Pulse-width modulation technique for three level bridges are reducing harmonic content and efficiency

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ABSTRACT

The proposed AC-DC full bridge converter converts the input AC voltage into DC and boost with a high voltage gain in a three level PWM converter and switched capacitor topology. For high voltage gain in AC-DC converters many techniques are proposed in literature. In this work, pulse width modulation and switched capacitor technique is used in AC-DC converter is a method for attaining high voltage gain. Pulse-width modulation (PWM) is a modulation technique used to encode a message into a pulsing signal. Although this modulation technique can be used to encode information for transmission, its main use is to allow the control of the power supplied to electrical devices. Three level bridge and switching capacitor technique are used for AC-DC bridge converter. The three level bridges are reducing harmonic content and efficiency is high because all devices are switched at the fundamental frequency.

Key words- AC-DC Converter, Full Bridge, Pulse Width Modulation, Voltage Gain

1. INTRODUCTION

Three phase ac-dc converters have been developed to a matured level with improved power quality in terms of power- factor correction, reduced total harmonics distortion at input ac mains, and regulated dc output in buck, boost, buck-boost, multilevel and multi pulse modes with unidirectional and bidirectional power flow. Three stage air conditioning dc transformation of electric power is broadly utilized in customizable paces drive (ASDs), uninterruptible power Supplies (UPSs), HVdc frameworks and utility interfaces with nonconventional vitality sources, for example, sunlight based Photovoltaic systems(PVs), and so on., battery vitality stockpiling systems(BESSs), in process innovation, for example, electroplating, welding units and so on., battery charging for electric vehicles, and power supplies for media transmission frameworks. Generally, air conditioning dc converters, which are otherwise called rectifiers are created utilizing diodes and thyristors to give controlled and uncontrolled unidirectional and bidirectional dc control. They have the issue of poor power quality as far as infused current music, resultant voltage twisting and poor power calculate at information air conditioning mains and gradually shifting undulated dc yield at load end, low productivity, and substantial size of air conditioning and dc channels. In perspective of their expanded applications, another type of rectifiers has been created utilizing new strong state selfcommutating gadgets, for example, MOSFETs, protected entryway bipolar transistor (IGBTs), door kill thyristors (GTOs), and so on.

1.1 BASIC PWM STRATEGY AND PERFORMANCE INDICES

PWM has become an accepted control strategy and is preferred in almost all power conversion systems. It is an operation performed on 'raw' voltage and current waveforms to shape their spectra in a way beneficial to a particular application. Spectra shaping involves the creation of a 'dead band' between wanted and unwanted components. This may drastically increase the switching frequency of the devices and may even de-rate them. A PWM strategy should aim at a wide range of linear operation, minimum number of switching, reduced content of Lower Order Harmonics (LOH) and lowered distortion in both voltage and current waveforms. A control strategy should be designed in such a way that the system offers an output voltage spectrum as shown in Figure 1.1.

Past four decades variety of PWM techniques suitable for the demands have been developed and discussed. The basic method is called Sinusoidal Pulse Width Modulation (SPWM) (Ned Mohan 2003), where the angular width of the pulses varies in sine fashion. SPWM technique enjoys an assortment of advantages such as high output quality, less THD, low distortion and low rating filter component.

