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Modelling of Hysteresis Current Control Based Statcom for Reactive Power Compensation

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ABSTRACT: This paper study on a reactive power compensation by the modelling of Statcom that uses a hysteresis current control technique to regulate the reactive power at the point of common coupling. Now a day's the electronic equipment's use increased in a very rapid manner. Along with all these power electronic equipment the use of renewables in the power system also increases. All these applications injects harmonics in the system and increased line losses. After the analysis of simulation results we can see that the present technique of reactive power compensation and improves the PQ and the voltage sag and current harmonics efficiently and with better reliability. Statcom shows a fast dynamic response. During faults statcom provides voltage support and increases transient stability. The Matlab/ Simulink software indicates the superior performance of the proposed control system as well as the precision of the proposed models

KEYWORDS: Total Harmonic Distortion THD, Static Synchronous compensator Statcom, Flexible AC transmission system FACTS, Power quality.

I. INTRODUCTION

The power quality means the quality of the supply voltage with respect to the voltage sags and swells, voltage unbalance, flicker and interruptions. The power quality limits determined in various countries transmission and distribution rules and codes. Heavy loads with the nonlinear type of characteristics, consumptions, time varying and high voltage instruments uses the power electronic devices are the main source of interference in the grid. For example if we consider the device like electric arc furnace which is having a character of varying loads dynamically and thus affects the power quality usually in a distribution system. These problems may degrade the power factor performance of the operating system and they cause other severe problems includes heating of equipment's. Errors in instruments scale and failures of sensor devices and capacitor blow out. Technological advancements resulting in the extreme implementation of nonlinear loads in the power electronics field and this section has a much better scope for the researcher, engineer and others who are concerned for the harmonics interpretation in the power system. The harmonics current generated from the nonlinear loads will cause a significant power quality problems to the power system. This will degrade the power factor performance and may cause very severe problems in the power system. This will include overheating of system equipment's, errors in the measuring instruments, failures of sensitive devices and capacitor blowing. [1]

To restrict the harmonics current IEEE standard 519 latest version has been designed and formulated, it is noted that in the harmonics standard codes the total harmonic distortion for current should be almost 5 %. So the 5% level of THD in the harmonic current is always the challenges for the designers and engineers to achieve this target. To achieve this target the conventional passive harmonic filters has been applied.

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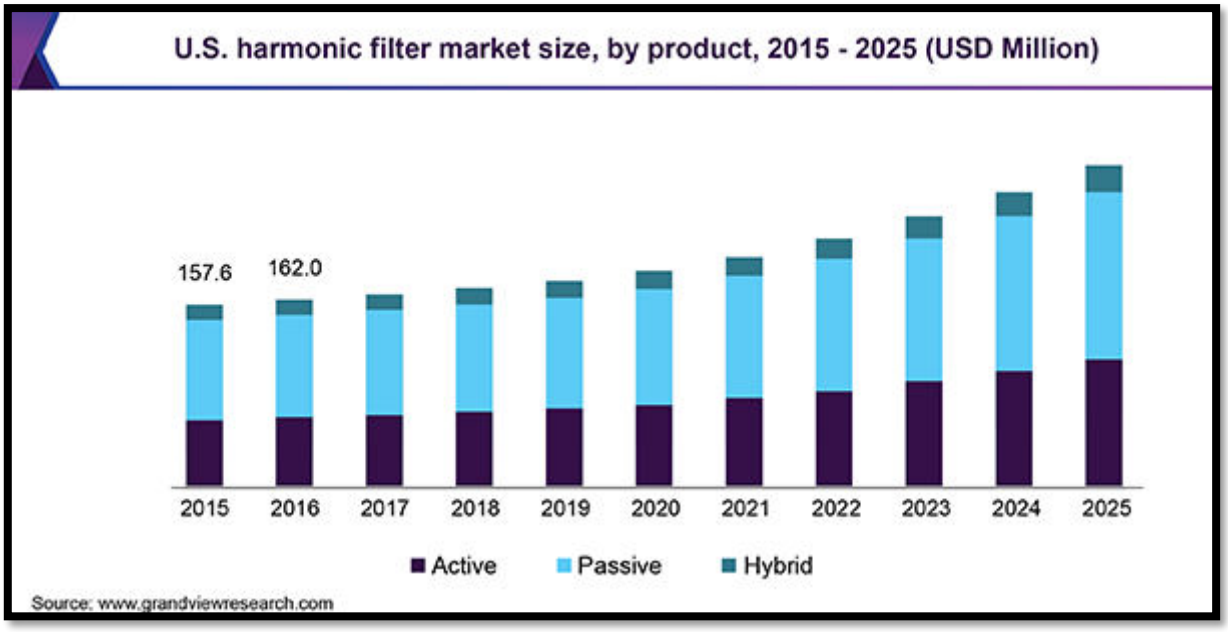

