A PROTOTYPE OF THE POWER SUPPLY CONTROL SYSTEM IN BEPCII

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Abstract

BEPCII will construct double rings in the current BEPC tunnel. There will be approximately 400 magnet power supplies in the storage rings and transport line. The power supplies in the rings need to be redesigned as they will vary nearly from 90 to 300 in amount. According to the requirement of control precision and stability of the magnet power supplies and the investigation on the front-end hardware, we decided to use a BNL-designed PSC/PSI (Power Supply Controller/Interface)[1][2] to control high precision power supplies. The PSI will be installed in the power supply. The PSC will reside in the VME-64x crate. They are connected with a pair of fiber optic cables. The PSC can control up to six PSIs. All corrector power supplies will be controlled by IP I/O modules[3]. In order to preserve our investment in the hardware, the existing CAMAC hardware in the transport line will remain. The CAMAC will be connected to the VME system via a VME-CAMAC interface board[4]. Therefore, the front-end consists of VME crate, PowerPC750, PSC/PSI, VME IP I/O modules and VME-CAMAC interface boards. It's necessary to first build a control prototype of the power supply with different types of I/O modules for testing the performance of these I/O modules. Control and monitoring of the prototype power supply will be implemented with EPICS toolkit[5]. The paper describes the progress and software development of the control prototype and discusses the plan for the near future.

1 OVERVIEW

BEPCII[6] will be constructed for both high energy physics (HEP) (1 to 2 GeV) and synchrotron radiation (SR) (2.5 GeV) researches. Control and monitoring of the power supplies must meet the physical requirement in the two modes. Particularly, all power supplies should do synchronously ramping from the colliding mode to the synchrotron radiation mode besides the basic functionally (setpoint, readback, control and status).

We spent a lot of times on investigating the control system of the domestic and foreign labs, finally we chose the control architecture of the front-end of BEPCII which consists of VME-64x crates, Motorola PowerPC750 CPU boards and different type of I/O modules as shown in the figure 1. The SUN workstation is used for EPICS development.

The PSC/PSI is a BNL-designed integrated system for SNS. Control and monitoring of SNS power supplies was accomplished with the PSC/PSI. We think that PSC/PSI system is a best solution for our large power supply control after we studied it and discussed with BNL related people many times by email. It not only has a good performance and many advantages, but also now is commercial available.

The PSC/PSI is a very simple integrated system that provides all functions (setpoint, readback, control and status) with a single board at the power supply. The PSI has one 16-bit analog output, four 16-bit analog inputs, fifteen digital commands, and sixteen digital readback. The connection between the PSI and the power supply is with two cables:one for the analog signals and another for the digital signals. This installation is very simple. Communication between the PSI and PSC is through a pair of fibers that also provides electrical isolation.

Our prototype large power supply together with the PSI connectors is made in a domestic vendor's factory. Corrector power supplies still use the current specification of BEPC. The connection between the corrector power supply and control system is through transition modules. So, we use Acromag IP modules to control the corrector power supplies. Those power supplies and their CAMAC control system in transfer line will remain. The CAMAC system will be merged into VME system via a VME-CAMAC interface board.

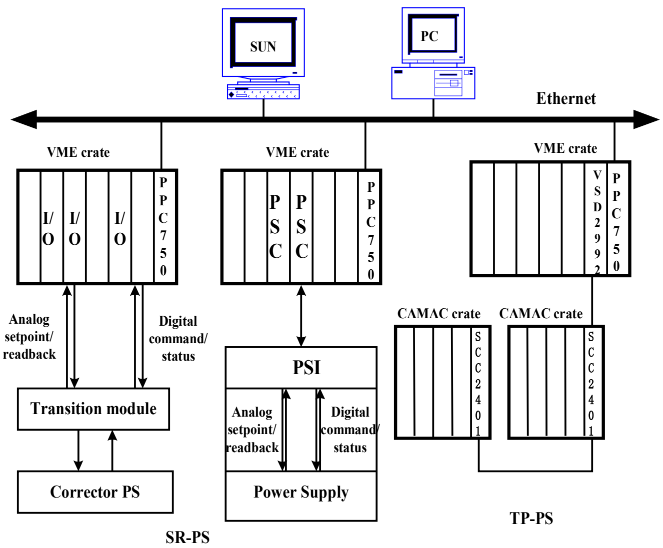

Figure 1. Control architecture for BII power supplies.

