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Improving the Power Quality Performance for Distributed Power Generation

Abstract

This project presents analysis and improvement of power quality (voltage sag, voltage swell) performance of grid connected inverter used in distributed generation. The developed controller controls power supplied by the DGs at the PCC. The controller is designed to deliver current at unity power factor at PCC. An increase in reactive power demand and harmonics at PCC due to change of load and grid impedance variation, would affect the system voltage at PCC. This project proposes the structure of the designed controller consists of output power with voltage control.

Keywords: *Point of common coupling(PCC), Distributed generation(DG) , Voltage Source Inverter (VSI)*

1. INTRODUCTION

The aim of this work is to improve the power quality for Distributed Generation (DG). Power quality is the combination of voltage quality and current quality. The electrical power quality is more concerned issue. The main problems are transient distortions in the line voltage such as swells, sags and voltage asymmetries. Distributed Generation (DG) also called as near load site generation, decentralized generation, generates electricity from the many small energy sources. In recent years, such as photovoltaic generation systems, wind generators and micro gas turbines, etc., have increased with the deregulation of the power market. Under such circumstances the environment surrounding the electric power industry has become ever more complicated and provides high-quality power in a stable manner which becomes an important topic. Here DG is assumed to include PV panel. Advantages of this system are constant power supply, constant voltage magnitude, un-interrupted power supply.

2. LITERATURE SURVEY

2.1 Existing System

The existing predictive control is based on step wave control in support of voltage source inverters for both power and voltage control, however this method is quite complicated and some digital predictive control strategies suffers from control delay and mainly Controllers uses the DC link voltage as one of the control parameters but this method is not superior for PV based DG units without DC-DC converters. The existing control techniques, mainly focus on voltage sag compensation and interruption at PCC. The existing system mainly for 3 Phase supply

