Solar Photovoltaic Interfaced Quasi Impedance Source Network Based Static Compensator for Voltage and Frequency Control in the Wind Energy System

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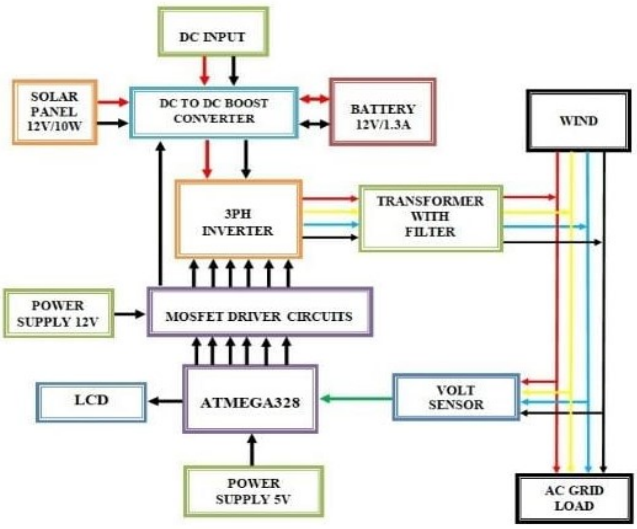
ABSTRACT - The deployment of power electronic devices has become a big concern for power quality in these days. The voltage stabilization of power distribution networks interconnected with Photo Voltaic (PV) is very critical in promoting the smooth operation of all linked devices in the distribution system. Voltage profile maintenance is one of the challenges in PV integration into the grid. Conventional devices such as passive filters, series and shunt filters, synchronous condensers, etc. are insufficient to alleviate numerous problems of power quality. The series compensator is used for voltage quality and the shunt compensator is used for current quality. Also, if these two problems of power quality are simultaneously mitigated, the device is used in the distribution system known as Unified Active Power Filter (UAPF). The shunt and series compensator of UAPF is equipped with a Z-source inverter(ZSI). This paper addresses voltage and current associated existing power quality concerns which including voltage sag, voltage swell, voltage and current distortion and simulates the UAPF device to alleviate these problems. The Unit Vector Template Generation (UVTG) with Improved Second Order Generalized Integrator (ISOGI) based Phase Locked Loop (PLL) is utilized for UAPF controller simulation and experimental results validated the proposed work.

I. INTRODUCTION

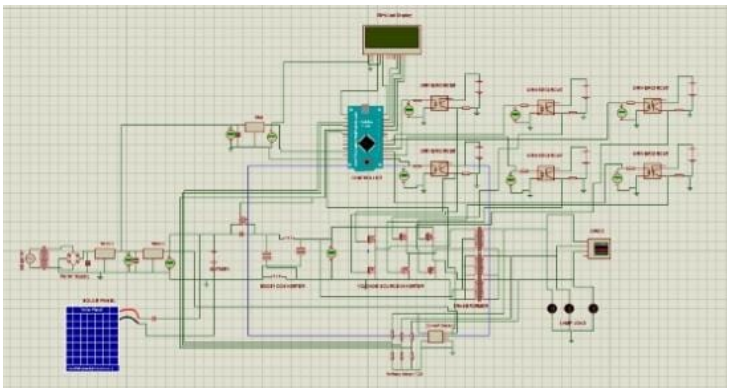
The electric apparatus has been very vulnerable to numerous problems of power quality. Problems of power quality result in serious economic or production losses. Many devices, such as a computer, uninterrupted power supply, drives, etc. are key factors of power quality problems. The issues of power quality will impact both the utility grid and other customers connected at the end of utility. As a consequence, researchers focus on power quality to minimize different power quality issues, to the obvious benefit of consumers and utilities respectively. Quality of power implies efficiency of voltage and current quality since the two parameters strive with the majority of issues of electricity supply. Voltage issues include voltage sag, voltage swell, voltage interruption, transient/notching, voltage distortion, etc. while current related issues include reactive power burden, voltage regulation, and harmonic current owing to non-linear loads, etc. Voltage slope and swell emerged while strong loads in the network were suddenly turned on or off. Voltage sag and swell emerged while large loads in the network were suddenly turned on or off. This tends to lead to equipment failure and loss of data. The first technique is the series and shunt passive filters, which mitigate problems in terms of power quality Though acceptable results have been obtained.

