Implementation of Decoupling of Fluctuation Power in Single Phase AC Circuit by using Symmetric Half Bridge Convertor

Mr. Sushant Mahaveer Chaugule1[1] Mrs. Prajakta Sushant Chaugule[2] Mr. Gopal S. Chaudhari[3]
[1]ME Student [2]Lecturer [3]Assistant Professor
[1,2,3]Department of Electrical Engineering
[1,3]Yadavrao Tasgaonkar Institute of Engineering and Technology, Bhivpuri Road Karjat, Mumbai, India
[2]Sharad Institute of Technology Polytechnic Yadrav, Ichalkaranji, India

Abstract— The electricity demand in the market is increasing with a tremendous amount. Hence To meet the energy requirement engineers are focusing on Technologies to generate power from Non renewable energy resources with help of new technologies based on Power electronics converters. But the main problem in this method is power on the AC side contains a fluctuating component that changes at a dual base frequency. To mitigate this large electrolytic capacitors have been used. The negative impact are it is not cost effective, Bulky in size. This drawback is eliminated by using two identical film capacitors are employed and connected in series in the DC link, whose midpoint is then connected to another phase leg through a small filtering inductor. It is well known as decoupling of active power decoupling with help of Power electronic Convertors.

Keywords: Power Electronic Convertors, Active Decoupling, Harmonics

I. INTRODUCTION

The fluctuating power in single phase system has adverse effects on system performance as it may potentially cause distorted input current of Power Factor Correction units, over- heating of conductors, energy storage devices, decrement in efficiency of PV systems. A general way to mitigate this problem is to use bulky electrolytic capacitors in the DC link so that they can act as buffers to the ac-side ripple power. The electrolytic capacitors are having high equivalent series resistance (ESR) and low ripple current capability. We cannot guarantee on life time of these capacitors during stressed condition with the nominal voltage and the ripple current. Therefore, they may cause troubles in applications like Solar invertors which require longer warrantee periods say 15-20 years.

Experts in this field have proposed their research work with different topologies with proven experimental results known as active power decoupling. The basic fundamental principle behind this topology is to introduce an extra active circuit in the system, so that the ripple power can be shifted away from the DC link and it is stored in passive components like inductors, film type capacitors in a more efficient and effective way with expanded lifetime. In order to achieve a simple and compact design and to break the limitation imposed by the front-end topology, this paper proposes a new topology to realize active power decoupling. Two identical film capacitors are employed and connected in series in the DC link, whose midpoint is then connected to another phase leg through a small filtering inductor. In this way, the DC-link capacitors may not only provide a high-voltage DC bus to support AC/DC or DC/AC conversion, but can also absorb the system ripple power. The added symmetrical half-bridge circuit is also easy to control, because the voltages of the two-film capacitors will both be sinusoidal. Moreover, the capacitors can be alternatively discharged to zero in case that high ripple power compensation is required, and the power decoupling can be accomplished without using additional energy storage inductors or capacitors.

A. Problem Statement

In single-phase AC alternating current systems, alternating current is variable, which changes to twice the normal frequency (f), this variable power is disadvantageous to the performance of the system. This problem can be solved by installing large electrolytic capacitors in the DC connector. Passive filtering can inevitably lead to low power density and limited system life. An alternative approach is to use active energy separation so that energy curling can be redirected to another energy storage device to achieve better system performance.

