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Harmonic Analysis in Non-linear Load by using Hybrid UPQC

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Abstract

In this paper MATLAB simulation of shunt active filter and passive filter is consist. A paper consists of both active and passive filter topology in harmonic reduction in non-liner load which is UPS. Combination of Active and Passive Gives Hybrid Concept. Harmonics reduction technique is useful to improve power quality of the system.
Keywords: Harmonics, Hybrid UPQC, Passive filter, UPS

I. INTRODUCTION

Considering the duality of its circuits, a series active filter should be a power electronics device that, in principle, would block harmonic voltages in the load from those appearing in the source. In fact, this would be a dual device of a shunt active filter. In the case of the shunt active filter, the source is represented by a voltage source and the load by a current source, including harmonic currents that have to be compensated by the shunt active filter. Therefore, the shunt active filter has to generate harmonic currents to cancel load harmonic currents. On the other hand, the series active filter should generate harmonic voltages to cancel the load harmonic voltages. However, since duality is being considered, in the case of the series active filter, the source should be a current source. This is not the case normally. In some cases, a combination of the source and its impedance can be considered as a current source. As a result, the series active filter operating as a dual circuit of the shunt active filter is rather a theoretical solution.

II. BLOCK DIAGRAM OF UPQC

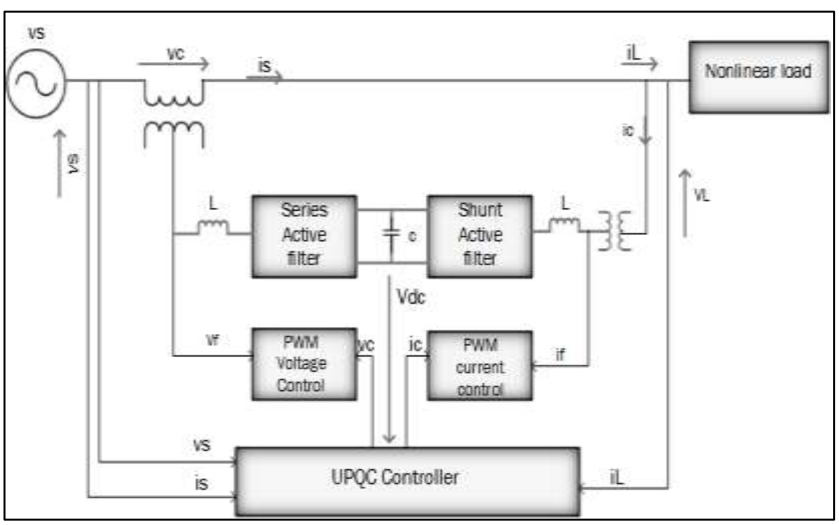

Fig. 1: Block Diagram of UPQC

Unified power quality conditioners (UPQCs) consist of combination of both the series and shunt active power filters for simultaneous compensation of current and voltage, which is applicable to being connected close to loads that generate harmonic currents, power distribution systems. The production of harmonics in load might affect some other harmonic sensitive loads which are directly connected at the same ac bus terminal. The UPQC which is one of the most flexible devices
in the new concept of "custom power" for harmonic compensation. It can be compensating not only imbalances and harmonic currents of a nonlinear load, but it can be useful also imbalance and harmonic voltages of the power supply. So, this is how, it improves the power quality delivered for some other harmonic sensitive loads. Thus, the UPQC done both principles of series voltage compensation and shunt current compensation into a single device.

