Modified Elimination technique of Harmonics in 12-Pulse Diode Rectifier Using Current Sources

G. Kranthi Kumar,
Assistant Professor
Department of Electrical and Electronics Engineering ,
Chaitanya Institute of Technology and Science,
Hanumakonda, Warangal, Telangana, India

Bhukya Redyanayak
M.Tech student, P.E.
Department of Electrical and Electronics Engineering,
Chaitanya Institute Of Technology And Science,
Warangal, Telangana,India

Abstract: With the expanding number of electric vehicles (EV) in this days, the power system is facing huge challenges of the high penetration rates of EVs charging stations. In this paper, we describe a new method to profile the converter output current to be triangular due to which it has low ac-side harmonic present. Extra advantage of this type of approach is that we use the dcside filter to minimize volt-amperes rating of current source used to profile the dc-side rectifier current. One more additional benefits of the proposed method is simple integration of dc energy storage and its reducing harmonic even, initial rectifier current is discontinuous.

Keywords: 12-pulse diode rectifier, energy storage, harmonics, active power filter.

I. INTRODUCTION

Nowadays there is a need of high energy usage, so it is necessary to use the electric energy efficiently. The environmental pollution, rising fossil fuel prices and more dependency on internal combustion engine (ICE) technology employed in vehicles should be reduced and the widespread use of electric vehicle (EV) as the transportation of choice in 20 to 30 years times should be increased. The potential impact of these vehicles on the power quality of the electric grid is poorly understood. Power quality problems such as total harmonic distortion (THD) and lagging power factor can be taken into account and it can be reduced by using a rectifier. The older technology use a NPC converter which act as a rectifier for converting ac into dc components. In this, I use a VNR converter for the purpose of rectification process and it is used to reduce the harmonics level and improving the power factor.

A standard way to eliminate ac-side harmonics is to use active, passive, or hybrid power filters. Although

these methods are well understood and widely used, passive filters are bulky, while active filters require complex control and specialized power electronics. An alternative method controls the current draw from the dc side so as to minimize the ac harmonics. Researchers have shown that, for the 12-pulse rectifier, the AC-side harmonics are minimized by shaping the two six-pulse rectifier output currents to be triangular and out of phase. The resulting total harmonic distortion (THD) is as low as 1%.Researchers exploit this property; while effective at reducing the harmonics, the circuitry used to shape the current is placed in path of the load current, resulting in substantial VA rating. In this project, we propose a new method of profiling the dcside rectifier current by using current sources placed in parallel with each six-pulse rectifier bridge to inject current and shape the rectifier output current.

In this paper, we propose a new method of profiling the dc-side rectifier current by using current sources placed in parallel with each six-pulse rectifier bridge to inject current and shape the rectifier output current. The method is simple to implement and makes use of standard series-connected isolated gate bipolar transistor or metal oxide semiconductor fieldeffect transistor (MOSFET) modules. The property of the resulting current sources is that they are able to deliver power to the load, allowing for the integration of an energy storage system on the dc side. The VA rating required to profile the current is substantially reduced by a proper choice of the dc-side LC filter parameters.

II. BACKGROUND WORKS

. The Solid-State power electronic converters are generally used for providing controlled power to electrical loads like personal computers; printers; heating, ventilation, and air conditioning (HVAC) systems; adjustable speed drives, elevator drive, arc furnaces and arc welders. These loads are considered as nonlinear loads because of the fact that they pull harmonic currents from the ac mains along with their active power demand. In addition, with unbalanced condition of three-phase systems, they draw neutral currents in excess. The injected harmonics, reactive power demand, imbalance, and large neutral currents pose more load on the utility power system equipment, raise the power system losses, and thus degrade the power system efficiency. Compensation techniques like passive or active power filtering (APF) are helpful in improving the line side power quality for the purpose of complying with harmonic guideline standards like IEEE 519-1992 [1]. Power quality issues can be resolved with passive filters, although, passive filters have their own demerits; which comprise of the source impedances dependency, parallel/series resonance, aging of passive components, unmanageable filter currents and reactive power that could be generated [2]. Owing to semiconductor device development, the APF tends to become a highly hopeful compensator solution [3]–[6]. Based on the installation techniques, the APF could be classified as a series APF, a hybrid APF, and a shunt APF. The series APF is always connected in series to the grid bay transformer. Along with voltage protection for loads, it could also yield good harmonics current filtering with a variety of control techniques [7]–[9]. Nonetheless, the availability of a series-connected transformer hugely increases the complexity.

