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A Fast Acting Dc-Link Voltage Controller For 3-Phase Dstatcom to Compensate Ac & Dc Loads

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ABSTRACT

The transient reaction of the conveyance static compensator (DSTATCOM) is vital while repaying quickly fluctuating uneven and nonlinear burdens. Any adjustment of the heap influences the dc-connect voltage straightforwardly. The unexpected evacuation of burden would bring about an expansion in the dc-connect voltage over the reference esteem, while an abrupt expansion in burden would diminish the dc-interface voltage underneath its reference esteem. The appropriate activity of DSTATCOM requires variety of the dc-connect voltage inside as far as possible. Ordinarily, a relative indispensable (PI) regulator is utilized to keep up with the dc-interface voltage to the reference esteem. It utilizes deviation of the capacitor voltage from its reference esteem as its feedback. Nonetheless, the transient reaction of the ordinary PI dc-connect voltage regulator is slow. In this paper, an effective dc-connect voltage regulator in light of the energy of a dc-interface capacitor is proposed. Numerical conditions are given to process the increases of the traditional regulator in light of effective dc-connect voltage regulators to accomplish comparable quick transient reaction. The nitty gritty reproduction and exploratory investigations are completed to approve the proposed regulator.

1. INTRODUCTION

Electric power distribution network becomes more increasingly important and plays an essential role in power system planning. This type of power systems has a major function to serve distributed customer loads along a feeder line, therefore under competitive environment of electricity market the electric energy transfer must not be interrupted and at the same time there must provide reliable, stable and high quality of electric power. The three phase four- wire distribution systems are facing severe power quality problems such as poor voltage regulation, high reactive power, load unbalancing, excessive neutral current, poor power factor etc . Three phase four-wire distribution systems are used in commercial buildings, office buildings, hospitals etc. Most of the loads in these locations are non-linear loads and are mostly unbalanced load in the distribution system. The voltage regulation is also poor in the distribution system due to the unplanned expansion and the installation of different types of loads in the existing distribution system. There are mitigation techniques for power quality problems in the distribution system. The literature records the evolution of different custom power devices to mitigate the above power-quality problems by injecting voltages/currents or both into the system. [1] The static synchronous compensator (STATCOM) using voltage source inverters has been accepted as a competitive alternative to the conventional Static VAR compensator (SVC) using thyristor-controlled reactors STATCOM functions as a synchronous voltage source. It can provide reactive power compensation without the dependence on the ac system voltage. By controlling the reactive power, a

STATCOM can stabilize the power system, increase the maximum active power flow and regulate the line voltages. Faster response makes STATCOM suitable for continuous power flow control and power system stability improvement. STATCOM is employed at the distribution level or at the load end for the power factor improvement and voltage regulation alone it is called DSTATCOM. When it is used to harmonic filtering in addition or exclusively it is called active power filter. The DSTATCOM consists of a current-controlled voltage-source inverter (VSI) which injects current at the PCC through the interface inductor. The operation of VSI is supported by a dc storage capacitor with proper dc the transient response of the voltage across it. The transient response of the DSTATCOM is very important while compensating AC and DC loads. In some of the electric power consumers, such as the telecommunications industry, power-electronics drive applications, etc., there is a requirement for ac as well as dc loads. The telecommunication industry uses several parallel-connected switch-mode rectifiers to support dc bus voltage. Such an arrangement draws nonlinear load currents from the utility. This causes poor power factor and, hence, more losses and less efficiency. Clearly, there are PQ issues, such as unbalance, poor power factor and, hence, more losses and less efficiency. Clearly, there are PQ issues, such as unbalance, poor power factor, and harmonics produced by telecom equipment in power distribution networks. Therefore, the functionalities of the conventional DSTATCOM should be increased to mitigate the aforementioned PQ problems and to supply the dc loads from its dc link as well. The load sharing by the ac and dc bus depends upon the design and the rating of the VSI.

2. POWER QUALITY

Power Quality Problems
Voltage Power Quality Problems
Effects of PQ Quantities
Sources of Power Quality Problems
Solution of Power Quality Problems
Other Possible Solutions

3. CUSTOM POWER DEVICES

An electric circulation framework is essential for an electric framework between the mass power source or sources and the shopper's administration switches[7].The mass power sources are situated in or close to the heap region to be served by the dissemination framework and might be either creating stations or power substations provided over transmission lines. Appropriation frameworks overall isolated into six sections in particular, sub transmission circuits, conveyance substations, dissemination or essential feeders, circulation transformers, optional circuits or auxiliary's and customer's administration associations and meters or buyer's administrations. With an expansion in load interest, trouble on lines and the voltage level is tested. Presently a day's keeping up with voltage extent at a satisfactory reach is one of the significant framework limitations. The idea of Realities was grown initially for transmission organization. Realities innovation opens up new open doors for controlling power and improving the usable limit of the current transmission framework. The expression "Realities" (Adaptable AC Transmission Frameworks) covers a few power hardware based frameworks utilized for AC power transmission and dispersion. Given the idea of force hardware gear, Realities arrangements will be especially reasonable in applications requiring at least one of the accompanying characteristics: (a) Fast unique reaction (b) Capacity for successive varieties in yield (c) Easily movable result.

