Development and Test of Simultaneous Power Analysis System for Three-Phase and Four-Wire Power System

Hun Oh[1], In Ho Ryu[2] and Jeong-Chay Jeon[3]*

[1]Department of Electrical and Information Communication Engineering, WonKwang University Engineering, #460, Iksandae-ro, Iksan-si, Jeonbuk, Rep. of Korea
[2]Department of IT Applied System Engineering, Chonbuk National University #664-14, 1-ga, Duck-jin Dong Duck-jin Ku, Jeonju, 561-756, Rep. of Korea
[3]Korea Electrical Safety Corporation
#27 Sangcheon-ri, Cheongpyeoung-myeon, Gapyeong-gun, Gyeonggi-do, 477-814, Rep. of Korea
kescoin@naver.com*

Abstract. This paper presented voltage 8-channel and current 10-channel power measurement system that simultaneously can measure and analyze power components for both supply and demand side. The developed system was tested using ac power source. The test results showed that accuracy of the developed system is about 0.2 percent. Also, simultaneous measurement field test of the developed system was implemented by applying in the supply and demand side of three-phase power system.

Keywords: Multi-channel, Power Analysis, Three-Phase, Voltage, Current

1 Introduction

The various problems including malfunction of control devices, data loss of computer systems and overheating of cable and transformer have been generated. These problems and concerns created the needs of the measurement of power components such as active, reactive and apparent power, root-mean-square (rms) values of voltage and current, power factor and power quality [1, 2]. There are many variants of power measurement available in the field ranging from hand-held instruments to portable monitors. These instruments have voltage 4-channel and current 5-channel and provide three-phase and four-wire metering. Therefore, they can measure power components of only one side that is supply or demand side of three-phase and four-wire power system. But, in order to effectively improve energy efficiency and solve power disturbances, power components measurement for both supply and demand side of power system must be implemented before appropriate action on power problems is taken [3].

This paper presented voltage 8-channel and current 10-channel power measurement system that simultaneously can measure power components for supply and demand side of power system. The accuracy of active, reactive and apparent power measurement and harmonic analysis by the developed system was tested using ac

power source (PACIFIC 345AMX). The test results showed that accuracy is about 0.2 percent. In the field test of the developed system, the power components measurement for all phases of load and source side in three-phase power system was simultaneously implemented.

2 The system architecture

Figure 1 shows the basic block diagram of the proposed multi-channel power measurement system. The proposed system is largely consisted of analog signal input block with voltage 8-channel and current 10-channel measuring sensors, analogue to digital conversion (ADC) block converting analog signal into digital signal, digital signal processing block controlling circumference installations and performing operation function, programmable logic device (PLD) block performing system interface processing, memory block of static RAM (SRMA) and flash ROM (FROM), interface block to transfer the metering results to a personal computer via a serial link for display, and operation power source block supplying operation power of the proposed system. The proposed system was constructed on a single printed circuit board (PCB)

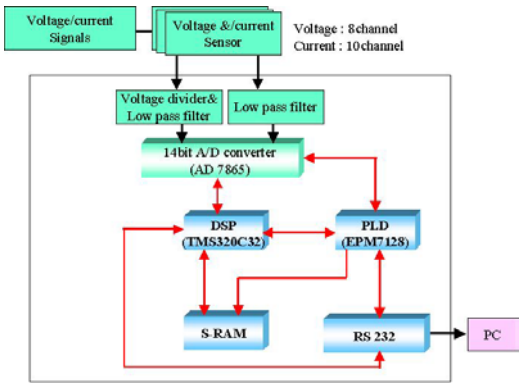

Fig. 1. Block diagram of the proposed system

3 Test and results

The First, accuracy of power (active, reactive and apparent power) measurement and harmonic analysis by the developed system was tested, Test system, which is consisted of programmable ac power source (PACIFIC 345AMX) and load, was constructed. Programmable ac power source can produce voltage with arbitrary magnitude and frequency. Test results indicated that the developed system yielded less than 0.2 % error in all case. In order to verify that the developed system can simultaneously measure power components for both supply and demand side of power system, the developed system was connected with load and source side of

three-phase power system

4 Conclusion

The voltage 8-channel and current 10-channel power measurement system to simultaneously analyze power components and harmonics in several points of power system was designed and implemented. Voltage and current measurement errors of the developed system were revised, and accuracy of power (active, reactive and apparent power) and harmonic measurement was tested by comparing power components outputted in the programmable ac power source with that calculated by the developed system. All the test results showed that the measurement error is less than 0.2 percent. For field test, the developed system was connected with load and source side of three-phase power system that capacitor and inductor to improve power factor were installed. The result of field test showed measurement of power components for all phases of load and source side was simultaneously implemented.

As the results of field test, it was certificated that the measurements of power components such as voltage and current waveforms, reactive power and harmonics for all phases of load and source side using the developed system can be simultaneously implemented and the proposed system can be effectively applied to measure power components of power system in order to solve power disturbances.

References

1. Dong-Jun Won, Il-Yop Chung, Joong-Moon Kim, Seon-Ju Ahn, Seung-Il Moon, Jang-Cheol Seo and Jong-Woong Choe, "Power Quality Monitoring System with a New Distributed Monitoring Structure", *KIEE Trans. on PE*, Vol. 4-A, No. 4, pp. 214-220, 2004
2. J. Arrillaga, N. R. Watson and S. Chen, " Power System Quality Assessment", WILEY, January, 2001
3. Ringo P K Lee, L L lai and Norman Tse, "A Web-based Multi-channel Power Quality Monitoring System for a Large Network", *Power System Management and Control, 17-19 April 2002 Conference Publication* No. 488, pp. 112