III. SYSTEM CONFIGURATION

A new proposed approach in this project is insert three current source in to the circuit .two current source and are used to profile the rectifier output current to be triangular so that the harmonic content in ac-side can be eliminated. In addition to inject active power in to the system we also show that the proper use of lc filter design we can minimize the VA rating required for current source to eliminate the harmonic. For example, in direct profiling case the direct comparison with other proposed method is more difficult because the VA rating of the voltage source be a function of design of whole system. The hardware implementation of three current source are

shown in figure and current source can be design using two cascade buck-and-boost converter and which two provide two independent current source and .third current source.

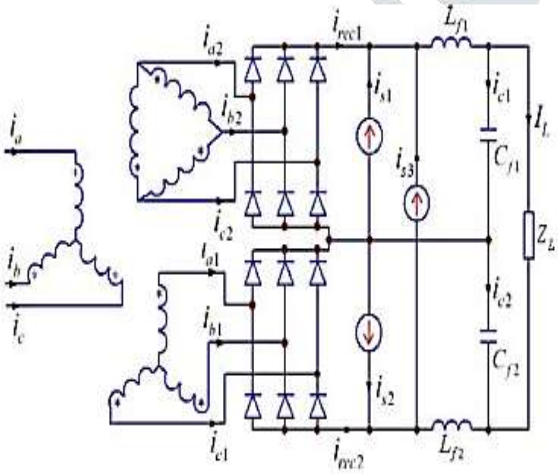

Fig.1 Configuration of the proposed ac/dc rectifier with current sources formed by two buck-andboost converters

The supply of dc bus is form the dc bus of cascade buck-andbust converter, same as active filter design; otherwise this dc bus can be used as dc energy storage. Advantage of proposed method with respect to existing method:

(i).parallel connected current source can be used as both energy storage system and to inject active power.

(ii).additional 360 Hz transformer is eliminated which are used in ref.no [8]-[11].

(iii).proposed method still work if the output current is discontinuous but existing method cannot be used when output current are discontinuous and only used for continuous current.

(iv).the current source work when the difference between current source and compensation are comparatively less.

System Analysis And Parameter Optimization:

We design a system whose main function is to shape the rectifier current of each 6-pulse rectifier to be triangular. To improve the efficiency of the system we should need to minimize the VA rating of the current source by the use of proper choice of filtering component. The equivalent circuit of the 12-pulse converter is shown in fig.

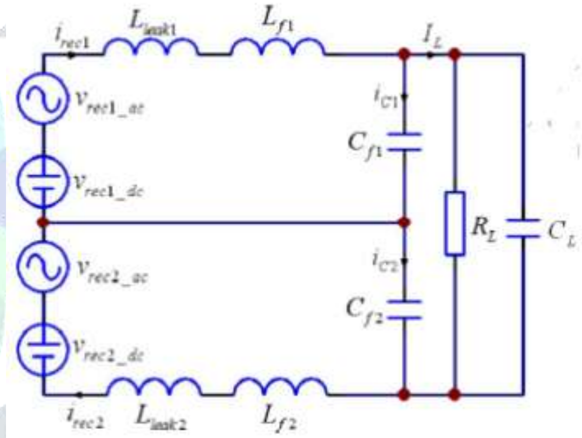

Fig 2: Equivalent circuit of the 12-pulse rectifier

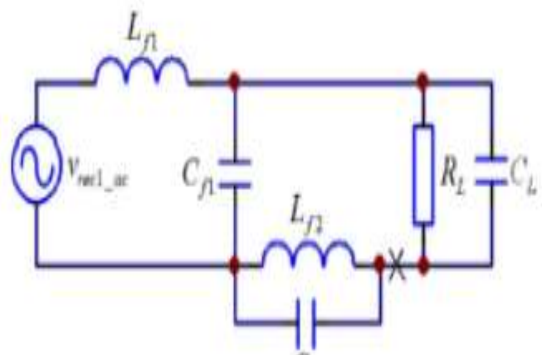

Fig 3: Decoupling of the currents produced by the fundamental of vrec1_ac.

