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# **MULTISTRING MULTILEVEL INVERTER TOPOLOGY FOR MICROGRID APPLICATIONS**

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**ABSTRACT :** *Multi-String Multilevel inverters are the new technology of power converter options for high-power applications. This paper presents a three phase multistring multilevel inverter for micro grid applications. The multilevel topology consists of several H-bridge cells connected in series, each one connected to a string. The simplified multilevel inverter needs only 6 switches whereas 8 switches are required in the conventional cascaded H-bridge multilevel inverter. Two active switches are operated across the line frequency. The multistring inverter topology offers better output waveforms, small LC filter size, less electromagnetic interference and total harmonic distortion. Finally, the results are compared between the without and with phase disposition pwm technique for both the multistring cascaded H-Bridge inverter and multistring multilevel inverter of in MATLAB/Simulink environment.*

**Key Words:** *Multistring Multilevel, Micro-grid, Cascaded inverters*

## **I. INTRODUCTION**

The advancement of multilevel inverters give rise to convert power in multiple voltage steps achieving lower switching losses, better electromagnetic compatibility, higher voltage capability and improved power quality. The multilevel converters achieve high-voltage and high currents by means of a series of number of switching devices, each of which lies within the ratings of the individual power devices. Among the multilevel Converters [1-3], the cascaded H-bridge topology (CHB) is particularly attractive in high-voltage applications, because it requires the least number of components to synthesize the same number of voltage levels.

These converter topologies can generate high-quality voltage waveforms with power semiconductor switches operating at a frequency near the fundamental [4]. Although, in low-power applications, the switching frequency of the power switches is not restricted, a low switching frequency can increase the efficiency of the converter. Additionally, multilevel converters feature several dc links, making possible the independent voltage controls. A single-phase grid-connected inverter is usually used for residential or low-power applications of power ranges that are less than 10 kW [5]. Multilevel inverters offer improved output waveforms and lower THD. Multilevel inverters are promising; they have nearly sinusoidal output-voltage waveforms, output current with better harmonic profile, less stressing of electronic components owing to decreased voltages, switching losses that are lower than those of conventional two-level inverters, a smaller filter size, and lower EMI, all of which make them cheaper, lighter, and more compact [6-7].

This paper presents a three phase multi-string multilevel inverter for microgrid application.

## **II. MULTISTRING MULTILEVEL INVERTER**

The multi-string multilevel inverters configuration consists of two high step-up dc/dc converters connected to their individual dc-bus capacitor and a simplified multilevel inverter. Input sources, DER module 1, and DER module 2 are connected to the inverter followed a linear resistive load through the high step-up dc/dc converters. The studied simplified five-level inverter is used instead of a conventional cascaded pulse width-modulated (PWM) inverter because it offers strong advantages such as improved output waveforms, smaller filter size, and lower EMI and THD.

### 2.1 Cascaded H-Bridge Inverter

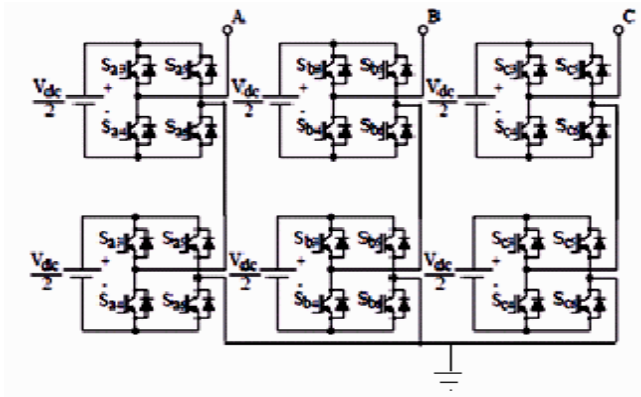


Fig.1 Three phase cascaded multilevel inverter

Fig.1 shows the cascaded H-Bridge inverter Configuration for three phases. By using single H-Bridge 3 voltage levels can be obtained. The number of output voltage levels of cascaded Full H-Bridge is given by  $2n+1$  and voltage step of each level is given by  $V_{dc}/n$ , where  $n$  is the number of H-bridges connected in cascaded.

