International Journal of Current Research and Modern Education (IJCRME)
ISSN (Online): 2455 – 5428 & Impact Factor: 3.165
Special Issue, NCFTCCPS - 2016

PV BASED SINGLE PHASE QUASI Z-SOURCE INVERTER WITH DFR CONTROL

K. Sivaprakasam* & S. Chandrasekaran**
* PG Scholar, Department of EEE, Arasu Engineering College, Kumbakonam, Tamilnadu
** Assistant Professor, Department of EEE, Arasu Engineering College, Kumbakonam, Tamilnadu

Abstract:

In single-stage photovoltaic (PV) system, there is a power irregularity exist between the AC yield and DC input. A voltage unbalance in a single phase system cause double frequency ripple in the dc link. A buffered passive network has to be connected with the double-frequency ripple (DFR) system. The DFR buffering can be achieved by the high reliable film capacitors. In this paper, the new control strategy has been implemented by reducing capacitance for DFR buffering in single-phase quasi-Z-source inverter applications. The low input voltage DFR can be achieved by proposed control system with minimal capacitance, without applying any additional hardware components.

Index Terms*:* Double Frequency Ripple, Quasi Z-Source, Capacitance Reduction & Photovoltai

1. Introduction:

When output voltage variation occurs in the renewable energy system due to Irradiance, temperature raise, there exist two traditional converters: voltage- source or (voltage-fed) and current- source or (current-fed) converters or inverters depending on power flow directions. The voltage fed Z-source and Quasi Z- source inverter has been considering for photovoltaic applicationinrecentyears.The ability to boost and buck voltage makes the Z-source inverter very attractive for these applications. It is used in PV system which connected to a single phase load. A semi Z- Source is leading technology gained from ZSI. When QZSI is one stage power transformation devices which lie on a passive network relate for inverter to PV module. A Quasi has some rare factor such as low component rating and draws stable dc current when relatedtootherbuckboostconverter.

By shoot through states utilized by the semi Z- source inverters, to help the dc voltage without DC/DC converter. In these structures a semi Z- source inverter is used to get inversion and boost function in one single stage. The shoots through states are banned in the conventional voltage source inverter. The impedance network is employed between the PV system and Inverter. The semi Z-source inverter displays more accuracy in PV application because of its skill of handling shoot through states. The two stage conversion contains dc-dc converter and dc-ac converter. The switching devices in dc-dc converter will increase the cost and increase complexity in control system. It also decreases the efficiency. The single stage converter is proposed for PV system. The QZSI will be used to learn the low frequency ripple issue. The ability to boost and buck voltage makes the Z- source inverter very attractive for these applications. It is used in PV system which connected to a single phase load. A Quasi Z-source is modern technology gained from ZSI.

