A POWER QUALITY CONTROLLER FOR SYNCHRONOUS GENERATOR BASED DIESEL PV HYBRID MICROGRID

[1]P.Madhavi,[2]T.Ravi Kumar,[3]M.Rajesh
[1]PG Scholar,[2]Associate Professor,[3] Assistant Professor, Dept. Of E.E.E
[1,2,3]Geethanjali Institute Of Science And Technology, SPSR Nellore(Dt),A.P.

Abstract— This paper shows a secluded microgrid, with synchronous generator(SG) based diesel generation(DG) framework in combination with solar photo-voltaic(PV). The DG supplies power to the heap straightforwardly, and a battery upheld voltage source converter (VSC) is associated in shunt at point of normal coupling (PCC). The PV exhibit is associated at DC-link of the VSC through a boost converter. A high request streamlining based adaptive channel control plan is utilized for maintaining the quality of PCC voltages and source ebbs and flows. This controller makes the waveform free of mutilation, expels mistakes because of unbalances, corrects the power factor and makes the source current smooth sinusoidal, irrespective of the nature of load.

I.INTRODUCTION:

Renewable energy (RE) is being gazed upon as the ultimate panacea for tackling global warming, changing climate and controlling the continued depletion of fossil fuels. Hence, researchers, government sectors and utilities altogether are trying to integrate RE systems into the power grid and distribution networks. In the current scenario, the solar energy is the best form of RE in terms of its clean nature, noise-less, non-polluting and available in abundance even in remote locations. Some of the major potential challenges to be faced when integrating solar photovoltaic (SPV) system with the grid are voltage instability, reliability, weak grid system and degraded power quality. The SPV system has proved to be a cutting edge technology in the field of power system as it has been very effective in supplying power at remote locations where transmission networks can't reach, as it is easy to install, requires low maintenance and has various other advantages. In a conventional double stage topology, first stage involves maximum power point tracking and the second stage controls the extracted power into the distribution network.

Burning of fossil fuels for producing electricity has been a major cause of global warming. Thus, researchers have been looking for alternative sources for electricity production, which are sustainable and environment friendly. Moreover, countries are working towards making their whole automobile fleet and electricity production sectors free of burning fossil fuels. This has led to rise in renewable based energy systems such as PV, wind, hydro, biomass, ocean thermal energy, tidal energy, etc. Lately, renewable energy based micro grids are becoming increasingly popular to supply power to urban, rural or remote areas. Such systems can be operated with or without grid . These sources are imperishable and cause no harm to the environment, however, their variable and fluctuating nature makes the task of integrating them a real challenge. This gives rise to the need of intelligent controllers which can regulate the voltage, current and frequency of the system in case of presence/absence of grid or linear/nonlinear load or unbalance in the three-phase systems, and hence, make the system more stable, reliable and secure.

II.LITERATURE REVIEW:

Diesel engines can be utilized with permanent magnet synchronous generators, induction generators or synchronous reluctance generators, and so forth.The best eco-friendliness is obtained in diesel generators when they are worked at 80% to 100% of their evaluated limit 8. Diesel generators have been source of power for long. In urban regions, they are utilized as a backup where as in provincial regions; it is one of the essential sources of power. Therefore, the PV based micro grids could be made increasingly steady and dependable by integrating them with diesel generators. Numerous creators have taken a shot at such frameworks and proposed controllers for regulating voltage, current and power stream, 0. Nonetheless, utilization of vitality stockpiling gadgets alongside PV-DG not just aides in reducing rating of DG, it additionally productively deals with the homeless people and maintains the DC-link voltage. Numerous specialists have proposed power quality controllers for smaller scale grids. Least mean square (LMS) is an old method of removing commotion and mutilations from the sign. In light of LMS, calculations, for example, hyperbolic digression capacity based LMS, adjusted variable advance sifted x LMS (FXLMS) based control, and so forth have been exhibited in request to accomplish burden leveling, voltage and recurrence control and power quality improvement. LMF is a higher request channel when contrasted with LMS, and in this manner, it has a higher sign to commotion proportion (SNR) 4. The prevalence of this control over traditional LMS calculations, as far as mean square mistake (MSE) and steadiness has been presented. This paper exhibits an adaptive channel, in a three-phase DG-PV based isolated miniaturized scale grid. It expels the harmonics present in the current because of the nonlinear loads, and makes it smooth sinusoidal, accordingly, reducing the all out symphonies twisting (THD) according to IEEE-519 standard. A lift converter associates PV and DC-link of VSC, and executes the greatest power point tracking (MPPT) for PV exhibit. The battery is straightforwardly associated at the DC-link.