Fig -1: Indian Harmonic filter market

Statcom designed has different components with different roles in the model, The DC input voltage source converted to AC output voltage, a pulse width modulation inverters using insulated IGBT and uses pulse width modulation technique to produce the smooth waveform from a dc voltage source with a chopping frequency of few KHz, the IGBT based voltage source converter uses a constant DC voltage and varies its output by varying modulation index. DC link capacitor is used to supply a constant DC voltage to the converter. The transformer which is connected between the converter and power system will acts as a coupler and neutralize the square wave produced by the converter. Harmonics filters also connected to suppress the harmonics and high frequency components due to converter.

Fig -2: Commercial active power filter

II. CONTROL SYSTEM ALGORITHM

Hysteresis Current Control

This algorithm is used extensively due to its simple mechanism of implementation. The main operation is done by the comparison of the current error and the hysteresis band. In this method the error is placed between hysteresis band. Whenever the error will increase from the upper limit or goes down below the lower limit the command will be sent to the control switch to control and limit the error with in the preset band and to produce the reference current. This will

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give quick control ability with high accuracy and does not require any system information about the parameters. Fixed band hysteresis suffer from a high frequency variation which cause noise and increased switching losses.

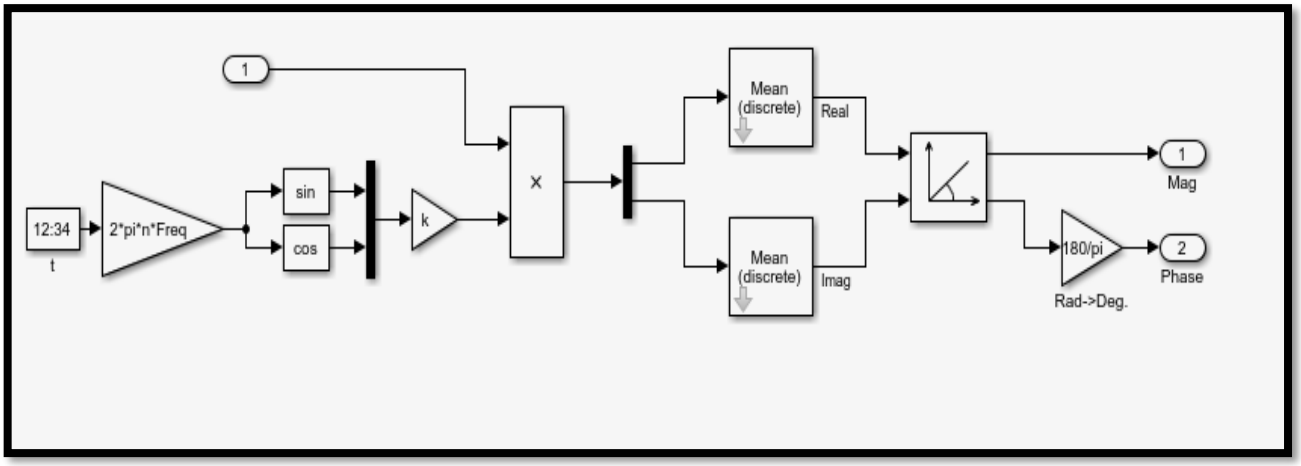

Fig. 3 triggering circuit of SPWM

This Simulink diagram represents a triggering circuit used in SPWM (Sinusoidal Pulse Width Modulation) specifically, it's part of a Phase-Locked Loop (PLL) or synchronization system that helps detect the magnitude and phase angle of an input signal (such as grid voltage).III. Assumption and Model Description

The input signal (on the left) represents a time-varying waveform such as an AC voltage.
The "2piFreq*t" block generates an angular reference signal (ωt), where:

$$\omega=2\pi f\omega = 2\pi f\omega=2\pi f$$

The sin and cos blocks generate sine and cosine reference signals corresponding to that frequency.

