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Research paper

Effective elimination of harmonics on the part of chosen dc bus in dual active type converter

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Abstract

In order to manage the flow of power in the dual bridge type converter, a modulation technique called phase shifted square wave is employed. As an outcome, increased range of ripples in current is resulted, and that further provokes the vibration in inductance and capacitance circuit. Due to this effect, there exists uncertainty in the value of current and voltage, failure of operating components and stress in the filter. To miti-gate the above ill effects, three level modulation can be done using three phase shift square wave control angles. These three angles now elimi-nate the harmonics in chosen DC link and the harmonic eliminating procedure is justified and simulated.

Keywords: *Phase Shifted Square Wave (PSSW); Dual Active Bridge; Zero Voltage Switching (ZVS); Active Harmonics Suppression (AHS)*

1. Introduction

Bidirectional power between two direct current sources can be achieved by using dual type bridge, which has natural potential of energy translation with minimum difficulty [4] high efficiency [5], increased density of power .In order to improve the efficiency of the converter, it has to be operated at zero voltage switching, so that losses within the switches are minimized thereby improving the switching frequency [6].Therefore for designing the active dual bridge, it is necessary to sharply find out borderline of ZVS. The borderlines are determined by analyzing the shift angle among the PSSW'S pattern of modulation. The borderline is specified by the duty cycle of PSSW and potential level in the dual active bridge. There are number of methods that have been proposed earlier to identify the ZVS state for dual type converter [8,], [9].Techniques like steady state analysis, small signal state space model [11] [12] have also been used for analyzing the active dual type converter. In all the specified methods only one inductance is placed at the centre of two bridge and hence the phenomenon like dead-time of switching, parasitic value of capacitor cannot be taken into consideration whenever three level switching category is used along with single phase dual type bridge, the linear domain category involves complex steady state process. In order to cross all this shortcomings, even much new approaches are being carried out for analyzing the harmonics.But,only the procedures have been framed incorporating easy basic components [13] [14]. Hence, this work clearly depicts the analytical procedure by doing harmonic investigation to clearly find the borderline of ZVS for three phase as well as single phase dual type bridge converter for the complete bound of operation. [1] [2] [3]. Therefore the approach splits the switching arrangement of the two bridges similar to framework of harmonics. Then with the use of admittance network in two port, the circulating current is evaluated which is considered as equivalent to harmonic forms. By this way, every harmonic are denoted by single service of voltage, duty angle and phase shift square wave. This easily permits effects like switching dead time, second order things to be admitted in investigation. Finally the sum of all these harmonics present in the current is calculated, so that current's polarity can be formed since there is always a change of state of switch and also to determine the condition of ZVS occurance.Suggested path grants brand model framework which is thought –through for transformer with high frequency range which generally pairs two active bridge [15] [16]. Further, the closed solution of single and three phase DAB process are compared with usual time domain result in order to make sure of the efficiency of the path.Thus,leading outcome utilizing numerical integration depict, on what way the difficult networks which are coupled achieve result in a region.

2. Proposed design

2.1. Topology

An active dual converter falls under the category of bidirectional converter consisting of inductor used for transfer of energy, capacitor which is dc-linked, transformer with high frequency and eight semiconducting devices. It is otherwise linked for comparing with normal full bridge rectifier which is of controlled type. Since DAB has similar primary and secondary side bridges, it is exclusively selected for applications like small green power node. The dual active bridge in order to achieve ZVS through the snubber circuit and transfer of energy through inductor, an antiparallel diodes are implemented across the switching device. Since MOSFET has inbuilt body diode and output capacitance in drain-source terminal, it is advanced for increased range of potential. research in the field of power electronics highly concentrates on materials with high band gap, like silicon Carbide, as they have increased thermal rating, high potential range and the energy is low during the turning on process, which is shaping on the part of operating the converter with increased switching frequency.

