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Comparison of Z-Source Converter and T-Source Converter Supported Pulse Width Modulation Techniques

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Abstract: ***The height would like of other energy resource to satisfy the demand in energy additionally induced the analysis within the space of power converters. The Z-Source converter which might be used for each current and voltage sources is employed for each buck and boost operation in numerous renewable energy applications like wind and alternative energy conversion system. to boost the operation of the converter additional, completely different topologies being projected. The T-source converter is that the changed style of Z-source converter with the reduced variety of passive elements. The paper proposes comparison of the Z-Source converter and T-Source converter supported pulse width modulation technique like Single pulse width modulation, sinusoidal pulse width modulation, Space vector pulse width modulation techniques. The system level simulation is performed using MATLAB/SIMULINK software.***

Keywords: Z-source converter, T-source converter, PWM, single pulse width modulation, Sinusoidal pulse width modulation, Space vector pulse width modulation

1. Introduction

The rise in energy demand on the opposite hand triggers the analysis on power converters. The varied renewable energy resources like wind, solar, tidal, etc will be used with most potency by mistreatment applicable power converter. Because the availableness of those resources is greatly unsure the facility conversion system depends on the acceptable power converter and controller unit such they deliver constant output voltage with constant frequency. The z-source converter designed by china researcher F. Z. Peng in the year 2004 overcomes the difficulties in standard voltage and current supply converter. The huge advantage of the Z- source converter is that it will be used for each current and voltage sources with none modification in circuit style. Besides each Buck and boost operation will be accomplished mistreatment Z-source converter. The facility conversion stages additionally get reduced leading to improved potency of the system in energy conversion method. To boost the performance of the Z- source converter different topologies of Z-source converter has been projected by numerous researchers by different attainable combination of arrangement of passive elements. Among completely different topologies of Z-source converter, the topology that is being thought of for analysis is T-source converter. Because the converter comes from the basis of Z-source converter and therefore the arrangement of passive elements seem like the alphabet 'T', the converter is known as changed Z-source converter or T-source converter. The boost operation of the converter is achieved mistreatment the construct of shoot-through period. Completely different PWM techniques like Single pulse width modulation, Sinusoidal pulse width modulation, Space vector pulse width modulation techniques are available in literatures to manage the gating pulse to the converter switches.

2. Z-Source Converter

The main objective of static power converters is to provide associate AC output from a dc power supply. Z-source converter is associate electrical converter that employs a singular Z-source network not to mention the electrical converter main circuit to the facility supply. This electrical converter has distinctive options in terms of voltage (both buck & boost) compared with the standard electrical converters. A two-port network that consists of a split-inductor associated capacitors square measure connected in X form is used to produce a Z-source coupling the electrical converter to the dc supply, or another converter. The DC source will be either a voltage or a current source. Therefore, the DC supply will be battery, diode rectifier, Thyristor converter, fuel cell, PV cell, associate inductance, a condenser, or a mix of these. Switches employed in the converter will be a mix of switching devices and anti-parallel diode as shown in Fig. 1

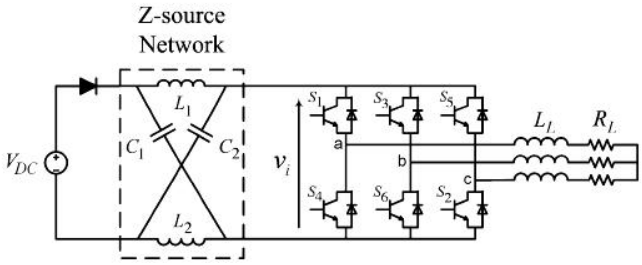

Figure 1: Z-Source electrical converter

Six switches square measure employed in the circuit; is historically composed of an influence electronic transistor associated an opposing parallel (or freewheeling) diode to produce bidirectional current flow and unifacial voltage interference capability.

