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# Enhancement of Three Phase system to optimize Active Power Filter based on Clarke and park transformation to minimize the losses power

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**Abstract**

In this paper, new method is suggested for three phase power system to enhance the efficiency of whole system for active power filter APF by using the park and Clarke transformation. the drawbacks of traditional electrical system without APF is that it had distorted wave with low response. Therefore, the main idea of APF is to achieve high quality of system and make the system good smooth with low distortion. The activity of APF is increased by park and Clarke transformation because the transformation convert the three phase system to two phases which make the system more simplicity and consequently the method is considered with almost free of harmonics, with approximately unity power factor, and robustness for disturbance of load. The presentation of this new method was initially designed by using Matlab and the opportunity of proposed APF for removing system harmonics was established in stable and temporary conditions. The results show that the suggested APF eliminate the drawback of system. The active power is also increased and measures based on converting the current from abc to direct –quadrature dq0 axis by park transformation. finally, the system of electrical power with APF via transformation is more active and high performance over the traditional method.

**Keywords:** Active power filter, park transformation, Clark transformation, power losses

## INTRODUCTION

The three phase electrical generation system provides the electrical current for load by using passive filter of RLC filter. Usually, the conventional bridge rectifier, are mainly used to convert the AC to DC and supply the inverters which lead harmonics problem. The harmonics causes low efficiency [1].the active and passive filter are explained also [2]-[5]. The RLC together generate passive filter. The main problems of passive filter that it is appropriate for a precise harmonic and not active for improving power factor [6]-[10].

The active power filter (APF) is applied to solve the problems of passive power filter to increasing the efficiency and minimizing the current fluctuating. Additionally, the regulator of the APF is difficult, subsequent in low consistency, and it is simple to implement to remove difficulties. APF is used to remove harmonics of current [11]-[17].

## ACTIVE POWER FILTER APF WITH PARK AND CLARKE TRANSFORMATION

The APF are the developing strategies, which is used to remove the harmonics of current. Figure 1 shows the block diagram of APF.

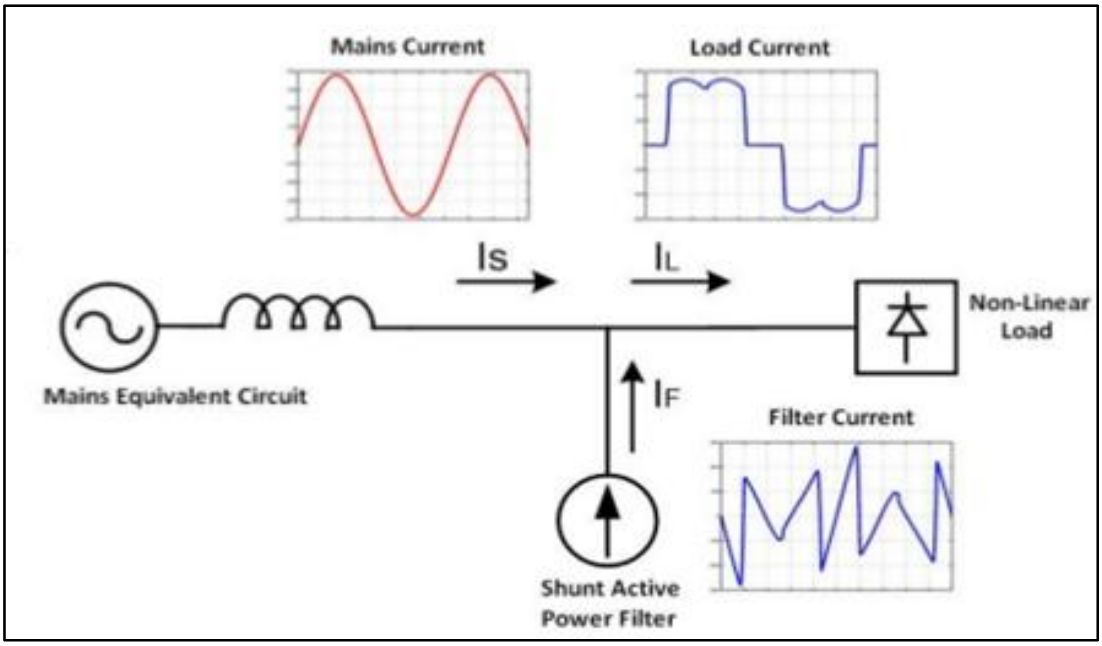


**Figure 1:** Block diagram of APF

The Clarke transformation with park transformation are used to convert the three phase to two phases in order to remove the complexity of system and to make the system is simple.

