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Power quality improvement of self contained induction generator

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ABSTRACT- *As a promising renewable alternative, the wind power is one of the significant sources of generation. Reactive power compensation and harmonic reduction in a low voltage distribution networks for integration of wind power to the grid are the main issues addressed in this paper. This paper proposes a control scheme based on instaneous Pq theory for compensating the reactive power requirement of a three phase grid connected wind driven induction generator as well as the harmonics produced by the non linear load connected to the PCC using STATCOM. The proposed control scheme is simulated using MATLAB/SIMULINK. The Simulation results are presented in this paper.*

The integration of wind power to grid introduces power quality issues, which mainly consist of voltage regulation and reactive power compensation. Induction machines are mostly used as generators in wind power based generations. Induction generators draw reactive power from the grid to which they are connected. Therefore, the integration of wind power to power system networks is one of the main concerns of the power system engineers. The addition of wind power into the electric grid affect's the power quality [1]. During the last few years, power electronic technology plays an important role in distributed generation and integration of in d energy generation into the electric grid[2]. A non-linear load on a power system is typically a rectifier (such as used in a power supply), some kind of arc discharge device such as fluorescent lamp, electric welding machine, or arc furnace because current in these systems is interrupted by a switching action, the

1.INTRODUCTION

current contains frequency components that are multiples of the power system frequency. It changes the shape of the current wave form from a sine wave to some other form and also create harmonic currents in addition to the original(fundamental frequency) AC current. The most used unit to reduce the harmonics produced by the non linear load. Compensate for reactive power in the power systems are either synchronous condensers or shunt capacitors, the latter either with mechanical switches or with thyristor switch, as in Static VAR Compensator (SVC). The disadvantage of using shunt Capacitor is that the reactive power supplied is proportional to the square of the voltage. Consequently, the reactive power supplied from the capacitors decreases rapidly when the voltage decreases [3]. To overcome the above disadvantages; STATCOM is best suited for reactive power compensation and harmonic reduction. It is based on a controllable voltage source converter (VSC). By control of the voltage source converter output voltage in relation to the grid voltage, the voltage source converter will appear as a generator or absorber of reactive power [6]. Fig 1 show the block diagram of grid connected system. In this 3-phase separately excited induction generator feeding non linear load has been presented. A STATCOM is connected at the point of common coupling with this system in order to compensate the reactive power requirements of induction generator as well as load and also to

reduce the harmonics produced by the non linear load

1.1 WHY REACTIVE POWER ANALYSIS ?

When a voltage and/or current waveform is distorted, it causes abnormal operating conditions in a power system such as:

Voltage reactive powers can cause additional heating in induction and synchronous motors and generators.

Voltage reactive powers with high peak values can weaken insulation in cables, windings, and capacitors.

Voltage reactive powers can cause malfunction of different electronic components and circuits that utilize the voltage waveform for synchronization or timing.

Current reactive powers in motor windings can create Electromagnetic Interference (EMI).

Current reactive powers flowing through cables can cause higher heating over and above the heating that is created from the fundamental component.

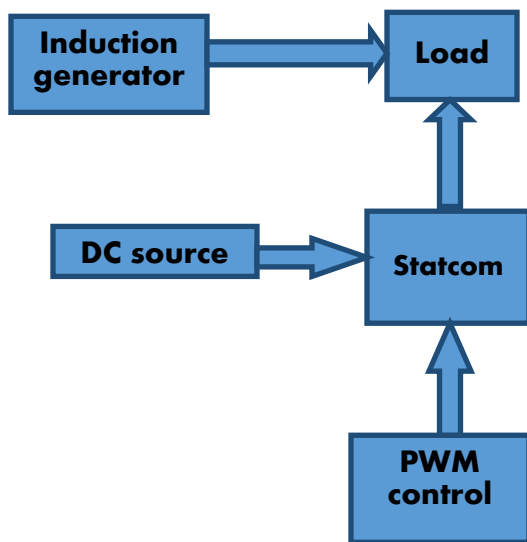
Current reactive powers flowing through a transformer can cause higher heating over and above the heating that is created by the fundamental component.

Current reactive powers flowing through circuit breakers and switch-gear can increase their heating losses.

RESONANT CURRENTS which are created by current reactive powers and the different filtering topologies of the power system can cause capacitor failures and/or fuse failures in the capacitor or other electrical equipment.

False tripping of circuit breakers and protective relays.