Numerous specialists have proposed power quality controllers for small scale grids. Least mean square (LMS) is an old strategy of removing commotion and bends from the sign. In view of LMS, calculations, for example, hyperbolic digression capacity based LMS [12], changed variable advance separated x LMS (FXLMS) based control [13], and so forth have been exhibited in request to accomplish burden leveling, voltage and recurrence control and power quality upgrade. LMF is a higher request channel when contrasted with LMS, and therefore, it has a higher sign to commotion proportion (SNR) [14]. The prevalence of this control over ordinary LMS calculations, as far as mean square blunder (MSE) and solidness has been introduced in [15] and [16].

III.EXISTING SYSTEM:

Existing strategy proposed the utilization of a least mean fourth (LMF) based calculation for single-arrange three-stage grid coordinated SPV (Solar Photovoltaic) framework. It comprises of SPV cluster, VSC (Voltage Source Converter), three-stage grid and direct/nonlinear burdens. This framework has a SPV exhibit combined with a VSC to give three-stage dynamic power and likewise goes about as a static compensator for the receptive power remuneration. It additionally adjusts to an IEEE-519 standard on harmonics by improving the nature of power in the three-stage distribution network. In this way, this framework serves to give harmonics lightening, load adjusting, power factor correction (PFC) and controlling the terminal voltage at the PCC (Point of Common Coupling). So as to expand the productivity and greatest power to be extricated from the SPV cluster at different natural conditions, a solitary stage framework is utilized alongside P&O (Perturb and Observe) strategy for MPPT (Maximum Power Point Tracking) incorporated with the LMF based control procedure.

Adaptive filter theory has demonstrated its potential in tracking changes in the environment and characteristics of the unknown systems in which this filter is used. With changing environment, the filter parameters are self-adjusted that the behaviour of the system of the filter and environment are kept in order to serve its purpose. The LMF method is one of the algorithms from the family of the adaptive filters. LMF has been first proposed by Wallach and Widrow in 1984 as a modification to the LMS (Least Mean Square) algorithm. The LMF method has significantly lesser noise in the weights than the conventional LMS algorithm when the time constant values for both the methods are set to be equal. The main goal of this algorithm is to provide a reduced steady state of maladjustment for the assumed rate of learning as compared to the LMS technique. It has been observed that the LMS technique cannot attain good steady state performance in environments having low SNR's (Signal to Noise Ratios) as it works like a lower order adaptive filter. To overcome this problem and to improve the steady state performance of the system, a fourth-order power optimization has been applied which can eliminate noise interferences even in low SNR regions 8. Hence, the LMF method acts as a higher order adaptive filter in which the updating equation involves fourth order power optimization. It has been observed that adaptive algorithms like LMF with high order moments of errors perform better MSE (Mean Square Error) than conventional LMS algorithms which has been proved . MSE is a parameter which gives an idea about the performance of error involved with the algorithm

IV.PROPOSED SYSTEM:

A. SYSTEM DESIGN AND MODELING

Fig. 1 depicts the configuration of the system. A two stage PV system is supplying power to the nonlinear load, through a VSC. The battery is connected directly at the DC-link. An SG based DG is connected at PCC to provide support power in case of low or absence of isolation.