III. SINGLE TUNED PASSIVE FILTER

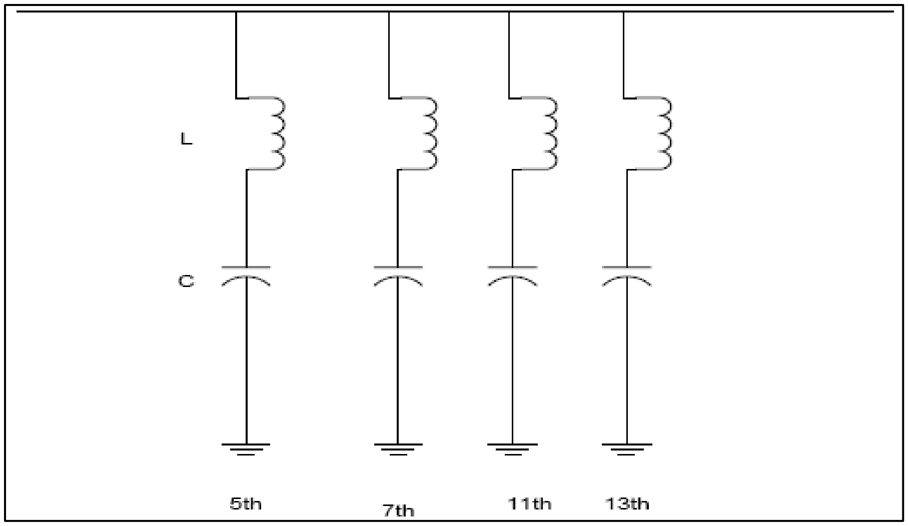

Fig. 2: Single Tuned Filter

In industry this type of filters are most commonly used. It presents very low impedance through which all current of that particular frequency will be diverted at tuning frequency. Thus is widely used in any industrial applications. Design procedure of passive filter requires accurate knowledge of harmonic developing in load. Because of the passive filter always provide reactive compensation to degree dictated by volt-ampere size and voltage of the capacitor bank used. They can in fact be designed for double purpose of providing filtering action and compensating power factor to the desired level if more than one filter is used for example sets of 5th, 7th, 11th and 13th branches