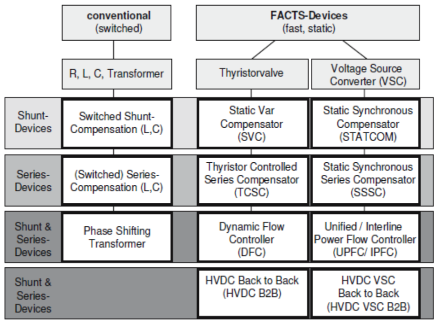


Fig. Overview of major facts devices.

The types of FACTS controllers are:

- SERIES
- SHUNT
- SERIES-SHUNT
- SERIES-SERIES

Configurations of facts devices

Series Controllers
Shunt Controllers
Combined series-series Controllers
Combined Series-Shunt Controllers

RESULTS AND DISCUSSION

This chapter deals with the simulation results of the transient response of the dc-link voltage controller. The transient response of the DSTATCOM is very important while compensating ac& dc loads.

Dstatcom compensating ac and dc loads

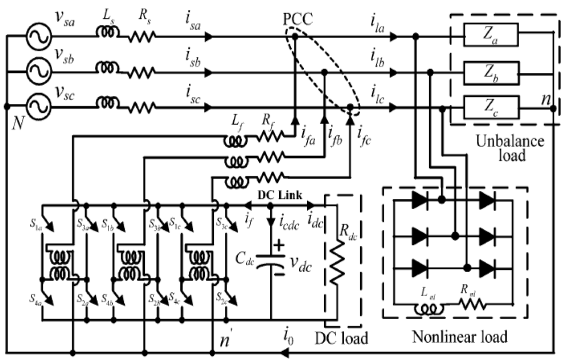


Fig. Three-phase, four-wire compensated system using the H-bridge VSI topology-based DSTATCOM
The transient reaction of the dstatcom is vital while repaying ac and dc loads. Fig shows a three-stage, four-wire-remunerated framework utilizing a H-span VSI geography based DSTATCOM repaying unequal and nonlinear ac load. Furthermore, a dc load is associated across the dc interface. The DSTATCOM comprises of 12 protected door bi polar semiconductor (IGBT) switches each with an

enemy of equal diode, dc capacity capacitor, three detachment transformers, and three point of interaction inductors. H-span VSIs are associated with the PCC through interface inductors. The straight transformers forestall a short out of the dc capacitor for different blends of the exchanging conditions of the VSI. The inductance and obstruction of the direct transformers are additionally remembered for and .The reenactment studies are completed as displayed underneath.

Simulation studies

Conventional PI dc-link voltage controller

Conventionally a PI dc-link voltage controller is used to maintain the dc-link voltage at the reference value. It uses the deviation of the capacitor voltage from its reference value as its input. The simulation parameters are taken as shown in the table 4.1

Simulation parameters

System parameters	Values
Supply voltage	400V,50 HZ
Unbalanced loads	z_a =25, z_b =44+j25.5, z_c =50+j86.6
Nonlinear load	Universal bridge
Dc load	R_{dc} =100
DC capacitor	C_{dc} =3000e-6
Reference dc-link voltage	V_{ref} =700
Gains of conventional DC-link voltage controller	K_p =40, Ki =20
Gains of fast acting dc-link voltage controller	K_{pe} =0.11, K_{ie} =0.055

