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A Novel H-Bridge Converter With Low Common Mode Noise

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***ABSTRACT*—This paper presents a novel bidirectional H-Bridge converter to reduce the common mode noise and subsequently electromagnetic interference. The proposed H-Bridge converter consists of two switch legs in addition to the available switch legs of a normal H-Bridge converter. It is capable of both unidirectional AC-DC rectification and bidirectional conversion according to the switch operation. The simulation results prove that the proposed circuit has electromagnetic compatibility and low total harmonic distortion shows the reduced common mode noise.**

I INTRODUCTION

Common mode noise is generally caused by electromagnetic interference. Common-mode noise in terms of ac power is the noise signal between the neutral and the ground conductor. Common-mode noise impulses tend to be higher in frequency than the associated normal mode noise signal, since the majority of the common-mode signals originate from capacitive coupled normal mode signals.

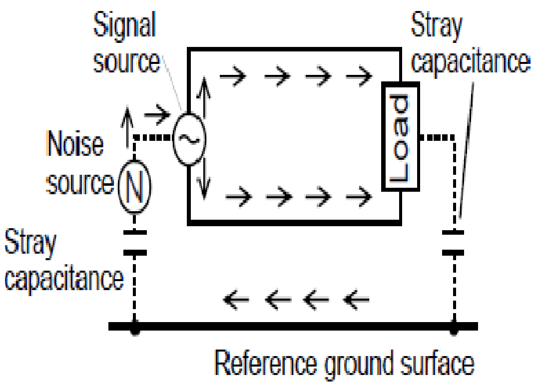

Fig.1. Common mode noise

Common mode noise is conducted on all lines in the same direction with an ac supply line.

Therefore to supress the common mode noise line bypass capacitor is used. Noise flows through ground lines,capacitor,metallic casing, stray capacitor and finally returns to noise source.

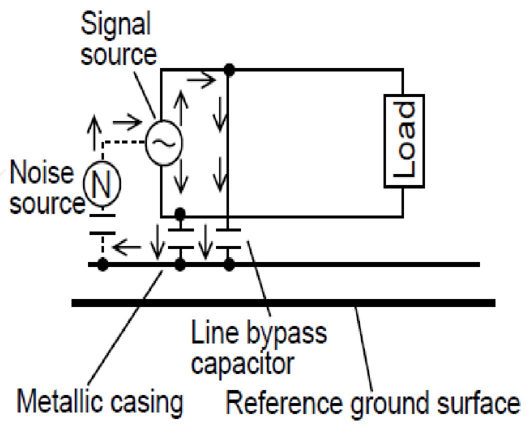

Fig.2. Elimination of common mode noise

The biggest source of common mode noise is the difference in potential between two physical remote grounds. The second significant common mode noise source is ungrounded sources. This can occur when a separate power supply is used to power the field device remotely and the power supply is left ungrounded.

The common mode current in any converter is produced when the voltage levels of the input and output terminals with respect to the earth ground are not same. Therefore making the voltage levels of the input and output grounds are essential. It is possible by connecting input and output terminals by solid connection and therefore common mode current and consequently common mode noise can be reduced.

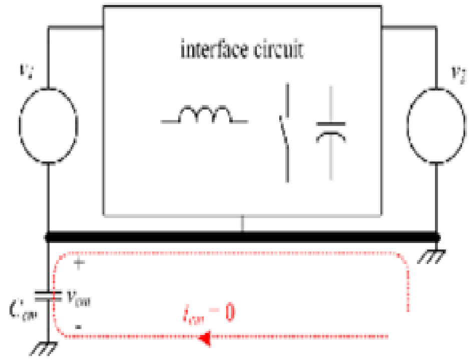

Fig.3. Location of parasitic capacitance

Therefore for low common mode noise the grounds of the input and output devices are connected as shown in the fig.3. The interface circuit here is a modified H-bridge converter with additional switch legs.

II PROPOSED CIRCUIT

The proposed H-Bridge converter with additional switch legs is a bidirectional converter. Bidirectional power conversion is possible according to the switch operation.

This provides low common mode noise and electromagnetic interference by solid connection between the input and output terminals.

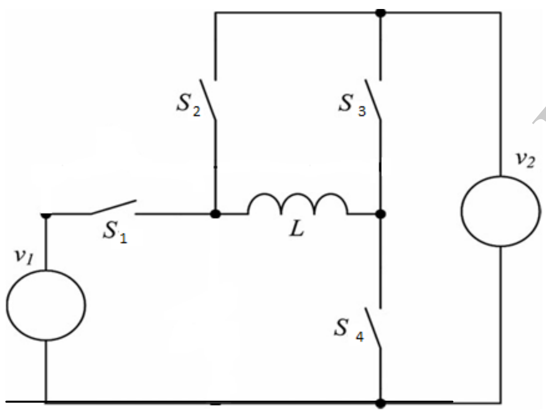

Fig. 4. Proposed H-Bridge converter

The switches in the figure 4 are replaced by the semiconductor devices according to the application.

