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PV BASED SHUNT ACTIVE HARMONIC FILTER FOR ELMINATION OF HARAMONICS

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Abstract- This Paper explores about the analysis of the two stage "SOLAR PV" System using "Shunt Active Harmonic Filter". Recently, during the industrial revolution, due to innumerous amount of erratic loads,the current harmonic problem has had an impact on the distributed power system. The SAHF system offers load compensation, power factor improvement, and harmonic mitigation. The three-legged VSC and DC power taken from the PV module are used to build the SAHF system. The first stage of this double-stage system is a DC-DC step-up converter that uses the "MPPT" algorithm. The Perturb and observe algorithm is used to extract the most power possible. In the second stage, hysteresis and the PI controller are used to determine the reference current extraction driven by a current controller and PWM.

Keywords: SAHF, MPPT, P&O, PWM-VSI, VSC

I) Introduction :-

We know that fossil fuels which are extracted from decomposing plants and animals are the primary source of energy for many years.Petroleum and Liquid Petroleum gas are the examples of fossil fuels. Though it is a Natural source of energy over the years it had several disadvantages such as these being exhaustible, cannot be reused again and the main disadvantage is it cause global warming which makes to increase the temperature on the earth's surface. To overcome these difficulties the present trend had been shifted toward non-conventional energy sources such as solar, wind, geothermal, etc. Here we use PV- based systems in our project, these PV-based systems are been widely used in so many applications. Nowadays the power electronic devices had been used in almost all applications and non-linear loads also join these applications which cause to introduction of harmonics in our systems.

According to IEEE standards or electrical equipment works desirably when the harmonic of our system does

not exceeds 5%. We use the passive filters to minimize the harmonics but due the resonance problem and complexity in the design and the number of faults in the filter make the passive filter minimize its usage.

Photo voltaic based Active Power Filter has gained more popularity. By using the APF we can remove the harmonics from the output given by the PV module. Here, there is a drawback for the "Photo volatic system" as the installation cost for Photo Volatic module is quite high, to overcome this drawback we use Active filters.In practical usage of PV-APF filter is depend upon various factors such as temperature and irradiance level.

Most of the researchers are working on various configurations such as CIC, SIC and MSIC. In a 3-Φ system which can be used for both series and shunt compensators had benefits of harmonic compensation and load regulation of voltage. Here, the researchers test the PV-based integrated with universal power quality conditioner to check in both static and dynamic condition. In a multipurpose Photovoltaic system using (LWDF) is recommended as it minimizes the harmonics, injects the active power in the system and provides the grid balancing, for a multipurpose approach improved filter is proposed it can extract the current with resilient of voltage. Now, the analysts introduces the 3-Φ "SEHAF" it will be analyzed using PI controller and fuzzy logic control. When compare to the traditional P & O technique Maximum power point tracking with Petrub and observation based on the Kalman filter is the most faster and accurate researchers keep on analyzing the Photovolatic system when combined with UAF which is based on the resonant proportinol control, in this method it takes core active component from deviated and unstable load more precisely with least Numerical Analyisis.

Our paper mainly focus on the combination of PV module with SAHF and analyzes the performance of various parameters here the extraction of current power theorem is used as it does not need any synchronization. Here it draws the DC from the supply and compares the voltage with the fixed defined voltage by ProportinalIntegral Controller. To transfer DC absorbed by the filter and DC current taken via PWM hysteresis controller is used to track the maximum point of the photovolatic module we use the Perturb and observe algorithm

II) Photo Voltaic and Shunt Active Harmonic Filter Model

The direct current (DC) output generated by Photo Voltaic module is bridged to DC-DC boost converter, which is used to increase the voltage level to a suitable level for the Shunt Active Harmonic Filter system. The Shunt Active Harmionic Filter system is a fruitful method for mitigating disturbances in the system. This is accomplished by injecting an alternating current (AC) with the same size as the disturbances but with a phase shift of 180^0 which cancels out and removes the disturbances.

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(i) Generalised Photi Voltaic Model

