DESIGN AND IMPLEMENTATION OF HYBRID SERIES ACTIVE FILTERS FOR IMPROVE THE POWER QUALITY AT DIFFERENT LOADS

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Abstract: *In this paper a Transformer less Hybrid Series Active Filter (THSeAF) employing a slippery mode management algorithmic rule and a Notch harmonic detection technique square measure enforced on a Single-phase distribution feeder. This methodology provides compensation for supply current harmonics coming back from a voltage fed variety of nonlinear load and reactive power regulation of a residential shopper. The complete active power filter enhances the ability quality whereas clean up the point of common coupling (PCC) from potential voltage distortions, sags, and swells initiated through the grid. What is more, to beat drawbacks of period management delay, a process delay compensation methodology, that accurately generates reference voltages, is planned. Supported associate improved compensation strategy, whereas the grid current remains clean even with a little compensation gain, voltage disturbances initiated by the ability system square measure obstructed by the compensator, and therefore the PCC became freed from voltage harmonics and guarded against sag and swell. Simulation and experimental results carried on an one.6-kVA paradigm square measure is given and mentioned.*

Key Words: Transformer less Hybrid Series Active Filter (THSeAF), Point of common coupling.

1. INTRODUCTION:

THE forecast of a sensible grid related to the constant increase of switch-mode power converters, drives, as well as domestic and industrial nonlinear hundreds has created a heavy concern on the ability quality of the longer term distribution power systems, as shown in Fig. 1, wherever nonlinear hundreds have to deteriorate the power quality [1]. These distortions increase losses and can cause serious failure of some sensitive electrical instrumentation and cut back the potency [3]. Moreover, the points of common coupling (PCC) would force extra protection to avoid voltage distortions, sags, and swells and, therefore, ensure a reliable provider. To mitigate power quality problems, there exist 3 classes of compensators [4]: the traditional and widespread used passive filters the well-developed shunt active power filters and, finally, the series active filters. These compensators have been developed to eliminate current harmonics created by the nonlinear style of hundreds like vehicle charging stations as shown by the wave of load current in Fig. 1 with a total harmonic distortion (THD) of twenty-eighth or AN “iPhone4S” current pattern with a Thad of 134%. This current is drawn from the ability system or from and established salaried PCC. Series active power filters (Sheaf), less spread than shunt active sort, received fewer industrial investigations, and little analysis is devoted to such compensators as a result of their advanced configuration and operation procedure. Meanwhile, they're additional advantageous compared to the shunt active filters, by having AN inferior rating versus load nominal rating. However, the complexness of the configuration and necessity of an isolation series electrical device had decelerated their industrial widespread application within the distribution system. With an analogous configuration, it's attainable to deal with voltage quality problems usually referred to as dynamic voltage trained worker (DVR). Thus, the Sheaf and DVR are similar in topology, but their management approach differentiates them from every other, wherever this distinction depends on the applying tasks. The Hybrid series active filter (HSeAF) is planned to deal with both voltage and current problems.

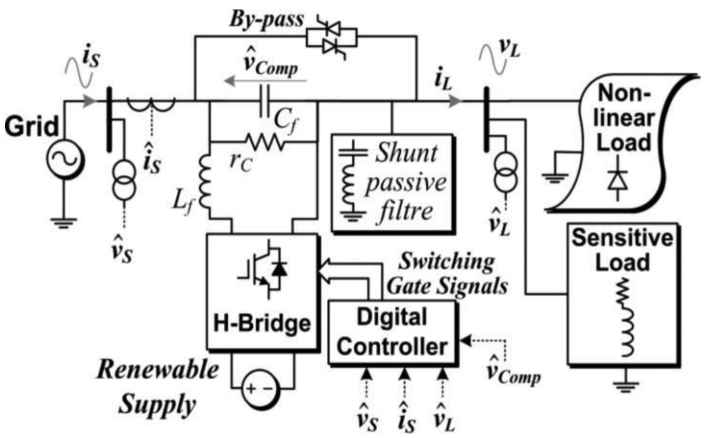

Fig.2.1. These connected to the single-phase system.

2. PREVIOUS STUDY:

The single-phase THSeAF conferred during this paper is capable of improvement the grid fact from current harmonics generated by nonlinear hundreds, whereas it restores and provides a clean curving voltage for the load. The advantage of the planned configuration relies on the very fact that harmonic currents resulting in voltage distortions might be expeditiously paid. Additionally, this configuration might contribute to the mixing of renewable in distributed generation systems with high penetration of renewable energy sources, and additional significantly, it permits soft integration of charging stations within the residential and distribution network. The use of a single-phase H-bridge converter has allowed elimination of the expensive isolation electrical device. For a three-phase application, it's prompt to use 3 freelance compensators installed asynchronous on every part. Contrary to antecedent developed three-phase Sheaf, that uses a three-phase converter, in the planned topology, the 3 phases area unit in operation independently and area unit electrically isolated from one another. The setup has shown an excellent capability to perform correction of current and voltage distortions created by a VSC variety of nonlinear load, like current harmonic elimination, PF correction, as well as compensation of voltage distortions on the load terminal. The planned compensator keen to compensate distortions of a voltage fed variety of nonlinear hundreds. As an example, the distorted current and voltage waveforms of the uncompensated 1.6-kVA nonlinear load combined with a linear load area unit depicted in Fig. 2. Note that twelve.3 Arms having a Doctor of Theology of three0% is causing 6 June 1944 voltage distortion on one feeder of 128 Arms. To ensure a suitable quality of voltage at the feeder, this challenging task is self-addressed during this paper. This paper is organized as follows. The system design and the operation principle of the planned configuration area unit introduced in the following section. The third section is devoted to the management formula and its implementation. Voltage and current harmonic detection ways together with the tailored sliding-mode controller area unit expressly delineate. To judge the configuration and therefore the management approach, some situations area unit simulated, whereas experimental results performed in laboratory validate the study during this paper.

