International Journal of Global Engineering (IJGE) E- ISSN: 2456-3099
VOL 1 ISSUE 3 PAGES: 150 TO 155
Received: 10-03-2017. Published: 31-03-2017.

FUZZY LOGIC CONTROLLER BASED DC-BUS VOLTAGE REGULATION FOR DC-DISTRIBUTION SYSTEM WITH SINGLE PHASE BIDIRECTIONAL INVERTER.

[1]S.Naveena, [2]J.Jeevitha, [3]Mrs.R.Thenmozhi, [4]Mr.M.Sudhakaran
[1,2]UG Student, Dept. of EEE, Ganadipathy Tulsi's Jain Engineering College, Vellore, India,
[3]Ass Prof, Dept. of EEE, Ganadipathy Tulsi's Jain Engineering College, Vellore, India,
[4]Asso Prof, Dept. of EEE, Ganadipathy Tulsi's Jain Engineering College, Vellore, India.

ABSTRACT

This paper presents dc-bus voltage regulation for a dc distribution system integrated with a single-phase bi- directional inverter. In a dc distribution system, a bi- directional inverter controls its inductor current to balance power flow and regulate the dc-bus voltage. For enhancing, the operational reliability and availability of the dc distribution system, the bi- directional inverter shifts the dc-bus voltage to different levels according to the load conditions. This shift mechanism can also reduce the possibility of entering under or over voltage protection without increasing dc-bus capacitance. Stability analysis of the dc-bus voltage regulation under capacitance variation is also addressed.

Index Terms : DC-bus voltage regulation, single phase, bidirectional inverter, dc loads.

1. INTRODUCTION:

Most of electrical loads are indirectly supplied by ac sources which are rectified and buffered by bulky capacitors. If the loads can be directly supplied by the dc voltage sources in a dc distribution system, about 20 % of component cost and 8 % of power conversion loss can be saved. Hence, the dc distribution was proposed and discussed recently. Since, various load requirements will affect the dc-bus voltage, the system needs a power converter unit to regulate the voltage. The voltage regulation approaches with MPPTs. An MPPT adjusts its tracking power to regulate the dc-bus voltage, so as it might not draw the maximum solar power from PV panels. Some systems use battery banks and chargers/dischargers to regulate the dc-bus voltage by storing the solar energy at off-peak-load time to compensate the peak-load requirement, which reduces the effectiveness of energy usage and increases system cost. Considering the overall system cost and the regulation capability, a bi-directional inverter is introduced to achieve a harmonized ac/dc distribution system. Its regulation capability will not change with weather condition or battery size.

1. BLOCK DIAGRAM:

In a dc-distribution system with loads connected to the dc bus, the bus voltage regulation is critical to maintain normal operation. When the PV power is higher than the load requirement, the bi- directional inverter injects surplus power into the ac grid, which is defined as "grid-connection mode". On the contrary,

International Journal of Global Engineering (IJGE) E- ISSN: 2456-3099
VOL 1 ISSUE 3 PAGES: 150 TO 155
Received: 10-03-2017. Published: 31-03-2017.

the inverter draws power from the ac grid to compensate the load requirement, which is defined as "rectification mode".

