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Controlling of Active and Reactive Power Using "IRPT" with Renewable Source

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Abstract:

In present time, The worldwide energy demand is increased. This energy demand is full filled with advancement in power electronics technology. The PV module consist of several pv cells connected in series in order to ensure useful output voltage level. The electrical power supplied by PV power generation system depends on solar radiation and temperature. The efficiency of given system get increased by using MPPT. A MPPT circuit which allows the maximum output power of the PV array. The MPPT algorithm, the synchronization of the inverter and connection to the grid with P-Q Theory. This project studies the possibility in variation of load current in three phase system based on P-Q Theory. A PV system with MPPT connected to a three phase grid is presented. For the non linear load the active filter currents obtained from the instantaneous active and reactive powers, this will getting from P-Q Theory.

Keywords — **Active Power , Reactive Power , Instantaneous Theory , Renewable Source.**

I. INTRODUCTION

Our society is fully dependent on the power generating station. The power system comprises of three parts i.e. generation, transmission and distribution of electrical power. Now a days due to lake of the Non-renewable sources like coal etc. So due to day by day increasing demand of electricity and fulfill this demand our society is turns towards the renewable sources like wind energy and solar energy. Use of linear electrical loads like transformers and motors etc. There is a problem of unbalance of current waveforms and unbalancing in power system. Voltage unbalancing due to the fluctuation of the reactive loads. This reactive power is compensated by the series compensator and shunt compensator. Among of these STATCOM is most effective device for mitigation of voltage Fluctuation and unbalancing.

In recent years, electric utilities and end users are aware about the power quality. There has been an increased emphasis and concern for the quality of power delivered to commercial establishments, factories and residences. Power systems

voltage and current waveforms are distorted by the use of power converters. Because of use of linear electrical devices, the power system is affected from different types of problems like voltage sag, voltage swell, stability, frequency deviation, faults etc. voltage, current and frequency of a power system are frequently violated because of this problems.

II. ABOUT DSTATCOM

A DSTATCOM as shown in Figure 1 consist of a two level voltage source converter (VSC), a dc energy storage device, a coupling transformer connected in shunt with the ac system, and associated control circuit. 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 DSTATCOM output voltages allows effective control of active and reactive power exchanges between the DSTATCOM and the ac system.[3]
The VSC connected in shunt with the ac system provides multifunctional topology which can be used for up to three quite distinct purposes like:-

1. Compensation of reactive power
2. Correction of power factor
3. Elimination of current harmonics

The design approach of the control system determines the priorities and functions developed in each case. In this case, DSTATCOM is used to regulate voltage at the point of connection.

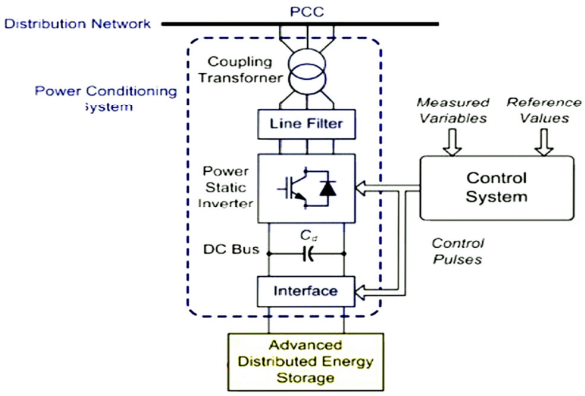


Figure 1

DSTATCOM involves following parts:

Isolation Transformer:
It connects the DSTATCOM to the distribution network and its main purpose is to maintain isolation between the DSTATCOM circuit and the distribution network.

IGBT based converters:
These converters are used to generate the output voltage which is controlled in magnitude and phase angle to generate required lagging or leading reactive current, depends on the load.

L-C filter:
The L-C filter is generally used to diminish harmonics and correlate converter output impedance to enable multiple parallel inverters to share current. The L-C filter is preferred in according to the type of the system and the harmonics are present at the output side of the converter.

Control block:
Control block is used to generate compensating current as per requirement. It can also control the external devices like manually switched capacitor banks. These control blocks are designed based on the different control theories like IRPT, SRFT, FT etc.

Controlling Scheme of DSTATCOM

The main objective of any controlling scheme is that it should have a fast response, flexible and easy to implement. The control algorithms of a DSTATCOM are mainly implemented in the following steps:

- Measurements of system voltages and current and signal conditioning
- Calculation of compensating signals
- Generation of firing angles of switching devices

As per following steps, Instantaneous Reactive Power Theory is the flexible control scheme. This method is also easy to implement and it should give fast response compare to the other controlling schemes.[3]

III. HYSTERESIS CURRENT CONTROLLER

The hysteresis pulse-width modulation, consists in direct forcing of the line current flow according to the reference current signals i^*_A; i^*_B; i^*_C. This type of the modulations employed for the nonlinear control circuit with the hysteresis relays. The basic block diagram of hysteresis current control PWM is shown in fig.2.

