SINGLE PHASE SINGLE STAGE SWITCHED-BOOST INVERTER WITH FOUR SWITCHES

V. K Ali Fathimathul Farasana[1], G. Ranjithkumar[2], R. Manivannan[3], Dr. N. Kaleeswari[4] & N. Arun Prasath[5]

[1]PG Student, Department of EEE, EASA College of Engineering, Coimbatore, Tamil Nadu, India

[2,3]Assistant Professor, Department of EEE, EASA College of Engineering,, Coimbatore, Tamil Nadu, India

[4]Professor, Department of ECE, EASA College of Engineering, Coimbatore, Tamil Nadu, India

[5]Senior Assistant Professor, Department of ECE, EASA College of Engineering, Coimbatore, Tamil Nadu, India

ABSTRACT

The DC source voltage is greater than the peak ac output voltage in voltage source inverters (VSIs), which are buck dc-ac power converters. When two power switches in a leg are turned ON at the same time, a dc voltage source is shorted out. To obtain a high ac output voltage when a low input voltage is employed, a second boost dc-dc converter is installed in front of the inverter bridge. The end result is a second, high-priced, low-efficiency power converter with two stages of dc-dc-ac power conversion. Here, a brand-new, four-switch single-phase, single-stage switched-boost inverter is suggested. Its primary characteristics include shoot-through immunity, constant input current, and buck/boost voltage with single-stage conversion. The operating theories and simulation findings for the suggested inverter are presented in this research.

KEYWORDS: *Single Phase Single Stage Inverters, Quasi-Z Source Inverter, Quasi-Switched Boost Inverter*

INTRODUCTION

It suggests a brand-new, four-switch single-phase, single-stage switched-boost inverter. The essential characteristics of the suggested inverter are continuous input current. Shoot-through immunity and buck/boost voltage with single-stage conversion are further crucial elements. The simulation and experimental results matched those of the theoretical study. In addition to having shot through immunity over boost inverters, the proposed inverter employs one less switch and one more capacitor than qSBI. While comparing with the qZSI, the proposed inverter employs one more diode and one less inductor. The inverter has all of the qZSI and Qsbi's intrinsic advantages.

STATEMENT OF THE PROBLEM

The buck dc-ac power conversion method is traditionally used by voltage source inverters (VSIs), where the source's dc voltage is higher than the peak output voltage. Due to a short circuit in the dc voltage supply, the two power switches in a leg cannot be turned ON simultaneously. Additionally, to obtain a high ac output voltage while using a low input voltage, a boost dc-dc converter is installed in front of the inverter bridge. As a result, the cost and efficiency of the additional two-stage dc-dc-ac power converter were high.

OBJECTIVES OF THE STUDY

- Create a new single-phase, single-stage switched-boost inverter with four switches with Continuous input current as its key feature.

- High dependability Inverter that protects against the open-circuit and shoot-through phenomena.

- An inverter with two-stage dc-dc-ac power conversion that does not require an additional power converter. the conversion of power in one stage

RESULTS AND DISCUSSION

Single Phase Single Stage Inverters

A voltage source inverter, often known as a VSI, is a converter that changes a voltage's waveform from one that is unidirectional to one that is bidirectional, or from DC to AC. In the event of an ideal power supply, the inverter maintains a constant voltage throughout the procedure.

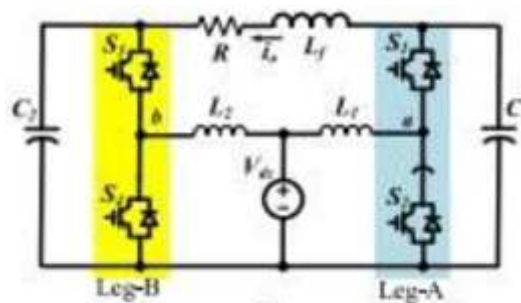**Conventional Single-Phase Single-Stage Boost Inverter**