IV. CONTROL STRATEGY FOR SHUNT ACTIVE FILTER

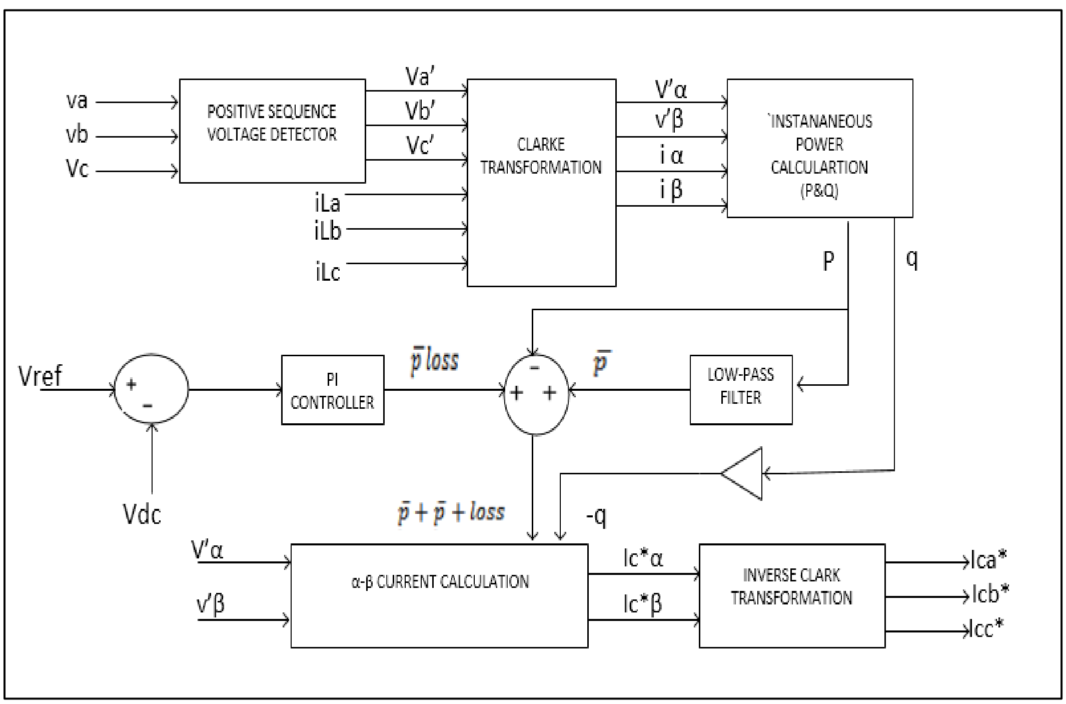

Fig. 3: Control Strategy for S.A.F

The phase voltages va, vb, and vc at the load terminal consists mainly of the positive-sequence component (V+1), but can be unbalanced (containing negative and zero-sequence components at fundamental frequency), and can also contain harmonics from any sequence component. The detection of the fundamental positive-sequence component of va, vb, and vc is necessary in the sinusoidal current control strategy shown in Fig. 4. This control strategy makes the shunt active filter to compensate load currents, so that only the active portion of the fundamental positive-sequence component, which produces average real power p only is supplied by the source.

V. MATLAB SIMULINK DIAGRAM

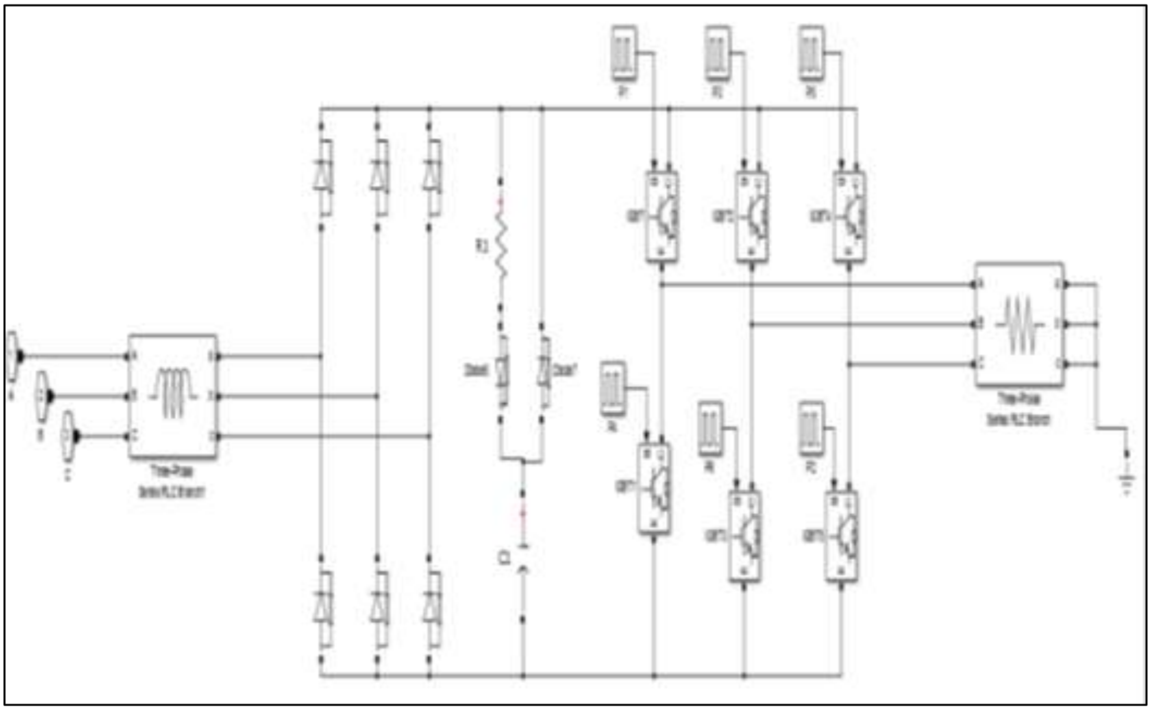

Fig. 4: Simulation of Non-Linear Load (UPS)

A. *System Parameter:*

SR NO.	SYSTEM	SUBSYSTEM	PARAMETER	VALUE
1	NONLINEAR LOAD (UPS)	3-ϕ INDUCTOR BRANCH	INDUCTANCE	5 mH
		RESISTOR	RESISTANCE	1 OHM
		CAPACITOR	CAPACITANCE	1 μf
		3-ϕ RESISTOR BRANCH	RESISTANCE	50 OHM