### 2.2 Hybrid H-Bridge Inverter

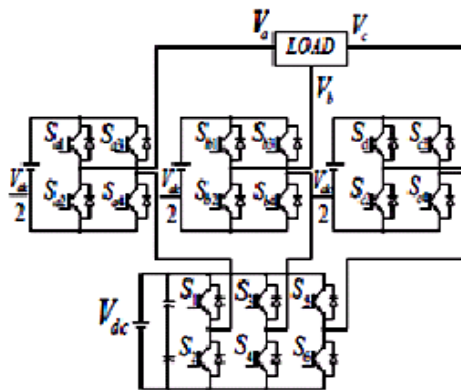


Fig.2 Three phase cascaded hybrid H-Bridge multilevel inverter

Fig.2 shows the three phase Hybrid H-Bridge inverter configuration. Five voltage levels can be achieved by using single Hybrid H-Bridge. The number of output voltage levels of a cascaded Hybrid H-Bridge is given by  $4n+1$  and voltage step of each level is given by  $V_{dc}/2n$ , where  $n$  is number of H-bridges connected in cascaded.

### 2.3 Modulation Topologies for Multilevel Inverters

To control the flow of power in the inverter, the switches alternate between two states - turned off (so no current flows), or saturated (turned on completely, with only a small voltage drop across the switch). This happens rapidly enough that the inductors and capacitors at the input and output nodes of the inverter average or filter the switched signal. The switched component is attenuated and the desired DC or low frequency AC component is retained. This process is called Pulse Width Modulation (PWM), since the desired average value is controlled by modulating the width of the pulses. There are many different ways of generating PWM switching edges. Any technique can probably be placed into one of the following three categories:

- I. Off-line or pre-calculated PWM technique
- II. Hysteresis control PWM

III. Carrier based PWM

III. SIMULATION AND RESULTS

By simulating the three phase five level inverter with pwm technique as shown in Fig.3 the reduction of harmonics in the output waveform shown in Fig.4 is observed. The simulink diagram of 3- $\phi$  multistring multilevel inverter with pwm is shown in Fig.5. The output of the circuit is shown in Fig.6.