Figure 1

The typical single-phase, single-stage boost inverter is displayed below. It has a passive load, four switches, two inductors, two capacitors, and two capacitors (RLf). The load is differentially linked between the output terminals of the two bidirectional dc-dc boost converters that are used in the boost inverter. To produce a sinusoidal voltage, the boost inverter's two separate boost dc-dc converters are each controlled by two 180° phase-shifted dc-biased sinusoidal references. A current feedback control method is suggested to reduce the second-order harmonic current component at the input side because the single-phase boost inverter adds a low-frequency (LF) ripple current at the source.
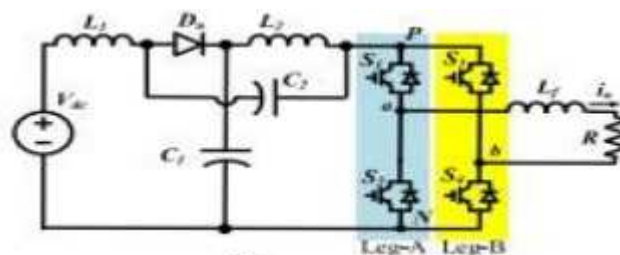
Quasi-Z Source Inverter

Figure 2

The single-phase qZSI is depicted in the above picture, where two H-bridge inverter legs are connected by a qZS network made up of two capacitors and two inductors. A shoot through state is employed in the qZSI to boost voltage without introducing any errors into the power circuit. The number of shoot-through states in a single switching phase is two. As a result, the inductors' operating frequency is twice as high as their switching frequency. The input current of the qZSI is continuously flowing since the source voltage is directly coupled to the inductor.
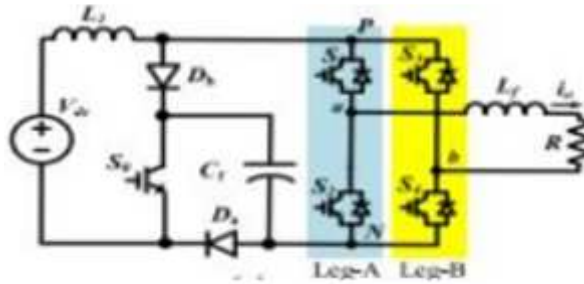
Quasi-Switched Boost Inverter

Figure 3

The single-phase single-stage qSBI is depicted in Fig. The single-phase qSBI has one fewer capacitor and one less inductor than the single-phase qZSI and boost inverter, but it also requires an additional switch and diode. With a single stage of power conversion, the single-phase qSBI has all the positive features of the single-phase qZSI, such as continuous input current, shoot-through immunity, and buck-boost output voltage.
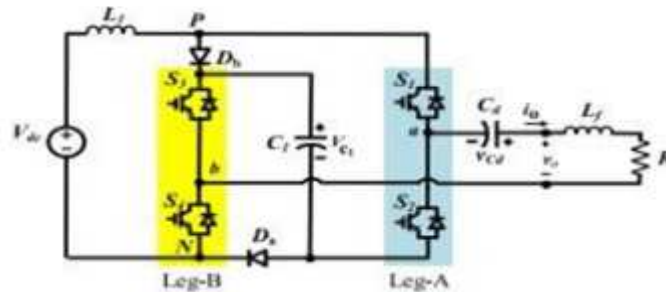
Proposed Inverter with Four Switches

