A Study on PWM and SPWM control and CAN Communication Realization in the Wind-Solar photovoltaic hybrid power System Using DSPIC30F4013

Kang Kyong-Mo[a*], Kim Song-Jae[b] , Kim Un-Chol[b], Ji Song-Chol[c], Pak Chang-Yon[a], Han Kuang-Jin[a]

[a] **Ham Hung University of hydraulics and power , Ham Hung , Democratic People's Republic of Korea**

[b] **Kim Chaek Industrial University, Pyongyang , Democratic People's Republic of Korea**

[c] **KPyongyang Architecture University, Pyongyang , Democratic People's Republic of Korea**

AUTHOR or CONNETION INFORMATION

* E-mail: kangkyongmo@163.com

ABSTRACT

In this paper, we study the data transmission method by CAN communication, PWM and SPWM control method of the chips capable of CAN communication in wind - solar photovoltaic hybrid power generation system, and introduced the method of using DSPIC30F4013.

1. Introduction

The reality of today, which requires more energy due to the gradual depletion of fossil energies and the continuous development of the economy, requires the wider use of various renewable energies.

Wind energy and solar energy can be said to account for a large part of them.

However, wind and solar energy are subject to many factors such as climate, season, natural environment and weather.

Wind turbine, solar power generation, and power utilization efficiency improvement are important advances in terms of new energy generation technologies.

We install the DSPIC30F4013 capable of CAN communication on the control units of the wind turbine and PV panel array , the main controller is installed with the CAN communication communication equipment, take various kinds of sensing and control signals can be quickly and accurately responded to demands of load output follow-up, realize PWM and SPWM control by chip, improve communication and control system reliability.

2. Structure of Basic System

The structure of the basic system is as follows.

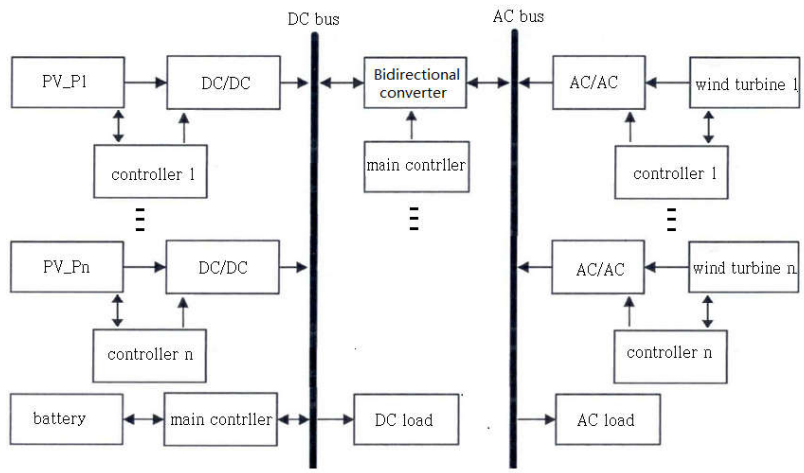

Fig 1. Structure of wind and solar photovoltaic hybrid power generation system

Every controllers detecte output voltage, current, power, PV panel angle and wind speed, carry data to data collecter of main controller using CAN communication.

The main controller synthesize data of data collecter and power (direct current and alternating current) required by the load side, carry control signals to the every controller with load-power form using CAN communication, also, send charge-recharge control signal of the battery and control signals of the bidirectional controller.

3. CAN communication connection

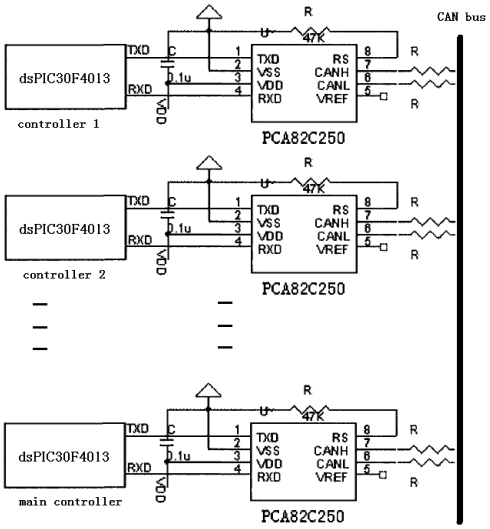

Fig 2. CAN communication connection

Control signals sent to the every controllers are the angle of the PV panel and operating points of AC / AC converter and DC / DC converter.