For unidirectional power flow switches s_2 and s_3 are replaced by unidirectional devices i.e, diodes and the switches s_1 and s_4 are replaced by Mosfets. The modified H-Bridge converter with four switches for AC-DC unidirectional power flow from source(v_1) to load (v_2) is shown in fig 5.

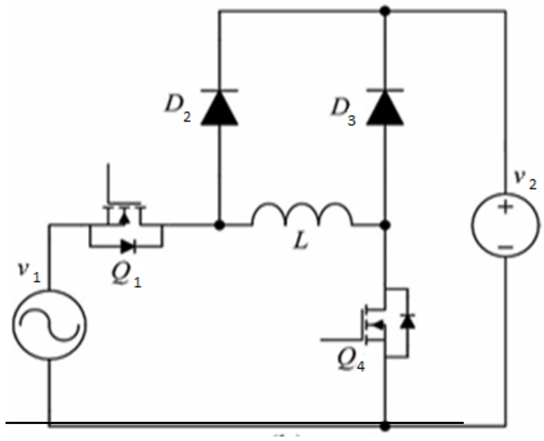

Fig.5. Proposed converter for unidirectional flow

The proposed H-Bridge converter can also handle the bidirectional power flow by replacing the switches shown in figure.4. by Mosfets. The power flows from v_1 to v_2 and also from v_2 to v_1 by switch operation. The modified H-Bridge converter for bidirectional power flow is shown in the fig. 6.

III OPERATION

The operation of the H-Bridge converter with four switches is explained below. It consists of four modes of operation and is capable of handling both positive and negative polarities by changing the switch operation.

In the first mode, only switches s_1 and s_4 operates and energy is stored in the inductor from voltage source v_1.

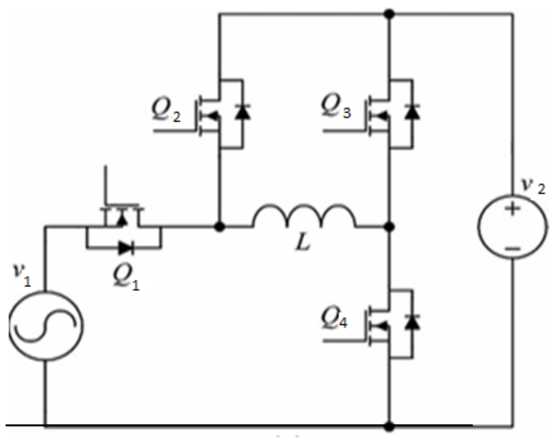

Fig.6. Proposed converter for bidirectional flow

In the second mode of operation, s_1 and s_3 operates and in this mode energy is transferred from v_1 to v_2 through the inductor.

In the third mode, s_2 and s_4 operates. The energy stored in the inductor is discharged to the load v_2.

In the fourth mode of operation only the switches s_2 and s_3 operates. Energy in the inductor is circulated in between s_2 and s_3 but it is not transferred to any load.

