MITIGATING THE POWER QUALITY ISSUE USING IUPQC

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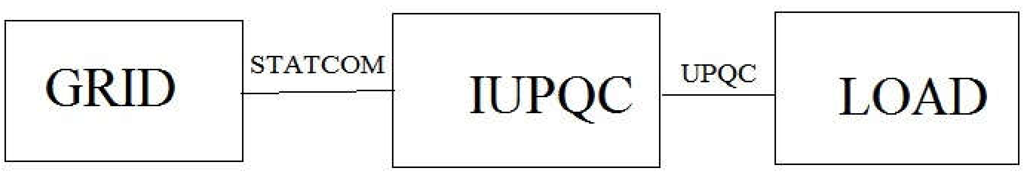
ABSTRACT

Due to increased demand for microgrods and renewable source energies there need to be a viable solution for power quality issues. These power quality issues need a look for proper flow of active and reactive power through the line and control the voltage regulation in the system. In this paper we are presenting a optimal solution for power quality issues that need a major concern. Here in this paper an IUPQC is developed with the available facts device and its operation is designed such that same device can operate as STATCOM and UPQC based on the requirement. The viable solution has be done using the MATLAB/SIMULINK models.

INTRODUCTION

Power electronics brought a vast revolution in power system with its switching devices which has a voltage and current control capability. The basic gate control devices are voltage controlled devices and base control devices are current control devices. Due to these advancements in the power industry there has been a huge increased active power and reactive power control capability. These advancements raised to a new topic called FACTS which are the heart of voltage and power control technology. These FACTS devices are used for controlling the voltage issues such as voltage sag, voltage swell, voltage flickering. In deed they have the capability to control the active and reactive prower control ability. But the problem with the power electronic switching devices is that basically they are non linear devices because of this problem there may be a chance of generation of harmonic content which may effect the system performance. These devices need a pure sinusoidal supply voltage for proper functioning of the convert or inverter application. The major problem that power system dealing with is about voltage non linearity's in the system due to faults and improper connection of microgrids and distributed generations to the main grid system. They need a proper power electronic devices for best connection of this.

The major issue considered in this paper is about the regulating the power flow in the grid side configuration and load side configuration. Most commonly used facts devices in this operation is STATCOM and UPQC. So if we need to control these fault in the power we need to arrange these devices at optimal locations for effect control of the system and reduce the harmonics developed in the system and mitigate these errors caused regularly in the system. If the both power control devices are installed in the system the cost of the system increases drastically so that it may not become the optimal solution for various problems that are discussed above. So the point is to develop a single device that has to work as the STATCOM and UPQC under required system conditions. So this paper presents a IUPQC which has the ability to operate both as STATCOM and UPQC under specific required conditions. For regulating the problems in grid side the device works as STATCOM and for regulating the problems in load side it works as UPQC



The block diagram shows the dual operation of iupqc as statcom and upqc on grid and load side. The designed system is also able to connect the grid to the microgrid and can feed the power with out harmonics to the load even though the load is nonlinear this will not carry the harmonics from load to source side.

FUNCTIONAL REQUIREMENTS OF STATCOM:

The main functional requirements of the STATCOM in this thesis are to provide shunt compensation, operating in capacitive mode only, in terms of the following.

- Voltage stability control in a power system, as to compensate the loss voltage along transmission. This compensation of voltage has to be in synchronism with the AC system regardless of disturbances or change of load.

- Transient stability during disturbances in a system or a change of loadz
- Direct voltage support to maintain sufficient line voltage for facilitating increased reactive power flow under heavy loads and for preventing voltage instability
- Reactive power injection by STATCOM into the system

CONTROL OBJECTIVES OF UPQC:

