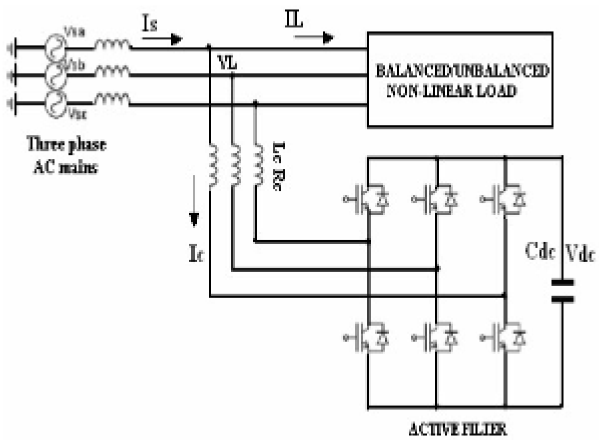


Figure 2.2: Configuration of three-phase shunt active power filter

2.1 Hysteresis Based Current Controller

A Hysterisis current controller is used over reference supply currents and sensed supply currents to generate gating signals to the IGBT's used in the VSI Bridge working as the AF. In response to gating pulses to the AF, eliminates harmonics, correct the power-factor at PCC to nearly unity and balances the unbalanced nonlinear load while maintaining a self-supporting dc bus of the AF. The actual current is forced to track the sine reference within the hysteresis band by back and forth (or bang-bang) switching of the upper and lower switches. The inverter then essentially becomes a current source with peak-to-peak current ripple, which is controlled within the hysteresis band, which makes the source current to be sinusoidal.

2.2 Ramp-comparator Current Controller

In this method the actual values of the three -phase load currents are measured and compared to the reference currents. The generated error signals are compared to a triangular waveform of fixed frequency and amplitude. The fallowing fig2.3 shows the block diagram of the Ramp-comparator current controller.

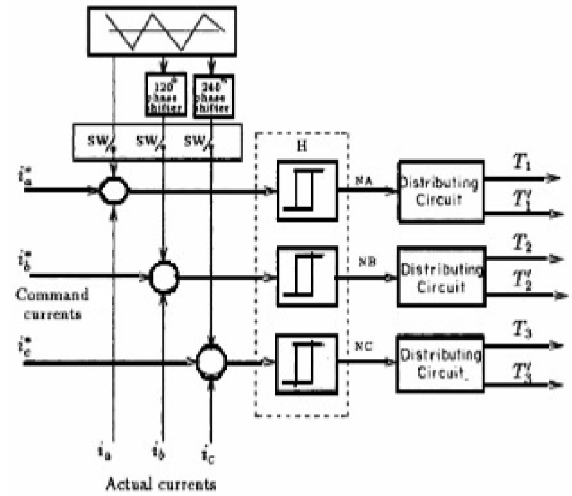


Figure 2.3: The block diagram of Ramp-comparator current Controller

2.3 PI Controller

Comparison of Average value of DC bus voltage (V_{dc}) and reference value of dc bus voltage (V_{dc*}) of the AF results in a voltage error, which is fed to a PI controller as shown in figure.

$$V_{dc\ error} = V_{dc}* - V_{dc}$$

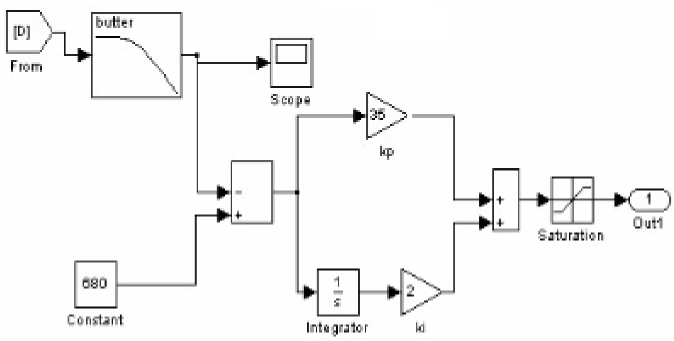


Figure 2.4: PI controller

Here, proportional (K p) and integral gains (K i) are so chosen, such that a suitable DC bus voltage response is achieved. The output of PI controller is taken as amplitude (I sp*) of the reference supply currents.

PI Controller Gain Constants:
Proportional controller gain value =0.35.
Integral Controller gain value = 2.
The Capacitor Reference Voltage = 680 V.

Different current control techniques available for obtaining the reference currents for active filter circuit are discussed in this chapter. Indirect current control technique is used in this work, which is easy to implement, and requires less number of current sensors and transformations.

3. Simulation Model Result

The simulation model for the indirect current control is shown in fig: 2. Three phase supply is used under both balanced and unbalanced conditions. Unbalanced case fifth and seventh harmonics are high. Third harmonic content was zero because of tree phase.

