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MULTILEVEL CONVERTERS USED FOR RENEWABLE DISTRIBUTED SYSTEMS

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ABSTRACT

A single phase grid connected converter is mainly used for low-power renewable distributed systems. The proposed converter architecture is based on the full-bridge topology. There are additionally two power switches and two diodes used. Charging and discharging of two capacitors are used to create the two added levels. Here, a specific pulse width modulation technique is used. It is used to balance the midpoint voltage of the capacitors. Pulse width modulation is nothing but changing on and off time period of a waveform without changing its frequency. The power loss comparison also takes place here. The harmonics are also reduced here. MPPT technique is used to obtain the maximum power.

KEYWORDS: DC-AC Conversion, Distributed Power Generation, MPPT Technique, Multilevel Converters, Midpoint Voltage Control

INTRODUCTION

Global energy consumption tends to grow continuously. To satisfy the demand for electric power against a background of the depletion of conventional, fossil resources the renewable energy sources are becoming more popular. In electricity companies the output current grid connected converters is needed[1].The converter topology uses the grid connected converter without uses the galvanic isolation. This process is known as transformer less architectures [2]. The unipolar Pulse Width Modulation is applied to the full-bridge topology.

Harmonic is the important concept in converter output voltage. We have to reduce the harmonic content by using the multilevel topologies. It is also mainly used to reduced the switching power losses and electromagnetic interference (EMI)[3].

FIVE-LEVEL TOPOLOGIES

Half-Bridge NPC

The NPC-leg consists of eight transistors in series. The clamping diodes are used to provide the additional voltage levels. Transformer less photovoltaic converters are used [2].

Cascaded Full-bridge

Multiple PV-strings are used in this technique. There are independent DC-sources are required for this process. The unipolar and hybrid modulations used in the carrier-based pulse width modulation technique.

NPC Full- Bridge

The neutral point clamped diode full-bridge circuit does not require the independent DC sources. The trade-off between the performance and complexity is takes place. Compare with NPC half-bridge and the NPC full-bridge, the

output from the full-bridge is twice compared with the half-bridge circuits. The output current ripple in this NPC full-bridge also twice at the switching frequency.

Hybrid Five-Level Topologies

In this process only three devices are conducting. The number of devices is reduced compared with the NPC full-bridge method. Here, the flying capacitor is used to provide the additional voltage level. Only six devices are needed and in that the conducting devices are three.

MPPT Algorithm

This algorithm is mainly used to determine the maximum power from all conditions. The output from the PV arrays are mainly based on the atmospheric conditions , therefore in order to collect the maximum available power the operating point needs to be tracked continuously using a Maximum Power Point Tracker algorithm . To find the maximum power point (MPP) for all conditions, the MPPT algorithm is used.

MULTILEVEL CONVERTER

In renewable energy systems the sources are may be in AC or DC.As per load requirement the power is used for grid connected systems.The DC is converted to the desired AC voltage. So, the dc-ac converters are used for the PV application. The multilevel converters are used to reduce the loss while converting the DC into AC.

The switches T1 and T4 on at a positive semi period. Different PWM techniques are used to drive the converter and also it depends on the modulation index also. At negative semi period the switches T2 and T3 will be in on state. Modulation Index is the ratio of the maximum deviation frequency to the frequency of modulation. In other words it is the ratio of the spread in frequency spectrum to the frequency that was used to modulate the carrier. The relationship between the amplitudes of the modulating signal and carrier is important. This relationship is expressed in the terms of a ratio known as the modulation index.

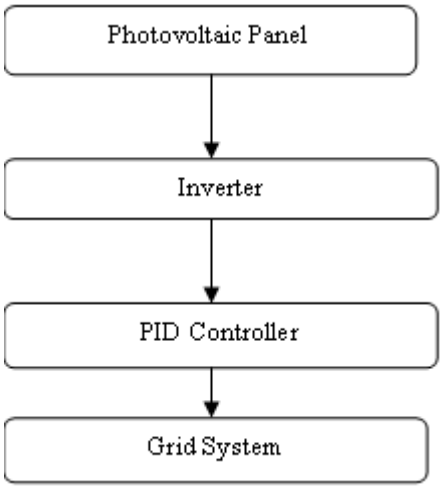

Figure 1: Block Diagram of the Circuit

Photovoltaic cells use semiconductor technology to transform the energy in sunlight into electricity. Silicon is the most widely used semiconductor material in PV cell, which consists of a junction consisting of n and p-doped. When light (photons) strikes the junction, the energy in the photons is converted to electric power. The output voltage level will be provided by discharging of the high side and low side capacitance. The PWM technique is used to keep constant output voltage in the transformer less inverter for photovoltaic applications.

FOUR-QUADRANT OPERATION

In order to maximize the efficiency and to comply with international regulations, converters are required to work with unity power factor. The inverter, utilizing the voltage sourced inverter (VSI) configuration, allows the local residential PV generation to actively supply reactive power to the utility grid. A low complexity grid synchronization method was introduced to generate the parallel and orthogonal components of the grid voltage in a highly computationally efficient manner in order to create a synchronized current reference to the current control loop.