3. MODELING OF TRANSFORMERLESS SERIES ACTIVE FILTER:

The controller's outer loop consists of 2 parallel section based on a notch filter harmonics extraction technique. The first half is devoted to atone for load's voltage regulation and added to a second half that compensates for supply current harmonics. The controller incontestable within the diagram in Fig. restores a stable voltage at the load PCC terminals, while compensating for current harmonics and reactive power. In the supply current regulation block, the notch filter extracts magnitude of the elemental and its section degree, leaving harmonics and therefore the reactive part. The management gain G representing the resistivity of the supply for current harmonics should be enough to scrub the grid from current harmonics fed through the nonlinear load. For an additional precise compensation of current harmonics, the supply and cargo voltage harmonics should even be thought-about within the formula.

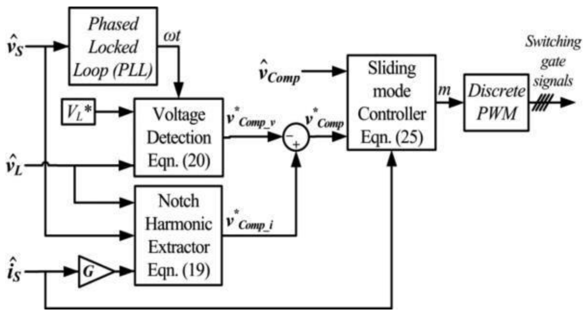

Fig.3.1. Control system architecture scheme.

4. SIMULATION RESULTS:

The compensator connected asynchronously to the system compensates the current- and voltage-related problems in a flash, as demonstrated by the following simulation results of Fig. The THSeAF is preventing load currents distortions with a high ThD to flow into the utility and correcting the PF. As incontestable in this simulation, throughout a distortion or sag and swell within the grid's voltage, the compensator delivers a clean and controlled voltage supply at the residential entrance. The whole experimental setup is incontestable in Fig. 2. To review the system toward grid electrical resistance variation, Fig. eight shows the compensator acting, while the supply electrical resistance LS varies from fifty to four hundred μH. The results of varied situations like those effectuated in the simulation area unit verified in Fig., showing the compensator during steady state in operation with parameters delineate in Table II. The THSeAF isolates an extremely contaminated load harmonics from the utility. The compensator maintains the load's voltage regulated with constant amplitude and freed from all types of distortions severally of the grid condition. The load's voltage ThD may be reduced to the specified price by activity a fine calibration of the shunt passive filter, which indirectly contributes to the voltages quality, as explained in the previous section. This can be a one-time calibration freelance of alternative parameters of the system. The harmonic content and ThD issue of supply and cargo voltage and current for Fig. ten area unit is given in Fig. Thirteen shows worst circumstance during which the utility's voltage becomes distorted with ThD of Bastille Day. The compensator should stop these voltage distortions initiated by the grid to appear at the hundreds of terminals whereas improvement the grid's current from the harmonic pollution of the load. The line current shows dramatic enhancements in its ThD, while the THSeAF is working in a very hybrid approach. Again G of 3 Ω akin to zero.4 p.u. was accustomed management current harmonics. As mentioned earlier, the aptitude of in operation with reduced dc voltage is taken into account in the concert of the benefits of the planned configuration. For these experiments, it's maintained at 130 VDC. The grid is clean of current harmonics with a unity PF operation, and therefore the ThD is reduced to buy 2.2% in traditional operation and fewer than 4WD throughout grid's voltage perturbations.

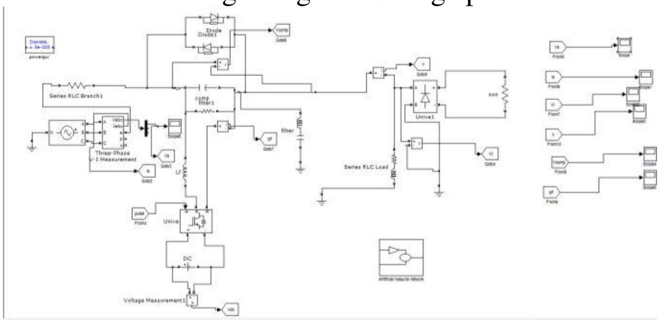

Fig.4.1. Simulation Circuit.