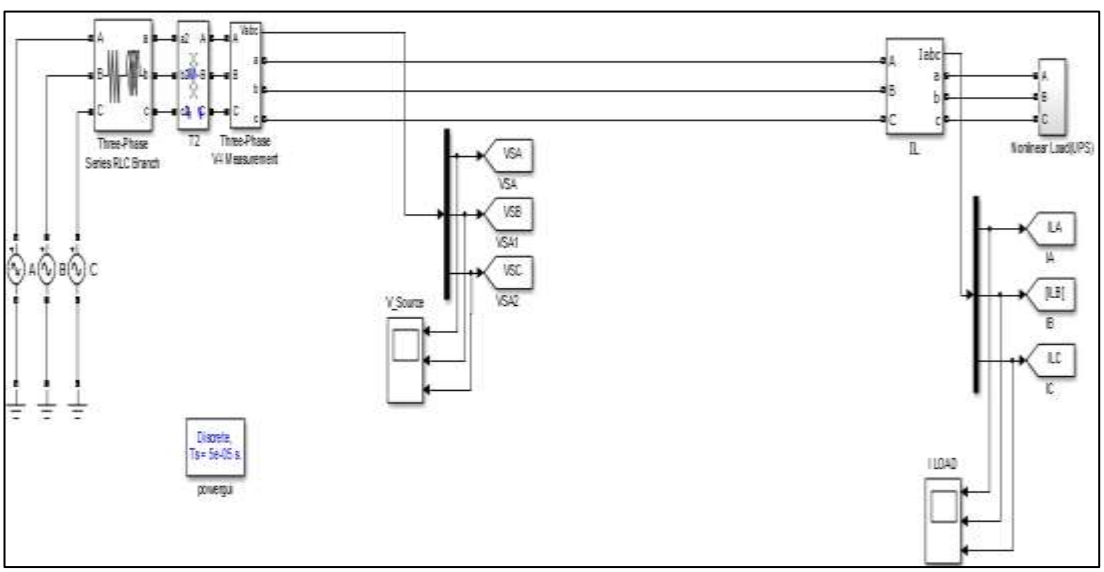

Fig. 5: Power System Network without UPQC

B. System Parameter:

SR NO.	SYSTEM	SUBSYSTEM	PARAMETER	VALUE
1	SOURCE	SOURCE IMPEDANCE	RESISTANCE	1 OHM
			INDUCTANCE	12 mH
		SOURCE VOLTAGE	VOLTAGE	230 V (PEAK)
2	3-ϕ SERIES TRANSFORMER (Y-Y)		RATING	100 KVA, 50 HZ
			PRIMARY	400 V
			SECONDARY	400 V

