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A Real Time Implementation of Novel Reactive Power Compensation using D-STATCOM

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Abstract

D-STATCOM is a compensating device which is used to control the flow of reactive power in the distribution systems. Most of loads in this system, being inductive in nature consume more reactive power. As a result, power factor of load deteriorates and this limits the active power flow in the line. The paper aims at developing a D-STATCOM, based on voltage source converter, which injects the reactive power in distribution line. The output voltage of D-STATCOM is made leading to that of system voltage for the purpose of controlling VAR generation. Implementation of D-STATCOM by using PI controller is carried out in MATLAB/ Simulink.

Keywords: D-STATCOM, Reactive power, FACTS, PI Controller

INTRODUCTION

The FACTS devices provides a fast and reliable control over transmission parameters, like voltage, line impedance and phase angle between the sending end and receiving end voltage. On the other hand the custom power device is used for low voltage distribution and improves the power quality due to which the system becomes reliable. Custom power devices are very similar to the FACTS devices. Most widely known custom power devices are D-SATCOM, UPQC, DVR among them D-STATCOM is well known as it can provide cost effective solution for the compensation of reactive power .A FACTS is a power electronic based device which maintains the power quality by maintaining better flow of power and controls the dynamic stability of the system by changing the system parameters like voltage, phase angle, impedance. In this paper Distributed Static Compensator (D-STATCOM) is used. A D-STATCOM is a VSI fed power electronic device which is connected in shunt to the network to mitigate the harmonics and other power quality problems. The performance of the D-STATCOM depends on different control algorithms which are used for extraction of reference currents and to provide pulses to the gate terminals of the VSI. A literature review has been performed on different types of studies over D-STATCOM. The D-STATCOM is highly effective in providing load voltage regulation; however, maintaining load voltage at rated value has several unwanted effects from customer point of view. With voltage of 1p.u. at load point, DSTATCOM forces load to operate always at rated power. The STATCOM used in distribution systems is called DSTATCOM (Distribution-STATCOM). It can exchange both active and reactive power with the distribution system by varying the amplitude and phase angle of the converter voltage with respect to the line terminal voltage.

EXISTING SYSTEM

The FACTS devices provides a fast and reliable control over transmission parameters, like voltage, line impedance and phase angle between the sending end and receiving end voltage. On the other hand the custom power device is used for low voltage distribution and improves the power quality due to which the system becomes reliable. Custom power devices are very similar to the FACTS devices. Most widely known custom power devices are D-SATCOM, UPQC, DVR among them D-STATCOM is well known as it can provide cost effective solution for the compensation of reactive power. A FACTS is a power electronic based device which maintains the power quality by maintaining better flow of power and controls the dynamic stability of the system by changing the system parameters like voltage, phase angle, impedance. In this paper Distributed Static Compensator (D-STATCOM) is used.A D-STATCOM is a VSI fed power electronic device which is connected in shunt to the network to mitigate the harmonics and other power qualityproblems.

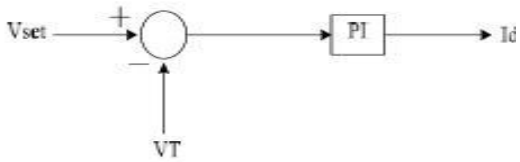
DESIGN OF DSTATCOM

A. Principle of DSTATCOM

A D-STATCOM (Distribution Static Compensator), which is schematically depicted, consists of a two-level Voltage Source Converter (VSC), a dc energy storage device, a coupling transformer connected in shunt to the distribution network through a coupling transformer. The VSC converts the dc voltage across the storage device into a set of three-phase ac output voltages. These voltages are in phase and coupled with the ac system through the reactance of the coupling transformer. Suitable adjustment of the phase and magnitude of the D-STATCOM output voltages allows effective control

of active and reactive power exchanges between the D-STATCOM and the ac system. Such configuration allows the device to absorb or generate controllable active and reactive power. The VSC connected in shunt with the ac system provides a multifunctional topology which can be used for three quite distinct purposes: 1. Voltage regulation and compensation of reactive power; 2. Correction of power factor; 3. Elimination of current harmonics. Here, such device is employed to provide continuous voltage regulation using an indirectly controlled converter. As the shunt injected current *Ish* corrects the voltage sag by adjusting the voltage drop across the system impedance *Zth*. The value of *Ish* can be controlled by adjusting the output voltage of the converter .

