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Power Quality Improvement using Shunt Active Power Filter with PI and PID Controller

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ABSTRACT
Problems caused by power quality have great adverse economical impact on the utilities and customers. Current harmonics are one of the most common power quality problems and are usually resolved by the use of shunt passive or active filters. In this paper we have compared the THD values of Shunt active power filter with PI and PID controller application for a given model. The design concept of the adaptive shunt active filter is verified through simulation studies and the results obtained are discussed. THD is most suitable to control the shunt active power filter in term of total harmonic reduction (THD). MATLAB/SIMULINK power system toolbox is used to simulate the proposed system.

KEYWORDS: Power Quality, PI, PID, Shunt Active Power Filter (SAPF), Hysteresis Current Controller, Harmonics, MATLAB/ Simulink

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I. INTRODUCTION

Nonlinear loads appear to be current sources injecting harmonic currents into the supply network through the utility's Point of Common Coupling (PCC). This results in distorted voltage drop across the source impedance, which causes voltage distortion at the PCC. Other customers at the same PCC will receive distorted supply voltage, which may cause overheating of power factor correction capacitors, motors, transformers and cables, and mal-operation of some protection devices. Therefore, it is important to install compensating devices to eliminate the harmonic currents produced by the nonlinear loads. In fact, many publications have already proposed innovative techniques to alleviate the current harmonics produced by these nonlinear loads and major researches have been carried out on control circuit designs for active filters .

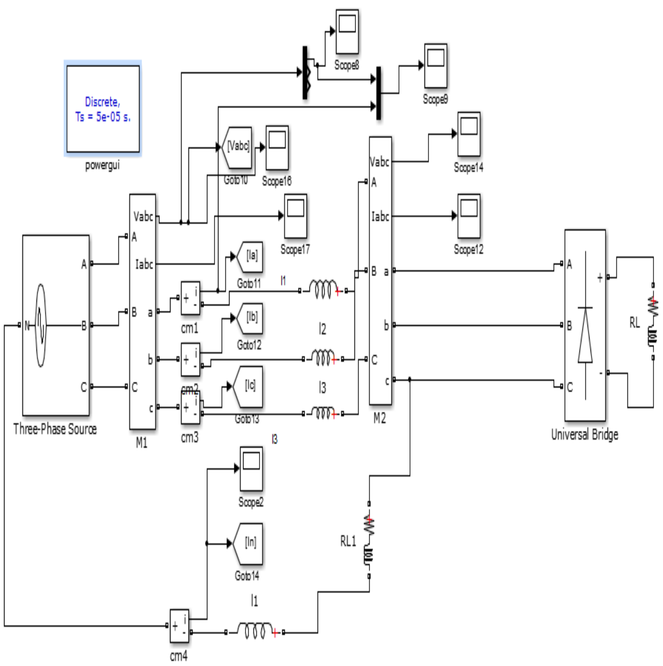


Fig1(a) Basic Simulink Model

II. BASIC MODEL WITH SAPF

We run this model in Simulink and see the results of the measurement devices in graphical form and measure the THD of the three phase currents separately. All the graphs are shown below and THD of each phase is tabulated.

In this paper we have analyzed the three phase four wire distribution system and point out the problems associated due to use of unbalanced non- linear loads. By the use of SAPF we have reduced current harmonics of the system which is shown in table. It also improves power factor and reduces neutral current which make system stable. The simulation results confirm the improvement of the quality of energy, by maintaining the *THD* of the source current after compensation well below*5%*, the harmonics limit imposed by the IEEE-519 standard.

III. PID CONTROLLER MODEL TECHNIQUE

Basic controller simulink model with Shunt Active Power Filter of controller with PID Controller