The shunt connected converter has the following control objectives

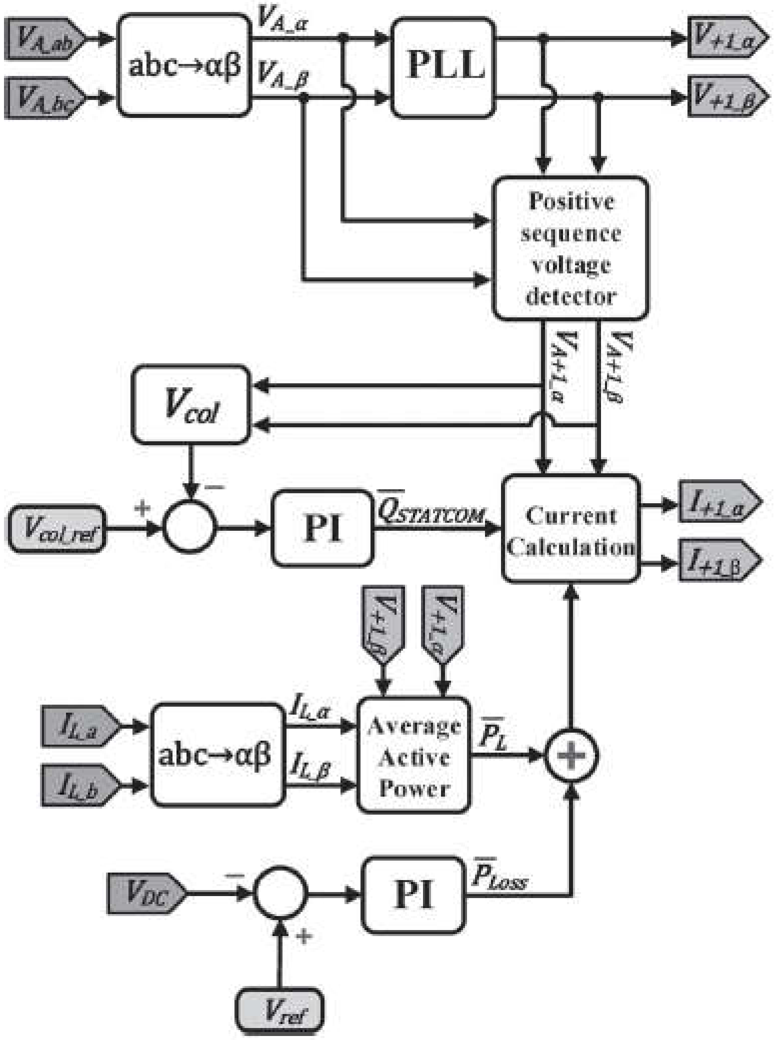
1. To balance the source currents by injecting negative and zero sequence components required by the load.
2. The compensate for the harmonics in the load current by injecting the required harmonic currents.
3. To control the power factor by injecting the required reactive current (at fundamental frequency).
4. To regulate the DC bus voltage.

a) According to the conventional iUPQC controller, the shunt converter imposes a controlled sinusoidal voltage at bus B, which corresponds to the aforementioned functionality (d). As a result, the shunt converter has no further degree of freedom in terms of compensating active- or reactive-power variables to expand its functionality. On the other hand, the series converter of a conventional iUPQC uses only an active-power control variable *p*, in order to synthesize a fundamental sinusoidal current drawn from bus A, corresponding to the active power demanded by bus B. If the dc link of the iUPQC has no large energy storage system or even no energy source, the control variable *p* also serves as an additional active-power reference to the series converter to keep the energy inside the dc link of the iUPQC balanced. In this case, the losses in the iUPQC and the active power supplied by the shunt converter must be quickly compensated in the form of an additional active power injected by the series converter into the bus B. The iUPQC can serve as: a) “smart” circuit breaker and as b) power flow controller between the grid and the micro grid only if the compensating active- and reactive-power references of the series converter can be set arbitrarily. In this case, it is necessary to provide an energy source (or large energy storage) associated to the dc link of the iUPQC. The last degree of freedom is represented by a reactive-power control variable *q* for the series converter of the iUPQC. In this way, the iUPQC will provide reactive-power compensation like a STATCOM to the bus A of the grid. As it will be confirmed, this functionality can be added into the controller without degrading all other functionalities of the iUPQC.

CONTROL STRATEGY

The control block diagram is shown below. The control scheme is implemented with converting the threephase system variables into two phase system. Generally the control strategies are designed with two phase parameters or DQ component parameters. In this system we are designing the system in Alpha Beta model. The very first step is to convert these parameters into alpha beta model and sending this converted model to a PLL. The operation of PLL is to give the phase,frequency and amplitude of the signal individually. The obtained voltage signals are fed to the positive voltage sequence detector for controlling the voltage. The positive sequence signal are used for control voltage. This control voltage is again compared with the voltage control reference module. When ever the $V_{control}$ is greater than the reference control an error signal is developed and it is given to the PI controller. The PI control is designed with k_p and k_i constants. These constants are derived from trail and error process. The PI controller will reduce the steady state errors that are developed in the system.

The current signals are also converted to alpha and beta model for further control process. These current parameters are used to control the active power models.