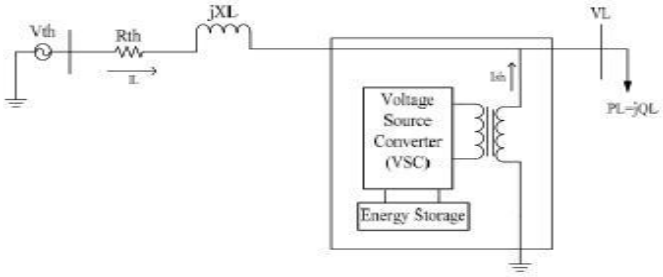
B. Control for Reactive Power Compensation



The aim of the control scheme is to achieve constant voltage magnitude at the point where a sensitive load under system disturbances is connected. The control system only measures the rms voltage at the load point. The VSC switching strategy is based on a sinusoidal PWM technique which gives simplicity and provides good response. As custom power is a relatively low-power application, PWM methods offer a more flexible option than the fundamental frequency switching methods used in FACTS applications. Apart from this, high switching frequencies can be used to improve on the efficiency of the converter, without incurring significant switching losses. The controller input is an error signal obtained from the reference voltage and the rms terminal voltage measured. Such error is processed by a PI controller; the output is the angle 0, which is provided to the PWM signal generator. It is important to note that in this case, of indirectly controlled converter, there is active and reactive power exchange with the network simultaneously. The PI controller processes the error signal and generates the required angle to drive the error to zero, i.e. the load rms voltage is brought back to the reference voltage

Proposed system

The D-STATCOM is highly effective in providing load voltage regulation; however, maintaining load voltage at rated value has several unwanted effects from customer point of view.



With voltage of 1p.u. at load point, DSTATCOM forces load to operate always at rated power. The STATCOM used in distribution systems is called DSTATCOM (Distribution-STATCOM). It can exchange both active and reactive power with the distribution system by varying the amplitude and phase angle of the converter voltage with respect to the line terminal voltage