2.2 Block diagram

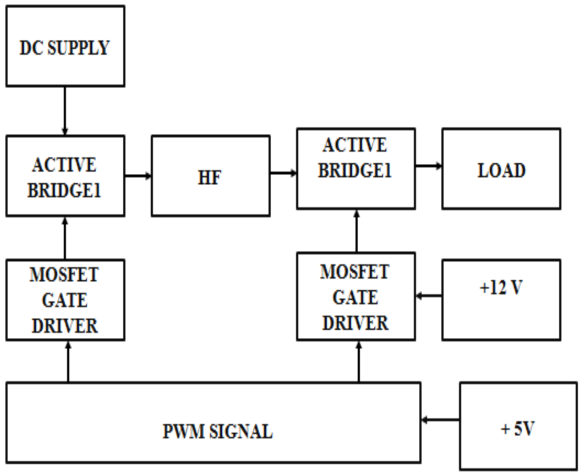

Fig. 2.1: Block Diagram.

2.3. Advantages

Proposed topology is appealing as it is more suitable for decreased potential increased current purpose and it also helps in decreasing the size of the converter. By implementing the approach, the harmonics, present in the DC bus has been effectively lessened by the process of frequency analysis and by implementing Active Harmonic Suppression control strategy .From this work, it can be inferred that, selective component of harmonics can be eliminated by incorporating three-level adaptive modulation for single phase dual active bridge converter. For particular working range, the waveform representation has been included to prove the effect of analysis of control methodology that is implemented in this work.

2.4. Harmonic analysis

In the single phase active dual bridge model, the admittance matrix which resembles the transformer of single phase links the two bridges. The design model is comprised of DC inductance and capacitance which forms the resonant circuit. The phase of square waves are dislocated by an angle of alpha and beta respectively due to three level modulation. As a result, there is a dislocation of output voltage between two bridges by an angle ‘δ’.This in turn controls the flow of power.

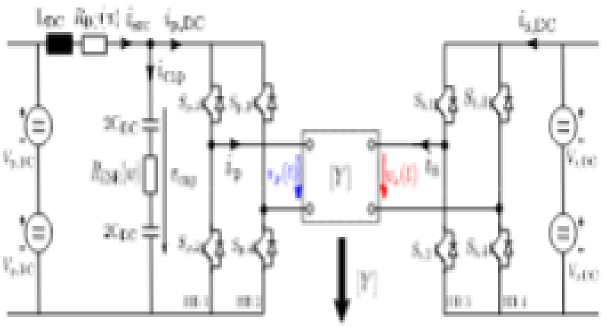

Fig. 2.2: Circuit Diagram-Suppression of Oscillations in the Primary and Secondary Part of DC Bus.

With the approach of Active Harmonic suppression, on the two sides of dual bridge converter, resonance in the secondary side can be eliminated with the change in duty cycle’β’.But, constraint comes into account when we want to simultaneously eliminate the current harmonics present at the two sides .This will result in complexity of transferring power and difficulty in achieving zero voltage switching across the dual bridge.

3. System design

The following simulation show the MATLAB design of the proposed system

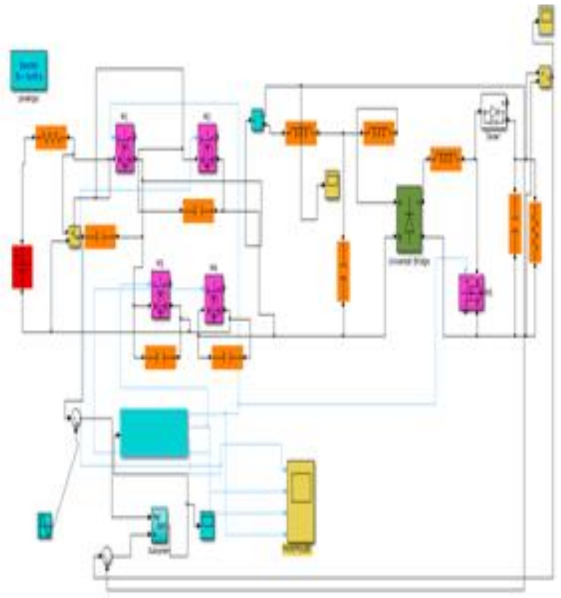

Fig. 3.1: Proposed Simulation Circuit.

