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# Power factor improvement using Boost converter

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**Abstract—**The devices generally used in industrial, commercial and residential applications need to undergo power electronics converter for their proper functioning. They are connected to the grid comprising of non-linear loads and thus have non-linear input characteristics, which results in produced distortion input line current. Also, current comprising of frequency components at multiples of line frequency is observed which lead to line harmonics. Due to the increasing demand of these devices, the line current harmonics pose a major problem by degrading the power factor of the system thus affecting the performance of the devices. Hence there is a need to reduce the line current harmonics so as to improve the power factor of the system. This has led to designing of Power Factor Correction circuits. Rectifier is commonly used for AC-DC power conversion. As mention above that with the help of rectifier the input line current waveform will distorted. And leads to insert line harmonics, and result of that poor power quality and poor power factor. Now, to improve power factor in that type conversion is to introduced an input current wave shaper between rectifier and load.

**Keywords**-Rectifier; Boost Converter; Power Factor; THD

## I. INTRODUCTION

DC power supplies are extensively used inside most of electrical and electronic appliances in the world today, such as in computers, monitors, televisions, audio sets and others. There are commonly known as rectifiers. The nature of rectifiers either it is conventional or switch mode types, all of them contribute to low PF, high THD and low efficiency to the power system. With the imposed of harmonic standards such as IEC 61000-3-2 by international community's The objective of this project is to develop a circuit with all the necessary components and control system that will in-cooperated into the design of any single-phase rectifier hence, improves the PF and reduces the current harmonics. The process of shaping the input current is done by the Boost converter, which is properly controlled by the related circuitry. The control circuits for this project used low-cost components, easily available yet giving excellent performance and satisfactory results.

## II. DIFFERNENT POWER FACTOR CORRECTION TOPOLOGY

There are basically two types of topology for power factor correction.

1. Active power factor control topology.
2. Passive power factor control topology.

Passive solution have lots of disadvantages and limitation like, For achieving better power factor the dimension of the filter increases. Due to the time lag associated with the passive elements it has a poor dynamic response. The voltage cannot be regulated and the efficiency is somewhat lower. Due to presence of inductors and capacitors interaction may take place between the passive elements or they may interact with the system and resonance may occur at different frequencies. Although by filtering the harmonics can be filtered out, the fundamental component may get phase shifted excessively thus reducing the power factor. The shape of input current is dependent upon the fact that what kind of load is connected. While in active solution cause of lots of advantages like, The weight of such a system is very less. The dimension is also smaller and a power factor value of over 0.95 can be obtained through this method. Eliminate the harmonics to remarkably low values. By this method automatic correction can be obtained for the AC input voltage. It is capable of operating in a full range of voltage. Active solution is more popular than Passive solution.

## III. SIMULATION OF RECTIFIER CIRCUIT FOR PFC

 

Here is a simple simulation of rectifier circuit which will give desire output voltage and current but due the nature of rectifier circuit its make poor power factor and low THD in source side.