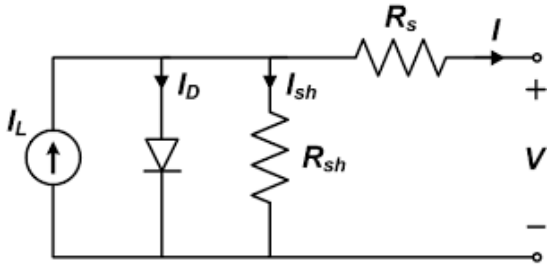

Fig 1: Circuit Diagram of Photo Voltaic Cell

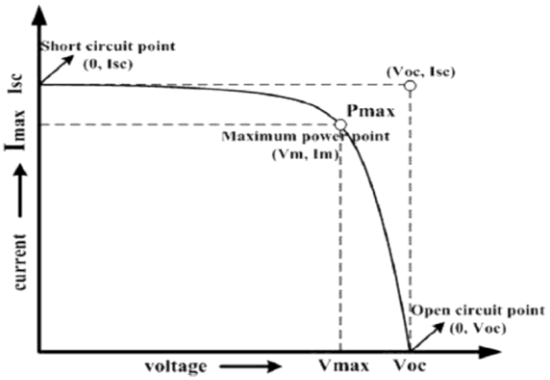

Fig 2: Current & Voltage Features of Photo Voltaic Cell

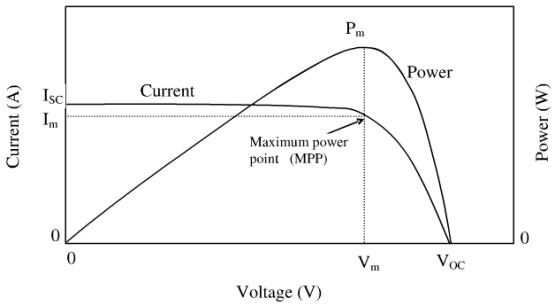

Fig 3: Power and Voltage features of Photo Voltaic Cell

Here, Photo Voltaic system contains solar module where the photovoltaic effect takes place, i.e, the process of conversion of light energy to electrical energy. The diagrams which are reprsented in the above. In the above figues represent the MPPT of the PV cell in most efficient manner.

The current in the diode is reprsented by SHOCKLEY equation, i.e

Id=Is[exp(qv/nkt)-1]

(2.1)

Opencircuit voltage and shortcircuit current are obtanied by setting voltage equal to zero for shortcircuit current and current equal to zero for opencircuit voltage, i.e., (V=0 for Isc, I=0 for Voc)

Voc=nkt/qIn[I/I0]

(2.2)

Vmp=Voc-KT/qIn[(Vmp/nKT/q)+1] (2.3)

FF=(Vmp*Imp)/(Voc*Isc) (2.4)

η =FF*Voc*Isc/Pin

(2.5)

(ii) Universal APF

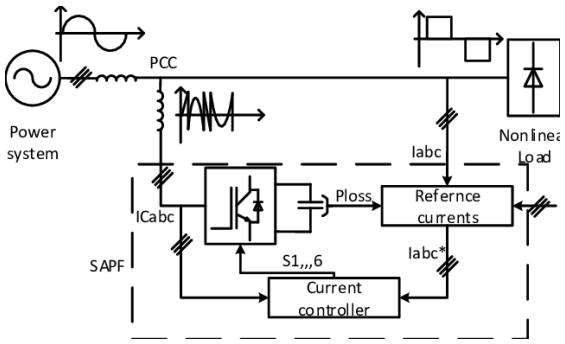

Fig 4: Schematic diagram of SAHF

The presence of abnormal loads in the system introduces the harmonics in the system, which are multipled with the core component of the current. Here, the shunt active harmonic filter helps to eliminate the harmonics by injecting a current of same magnitude with an opposite phase shift of 180^0 .

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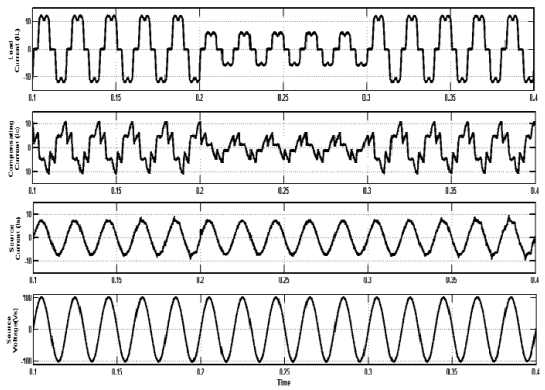

Fig 5: Waveform of SAHF

The presence of abnormal loads in the system introduces harmonics in the system, which are multipled with the core property of the current. Here, shunt active harmonic filter helps to eliminate the disturbances by inoculating a current having of same magnitude with an opposite phase shift of 180^0 . The SAHF produces the instance of current with the help of PI controller or fuzzy controller. Here, the base current which is needed to set the dc link capacitor are transformed to switching Pulse via pulse width modulation.