Evey controllers and main controller are DSPIC30F4013. Using the PWM function of the chip, the main controller sends the control signals of the bidirectional converter, and the every controllers output the control signals of the AC / AC converter and DC / DC converters.

The movable bar is controlled by the forward-reverse rotation of the control motor and moves to the maximum output point according to the light intensity. However, control angle is changed by the load output traking of the main controller, when the output produced is too large compared to the load, some wind turbines or PV panels may be disconnected from the power system by the control signal of the main controller.

4. Realization of PWM and SPWM control

The PWM output at the DSPIC4013 has a resolution of 16 bits and the output frequency can be up to 10MHz.
The PWM period can be given in MPLAB as follows.
When the duty cycle is 1/2 of the PWM period, PR2=6536; OC2CON=0x2007; T2CON=0x8000; OC2R=0x8000;,
when the duty cycle is 1/4 of the PWM period, PR2=6536; OC2CON=0x2007; T2CON=0x8000; OC2R=0x4000;,
when the duty cycle is 1/16 of the PWM period, PR2=6536; OC2CON=0x2007; T2CON=0x8000; OC2R=0x1000;.
The Proteus simulation results show the PWM output control of the different frequency.

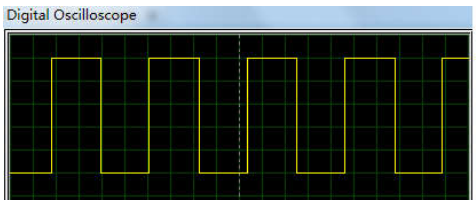

Fig 3. When the duty cycle is 1/2 of the PWM period

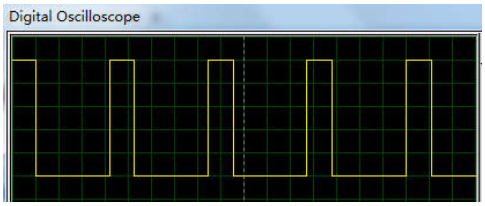

Fig 4. When the duty cycle is 1/4 of the PWM period

Fig 5. When the duty cycle is 1/16 of the PWM period

The PWM output signal is used as control signal for each converters.
The simulation circuit for the buck circuit using the PWM output signal and the results are as follows.

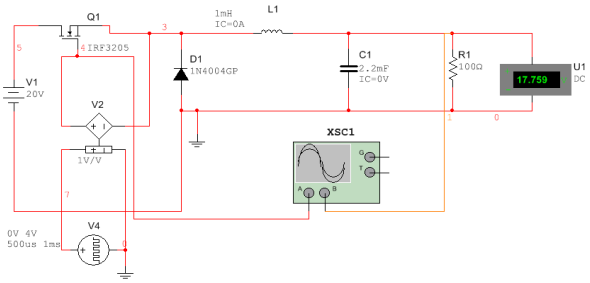

Fig 6. buck simulation circuit (multisim2014)

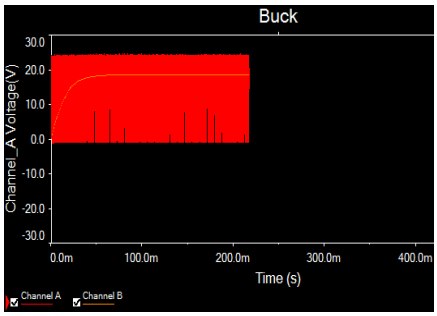

Fig 7. When the duty cycle is 1/2 of the PWM period(U=17.8V)

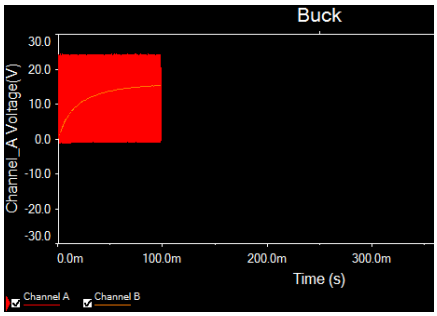

Fig 8. When the duty cycle is 1/4 of the PWM period(U=14V)