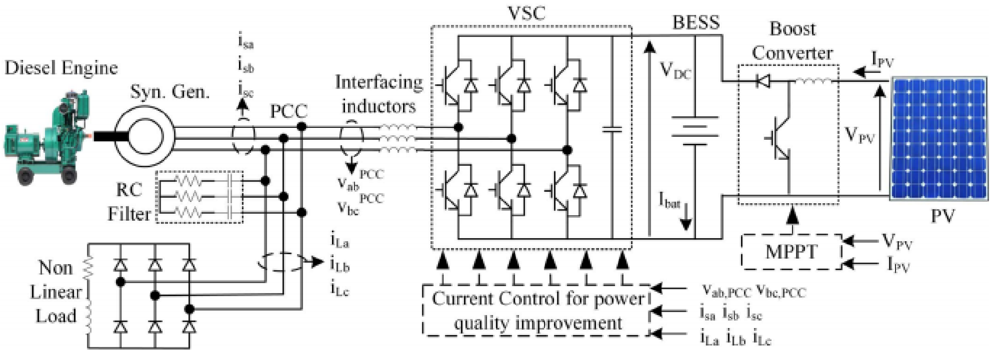


Fig. 1 System model

B. VSC CONTROL

The adaptive control for regulating power quality at PCC through VSC is appeared in Fig. 2. It figures the heaviness of the dynamic and responsive parts of flows and gauges the reference current for each phase, using the in-phase and quadrature unit formats of voltage.

