Design & Simulation Of New Converter Topology For Solar Power Generation System

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Abstract- A new solar power generation system is composed of a dc/dc power converter and a new seven-level inverter. The dc/dc power converter integrates a dc–dc boost converter and a transformer to convert the output voltage of the solar cell array into two independent voltage sources with multiple relationships. This new seven-level inverter is configured using a DC-DC converters and a full-bridge power converter, connected in cascade. The DC-DC converters converts the two output voltage sources of dc–dc power converter into a three-level dc voltage, and the full-bridge power converter further converts this three-level dc voltage into a seven-level ac voltage. In this way, the proposed solar power generation system generates a sinusoidal output current that is in phase with the utility voltage and is fed into the utility. The salient features of the proposed seven-level inverter are that only seven power electronic switches are used i.e., three switches and three dc sources to generate three level dc voltage and one bridge circuit to convert this three level dc voltage to seven level ac voltage. Where in conventional converter three bridge circuit along with three dc sources are required to generate seven level voltage.

Index terms- Grid-connected, Seven-level inverter.

1 Introduction

The energy consumption of the world is increasing dramatically with the rapid increase of population. Renewable energy resources are holding the predominant place for satisfying the future energy demand. Among the available renewable sources, wind and solar are predominant ones, since they have more advantages on production, maintenance, etc, when compared with others. The extensive use of fossil fuels has resulted in the global problem of greenhouse emissions. Moreover, as the supplies of fossil fuels are depleted in the future, they will become increasingly expensive.

Electrical Energy already constitutes more than 30 % of all energy usage on Earth. And this is set to rise in the coming years. Its massive popularity has been caused by its efficiency of use, ease of transportation, ease of generation, and environment-friendliness. Thus, the power generation using solar energy is becoming more important since it produces less pollution and the cost of fossil fuel is rising, while the cost of solar arrays is decreasing. In particular, small-capacity distributed power generation systems using solar energy may be widely used in residential applications in the near future.

2 Conventional Seven- Level Inverter

The fig 1(a) shows the simulink model of the conventional seven level inverter. When the switches S1 and S2 are ON the voltage +Vs1 will appear across the load. When the switches S5 and S6 are ON along with the switches S1 and S2 the voltage +(Vs1+Vs2) will appear across the load. Similarly when the switches S9 and S10 are ON along with the switches S1, S2, S5, S6, the voltage +(Vs1+Vs2+Vs3) will appear across the load. Similarly the remaining switches are turned ON in the same way to get negative half of the load voltage.

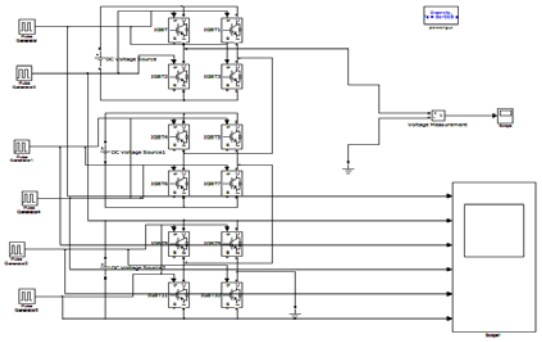

Fig 1(a): Conventional 7-Level Inverter

3 Proposed Seven- Level Inverter

The figure 3(a) shows the simulink model of the proposed 7-level inverter. When the switch S5 is ON along with the switches S1, S2 and the diodes D2 and D3, the voltage Vs1 will appear across the load. When the switches S5 and S6 are ON along with the switches S1, S2 and the diode D3, the voltage (Vs1+Vs2) will appear across the load. Similarly when the switches S5,S6 and S7 are ON along with the switches S1 and S2 the voltage (Vs1+Vs2+Vs3) will appear across the load.Similarly when the switch S5 is ON along with the switches S3, S4 and the diodes D2 and D3, the voltage -Vs1 will appear across the load. When the switches S5 and S6 are ON

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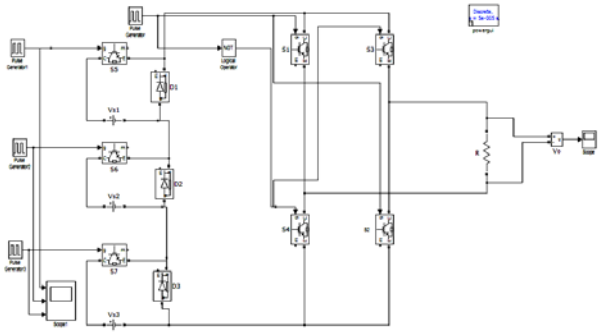