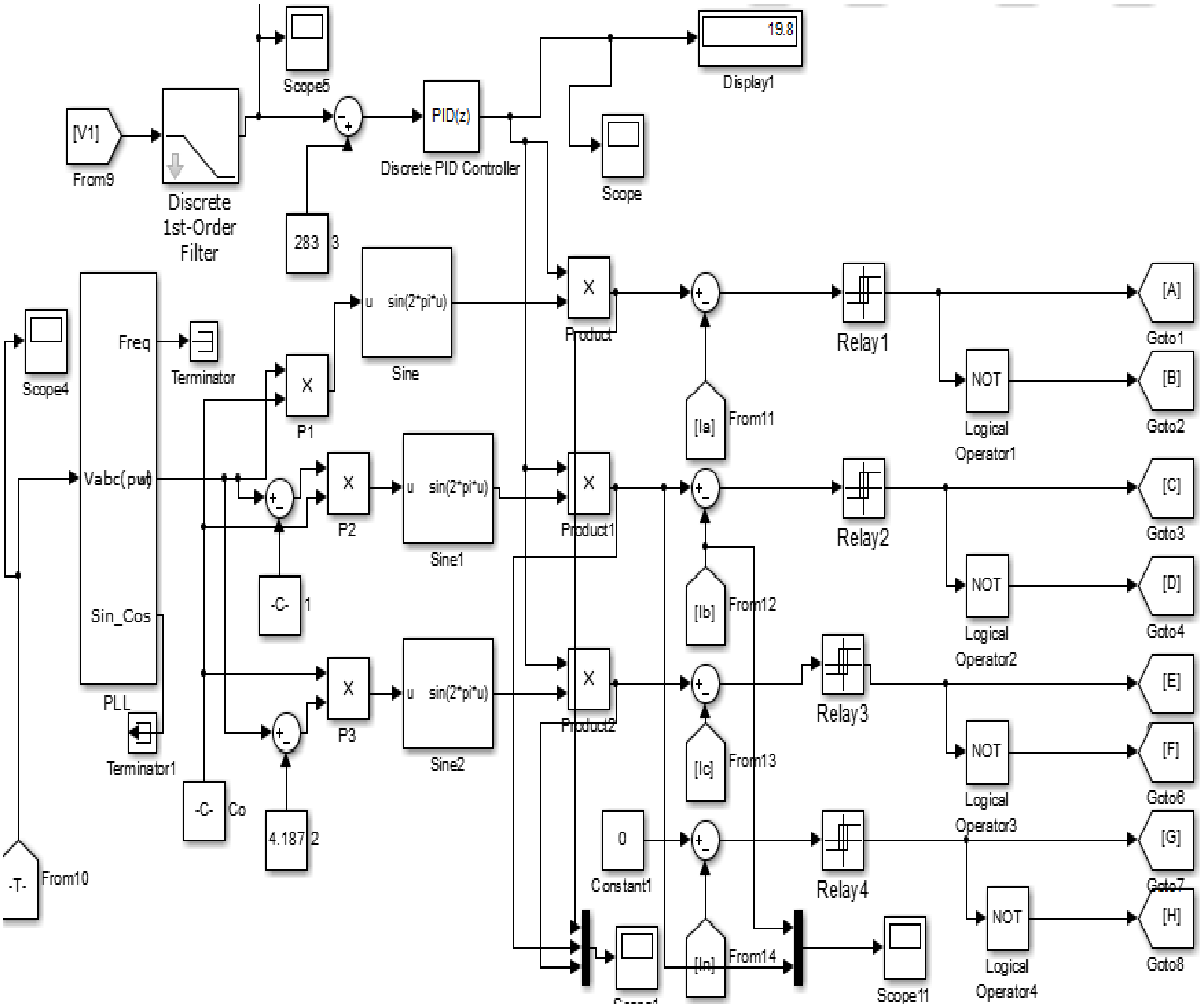


Fig.2 Parameter of Analysed system

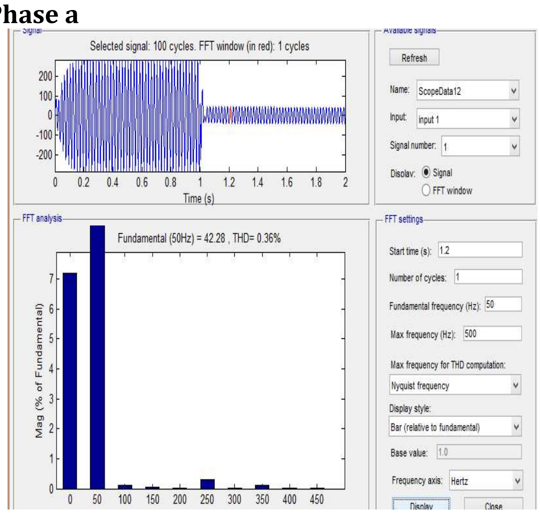
Symbol	Quantity	Value
V_g	Supply voltage	100V(r.m.s.)
F	Grid frequency	50 Hz
L_L	Line Inductance	4.66Mh
K_P	Proportional Gain	1.9
K_I	Integral Gain	7.5
L_{sh}	Coupling Inductance	1.5Mh
C_{dc}	APF DC Capacitor	1100e-6F
V_{dc}	DC link Capacitor Voltage	283V