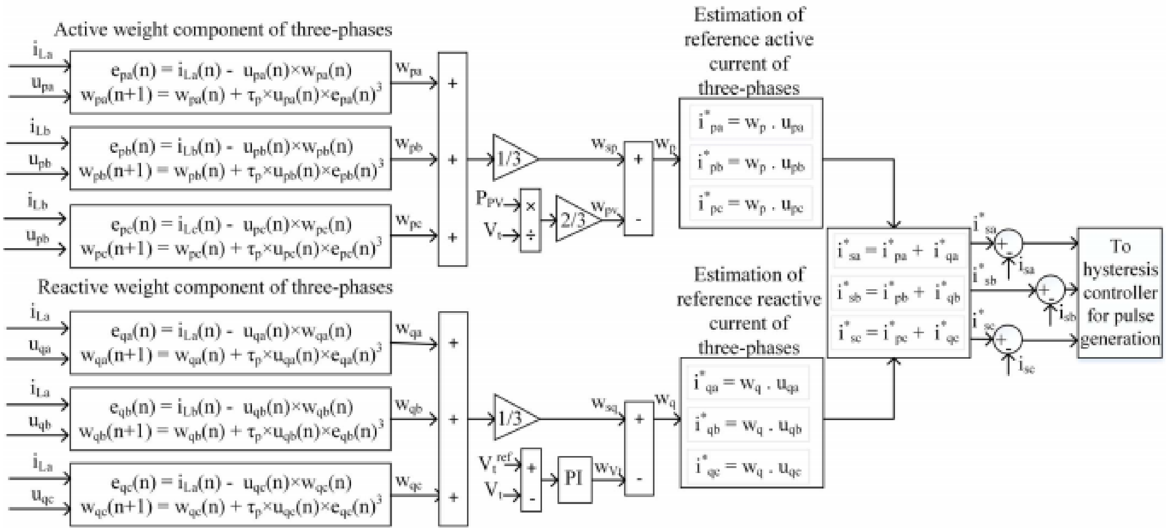


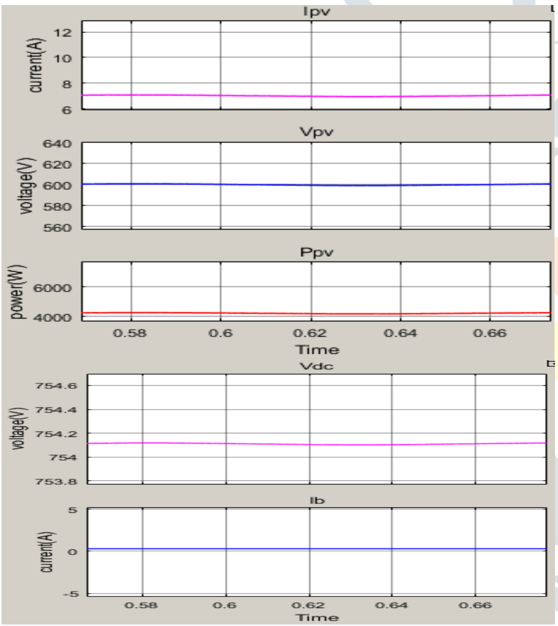
Fig. 2 Adaptive filter for power quality improvement

V. SIMULATION RESULTS

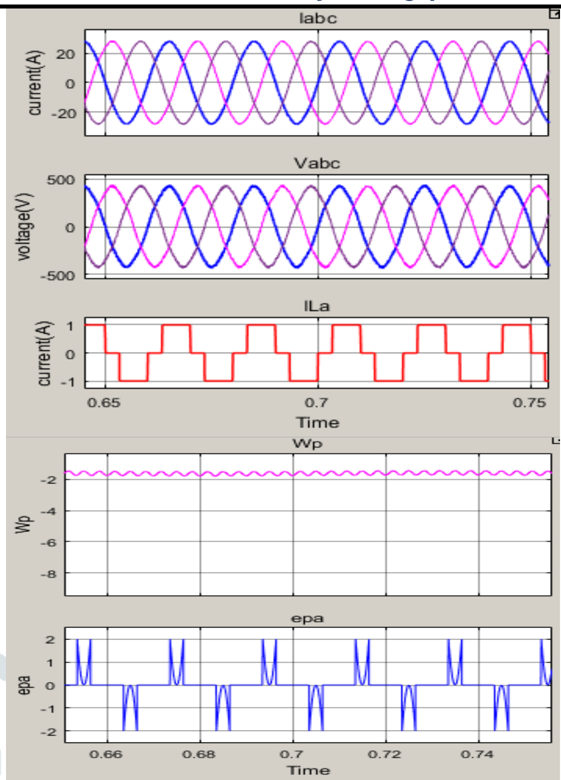
The proposed micro-grid is simulated in MATLAB/Simulink and the responses for change in load, load unbalance and PV variation are observed.

A. Steady State Operation

The steady state response where the load is constant, and is supplied power by both DG and PV, is shown in Fig. 3. The DC side parameters i.e. PV voltage, current and power, DC-link voltage and battery current can be seen in Fig. 3(a). It can be noted that PV is operating in MPPT at solar isolation of 500W/m2. The load and DG side voltage and currents are shown in Fig. 3(b). The internal parameters of the control wp and epa are also shown in the same figure. The THD in currents and voltage are presented in Table I.



(a)



(b)

Fig. 3 Steady State Response of DG-PV micro-grid.

TABLE I

Total Harmonic Distortions

Parameter	Signal	THD
Load Current	i_{La}	34%
DG Current	i_{sa}	7.74%
PCC Voltage	v_{sab}	8.06%

