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Emphasizing power virtue by harmonics and resorting frequency in power Grid

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ABSTRACT

Today energy sources, oil, coal, and natural gas, are running out, can tomorrow's energy come from solar? Yes it can, this solar energy is typically interfaced to a power grid through Grid-tie inverters. The frequency mismatch between the grid and the interfacing circuit often generates harmonic resonances, frequency mismatch thus yielding reduced power quality. As the penetration of renewable energy and other forms of distributed generation increases, the interaction issues between the sources and interfacing devices have become an important research area in order to guarantee the grid stability and power quality. Frequency mismatch problems, Harmonic regulation are solved to guarantee power quality. The existing concept used was passive filter to reduce the harmonic contents at the output voltage. In the proposed idea Active filters is used to avoid harmonics. This paper discusses the design issues of such parameters and proposes modifications to the previously presented methods.

Keyword: PV, Synchronizing system, Grid connected system.

INTRODUCTION

Today, the demand for green energy is very strong and energy source oil, coal and natural gas are running out can tomorrows energy come from wind and solar? Some think so, but others believe that the atmosphere is too vast ant that we cannot harness wind power on a major scale. Wind, blowing constantly in swift currents around the world, offers enormous energy potential. In spite of man's ability to create mighty instruments, he has not been able to harm totally this awesome power of nature. The wind remains beyond a desirable o of control in spite of all our technological advances. One possible option for meeting this demand is to convert solar energy into electrical energy. This process is supported by the photovoltaic (PV) solar panel, which produces various DC output voltages and output power. In the conversion from DC to AC power, dedicated inverters maintain the right working point for the solar panel to maximize its use of solar energy. In using solar energy as renewable energy, solar cells offer a potential attractive means for the direct conversion of sunlight into electricity with high reliability and low maintenance, as compare with solar-thermal systems. The present disadvantage is high cost to build it and the difficulty of storing large amounts of electricity for later use. The cost of solar cells is expected to be considerably reduced when cells are manufactured in large quantities using new production technique for obtaining ribbons or sheets of single crystal silicon.

Issues and challenges involved in the present work: In the existing system we have passive filters to reduce the harmonics andPWM inverters can control their output voltage and frequency simultaneously. And also they can reduce the harmonic components in load currents. These features have made them power candidate in many industrial applications such as variable speed drives, uninterruptible power supplies, and other power conversion systems.

However, the reduction of harmonic components in output currents is still the focus of major interest to alleviate the influences of electro-magnetic interferences or noise and vibrations. In existing system single-phase seven-level PWM inverter is presented to alleviate harmonic components of the output voltage and the load current. Operational principles with switching functions are analysed.

Issues of existing system: In existing system we use passive filters to reduce harmonics. Even though we have advantage in passive filters, there is also some drawbacks in the existing system. The components used in passive filters are larger in size and it require high maintenance. The operational cost is high. While using passive filters, there is no isolation between input and output.

Scope and objectives of the present work: The aim of this paper is to model synchronizing circuit for PV generation, maintain the frequency and to improve the power quality by reducing the harmonics. To maintain frequency we use zero crossing detector and to reduce the harmonics we use active filters.

Formulation of the Problem

Power Quality is one of a major constraint in power system transmission, distribution and generation. The abnormal growth of Electric Energy consumers, power demand is also being increased. Harmonic to the grid may bring,

1. Additional power losses
2.Cause device malfunction, and
3.Even induce system instability

Methodology of Present Work:

Zero crossing detector technique: Zero crossing detection is the most common method for measuring the frequency or the period of a periodic signal. When measuring the frequency of a signal, usually the number of cycles of a reference signal is measured over one or more time periods of the signal being measured. Measuring multiple periods helps to reduce errors caused by phase noise by making the perturbations in zero crossings small relative to the total period of the measurement. The net result is an accurate measurement at the expense of slow measurement rates. Zero crossing is the point of choice for measuring phase and frequency. The reference is usually easy to establish and the signal's amplitude rate of change is maximum at signal zero. Phase synchronized triggering requires placing additional constraints on zero crossing detection. Depending upon the frequency for a particular application and the degree of signal processing, these methods can require high-speed processing components that are too expensive for low cost applications.Fairchild Semiconductor has developed special purpose integrated circuits for silicon controlled rectifier (SCR) and triac control for low power applications. Such optical -isolated devices offer an additional advantage of electrical isolation between instrumentation and gate firing circuits. However, the design has no provision for mitigating multiple zero crossing nor does it compensate for diode forward voltage drop. Whether measuring period, frequency, or phase, the sources of errors are the same. When measuring a signal for the purposes of synchronization, fast and accurate frequency measurements are required. This requirement also translates into low phase distortion that can be introduced by frequency filtering and by measurement delays. The purpose of the instrumentation circuits and techniques discussed below are to reduce frequency errors due to multiple zero crossings (more than two per period) and reduce phase errors by advanced or delayed zero crossing.