3. T-Source Converter

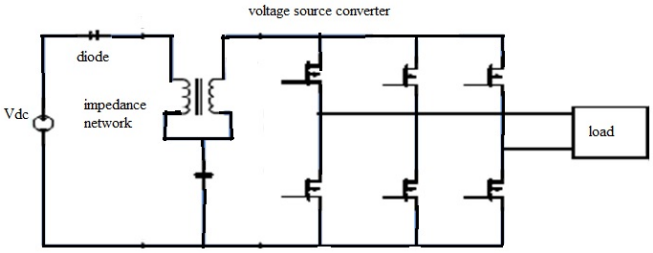

Figure 2: T-Source converter

T-source converter is that the changed style of Z-source converter that is achieved by modification within the resistance (Z-source) network. The series arm inductors L1 and L2 and the diagonal arm capacitors C1 and C2 square measure replaced with impulse electrical device with tiny inductive leak and a capacitor C. the reduction in passive elements reduces harmonic content within the output voltage. Fig.2 represents the circuit of T-source converter. The resistance (Z-source) network style permits the Voltage source converter to be operated in a very state known as the shoot-through state during which the two switch devices in the same leg square measure at the same time switched-on to impact short-circuit of the dc link. Throughout this state, energy is transferred from the inductors to capacitors, thereby giving rise to the voltage boost capability of the electrical converter. The absence of dead time in the gate signals, improves the facility quality and transient response of the system consequently desired curved output voltage is obtained with low price of LC filter (Zhi Jian Chow dynasty, et al., 2008). The voltage and frequency of the electrical converter is controlled by dominant the shoot-through zero states (F. Z. Peng et. al 2004). The unremarkable used switches square measure Metal compound Semi-Conductor Field impact electronic transistor (MOSFET), Insulated Gate Bipolar electronic transistor (IGBT), Bipolar semiconductor unit (BJT), semiconducting material Controlled Rectifier (SCR), gate shut down Thyristor (GTO) etc. Here we have a tendency to used IGBT because the switch because it combines the benefits of each BJT and MOSFET.

4. Comparison of Z-Source converter and T-Source converter supported Pulse width Modulation Techniques result with MATLAB/SIMULINK package

Z-Source converter provides the buck-boost performance at the dc aspect as a result of this the electrical converter performance parameters like power, efficiency will increase higher than the two ancient electrical converters however currently a days the researchers largely concentrating on the less complexness in style and high performance operating for overcoming additional issues within the Z-source converter like network style complexness and operational performance parameters they will style the another converter by mistreatment a similar parameters within the network however the arrangement of the parameters square measure completely different as compared to the Z-Source converter, the parameters square measure organized within the style of the T-shape that the electrical converter known as because the T-Source converter .The electrical converter provides the batter performance as compared to the Z-source converter ,even it having the (Z-source network with same parameters and additionally the operation of the resistance Z-source network same within the two inverters however the performance of the two inverters will be compared by mistreatment the heartbeat width modulation techniques like single pulse width modulation technique, sinusoidal pulse width modulation technique and Space vector pulse width modulation technique for Z-Source converter and T-Source converter the operation of the two electrical converter square measure same performance, depending upon the heartbeat width modulation technique and also modulation index, duty ratio and boost issue of the impedance network, the impedance network designed by mistreatment the modulation index and duty ratio thought of because the but the one and therefore the boost issue relying upon the modulation index, duty ratio of the impedance network.

1. Single Pulse width Modulation Technique

In the case of single pulse width modulation technique the two converter parameters capacitor and inductance will be designed supported the thought of modulation index and duty ratio, the designed capacitor and inductance values for the Z-Source electrical converter. L1=L2=180mH, C1=C2=900μF, balanced Three phase load resistance R1=R2=R3=8Ω, and equally for the T-Source electrical converter C=18μF, L1=L2=L3=50mH, Lm=10mH, balance three phase load resistance R1=R2=R3=8Ω. Fig.3. shown comparison of the Line voltages of the Z-Source converter and T-Source converter.

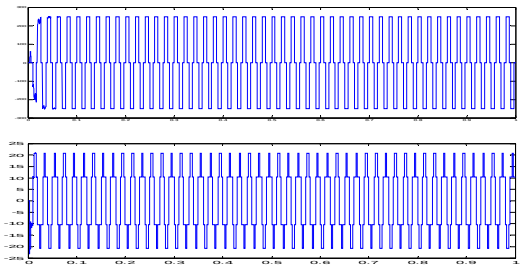

Figure 3: Line voltage

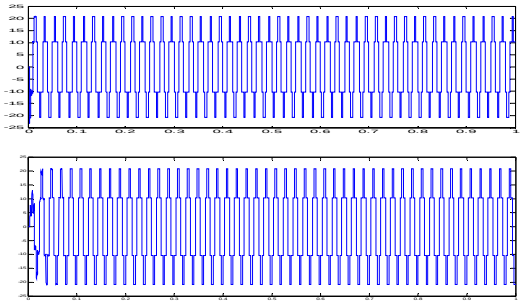

Figure 4: Phase current

2. Sinusoidal Pulse width Modulation Technique

In the case of Sinusoidal pulse width modulation technique the two converters parameters capacitor and inductance will be designed supported the thought of modulation index and duty ratio, the designed capacitor and inductor values for the Z-Source converter L1=L2=5mH,

C1=C2=750µF, balanced three phase load resistance R1=R2=R3=8Ω, And equally for T-Source converter C=600µF, L1=L2=L3=300mH, Lm=10mH balanced three phase load resistance R1=R2=R3=8Ω. Fig.5.shows line voltages of the Z Source electrical converter and T Source converter based supported Sinusoidal Pulse width Modulation Technique.