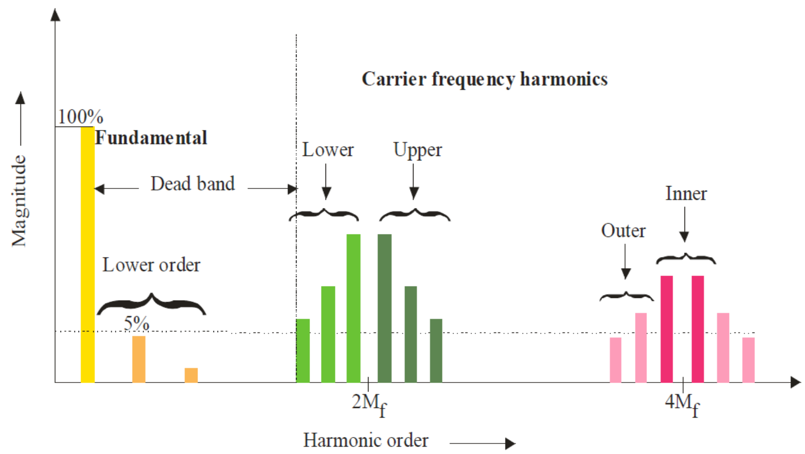

Figure 1.1: Desired frequency spectrum in a PWM converter

2. SOFT SWITCHING CONVERTER TOPOLOGIES

The basic circuit diagram of conventional boost PWM switch is shown in Figure 2.1. A fundamental deviation from the conventional forced turn-off approach is the 'zero current' switching technique reported in references. In probing for a general zero current switching (ZCS) technique, authors have proposed the 'resonant switch' in reference. By simply replacing the power switches in conventional PWM converters by resonant switches, new families of converters called 'quasi-resonant' converters were introduced. This new family of converters can be viewed as hybrid converters between PWM converters and resonant converters. Diverse forms of quasi-resonant concepts in PWM converters have been reported in literature. These quasi-resonant converters utilize the principle of inductive or capacitive energy storage and transfer in a similar fashion as PWM converters and the circuit topologies also resemble those of PWM converters. It is to be noticed that, in these converters, a LC tank circuit constantly display close to the power switch and is utilized not exclusively to acquire the sinusoidal voltage or current waveforms of the power change additionally to store and exchange vitality from contribution to yield in a way like the regular thunderous converters.

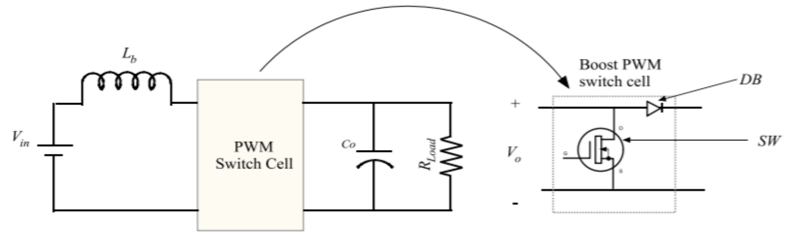

Figure 2.1: Conventional boost converter PWM switch cell

3. IMPLEMENTED METHODOLOGY

PWM signals are pulse trains which are applied to the gate of switches to perform the operation of converter. The pulse trains are fixed frequency and magnitude and variable pulse width. There is one beat of settled extent in each PWM period. In any case, the width of the beats changes from period to period as indicated by a regulating signal. At the point when a PWM flag is connected to the entryway of a power transistor, it causes the turn on and kills interims of the transistor to change starting with one PWM period then onto the next PWM period as indicated by the same regulating signal and thus working of converter begins. The recurrence of a PWM flag must be substantially higher than that of the regulating signal, the major recurrence, with the end goal that the vitality conveyed to the heap depends generally on the tweaking signal. The control of yield voltage is done utilizing beat width balance.

