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Twenty Seven-Level Inverter For Fuel Cell Application

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ABSTRACT

A single-phase twenty seven-level inverter for Fuel Cell application, with a novel PWM control scheme is proposed in this paper. Distributed generation is expected to play a significant role in remedying the many shortcomings in today's energy market. In particular, fuel cell power generation will play a big part due to several advantages. Still, it is faced with its own challenges to tap into its potential as a solution to the crisis. Hence the proper topology of inverter and the boost converter may improve the potential of Fuel Cell and we can use this alternative source to meet the power demand. The inverters produce an output voltage or a current with levels either 0 or +ve or-ve V dc. They are known as two-level inverters. Multilevel inverter is to synthesize a value nearer to sinusoidal voltage from several levels of dc voltages. Multilevel inverter has advantage like minimum harmonic distortion. Multi-level inverters are emerging as the new breed of power converter options for high power applications. In this research work hardware model of twenty seven -level single phase Modified H-Bridge inverter with Bidirectional switches has been developed using MOSFETS. Gating signals for these MOSFETS have been generated by PWM technique. In order to maintain the different voltage levels at appropriate intervals, the conduction time intervals of MOSFETS have been maintained by controlling the pulse width of the gating pulse.

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INTRODUCTION

The renewable energy sources such as fuel cell is considered as alternative source to fossil energy the main reason is due to pollution and efficiency.For the past 10 years the proton exchange membrane fuel cell (PEMFC) has been considered as a promising kind of fuel cell because of its low working temperature, compactness and easy and safe operational modes.

An inverter is basically a device that converts electrical energy of DC form into that of AC. A variable output voltage can be obtained by varying the input dc voltage and maintaining the gain of inverter as constant. If the dc input voltage is fixed and it is not controllable, a variable output voltage can be obtained by varying the gain of the inverter. The inverter gain may be defined as the ratio of the ac output voltage to the input voltage.

1.1 *Fuel Cell:*

The fuel cell is drawing the attention by researchers as one of the most promising power supply in the future. Due to high efficiency, high stability, low energy consumed and friendly to environment, this technology is in the progress to commercialize. Fuel cell has higher energy storage capability thus enhancing the range of operation for automobile and is a clean energy source.

PROTON exchange membrane (PEM) fuel cell is a device that converts chemical fuels into electric power, with many advantages such as clean electricity generation, high-current output ability, high energy density, and high efficiency. The PEM fuel cell presents a low voltage output with a wide range of variations. For the PEM fuel-cell system applications, the dc–dc converter must be concerned with the following design criteria: large step-up ratio, low-input-current ripple, and isolation.

Multilevel Inverter:

The power generated by the inverter is to be delivered to the power network, so the utility grid, rather than a load, was used. The dc–dc boost converter was required because the PV arrays had a voltage that was lower than the grid voltage. High dc bus voltages are necessary to ensure that power flows from the PV arrays to the grid. A filtering inductance

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Lf was used to filter the current injected into the grid. Proper switching of the inverter can produce seven output-voltage levels (*V*dc, 2*V*dc/3, *V*dc/3, 0, −*V*dc, −2*V*dc/3, −*V*dc/3) from the dc supply voltage.

Conventional two-level inverters are mostly used today to generate an AC voltage from a DC voltage. The two-level inverter can only create two different output voltages for the load, Vdc/2 or –Vdc/2 (when the inverter is fed with Vdc). To build up an AC output voltage these two voltages are usually switched with PWM. Though this method is effective it creates harmonic distortions in the output voltage, EMI and high dv/dt (compared to multilevel inverters). This may not always be a problem but for some applications there may be a need for low distortion in the output voltage.

The concepts of Multi Level Inverters (MLI) do not depend on just two levels of voltage to create an AC signal. Instead several voltage levels are added to each other to create a smoother stepped waveform, with lower dv/dt and lower harmonic distortions. With more voltage levels in the inverter the waveform it creates becomes smoother, but with many levels the design becomes more complicated, with more components and a more complicated controller for the inverter is needed.

2.1 Existing Model System Description:

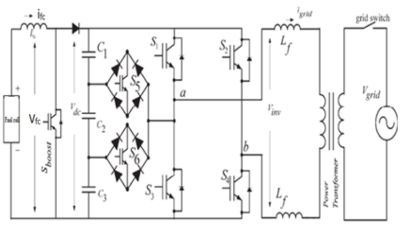

Fig. 2.2: Single phase 7 level inverter.