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IV RESULTS

A .SIMULATION OF THE PROPOSED AC-DC OPEN LOOP CONVERTER

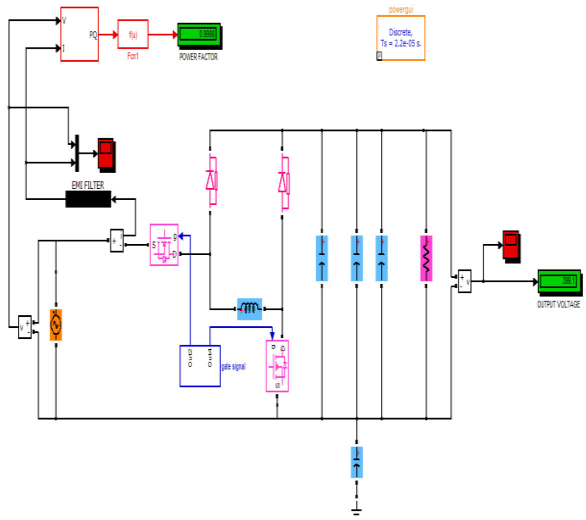

Fig.7. Simulation Diagram Of The Proposed Ac-Dc Open Loop Converter

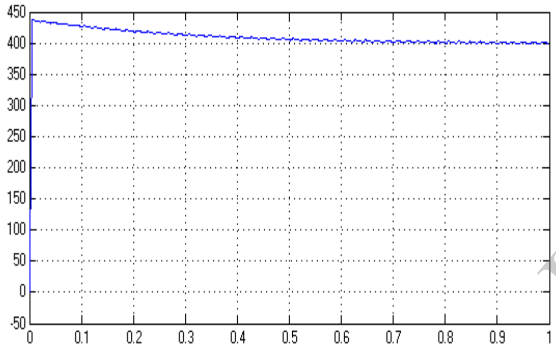

Fig .8. output voltage Of The Proposed Ac-Dc Open Loop Converter

B .SIMULATION OF THE PROPOSED AC-DC CLOSED LOOP CONVERTER

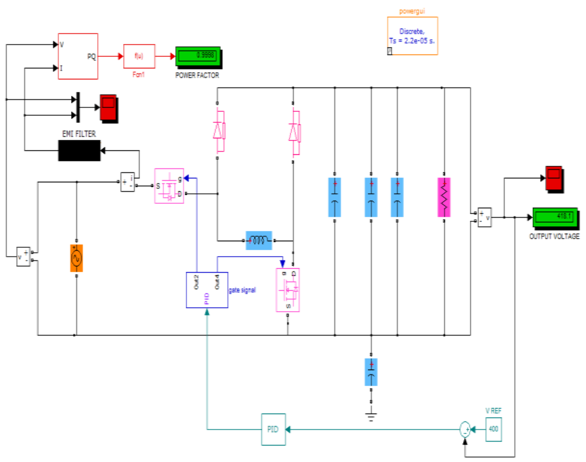

Fig.9 . Simulation Diagram Of The Proposed Ac-Dc closed Loop Converter

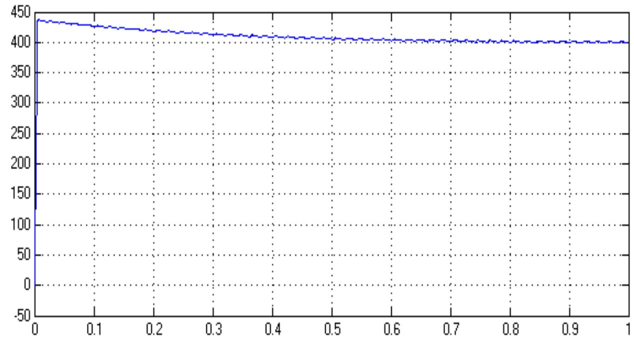

Fig .10. output voltage Of The Proposed Ac-Dc closed Loop Converter

C .SIMULATION OF THE PROPOSED BIDIRECTIONAL CONVERTER

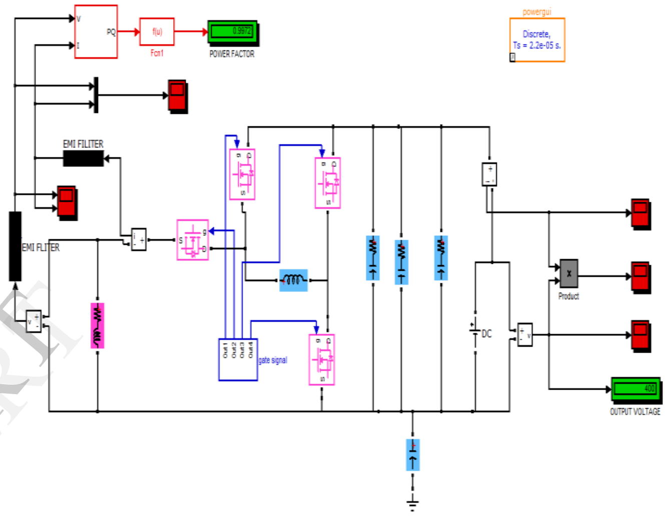

Fig.11. Simulation Diagram Of The Proposed Bidirectional Converter

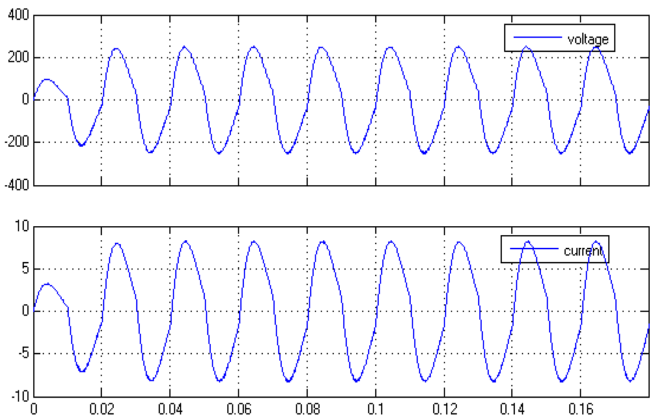

Fig .12. Output voltage and current Of The Proposed Bidirectional Converter

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D. THD ANALYSIS OF THE CONVENTIONAL AND PROPOSED CONVERTER

