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DESIGN AND SIMULATION OF THREE PHASE THREE LEVEL AC-DC CONVERTER USING PULSE WIDTH MODULATION

S.Sowntharya [1], Power Electronics And Drives, PG Scholar, Anna University Regional Campus, Coimbatore

Abstract

The pulse width modulation signal in each phase of the output is formed when a reference signal, a sine wave of a desired frequency, is compared with a timing signal, a triangular wave of higher frequency. In order to improve the harmonic contents of the resultant PWM signal, the reference and timing waves have to be synchronized, i.e for any desired frequency of output signal, there must be an integral number of timing wave periods per each period of the reference wave.
Used as a control signal for switching inverters, it may cause dangerous short circuit conditions ("shoot-through") in an inverter at each moment when the PWM signal changes polarity. To avoid this danger, a special "lock-out" time interval is usually inserted into the PWM control signal at each of its zero crossing.
The danger of shoot-through conditions is eliminated if the polarity of the timing wave is made the same as the polarity of the reference wave. The resulting PWM control signal would toggle only one (upper or lower) transistor in each phase of the inverter during a whole half-period of the reference signal for a given phase, while the other transistor would remain OFF. The modulation technique with the above properties has been named unipolar modulation.

Index Terms: AC-DC converter, pulse width modulation, three phase system, load

I INTRODUCTION

Conversion of power from one form to the other is an ultimate task in renewable energy applications in order to meet the power necessities of the utilities. Special switching components are used in this type of power conversions.Power converters comprised of four basic categories of components, semiconductor switches, gating and control systems, inductive components and capacitive components. The inductive and capacitive components are used to dynamically store the electrical energy for circuit power flow damping, filtering and transformation.

Switch gating and control system is used to control the ON and OFF states of the switches so that the circuit operates in a stable, efficient and protective condition. Innovative improvements in the semiconductor switch designs have been the driving force for the advancements and implementations of power conversion stages in stand-alone or grid connected power conversion systems.

AC-DC power system are forced to be implemented with input power factor correction

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to fulfill with harmonic standard concept for used thefollowing methods.

- The first method is to add inductors to filter out Low frequency input current harmonics.this type converter is simple and expensive.this system is heavy and bulky.
- The second method,use two stage converter.
  Stage 1:preregulator(control input current)
  Stage 2:DC-DC converter(control DCbus voltage),its contain two separate switch mode converter to increase cost and size.
- Third method to placed PFC and isolated Dc-Dc conversion technique.This method reduced the cost,but its worked two sparate switch mode converter.The above three inverter do not produce low frequency input current harmonics.

Three phase single stage converter operate with discontinuous current. So the current stress are increased. This system need to large input filter to filter the high frequency harmonics. The above drawbacks are overcome for this project.In this project to implement the power factor correction of the Ac-Dc power supplies by the PWM techniques. In this project used to space vector PWM techniques to convert Ac-Dc.In this SVPWM method used to the improvement of harmonic reduction to increase the efficiency of the converter. In this system provide the output current that is continuous for almost all load ranges, a DC bus voltage that is less than 450V for all load conditions and a superior input current harmonic content from add the interleaved structure. In this system, a new interleaved three-phase single-stage PFC AC-DC converter that uses flying capacitor structure with SVPWM to improve efficiency of the converter at the light load condition.

. A new interleaved three-phase single-stage PFC AC-DC converter that uses flying capacitor structure with standard phase-shift PWM is the another method. In this project the converter to improve efficiency of the converter particularly at light load conditions. Its PWM method modified to implement the efficiency from the SVPWM of this converter.Pulse-width modulation (PWM) is a technique where the duty ratio of a pulsating waveforms controlled by another input waveform. The intersections between the references voltage waveform and the carrier waveform give the opening and closing times of the switches.

PWM is commonly used in applications like motor speed control, converters, audio amplifiers, etc. For example, it is used to reduce the total power delivered to a load without losses, which normally occurs when a power source is limited by a resistive element.PWM is used to adjust the voltage applied to the motor. Changing the duty ratio of the switches changes the speed of the motor. The longer the pulse is closed compared to the opened periods, the higher the power supplied to the load is. The change of state between closing (ON) and opening (OFF) is rapid, so that the average power dissipation is very low compared to the power being delivered. PWM amplifiers are more efficient and less bulky than linear power amplifiers. In addition, linear amplifiers that deliver energy continuously rather than through pulses have lower maximum power ratings than PWM amplifiers.

There is no single pulse width modulation (PWM) method that is the best suited for all applications and with advances in solid-state power electronics device and microprocessor,

Various pulse-width modulation (PWM) techniques have been developed for industrial applications.In this project AC-DC converter (rectifier) will be used. The rectifier converts fixed AC to variable DC.