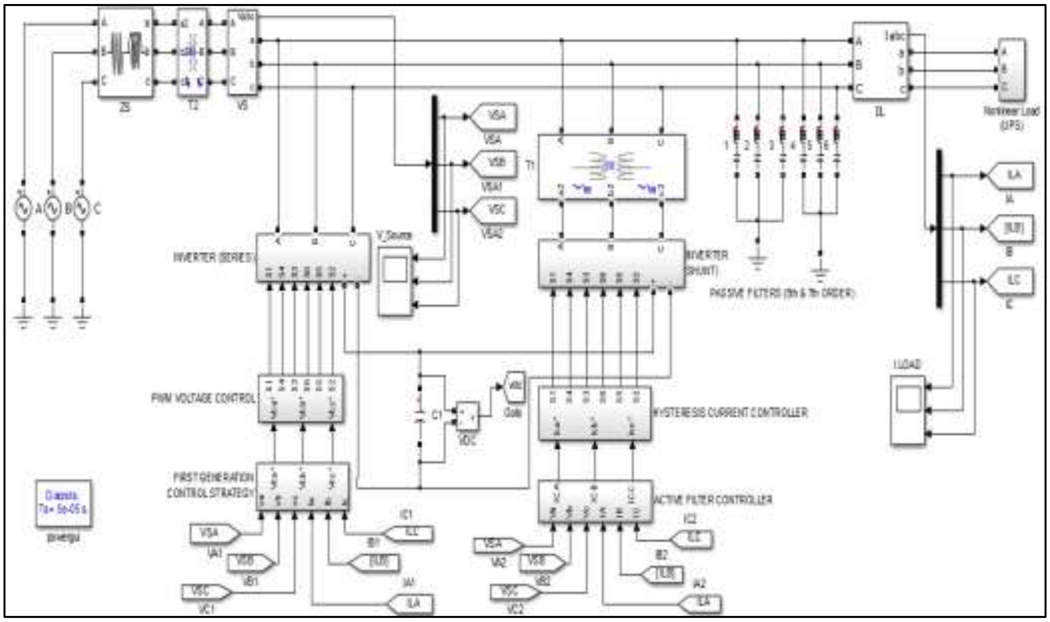

Fig. 6: Power System Network with Hybrid UPQC

VI. SIMULATION RESULTS & THD ANALYSIS

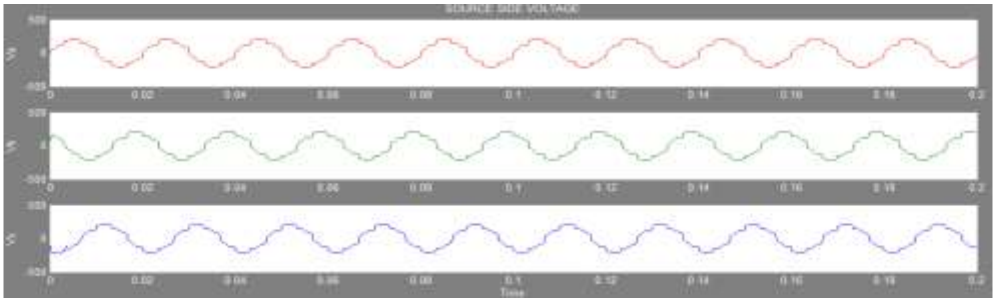

Fig. 7: Result of Source Voltage (without Hybrid UPQC)

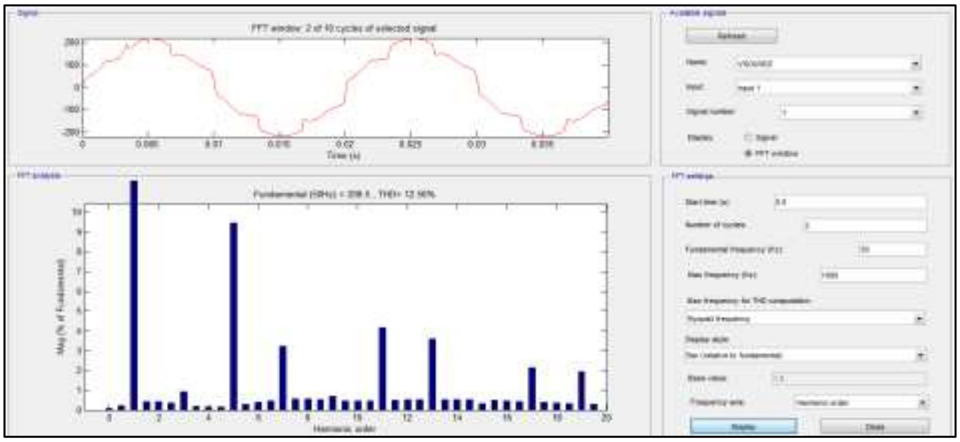

Fig. 8: THD of Source Voltage (without Hybrid UPQC)