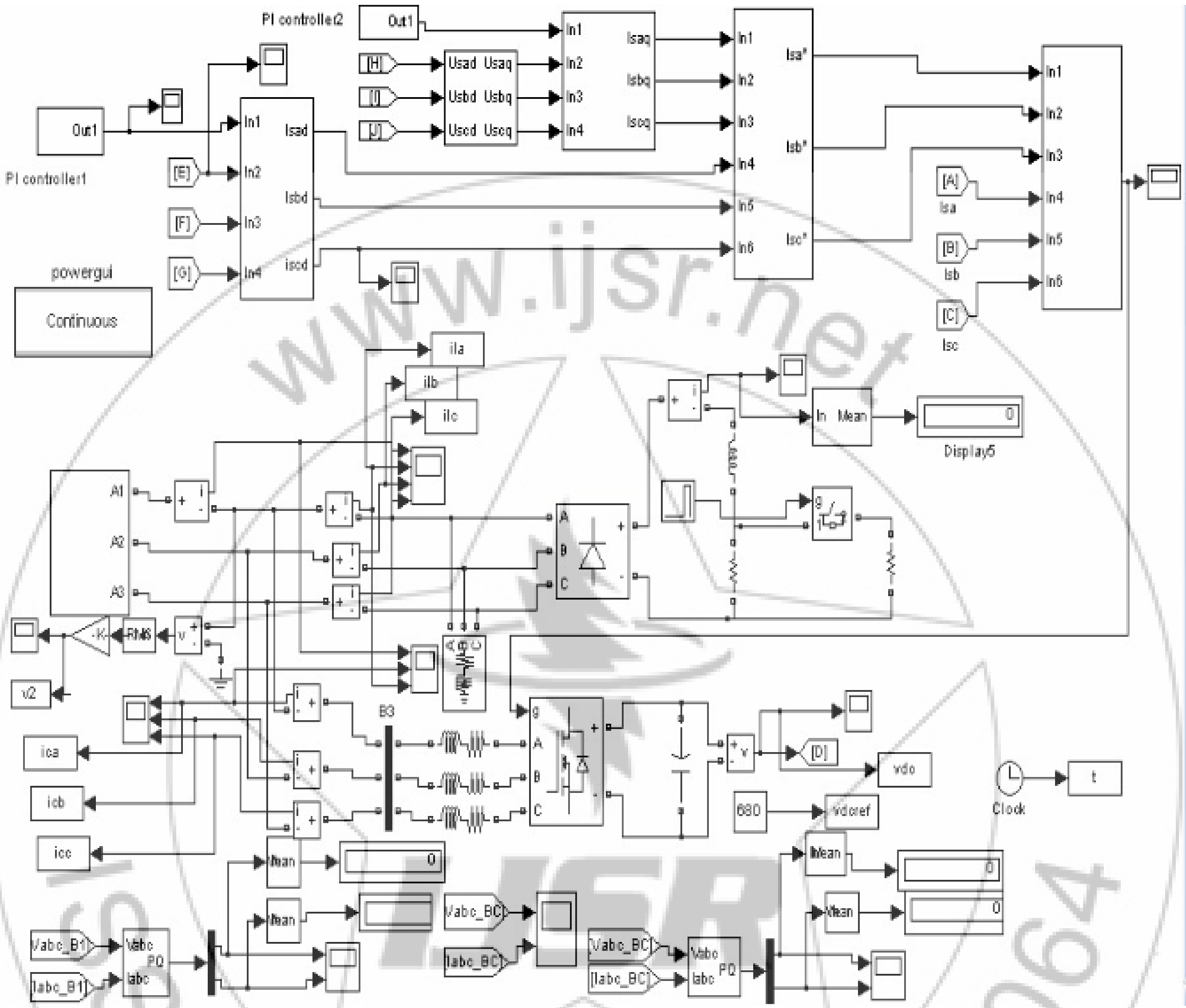
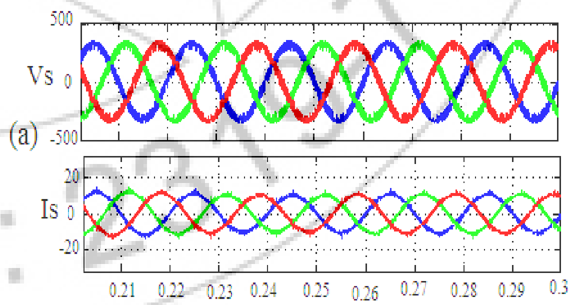


Figure 2.5: The Simulink Model for Voltage regulation

The simulation results of the shunt active power filter is carried in MATLAB/Sim Power Systems environment. The simulation results are shown below. As can be seen from the figure, the non-linear load is a three-phase bridge rectifier feeding an adjustable speed drive. The simulation is done for various source and load conditions for providing harmonic compensation, load balancing and reactive power compensation. It can be clearly seen that by using Synchronous detection technique THD value is less compared to indirect current control technique.



