Clean Energy for Sustainable Economy and Environment

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Optimal Operation of Three Phase Three Wire Two Stage Grid Interfaced SPV System Under Weak Grid Condition

*Bhim Singh and Vandana Jain (2015EEZ8114)

Abstract

An advanced frequency locked loop (AFLL) based control algorithm for a three phase grid tied SPV system for the extraction of the fundamental component of the load current. This control provides
grid current balancing
load balancing
Harmonics reduction
stabilization of grid under voltage unbalance, sag/swell conditions
reactive power compensation

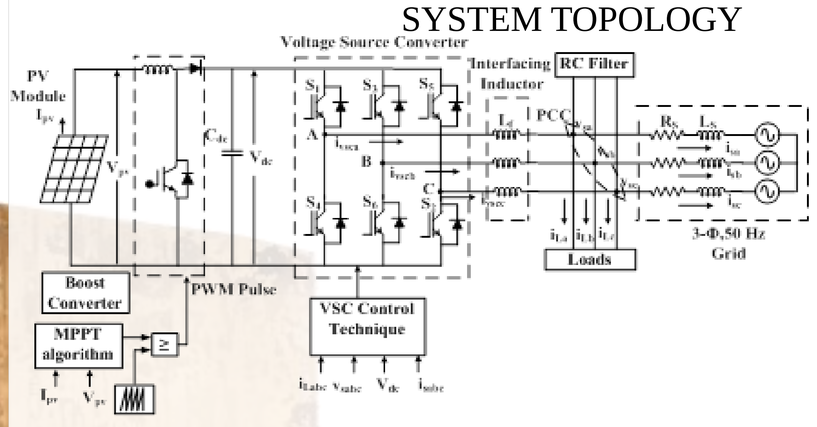
Introduction

Solar photovoltaic (PV) grid interfaced power generating system is main technology to:

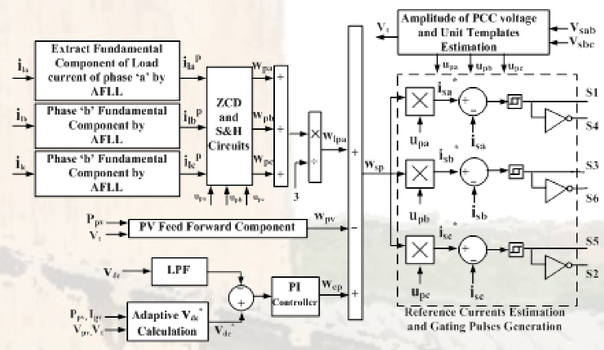
- overcome the energy problems
- overcome the global warming
- supply clean bulk power to grid
- meet peak power demand
- avoid battery systems

Materials and Methods

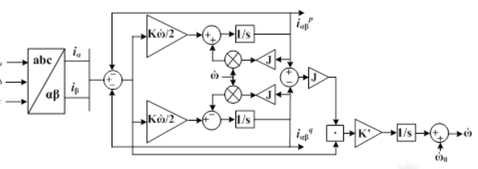
SYSTEM TOPOLOGY



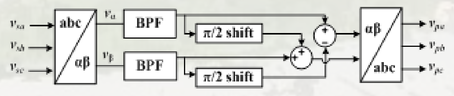
CONTROL ALGORITHM



AFLL Block diagram

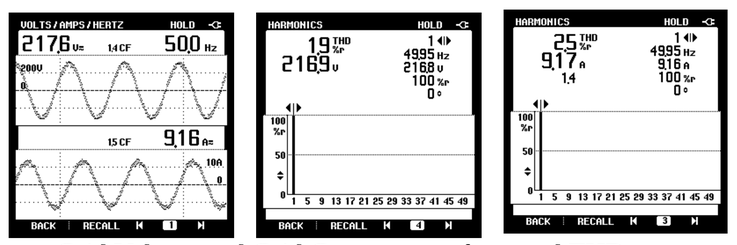


Unit vectors calculation



Result

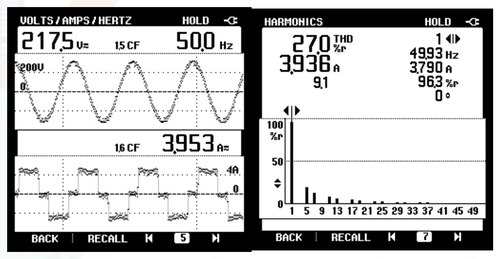
Response of System Under Balanced, Unbalanced Nonlinear Load