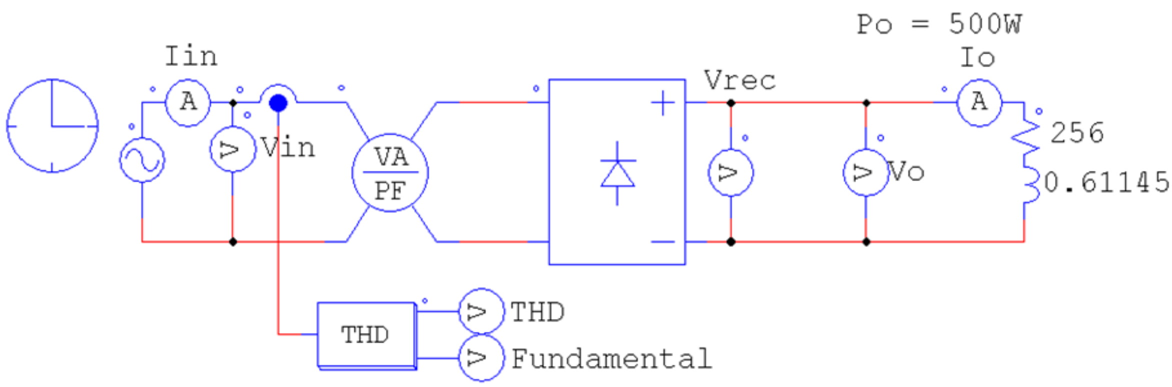


***Figure 1. Simulation of AC-DC without boost converter***

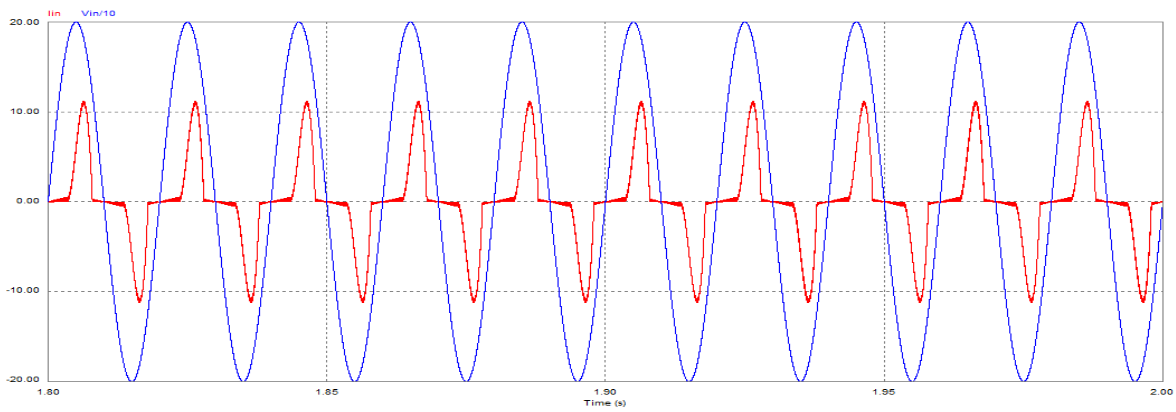


***Figure 2. Source voltage and current***

From the above simulation it is clear that power factor of such AC-DC converer is 0.45. and 48% THD. Which is far away from IEEE standard. For improvement in power factor and reduce THD level boost converter can apply in next simulation.

## IV. SIMULATION OF CONTROL BOOST CONVERTER PFC

In a boost converter the output is greater than the input voltage that's why name "Boost". A boost converter using MOSFET is shown in figure. The circuit operation can be divided in two modes. Mode-1 being when transistor switch is switched on at t=0. The input current, which rises, flow through inductor L and transistor Q1. Mode-2 being when transistor switch off t=t1. The current that was flowing through the transistor would now flow through L, C, Load and diode D. the inductor current falls until transistor Q1 is turned on again in the next cycle. The energy stored in inductor L is transferred to the load. The equivalent circuit for the modes of operation is shown in figure. The waveforms for voltage and current are shown in figure for continuous load current, assuming that the current rises or fall linearly.

 

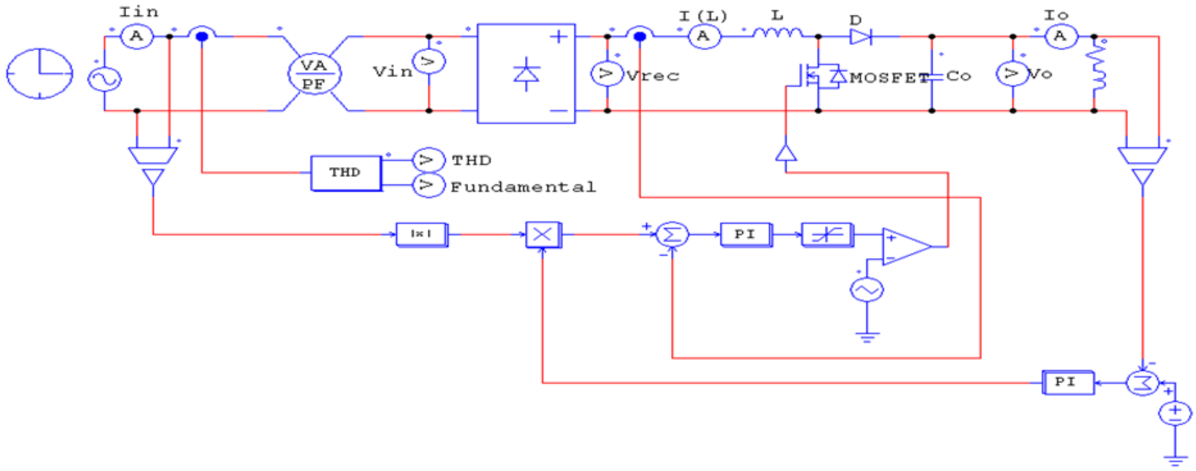


*Figure 3. Simulation of AC-DC converter with boost PFC*

All simulations are carried out in PSIM simulator. With equal load (RL) condition say 500W. And consider steady state condition for better understanding of simulation.