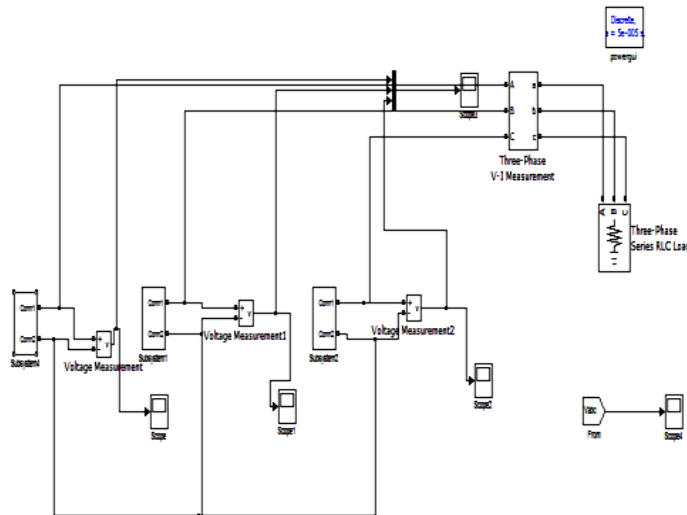


Fig.3 Simulink diagram of 3- $\phi$  multilevel inverter with pwm

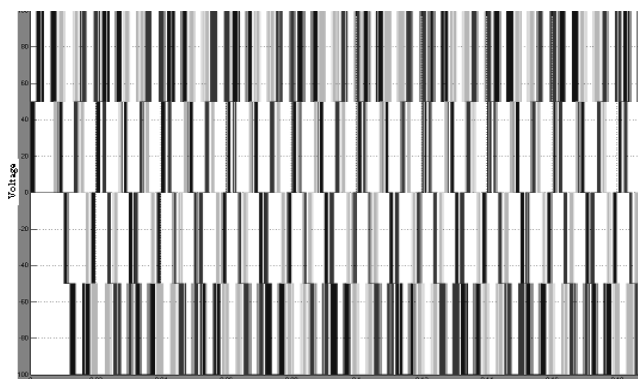


Fig.4 Output voltage of 3- $\phi$  multilevel inverter with pwm

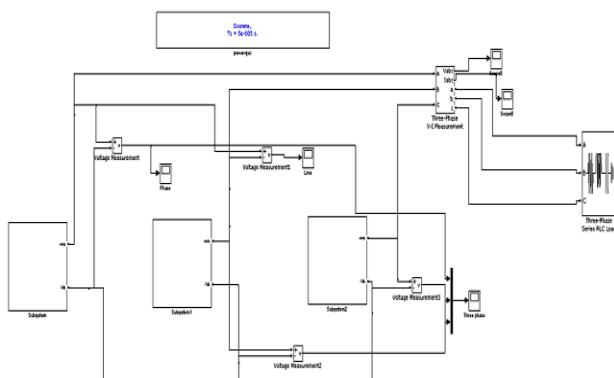


Fig.5 Simulink diagram of 3- $\emptyset$  multistring multilevel inverter with pwm

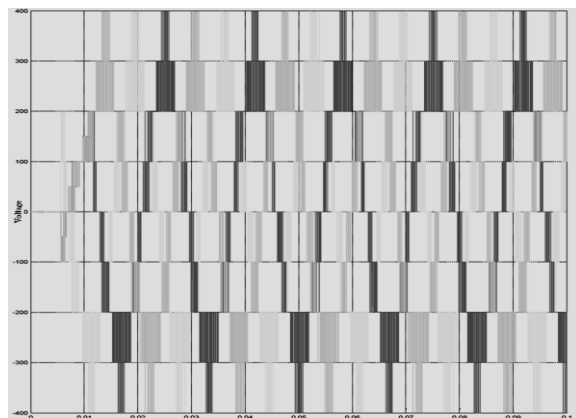


Fig.6 Output voltage of 3- $\emptyset$  multistring multilevel inverter with pwm

#### IV. CONCLUSION

A three-phase cascaded H-bridge inverter and a three-phase multistring multilevel inverter for microgrid application are simulated and the output voltage waveforms are presented. The PWM technique has been implemented for both the circuits. The behavior of the proposed multilevel inverter was observed to be satisfactory and reduces the switching losses when compared to a traditional cascaded multilevel inverter.

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#### REFERENCES

- [1] M. Calais and V. G. Agelidis, "Multilevel converters for single-phase grid connected photovoltaic systems—an overview," in *Proceedings of IEEE International Symposium on Industrial Electronics*, vol. 1, pp. 224–229, 1998.
- [2] Yi-Hung Liao, Ching-Ming "Newly- Constructed Simplified Single-Phase Multistring Multilevel Inverter Topology for Distributed Energy Resources", *IEEE Transactions on Power Electronics*, vol. 26, no. 9, pp. 2386 - 2392, 2011.
- [3] N. Hatziaargyriou, H. Asano, R. Irvani, and C. Marnay, "Microgrids," *IEEE Power & Energy Magazine*, vol. 5, no. 4, pp.78-94, Jul/Aug. 2007.
- [4] F. Katiraei, R. Irvani, N. Hatziaargyriou, and A. Dimeas, "Microgrids management," *IEEE Power Energy Mag.*, vol. 6, no. 3, pp. 54-65, May/Jun. 2008.
- [5] C. L. Chen, Y. Wang, J.S.Lai, Y.S.Lee, and D. Martin, "Design of parallel inverters for smooth mode transfer microgrid applications," *IEEE trans. Power Eletron.*, vol. 25, no.1 pp. 6-15, Jan.2010.
- [6] P. K. Hinga, T. Ohnishi, and T. Suzuki, "A new PWM inverter for photovoltaic power generation system," in *Conf. Rec. IEEE Power Electron. Spec. Conf.*, 1994, pp. 391–395.
- [7] Y. Cheng, C. Qian, M. L. Crow, S. Pekarek, and S. Atcitty, "A comparison of diode-clamped and cascaded multilevel converters for a STATCOM with energy storage," *IEEE Trans. Ind. Electron.*, vol. 53, no. 5, pp. 1512– 1521, Oct. 2006.