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Nine level transformer less inverter for PV Applications

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ABSTRACT:

In recent times there is a huge demand in reduced switched multilevel inverter. The multilevel inverter is one of the attractive features in harmonics elimination. This paper proposes single source nine level inverter with reduced switching devices for single phase AC applications. This makes the system larger in size, weight as well as less cost effective. The proposed multilevel inverter has the ability of producing nine levels with reduced number of switches and source. In addition to that the single source nine level inverter utilizes the simplified control algorithm which reduces the complexity. The Pulse Width Modulation (PWM) scheme is one of the most common control techniques which have the simple structure. The operation of the circuit and control algorithm is discussed in detail

Keywords:
Photovoltaic systems, Transformer less inverters, common ground voltage, multilevel inverters.

1. INTRODUCTION:

Nowadays, use of photovoltaic (PV) system for generation of electrical energy in commercial and private sector is rapidly increasing. Inverter is used for conversion of energy generated by PV panel which is fed to the ac grid. PV inverter is designed in such a way that to lower size, weight and cost of the PV system with increased efficiency. There are two types of inverter are used for PV system one is with galvanic isolation and another is without galvanic isolation. PV inverter with galvanic isolation provides the isolation between grid and PV panel. Transformer is used for galvanic isolation. Due to galvanic isolation the safety is increased, but transformer reduces the efficiency because of additional power stage. Efficiency of the system is increased with features of smaller, lighter and easy to install by grid connected PV inverter without transformer. Common mode resonant circuit is creating in transformer less grid connected PV inverter which includes PV parasitic capacitance, grid impedance and filter. Leakage current is generated due to common mode that circulates through the parasitic capacitance towards the ground. Leakage current value is affected by parasitic capacitance, modulation strategy and common mode voltage. Parasitic capacitance value depends on whether condition, surface of cells, distance between cells, PV panel and frame structure. Leakage current is reduced by two methods, one with lower the high frequency transition in terminal voltage and maintaining constant common mode voltage (CMV).

A multilevel inverter is a power electronic device that is capable of providing desired alternating voltage level at the output using multiple lower-level DC voltages as an input. Mostly a two-level inverter is used in order to generate the AC voltage from DC voltage.

This paper proposes the multilevel inverter which comprises of nine levels, single source, less number of switches. The proposed nine level inverter also utilizes the PWM technique for the alleviation of harmonic problem to a greater extent. The circuit operations and control strategy are clearly observed from the previous

reference works and the proposed work explained in detail with experimental results.

Pulse Width Modulation (PWM) is widely employed to control the output of static power inverters. The reason for using PWM is that they provide voltage and/or current wave shaping customized to the specific needs of the application under consideration. It is lastly performance and cost criteria, which determines the choice of a PWM method in a specific application.

2. LITERATURE SURVEY:

Zhang et al proposed solution for maintaining constant CMV. To generate three levels in the output voltage eight switches are used in this configuration. Switching losses reduces in this topology but there are high conduction losses. If more than three level operations needed, extra number of switches is required.

Ji et al proposes one topology based on constant CMV with low switching losses. Two diodes and six switches are used in this topology. This method is less convenient to extend the number of levels in the voltage and it has high conduction losses.

Islam and Mekhilef proposed another topology to lower leakage current by retain constant CMV. Six switches are used for generation of three levels in the output voltage. Conduction losses and switching losses are more and this topology cannot be extended to more than three levels.

From the above mentioned discussion, we conclude that we need transformer less inverter with minimum semiconductor switches to increase efficiency and economy. Along with extension of higher number of level in output voltage, Switching and conduction losses is also minimum. This paper proposes one solution to minimize leakage current with less conduction and switching losses for transformer less grid connected PV inverter. Leakage current is minimized by avoiding high frequency transition in terminal voltage with proposed PWM technique. Eight switches are required for generation of nine levels in the inverter output voltage.

3 Nine level inverter:

A better strategy for power electronic interface for photovoltaic power generation system to overcome all the limitations of conventional technique is required. For this purpose a nine-level inverter is introduced. This nine-level inverter is used for injecting the real power of the photovoltaic power into the grid.

