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Design and testing of high stability power supply for high energy photon source

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The High Energy Photon Source (HEPS) is the fourth-generation synchrotron photon source. Compared with the third-generation synchrotron photon source, the brightness is 100-1000 times higher, and the electron emittance of the storage ring is low to the diffraction limit of light. Through physical calculations, it is required that the stability of the storage ring quadrupole magnet power supply be better than 10ppm, and the accuracy of output current be better than 80ppm. This high demand for technical parameter poses a challenge to the development of high precision and stability power supplies. The main circuit topology of the power supply adopts a phase shifted full bridge soft switching scheme, which avoids interference caused by switching noise and improves power stability and efficiency. The high-precision digital power supply controller based on FPGA improves the sampling speed and control accuracy of the power supply, and the constant temperature control circuit ensures that the output current of the power supply meets the requirements of HEPS for power supply performance. In the batch testing section, a testing facility was built to test the stability, accuracy, repeatability, voltage ripple, and other parameter of high precision and stability power supplies. After a year and a half of testing, the performance tests of 1066 power supplies, including linear accelerators power supplies, booster power supplies, storage rings power supplies, dipole and quadrupole combined power supplies, dipole and quadrupole power supplies, were completed. The results all met and exceeded the design specifications. The HEPS high precision and stability power supply meets the design requirements in terms of current stability, accuracy, repeatability, voltage ripple, and other aspects. The batch test results show that the power supply performance using the full bridge phase shifting soft switching technology combined with high-precision digital controller scheme is excellent, and the power supply consistency is good, providing a guarantee for the successful operation of HEPS in the future.

Footnotes

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