Figure 4

The suggested single-phase, single-stage SBI with four switches is depicted in Fig. The second H-bridge leg with two switches S3 and S4 replaces the switch. As a result, the proposed inverter has one fewer active switch than the qSBI. One inductor (L1), one capacitor (C1), two diodes (Da, Db), and four switches make up a switched-boost network. In order to eliminate the dc offset component at the output, a capacitor Cd filter is employed. An inactive load is connected to the inverter's output (RLf). While Da is entirely forward-based, a boost converter is created by the combination of L1, C1, Db, S1, and S2. Another boost converter functions as L1 + C1 + Da + S3 + S4 when Db is fully forward based.
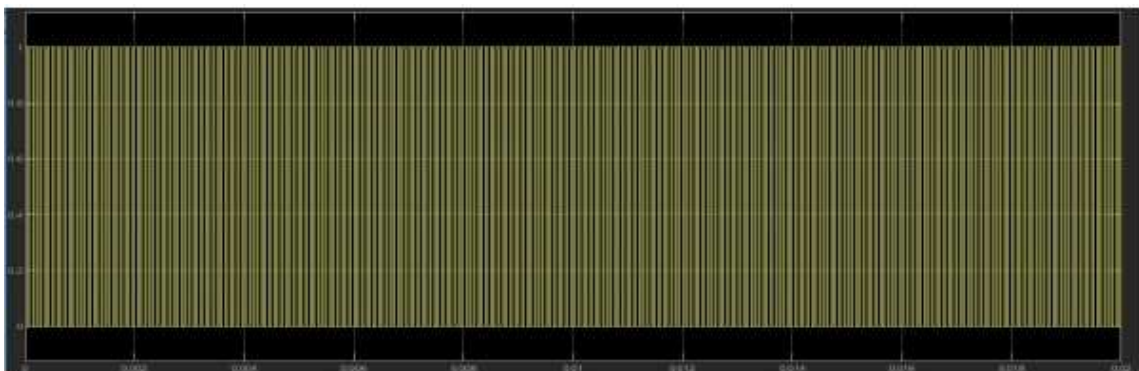
SIMULATION
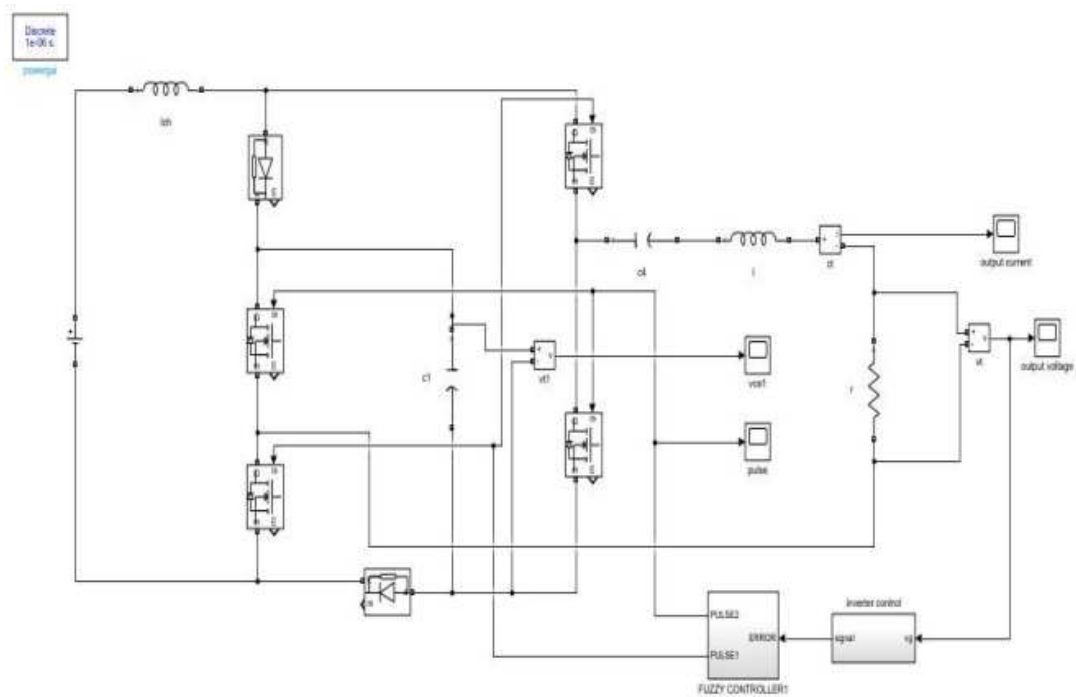
Figure 5

