

UPGRADE OF CORRECTOR POWER SUPPLIES FOR POHANG LIGHT SOURCE*

I. S. Ko[†], K. M. Ha, S. C. Kim, J. H. Suh, J. Y. Huang, H. S. Kang, and J. Choi
Pohang Accelerator Laboratory, Pohang 790-784, Korea

Abstract

There are 70 vertical and 70 horizontal correctors for Pohang Light Source. Until 2003, power supplies for these correctors were based on 1980's technology, so the global orbit feedback system was not possible with poor 12 bit resolution. In 2003, a task force team was assembled to develop new power supplies with BESSY type DAC cards. By summer 2004, two vertical correctors in each lattice were connected with new power supplies, and the global orbit feedback was available within the accuracy of 5 microns. However, this replacement was not enough to satisfy the beam stability requirement of 2 microns for PLS. We have launched another power supply design based on all digital technology. This attempt was completed within a year, and 80 units were assembled in house. Currently, the global orbit feedback system is running successfully with new digital power supplies and the compensation of chamber motion due to the thermal load by using digital displacement transducers attached on each BPMs.

INTRODUCTION

Pohang Light Source (PLS) has 12 cells with one super-period. There are 70 vertical and 70 horizontal correctors for orbit correction. PLS has provided stable photon beam to beamline users since corrector magnet power supplies (CMPS) were upgraded to more stable ones by 2005. CMPS for synchrotron radiation source is required to have long-term stability, high precision current control, and control repeatability. The CMPS has been upgraded two times incorporating the available technology of magnet power supply at those times.

Until 2003, power supplies for these correctors were based on 1980's technology with 12 bit of current granularity and the hysteresis current controlled full-bridge converter type, so the global orbit feedback system was not possible with poor 12 bit resolution. With the 12-bit power supply, 1 bit current change of CMPS resulted in about 6 μm change of global orbit, which is not acceptable to beamline users. As the 12-bit power supply was too coarse to be used in global orbit feedback, we had to replace the power supply with the granularity of better than 16 bit. In 2003, a task force team was assembled to develop new power supplies. At that time as a first upgrade model we decided to adopt DAC/ADC card developed for BESSY-II which is capable of 20-bit control granularity [1]. The first upgrade model was analog type. Only 22 among 70 power supplies for the

vertical plane were replaced with the first upgrade model because of the budget limitation while 22 power supplies for horizontal plane were replaced with the modified module of the existing power supply whose DAC/ADC granularity was improved to 16 bit. The selected corrector magnets which are located upstream and downstream of the straight sections can effectively counteract the orbit change due to gap change of insertion devices. The orbit stability after the first CMPS upgrade was less than 1 μm for short-term (< 5 min) and 5 μm for long-term (> 12 hours).

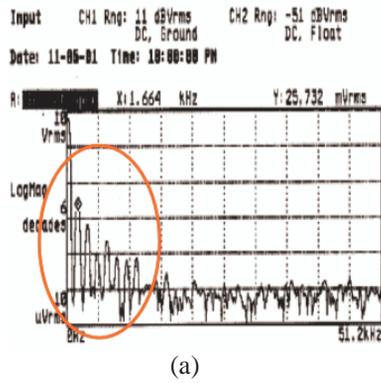
However, this replacement was not enough to satisfy the beam stability requirement of 2 microns for PLS. In order to attain that requirement, more corrector power supplies should be replaced with better ones. Moreover some improvement was issued on the power supply itself; better stability and better control granularity. We have launched another power supply design based on all digital technology. This attempt was completed within a year, and 80 units were assembled in house. At that time we decided to adopt newly established-digital technology for magnet power supply which was developed in PSI [2]. We fabricated 70 power supplies with digital architecture for vertical plane and put them into operation in September 2005. The second upgrade of CMPS is fully digital technology and has a control resolution of 1 ppm and short-term (< 5 min) stability of ± 2 ppm and long term (< 24 hours) stability of ± 10 ppm [3]. The 22 power supplies of first upgrade model were moved to horizontal plane correctors. As the number of available good CMPSs was increased in both planes, 34 correctors were used in each plane for global orbit feedback. The resultant orbit stability for 12 hours improved to 2 μm , and the orbit variation at each correction step in global orbit feedback was not clearly seen in beamlines. The global orbit feedback runs every 2 seconds. The digital type power supply communicates with VME via fiber optics module at 5 Mbps.