3.1Circuit configuration:

The circuit configuration of the nine-level inverter applied to a photovoltaic power generation. As can be seen, it is configured by a solar cell array, a dc–dc converter, a nine-level inverter, eight switches, and a DSP (Digital signal processor)-based controller. Switches SW1 and SW8 are placed between the nine-level inverter and the utility, and they are used to disconnect the photovoltaic power generation system from the utility when islanding operation occurs.

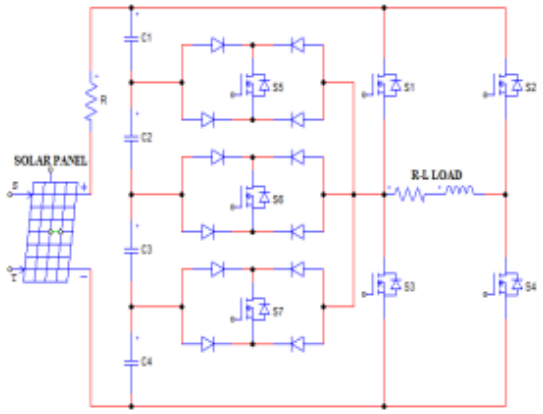

Fig1: solar power based nine level inverter

The new sun oriented based nine level inverter investigated and created from fell 9 level inverter. The proposed inverter comprises of fundamental H-connect inverter alongside Three bidirectional switches, and a four capacitor go about as voltage cutter as said in figure 4. This changed topology utilizes sun based power rather than DC voltage and which utilizes fewer switches and voltage sources. The proposed inverter can be broke down for various load are R, RL and enlistment engine stack. The inverter utilizes operation as clarified in nine exchanging states framed by sine PWM system. PIC Microcontroller which customized by Embedded C. The beat width of the IC changed by changing the codes of the Programming utilizing Dubbing Technique which utilized pick kit2 programmer. The proposed inverter exchanging state as clarified in the underneath table.1

VO	S1	S2	S3	S4	S5	S6	S7
Vdc	1	0	0	1	0	0	0
3Vdc/4	0	0	0	1	1	0	0
Vdc/2	0	0	0	1	0	1	0
Vdc/4	0	0	0	1	0	0	1
0	1	0	1	1	0	0	0
0	0	1	0	0	0	0	0
(-)Vdc/4	0	1	0	0	1	0	0
(-)Vdc/2	0	1	0	0	0	1	0
(-)3Vdc/4	0	1	0	0	0	0	1
(-)Vdc	0	1	1	0	0	0	0

Table.1. Switching states of proposed inverter

The distinctive exchanging conditions of proposed inverter The table 1.The full voltage got by activating switch 1 and 4,the 0.75 Vdc voltage

acquired by the switch 1&5. 0.5 Vdc % of info voltage got by activating Switch 4&6. Zero voltage got by either switch 2 or switch 1,3&4 . Amid that period different switches are in OFF mode. The -0.25 Vdc % negative voltage acquired by setting off the switches 1&5. The half negative voltage got by setting off the switches 2&7. The -0.5 Vdc negative voltage acquired by setting off the switches 2&8. The full negative voltage got by setting off the switches 2& 3. As such The Negative voltage got by rearranging alternate changes regarding the positive voltage and comparing negative voltage are gotten.

3.1 PIC Microcontroller:

Fig 2: PIC microcontroller

NEED FOR PIC:

Cost Effective: The peripheral Interface controller is very cost effective, that is the different model PIC's are available with proportional cost.
Easily Available. The different models are easily available in the market.

4. ACKNOWLEDGEMENT

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5 CONCLUSIONS:

A photovoltaic power generation system with a five-level inverter is introduced. The nine-level inverter can perform the functions of regulating the dc bus voltage, converting solar power to ac power with sinusoidal current and in phase with the utility voltage, balancing the two dc capacitor voltages, and hence overcome the main limitations of the conventional power electronic interface for photovoltaic power generation system. Main advantages of proposed nine level grid connected PV inverter are,

- Less switching power loss
- Reduced harmonic distortion
- Reduced EMI
- Simplified control circuit
- Capacitor voltages can be easily balanced
- Better power efficiency
- Capacity of output filter can be reduced
- Cheaper, lighter and more compact

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