The Clarke transformation converts the abc to d-q or abc to α-β. In addition, the park transformation converts α, β to d-q. Also, there is also inverse park transformation and inverse Clarke transformation. figure 2 and 3 show the park and Clarke transformation.

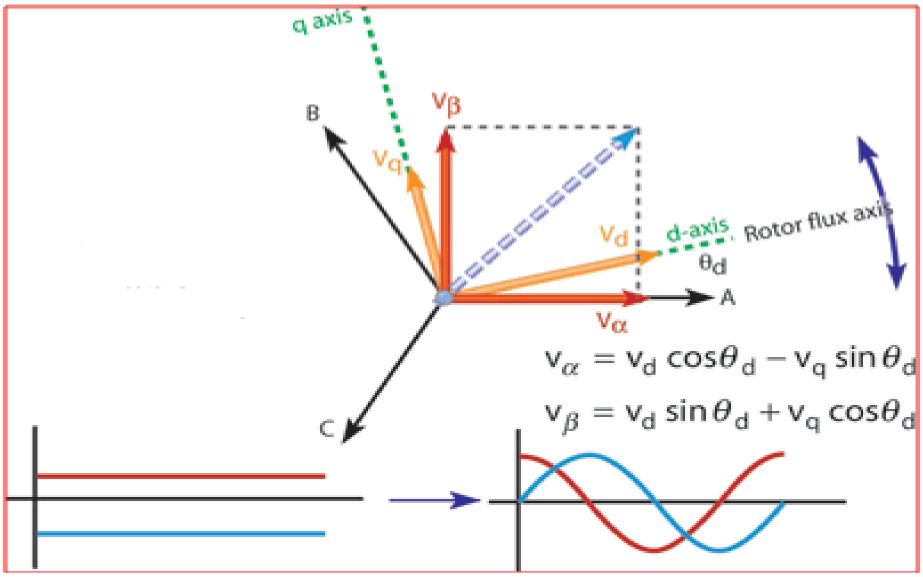


**Figure 2:** Park transformation

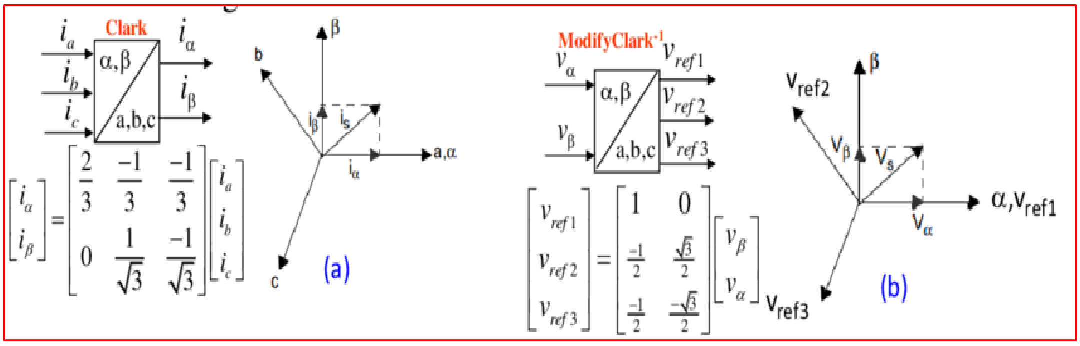


**Figure 3:** Clarke transformation

## THE PROPOSED METHOD WITH RESULTS

In this proposed system**,** the park and Clarke transformation is used to optimize the APF of electrical power system to enhance the system efficiency. The first step of this system is converting a,b,c to α,β based Clarke and subsequently the α,β convert to d-q via park transformation. the Simulink of APF with these transformation is shown in figure 4.