Fig 3(a): Proposed 7-Level Inverter

along with the switches S3, S4 and the diode D3, the voltage –(Vs1+Vs2) will appear across the load. Similarly when the switches S5,S6 and S7 are ON along with the switches S3 and S4 the voltage -(Vs1+Vs2+Vs3) will appear across the load. Hence seven level output voltage is achieved i.e. +Vs1, +(Vs1+Vs2), +(Vs1+Vs2+Vs3), 0, -Vs1, -(Vs1+Vs2), -(Vs1+Vs2+Vs3).

4 Simulation Results

Here three input dc source of each 25V is used. The gating pulses for both conventional cascaded and proposed seven level inverter is as shown in fig 4(a)and fig 4(b). the output voltage waveform for both conventional cascaded and proposed seven level inverter is as shown in fig 4(c) and fig 4(d). From the simulation results we can conclude that form proposed topology we can achieve sevel level output with minimum number of switches and reduced switching loss compared to conventional cascaded seven level inverter.

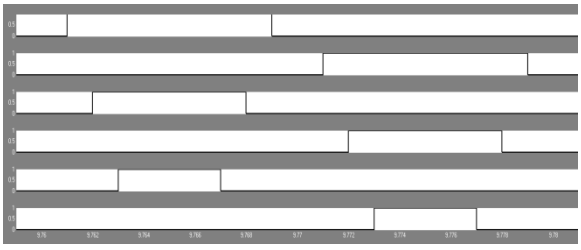

Fig 4.1(a): Gating Pulses For Conventional 7-Level Inverter

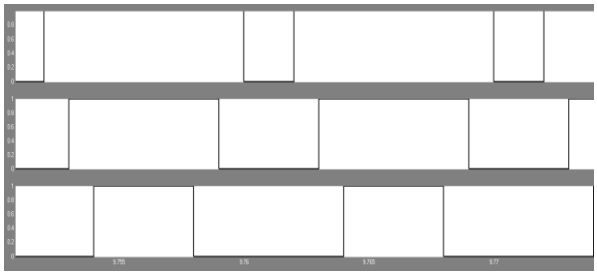

Fig 4(b): Gating Pulses For Proposed 7-Level Inverter

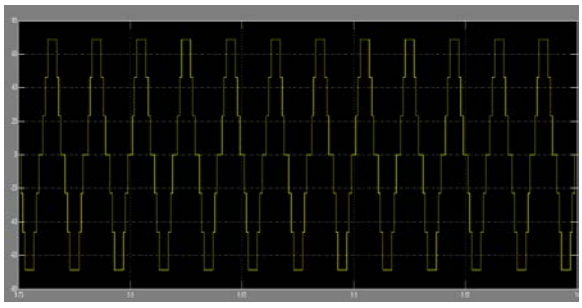

Fig 4(c): Output Voltage Of Conventional 7-Level Inverter

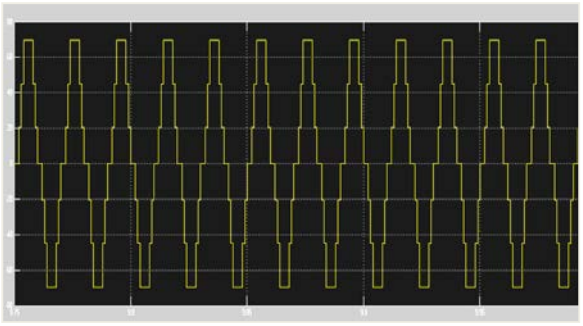

Fig 4(d): Output Voltage Of Proposed 7-Level Inverter

5 Conclusion

The proposed seven level inverter topology comprise seven power electronic switches(IGBT) i.e., three switches and three dc sources to generate three level dc voltage and one bridge circuit to convert this three level dc voltage to seven level ac voltage. Where in conventional converter three bridge circuit i.e., 12 power electronic switches along with three dc sources are required to generate seven level voltage. Hence the proposed seven level inverter topology yields reduced number of switches and switching loss in compare to conventional cascaded inverter to generate seven level voltage.

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