# Power factor correction using Boost Converter

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***Abstract*—There is great expansion in semiconductor devices nowadays and their expansion has led to new discoveries. The usage of new devices has also led to increase in current flowing through the devices causing low power factor and harmonic distortion in the circuit. The need for improvement of power factor is necessary and it's important to reduce line current harmonics. Our paper aims to develop a circuit for improvement of power factor and also the reduction in harmonics with the help of boost converter circuit. The software simulation are performed on MATLAB SIMULINK.**

***Index Terms*—power factor correction, harmonic distortion, boost converter.**

## INTRODUCTION

Any converter which converts one form of power to other has a rectifier in its basic circuit. The conversion devices require harmonic rich ac line current and this causes low factor and distortion in harmonics. Various power factor improvement techniques are employed for this among which boost converter technique is the most desirable one and is extensively used for ac/ac and dc/dc conversion. Boost converter technique provides high output voltage with proper controlling and increased power factor .

This paper deals with the simulation of basic rectifier circuit and the analysis of current and voltage waveforms.Then is circuit is made advanced by implementing technique of active PFC IC L6561 in software simulation and subsequent effect on current and voltage waveforms is studied ,expecting better results.All the simulation work is done in MATLAB simulink.

## I. MATHEMATICAL FORMULATION

### *A. Boost Converter*

Boost converter is a dc/dc converter which gives an increased output for a particular input voltage.the inductor in the ciruit resist the changes in current.the boost converter works in following manner:

When the switch is turned current flows through the inductor and energy is stored in it. When the switch is turned-OFF, the stored energy in the inductor tends to collapse and its polarity changes such that it adds to the input voltage as shown in Figure 1.
Voltage across the inductor and the input voltage are in series and together charge the output capacitor to a voltage higher than the input voltage.

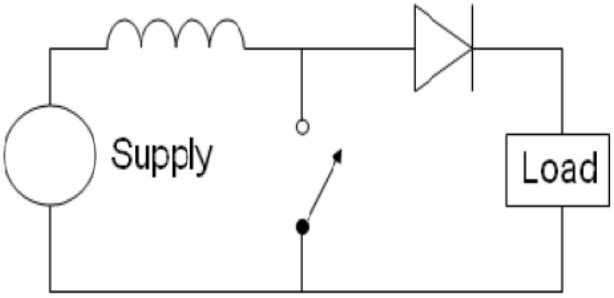


Figure 1.
Boost Converter

The basic principle of a Boost converter as shown in Figure 2.It consists of 2 distinct states: i. In the On-state, the switch S is closed ,resulting in an increase in the inductor current ii. In the Off-state, the switch is open and the only path offered to inductor current is through the fly back diode D, the capacitor C and the load R. This result in transferring the energy accumulated during the On-state into the capacitor.

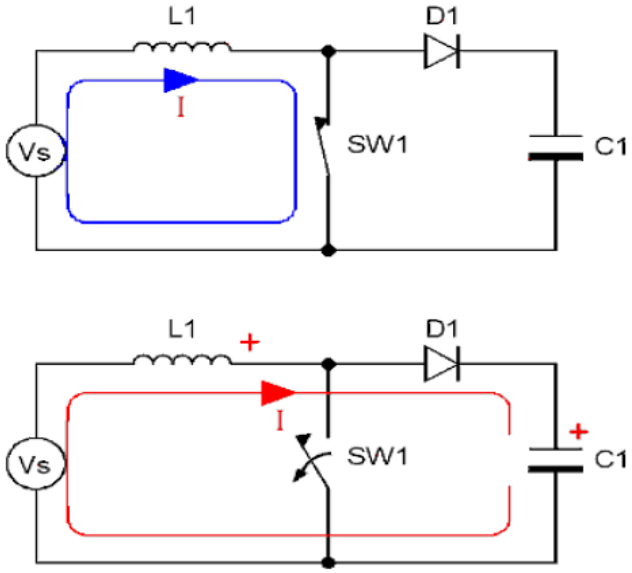


Figure 2
Operation Circuit of Boost Converter

**Continuous Mode:**
When a boost converter operates in continuous mode, the current through the inductor falls to zero. Figure-3 shows the typical waveforms of currents and voltages in a converter operating in continuous mode.
The output voltage can be calculated in steady conditions after operation.