When the instantaneous value of the line phase current exceeds its reference value than the respective grid phase is instantly connected to the negative node of the DC-link voltage. Otherwise the grid phase is switched to the positive node in the DC-link. This process is carried out simultaneously and independently for two other phases.[4]

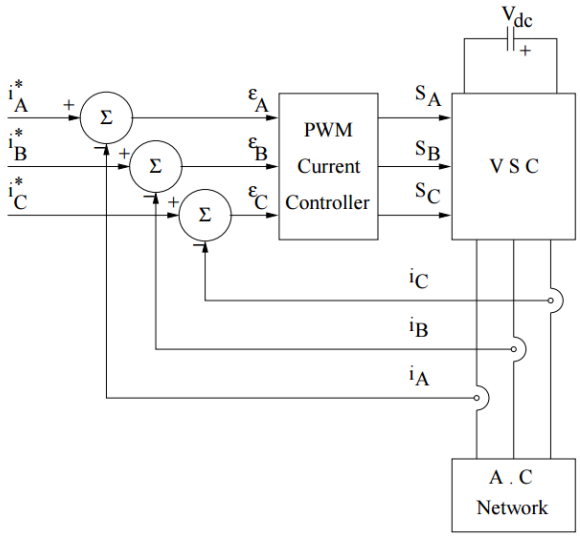


Figure 2

IV. INSTANTANEOUS REACTIVE POWER COMPENSATOR

Various type of reactive power compensators has been researched and developed to provide power factor correction. Notably, the static reactive power compensator comprising switching devices, which requires practically no energy storage components such as capacitors or reactors, was proposed by Gyugyi. However, it has been considered that the compensators eliminate only fundamental reactive power in steady state. The generalized control strategy including the compensation of the fundamental reactive power in transient state. In this theory compensator can eliminate not only the fundamental reactive power in transient state but also some harmonics currents.

V. BLOCK DIAGRAM

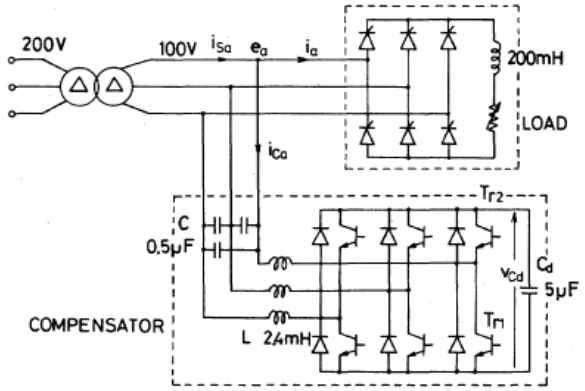
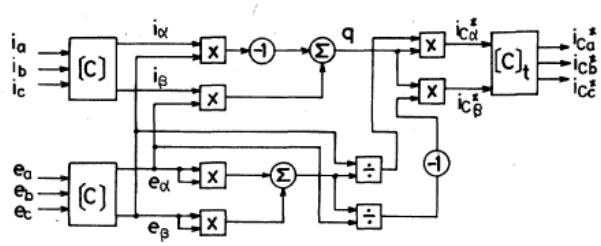


Figure 3

Figure 3 show that the compensator generate reactive power as per the requirement. The block diagram also control the transmission line. In this diagram transistor, diode, dc capacitor, filter capacitor and filter reactor are use.



$$[C] = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & -1/2 & -1/2 \\ 0 & \sqrt{3}/2 & -\sqrt{3}/2 \end{bmatrix}$$

Figure 4

The figure 4 show the control block of instantaneous reactive power compensator. In this control block the value of C is very important. Fig shows the control circuit of the compensator. The references of the compensating currents iCa*, iCb* and iCc*are calculated instantaneously without any time delay by using the instantaneous voltages and currents on the load side. The control circuit consists of several analog multipliers, dividers, and operational amplifiers. Note that neither low-pass filters nor integrators exist in the control circuit [3].

VI. CONCLUSION

In this paper Instantaneous Reactive Power Theory control algorithm of DSTATCOM is discussed above, the appropriate method is applied to mitigate voltage sag and voltage swell, thus improving power quality using DSTATCOM.

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