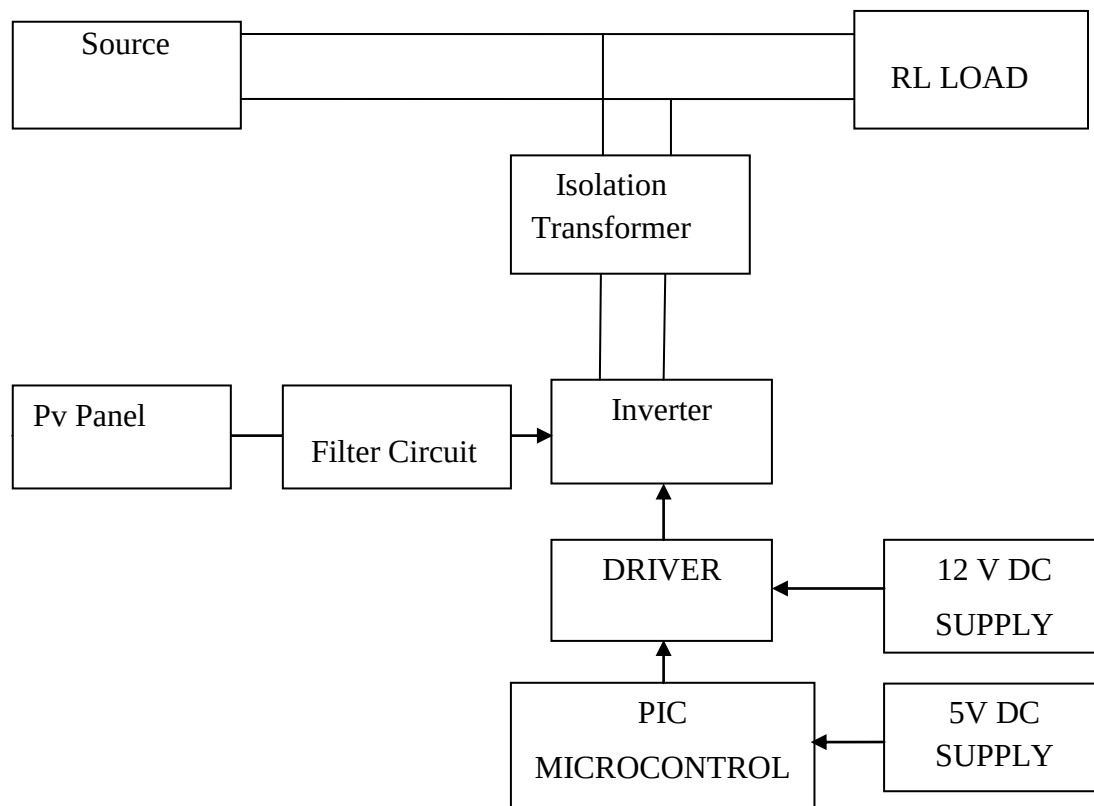
2.2. Proposed System

This paper focus on control of power for maintaining rated power at PCC (Point of common Coupling) .The principle of voltage swell and sag control during load change local or grid impedance variation and propose system for 1 Phase supply.

3. HARDWARE & SOFTWARE REQUIREMENTS

- 1.MATLAB – SIMULINK
- 2.ORCAD/PS PICE
- 3.PIC MICROCONTROLLER

4. BLOCK DIAGRAM



4.1 Block Diagram description

- PV panel : 12 V DC.
- Transformer : Step down transformer 230v to 12v And isolation transformer
- Rectifier: Used for converting AC TO DC Supply(12v to 5v) for PIC Microcontroller .
- Inverter: VSI Used for converting DC to AC Supply
- Driver circuit: It consist of
 - 1) Buffer Ic HCF4050
 - 2) Optocoupler MCT2E
 - 3) Transistor
 - PNP BEL100P
 - NPN 2N2222
 - 4) Resistors
 - 1K Ω
 - 100 Ω

It has two functions a) Amplification b) Isolation.

- Load : RL Load
- Pulse generator: It consist of
 - 1) Bridge rectifier (1mA)

- 2) Electrolytic Capacitors
- 3) Crystal oscillator
- 4) Resistor – 33 ohm , 5Vdc
- 5) IC PIC165877A
- 6) Voltage Regulator

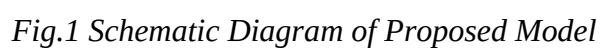
Here we have used PIC Microcontroller (PIC 16F877A) for generating pulse.

5. WORKING PRINCIPLE

The proposed system consists of Pv panel connected to the grid-interfacing inverter as shown in block diagram. The voltage source inverter is a key element of a DG system as it interfaces the renewable energy source to the grid and delivers the generated power. Usually, photovoltaic energy sources generate power at variable low dc voltage. The filter capacitor across the input terminals of the inverter provides a constant dc link voltage. The dc-link plays an important role in transferring this variable power from Pv panel to the grid.

We are using PIC 16F877A for producing switching pulses to multilevel inverter. The microcontroller are driven via the driver circuit so as to boost the voltage triggering signal to 9V. To avoid any damage to micro controller due to direct passing of 230V supply to it we provide an isolator in the form of optocoupler in the same driver circuit.

The driver circuit forms the most important part of the hardware unit because it acts as the backbone of the inverter because it gives the triggering pulse to the switches in the proper sequence. The diagram given above gives the circuit operation of the driver unit. It is used to provide 5 to 12volts to switch the MOSFET Switches of the inverter. Driver amplifies the voltage from microcontroller which is 5volts. Also it has an optocoupler for isolating purpose .So damage to MOSFET is prevented. Voltage variation at PCC is compensated by suitably by supplying or injecting the voltage from Pv panel.