2. RELATED WORK



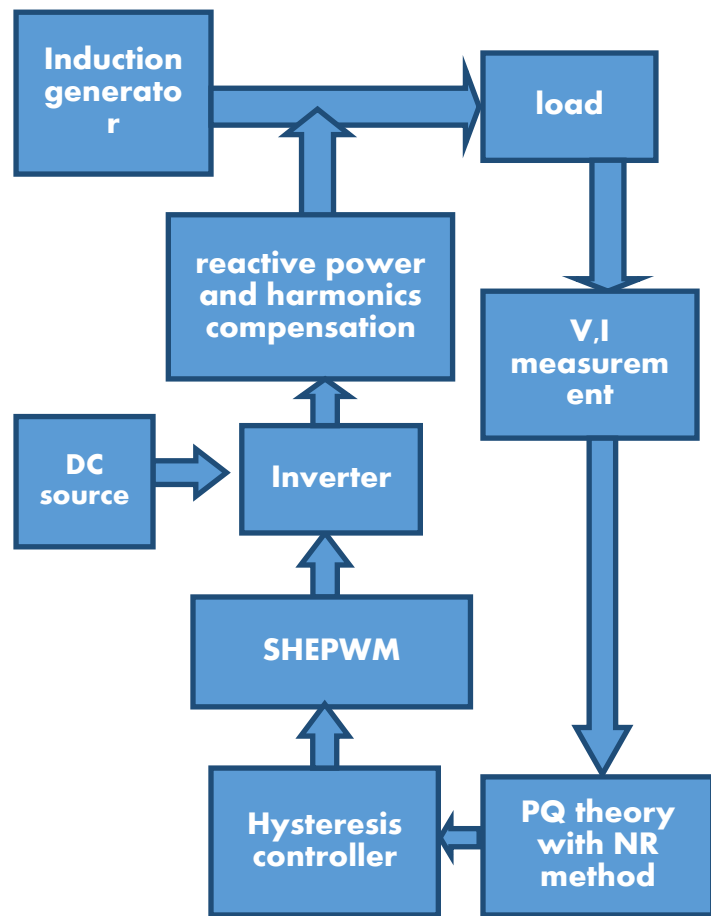
In existing method open loop control is implemented so reactive power compensation is not too good. And response time for compensating reactive powers is high. So power losses are high. Normal PWM technique is used so harmonics are also high.

2.1 Proposed system

In proposed method we implemented Closed loop Hysteresis current control method so there is accurate calculation and compensation of reactive power.

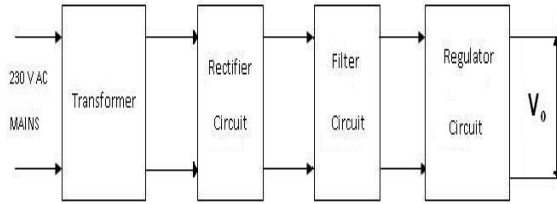
SHEPWM is used so harmonics are lower than 3%.

So power quality of induction generator is high.



3. HARDWARE USED

3.1 Power Supply:



Power Supply is an important part of a circuit. It provides required supply to different blocks of the circuit from input 230V AC. The main blocks include transformer, rectifier circuit, filter circuit, and regulator circuit. For our project we require + 5 Volt and +12 Volts supply. +5 Volts is given to Micro-controller board.

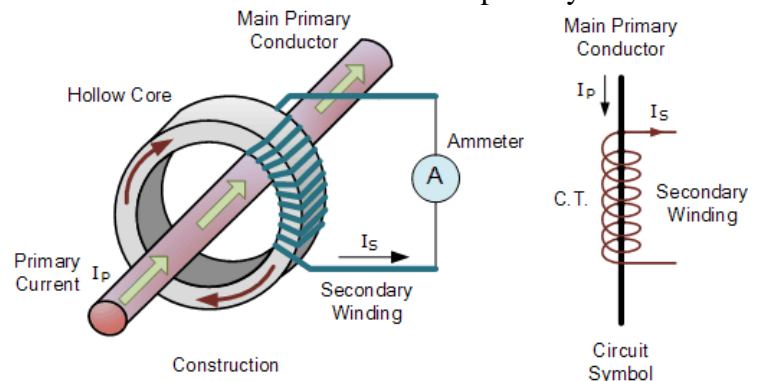
3.2 Microcontroller- ATMEGA8

The ATmega8 provides the following features: 8 Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 512 bytes of EEPROM, 1 Kbyte of SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte oriented Two wire Serial Interface, a 6-channel ADC (eight channels in TQFP and QFN/MLF packages) with 10-bit accuracy, a programmable Watchdog Timer with Internal Oscillator, an SPI serial port, and five software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next Interrupt or Hardware Reset.

In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low-power consumption. The ATmega8 is supported with a full suite of program and system development tools, including C compilers, macro assemblers, program simulators, and evaluation kits.