The following simulation show the input gate pulse

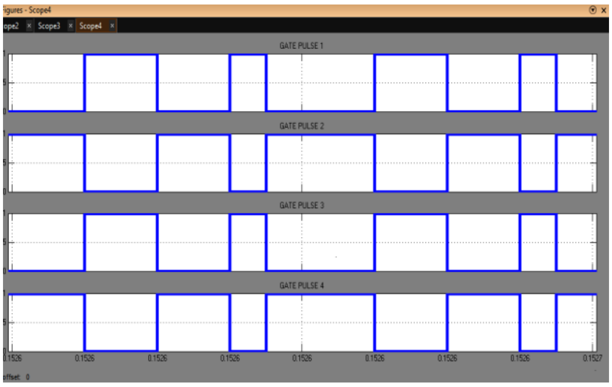

Fig. 3.2: Gate Pulse.

The following simulation shows the waveform of inductor current

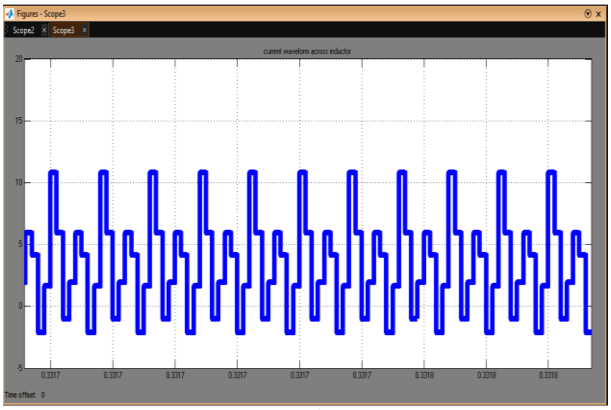

Fig. 3.2: Current Waveform across Inductor.

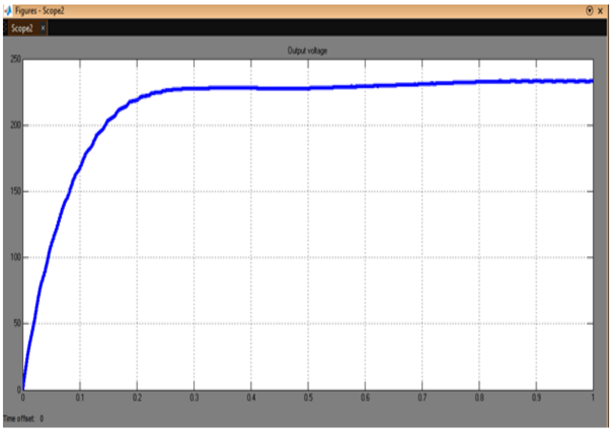

Fig. 3.3: Output Voltage.

The work certainly illustrates regarding the elimination of current harmonics by implementing three-level adaptive modulation technique to overcome the oscillations present on the part of DC bus, which is a common issue for all converters that are used practically. This proposed topology not only eliminates the current harmonics, but also allows the converter to work with increased current and decreased voltage purposes. The control strategy also reduces the size of the converter.

4. Conclusion

The work deals with the identification of harmonics on the part of chosen DC bus in dual active bridge converter by adopting the pattern of phase shifted square wave switching method. This results in the formation of harmonics on the part of DC bus, on both sides of the bridges. Hence, inorder to relieve the effect, an adaptive three-level modulation is introduced effectively to eliminate the harmonics. The designed system has been simulated and the results are obtained. The input voltage for the designed system is set to 100V and the output voltage is obtained as 233V.

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