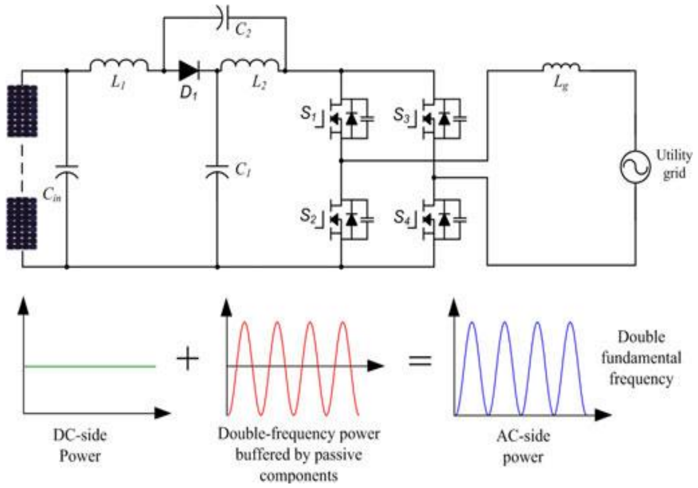

Figure 1: Diagram of a Single phase QZSI Based PV System

2. Existing System:

In this system there are some problems are available. To buffer the DFR energy a large capacitance is needed. Electrolytic capacitors are usually used due to their high capacitance. They can only be mounted vertically, because of liquid electrolyte inside them. They have a higher leakage current and not suitable for low frequency application. They are physically larger. So electrolytic capacitor considers being weak component regarding to lifetime for outdoor operation. The system can deliver a voltage lower than dc input voltage, since they are buck converter because of triggering two switches in the same legs. Due to irradiation and temperature raise the maximum power point of a solar panel varies. For a PV application an MPPT algorithms are used to gain maximum power from the PV panel. The maximum power from PV system obtained by using MPPT. As compared to all the algorithms P&O algorithm are most common used for an advantage of an easy implementation.

2.1 Functional Blocks:

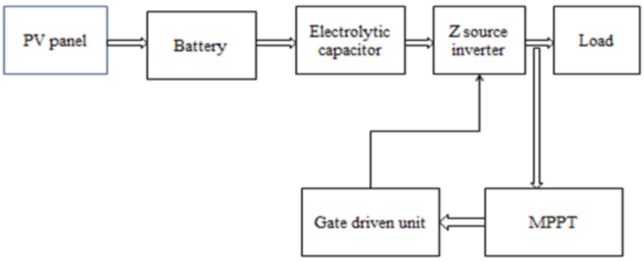

Figure 2: Block Diagram of Existing System

2.2 Circuit Diagram:

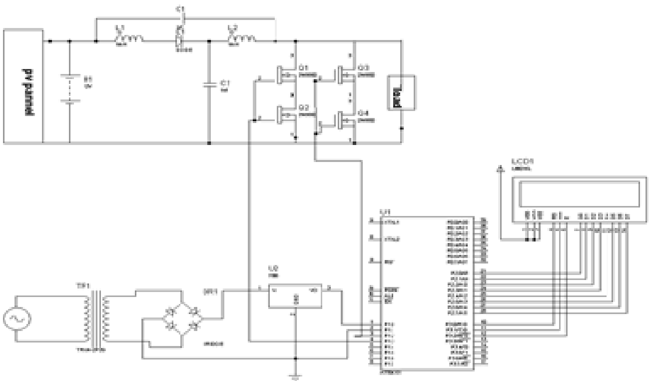

Figure 3: Circuit Diagram of Existing System

3. Proposed System:

The restriction in the current system resolved by the proposed system. The non-polarised film capacitors have superior characteristic, these are widely used for AC signal and power flow. Film capacitors are relatively cheap, stable over time and have low self-inductance and equivalent series resistant. The high voltage and high current can be done by high précised capacitance values. They have long shelf and service life, and very reliable with a very low average failure rate. The PV array draws constant current by using Quasi Z Source Inverter and it also handling a wide input range. The impedance network to allow voltage boost and inversion in a single stage. An MPPT cannot be track the constant voltage to the PV system. So fuzzy logic system is employed. A fuzzy logic control system that analyses analogy input values logical variables deals between 0 and 1. An MPPT with Sliding mode controls are used in the system.