II EXISTING SYSTEM OF THREE-PHASE AC-DC CONVERTER

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Three-phase single-stage PFC AC-DC converter touse passive method to contain large capacitor and inductor. So the system goes to large size and complex. It required to separate switch mode capacitor. There is a need to have a large input filter out large input current ripples at this current is discontinuous.

The system has a very high output ripples as its output current must be discontinuous. This system need for significant input filtering due to the large amount of ripples. Single-stage power-factor-correction (SSPFC) converter that have PFC and isolated DC-DC conversion in a single power converter. so that they are simpler and cheaper than two-stage converter.

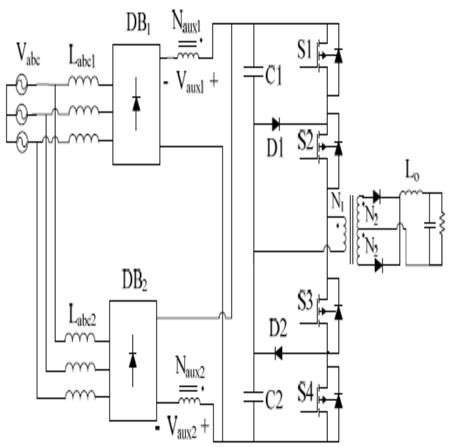

Figure 2.1 Three phase AC-DC converter

III THREE-PHASE AC-DC CONVERETRE WITH FLYING CAPACITOR

In figure 3.1 explain the power conversion of Ac source to dc side. Three phase power supply applied to the two diode bridge circuit through the line impedance and across connected to the auxiliary winding and its connect to switching circuit and flying capacitor loop its output connected to the transformer and load side.

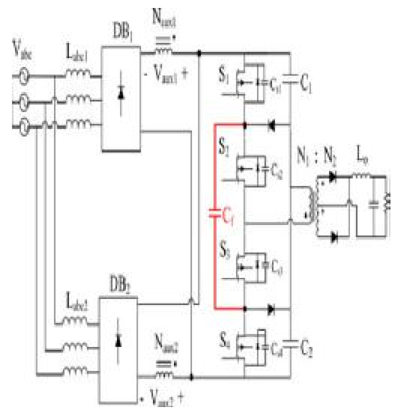

Figure 3.1 Proposed three-phase AC-DC converters with flying capacitor

The proposed converter uses auxiliary windings that are taken from the converter transformer to act as "magnetic switches" to cross out the DC bus capacitor voltage so that the voltage that appears across the diodebridge output is zero. Auxiliary Winding 1 (Naux1/N1=2) cancels out the DC bus positive, so that the output voltage of Diode Bridge 1 (DB1) is zero and the currents in input inductors La1, Lb1, and Lc1 rise. Auxiliary Winding 2 (Naux2/N1=2) cancelsout the DC transport voltage when the essential voltage of the primary transformer is negative, so that the output voltage of Diode Bridge 2 (DB2) is zero and the currents in input inductors La2, Lb2, and Lc2 rise. When there is no voltage across the main transformer primary winding, the total voltage across the DC bus capacitors appears at the output of the diode bridges and the input curent falls since this voltage is greater than the input voltage. If the input currents are discontinuous, the plaster of the input current will be sinusoidal and in phase with the input voltages.

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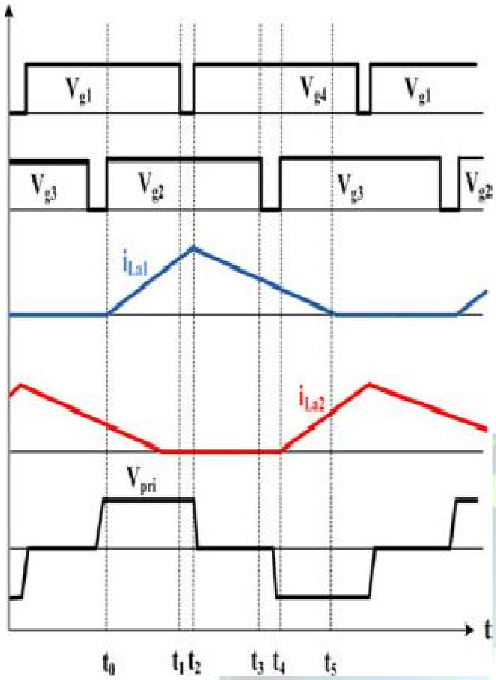

Figure 3.2 Typical Waveform of AC-DC Converter

As "magnetic switches" to cancel the dc bus capacitor voltage so that the voltage that appears across the diode bridge output is zero. When the primary voltage of the main transformer is positive, Auxiliary Winding 1 cancels out the dc bus voltage so that the output voltage of Diode Bridge 1 (DB1) is zero and the currents in input inductors La1, Lb1, and Lc1 rise.