SIMULATION RESULTS

The simulation has been done for three conditions.1.system response for no load condition 2. When connected to a two phase diode rectifier

The simulink blockdiagrams are presented below

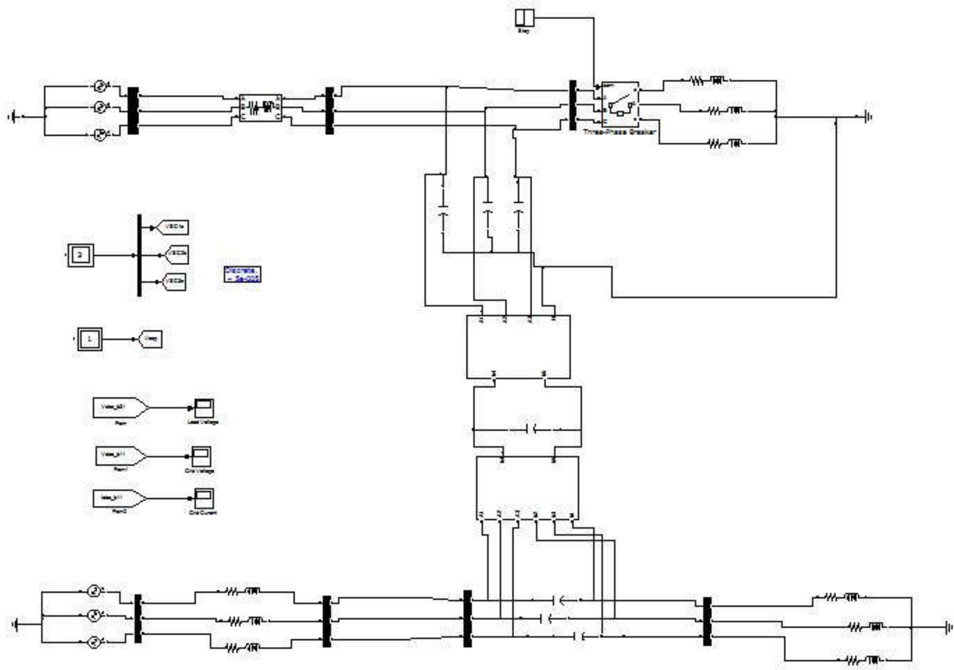


Fig IUPQC under noload condition

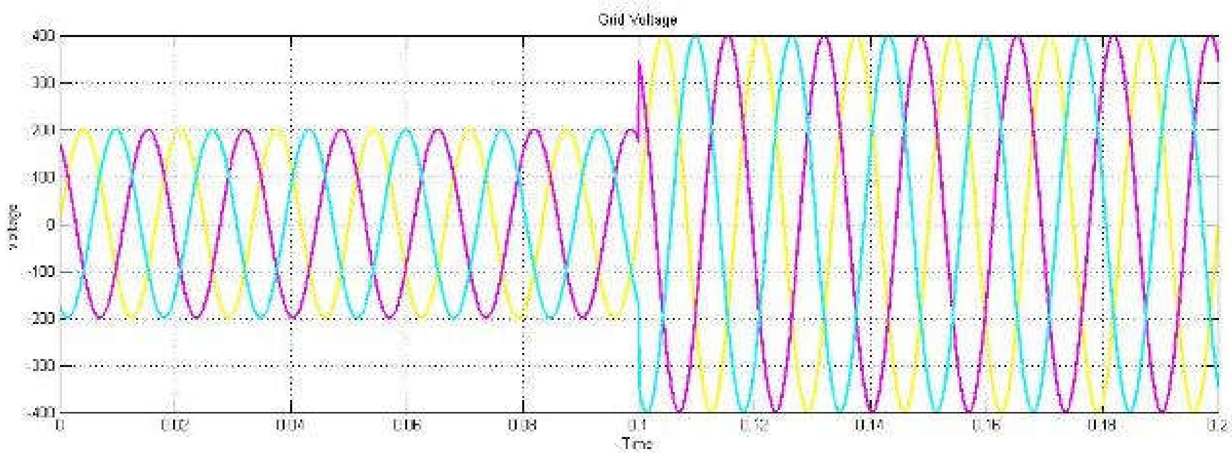


Fig Grid Voltage

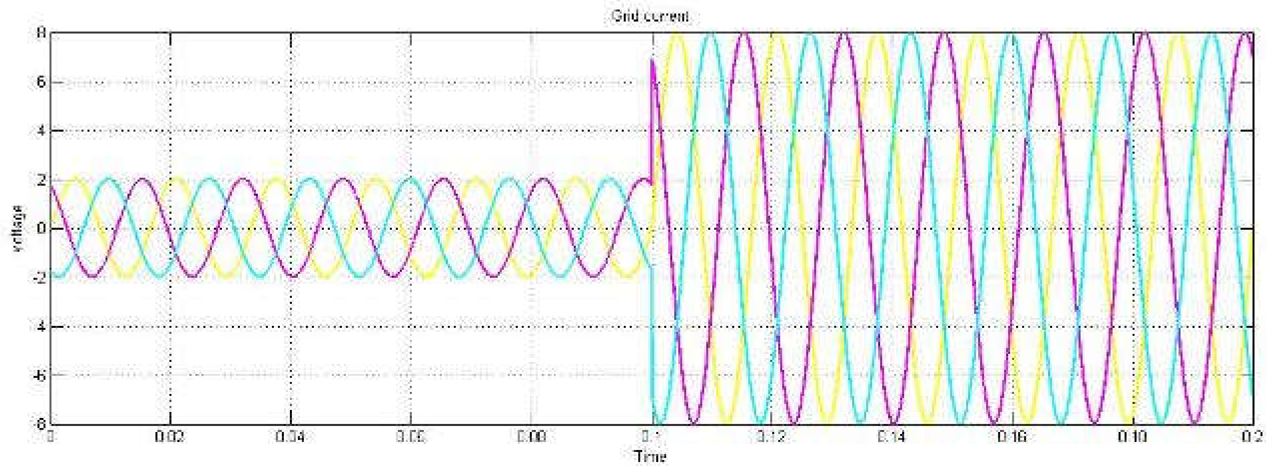


Fig Grid Current