$V_s(t)=V_{sm}\sin\varphi t$ (2.6)

$I_s(t)=I_L(t)-I_h(t)$ (2.7)

$I_L(t)=I_1(\sin\varphi t+\Phi_1)+\Sigma I_h\sin(n\varphi t+\Phi_h)$ (2.8)

$P_L(t)=I_L(t)*V_s(t)$ (2.9)

$P_f(t)=V_{sm}I_1\sin^2 t*\cos =V_s(t)*I_s(t)$ (2.10)

$I_s(t)=P_f(t)/V_s(t)$ (2.11)

III PV BASED SAHF SYSTEM

This system combines a photovoltaic (PV) array with (SAHF) to minimize the disturbance caused by a nonlinear load.

Here PV array system uses a (P&O), (MPPT) controller to maximize the power output of the Photo voltaic modules. The output of Photo Voltaic array system is then linked to the Shunt Active filter system linked to shunt configuration with the nonlinear loads

The Shunt active filter system is executed with a (PWM),(VSI) controller, which generates switching pulses to control the SAHF. An HYSTERIS controller is used to produces the switching pule for Voltage source inverter.

The SAHF system also includes a PI controller, which extracts the core current from the main source this core current is now weigh up with the supply current to produce switching pulses for SAHF. By doing so, the Shunt Active Filter produces a current of same immensity of base current but with a 180^0 shift, on cancelling the disturbances makes it free from disturbances.

Overall, PV-SAHF system is an effective solution for mitigating harmonic distortion in power systems, while also generating renewable energy from PV modules.

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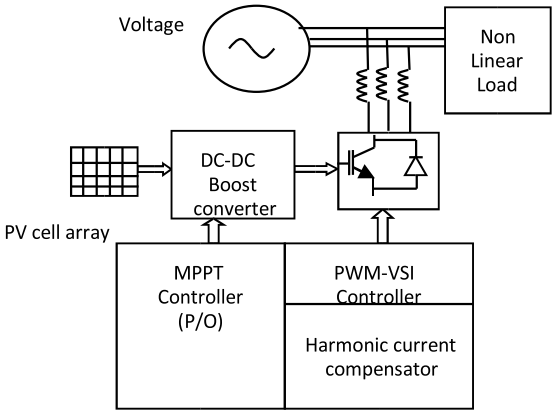

Fig.6.Block diagram ofPV-APF system

i)DC-DC Boost Converter

The DC-DC step up converter is a device that increases the voltage of a DC power source, such as the output of a PV module. The converter consists of an IGBT that is managed by a PWM signal generated by an MPPT controller. The converter also includes two energy depository elemnts.

Here, when the IGBT switch is closed the current moves in the depository elements and produces the attracting filed. Here, when the switch is open there would be require less energy. As, the result the direction of the depository element reverse and makes capacitor charged with the help of diode. hence the corresponding output is shown in the below equations.

Since, Photo Voltaic output differs so in order to avoid rthat we use MPPT algorithm to get maximum working conditions. Here the output is obtained in the DC format when it is passed to DC-AC convertor can be used for so many applications in electricity. This converts the DC voltage into AC voltage, making it compatible with grid voltage.

$$d(V*I)/dt=0 \quad (3.1)$$

$$V_{mp}=V_{oc}-KT/qIn\{V_{mp}/Nkt/q\}+1\} \quad (3.2)$$

ii)DC-AC Boost Converter

It seems like you are describing a 3-Φ, bifacial DC-AC converter system that uses a six-leg topology. The system generates a 3-Φ AC supply by delaying the switching of three of the inverter arms by 120 degrees. The semiconductor switches of the inverter are gated through pulse width modulation (PWM) pulses generated by an SAHF (synchronous average harmonic frequency) controller.

To extract the base current ,a (proportional-integral) controller is used. The 3-Φ of the current is examined by unit sine wave which is in same phase with the voltage. The sin vector is convoluted by the peak reference current, Imax, which is evaluated by the PI controller, to produce the desired current.

Overall, this system is likely used in power electronics applications to convert DC power into AC power and control the voltage and frequency.

$$U_{sa}=V_{sa}/V_{sm}=Sin\varphi t$$

$$U_{sb}=V_{sb}/V_{sm}=Sin(\varphi t-120^0)$$

$$U_{sc}=V_{sc}/Vsm=Sin(\varphi t+120^0) \quad (3.3)$$

Now,for reference current

$$I_{sa}^*=I_{max}^*U_{sa}$$

$$I_{sb}^*=I_{max}^*U_{sb}$$

$$I_{sc}^*=I_{max}^*U_{sc} \quad (3.4)$$

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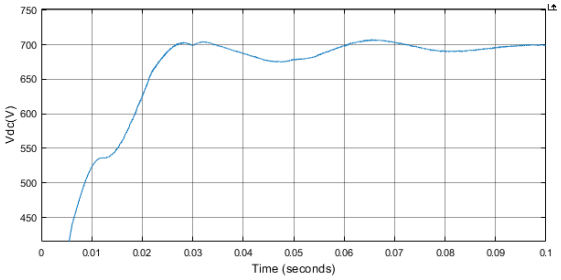
IV SIMULATION RESULT AND ANALYSIS