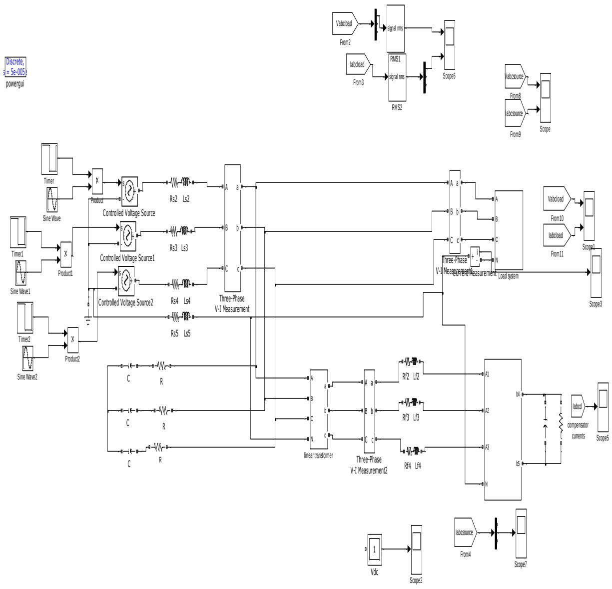
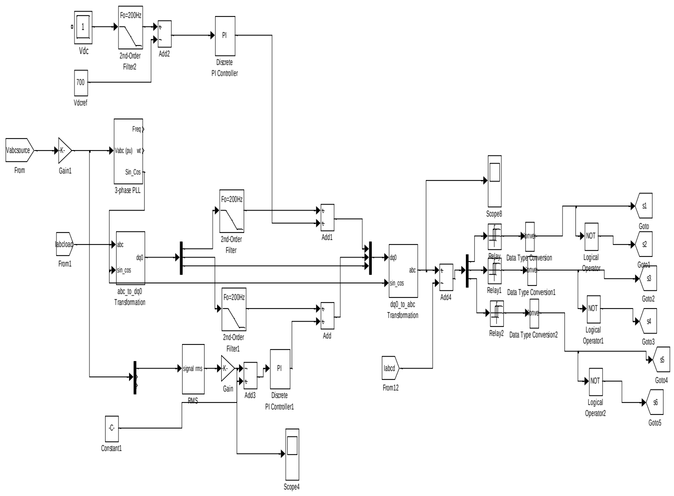
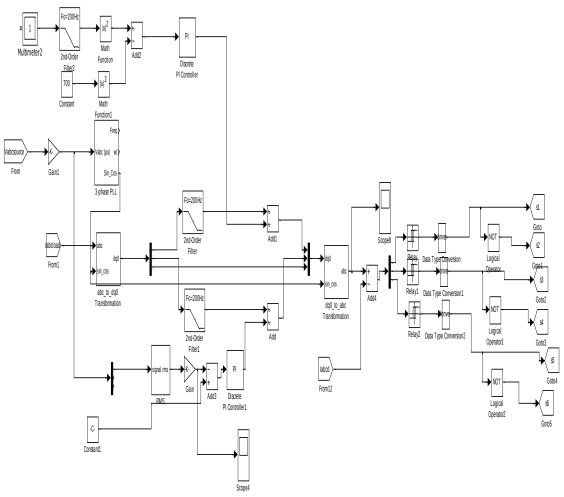


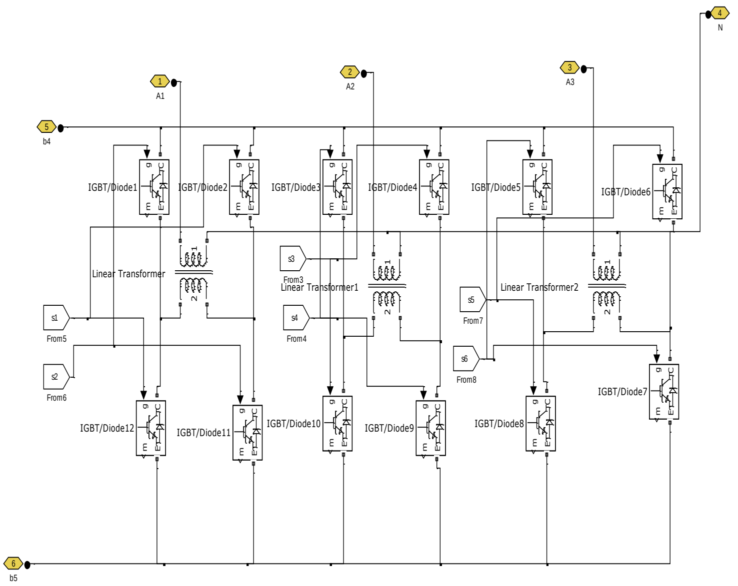
Fig. SIMULINK model of the system with DSTATCOM