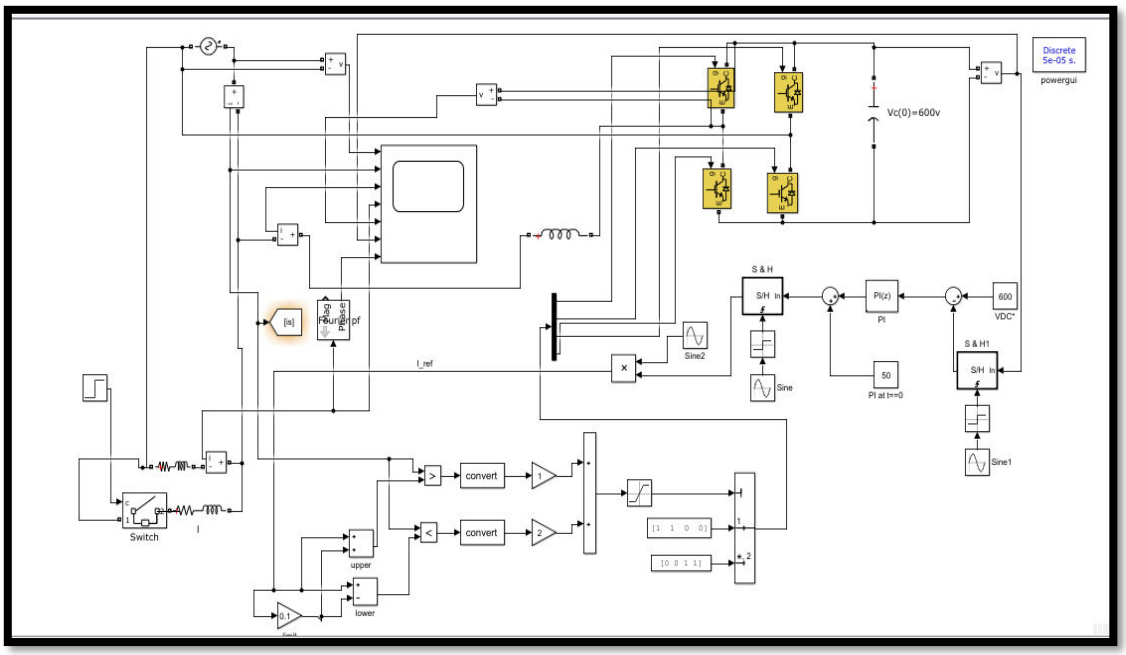

Fig. 4 Proposed Mode of Statcom

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III. RESULT AND DISCUSSION

The waveform are smooth sinusoidal and the currents are nearly sinusoidal, they are phase shifted by 120 degree, their amplitude are being controlled by hysteresis current controller to follow the reference current.This shows that modelled statom is successfully tracking the reference current and injecting reactive power as required to stabilize the bus voltage. The rectangular waveform is typical hysteresis current control switching signal.The frequency increases when current error grows and decreases when error is small.