HARDWARE CONFIGURATION

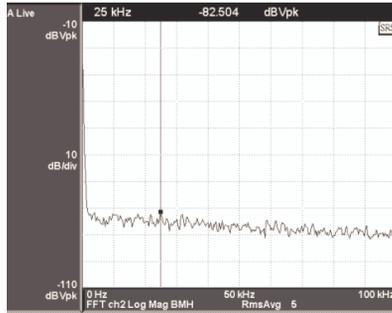
The control granularity of CMPS should be small enough to make the beam oscillation by orbit feedback invisible in beamline experiments. In order to get high precision control granularity, 19 to 24 bit DAC board was developed in BESSY-II. A power supply with digital control architecture was developed in PSI and successfully applied in DIAMOD for a few watts to 1 MW power supply. Digital-controlled power supply is capable of providing high resolution above 19-bit and

* Supported by the Ministry of Science and Technology of Korea.

[†] isko@postech.ac.kr

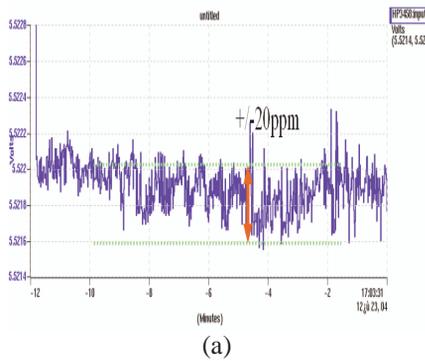


(a)

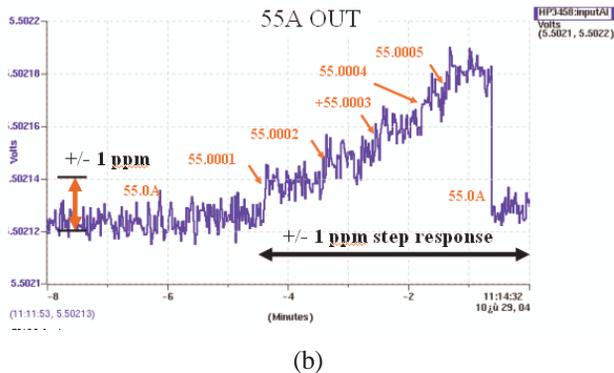


(b)

Figure 3: Output current noise spectrum: (a) Old CMPS, (b) Digital CMPS.



(a)



(b)

Figure 4: Short-term stability: (a) Old CMPS (20 ppm/Div), (b) Digital CMPS (1 ppm/Div).

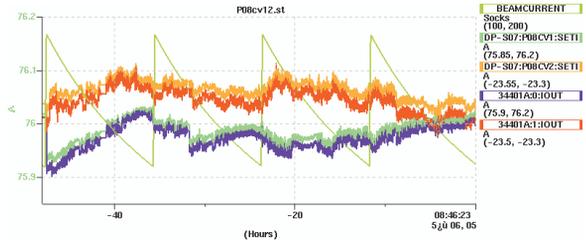


Figure 5: Current variations of the setting and reading of two CMPS (P08CV1 and P08CV2).

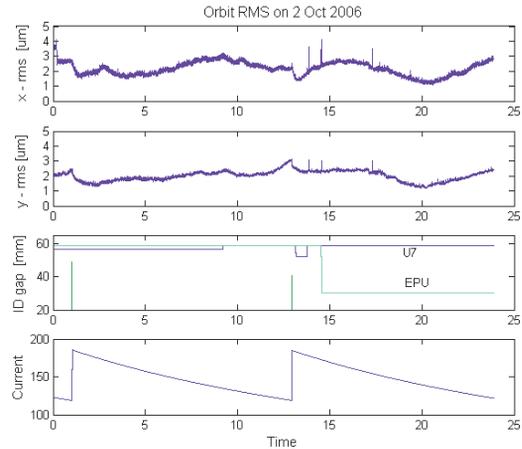


Figure 6: Orbit stability measured for one day.

CONCLUSION

PLS CMPS has been upgraded continuously since 2003, and played an important role in orbit stabilization. The high performance digital power supplies installed in 2005 have been working well up to now and the orbit stability has improved remarkably. The power supply itself shows a good reliability. Currently, the global orbit feedback system is running successfully with the digital power supplies and the compensation of chamber motion due to the thermal load by using digital displacement transducers attached on each BPMs [4].

REFERENCES

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