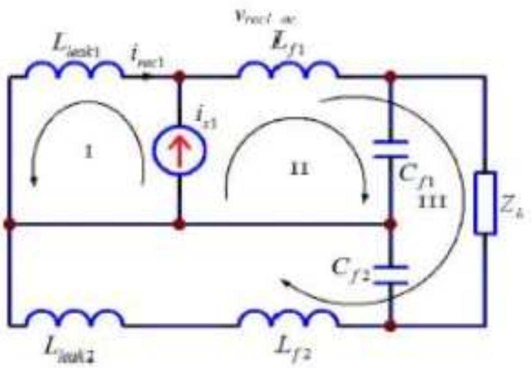

Fig 4: Equivalent circuit forthe upper current sourceusing the superposition principle

IV. SIMULATION RESULTS

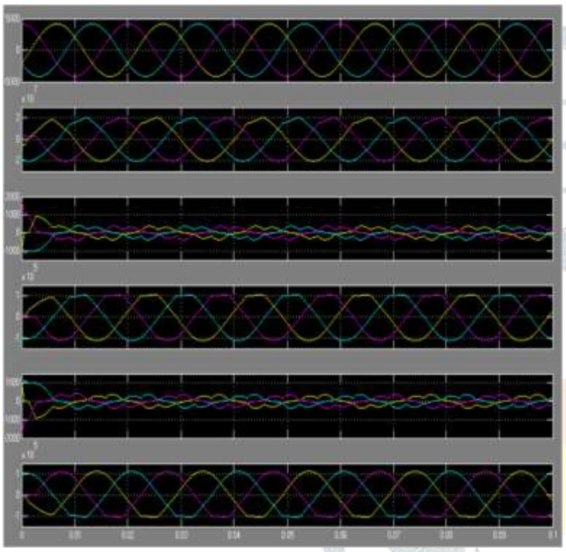

Fig 5

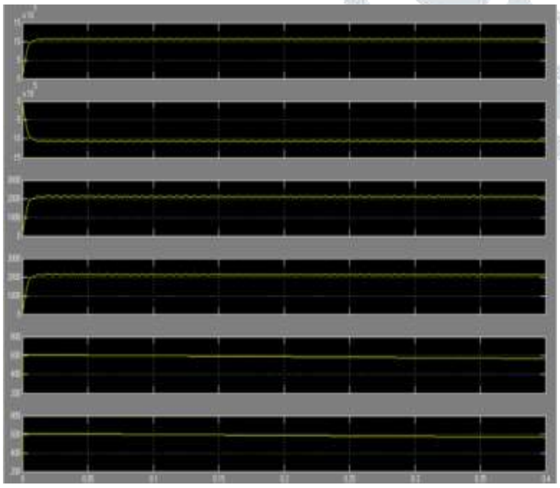

Fig 6

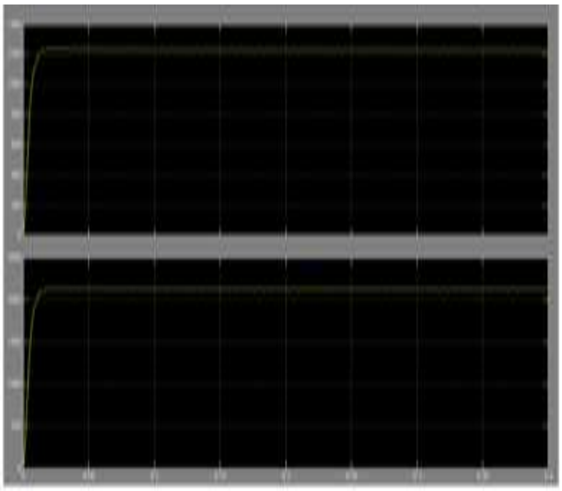

Fig 7

V. CONCLUSION

In this project we reduce the harmonic content of the 12-pulse diode converter by the help of current profiling circuit .the current profiling circuit are used in parallel with the rectifier output current circuit. In comparison with similar approaches, the proposed method has apparent advantages of eliminating the use of low frequency transformers for shaping the rectifier output current, providing energy storage interface to the system and functioning regardless of the continuality of the initial rectifier output current. Simulation of a high-power industrial ac/dc rectifier verified the parameter optimization of the system, while experimental results show significant reduction of harmonics in the line current.

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Authors:

G. Kranthi Kumar,
Assistant Professor
Department of Electrical and Electronics Engineering
Chaitanya Institute of Technology and Science,
Hanumakonda, Warangal, Telangana,India.

Bhukya Redyanayak Pursuing M.Tech (PE), Department of Electrical and Electronics Engineering from Chaitanya Institute Of Technology And Science, Kakatiya University, Hanamkonda, Warangal, Telangana, India.