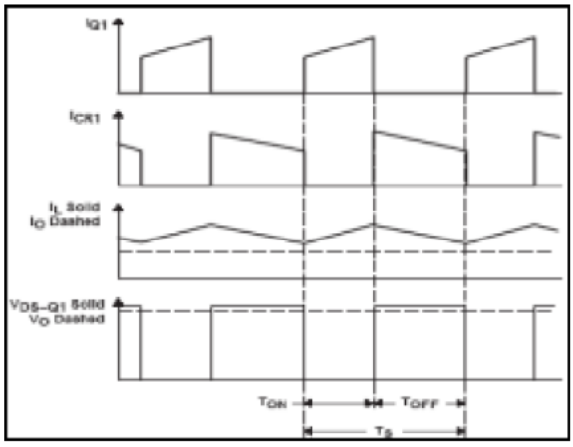


Figure 3.
Continous mode

**Discontinuous Mode**: If the ripple amplitude of the current is too high, the inductor may be completely discharged before the end of a whole commutation cycle.In this case ,the current through the inductor falls to zero during part of the period as shown in Figure-4. Although slight, the difference has a strong effect on the output voltage equation.

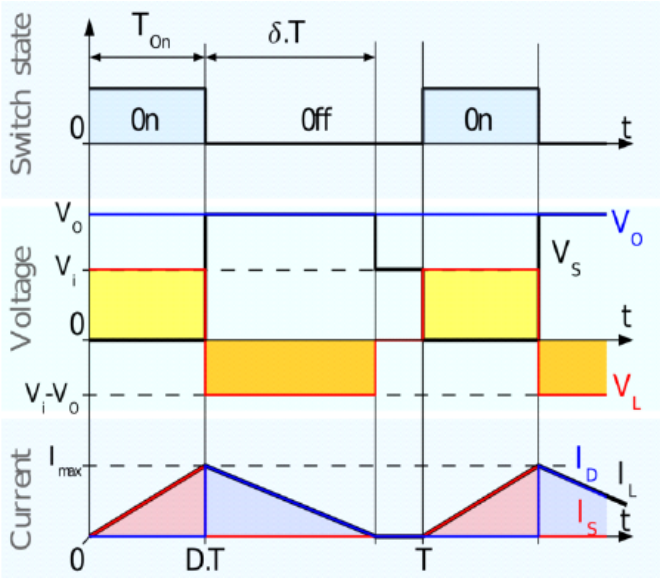


Figure 4
Discontinuous mode

*B. Power factor correction*

The power factor of an AC electric power system is defined as the ratio of the real power flowing to the load to the apparent power in the circuit, and is a dimensionless number between 0 and 1. Real power is the capacity of the circuit for performing work in a particular time. Apparent power is the product of the current and voltage of the circuit. Due to energy stored in the load and returned to the source, or due to a non-linear load that distorts the wave shape of the current drawn from the source, the apparent power will be greater than the real power.

In an electric power system, a load with a low power factor draws more current than a load with a high power factor for the same amount of useful power transferred. The higher currents increase the energy lost in the distribution system, and require larger wires and other equipment. Because of the costs of larger equipment and wasted energy, electrical utilities will usually charge a higher cost to industrial or commercial customers where there is a low power factor.

Linear loads with low power factor (such as induction motors) can be corrected with a passive network of capacitors or inductors,but the better method of increasing power factor and reducing the cost for customers is boost converter method.The IC used in the circuit is a specific power factor corrector IC which helps in bringing power factor to unity and increasing the output voltage.

## II .SIMULATION and RESULTS

This paper involves simulation of simple circuits with a gradual increase in complexity by inclusion of new components and their subsequent effect on the current and voltage waveforms. The waveforms of both the circuits are compared. All the simulation work is done in MATLAB Simulink.

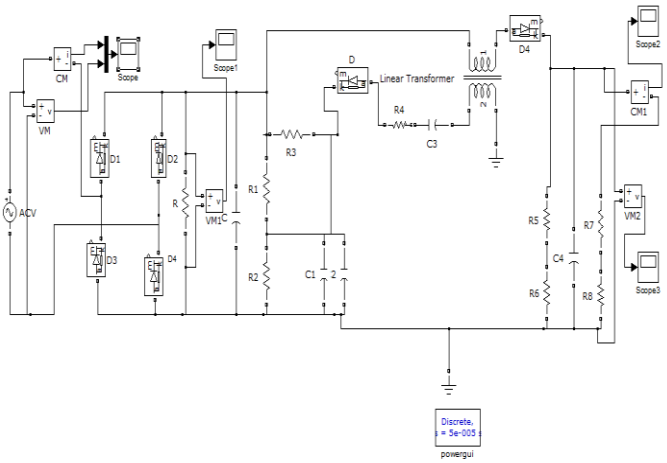


Figure 5
IC Implementation in MATLAB before PFC

**Simulation and results for Conventional Converter:**
The above circuit is pfc circuit without using IC and it is a simple converter which has rectifier for conversion from ac to dc and the load is provided at the end of circuit and the waveform of current and voltage are plotted.