The single-phase seven-level inverter was developed from the five-level inverter. It comprises a single-phase conventional H-bridge inverter, two bidirectional switches, and a capacitor voltage divider formed by C1, C2, and C3, as shown in fig 2.2. Switching combinations that generated 7-output voltage levels (0, −*V*dc, −2*V*dc/3,−*V*dc/3, *V*dc, 2*V*dc/3, *V*dc/3). The power generated by the inverter is to be delivered to the power network, so the utility grid, rather than a load, was used. The dc–dc boost converter was required because the fuel cell had a voltage that was lower than the grid voltage. High dc bus voltages are necessary to ensure that power flows from the PV arrays to the grid. A filtering inductance *Lf* was used to filter the current injected into the grid. Proper switching of the inverter can produce seven output-voltage levels (*V*dc, 2*V*dc/3, *V*dc/3, 0, −*V*dc, −2*V*dc/3, −*V*dc/3) from the dc supply voltage.

2.2 Proposed Circuit Model:

The proposed single-phase twenty seven-level inverter was developed from the nine-level inverter. It comprises a cascade connected three single-phase conventional H-bridge inverter, twelve MOSFET switches, and two multi tap transformers. The modified H-bridge topology is significantly advantageous over other topologies, i.e., less power switch, power diodes, and less capacitor for inverters of the same number of levels. Fuel stack were connected to the inverter via a dc–dc boost converter.

3. *Simulation Model:*

The simulation model of the 27 level inverter with fuel cell an input is designed using MATLAB and it is shown in fig 3.1 and the resultant wave form is shown in graph 3.2

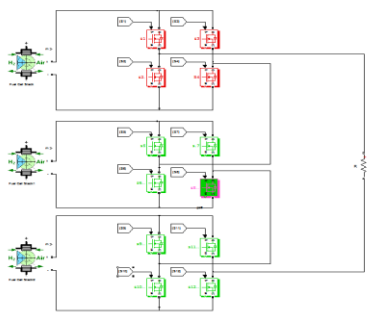

Fig 3.1: simulation model of 27 level inverter with fuel cell as input.

3.1 *Output Waveform:*

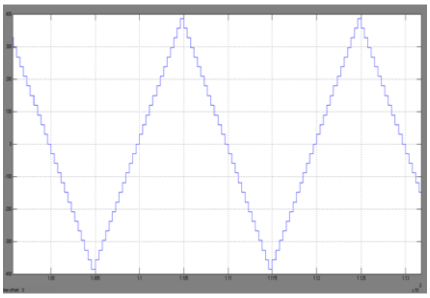

Fig 3.2: The output voltage waveform for the simulation model.

Conclusion:

Multilevel inverters offer improved output waveforms and lower THD. This paper has presented a novel PWM switching scheme for the proposed multilevel inverter. By this method, the THD value decreases, when increasing higher output voltage levels. Hence, the number of switches, cost, area required, protection circuit, cooling equipment, driving circuit get decreases, And also the switching losses decreases, efficiency increases.

MULTILEVEL INVERTER	THD VALUE
5-LEVEL	38%
27-LEVEL	1.26%

REFERENCES

Calais, M. and V.G. Agelidis, 1998. “Multilevel converters for single-phase gridconnected photovoltaic systems—An overview,” in *Proc. IEEE Int. Symp. Ind. Electron.*, 1: 224–229.

Kjaer, S.B., J.K. Pedersen and F. Blaabjerg, 2005. “A review of single-phase grid connected inverters for photovoltaic modules,” *IEEE Trans. Ind. Appl.*, 41(5): 1292-1306.

Cheng, Y., C. Qian, M.L. Crow, S. Pekarek and S. Atcitty, 2006. “A comparison of diode-clamped and cascaded multilevel converters for a STATCOM with energy storage,” *IEEE Trans. Ind. Electron.*, 53(5): 1512–1521.

Saeedifard, M., R. Iravani and J. Pou, 2009. “A space vector modulation strategy for a back-to-back five-level HVDC converter system,” *IEEE Trans. Ind. Electron.*, 56(2): 452–466.

Alepuz, S., S. Busquets-Monge, J. Bordonau, J.A.M. Velasco, C.A. Silva, J. Pontt and J. Rodríguez, 2009. “Control strategies based on symmetrical components for grid-connected converters under voltage dips,” *IEEE Trans. Ind. Electron.*, 56(6): 2162–2173.

Rodríguez, J., J.S. Lai, and F.Z. Peng, 2002. “Multilevel inverters: A survey of topologies, controls, and applications,” *IEEE Trans. Ind. Electron.*, 49(4): 724-738.

Rodriguez, J., S. Bernet, B. Wu, J.O. Pontt and S. Kouro, 2007. “Multilevel voltage-source-converter topologies for industrial medium-voltage drives,” *IEEE Trans. Ind. Electron.*, 54(6) 2930–2945.

Renge, M.M. and H.M. Suryawanshi, 2008. “Five-level diode clamped inverter to eliminate common mode voltage and reduce dv/dt in medium voltage rating induction motor drives,” *IEEE Trans. Power Electron.*, 23(4): 1598-1160.