3.3 Current Transformer (C.T.)

It is a type of “instrument transformer” that is designed to produce an alternating current in its secondary winding which is proportional to the current being measured in its primary.



Current transformers reduce high voltage currents to a much lower value and provide a convenient way of safely monitoring the actual electrical current flowing in an AC transmission line using a standard ammeter. The principal of operation of a basic current

transformer is slightly different from that of an ordinary voltage transformer.

3.4 MOSFET IRF840

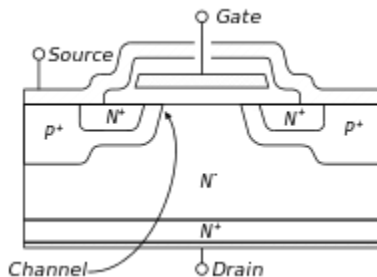
A **power MOSFET** is a specific type of metal oxide semiconductor field-effect transistor (MOSFET) designed to handle significant power levels.

Compared to the other power semiconductor devices, for example an insulated-gate bipolar transistor (IGBT) or a thyristor, its main advantages are high switching speed and good efficiency at low voltages. It shares with the IGBT an isolated gate that makes it easy to drive. They can be subject to low gain, sometimes to degree that the gate voltage needs to be higher than the voltage under control.

The design of power MOSFETs was made possible by the evolution of CMOS technology, developed for manufacturing integrated circuits in the late 1970s. The power MOSFET shares its operating principle with its low-power counterpart, the lateral MOSFET.

The power MOSFET is the most widely used low-voltage (that is, less than 200 V) switch. It can be found in most power supplies, DC to DC converters, and low voltage motor controllers

Basic structure



This paper has presented the Design of VSI MLI to improve the power quality in Grid system with and without battery. MLI system is an efficient mean for mitigation of PQ disturbances introduced to the grid. VSI based MLI compensator is a flexible device which can operate in current control mode for compensating voltage variation, unbalance and reactive power and in voltage control mode as a voltage stabilizer. The

latter feature enables its application for compensation of dips coming from the supplying network. The simulation results show that the performance of MLI system has been found to be satisfactory for improving the power quality at the consumer premises. Rectifier-based non-linear loads generated reactive powers are eliminated by MLI. When single-phase rectifier loads are connected, MLI currents balance these unbalanced load currents. Finally Matlab/Simulink based model is developed and simulation results are presented

4. SOFTWARE TECHNIQUES

4.1 Code Vision AVR

The AVR is a modified Harvard architecture 8-bit RISC single chip microcontroller which was developed by Atmel in 1996. The AVR was one of the first microcontroller families to use on-chip flash memory for program storage, as opposed to one-time programmable ROM, EPROM, or EEPROM used by other microcontrollers at the time.

Program memory: Program instructions are stored in non-volatile flash memory. Although the MCUs are 8-bit, each instruction takes one or two 16-bit words.

The size of the program memory is usually indicated in the naming of the device itself (e.g., the ATmega64x line has 64 kB of flash while the ATmega32x line has 32 kB).

There is no provision for off-chip program memory; all code executed by the AVR core must reside in the on-chip flash. However, this limitation does not apply to the AT94 FPSLIC AVR/FPGA chips.

4.2 Embedded C

Embedded C is used for microcontroller programming. There is a large and growing – international demand for programmers with 'embedded' skills, and many desktop developers are starting to move into this important area. Because most embedded projects have severe cost constraints.

4.3 AVRDUDE AVR PROGRAMMER

USBasp - USB programmer for Atmel AVR controllers. USBasp is a USB in-circuit programmer for Atmel AVR controllers. It simply consists of an ATmega8 and a couple of passive components. The programmer uses a firmware-only USB driver

5. Conclusion

This paper has presented the Design of VSI MLI to improve the power quality in Grid system with and without battery. MLI system is an efficient mean for mitigation of PQ disturbances introduced to the grid. VSI based MLI compensator is a flexible device which can operate in

current control mode for compensating voltage variation, unbalance and reactive power and in voltage control mode as a voltage stabilizer. The latter feature enables its application for compensation of dips coming from the supplying network. The simulation results show that the performance of MLI system has been found to be satisfactory for improving the power quality at the consumer premises. Rectifier-based non-linear loads generated reactive powers are eliminated by MLI. When single-phase rectifier loads are connected, MLI currents balance these unbalanced load currents. Finally Matlab/Simulink based model is developed and simulation results are presented

6. Reference

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- 2) A.Ghosh and G.Ledwich, " Load Compensating DSATACOM in weak AC system," IEEE Trans .Power Delivery, vol.18,no.4,pp.1302-1309,oct.2016