II. METHODOLOGY

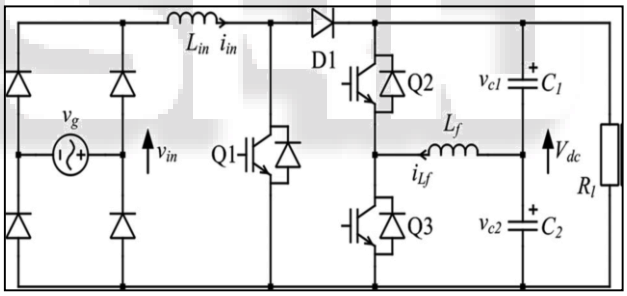

Fig. 1: (a) Symmetric half Bridge circuit

The Topology adopted for the decoupling of single phase AC Power is implemented as per below diagram two identical film capacitors are employed and connected in series in the DC link, whose midpoint is then connected to another phase leg through a small filtering inductor. In this means, the DC-link capacitors might not solely give a high-voltage DC bus to support AC/DC conversion, but can also absorb the system ripple power. The additional symmetrical half-bridge circuit is additionally simple to manage; as a result of the voltages of the 2 film capacitors can each be curved. Moreover, the capacitors is or else discharged to zero just in case that prime ripple power compensation is needed, and therefore the power decoupling is accomplished while not exploitation extra energy storage inductors or capacitors.

III. SIMULATION RESULTS

This topology is simulated on MATLAB/Simulink simulator .The equipments selected as per the design values which can provide the required double-line frequency harmonic power, and the resultant output power can be almost constant. The DC-link voltage has very slight voltage variation, as shown

in fig.3(c) which is around 10 V due to the errors in the closed-loop control. The closed-loop modifications with smaller change in gain can be applied to fine tune the voltage reference and to achieve more precise power decoupling.