2 PSC/PSI SYSTEM

For BEPCII, our software control platform is EPICS. Sun workstation is used for VxWorks/EPICS development. Meanwhile a PC/Linux is also used for EPICS development. We use two kind of CPU boards in the PowerPC750 family: MVME2431 and MVME5100. Two sets of PSC/PSI system have been built up. One is a VME based PSC/PSI system, another is a PSC/PSI standalone testing system.

For the development of the VME based PSC/PSI system, software control platform is either a workstation or a PC. In a portable configuration for VME based test, EPICS control platform is a laptop computer running Linux with EPICS base and extensions installation. IOC is MVME5100 running VxWorks kernel and EPICS application that are downloaded from the laptop.

2.1 VME based PSC/PSI system

The VME based PSC/PSI system has been built up. Figure 2 is portable configuration for VME based test. It is comprised of a small VME crate with a CPU board and PSC connected to a remote PSI.

Figure 2 Portable PSC/PSI Configuration

As our prototype power supply is a chopper PS which is supplied power by a DC machine，the definition of the PSI interface need to be changed. Meanwhile the VxWorks driver transferred from BNL has been modified. Our database template is configured with VDCT. The PC/Linux loads the CPU board with VxWorks kernel and an EPICS application and runs MEDM display software. The system has been tested with the prototype power supply. The functionality of the control interface is verified. All functions of PSC/PSI have been tested including current setting and readback, and on /ff control and status monitoring. The precision and stability of PSI DAC and ADCs have also been tested. The result has shown to meet the requirement with $5\text{x}10^{-5}$ accuracy and stability of our prototype power supply.

2.2 PSC/PSI standalone testing system

The PSC has a serial port that allows communicating with power supplies using just a single PSC/PSI pair and a laptop computer. So, a PSC/PSI standalone testing system (PC/LabView) has been done. Figure 3 is a test setup showing the standalone PSC connected to a PSI with Labview software running on a laptop. The serial port software is developed by our own. It is not only to do prototype testing of power supplies, but also to detect glitch of power supplies.

A Labview library is developed that supports all functions of the PSC/PSI via a simple serial port. Using the serial port, all functions of the PSC/PSI can be completely exercised. Setpoints and command can be issued, data can be read, burst mode parameters can be set, burst mode can be initiated, communication status can be monitored, errors can be detected etc.

Many VIs were built based on this library to checkout the PSC/PSI hardware. Users can easily build their own applications to handle up to 6 power supplies based on the library.

This system has also been tested with the prototype power supply including current setting and readback in normal mode. For fast reads, burst mode is used and data is stored in memory. Data in memory can be read out and created a curve for stability analysis.

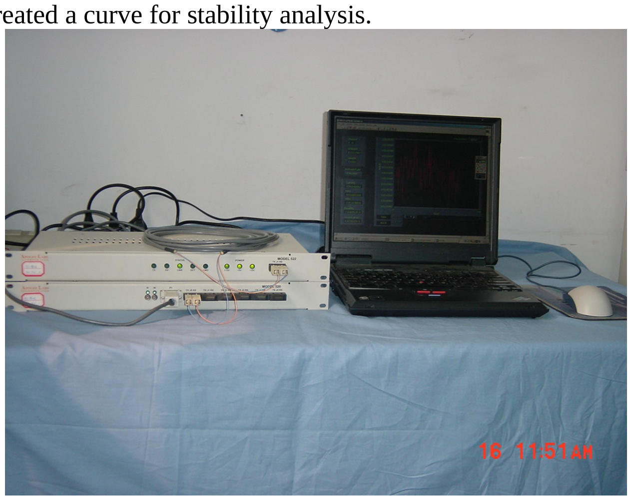

Figure 3. Standalone PSC Configuration.