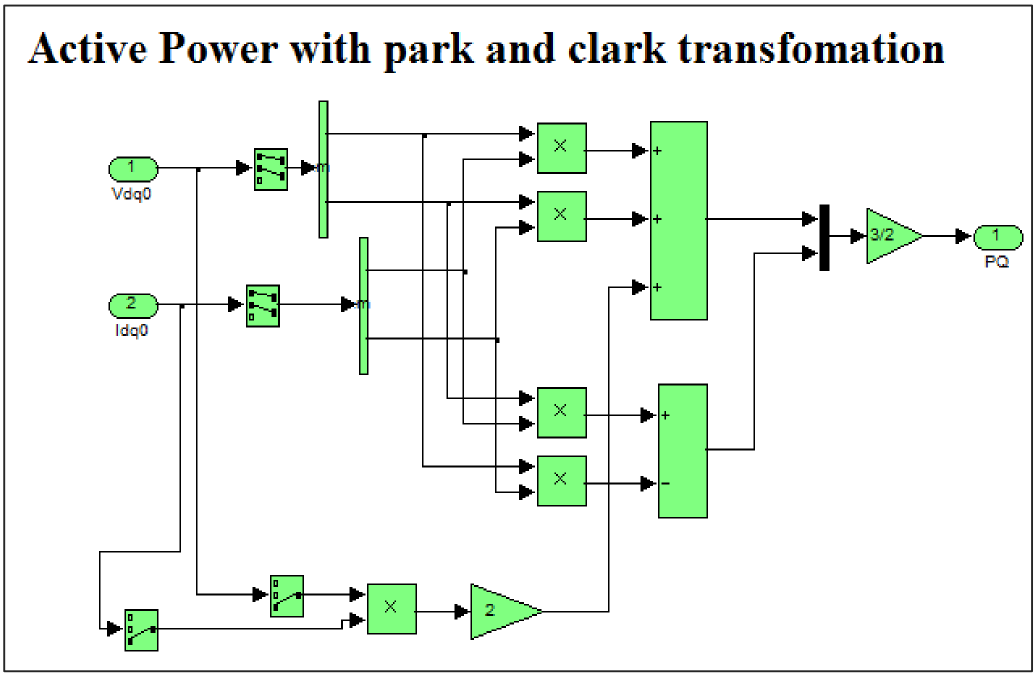


**Figure 4:** Simulink of APF

Figure 5 and 6 show the behaviour of current and voltage at the output of inverter under low load condition.

