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Modeling and Analysis of Controllers for PV sourced Grid Connected inverter with Unbalanced Nonlinear loads

M.Jeevitha[1], R.Naveen[2], G.Revanth Chakravarthi[3]

Department of EEE, Department of Mechanical, Adhi College of Engg & Tech, Kancheepuram

Abstract—nowadays, the majority of Photovoltaic power sources connected with the grid has been increased. One of the major problems is the poor PV utilization under changing operating condition. So in order to improve the PV utilization along with grid connected inverter, this system has been implemented with controller analysis and model. This system is mainly used for non linear load compensation. As well as, it also controls the active power generation and provides the reactive power compensation under unbalanced condition. And this module is also used to maintain the maximum injected power to the grid and also compensates the unbalanced nonlinear currents. In the existing method, Peak current of the inverter is reduced during the unbalanced grid-voltage sags with the help of current harmonics injection which increases the total harmonic distortion. In order to reduce the Total Harmonic Distortion, inverter current is maintain within its rated value in this proposed method. Also this module constitutes about voltage sag, swells problems and the controller has been designed using grid connected Inverter control techniques. As well as the maximum power point of PV is tracked using Incremental Conductance technique to reduce the error and improves the system efficiency. The theoretically designed models are confirmed using MATLAB/Simulink software.

Index Terms—Solar Power Generation, Grid connected inverter, Modeling and Controller Analysis, Unbalanced Nonlinear load, Current control, Compensation, Digital signal controller.

I. INTRODUCTION

The Photovoltaic System is the solar power generation system which has been widely used for the past decades in all over the world. It has been used in several domestic and industrial applications since it does not have any impact on the environment like pollution effects such as in other renewable energy sources[1]-[3].

As global warming crisis is increased due to the high rate of pollution produced by the recycling of industrial wastage and biogas, so in order to reduce such type of problems PV system can be effectively used for the power generation both in ON-grid and OFF-grid applications. However the installation cost of Photovoltaic System is high, it has been increasingly utilized for the grid connected systems. And also in order to improve the efficiency and the system stability in grid connected PV systems, a Power Electronic conversion is needed in between the PV source and the grid. It is also used to track the maximum power from the PV panels during the variation of solar irradiation and the temperature. Different types of MPPT techniques are developed such as Constant Voltage and Current, Perturb and Observe, Incremental Conductance [4]-[7]. Incremental Conductance method is used to track the maximum PV power. In this paper, a new mathematical model for grid connected PV inverter under unbalanced condition is presented. The proposed new model is based on the dq representation and it is derived on the basis of synchronous frames of reference. The controller is designed by using grid synchronization technique with voltage oriented control.

II. SYSTEM DESCRIPTION

Using PV cell-solar radiation is converted into DC current. Boost converter is implemented to boost and to maintain the constant dc-link voltage during irradiation. A controller is designed for PV sourced inverter depending upon variable dc voltage and variable dc current where power control is done. Switching time of the boost converter is derived from voltage control. Phase voltage and current is also controlled by using DSC TMS320F82335. Voltage and current signals are fed to the input of the power controller. The output of the power control is providing the voltage reference for the voltage controller and ac current reference to the current controller. The current controller generates the modulating signals and those signals are given to the PWM block.