6. SIMULATION

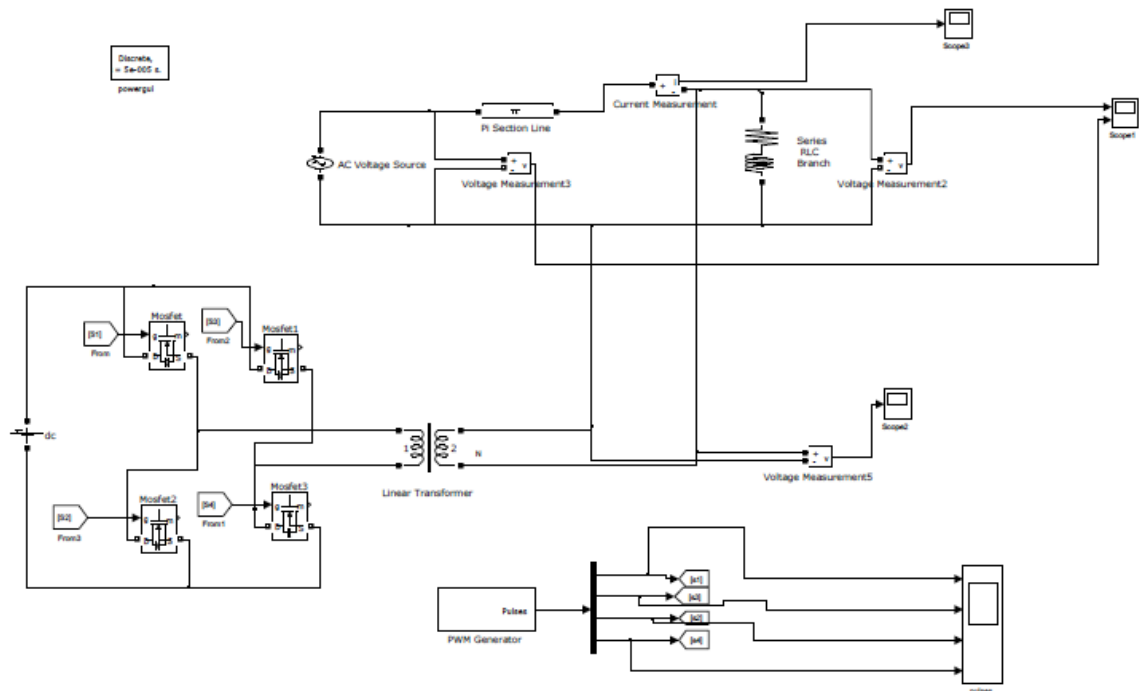


Fig 2. Simulation of Proposed Model

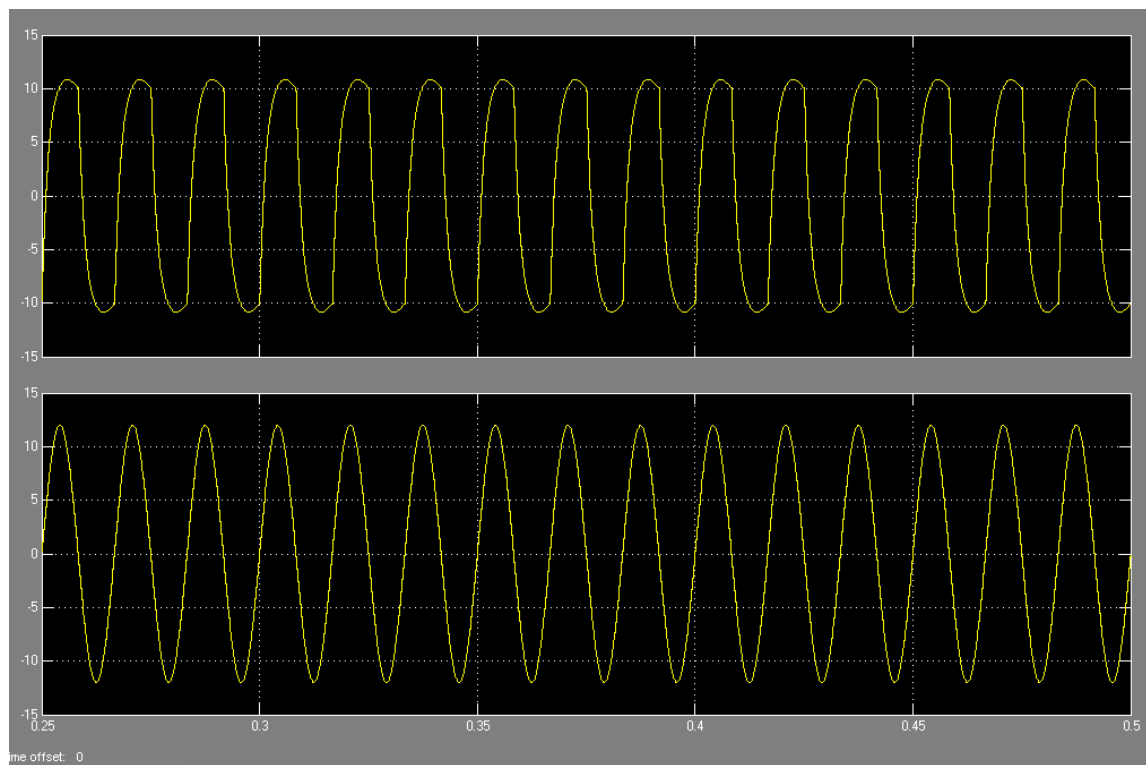


Fig 3. Output Waveform Before And After Injecting Voltage

7. EXPERIMENTAL SETUP

The prototype model of two proposed controllers have been developed at the rating of 5W PV sourced inverter is integrated with grid and load at the point of common coupling shown in Fig 3.