3.1 System Structure:

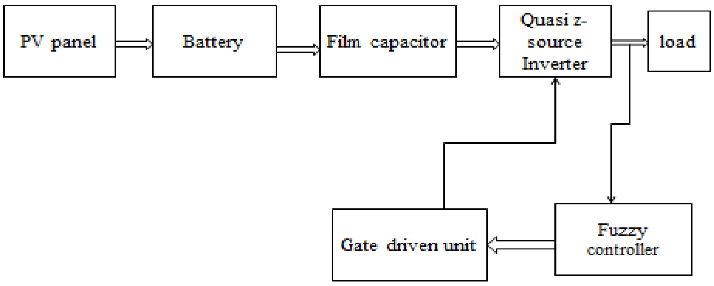

Figure 4: System Structure

3.2 Circuit Diagram:

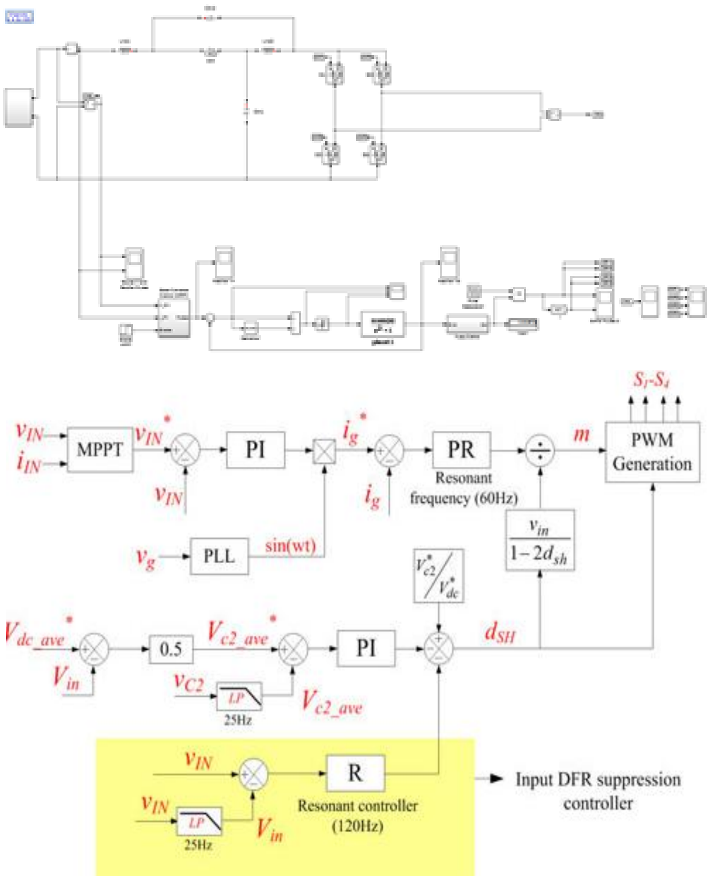

Figure 5: Circuit Diagram of proposed System

Fig 5 shows the control system of the proposed single phase Quasi Z source inverter. It contains the suppression controller for input DFR, current controller for grid connected system, capacitor voltage controller for Quasi Z Source, MPPT controller. An input voltage reference V*in which gives by MPPT controller. An PI controller regulate the error between V*in and Vin. By controlling d_{SH} the capacitor voltage is regulated.

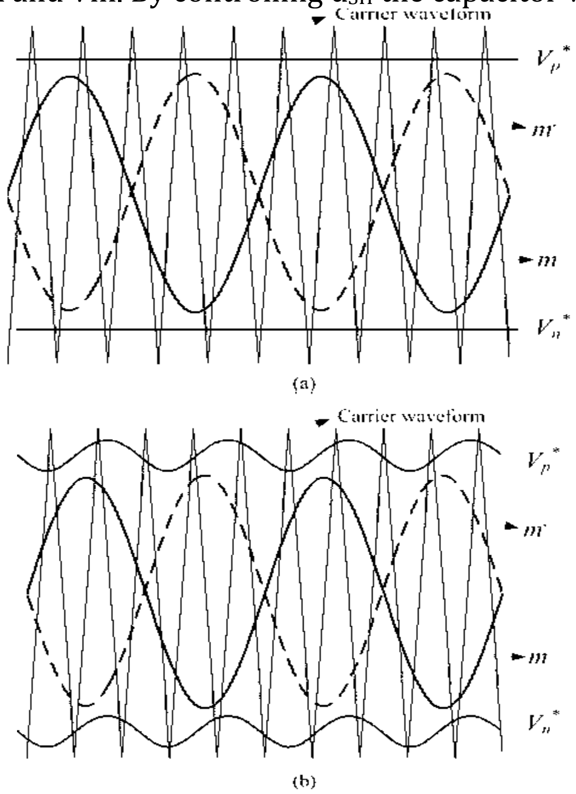

Figure 6: (a) Conventional method (b) Modified method.