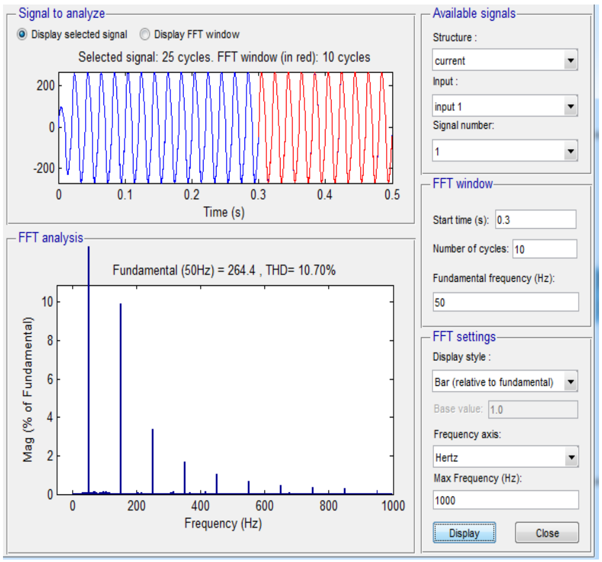

Fig.13 . THD of conventional H-Bridge converter

The THD of a conventional H-Bridge converter is 10.70% which shows in more common mode noise

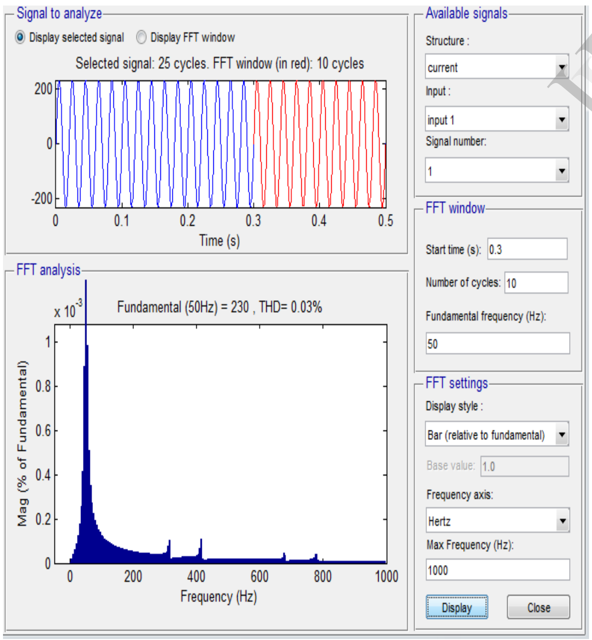

Fig 14. THD of closed loop AC-DC converter

The THD of a closed loop AC-DC converter is 0.03% which shows that the common mode noise of proposed circuit is less than that of the conventional circuit.

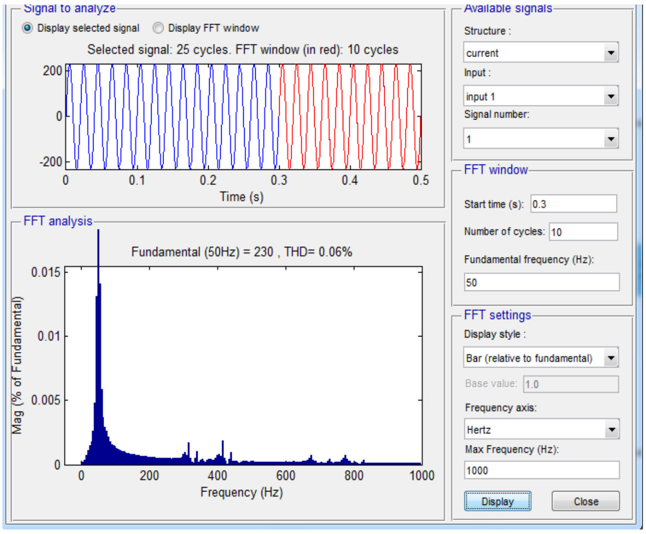

Fig .15 .THD of bidirectional converter

The THD of a bidirectional converter is 0.06% which shows that the common mode noise of proposed circuit is less than that of the conventional circuit.

V CONCLUSION

Thus the THD analysis of proposed closed loop AC-DC converter, Bidirectional converter and the conventional converter shows that the common mode noise of proposed circuit is less than that of the conventional circuit.

VI. REFERENCES

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