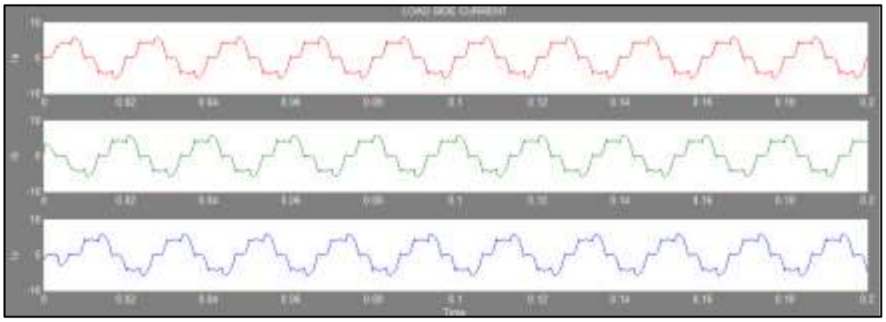

Fig. 9: Result of Load Current (without Hybrid UPQC)

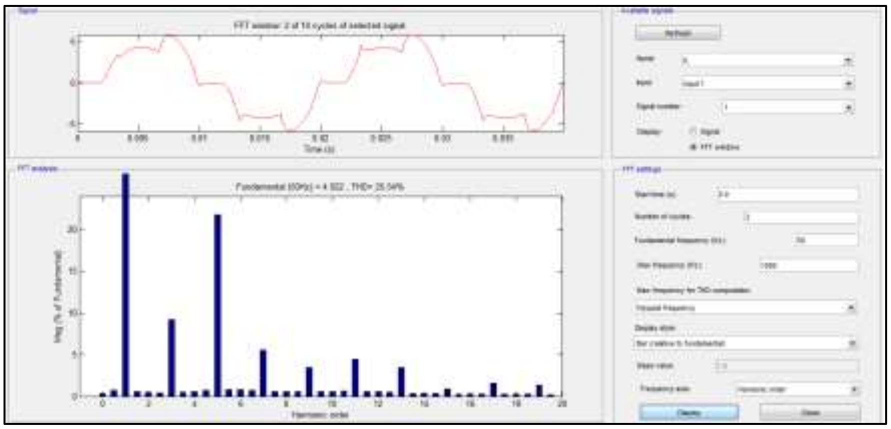

Fig. 10: THD of Load Current (without Hybrid UPQC)

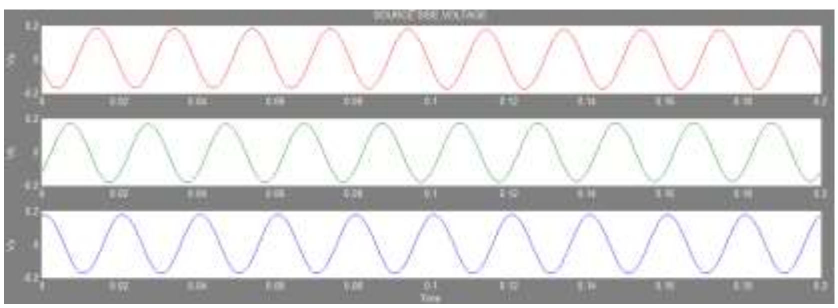

Fig. 11: Result of Source Voltage (with Hybrid UPQC)