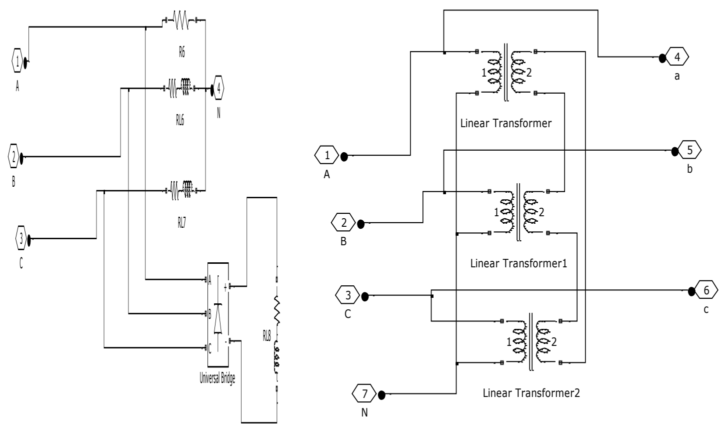
4.3. Simulink model of the conventional DC-link voltage controller



4.4. Simulink model of the fast acting dc-link voltage controller



4.5. Simulink model of the DSTATCOM(voltage source inverter)



4.6. Simulink model of the load subsystem and linear transformer.

In simulation initially at t=0.4s the amplitude is halved and at t=0.8s it is brought back to its original position. The source voltages and source currents are as shown in Fig.4.7 The compensator injects currents at t=0.4s to t=0.8s.the compensator injected currents are as shown in Fig.4.8. The load currents and load voltages are also presented in Fig.4.9.