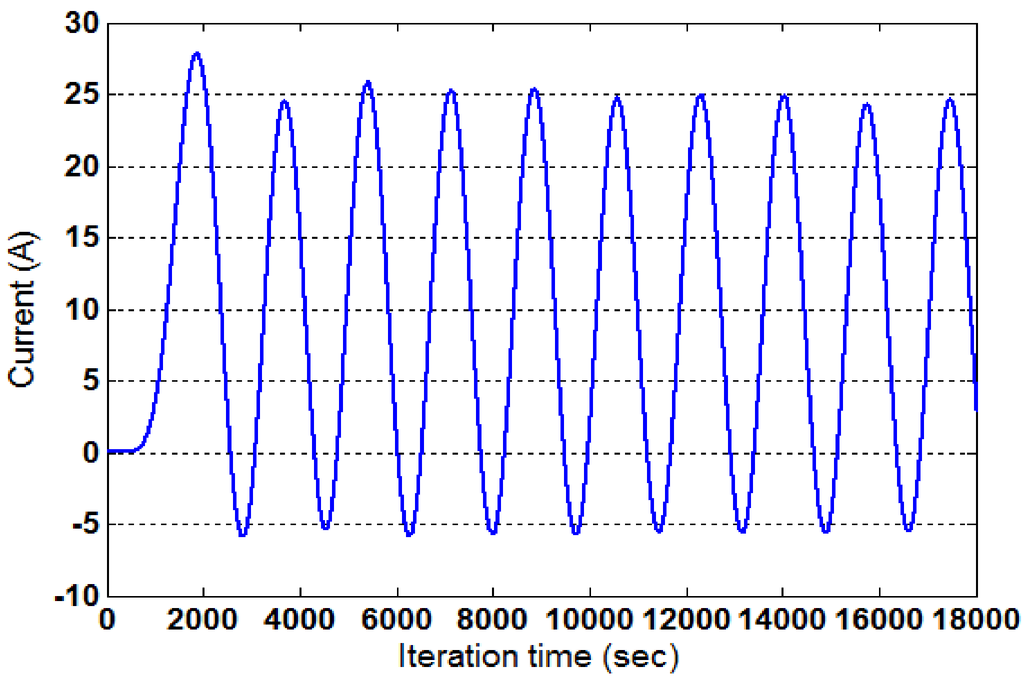


**Figure 5:** Current under low load

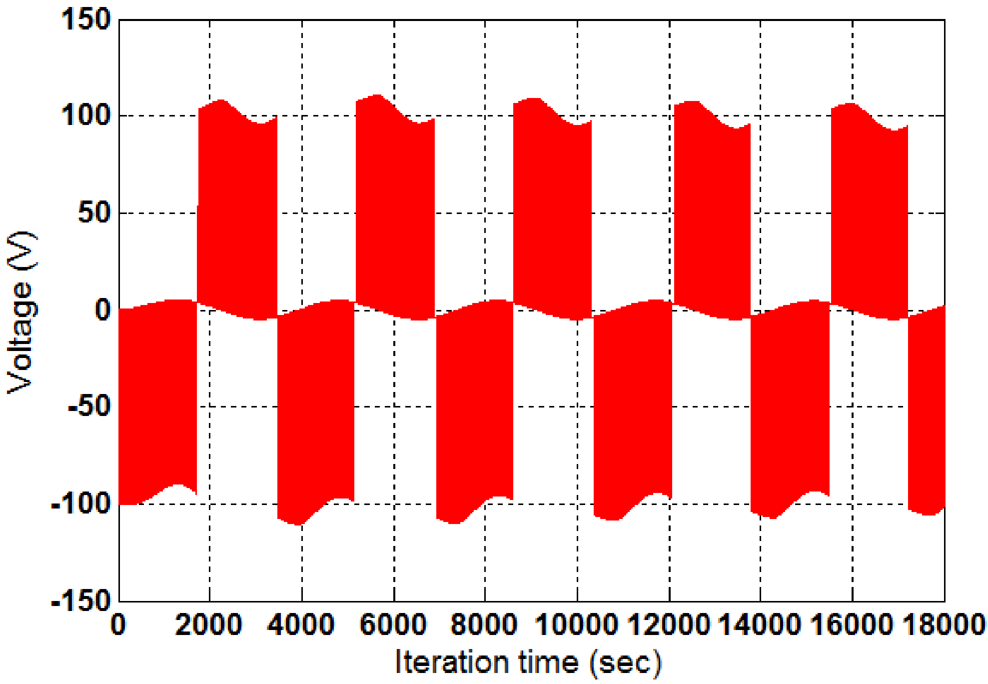


**Figure 6:** Output voltage from inverter

The oscillation error of current is almost zero which is equal to $0.5 \times 10^{-4}$ as appear in figure 7.