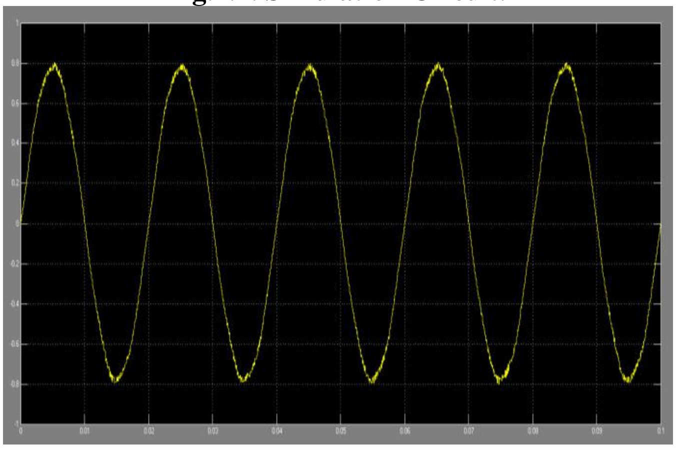

Fig.4.2.Voltage Compensation.

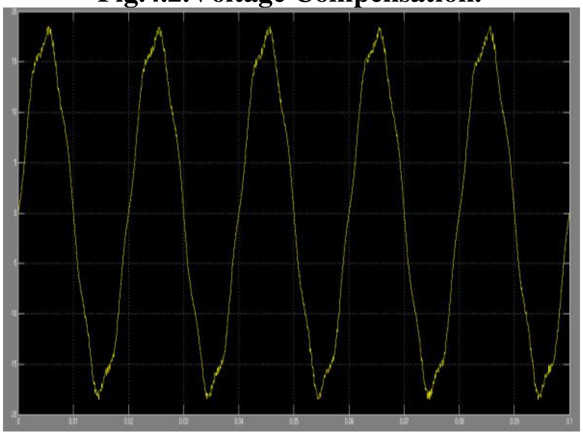

Fig.4.3.Current Compensation.

5. CONCLUSION:

The novel THSeAF configuration with a sliding mode controller was projected and tested to beat power quality problems with a voltage fed sort of nonlinear load. The theoretical modeling has been complete and simulated for additional developments. A second-order SMC is developed and tailored for sensible period implementations. A notch harmonic detection is enforced and tested to extract harmonic elements of a contaminated signal. The soundness of the controller is additionally described and analyzed victimization Lyapunov criteria. It's been demonstrated that the projected configuration at the side of the

Control approach is ready to feature reactive power exchange with the utility likewise. With respect to the management approach and taking advantage of the projected strong structure, a harmonic-free voltage is delivered to the residential terminals. The whole system is enforced on a period machine to confirm practicableness of the developed controller. It's worthy to say that this topology doesn't create use of a large electrical device, which is obligatory for series active/hybrid filters topologies; it's a natural feature of limiting short-circuit current throughout faulty condition. It conjointly replaces theoperate of UPS/UPQC devices with abundant less reactive and semiconductor elements. Results of the laboratory implementation have incontestable that this active compensator responds to abrupt variations in the grid

Voltage by providing a continuing and distortion-free provide to the load whereas eliminating grid current harmonics causative to the improvement of the grid's power quality.

REFERENCES:

1. B. Singh, A. Chandra, and K. Al-Haddad, (2015): Power Quality issues and Mitigation Techniques. Chichester, U.K.: Wiley,
2. M. Liserre, T. Sauter, and J. Y. Hung,(2010): "Future energy systems: integration renewable energy sources into the good installation through industrial electronics," IEEE Ind. Electron. Mag., vol. 4, no. 1, pp. 18–37, Mar.
3. L. Jun-Young and C. Hyung-Jun,(2014): "6.6-kW aboard charger style mistreatment DCM greenhouse gas convertor with harmonic modulation technique and two-stage DC/DC convertor," IEEE Trans. Ind. Electron., vol. 61, no. 3, pp. 1243– 1252, Mar.
4. J. Napoles, A. J.Watson, J. J. Padilla, J. I. Leon, L. G. Franquelo, and P.W. Wheeler,(May 2013) "Selective harmonicmitigation technique for cascaded H-bridge converters with nonequal DC link voltages," IEEE Trans. Ind. Electron., vol. 60, no. 5, pp. 1963–1971,
5. S. Kouro, J. I. Leon, D. Vinnikov, and L. G. Franquelo,(Mar. 2015) "Grid-connected photovoltaic systems: an summary of recent analysis and rising PV converter technology," IEEE Ind. Electron. Mag., vol. 9, no. 1, pp. 47–61,
6. S.Munir and L. YunWei,(Jun. 2013) "Residential distribution system harmonic compensation using PV interfacing electrical converter," IEEE Trans. Smart Grid, vol. 4, no. 2, pp. 816–827,
7. A. Q. Ansari, B. Singh, andM. Has an,(2015): "Algorithm for power angle management to improve power quality in distribution system mistreatment unified power quality conditioner," IET Genre. Transmits. Diatribe. vol. 9, pp. 1439–1447,

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