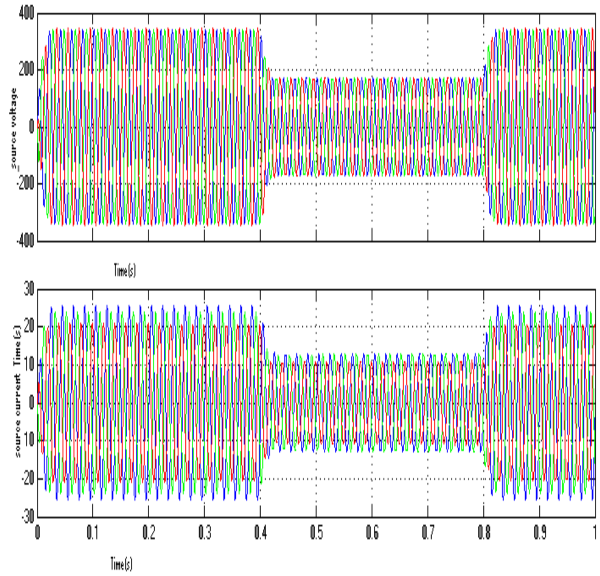


Fig.4.7. (a) Source voltage, (b) Source current

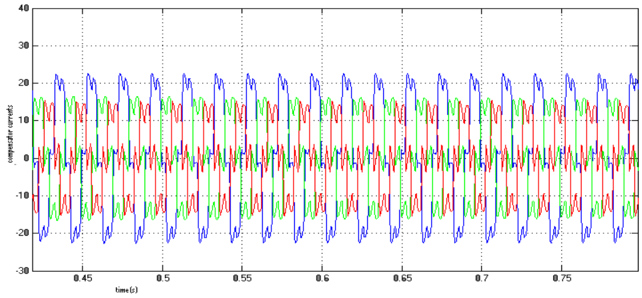


Fig.4.8. Injected currents

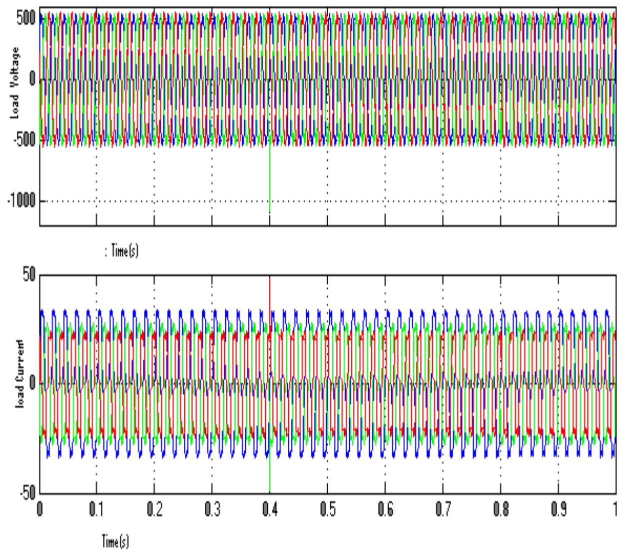


Fig.4.9. compensator currents

Transient response of the conventional PI dc-link voltage controller

The transient reaction of the customary dc-connect voltage regulator is in Fig.4.10. The complete burden which is mix of uneven and nonlinear burden is divided at the moment of =0.4. Because of the abrupt diminishing of the heap the dc-connect voltage is unexpectedly increment. In this manner there is an expansion in dc-connect capacitor voltage over the reference esteem. The dc-connect capacitor voltage is taken back to the reference esteem in light of the upsides of PI regulator gains after at =0.44s as displayed in Fig.4.10. Also, when the heap is changed back to the full burden at =0.8s the dc-connect capacitor supplies capacity to the heap and the dc-interface voltage is abruptly decline underneath the reference esteem. Thus, the dc-connect voltage is abruptly increments by evacuation of the heap and out of nowhere diminishes by expanding the heap. The capacitor voltage is taken back to its reference esteem at =0.84s because of the PI regulator activity. Transient reaction of the traditional dc-connect voltage regulator is exceptionally delayed as displayed in the Fig.4.10.

Transient execution of the Effective PI dc-interface voltage regulator

Drifters in the heap are viewed as equivalent to in the above reenactment study. At =0.4s the heap is abruptly decline and the dc-interface voltage is unexpectedly expanded over the reference worth and it is taken back to its reference esteem in view of the upsides of the PI regulator gains. The effective dc-connect voltage regulator happens at the following moment and it is taken back to its reference esteem at =0.42s as displayed in the Fig.4.11. At =0.8s the heap is unexpectedly expanded as made sense of before the effective regulator brings the dc-connect voltage to its reference esteem at =0.82s as displayed in the Fig.4.11

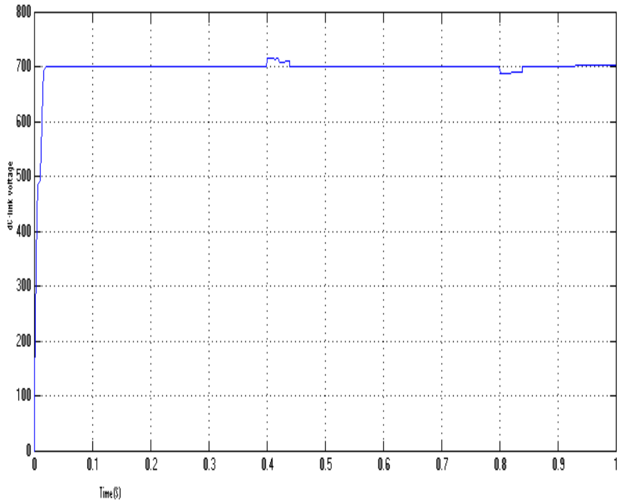


Fig .4.10 Transient response of the conventional PI DC-link voltage controller

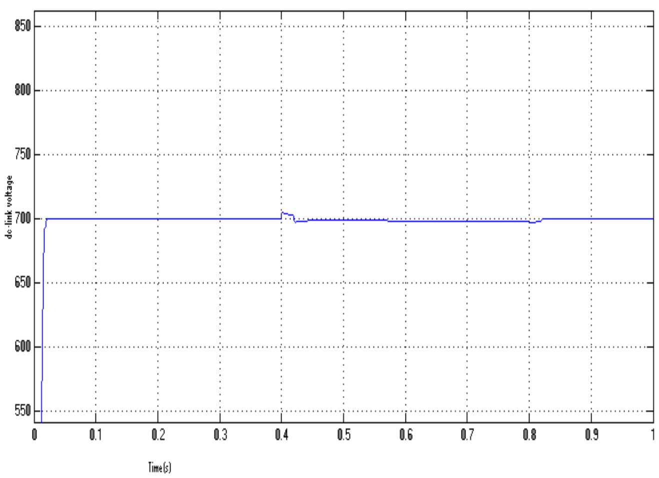


Fig.4.11. Transient response of the fast acting DC-link voltage controller

CONCLUSIONS

Over the span of this task work, writing is surveyed on STATCOM. Various Realities regulators are contemplated. Various reenactments are done in MATLAB R2009a/Simulink climate. Drifters in the heap are viewed as equivalent to in the above recreation study. It is seen that the STATCOM model can supply inductive and capacitive receptive power. A VSI geography for DSTATCOM remunerating ac unequal burdens and a dc load provided by the dc-connection of the compensator is introduced. The transient reaction of the dstatcom is vital while repaying quick shifting burdens. At the point when there is any adjustment of the heap it will straightforwardly impacts the dc-connect voltage .The transient reaction of the ordinary dc-interface voltage regulator is extremely sluggish. In this way, an energy based dc-connect voltage regulator is taken for the quick transient reaction.

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