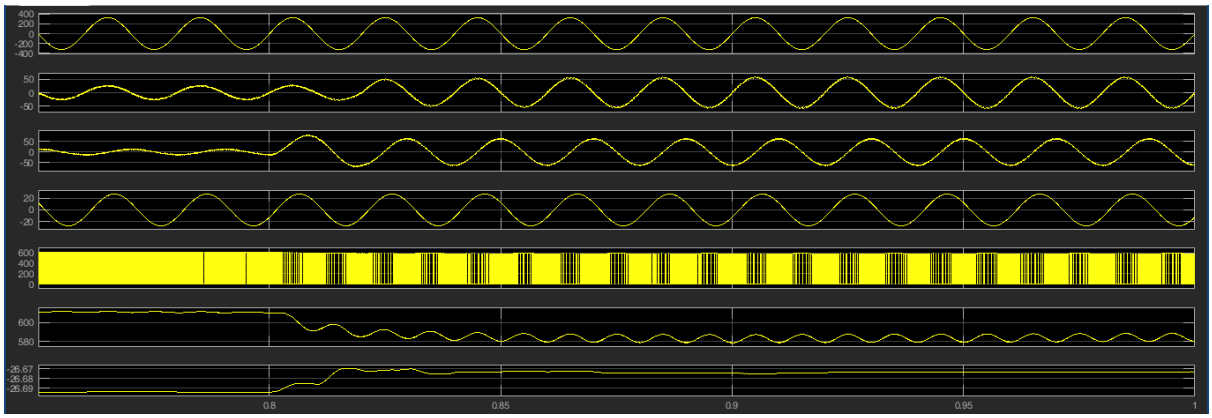

Fig. 5 Output waveform of simulation model

IV. CONCLUSION

The designed statcom operates correctly under hysteresis current control technique and the converter maintains sinusoidal line currents. The DC link voltage remains stable around 600 volts. The statcom effectively injects or absorb the reactive power to support system voltage. The simulation results shows that this model has proper current control, DC link regulation working and statcom compensating properly. The statcom compensates dynamically, when system voltage drops it injects reactive current and when voltage rises it absorbs reactive current.

V. FUTURE WORKS

In the next phase we can work for some other Facts devices like SVC and UPFC in the designed system to have an analysis of power quality improvements by introducing faults and various other disturbance just to know that which device will be suitable for this kind of wind and solar related projects included lots of harmonics in the system.The heating of power system devices and heating of equipment becomes the major issues and this should be resolved as necessary steps.

REFERENCES

1. Mr. Nileshkumar J. Kumbhar “To Study The MATLAB Simulation Of A Single Phase STATCOM And Transmission Line” International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 7, July – 2013
2. Jain, S.K.; Agrawal, P.; Gupta, H.O. Fuzzy logic controlled shunt active power filter for power quality improvement. IEEE Proc. Electr. Power Appl. 2002, 149, 317–328.Wang, H. Zheng, “Route and spectrum selection in dynamic spectrum networks,” in Proc. IEEE CCNC 2006, pp. 625-629, Feb. 2006.
3. Chanchal Katariya1 & Rakesh Shriwastava2 “Power Quality Improvement By Using D-STATCOM: Review” IOSR Journal of Electrical and Electronics Engineering e-ISSN : 2278-1676, p-ISSN : 2320-3331 PP 15-20
4. Salem Rahmani, Abdelhamid Hamadi, et al., “A combination of shunt hybrid power filter and thyristor controlled reactor for power quality.” IN IEEE Transactions on Industrial Electronics, Vol.61, No. 5, May 2014 On P (2152-2164).
5. G.Srinivas, T. Santosh Chaitanya “POWER QUALITY IMPROVEMENT USING FACTS DEVICE (STATCOM)” ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697, VOLUME-2, ISSUE-5, 2015.