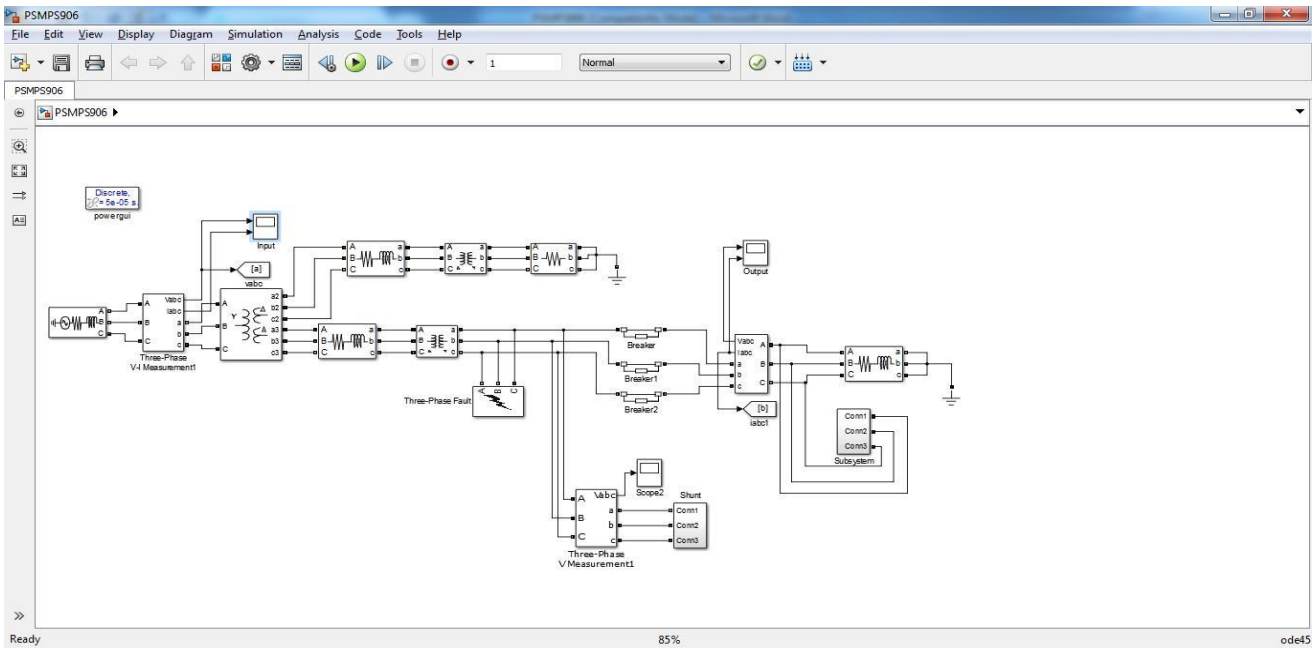


Figure 3 Simulation output

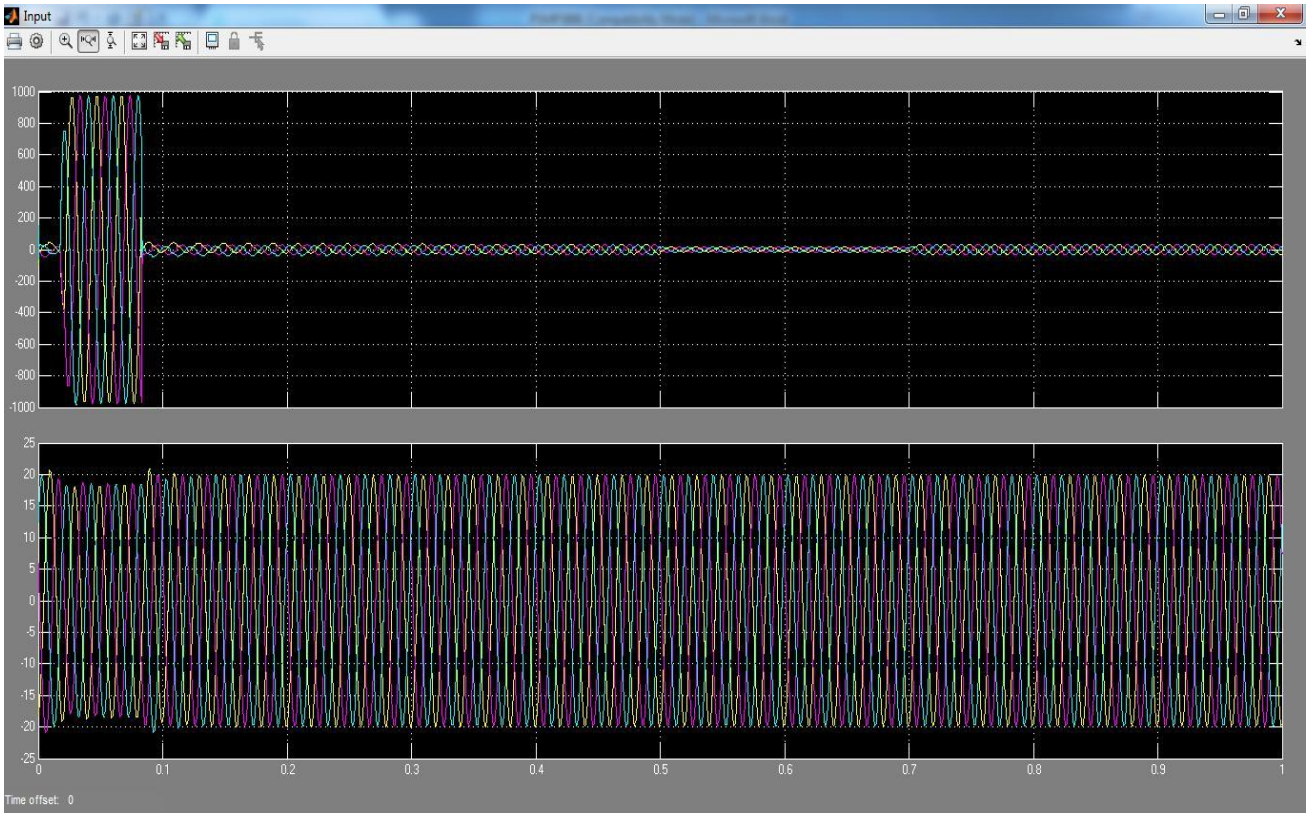


Figure 3.1 input scope

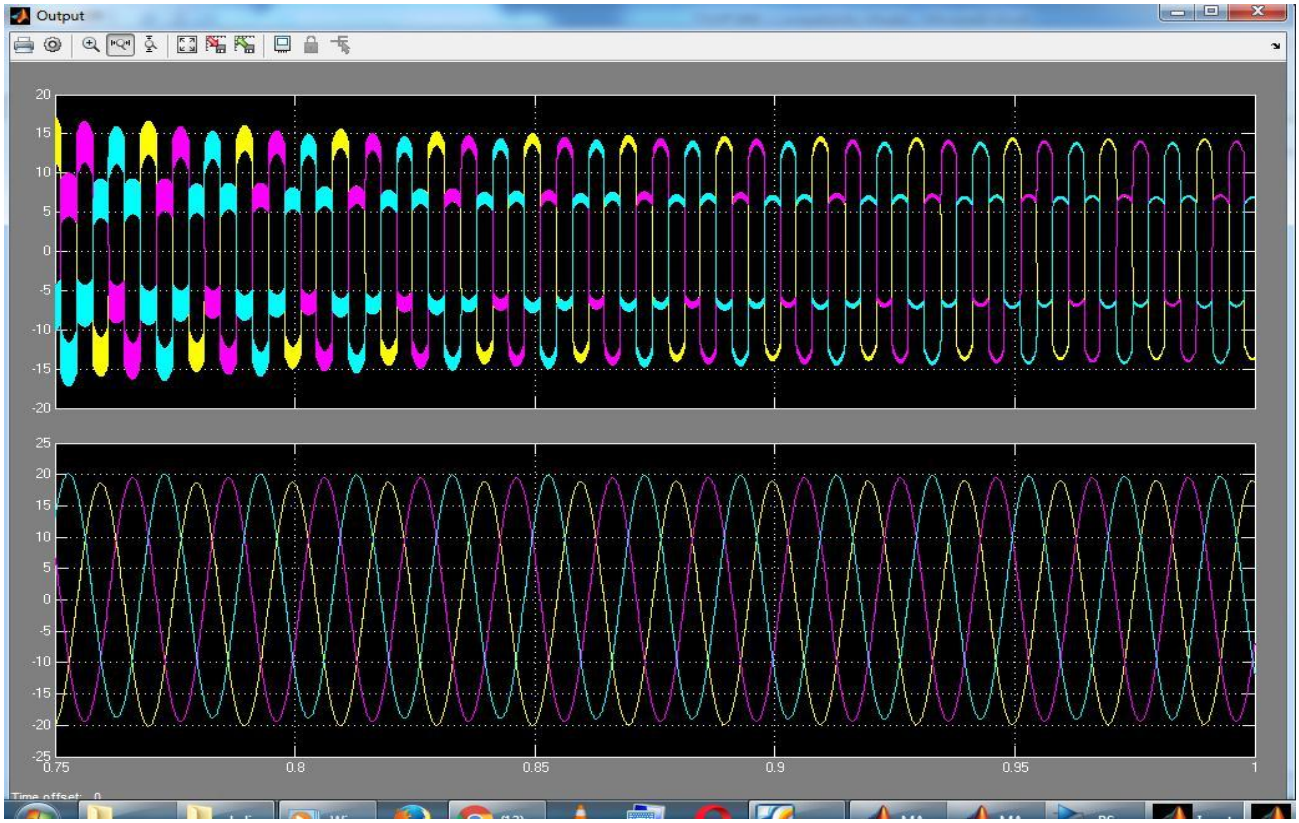


Figure 3.2. Output scope

Figure 3.3. Hardware model of D-Statcom

Figure 3.4. Output of Hardware model

CONCLUSION

In this paper we have studied and discussed about the custom power device i.e. D-STATCOM which operates on low voltage and how it is useful in compensation of reactive power as it injects the reactive power in the line. The device is actually acts as VSC which is been implemented at the load side of the system so as to improve the voltage profile of system and reduce the power losses. Hence, D-STATCOM improves the voltage stability of system.

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