When the primary voltage of the main transformer is negative, Auxiliary Winding 2 cancels out the dc bus voltage so that the output voltage of Diode Bridge 2 (DB2) is zero and the currents in input inductors La2, Lb2, and Lc2 rise. When there is no voltage across the main transformer primary winding, the total voltage across the dc bus capacitors appears at the output of the diode bridges and the input currents falls since this voltage is greater than the input voltage. If the input currents are discontinuous, then they will be naturally sinusoidal and in phase with the input voltages. The converters modes of operation are explained in this section.

IV DESIGN AND SIMULATION OF THREE STAGE THREE LEVEL AC-DC CONVERTER

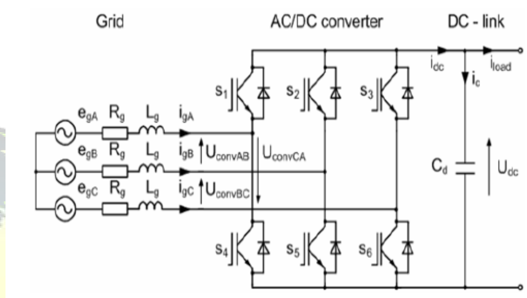

Figure 4.1 Three stage three level AC-DC converter

The proposed approach to control the output voltage (voltage regulation) is by off line computing the firing angles (α) for the expected voltage variation in this application (36v, 34v, 32v), using selective harmonic elimination pulse width modulation (SHE PWM) technique.
A new method is used to generate the PWM signal which controls the firing of the power circuit, where the period of PWM pulses are calculated by solving the set of equations off line to obtain the suitable firing angles represent the required output voltage. “Another set of firing angles is calculated for the expected voltage variation due to loading.”If the voltage varies the controller senses the voltage variation by taking all measurements, hence changing the duty cycle (PWM) signal in a way that suits the new voltage value in order to maintain the required voltage constant during load variation.
In this system reduced the third harmonics and increase the efficiency.

V SIMULATION AND RESULTS

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Here the x-axis represent time in seconds and y-axis represent output ac voltage, output dc voltage and input ac voltage respectively. Power-factor-corrected of AC-DC converter using space vector PWM was presented in this work. In this paper, the operation of the converter was explained and its achievability was confirmed with experimental results obtained from a prototype converter.

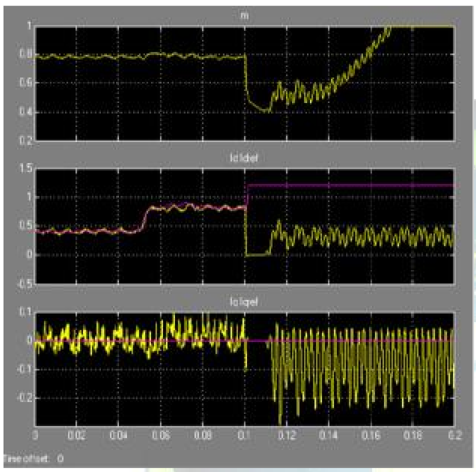

Figure 5.1 SIMULINK result of three-phase single-stage ac-dc converter

The efficiency of the new converter was compared to another converter of the same type. It was shown that the proposed converter has a better efficiency, especially under light-load conditions.

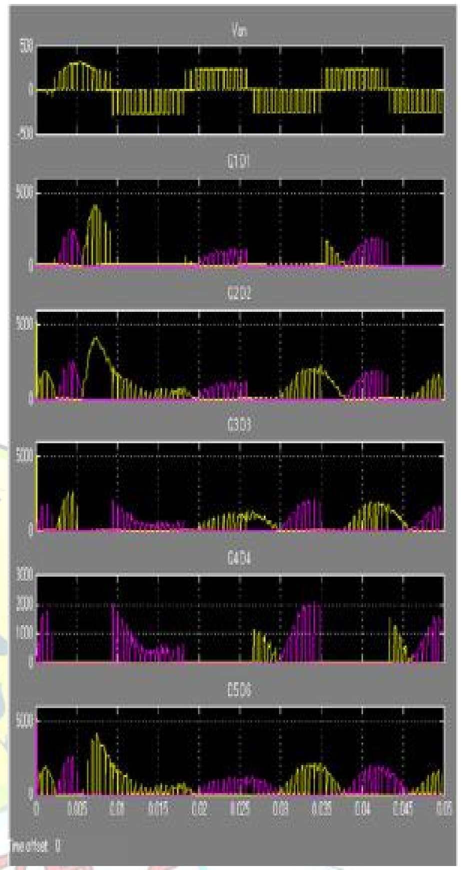

Figure 5.2: SIMULINK result of three-phase single-stage ac-dc converter

VI CONCLUSION

A new interleaved three-phase, three-level, single-stage very top and the very bottom switches can be turned ON with ZVS, due to a discharge path that is introduced by its flying capacitor. In this method produce high efficiency and PFC values compare to phase-shift PWM method. The design of the converter is allowed greater flexibility and ultimately improved performance and reduces third order harmonics.

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