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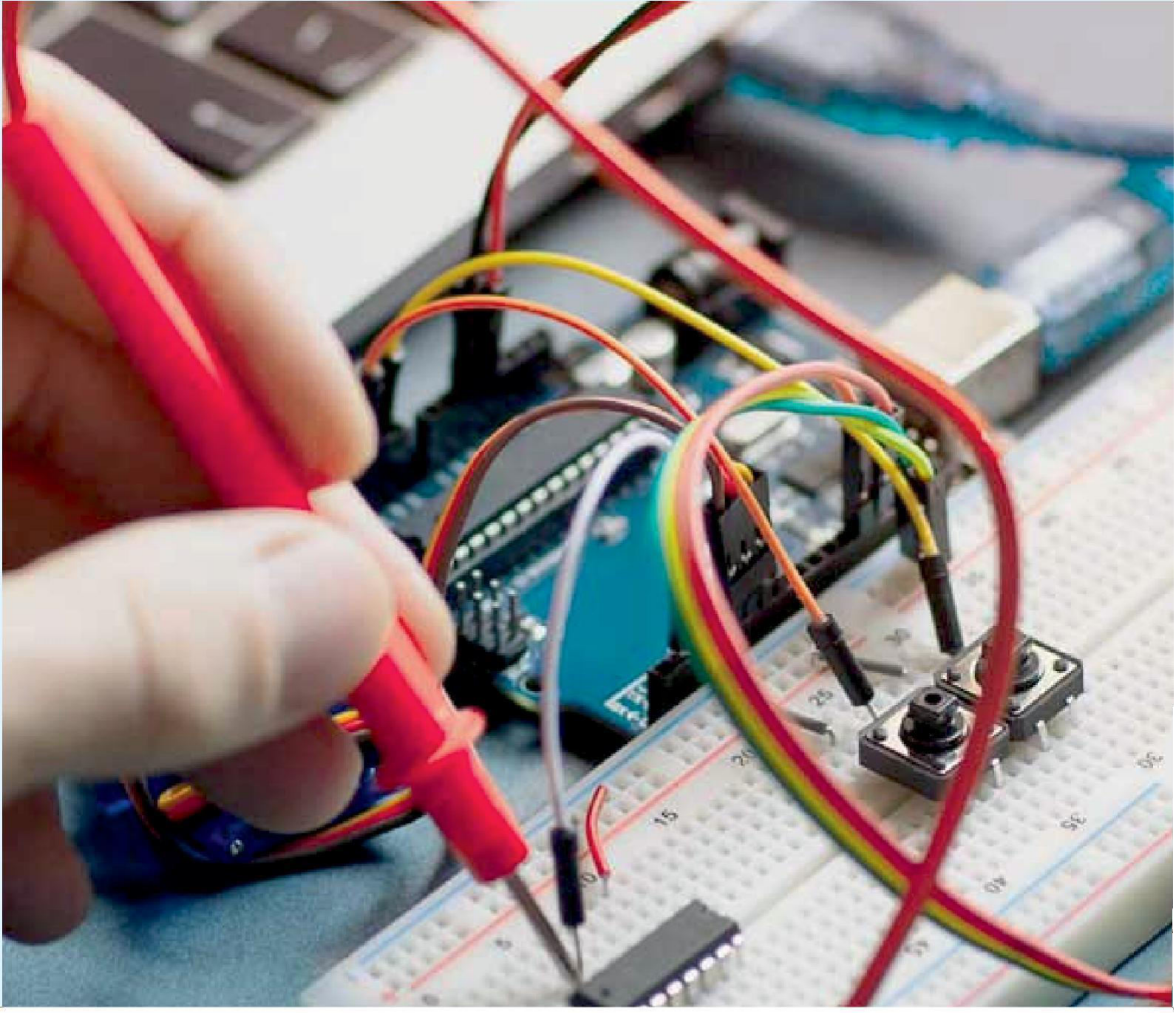
6. G. D. Marques "A comparison of active power filter control methods in unbalanced and non-sinusoidal conditions". IECON'98, August 31- September 4, pp. 444-449.
7. Chen, D., Xie, S.: Review of the control strategies applied to active power filters. In: IEEE International Conference on Electric Utility Deregulation, Restructuring and Power Technologies (DRPT2004), pp. 666-670 (2004).
8. G.W.Chang and T.C.Shee, "A comparative study of active power filter reference compensation approaches", Proc. IEEE Power Eng. Soc. Summer Meeting, Vol.2, July 2002, pp. 1017-1021.
9. Dr. Riesh Diwan, Sheikh Shadaab (2023), "Simulaion of Solar PV for single phase supply and battery charging for electric vehicle", JETIR January 2023 Volume 10, Issue 1.
10. G. Y. Choe, J. S. Kim, B. K. Lee, C. Y. Won, and T. W. Lee, "A bidirectional battery charger for electric vehicles using photovoltaic PCS systems," in Proc. IEEE Veh. Power Propulsion Conf., Sep.2010, and pp.1– 6.
11. J.A. Gow, C.D. Manning "Development of a Photovoltaic Array Model for Use in Power Electronics Simulation Studies", IEE Proceedings on Electric Power Applications, Vol. 146, No. 2, pp. 193



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