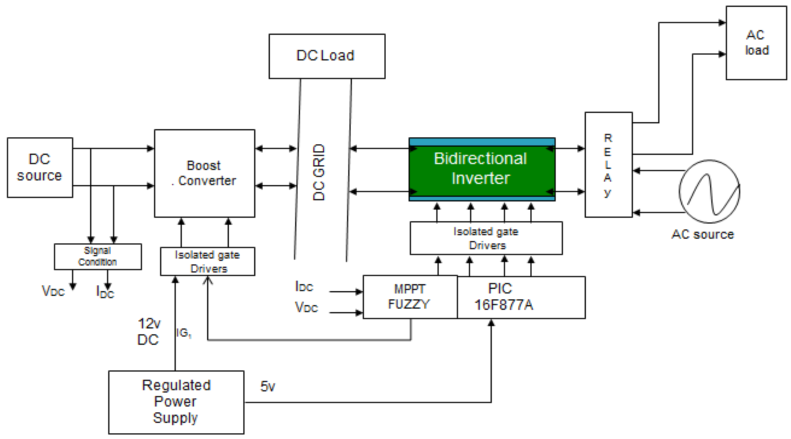

Fig.1. Block Diagram of Proposed System

When fuzzy logic control and the voltage control based proposed system are designed. The inverters need high resolution sensors to sense the dc- bus voltage for determining precise current commands. Due to switching noise, the inverters would adjust their current commands frequently over and increase line current distortion. Some inverters filtered out the ripple voltage with a bulky dc-bus capacitor, like an 18 F capacitor bank, but this will decrease voltage sensitivity to power variation and affect the accuracy of current commands. The dc-bus voltage has been regulated to a fixed level, thus an abrupt the voltage drop due to step-load changes will result in under/over voltage protection. For instance, when the voltage operation range of the dc bus in a single-phase system is 360~400 V and the current command is updated every line cycle, a step-loadchange will induce 40 V voltage drop. With a fixed voltage regulation, the system will be driven to under voltage protection before the inverter regulates the dc- bus is back to the nominal value of 380 V. This paper proposes, a linear dc-bus voltage shift scheme to balance power flow and to regulate the dc-bus voltage, which can reduce the dc-bus capacitance by 20 %.
Additionally, since the dc-bus capacitance will affect hold-up time, dc-bus voltage ripple, and voltage regulation for long-term operation should be considered. To determine current commands for regulating the dc-bus voltage tightly, design of dc-bus capacitance associated with the proposed regulation approaches is discussed. The initial dc-bus capacitance was estimated at the system startup and the real capacitance is determined online by considering aging effect, which has not been discussed in. Experimental results measured with a single-phase bi-directional inverter are presented to verify the analysis and discussion.

3. CIRCUIT DIAGRAM

In this circuit consist of PV panel, buck- boost converter, dc load and bi-directional inverter circuit are use based on the MPPT algorithm. Here, the solar energy is received from the PV panel and it will step-up the voltage with the usage of boost converter. Below fig 3.1 shows the circuit diagram of bi- directional

International Journal of Global Engineering (IJGE) E- ISSN: 2456-3099
VOL 1 ISSUE 3 PAGES: 150 TO 155
Received: 10-03-2017. Published: 31-03-2017.

inverter.

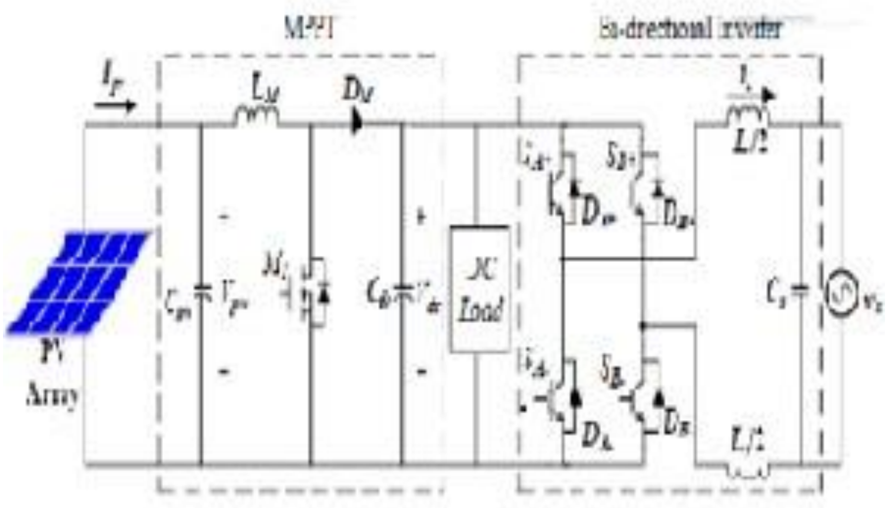

Fig.2. Circuit diagram

As per the circuit, a boost converter contains the inductance, the diode, the capacitor and MOSFET. When the power is flow the circuit the inductance will stores the energy in the form of electromagnetic while the diode is in OFF condition. When the diode is ON and act as forward bias condition the MOSFET is turned-off and inductor leaves the energy via diode and capacitor. The capacitor is used for charging/discharging purpose. The dc-bus get the power supply to operate the dc-loads and then bi-directional inverter is worked as an “Inverter mode” to convert dc to ac voltage to operate the ac-loads. It contains MOSFET switches to ON and OFF conditions. In other case, PV panel can be disconnect and ac source is used to operate the dc-loads due to bi-directional act as a “Rectification mode”.