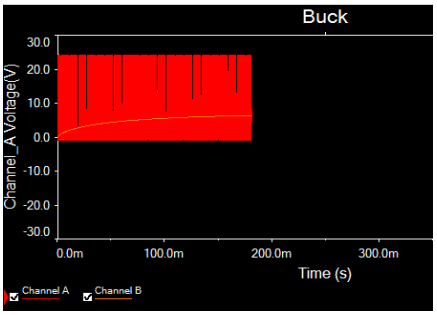

Fig 9. When the duty cycle is 1/16 of the PWM period(U=5.6V)

The SPWM control signal that can be used for the inverter can also be controlled from chip. The control program and simulation results are as follows.

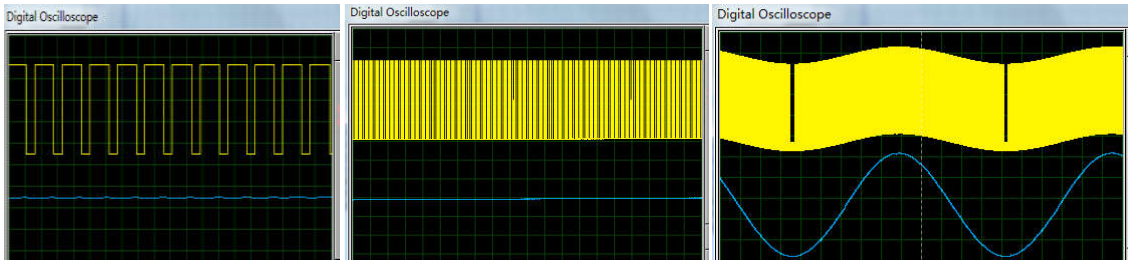

Fig 10. SPWM control signal simulation result

5. Conclusion

PWM control simulations and Buck circuit simulations using them, SPWM simulations show that they can be used directly in the wind - solar photovoltaic hybrid power generation system and guarantee the reliability of the control system with high precision. The realization of CAN communication using the PCA82C250 also guarantees the rapidity of power generation system communication.

References

[1] Zhang X, Ruan X B, Zhong Q C. Improving the Stability of Cascaded DC/DC Converter Systems via Shaping the Input Impedance of the Load Converter With a Parallel or Series Virtual Impedance[J]. IEEE Transactions on Industrial Electronics, 2015, 62(12): 7499-7512.

[2] Schuck M, Pilawa-Podgurski R C N. Ripple Minimization Through Harmonic Elimination in Asymmetric Interleaved Multiphase DC-DC Converters[J]. IEEE Transactions on Power Electronics, 2015, 30(12): 7202-7214.

[3] Li Y M, Tong Q, Yang X B, et al. Fixed-frequency adaptive off-time controlled buck current regulator with excellent pulse-width modulation and analogue dimming for light-emitting diode driving applications[J]. IET Power Electronics, 2015, 8(11): 2229-2236.

[4] DALWADIPG, CHINTAN R M. Feasibility study of Solar-Wind hybrid power system[J]. International Journal of Emerging Technology and a, 2012, 2(3):125-128.

[5] Aravindan P, Thangavel S, Sanavullah M Y. Maximum energy extraction in wind solar hybrid energy conversion system[J]. European Journal of Scientific Research, 2011, 63(1):90-98.

[6] Yerra S L, Mostafak. Modeling and control of hybrid photovoltaic wind energy conversion system[J]. International Journal of Advances in Engineering, 2012, 3(2):192-201.

[7] Valarmathi R, Palaniswami S, Devarajan N. Simulation and analysis of wind energy and photovoltaic hybrid system[J]. International Journal of Soft Computing and Engine, 2012, 2(2):193-200.

[8] Teena J, Arun S. Modeling of hybrid wind and photovoltaic energy system using a new converter topology[J]. Electrical and electronics engineering: an interna, 2012, 1(2):1-13.

[9] Dalwadi P G, Chintan R M. Feasibility study of Solar-Wind hybrid power system [J]. International Journal of Energing Technology and a, 2012, 2(3):125-128.

[10] Jacob T, Arun S. Maximum Power Point Tracking of hybrid PV and wind energy systems using a new converter topology[C]. Green Technologies (ICGT), 2012 International Conference on. IEEE, 2012:280-287.