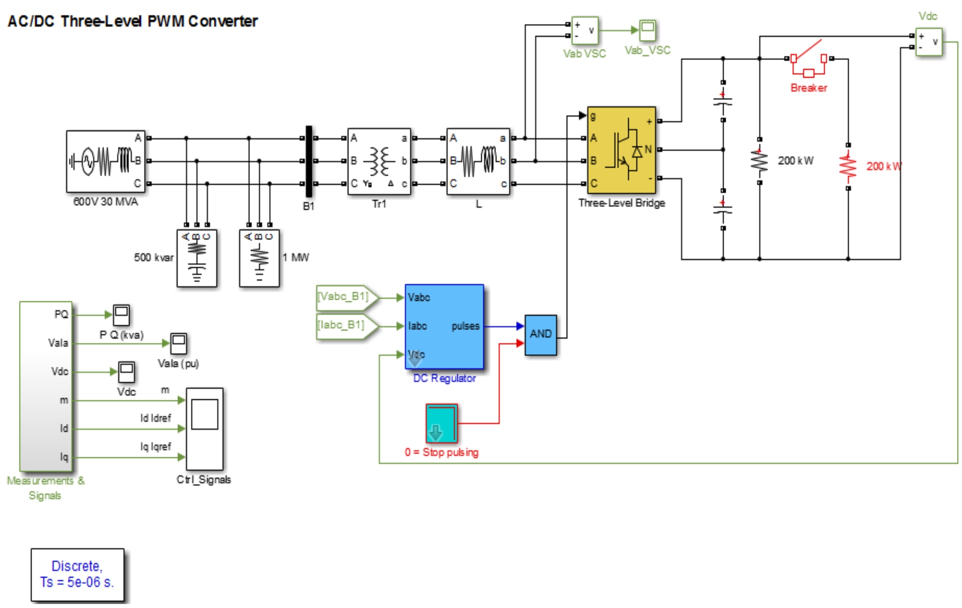

Figure 3.1: MATLAB Simulink Model of AC/DC Three Level PWM Converter

The block diagram of AC-DC converter is shown in Fig. 3.1 gives a constant ac input voltage to the MOSFET full bridge circuit, and that output is given to the primary side of the coupled inductor with low magnetizing inductance. The secondary sides of the coupled inductor are fed to the switched capacitor circuit and obtain high voltage dc output voltage.

3.1 THREE LEVEL BRIDGE

The Three-Level Bridge block implements a three-level power converter that consists of one, two, or three arms of power switching devices. Each arm consists of four switching devices along with their antiparallel diodes and two neutral clamping diodes as shown in the figure 3.2.

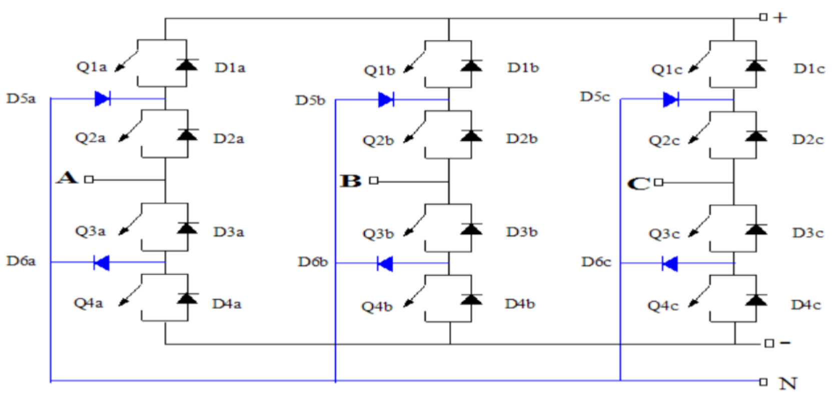

Figure 3.2: Working Diagram of Three Level Bridge

The type of power switching device (IGBT, GTO, MOSFET, or ideal switch) and the number of arms (one, two, or three) are selectable from the dialog box. When the ideal switch is used as the switching device, the Three-Level Bridge blocks implements an ideal switch bridge having a three-level topology.

4. RESULTS

Three-phase AC to DC converters are widely used in many industrial power converters in order to obtain continuous voltage using a classical three-phase AC-line. These converters, when they are used alone or associated for specific applications, can present problems due to their non-linear behavior. It is then important to be able to model accurately the behavior of these converters in order to study their influence on the input currents waveforms, Voltage and modulation index.

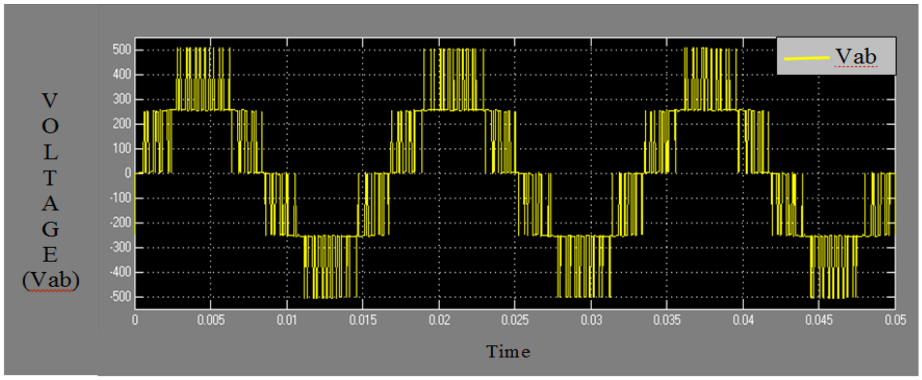

Figure 4.1: Output Voltage Waveform of the AC/DC Three Level PWM Converter

The primary function of the power converter is to control the voltage, current and frequency of the drive as per the motor requirements. Also they have to control the speed, torque, acceleration, deceleration and direction of rotation of the machine.

The proposed system is modeled and simulated in MALAB/ Simulink software. Then, the performance of AC-DC converter is tested with three quadrant DC drive system and performance of DC drive and converter are illustrated in figure from 4.2.