Hybrid PWM closed loop technique: In PWM technique pulses of unequal widths are generated. The pulse is generated by comparing a sinusoidal wave (modulating signal) of frequency 50HZ against a triangular wave (carrier signal). Each comparison gives one if the modulating signal is greater than the triangular carrier else zero. The number of pulses per cycle is decided by the ratio of the triangular carrier frequency to that of the modulating sinusoidal frequency. The main inverter refers to H2 Bridge and the auxiliary inverter refers to H1 Bridge. Since the low switching losses during PWM operation is required, the main inverter will operate only at square wave mode and auxiliary inverter will operate at PWM mode. In practical, if a single chip is used to generate the PWM signals, it normally has only one carrier signal with six PWM channels; nevertheless, the hybrid multi-level inverter requires 12 PWM channels for both main and auxiliary inverter. Thereafter, the referent signal of sinusoidal PWM (SPWM) used for the auxiliary inverter is modified.

iii) Shunt Active Filter: Shunt Active filters provide a fair solution to mitigate problems encountered due to harmonics on utility side. Harmonic resonance is not an issue with this type of filter. The filters are used for nonlinear load having time dependent harmonics. There are several topologies are considered such as Shunt active filter, series active filter, hybrid active filter with CSI and VSI inverter topologies are available. These filters are sized based on how much harmonic current is to be filtered.

Present work:
i) Grid Tie Inverter:

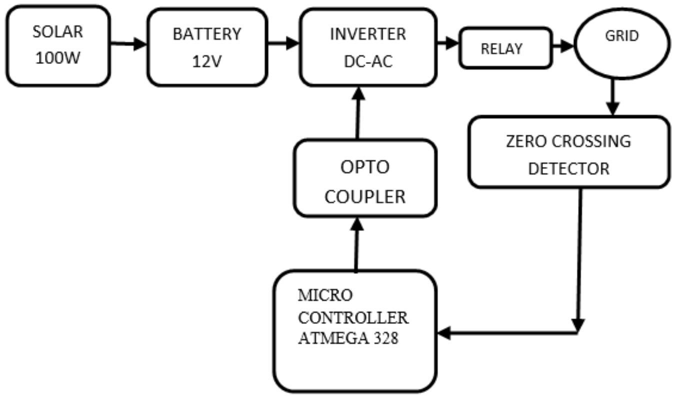

Fig.1.Block diagram using grid tie inverter

In above block diagram solar energy is the primary energy source. This DC energy is stored in the battery and it is fed to the inverter, which convert DC to AC. The microcontroller generates gating signal which is used to control the driver circuit. Synchronization takes place, to measure whether the output voltage of inverter is same as the grid output. To maintain the frequency we use zero crossing detector technique.

ii) Shunt Active Filter

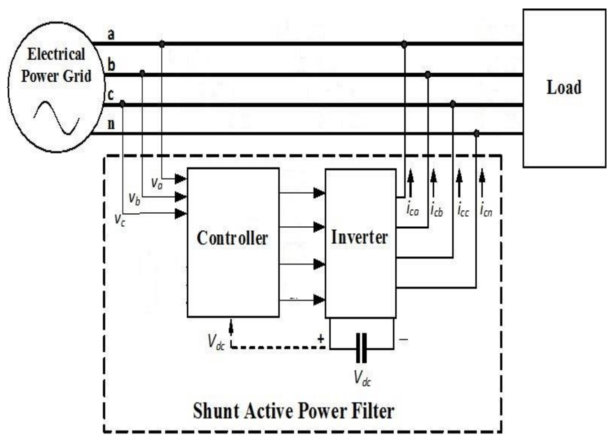

Fig.2.Block Diagram of Shunt Active Filter

In the above block diagram if the load gets unbalanced in the power system there occurs current harmonics in the neutral line. To reduce harmonics shunt active filters are used. In the active filter, TLP350 microcontroller is used, to give pulse to the inverter.