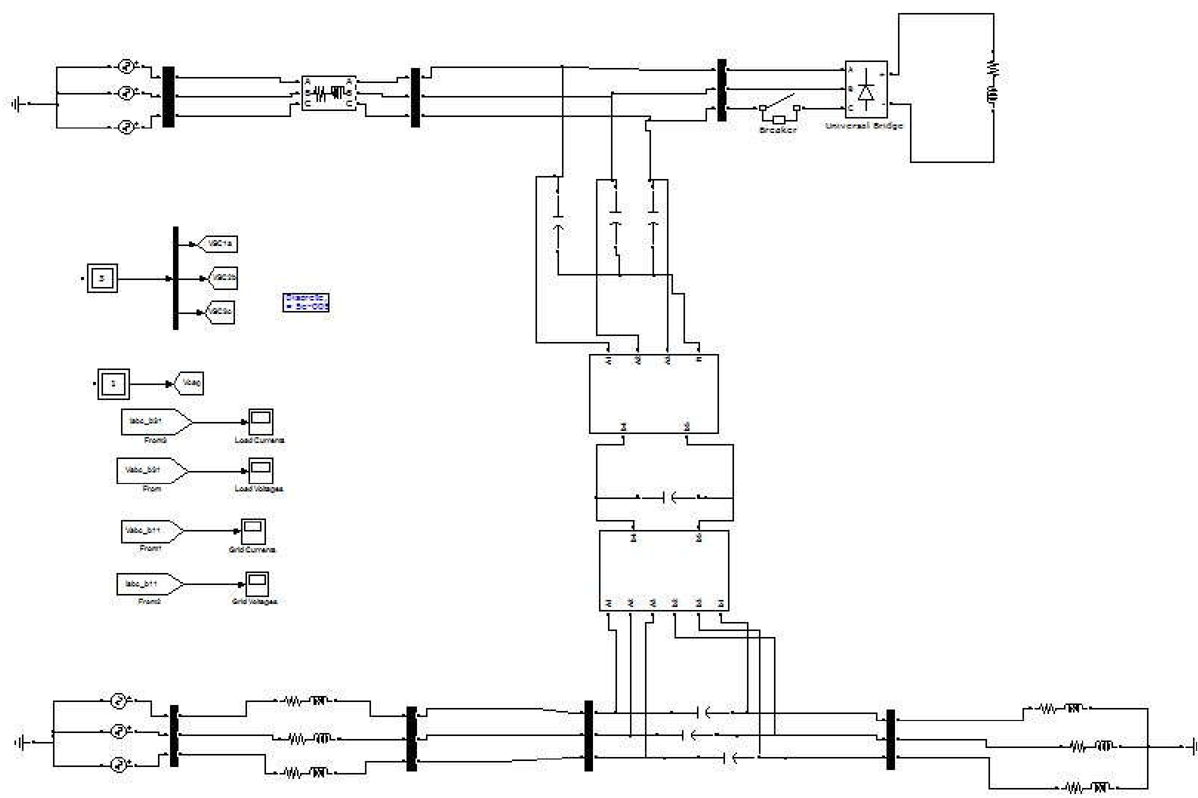


Fig IUPQC with two phase rectifier

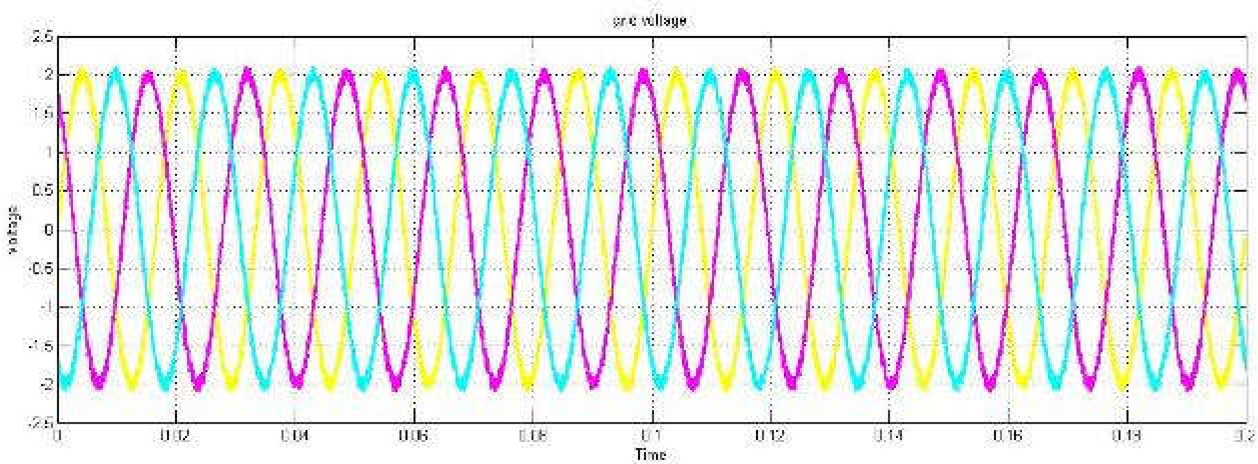


Fig Grid Voltage

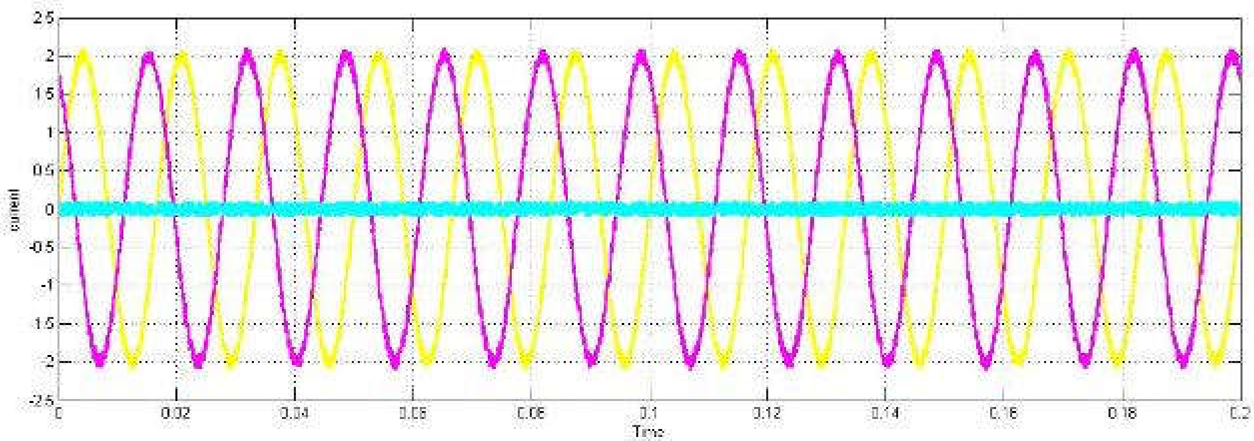


Fig Load current

CONCLUSION

An improved IUPQC has been designed and the control parameters are developed from the average active power. The DC link capacitor is used to regulate the active power flow in the system and to maintain the voltage regulation with in the limits. The control parameters are developed in alpha beta model and PI controller is used for controlling of power flow and to regulate the voltage variations. The developed system works as STATCOM if the there is a problem in the grid side and works as UPQC if the problem is in load side. Further the system may be connected to a microgrid for utility purpose.

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