4. SIMULATION TOOLS

In our project we are using **MATLAB**. The name MATLAB stands for **Matrix Laboratory.** It is the high performance language for technical computing. It integrates computation, visualization and programing in easy to environment where problems and solutions are expressed in familiar notations. Very important of MATLAB is toolboxes, it allows the users to learn and apply the specialized technologies. Areas in which toolboxes are available which include signal processing, control system, neural networks, fuzzy logic, simulation and many others.

HARDWARE CIRCUIT:

In this hardware circuit can be shows the bi- directional inverter operations.

International Journal of Global Engineering (IJGE) E- ISSN: 2456-3099
VOL 1 ISSUE 3 PAGES: 150 TO 155
Received: 10-03-2017. Published: 31-03-2017.

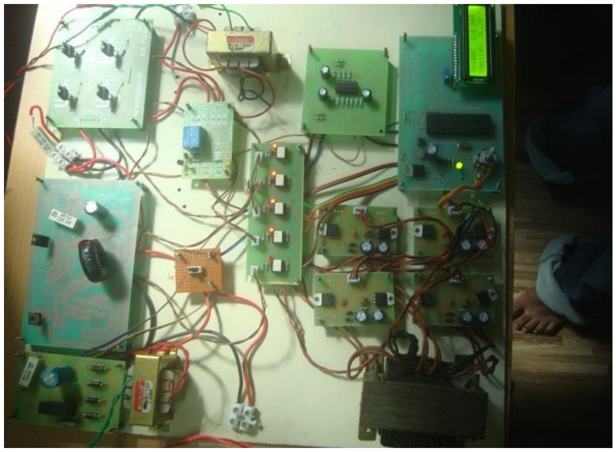

Fig.3. Hardware circuit for Bi-directional inverter

SIMULATION RESULTS

If the ac voltage having some oscillations to convert the dc to ac source, then these oscillations and ripples are compensated by using the bi-directional inverter. Since, the voltage level from the source may vary, the Fuzzy logic is implemented. The bulky capacitor used here is capable of reducing the harmonics range to a greater extent. The dc-bus get the power supply to operate the dc-loads and then bi- directional inverter is worked as an "Inverter mode" to convert dc to ac voltage to operate the ac-loads. The Bi-directional inverter brought up a heavy and very efficient output parameters as guided by the Maximum Power Point Tracking (MPPT) Technique. The below fig 6.1 shows the final output waveform of ac voltage.

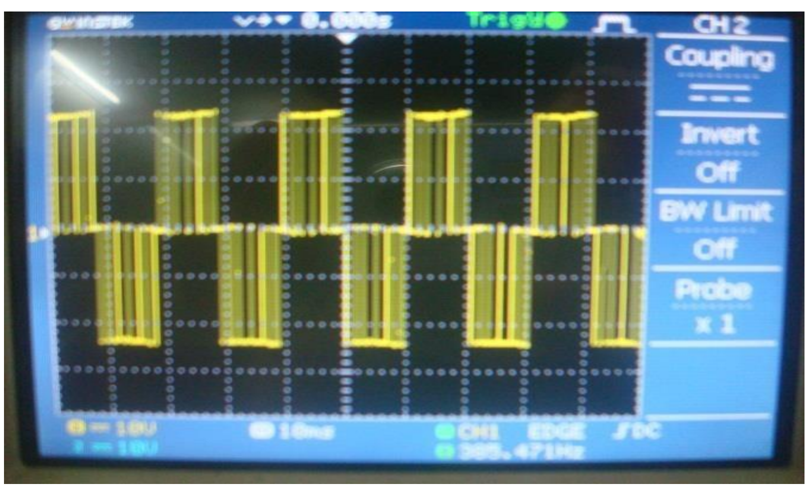

Fig.4. Simulation waveform

CONCLUSION

DC-bus voltage regulation with a single-phase bi- directional inverter scheme has been analyzed and implemented. This system can be reduce the mode- change frequency and the chance of under/over voltage protection, and can improve the operational reliability and availability. Additionally, a proper dc- bus capacitance has been also determined according to the aspects of dc-bus voltage ripple and energy-storage capability. The initial dc-bus capacitance is estimated at the system startup. After that, the capacitance parameter used for the dc-bus voltage regulation will be online determined according to the real capacitance without shutting down the system. Experimental results obtained from a dc distribution system, including an MPPT, a bi-directional inverter and dc loads, have verified the analysis and discussion.