(a)

Fig 7: Vdc

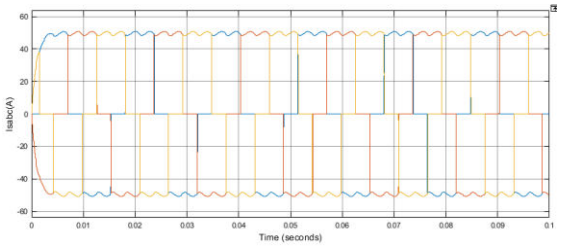


Fig 8: Source Current Without Connection of SAHF

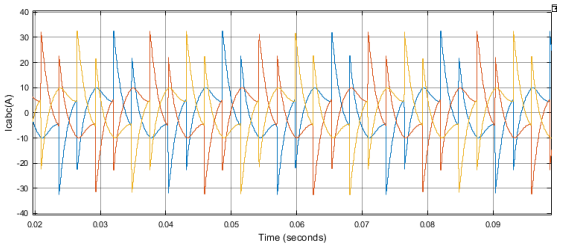


Fig 9: Compensating Current

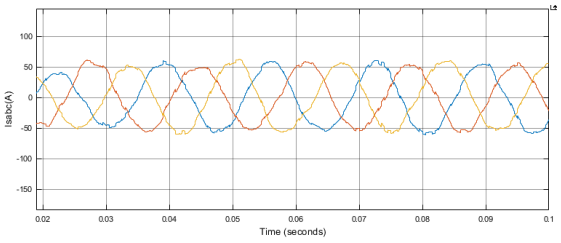


Fig 10: Source Current With SAHF

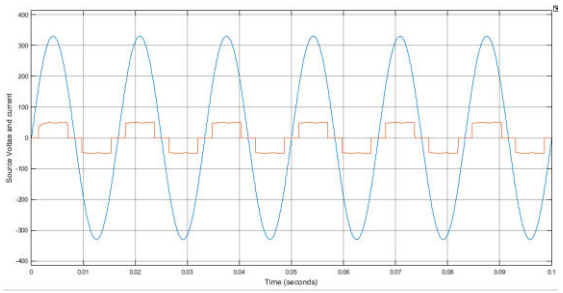


Fig 11: Power Factor Without Connection of SAHF

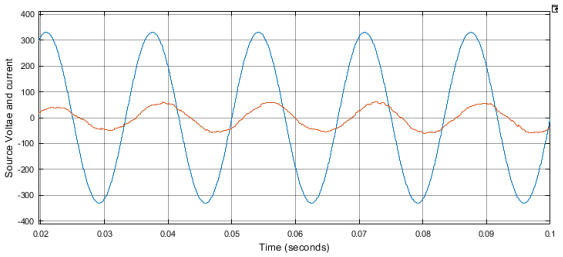


Fig 12: Power Factor With SAHF

The Photo Voltaic arrangement is evaluated. The Photo Voltaic array supplies power to the SAHF system, it starts producing current based on the base current taken from the Source. The Power Voltage and current and voltage features are been showed in tha above Figure 7. The MPPT of the Photo Voltaic array is determined based on the obtained characteristics, and a Perturb and observe Maximum power point tracking controller are used to examine the maximum operating conditions of the system.

Fig 8-10 show source current with and without SAHF. When SHAF is not connected to circuit, it consists of higher-order disturbances due to abnormal loads. Now, the pulse width modulation voltage source invertor generates the compensating current where

it is having same magnitude, but opposite phase shift leads to removal of the harmonics.

Fig 11-12 shows the power factor before and after connection with SAHF.

V CONCLUSION

The study involves implementing (P&O) based (MPPT) technique using boost converter to improve the efficiency of the Photo Voltaic array system. The SAHF system is shown with a pulse-width modulation voltage-source inverter controller, here we use HYSTERSIS controller which helps to generate pulses. A proportional integral is used to extract he current and control the voltage derived from the system.

The study discusses the about the analysis of photo Voltaic based Shunt Active Harmonic Filter under normal and abnormal conditions using matlab software. The results indicate the disturbances which are obtained satisfies the standards the main feature of our paper is not only minimizes the disturbances but also helps to better's the power factor. The proposed model has main advantage i.e it economically preferable when compared to other power electronic devices.

Overall, the study suggests that explained configuration of PV-SAHF system can precisely mitigate harmonics and improve power factor, while being cost-effective and easy to assemble.

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