The Fig (a) shows the modulation strategy of a conventional single phase Quasi Z Source inverter. To generate three-level voltage output the full bridge is modulated with 180. The speed duty ratio is generated by using two straight lines V*P and V*N. At the time of shoot through state all four switches S1-S4 are simultaneously turn on.

The Fig (b) shows the modified line with double frequency component of the shoot - through control lines V*P and V*N of the proposed control system.

3.3 Controller Circuit:

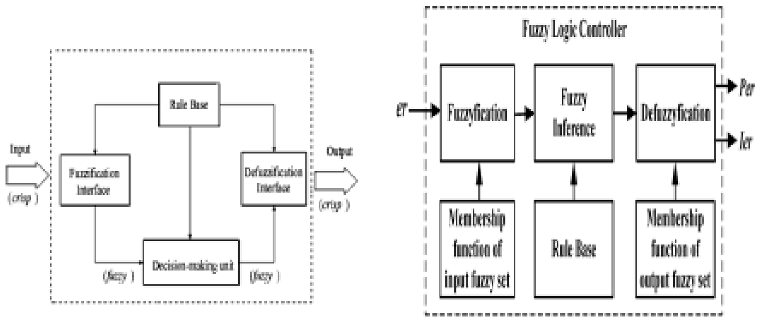

Figure 7: Basic configuration of a fuzzy logic system

Fuzzy logic is an approach that perform "true or false" (1 or 0) based on the "degrees of truth" of modern computer based technique. It performs analogy information regarding to logical variables between 0 and 1. By their very simple conceptually a fuzzy logic controller is generally used. It contains three stage process namely Input stage, Processing stage and output stage. The input stage performs membership function and truth values of maps sensor. The processing stage invokes result of the rules. The specific control output values are gained by output stage.

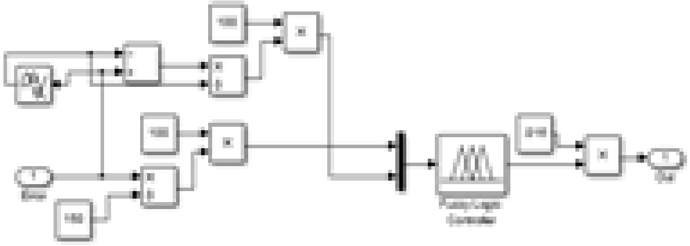

Figure 8: Circuit Diagram of Fuzzy Logic

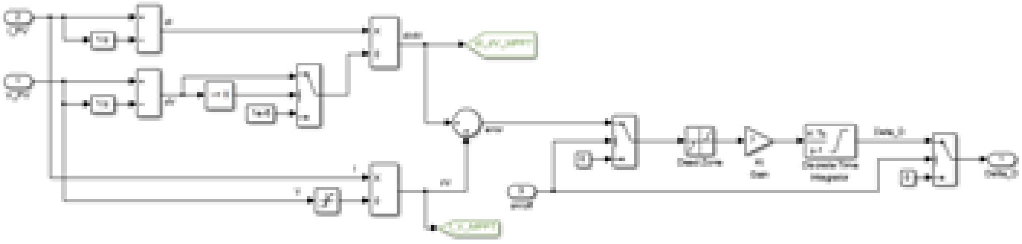

Figure 9: MPPT& Sliding mode Controller Circuit

Fig 9 shows the controller circuit for MPPT& Sliding mode. For a conventional system PI, MPPT controller is used. A proposed method Digital control like fuzzy logic and MPPT with sliding mode controller used.