IV. SIMULATION RESULTS

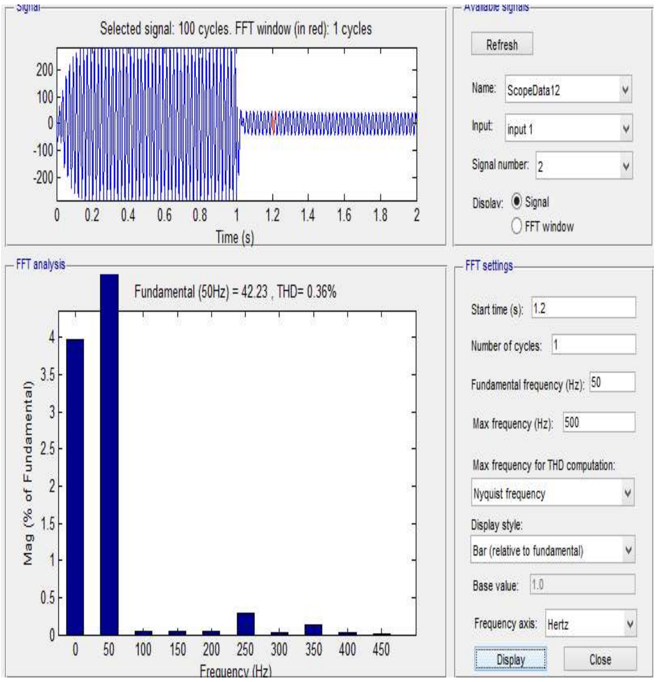
In this paper, the simulation model of proposed shunt active power filter is shown in below figures. The simulation model is done by using MATLAB / SIMULINK. The analyses of current harmonic and power quality improvement for proposed Simulink are given below.

THD current Graphs of all phases with filter using PID Controller

A. Phase a



B. Phase b



C. Phase c

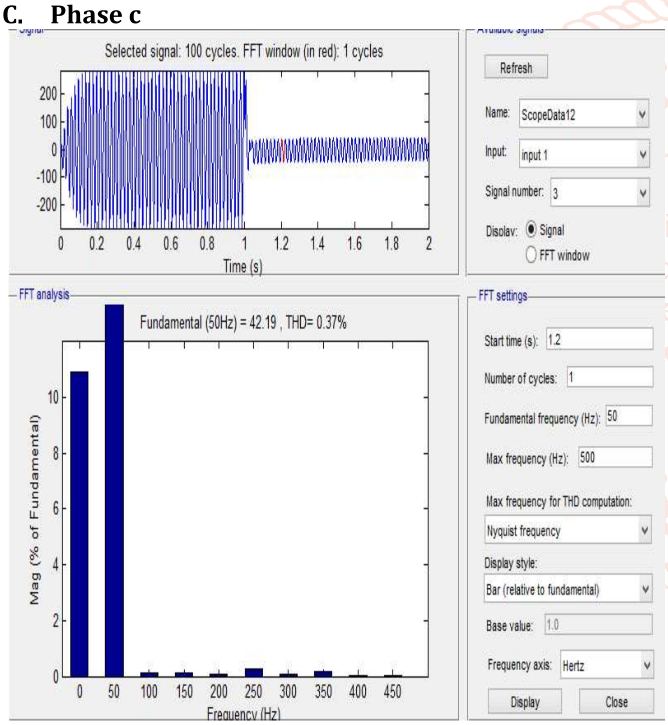


Fig.3 THD Current Comparison with PI and PID Controller

S. No.	THD	THD with SAPF with PI Controller	Reduced THD with SAPF with PID Controller
1.	Phase a	4.49%	0.36%
2.	Phase b	4.67%	0.36%
3.	Phase c	4.33%	0.37%

V. CONCLUSION

The shunt active power filter performance is analyzed by using the controller with PI and PID reference current generator.. This model developed by using the Matlab/Simulink

We get reduced THD with PID Controller as compared to PI Controller when connected with shunt active power filter(SAPF) using the given analyzed basic power system model.

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