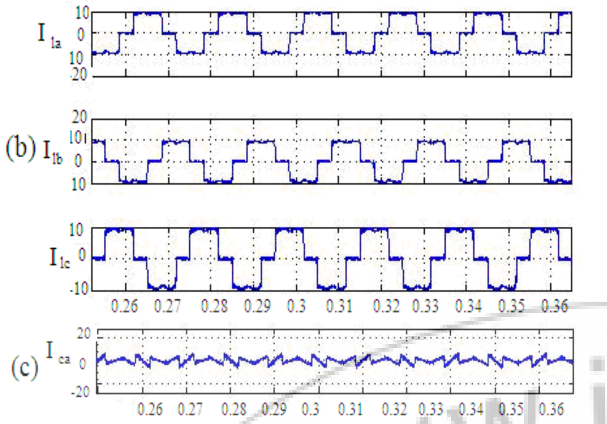


Figure 3.1: Indirect current control wave forms under balanced three phase (a) Supply voltage& current (b) load current (c) filter current

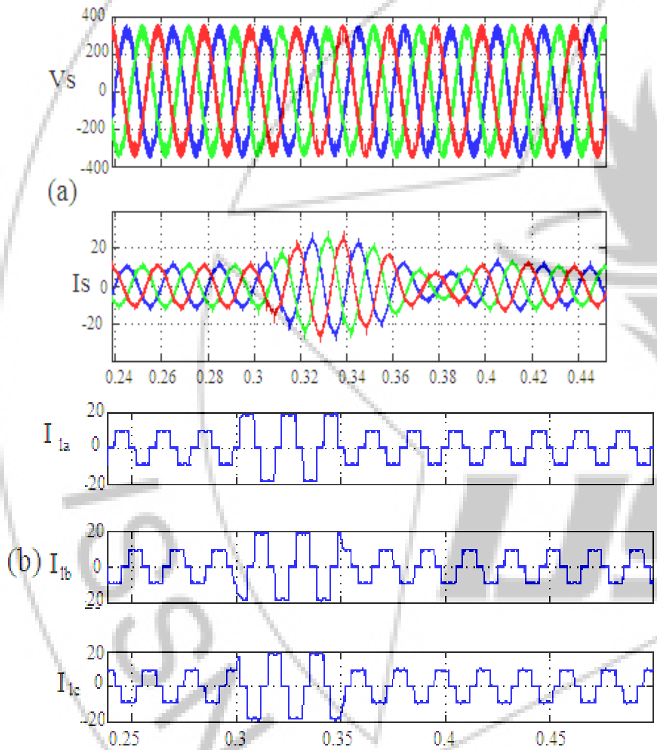


Figure 3.2: Indirect current control wave forms under dynamic Load condition load is changing from 5KW to 10KW to 5KW. Three phase (a) supply voltage& current (b) Load current

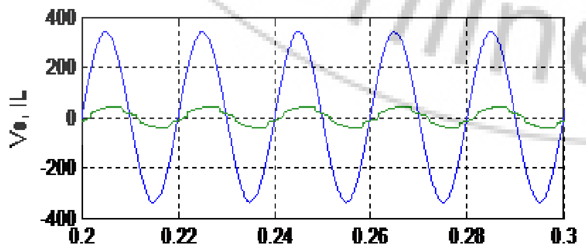


Figure 3.3: power factor is unity for supply voltage and current

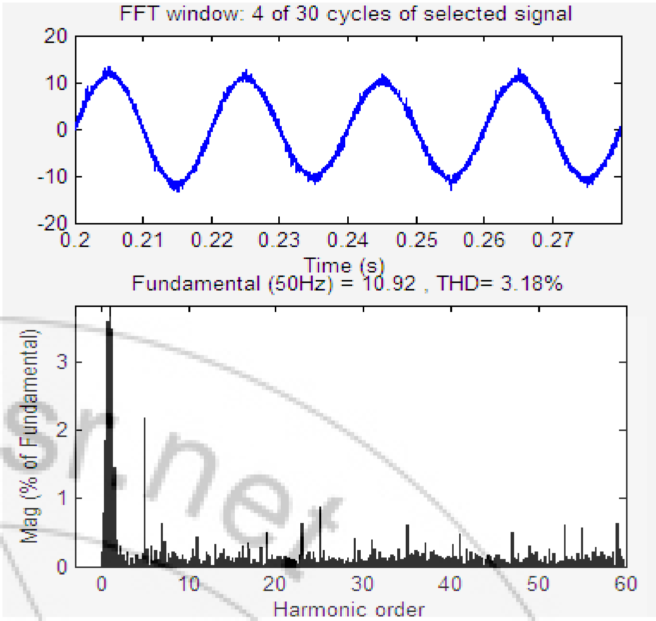


Figure 3.3: Indirect control FFT analysis for supply current

Table 1: shows that by using indirect current control the THD value

Control techniques	THD%
Indirect current control	3.18

4. Conclusion

In this paper, indirect current control method using equal current division technique have been applied to a shunt active power filter to compensate for reactive and harmonic currents under balanced and unbalanced source voltage conditions. The simulation has been carried out in MATLAB environment and power factor is unity for supply voltage, current.

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