A NEW SHOOT THROUGH CONTROL METHODS FOR DOUBLE STAGE QZSI- BASED DC/DC CONVERTERS

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Abstract- This paper presents the simulation of new shoot-through control methods for double stage quasi based Dc/Dc converters with high frequency step-up isolation transformer using matlab Simulink. The major goals are increase efficiency and also increase the stage of Quasi. The new shoot-through technique is used for inversion purpose this reduces the unequal switching frequencies of transistor in double stage quasi.

Keywords- DC/DC Converters, Quasi-z- Source Inverter, Shoot-Through Control Methods.

I. INTRODUCTION

The QUASI-Z-SOURCE inverter (q ZSI), as a sine wave inverter for ac loads, has been widely studied. In 2009, researchers of the Department of Electrical Drives and Power Electronics, Tallinn University of Technology proposed a new application field for the q ZSI as an isolated step-up dc/dc converter. The baseline topology of the quasi-Z-source (q ZS) based dc/dc converter consists of the quasi-Z source network that includes two capacitors a diode, and two inductors and .The high-frequency step-up isolation transformer is supplied by the IGBT based single-phase inverter . To reduce the turns ratio of the transformer a voltage doubler rectifier based on two capacitors and two diodes was implemented the output .The q ZSI inherits all the advantage so f the Z-source inverter, which can realize buck/boost, inversion and power conditioning a single stage with improved reliability. In addition, the q ZSI has the unique advantages of lower component ratings and constant dc current from the sources. All these features make q ZSI an attractive converter for renewable and alternative energy.

The proposed converter is designed to be a power conditioning unit for a fuel cell powered systems. It is characterized by low voltage and high current values, which normally results in high losses of the system. Thus, serious attention should be paid to loss reduction not only in conductors but also in the semiconductor switches of the inverter. Losses in IGBT switches can be significantly reduced by proper control methods. One of the benefits that the q ZS topology offers is soft switching without additional components. The number of soft switching transients achievable depends mostly on the modulation method.

In some cases both zero current switching (ZCS) and zero voltage switching (ZVS) are possible over full operation range.

Two basic shoot-through control techniques for the q ZS-based dc/dc converter were recently proposed: pulse width modulation (PWM) and phase shift modulation (PSM). In both cases, shoot-through is generated during zero states. The zero and shoot-through states are spread over the switching period so that the number of higher harmonic in the transformer primary could be reduced. To reduce switching losses of the transistors, the number of shoot-through states per period is limited by two. Moreover, to decrease the conduction losses of the transistors, shoot-through current is evenly distributed legs. According to both methods (PWM, PSM) are fairly identical in terms of conduction losses since the number of conduction states and their duration remain unchanged. However, due to an increased number of hard-switched commutations in the case of the PSM shoot-through method in detail. The authors have also proposed several new improved PWM control methods such as shifted shoot-through control and swapped PWM control, which allow us to achieve better performance of the converter.

II. QZSI NETWORK CIRCUIT

The QZSI circuit differs from that of a conventional ZSI in the LC impedance network interface between the source and inverter. The unique LC and diode network connected to the inverter bridge modify the operation of the circuit allowing the shoot-through
III. PWM SHOOT-THROUGH CONTROL METHODS OF QZS BASED DC/DC CONVERTER

A. PWM Control Principle
The PWM control principle of a q ZS-based dc/dc converter shoot-through states should be placed they would not disturb the shape of the primary voltage of the isolation transformer. This enables us to keep the number of higher harmonics to a minimum. One way to accomplish that is to generate shoot-through inside zero states. It must be pointed out that zero states are always generated by the same pair of switches: either the top and or the bottom and transistors. Currently the top side transistors were used. The minimum number of shoot-through states per period of the isolation transformer is two. One shoot-through state per period would cause discontinuous mode input current and the q ZSI starts to behave abnormally. In general, the maximum number of shoot-through states is not limited. However, one should bear in mind that every additional shoot-through state automatically increases the switching frequency of the transistors and switching losses. Thus, the number of shoot-through states should be kept to a minimum. During shoot-through the current through the inverter switches reaches its maximum. The voltage in the dc-link drops to zero.