DC Input Voltage
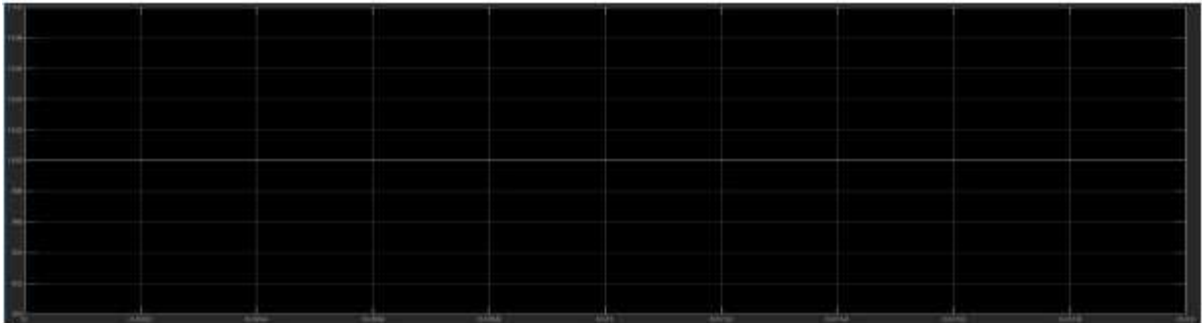
Figure 6

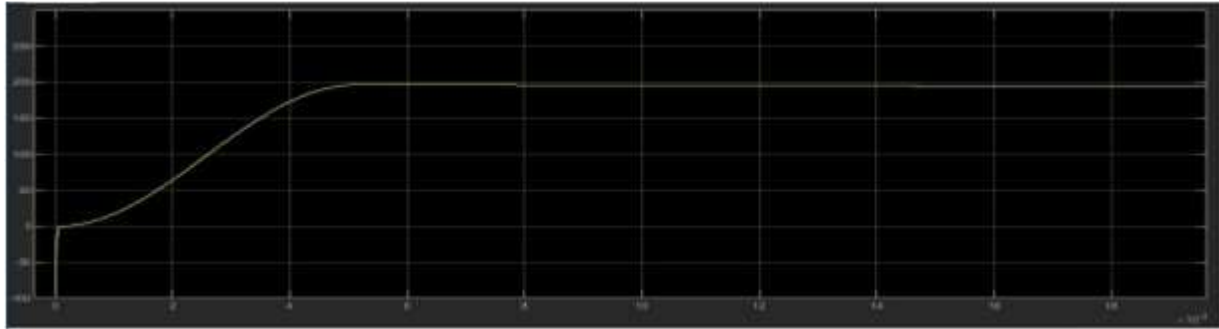**Gate Input Pulse**

Figure 7

Collector Emitter Voltage

Figure 8

Output Current Wave Form

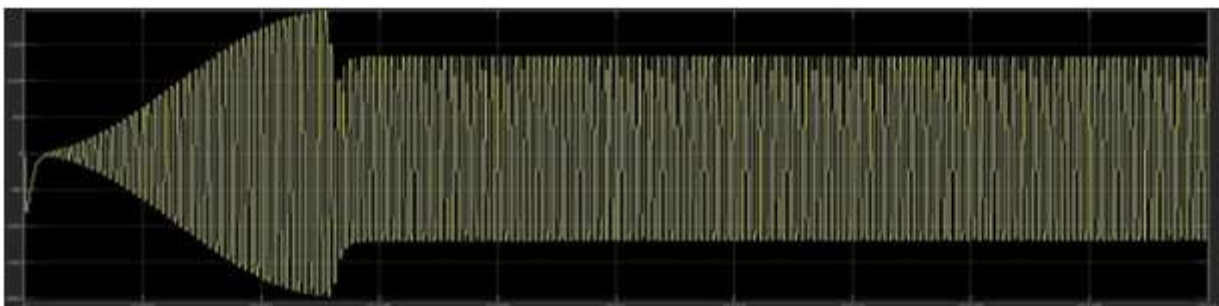**Figure 9**

Output Voltage Wave form

Figure 10

CONCLUSION

It was suggested to create a new single-phase, single-stage SBI with four switches. Due to its immunity against shoot-through and open-circuit phenomena, the suggested inverter has a high level of reliability. Additionally, the suggested inverter's ac output voltage is either higher or lower than the dc input voltage. The inverter cannot function with the capacitive load created by the capacitor and resistor linked in series, so the dc capacitor filter is employed to remove the dc component of the output voltage in this case. The proposed inverter does not improve the boost voltage capability when compared to the qZS/qSBI. To test the proposed inverter's working theory in both grid-connected and stand-alone modes, a laboratory prototype can be constructed. The suggested boost inverter adds an LF current at the input, just like a traditional boost inverter. To reduce the LF input current of the suggested inverter, more research should be done.

REFERENCES

1. *Y. Xue et al., "Topologies of single-phase inverters for small distributed power generators: An overview," IEEE Trans. Power Electron., vol.19, no.5, pp.1305–1314,Sep.2004.*

2. *S. Dasgupta, S.K. Sahoo and S.K. Panda, "Single-phase inverter control techniques for interfacing renewable energy sources with microgrid—part I: Parallel-connected inverter topology with active and reactive power flow control along with grid current shaping," IEEE Trans. Power Electron., vol. 26, no.3, pp.717–731,Mar.2011.*