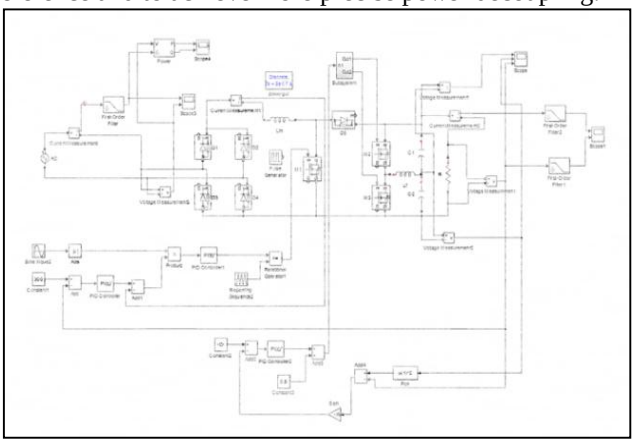

Fig. 2: (a) Simulation

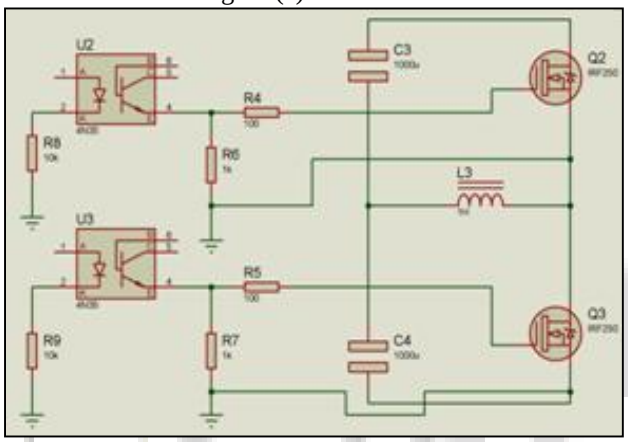

Fig. 2: (b) Decoupling circuit

IV. RESULTS

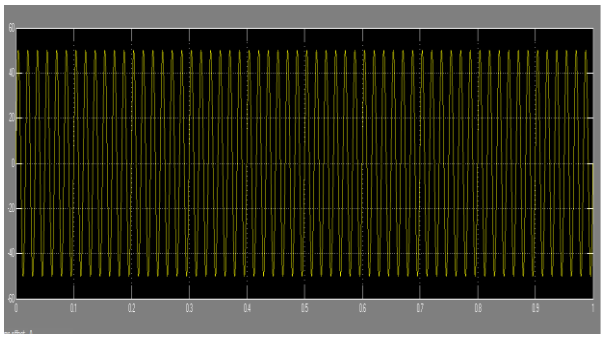

Fig. 3: (a) Input Voltage Waveform

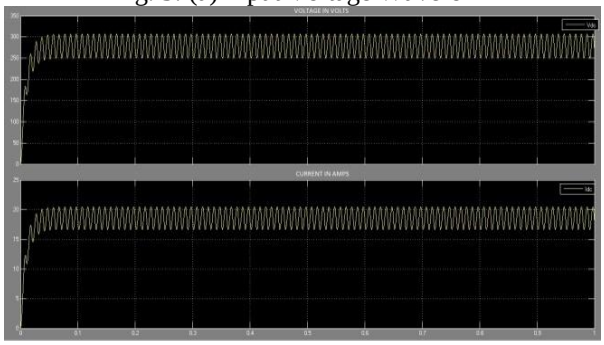

Fig. 3: (b) Output without Decoupling

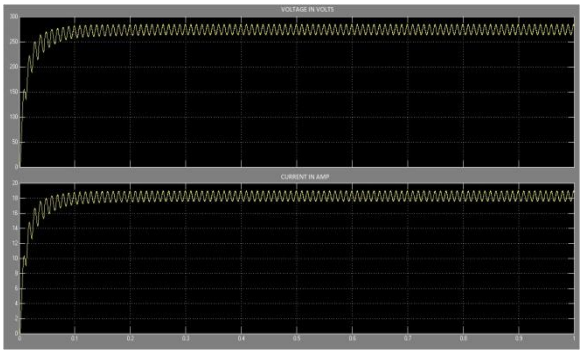

Fig. 3: (c) Output after decoupling

V. CONCLUSION

By comparing the total harmonic deformation with the compensation system and without the compensation system, we can see that the THD decreases by almost 10% using the proposed compensation method.

This project proposes a symmetric half-bridge circuit for separating fluctuating power in single-phase AC / DC and DC / ac systems. DC-capacitors in the proposed system can not only provide a high-voltage DC bus to support power conversion, but also absorb the power of the batteries that originate from the battery. The resulting system is more economical compared to other existing methods of separating active power, since it does not require additional passive components to store the energy of the system.

REFERENCES

[1] O. Garcia, J. A. Cobos, R. Prieto, P. Alou, and J. Uceda, "Single phase power factor correction: A survey," IEEE Trans. Power Electron., vol. 18, no. 3, pp. 749–755, May 2003.

[2] B. Singh, B. N. Singh, A. Chandra, K. Al-Haddad, A. Pandey, and D. P. Kothari, "A review of single-phase improved power quality AC-DC converters," IEEE Trans. Ind. Electron., vol. 50, no. 5, pp. 962–981, Oct. 2003.

[3] L. Huber, Y. Jang, and M. M. Jovanovic, "Performance evaluation of bridgeless PFC boost rectifiers," IEEE Trans. Power Electron., vol. 23, no. 3, pp. 1381–1390, May 2008.

[4] F. Musavi, W. Eberle, and W. G. Dunford, "A high-performance single- phase bridgeless interleaved PFC converter for plug-in hybrid electric vehicle battery chargers," IEEE Trans. Ind. Appl., vol. 47, no. 4, pp. 1833– 1843, Jul./Aug. 2011.

[5] F. Musavi, M. Edington, W. Eberle, and W. G. Dunford, "Evaluation and efficiency comparison of front end AC–DC plug-in hybrid charger topologies," IEEE Trans. Smart Grid, vol. 3, no. 1, pp. 413–421, Mar. 2012.

[6] M.Yilmazand P.T.Krein, "Reviewofbattery charger topologies, charging power levels, and infrastructure for plug-in electric and hybrid vehicles," IEEE Trans. Power. Electron., vol. 28, no. 5, pp. 2151–2169, May 2013.

[7] Y. Xue, L. Chang, S. B. Kjær, J. Bordonau, and T. Shimizu, " 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.

[8] Q. Li and P.Wolfs, "A review of the single phase photovoltaic module in- tegrated converter topologies with three different DC link configurations," IEEE Trans. Power Electron., vol. 23, no. 3, pp. 1320–1333, May 2008.