B. PWM Control With Shifted Shoot-Through
This modulation technique was proposed by the authors as an alternative to the conventional PWM control that was explained previously. To equalize transistor switching losses, the shoot-through states are shifted towards active states. As a result, there is one switching transient less for bottom side transistors, as indicated. The states are shown for one period of the isolation transformer. As it can be seen, bottom side transistors have now two times higher operating frequency compared to the top side transistors. Shoot-through states remain inside zero states, which is the condition required to keep the transformer voltage unchanged. Switching losses of transistors could be balanced to some degree. The switching frequency of top and bottom side transistors is still different, thus also switching losses. Since, the main target was to completely equalize transistor switching losses, we developed a further improvement method. The idea is to periodically swap transistors so that each transistor would work half the time as a top side and half the time as a bottom. Today’s major trend in power electronics is to increase efficiency. It is only achievable by optimizing operation parameters and components of a converter. One should avoid over- or under-loaded components. That is the reason why in the current research focus is on equalizing switching losses in the q ZS inverter. This paper discusses the PWM shoot-through control Method in detail. The authors have also proposed several new Improved PWM control methods such as shifted shoot-through control and swapped PWM control which allows us to achieve better performance of the converter. The only problem with the PWM shoot-through control is that it imposes unequal operating frequencies of the transistors, which results in unequal switching losses.

IV. OPERATING PRINCIPLE AND EQUIVALENT CIRCUIT OF QZSI

The two modes of operation of a quasi z-source inverter are:
(1) Non-shoot through mode (active mode).
(2) Shoot through mode.

ACTIVE MODE
In the non-shoot through mode, the switching pattern for the QZSI is similar to that of a VSI. The inverter bridge, viewed from the DC side is equivalent to a current source. , the input dc voltage is available as DC link voltage input to the inverter, which makes the QZSI behave similar to a VSI. Equivalent circuit of QZSI in Active mode

SHOOT THROUGH MODE
In the shoot through mode, switches of the same phase in the inverter bridge are switched on simultaneously for a very short duration. The source however does not get short circuited when attempted to do so because of the presence LC network, while boosting the output voltage. The DC link voltage during the shoot through states, is boosted by a boost factor, whose value depends on the shoot through duty ratio for a given modulation index. Quasi Z-source is an attractive converter for renewable and alternative energy resources, voltage double in rectifier side. This converter is designed to be a power conditioning unit for a DC power system. It is characterized by low voltage and high current values, normally results in high losses of the system reduction loss not only in the conductors but also in the semiconductors switches. Drawbacks: They are using single stage dc/dc converter. We cannot increase the efficiency fully in the single stage.

### Switching state sequence one period of pwm

<table>
<thead>
<tr>
<th>Active state</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero state</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Shoot-through</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Zero state</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
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<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Hence QZSI inherits all the advantages of the ZSI. It can buck or boost a voltage with a given boost factor. It is able to handle a shoot through state, and therefore it is more reliable than the traditional VSI. It is unnecessary to add a dead band into control schemes, which reduces the output distortion. In addition, there are some unique merits of the QZSI when compared to the ZSI. When implementing sine carrier PWM, the shoot through ratio, the boost factor and voltage gain of QZSI. It is observed that sine carrier PWM gives high shoot through duty ratio compared to triangular carrier, for the same modulation index, which reduces the voltage stress on the device and gives high peak output voltage. The simple boost control method has shoot through states spread uniformly which makes output free of low frequency ripples. QZSI has additional zero vectors or shoot through switching states that are forbidden in traditional VSI. For an output voltage boost to be obtained, a shoot through state should always be followed by active state. Three phase inverter must be controlled so that at no time both the switches in the same leg are turned on or else the DC supply would be shorted. This requirement may be met by the complimentary operations of the switches within a leg. The quasi Z-source inverter consists of an impedance network connected between the DC voltage source and the conventional VSI. A symmetrical impedance network consists of two identical capacitors and inductors connected. The isolation circuit offers isolation between the power circuit and the digital signal processor which generates the PWM pulses.

### V. SIMULATION RESULTS

The simulation is done on matlab software and the results are published below.

![Fig 3. shoot through state](image)

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![Fig 4. simulation circuit](image)

![Fig 5. shoot through output](image)

![Fig 6. inverter output](image)
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VI. Scope for Future Work

A grid-connected PV power generation system is one of the most promising applications of renewable energy sources. The proposed QZSI based PV power generation system is intended as a grid connected system and transfers the Maximum power from the PV array to the grid by maximum power point tracking technology. And also we can do this project in closed loop (high cost).

REFERENCES

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CONCLUSION

Thus the proposed QZSI inherits all the advantages of the ZSI and features its unique merits. It can realize buck/boost power conversion in a single stage with a wide range of gain that is suited well for application in PV power generation systems. The proposed QZSI has advantages of continuous input current, reduced source stress, and lower component ratings when compared to the traditional ZSI.