B. Effect of PV variation

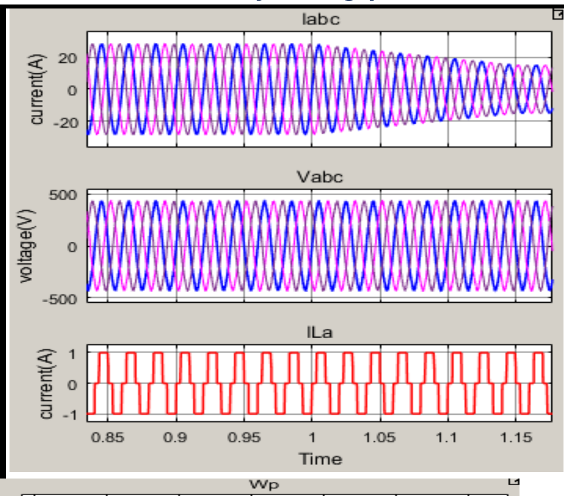
The response of system to PV insolation change is depicted in Figs. 4(a) and (b). At t = 1s, insolation rises from 500W/m2 to 1000W/m2, raising the PV power from 4.2kW to 8.4kW approximately, as seen in Fig. 4(a). Since the load current is constant, this leads to decrease in the net active weight of the DG current, thus, reducing the current drawn from DG. The same is depicted in Fig. 4(b). The DC-link and AC voltages are maintained constant by battery and VSC

C. Effect of Demand Variation

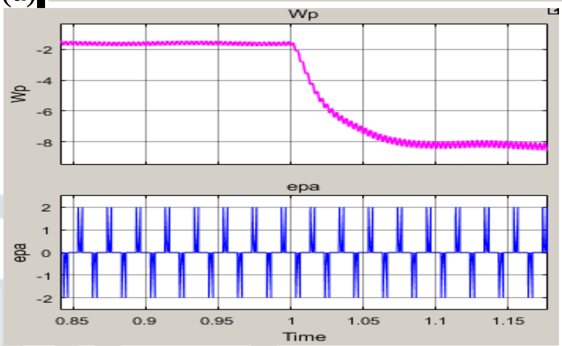
The effect of change in load is demonstrated in Figs. 4(c) and (d). The DC side voltage current and power remain same, as their is no change in the solar insolation. It can be observed from Fig. 4(d), that the reduction in load simply lowers down the current drawn from DG, as the active weight component has been decreased by the VSC controller. The quality of current and voltage are regulated all the time.

D. Effect of Unbalance

A single-phase open circuit fault is created in phase-a. The response of system is shown in Figs. 4(e) and (f). As net load has reduced, the source current of each phase is reduced, but it is still maintained balanced and pure sinusoidal by the controller. The system smoothly recovers and quickly reaches normal steady state, with normal DC and AC voltages.



(a)