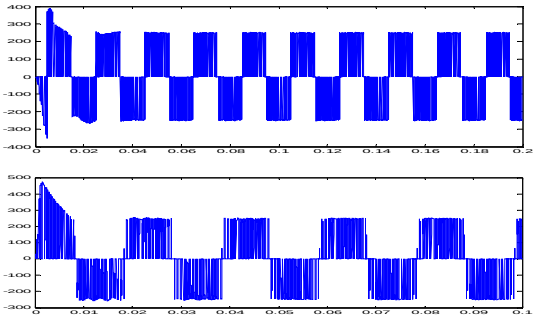

Figure 5: Line voltage

Fig.6.shown comparison of phase currents of the Z-Source converter and T Source converter supported the Sinusoidal Pulse width Modulation Technique.

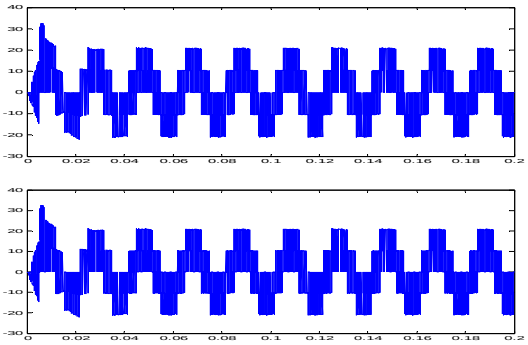

Figure 6: Phase current

3. Space Vector Pulse width Modulation Technique

In the case of Space vector pulse width modulation technique the two converter parameters capacitor and inductance will be designed based mostly on the thought of modulation index and duty quantitative relation, the designed condenser and inductance values for the Z-Source converter L1=L2=5mH, C1=C2=750µF balanced three phase load resistance R1=R2=R3=8Ω, equally for the T-Source converter C=600µF,L1=L2=L3=300mH, Lm=10mH balanced three phase load resistance R1=R2=R3=8Ω. Fig.7. shown line voltages of the Z-Source converter and T-Source converter supported Space vector Pulse width Modulation Technique.

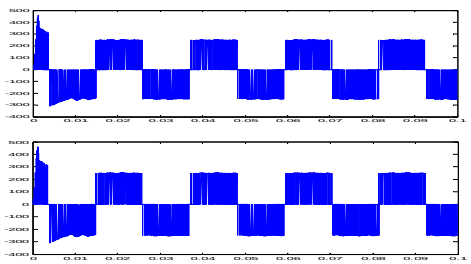

Figure 7: Line voltage

Figure 8 shown comparisons of phase currents of the Z-Source converter and T-Source converter supported the Space Vector pulse width modulation technique.

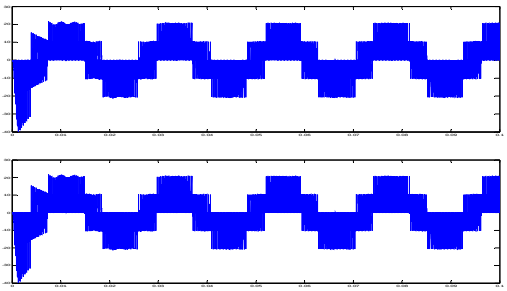

Figure 8: Phase current

5. Conclusion

The paper proposes comparison of the Z-Source converter and T-Source converter supported pulse width modulation technique like Single pulse width modulation, Sinusoidal pulse width modulation, Space vector pulse width modulation techniques. comparison ally complete that T-Source converter may be a single stage power converter which might be used as value effective various for Z-Source converter, contructionally each the converter square measure completely different however operationally each the converter square measure same, the T-Source electrical converter has the less reactive elements and provides the batter buck-boost operation as compared to Z-Source converter, obtained output voltage and current, power is same however efficiency is completely different as a result of the T-Source converter has the les reactive components and high batter buck-boot operation The system level simulation is performed mistreatment MATLAB/SIMULINK package.

6. Future Scope

The Comparison of the Z-Source converter and T-Source converter will be done by using Modified Space Vector Pulse Width Modulation Technique with the system level simulation is performed mistreatment MATLAB / SIMULINK package.

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