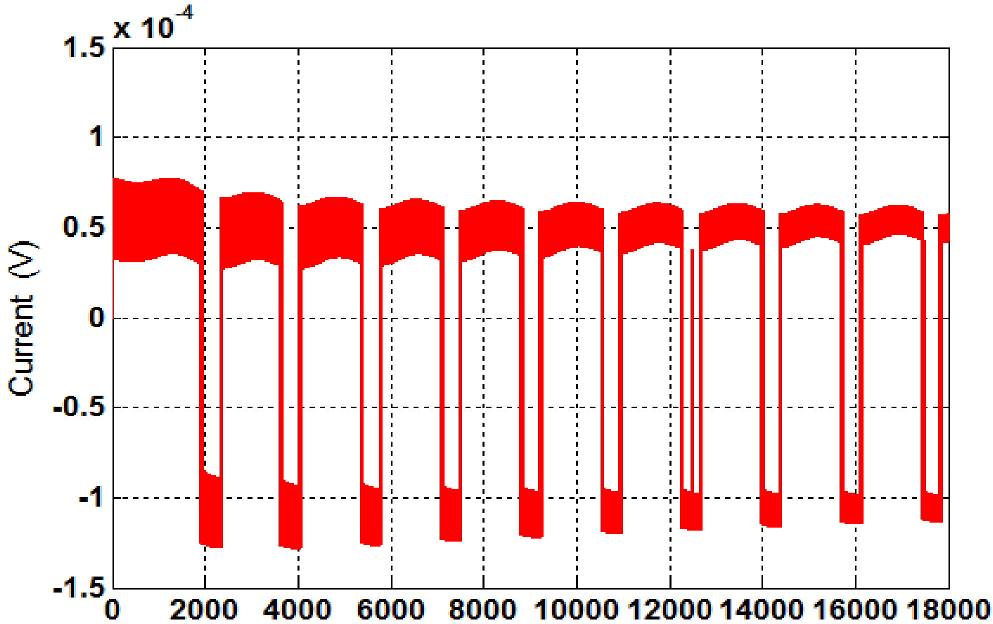


**Figure 7:** Error of current

The steady state of proposed system reached stability performance after 6000 of iteration time with range of fluctuating between 54 and 56 as shown in figure 8.

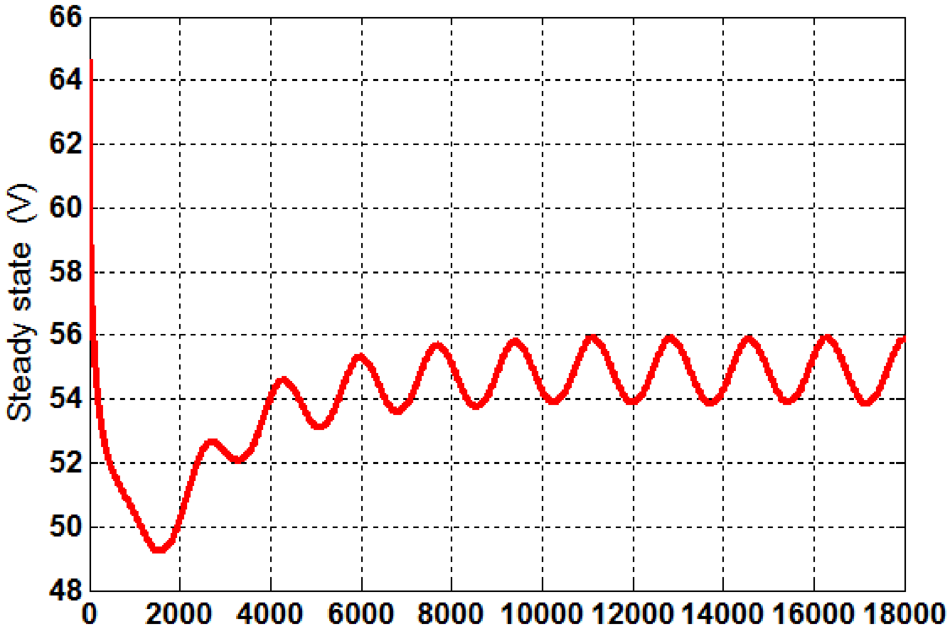


**Figure 8:** Steady state performance

The alfa and beta voltage and current after conversion by using inverse park transformation is shown in figures 9 and 10 that is free of distortion and smooth.