REFERENCES:

1. H. Rodríguez-Cortés, R. Alvarez-Salas,, M. Flota- Bañuelos. and M.F. Escalante, "Power factor compensation and DC-link voltage regulation for a single-phase PWM multilevel rectifier," IEEE Trans. Power Electronics, vol. 5, no. 8 , pp. 1456-1462, Jan. 2012.

2. T.-F. Wu, C.-H. Chang, L.-C. Lin, G.-R. Yu, and Y.-R. Chang, "DC-Bus Voltage Control With a Three- Phase Bidirectional Inverter for DC Distribution Systems," IEEE Trans. Power Electronics, vol. 28, no. 4, pp. 1890-1899, 2013.

3. J. M. Guerrero, P. C. Loh, T.-L. Lee, and M. Chandorkar, "Advanced Control Architectures for Intelligent Microgrids—Part II: Power Quality, Energy Storage, and AC/DC Microgrids," IEEE Trans. Industrial Electronics, vol. 60, no. 4, pp. 1263-1270, Apr. 2013.

4. L. Xu and D. Chen, "Control and design of a DC microgrid with variable generation and energy storage," IEEE Trans. Power Del., vol. 26, no. 4, pp. 2513–2522, Oct. 2011.

5. Z. Li, T. Wu, X. Yan, K. Sun, and J. M. Gurrero, "Power Control of DC Microgrid Using DC Bus Signaling," Proceedings of the 2011 IEEE APEC 2011, pp. 1926-1932, 2011.

6. J. Lee, B. Han, and Y. Seo, "Operational Analysis of DC Micro-grid Using Detailed Model of Distributed Generation," Proceedings of the 8th International on Power Electronics and ECCE Asia (ICPE & ECCE), pp. 248-255, 2011.

7. T.-F. Wu, C.-H. Chang, L.-C. Lin, and G.-R. Yu, "DC-Bus Voltage Control With a Three-Phase Bidirectional Inverter for DC Distribution Systems," IEEE Trans. Power Electronics, vol. 28, no. 4, pp. 1890-1899, Apr. 2013.

8. I. R. Balasubramanian, S. I. Ganesan, and N. Chilakapati, "Control Strategy for Power Flow Management in a PV System Supplying DC Loads," IEEE Trans. Industrial Electronics, vol. 60, no. 8, pp. 3185-3194, Aug. 2013.

9. R. A. Mastromauro, M. Liserre, T. Kerekes, and A. Dell'Aquila, "A Single-Phase Voltage-Controlled Grid-Connected Photovoltaic System with Power Quality Conditioner Functionality," IEEE Trans. Industrial Electronics, vol. 56, no. 11, pp. 4436-4444, Nov. 2009.

10. B. I. Rani, G. S. Ilango, and C. Nagamani, "Control Strategy for Power Flow Management in a PV System Supplying DC Loads," IEEE Trans. Industrial Electronics, vol. no. 8, pp. 3185-3194, Aug. 2013.

11. J. S. Park, J. H. Choi, B. G.. Gu, I. S. Jung, E. C. Lee and K. S. Ahn, "Robust DC-link Voltage Control Scheme for Photovoltaic Power Generation System PCS," Proceedings of the 31st International on Telecommunications Energy Conference, pp. 1-4, 2009.

12. H. Kakigano, Y. Miura, and T. Ise, "Low-Voltage Bipolar-Type DC Microgrid for Super High Quality Distribution," IEEE Trans. Power Electronics, vol. 25, no. 12, pp. 3066-3075, Dec. 2010.

13. M. A. Azzouz and A. L. Elshafei, "An Adaptive Fuzzy Regulation of the Dc-bus Voltage in Wind Energy Conversion Systems," Proceedings of the 2010 IEEE CCA, pp. 1193-1198, 2010.