3. *T. K. S. Freddy, N. A. Rahim, W.-P. Hew, and H. S. Che, "Comparison and analysis of single-phase transformerless grid-connected PV inverters," IEEE Trans. Power Electron., vol. 29, no. 10, pp.5358–5369, Oct.2014.*

4. *P. Sanchis, A. Ursæa, E. Gub´ıa, and L.Marroyo, "Boost DC–AC inverter: A new control strategy," IEEE Trans. Power Electron., vol. 20, no.2, pp.343–353,Mar.2005.*

5. *D. B. W. Abeywardana et al., "A rule-based controller to mitigate dc-side second-order harmonic current in a single-phase boost inverter," IEEE Trans. Power Electron., vol. 31, no. 2, pp. 1665–1679, Feb.2016.*

6. *D. B. W. Abeywardana, B. Hredzak, and V. G. Agelidis, "An input current feedback method to mitigate the dc-side low-frequency ripple current in a single-phase boost inverter," IEEE Trans. Power Electron., vol. 31, no.6, pp.4594–4603, Jun.2016.*

7. *N. Arun Prasath, N. Kumaresan, "A Novel Approach on Greedy Maximal Scheduling Algorithm on Embedded Networks," Networks and Complex Systems (IISTE), Vol. 5, Issue 3, pp 15-20, March 2015*

8. *N. Arun Prasath, N. Kumaresan, "Vehicle Speed Measurement and Number Plate Detection using Real Time Embedded System," Networks and Complex Systems (IISTE), Vol. 5, Issue 3, pp 15-20, March 2015*

9. *N. Arun Prasath, N. Kaleeswari, "Energy Efficient and Timing Error Mitigation Circuit Design Based on Clock Adjusment," Jundishapur Journal of Microbiology, Vol. 15, Issue 1, April 2022.*

10. *N. Arun Prasath, N. Kaleeswari, "Improved method for channel estimation in MIMOOFDM" International Journal of Research in Engineering and Technology, Vol 10, Issue 6, page: 17-24, June 2022.*

11. *N. Arun Prasath, N. Kaleeswari,"A Novel beam forming algorithm for Massive MIMO System using Kalman Formulation with Deep Learning" International Journal of Research in Engineering and Technology, Vol 10, Issue 6, page: 9-16, June 2022*