEE Power Engineering Society Summer Meeting.

[9] L. M. Tolbert, F. Z. Peng, T. G. Habetler, "A Multilevel Converter -Based Universal Power Conditioner," IEEE Transactions on Industry Applications, vol. 36, no. 2, Mar./Apr. 2000.

[10] A. Nabae, I. Takahashi, and H. Akagi, "A New Neutral-point Clamped PWM inverter," IEEE Trans. Ind. Applicat., vol. IA-17, pp. 518-523, Sept./Oct. 1981.

[11] M. D. Manjrekar, P. K. Steimer, and T. A. Lipo, "Hybrid multilevel power conversion system: a competitive solution for high-power applications," IEEE Trans. Ind. Applicat., vol. 36, 2000.

[12] Samir Kouro, Mariusz Malinowski et. al., "Recent Advances and Industrial Applications of Multilevel Converters", IEEE Transactions on industrial electronics, vol.57, no.8, pp. 2553- 2580, Aug 2010.

[13] Farhad Shahnia and B.B.Sharifian, "Harmonic analysis and modelling of transformerless electric railway traction drives," 13th International conference on Electrical Drives and Power Electronics (EDPE), Dubrovnik, Croatia, 26-28 Sep 2005.

[14] V.Kumar Chinnaiyan, Dr. Jovitha Jerome, J. Karpagam, and T. Suresh, "Control techniques for Multilevel Voltage Source Inverters," in Proceedings of The 8th International Power Engineering Conference (IPEC 2007), Singapore, pp. 1023-1028,3-6 Dec 2007.

[15] Muhammad H. Rashid, "Power Electronics Circuits, Devices and Applications, 3rd ed. , PEARSON publication, 2009.

[16] Jin Wang and Damoun Ahmadi, "A Precise and Practical Harmonic Elimination Method for Multilevel Inverters", IEEE Transactions on Industry Applications, vol. 46, no. 2, pp. 857-865, Mar-Apr 2010.

[17] Bin Wu, High Power Converters and AC Drives, IEEE Press, Wiley-Interscience, A John Wiley and Sons Inc., Publications, 2006.

[18] V. Naga Bhaskar Reddy, V. Narasimhulu, Dr. Ch. Sai Babu, "Control of Cascaded Multilevel Inverter by using carrier based PWM technique and implemented to Induction Motor drive," International Journal on Automatic Control and System Engineering ICGST-ACSE Journal), vol. 10, Issue 1, Dec 2010.

[19] L. M. Tolbert, F. Z. Peng and T.G. Habetler, "Multilevel converters for large electric drives", IEEE Transactions on Industry Applications, vol. 35, no. 1, pp. 36-44, Jan/Feb 1999.

[20] N. S. Choi, J. G. Cho, and G. H. Cho, "A general circuit topology of multilevel inverter," inProc. IEEE PESC"91, 1991.

[21] T. A. Meynard and H. Foch, "Multilevel conversion: High voltage choppers and voltage source inverters," in Proc. IEEE PESC"92, 1992.

[22] M. F. Aiello, P. W. Hammond, and M. Rastogi, "Modular multi-level adjustable supply with series connected active inputs," U.S. Patent 6 236 580, May 2001.

[23] P. D. Ziogas. The delta modulation technique in static PWM inverters. IEEE Trans 2004.

[24] H. Ertl, J. W. Kolar, and F. C. Zach. Basic considerations and topologies of switched-mode assisted linear power amplifiers. IEEE Trans. Industrial Electronics, 44(1):116–23, February 1997.

[25] Joachim Holtz and Bernd Beyer. Optimal synchronous pulse width modulation with a trajectory tracking scheme for high dynamic performance. IEEE APEC"92, pages 147–154, 1992.

[26] N. V. Suryanarayan, "Utilisation of electric power including electric drives and traction", New Age International (P) Limited, 2005.

[27] Jagdish Kumar, Biswarup Das, and Pramod Agarwal, "Selective Harmonic Elimination technique for a Multilevel inverter," in Proc. of 15th National Power Systems Conference (NPSC), IIT Bombay.

[28] Burak Ozpineci, Leon M. Tolbert, John N. Chiasson, "Harmonic Optimisation of Multilevel Converters using Genetic Algorithms", IEEE Power Electronics Letters, vol. 3, no. 3

[29] Ilhami Colak, Ersan Kabalci, Ramazan Bayindir "Review of multilevel voltage source inverter topologies and control schemes" Elsevier, Energy Conversion and Management Journal Jan 2010.

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089   (24*7 Support on Whatsapp)