3.4 Simulation Diagram:

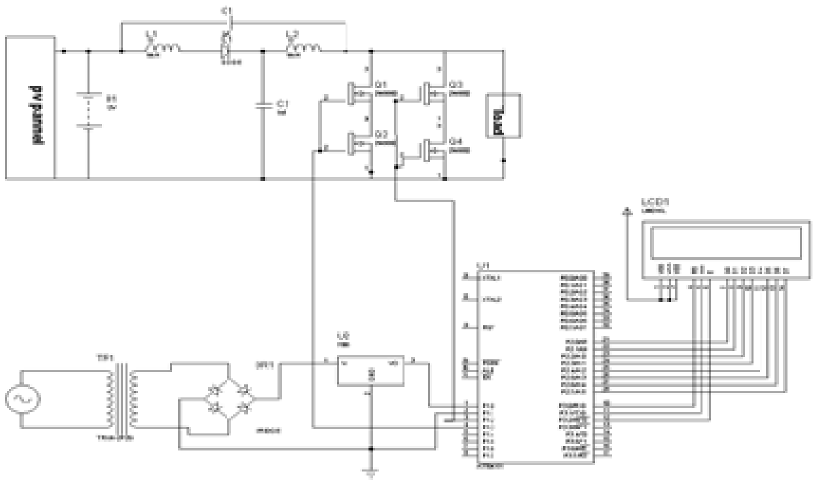

Figure10: Simulation Diagram of Existing system

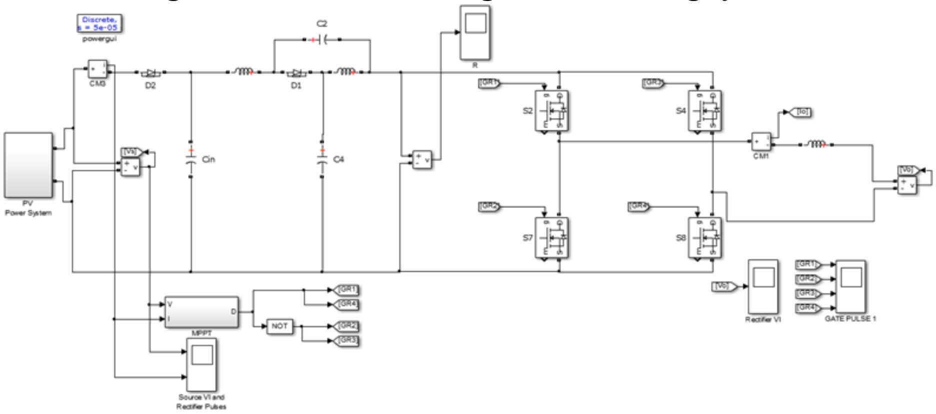

Figure 11: Simulation Diagram of Proposed System

4. Simulation Result:

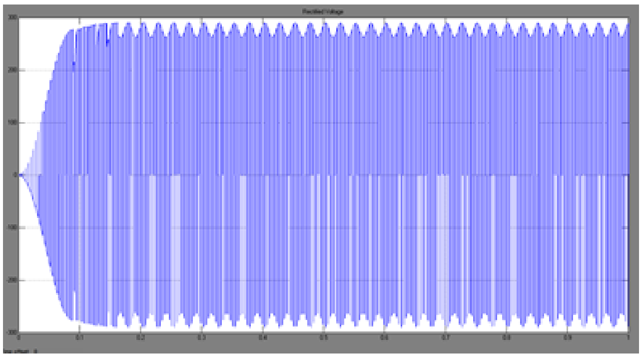

Figure 12: Inverter Output

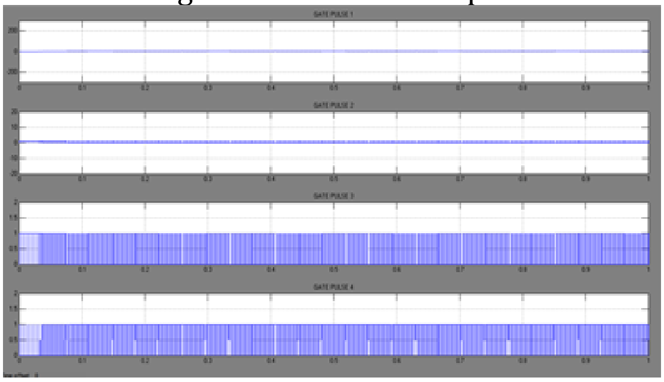

Figure 13: PWM Pulse

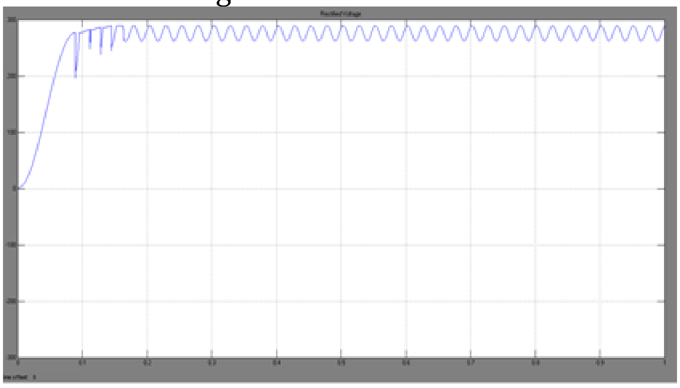

Figure 14: Z- Source Output

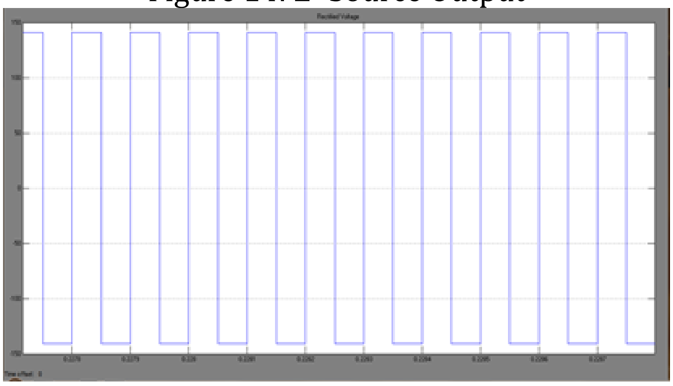

Figure 15: Inverter Output

Fig 15 shows the Inverter output voltage waveform of the proposed system which gives a voltage boost for a single stage conversion.

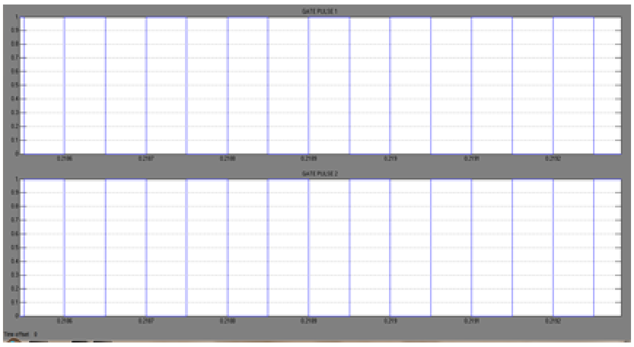

Figure 16: Gate Pulse

5. Conclusion:

In a single phase photovoltaic system there is a power irregularity exist between the AC yield and DC input which great Double Frequency Ripple. A buffered passive network has to be connected with the double-frequency ripple (DFR) system. The DFR buffering can be achieved by the high reliable film capacitors. From the input PV side to eliminate the ripple energy an input Double Frequency Ripple controller are used. The DFR buffering can be achieved by the high reliable film capacitors. From the input PV side to eliminate the ripple energy an input Double Frequency Ripple controller are used. The proposed system which delivers constant current from PV panel to boost the voltage in a single stage conversion. In this paper, the new control strategy has been implemented by reducing capacitance for DFR buffering in single-phase quasi-Z-source inverter applications. The low input voltage DFR can be achieved by proposed control system with minimal capacitance, without applying any additional hardware components.