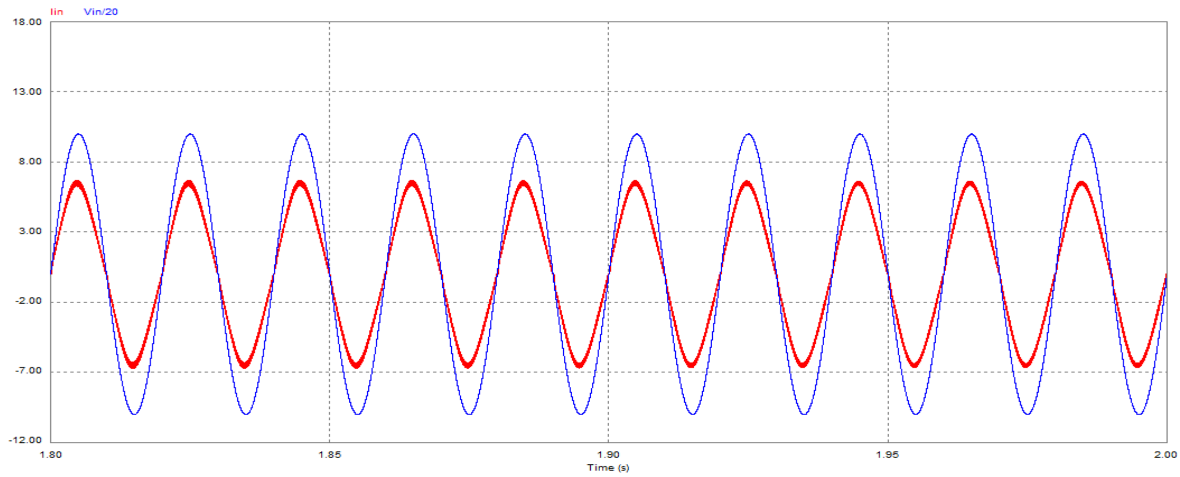


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*Figure 4. Source voltage and current*

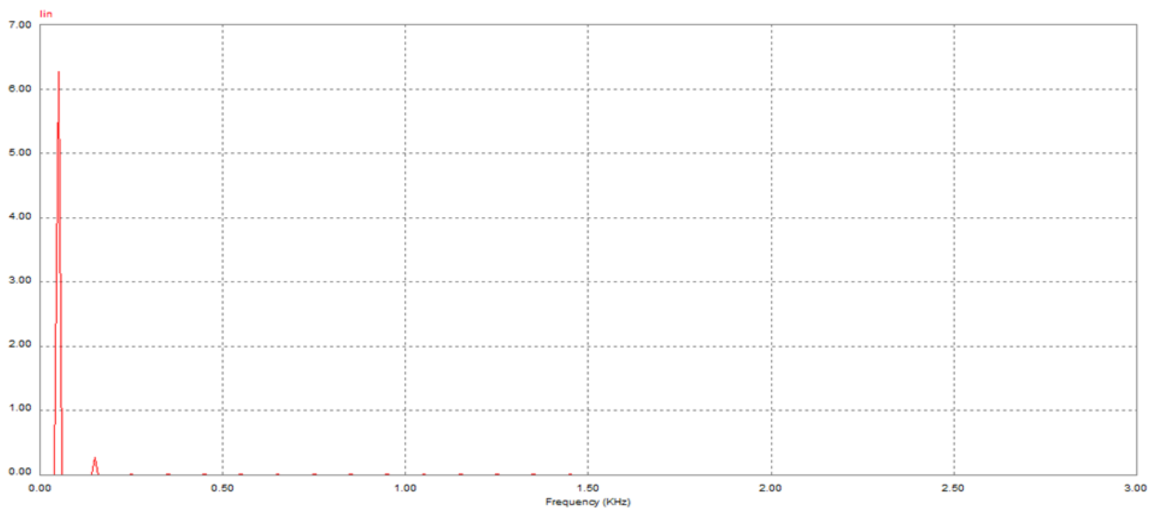


*Figure 5. Harmonics spectrum*

 

From the above solution the power factor is observerd 0.98. and 2.6% THD it is improved with compare to AC-DC converter with out boost PFC mean only conventional rectifier.this power factor can improve to unity if closed loop apply to the boost converter.

## V. CONCLUSION

From the simulation result it can be conclude that the AC-DC converter using boost converter is improve source power factor and THD in permisibal limit as per IEEE standard in source side.The Boost PFC circuit can be designed as a pre-converter to any rectifier that needs to be improved in PF and THD.

## VI. APENDIX

| | | |
|---|---|---|
| AC voltage source | : | 220V,50Hz |
| Load | : | 500W, 0.8pf lag. |
| Boost inductor : | 4mH | |
| Boost Capacitor | : | 781µF |
| Switching Frequency | : | 45KHz |

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