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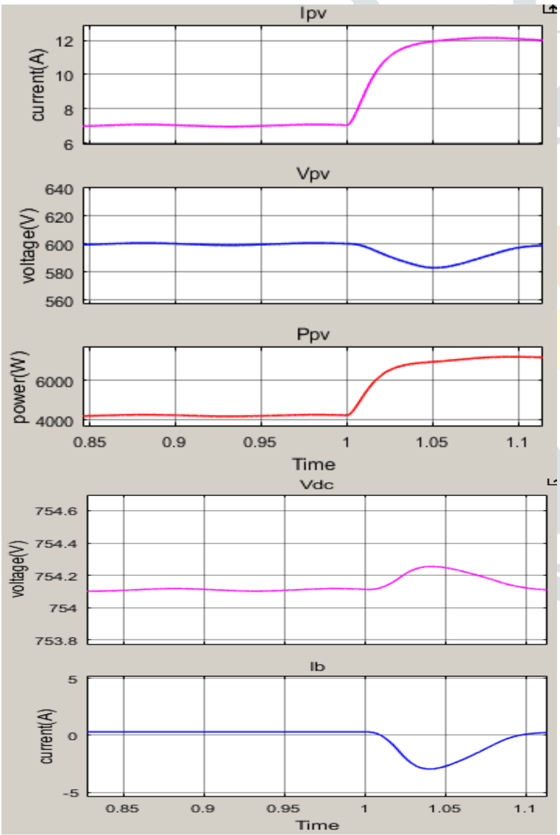
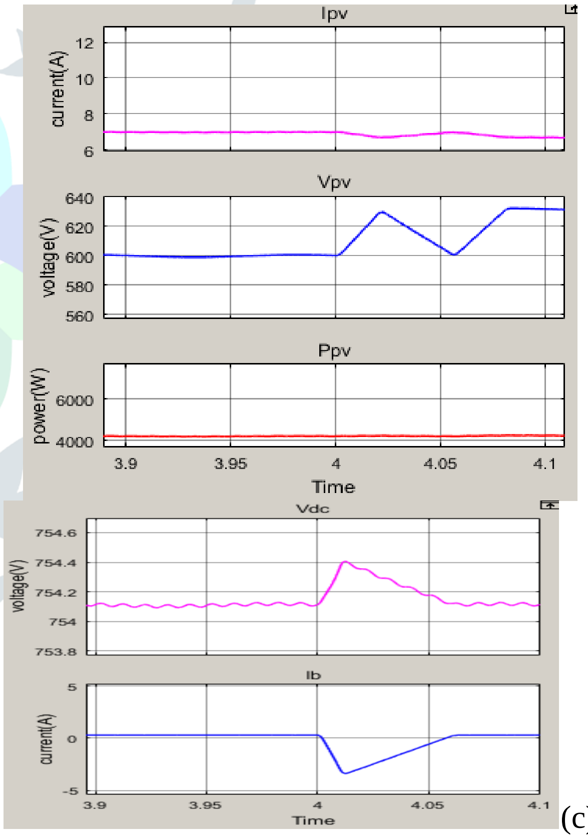
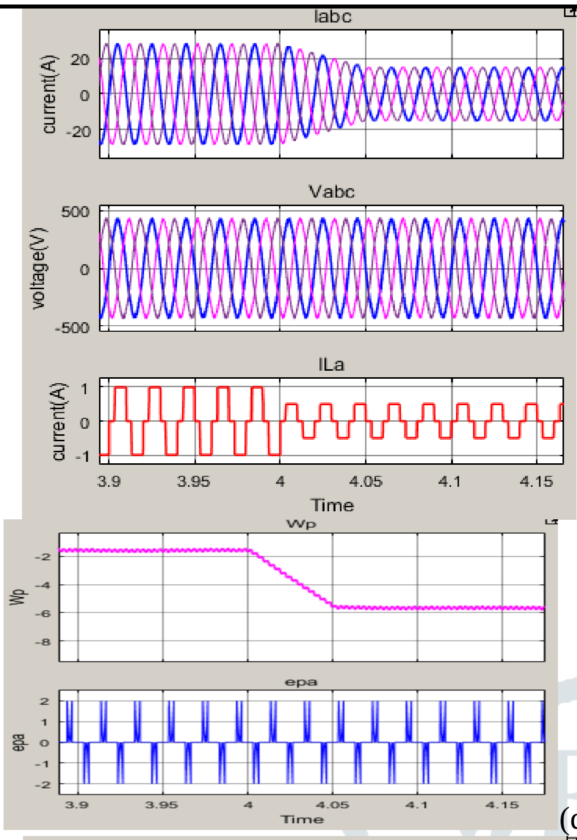
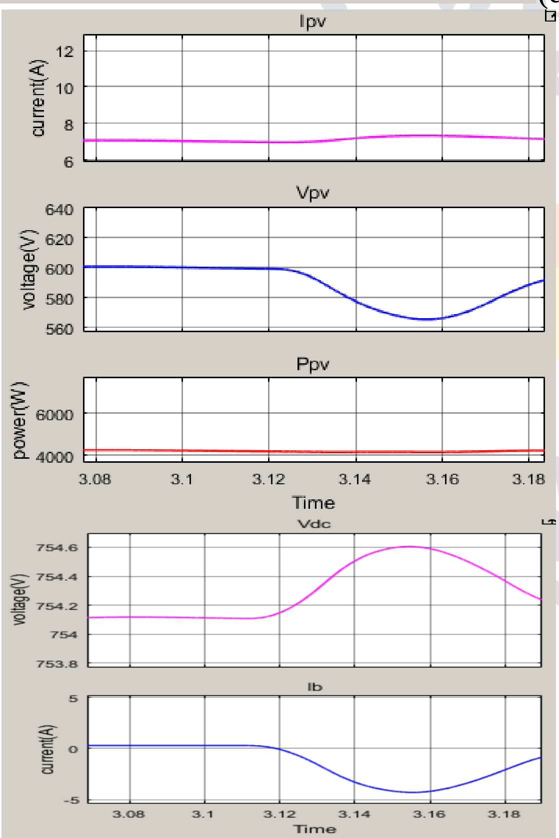