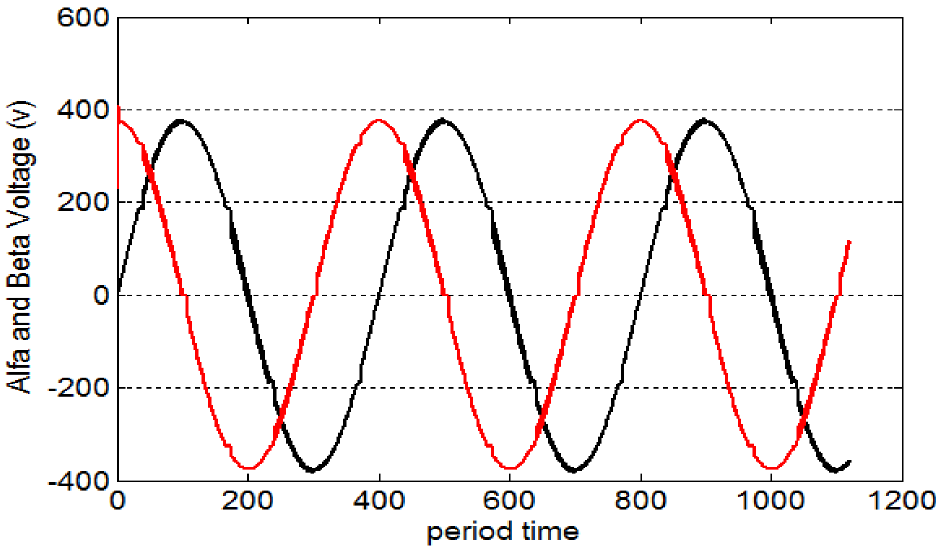


**Figure 9:** Alfa and Beta voltage

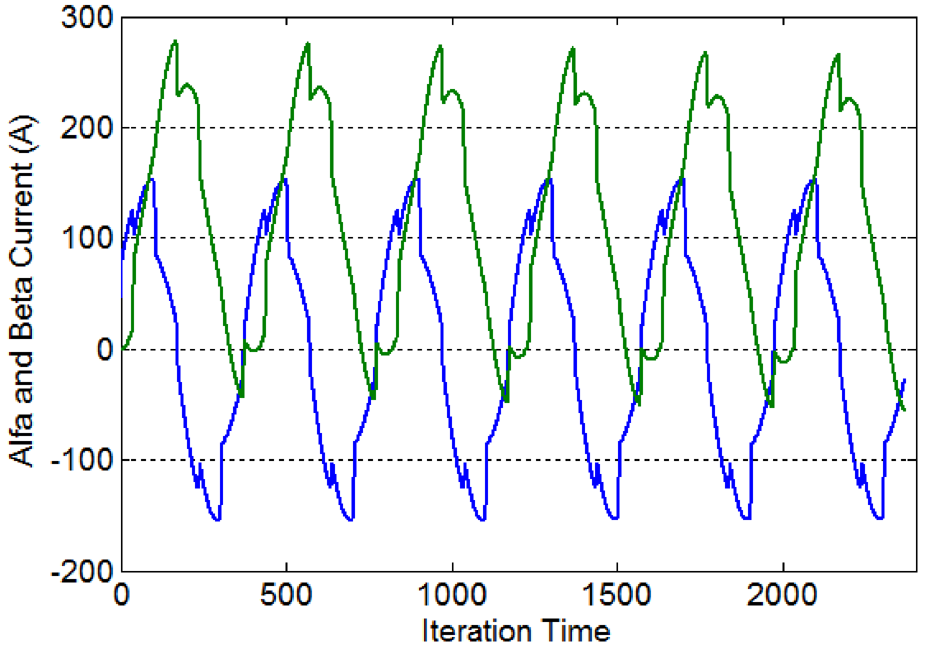


**Figure10:** Alfa and Beta current

The three phase load voltage at the terminal of system is shown in figure 11 which is free of ripple at low load condition.