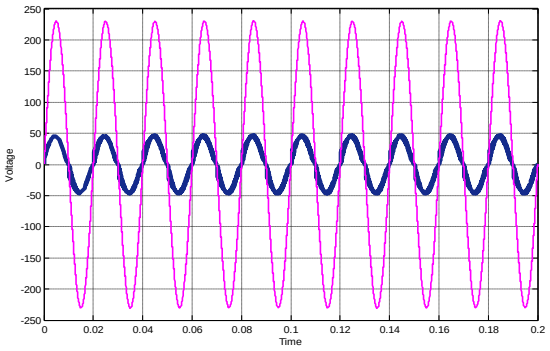


Figure 6

Waveform of circuit without using IC

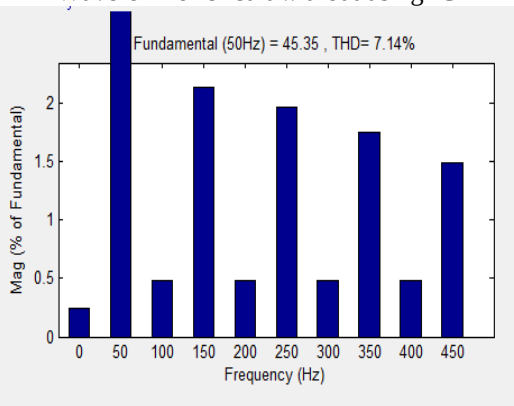


Figure 7

Fft analysis of circuit

**Simulation and results for rectifier with Power Factor Correction IC L6561:** Figure 8 shows the circuit with implementation of Power factor correction using IC L6561 in MATLAB and the output waveforms are plotted in graph as shown in figure 9 in which there is an improvement in power factor.

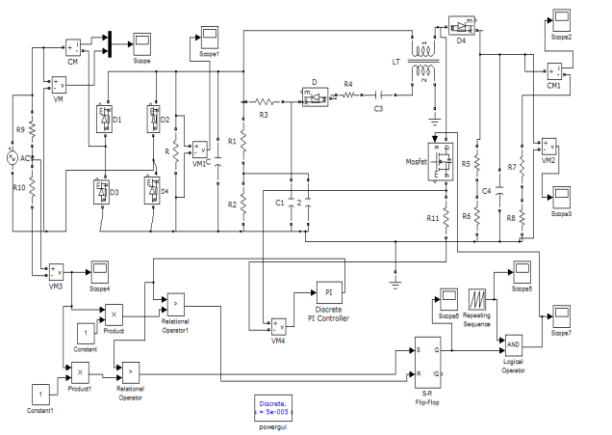

Figure 8

Pfc circuit using IC L6561

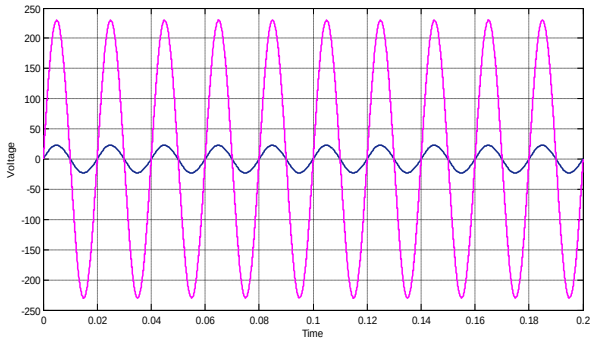


Figure 9

Waveform with increased power factor

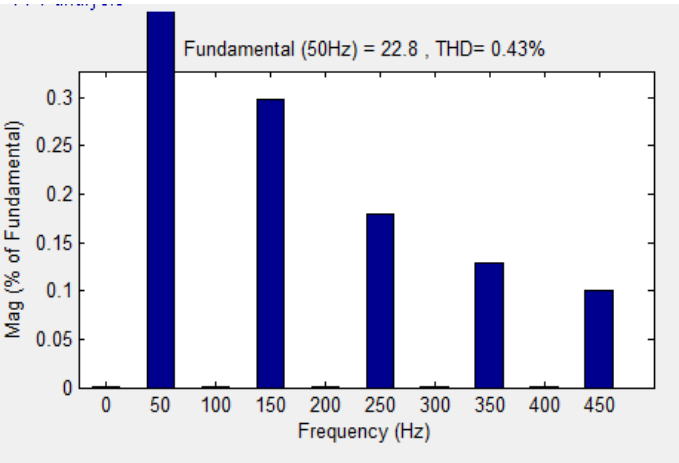


Figure 10

Fft analysis of circuit

## CONCLUSION

The Power Factor Correction with boost converter are simulated with MATLAB Simulink and waveforms are obtained. In this paper conventional converter ,Boost converter using IC L6561 is discussed. It is observed that the power factor is better for Boost Converter Circuit and the harmonic distortion has reduced a lot.

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