BLOCK DIAGRAM



Switched mode supplies can be used for many purposes including DC to DC converters. Often, although a DC supply, such as a battery may be available, its available voltage is not suitable for the system being supplied. For example, the motors used in driving electric automobiles require much higher voltages, in the region of 500V, than could be supplied by a battery alone. Even if banks of batteries were used, the extra weight and space taken up would be too great to be practical. The answer to this problem is to use fewer batteries and to boost the available DC voltage to the required level by using a boost converter. Another problem with batteries, large or small, is that their output voltage varies as the available charge is used up, and at some point the battery voltage becomes too low to power the circuit being supplied. The boost converter is different to the Buck Converter in that it's output voltage is equal to, or greater than its input voltage. However it is important to remember that, as power (P) = voltage (V) x current (I), if the output voltage is increased, the available output current must decrease.

SIMULATION DIAGRAM



Proteus is a best simulation software for various designs with microcontroller. It is mainly popular because of availability of almost all microcontrollers in it. So it is a handy tool to test programs and embedded designs for electronics hobbyist. You can simulate your programming of microcontroller in Proteus Simulation Software. After Simulating your circuit in Proteus Software you can directly make PCB design The purpose of this tutorial is to show you how to conduct an interactive simulation with a microcontroller using Proteus VSM and the VSM Studio IDE. The emphasis will be on practical usage of the simulator and IDE, with more detailed coverage of each topic being available in the reference manuals. This tutorial does not cover schematic entry; if you are not familiar with drawing in ISIS then you should take the time to work through the tutorial content in the ISIS reference manual.

The PV-UPQC output is tested by the experimental prototype by utilizing the UVTG technique with ISOGI based PLL. This paper addresses issues with power quality such as voltage sag, voltage swell, voltage and current distortions. Both the series and shunt inverters are connected back to back through the Z-source network. The three-phase source is connected to the linear load and nonlinear loads such as three-phase Resistive (R) Inductive (L) load and three-phase diode bridge rectifier supplying a resistive load and inductive load respectively. The series inverter of ZSI based PV-UAPF is connected to the power network through three single-phase transformers at the source side. The shunt inverter is connected in parallel at the load side through a coupling inductor. FPGA processor has been employed for the control of ZSI based PV-UAPF by sending switching signals. Hall effect transducers have been used for current and voltage sensing of the system. Experimental results have been analysed to validate the efficiency of ZSI based PVUAPF. Three different instances have been studied: balanced voltages with an unbalanced load, distorted voltages with unbalanced load and unbalanced grid supply voltages with an unbalanced load.

CONCLUSION

In this article, the UVTG with improved SOGI based PLL is used for ZSI-UAPF to combine PV systems into the utility grid with the enrichment of power quality. To establish reference source current and voltage signals, UVTG is used with improved SOGI-based PLL. In order to provide long-term voltage and current compensation, the green energy generation system holds up the DC bus voltage of the ZSI-UAPF. The topology suggested is provided by reliable energy storage systems such as a battery for the optimal use of solar energy. The excess electricity generated by the PV system is stored in the battery storage system. Thus, the conversion and transformation of the stored energy are carried out with the multi-mode feature. This simple control algorithm has accomplished harmonic mitigation, voltage, and current compensation. The harmonic distortion of the source current in non-linear loads with different current conditions is reduced to approximately 1.2%, below the 8% tolerable limit as defined by the IEEE standard 1547-2018. The test results show that the control and topological efficiency is more efficient in compensating the voltage and current disruptions than any other typical compensating unit.

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