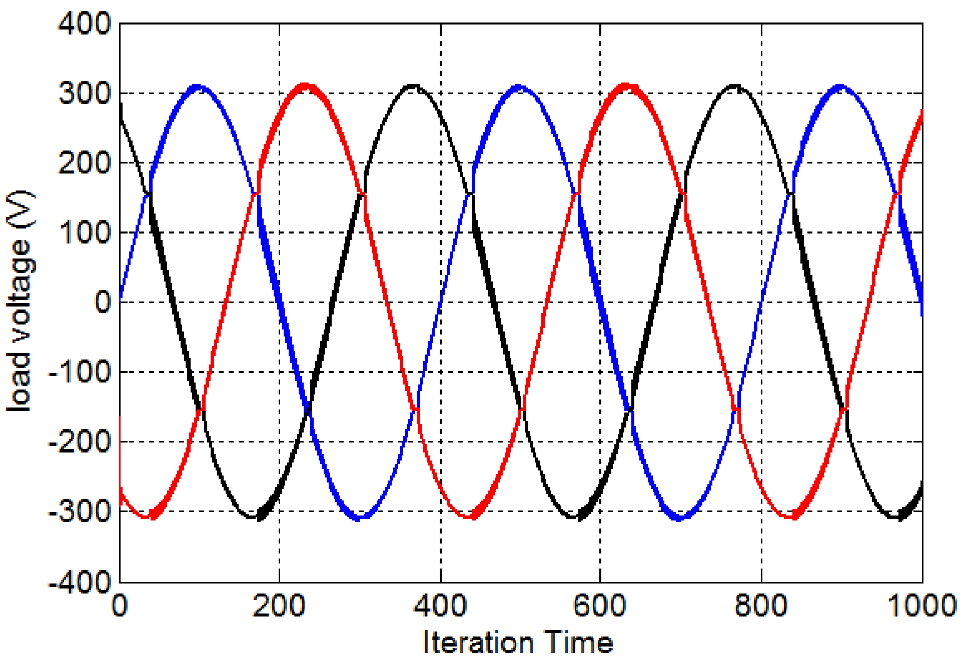


**Figure 11:** Three phase load voltage

The current with APF based on set voltage is symmetrical and almost equal to 200 A from peak to peak as shown in figure 12.

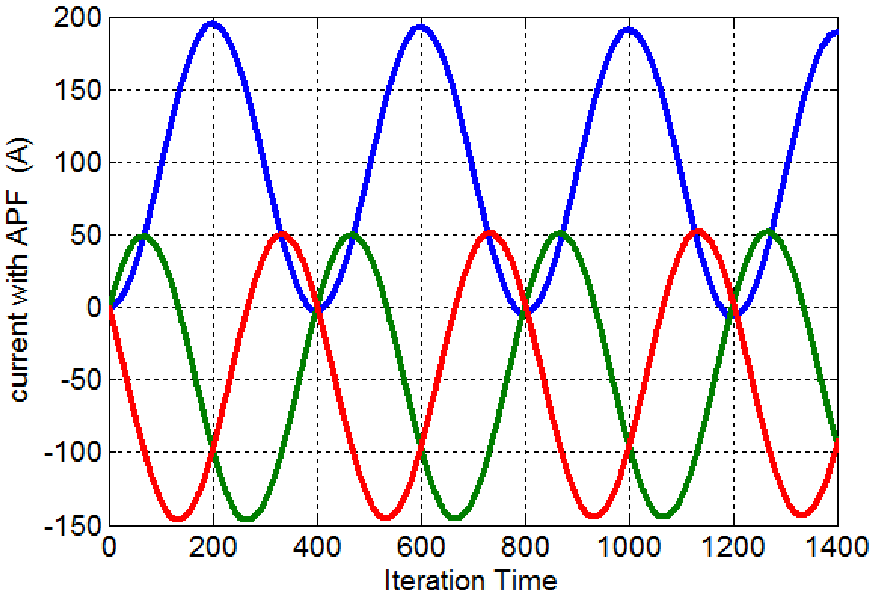


**Figure 12:** Current based on set system

The three phase load current of passive power filter in the traditional system without APF is shown in figure 13 which is had high distortion and fluctuating.

