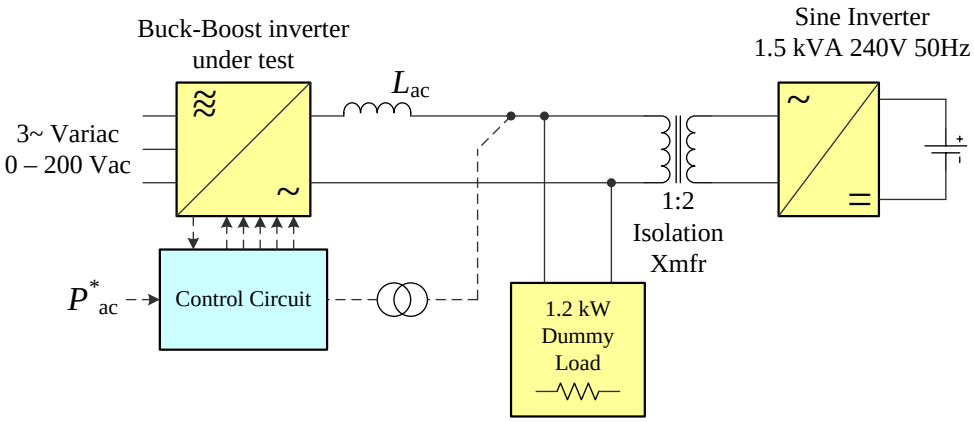

Figure 9. Experimental setup diagram

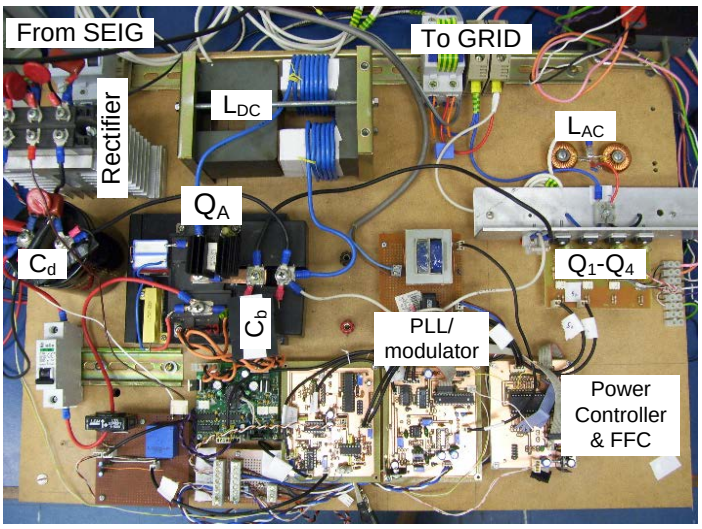

Figure 10. Photograph of inverter prototype

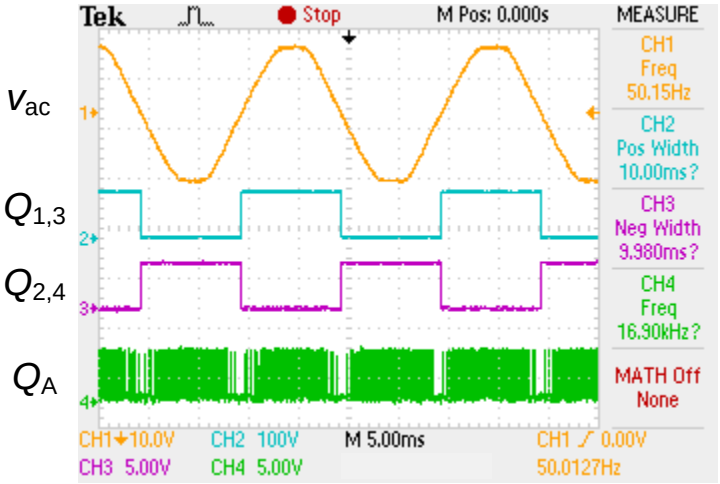

Figure 11. Measured grid voltage and gate signals generated by control circuit

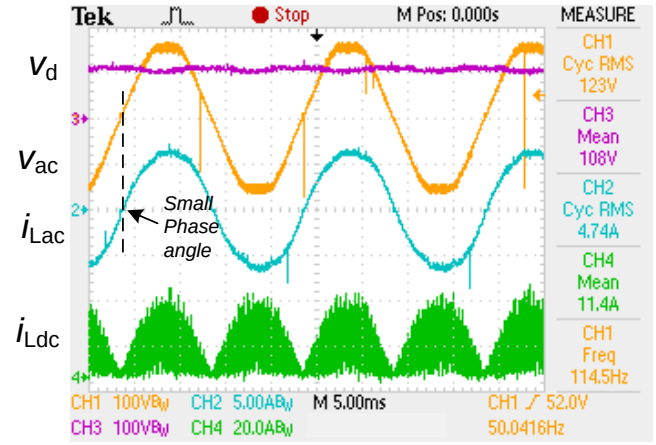

Figure 12. Measured voltage and current waveforms of buck-boost inverter

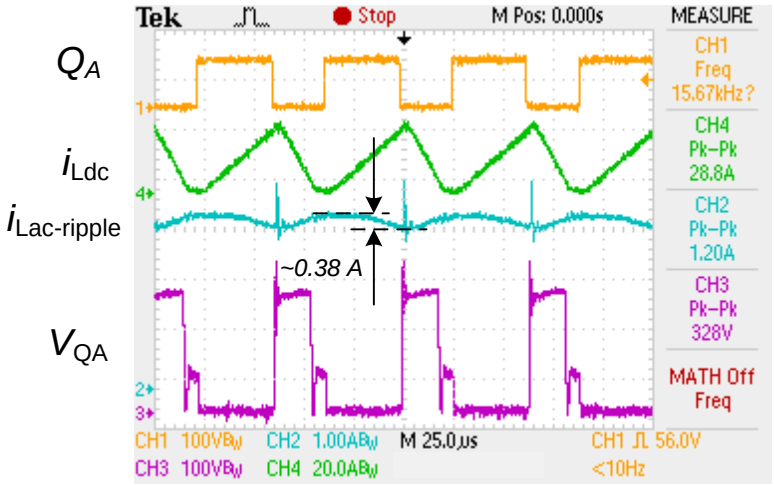

Figure 13. Detailed waveforms of buck-boost inverter

Low order frequency spectrum of inverter output current was also measured to reveal waveform quality. Frequency spectrum of output current depicted in Figure 14 shows total harmonic distortion and individual distortion which are well below 5%. Thus, it complies with most Total Harmonic Distortion (THD) limitation recommended by most power quality standards.

Figure 14. Measured frequency spectrum of inverter output current

IV. Conclusion

This paper has presented detailed analysis and design of the buck-boost inverter for wide input voltage application. Inverter parameters were obtained using both analytical and graphical methods which considers power quality of the inverter. Experimental results have been obtained using a scaled-down hardware prototype with results showing a strong correlation with simulations. A low cost microcontroller was sufficient to implement control circuit without compromising quality. Simulation result shows strong conformity to the converter design criteria. However, converter waveform test shows slight deviation from its design criteria. Test results showed ripple on output current is 3.25%. In term of waveform distortion, the THD of output current was less than 5% over a wide range of loads.

References

[1] L. Wang, H.W. Chen, and D.J. Lee, "Implementation of a DSP-based Power Converter for a Wind Induction Generator", *Power and Energy Society General Meeting - Conversion and Delivery of Electrical Energy in the 21st Century*, Pittsburgh, Pennsylvania, 2008.

[2] A. Macready, and C. Coates, "Low Cost Wind Turbine Controller", *the Australasian University Power Engineering Conference*, 2007.