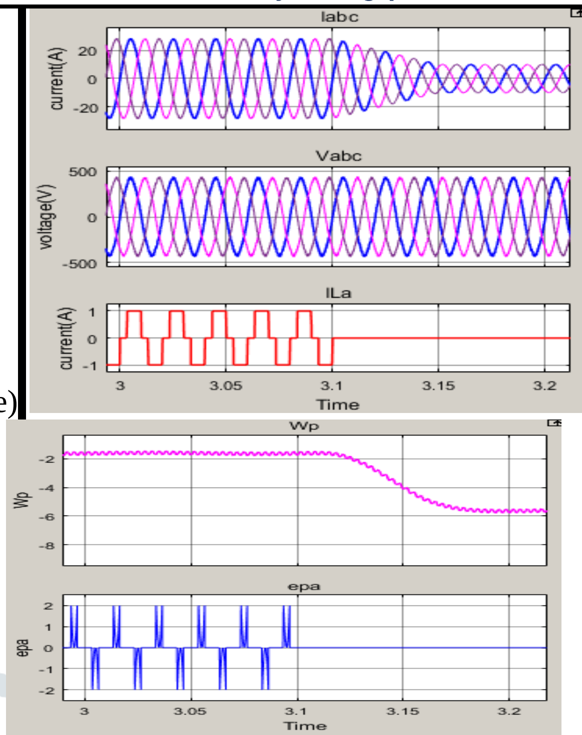


(c)



(d)





(e)

(f)

Fig. 4 Dynamic Response of DG-PV micro-grid

VI. CONCLUSION

An isolated SG based DG and PV half breed miniaturized scale grid has been exhibited here, with a battery supported VSC associated at PCC. Three-phase adaptive control is utilized for power quality improvement through VSC. The given framework and control have been mimicked in MATLAB/Simulink condition and results show their satisfactory exhibition in both unfaltering state and dynamic conditions.

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Author's Profile:

P.Madhavi is currently pursuing her M.tech in Power Electronics from Geethanjali institute of science and Technology, Nellore Dist.,A.P.She completed her under graduation in 2009 from Narayana engineering college Nellore Dist.,A.P**.**

Dr.T.Ravi kumar received Bachelor of Technology degree in Electrical & Electronics Engineering from Narayana engineering college Nellore, JNTUH and Master„s degree from JNTU college of Engineering, Anantapur . Currently,completed Doctorial Degree in KL University and working as an Associate Professor in Geethanjali Institute Of Science &Technology, Nellore, JNTU Anantapur, A.P. He is having 13 years of teaching experience .His areas of interests in Power systems and Power electronic & drives. His research interests include electric machines, machine drives, power electronics/conversion, and practical use and improvement of modern control and estimation theory in electric machine drives and power electronics control. He Has Published 17 Papers In Reputed Journals And Conferences.

Mr.M.Rajesh received Bachelor of Technology degree in Electrical & Electronics Engineering from Narayana engineering college Nellore, JNTUH and Masters degree from JNTUK, Kakinada . Currently, pursuing Ph.D in SV University ,Tirupathi and working as an Assistant Professor in Geethanjali Institute Of Science &Technology, Nellore, JNTU Anantapur, A.P. He is having 9 years of teaching experience .His areas of interests in Power systems security and protection and Power electronic & drives. He Has Published 10 Papers In Reputed Journals And Conferences.