IP I/O SYSTEM

There are about 140 corrector power supplies in the rings that still use original specification. The control interface between the corrector PS and control system will also remain. Using IP modules may be low in cost. So, IP I/O system has been set up. Figure 4 is a test set up which consists of a VME-64x crate with a CPU board and IPAC along with IP 235-8, IP 330, IP445 and IP440. These IP drivers and EPICS application and database for test are developed on the SUN workstation. IOC is MVME2431 board running VxWorks kernel and the EPICS application which are downloaded from the SUN workstation. A operator screen for test has been done. The system is being tested with a corrector power supply including current setting and readback, on/off control and monitoring, accuracy and stability of the analog output and input IP borads.

4 VME BASED CAMAC SYSTEM

Those power supplies and their CAMAC control system in transfer line will remain. So, a VME based CAMAC system is built up. Its application development is in process. It consists of a VME-64x crate with a CPU board(MVME2431) and a VME-CAMAC interface board and two CAMAC crates with a serial crate controller(SCC) and CAMAC I/O modules. The VME-CAMAC interface board is connected to the SCC. The SUN workstation will load the CPU board with VxWorks kernel and an EPICS application and runs MEDM display software.

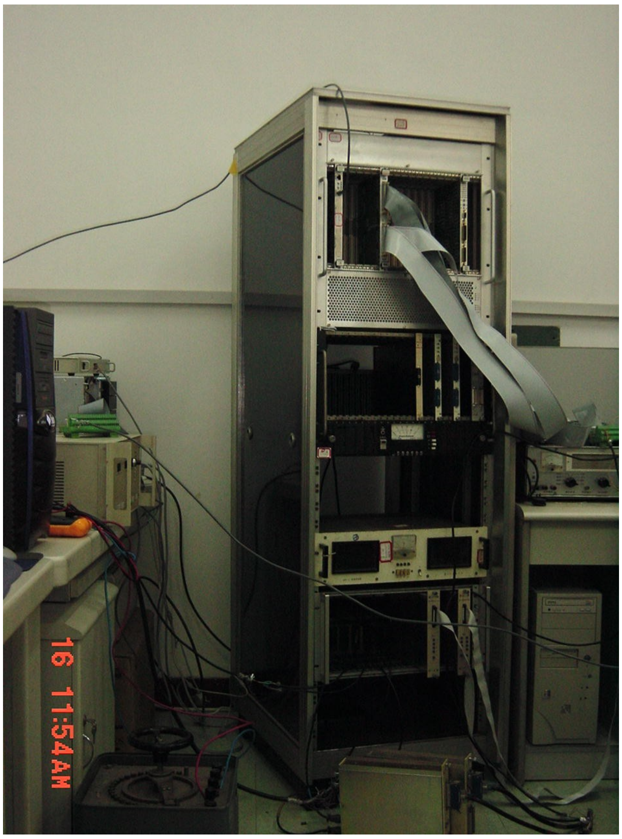

Figure 4 IP I/O System

SUMMARY

The development of the above three types of I/O modules must be finished before the end of this year. After that, we will evaluate the control accuracy and stability of these I/O modules. Then we will start to order the front-end hardware.

In the meantime, we will develop the application software for all power supplies including database and operator screen and ramping application program. EPICS offers several "display manager" client applications. Currently the operator screens are created by medm , later they will be changed to edm. We will use structured test files with extensive macro-substitution scripts to expand to the full database and operator screens configuration from primary template files. Ramp program and ramp record and its record support will be developed as well.

In addition, MVME5100 is better than MVME2431, which is compared to the performance of MVME2431. So, MVME5100 will be used as IOCs for power supply control. There are nearly 5000 signals to be controlled and displayed in the power supply control system. 6 IOCs will accomplish all power supply control.

New large power supplies made in the factory will first put in a test Hall, then will be moved into the tunnel. So, the portable PSC/PSI system is convenient for single large power supply test.

BEPCII will begin beam commissioning at the early of 2006. Thus, its control system must be finished in 2005 well.

6 REFERENCES

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