Grid Voltage and Grid Current waveform and THD

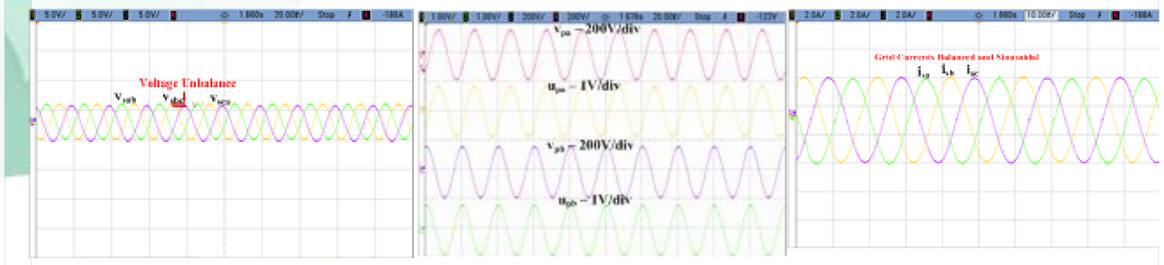
Grid Power | Load Power | SPV-VSC Power

Grid side THD's are within limits of an IEEE-519 standard

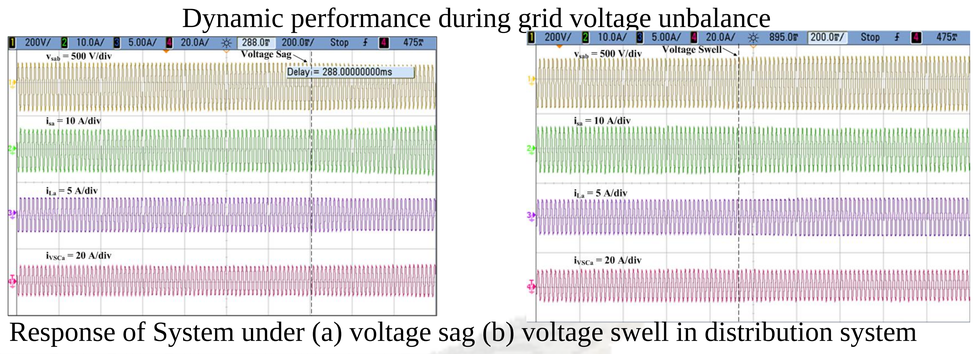


SPV power = 4.88 kW
Power fed to Grid = 3.43 kW
Power supplied to load = 1.42 kW
Losses = 4.88 – (3.43+1.42) = 0.03 kW = 30 W
Efficiency = 4.85/4.88 = 99.39 %

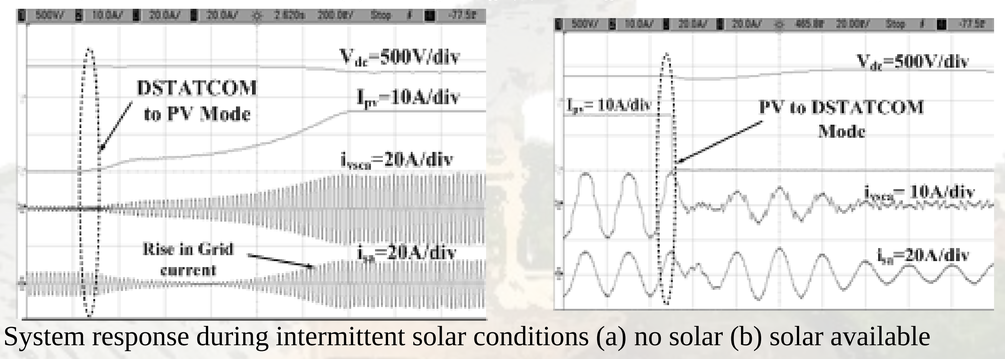
Load Current waveform and THD



Dynamic performance during grid voltage unbalance



Response of System under (a) voltage sag (b) voltage swell in distribution system



System response during intermittent solar conditions (a) no solar (b) solar available

Conclusions

This algorithm eliminates the harmonics, performs grid current balancing, improves the system performance during distorted and unbalanced grid conditions, thereby enhancing the response of the system

Grid side THD's are within limits of an IEEE-519 standard

Industrial Significance

The proposed research work finds application in single phase and three phase distribution networks for renewable power generation via solar PV powered system, power quality improvement via DSTATCOM or STATCOM and battery-less clean operation. Installation of this system as rooftop PV system for commercial as well as industrial buildings will ensure stability of the grid and increased involvement of consumers in the electrical market as they will be active participants in selling and buying solar power.

References

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Acknowledgement

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Department Name