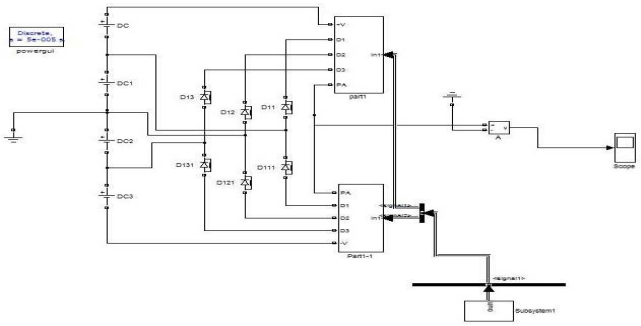

Figure 2: Five Level Converter

APPLICATION IN RENEWABLE DISTRIBUTED SYSTEMS

The control system of the proposed topology with MVC fed by a renewable energy source is presented, which concerns a single-stage structure. The dc source can be either a photovoltaic field or a wind generator followed by a three-phase active or passive rectifier. The inner loop regulates the current injected into the grid, whereas the outer voltage loop fixes the dc-link voltage. In a single-stage solution, the dc link is directly connected to the energy source, and the logic onboard the converter regulates the dc-link voltage in order to extract the maximum available power with an maximum power point tracking (MPPT) algorithm. In order to track the maximum power point during abrupt variations of weather conditions, the injected grid current and the dc-link voltage will be subject to sudden changes. In a double-stage converter, the proposed topology is preceded by a dc–dc converter, which implements the MPPT control, whereas the dc–ac converter works with a fixed dc-link voltage. In this configuration, the dc–ac converter will be subject only to injected grid current variations.

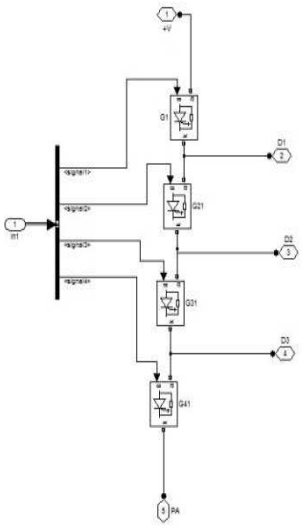

Figure 3: Subsystem of Five Level Inverter

The cascaded NPC full bridge topology will give high efficiency but the number of devices is increased in this process. Due to this complexity also gets increases. The freewheeling diode is used to avoid the energy trapped into the load. If the load is inductive means the antiparellel diode is known as freewheeling diode which is connected across the load to provide the path for inductive current to flow. The IGBT combines the advantages of BJT and MOSFET. Four quadrants mean the load current and load voltage will be either positive or negative. It forms the basis of the full bridge inverter.

SWITCHING CIRCUIT CONFIGUARATION

A full bridge configuration with SPWM unipolar voltage switching scheme is used as the switching circuit of the inverter. By selecting the full bridge configuration, the minimal allowed DC-link voltage can be set to be the peak value of the AC grid voltage (plus margins). A switching frequency of 30 kHz was selected based on considerations for the filter size and the practical implementation of the digital controller.

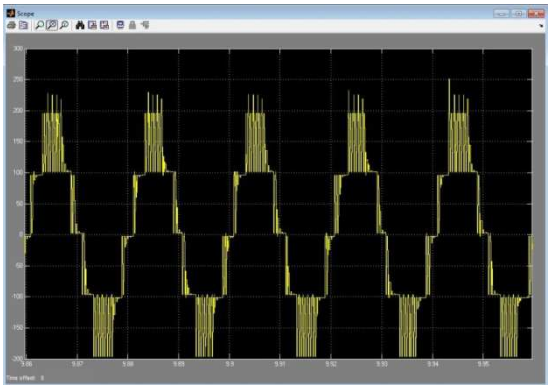

Figure 4: Output Waveform

CONCLUSIONS

The five level solution for single phase grid connected converters is obtained here. To obtain the maximum efficiency PWM technique is chosen here. It is also used to obtain the minimum number of commutations. The DC-link midpoint voltage is used to obtain the additional two levels. This also reducing the switching power losses and electromagnetic interference. The theoretical power loss comparison of the semiconductor takes place. The IGBT act as a active device which is mainly suitable for the PWM technique, and reducing the conduction power losses. The MVC (midpoint voltage control) is used to balance the midpoint voltage. The five level topology is suitable for unity power factor applications; otherwise the five level converter will produce the output only three levels. So, the total harmonic distortion and switching losses will get increased. We can improve the level of the converter to reduce the harmonic distortions.

REFERENCES

1. D. Infield, P. Onions, A. Simmons, and G. Smith, “Power quality from multiple grid-connected single-phase inverters,” *IEEE Trans. Power Del.*, vol. 19, no. 4, pp. 1983–1989, Oct. 2004.
2. R. Gonzalez, E. Gubia, J. Lopez, and L. Marroyo, “Transformer less single-phase multilevel-based photovoltaic inverter,” *IEEE Trans. Ind. Electron.*, vol. 55, no. 7, pp. 2694–2702, Jul. 2008.

3. S. Kouro, M. Malinowski, K. Gopakumar, J. Pou, L. Franquelo, B. Wu, J. Rodriguez, M. Pandrez, and J. Leon, “Recent advances and industrial applications of multilevel converters,” *IEEE Trans. Ind. Electron.*, vol. 57, no. 8, pp. 2553–2580, Aug. 2010.
4. J.-S. Lai and F. Z. Peng, “Multilevel converters—A new breed of power converters,” *IEEE Trans. Ind. Appl.*, vol. 32, no. 3, pp. 509–517, May 1996.
5. A. Shukla, A. Ghosh, and A. Joshi, “Control schemes for dc capacitor voltages equalization in diode-clamped multilevel inverter-based dstatcom,” *IEEE Trans. Power Del.*, vol. 23, no. 2, pp. 1139–1149, Apr. 2008.