6. References:

1. F. Z. Peng, “Z-Source Inverter,” IEEE Transactions on Industry Applications, vol. 39, No. 2, pp. 504-510, March/April 2003.
2. Miaosen Shen, Jin Wang, Alan Joseph, Fang Z. Peng, Leon M. Tolbert, and Donald J. Adams, “Maximum constant boost control of the Z source inverter.” in Proc. IEEE IAS’04, 2004, p.142.
3. Y. Huang; M. Shen; F. Z. Peng; J. Wang; “A Z-Source Inverter for Residential Photovoltaic Systems”, IEEE Transaction on Power Electronics, vol. 21, no. 6, pp. 1776-1782, Nov. 2006.
4. Shen, M.; Joseph, A.; Wang, J.; Peng, F.Z.; Adams, D.J., “Comparison of traditional inverters and Z-Source inverter”, in Conf. Rec. of IEEE Power Electronics Specialist Conference, pp.1692-1698, June, 2005.
5. E.Koutroulis, K.Kalaitzakis and N.C. Voulgaris, “Development of a microcontroller-based, photovoltaic maximum power point tracking control system”, IEEE Trans. power Electronics., vol.16, pp. 46-54, Jan.2001.
6. Kent Holland, Miaosen Shen, Fang Z. Peng, “Z-source inverter control for traction drive of fuel cell - battery hybrid vehicles” record of IEEE Industry Applications Conference, 2005 Volume 3, 2-6 Oct., 2005 pp.1651 – 1656.
7. Y. Li, S. Jiang, J. G. Cintron-Rivera, and F. Z. Peng, “Modelling and control of quasi-z-source inverter for distributed generation applications,” IEEETrans. Ind. Electron., vol. 60, no. 4, pp. 1532–1541, Apr. 2013.

8. Y. Huang, M. Shen, F. Z. Peng, and J. Wang, "Z -Source inverter forresidential photovoltaic systems," IEEE Trans. Power Electron., vol. 21,no. 6, pp. 1776–1782, Nov. 2006.
9. D. Cao, S. Jiang, X. Yu, and F. Z. Peng, "Low-cost semi-Z-source inverterfor single-phase photovoltaic systems," IEEE Trans. Power Electron.,vol. 26, no. 12, pp. 3514–3523, Dec. 2011.
10. W.Wei, H. Liu, J. Zhang and D. Xu, "Analysis of power losses in Z-source PV grid-connected inverter," in Proc. IEEE 8th Int. Conf. Power Electron.ECCE Asia, May 30–Jun. 3, 2011, pp. 2588–2592.
11. T. W. Chun, H. H. Lee, H. G. Kim, and E. C. Nho, Power control for aPV generation system using a single-phase grid-connected quasi Z-sourceinverter," in Proc. IEEE 8th Int. Conf. Power Electron. ECCE Asia, May30–Jun. 3, 2011, pp. 889–893.
12. L. Liu, H. Li, Y. Zhao, X. He, and Z. J. Shen, "1 MHz cascaded Z-sourceinverters for scalable grid-interactivephotovoltaic (PV) applications usingGaN device," in Proc. IEEE Energy Convers. Congr. Expo., Sep. 17–22,2011, pp. 2738–2745.
13. B.Ge, Q. Lei, F. Z. Peng, D. Song,Y. Liu,andA.R.Haitham, "An effectivePV power generation control system using quasi-Z source inverter withbattery," in Proc. IEEE Energy Convers. Congr. Expo., Sept. 17–22, 2011,pp. 1044–1050.
14. Y. Zhou, L. Liu, and H. Li, "A high-performance photovoltaic module integrated converter (MIC) based on cascaded quasi-Z-source inverters(qZSI) using eGaN FETs," IEEE Trans. Power Electron., vol. 28, no. 6,pp. 2727–2738, Jun. 2013.
15. X. Liu, H. Li and Z. Wang, "A fuel cell power conditioning system with low-frequency ripple-free input current using a control-oriented powerpulsation decoupling strategy," IEEE Trans. Power Electron., vol. 29,no. 1, pp. 159–169, Jan. 2014.