Experimental Work – Details

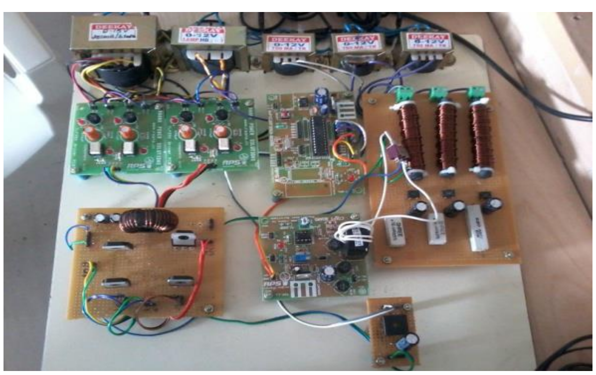

Fig.3.Hardware Model – Harmonics

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Fig.4.Hardware Model- Grid Tie Inverter

Harmonics mitigation passive filters were used traditionally, but due to certain drawbacks of resonance due to matching with line impedance, can compensate single harmonic at a time, bulky in weight they are not much in use. With development of semiconductor devices active harmonics filters with different current control strategies are extensively used. Shunt Active filter can be formed from topologies like CSI, VSI. There are many current control methods used in active filters.

Grid Tie Inverter: The Grid Tie inverter is the heart of the PV system and is the focus of all utility-interconnection. An inverter is a device that converts direct current to alternating current. The PV inverters are classified into two categories, Stand Alone Type and Synchronous.

RESULTS AND DISCUSSIONS

In our paper we have preferred renewable energy to deal with power demand and power quality. Frequency and harmonics are the two main parameters affiliated to power quality improvement. In this grid tie inverter system is most suitable to overcome the power demand and power quality is improved using synchronization technique. For matching the frequency, we go for zero crossing detector. In case of harmonics shunt active filters are used. In the results we have shown the variation before using filter and after using filters. Thus the power virtue has been emphasized.

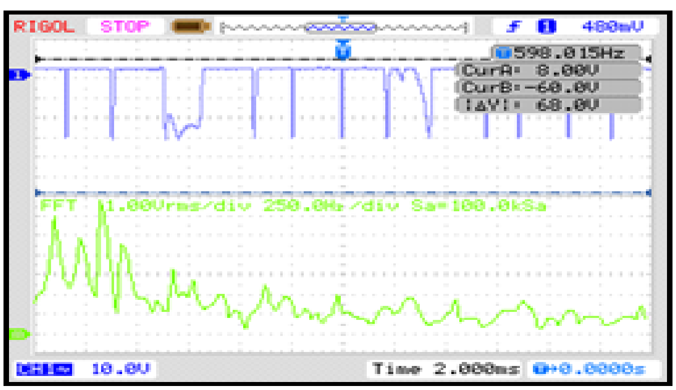

Fig.5.Neutral Current Harmonics Without Filters

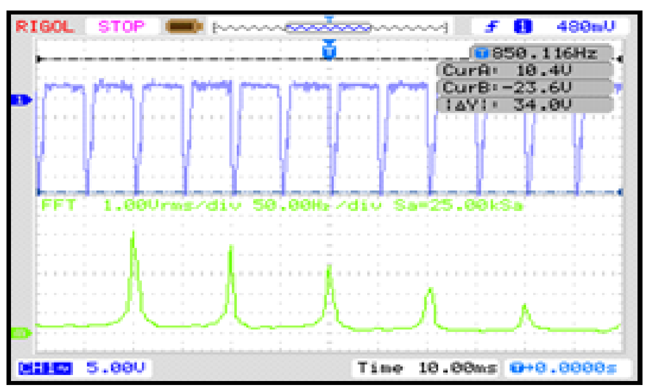

Fig.6.Neutral Current Harmonics With Filters

CONCLUSION

In this paper we have shown "An advanced grid-tied PV system" which is suitable to produce more energy from renewable energy sources. Grid tied system is more power efficient than a conventional solar system. It ensures full utilization of solar energy whereas battery discharge rate is 60% to 65%. There is harmonic injection in the grid due to nonlinear load on utility side. To mitigate this harmonics, Shunt active filter with VSI topology using Hybrid PWM closed loop technology is used to reduce harmonic distortions. Zero crossing detectors is used to eliminate frequency deviation. The deviation of the frequency from a set value can be used as feedback to adjust the power production and ensure that power quality is maintained. We can attain the condition of power generation equal to power demand based on input resources. Active filters operation rating and control is briefly analyzed. Harmonic level in Supply current is 27.32% without active filter implementation, after using active filter it is improved to 17.94%.

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