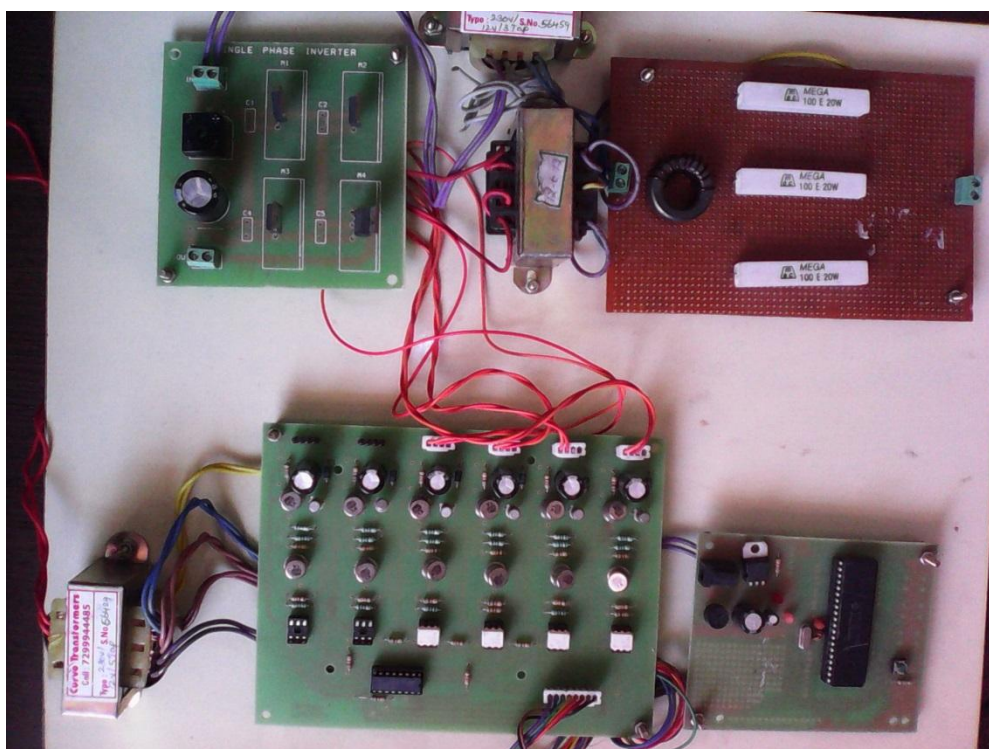


Fig 4. Experimental Setup Of Proposed System

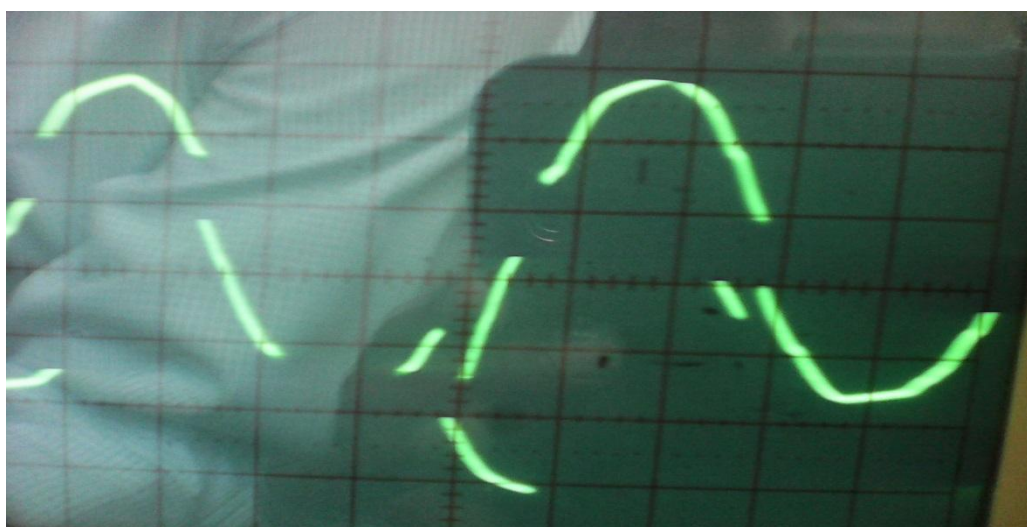


Fig 5. Waveform of voltage Before injecting voltage from proposed controller

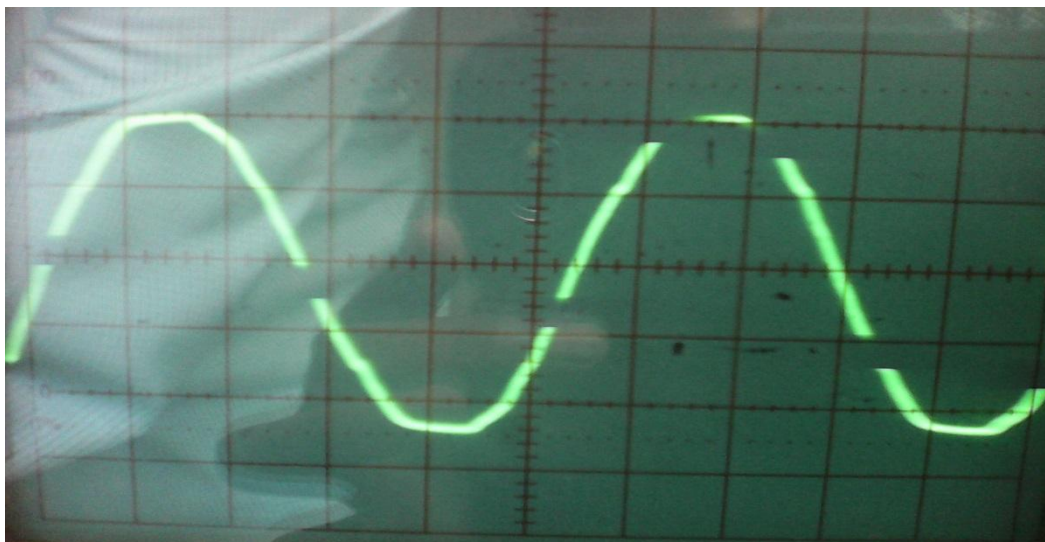


Fig 6 .Waveform of voltage After injecting voltage from proposed controller

8. CONCLUSION

This paper presents improvement of power quality (voltage sag and Voltage) at PCC of grid connected inverter used in distributed generation. The grid connected inverter is used to inject real power to conventional grid from distributed generator such as Pv cell.

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