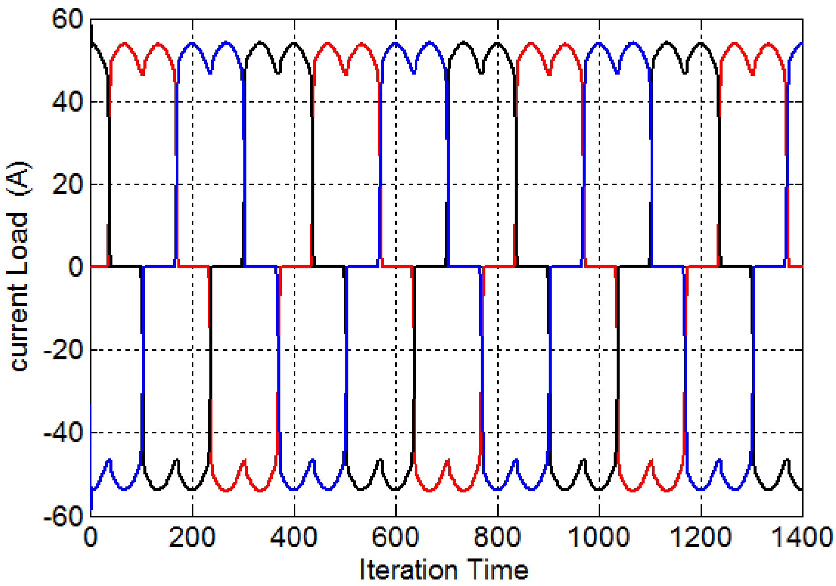


**Figure 13:** Current based on traditional system

The active power (P with green colour) and reactive power (Q with red colour) is provided by the d-q voltage and current as shown in figure 14.

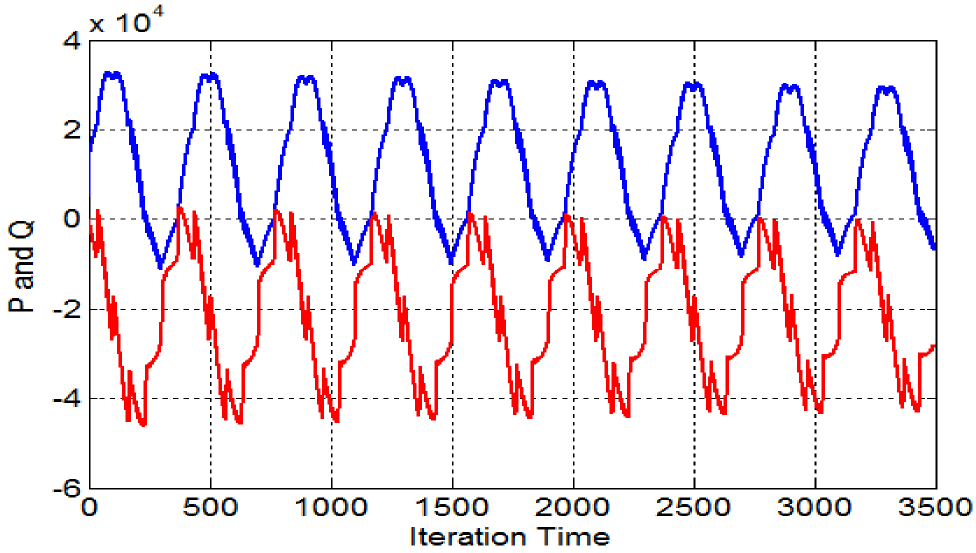


**Figure 14:** The Active and reactive power

## CONCLUSION:

In this the suggested method, an APF is used for decreasing the harmonic of current and increasing active power under variable load. In order to convert the nonlinear system to linearity, the park and Clarke transformation are applied in this system to remove the complexity of system and to increase the response of APF. This method is analysed under low conditions and it can be concluded that this electrical power system with suggested APF is proper for both stable and unstable system. the results show that the system with APF is better than the system with passive power filter for enhancing the efficiency of system based on minimizing the current harmonics.

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