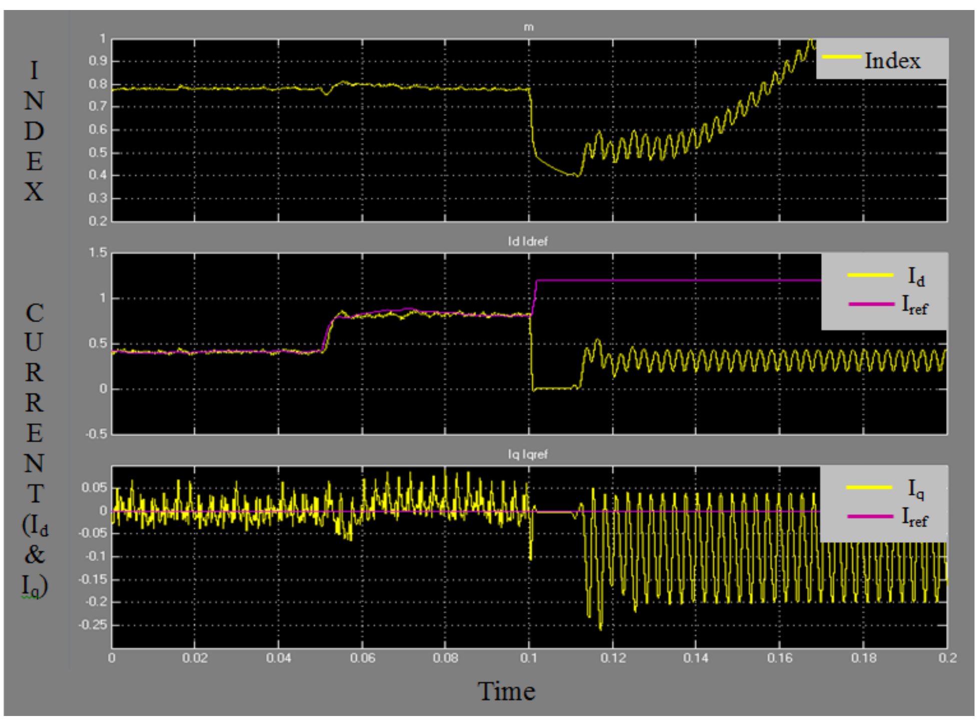

Figure 5.2: Output Control Signal waveform of the AC/DC Three Level PWM Converter

The development and advances in the technology of power semiconductor devices have revolutionized their application in industrial applications, the chief of which is the control of electric drives. It has become very essential to control the AC voltage and frequency with an application dictated performance requirements in ASD applications. There are several solid state power conversion topologies are available for performing AC-AC conversion.

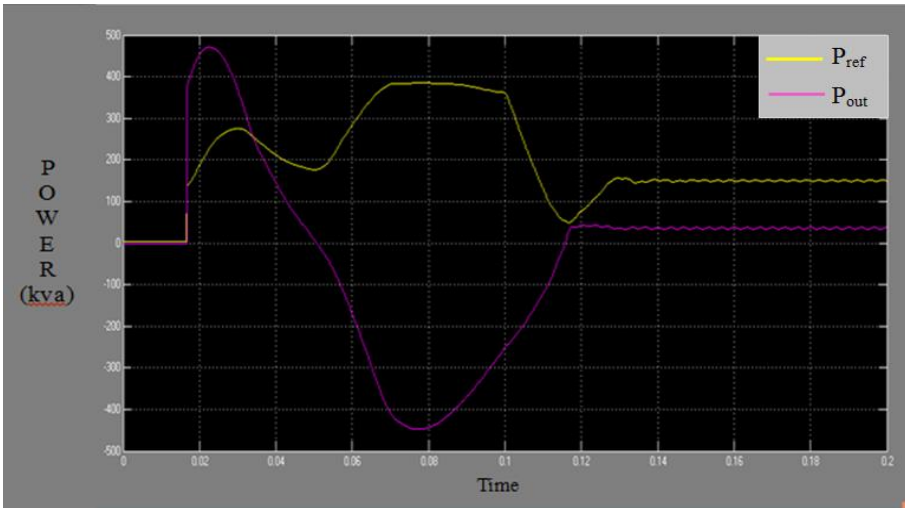

Figure 5.3: Output Power Waveform of the AC/DC Three Level PWM Converter

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