Sector Focused Cyclotron Power Supply Control System Upgrade

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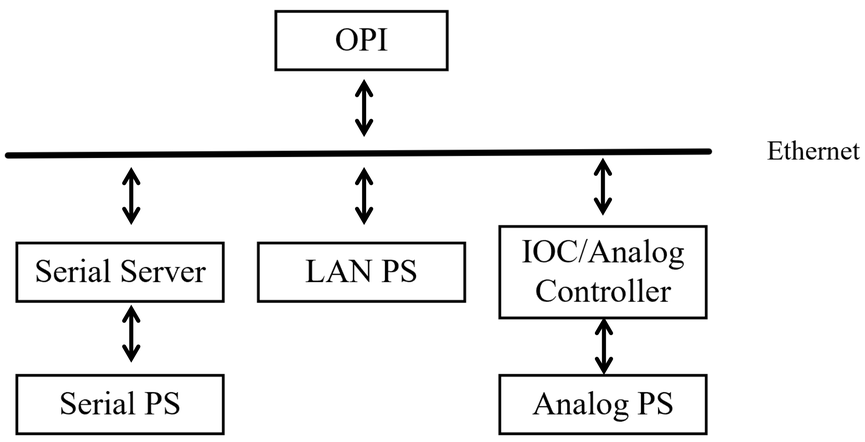
Introduction

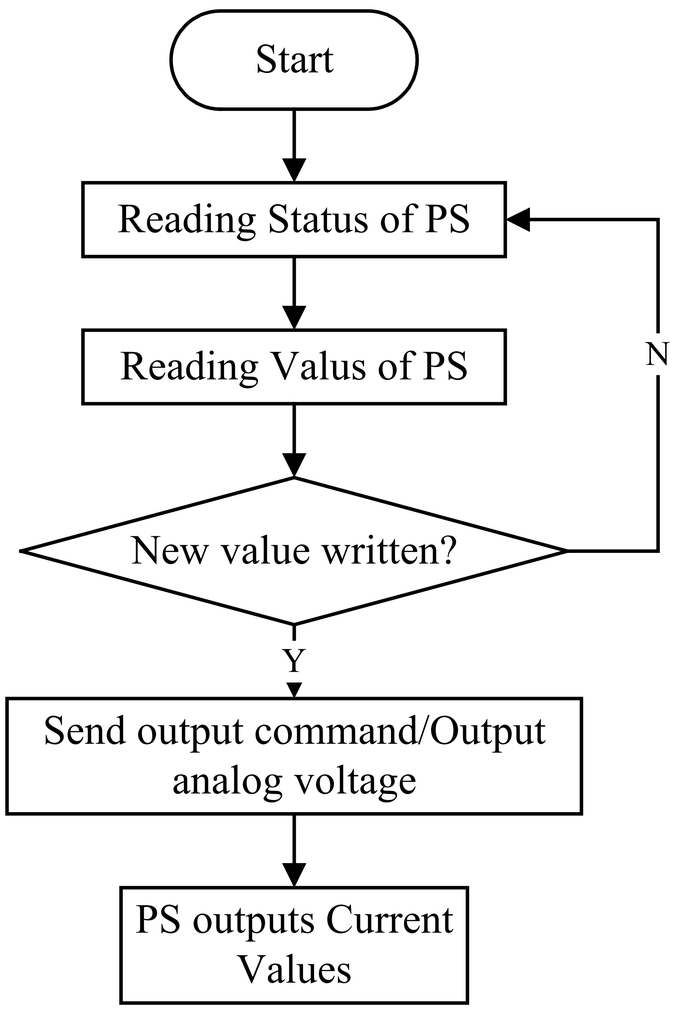
Lanzhou Heavy Ion Research Facility (HIRFL) includes Electron Cyclotron Resonance ion source (ECR), Sector Focusing Cyclotron (SFC), Separated Sector Cyclotron (SSC), Cooling Storage Ring (CSR) main ring and experimental ring, radioactive beam line, experiment terminals and other parts. The power supply control system is one of the important components of the accelerator, which can realize remote debugging, data storage and historical data analysis of the power supply. The old power supply control system adopts a centralized structure. If the main control device fails, the entire control system will not be able to operate. The new control system uses the EPICS architecture, changes to a distributed control system, and realizes control of multiple power supply types.

The Control System Structure



The control System structure is based on EPICS.

The Flow Diagram of the Control System



The Flow Diagram of the Power Supply Control Program

There are two types of power IOC control programs, one interacts with the power Supply controller through the communication interface, and the other uses the analog control module to output and input analog signals. Analog power supplies also require coefficients to make the power supply output consistent with reality. The input and output coefficients are written to the analog controller through IOC. The power supply for the communication interface only needs to send and receive data instructions through the serial port or network port.

The Hardware of PS Control System

The main controller of the power control system uses Advantech APAX5580, the output module is APAX5028, and the input module is APAX5017. APAX5580 adopts the sixth generation Intel® Core™ i7 processor, up to 2.6 GHz, 8GB DDR4 memory, compact fanless design, can be used for DIN rail installation in control cabinets, providing better EtherCAT performance, supports EtherCAT line, star, and ring redundant topologies.

The Power Supply Control System hardware.

APAX5017 has 12 input channels, configurable to ±150mV, ±500mV, ±1V, ±5V, ±10V, ±20mA, 0~20mA, 4~20 mA. APAX5028 has 8 output channels, which can be configured as ±2.5 V, ±5 V, ±10 V, 0~2.5 V, 0~5 V, 0~10 V, 0~20 mA, 4~20 mA. The SFC analog power supply uses ±10 V control signals. All three types of power control IOCs are in the same main controller.

Conclusion

SFC Power Supplies

SFC power supplies are distributed in different rooms, and IOCs are distributed in each room. The power supply control system operation is stable after adopting the EPICS distributed control system. It provides a guarantee for the stable operation of the SFC accelerator and can better conduct nuclear physics-related experiments.