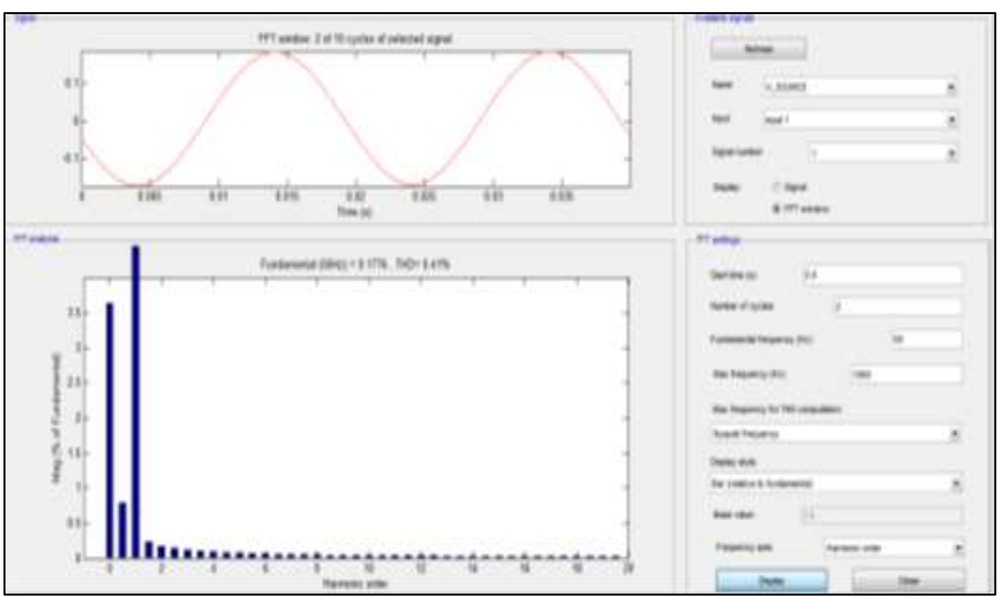

Fig. 12: THD of Source Voltage (with Hybrid UPQC)

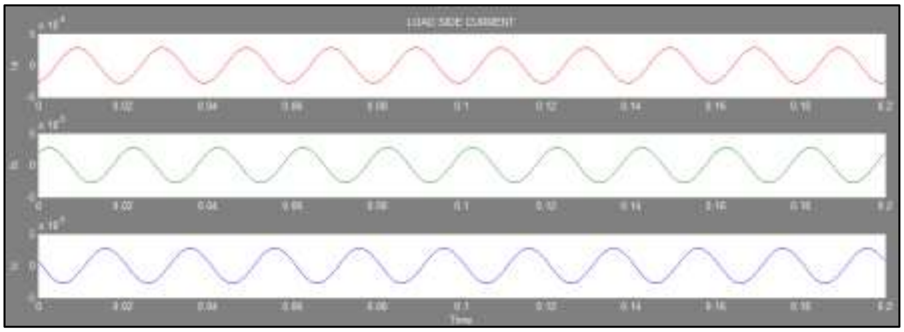

Fig. 13: Result of Load Current (with Hybrid UPQC)

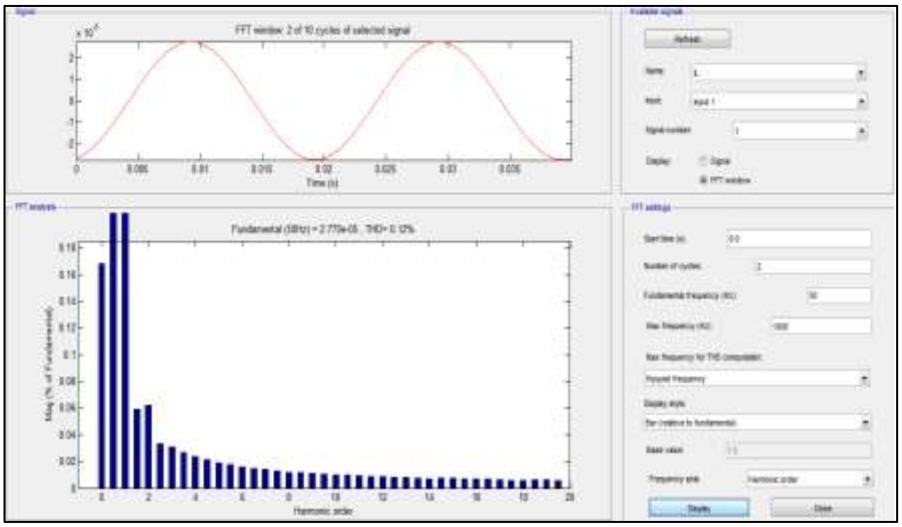

Fig. 14: THD of Load Current (with Hybrid UPQC)

A. *Comparison of Results*

SR. NO.	QUANTITY	%THD WITHOUT HYBRID UPQC	%THD WITH HYBRID UPQC	FIRING ANGLE
1	SOURCE VOLTAGE	12.56	0.12	180°
2	LOAD CURRENT	25.54	0.41	180°

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