[3] R. M. Hilloowala, and A.M. Sharaf, "A Utility Interactive Wind Energy Conversion Scheme with an Asynchronous DC Link Using a Supplementary Control Loop", *IEEE Transactions on Energy Conversion*, Vol. 9, pp. 558–563, 1994.

[4] R. Pena, R. Cardenas, R. Blasco, G. Asher, and J. Clare, "A Cage Induction Generator Using Back to Back PWM Converters for Variable Speed Grid Connected Wind Energy System", *The 27th Annual Conference of Industrial Electronics Society*, Denver, Colorado, 2001.

[5] R.Q. Machado, J.A Pomilio, and E.G. Marra, "Electronically Controlled Bi-Directional Connection of Induction Generator with a Single-Phase Grid", *The 27th Annual Conference of Industrial Electronics Society*, Denver, Colorado, 2001.

[6] A. Masaoud, H.W. Ping, S. Mekhilef, and H.O. Belkamel, "A New Five-level Single-phase Inverter Employing a Space Vector Current Control", *Electric Power Components and Systems*, Vol. 42, No. 11, pp. 1121–1130, 2014.

[7] Ammar Masaoud, Hew Wooi Ping, Saad Mekhilef, and Ayoub Taallah, "Novel configuration for multilevel DC-link three-phase five-level inverter" , *IET Power Electronics*, Vol. 7, No. 12, pp. 3052–3061, 2014.

[8] Md. Mubashwar Hasan, S. Mekhilef, and M. Ahmed, "Three-phase hybrid multilevel inverter with less power electronic components using space vector modulation", *IET Power Electronics*, Vol. 7, No. 5, pp. 1256–1265, 2014.

[9] S. Ganesh Kumar, S. Abdul Rahman, and G. Uma, "Operation of Self-Excited Induction Generator through Matrix Converter", *The Applied Power Electronics Conference and Exposition*, Austin, Texas, 2008.

[10] S.M. Barakati, M. Kazerani, and X. Chen, "A New Wind Turbine Generation System Based on Matrix Converter," *Power Engineering Society General Meeting*, San Francisco, California, 2005.

[11] F. Kang and S. Park, "Photovoltaic Power Interface Circuit Incorporated with a Buck-Boost Converter and a Full-Bridge Inverter", Vol. 82, 2005.

[12] M. Nagao, “Power Flow of Photovoltaic System using Buck-Boost PWM Power Inverter”, *The International Conference on Power Electronics and Drive System*, Singapore, 1997.