

PC CONTROL OF INJECTION POWER SUPPLIES

FOR THE BEPC STORAGE RING

S.Lu H.Ren H.Zhang R.Zhang,
Institute of High Energy Physics, Beijing, China
e-mail : hzhang@bepc3.ihep.ac.cn

abstract

A PC plays an important role to the power-supply control in the BEPC ring injection system. It functions as a gateway to set up a connection between the bitbus network and the Ethernet network. The bitbus control network consists of nine nodes, which control ring injection power supplies directly. The front-end signals are collected to the PC, and then any type of computers, which support TCP/IP protocol, can access the PC through the Ethernet network to share the resources. The PC is also used as a friendly man-machine interactive

interface to display data from power supplies and execute control functions.

1 BACKGROUND

The BEPC ring injection power supplies provide for 4 kickers, 2 lambersons, they are separately located at the Neighborhood of e+, e- ring injection points. They had been well controlled by self-developed pure hardware system with a standalone mode from 1987 till 1996. The main reason was to concern about that the strong

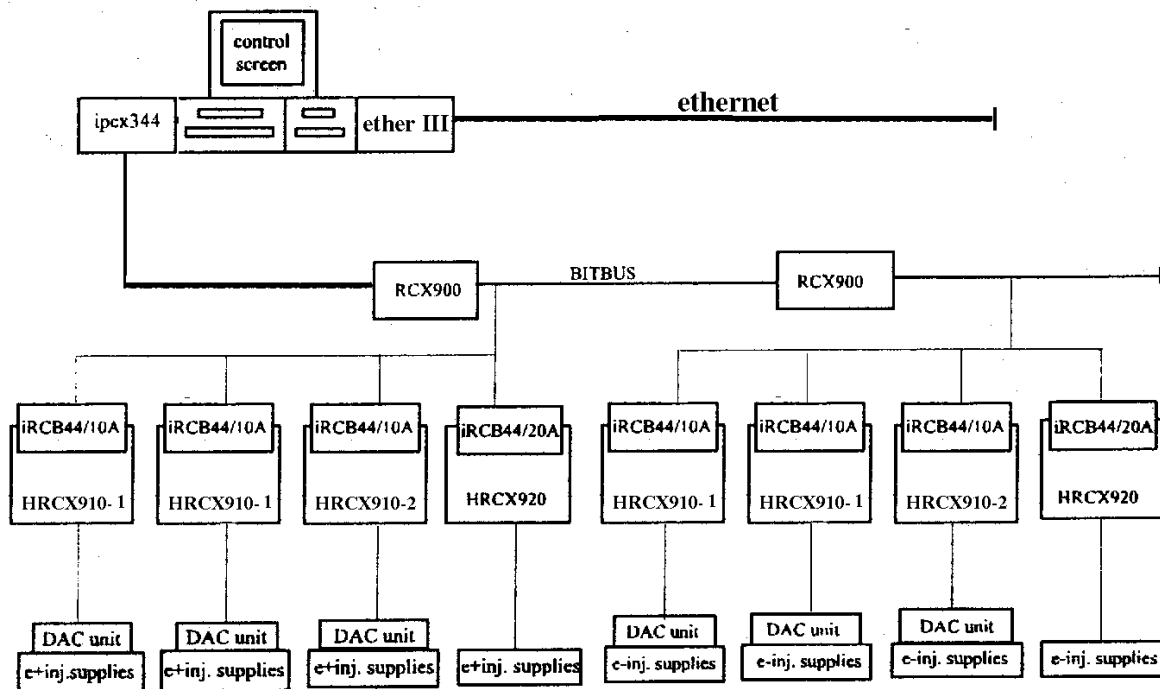


fig. 1 system hardware architecture

magnetoelectrical disturbing from large current pulse sources: kickers can lower the operation quality of the main VAX-VCC-CAMAC control system.

However, our consideration changed with new ideas. We tried using the fieldbus: bitbus to perform the distributed control over kickers and lambersons, rather than turning the control into a part of the main VAX-CAMAC control system.

After three-year hard work with our team members, a new computer control system had been put into operation in BEPC in Nov., 1996. Two years operations have proved the new PC-BITBUS distributed control system succeeded. This is the first time to come true to apply a fieldbus to BEPC control.

2 HARDWARE ARCHITECTURE

The interconnect hardware architecture for the new PC-BITBUS distributed control system shows in Fig.1. It is composed of 8 secondary stations and 1 master station. A PC 586 with 100 MHz clock is located at the central control room as the system extension to act as a system console. The stations operate as front-end I/O controllers.

The network works in the self-clocked mode with 375-baud rate with two segments; the messages are transferred to and from along the BITBUS network comply with the iDCX51 message format.

The secondary stations are sorted roughly to two types:
◦ The digital controller: 12-bit digital output with one clock plus several one-bit digital I/Os. See fig. 2.

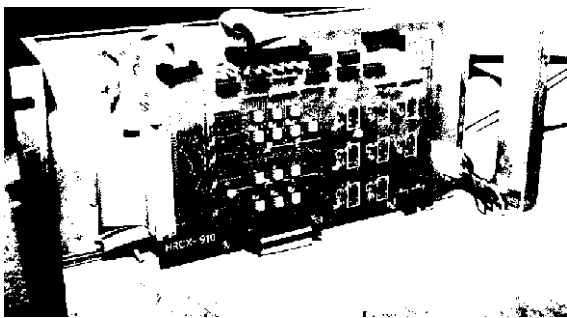


Fig. 2. The digital station on the bitbus interconnect

We use an iCB 44/10A digital I/O remote controller

with a bitbus interface and a self-developed digital adapter HRCX910, which utilizes some digital anti-disturbing measures to be sure the signal logic is right [1].

◦ Analog controller: 4 differential inputs with 12 bit resolution ranging 0-+10V. See Fig. 3.

We use an iCB 44/20A analog I/O remote controller with a bitbus interface and a self-developed analog adapter HRCX920 that utilizes some analog anti-disturbing measures and level transition [1].

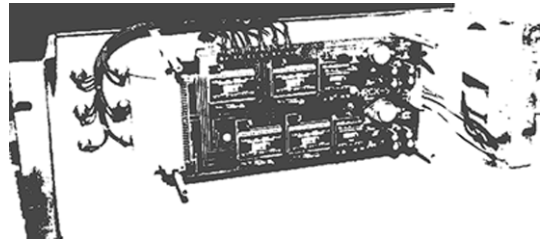


Fig. 3. The analog station on the bitbus interconnect

The secondary stations are as close to the devices as possible to reduce the magnetoelectrical interference.

The Master station is an iPCX344 intelligent bitbus interface with PC bus. It provides a gateway between the IBM PC or compatible computer and the bitbus-based distributed control environment [2].

The each distributed controller board on the bitbus interconnect didn't become in use till it was completely configured through jumpers.

Bitbus cable is dual twisted-pair one with shielding to carry signals safely.

3 SOFTWARE ARCHITECTURE

The software for the new PC-BITBUS distributed control system is classified into three parts:

◦ System software: the iDCX51 distributed control executive on every stations, the iRMX for windows with network version and MS-windows 3.1 on the PC, and lots of system calls under different operating systems.

◦ Utility software: groups of software tool like Intel C compiler, symbol debuggers, library functions, and many development tools under MD-DOS for bitbus stations.

◦ Application software: lots of application programs for

the PC-BITBUS distributed control system developed. The application software architecture for the interconnect is shown in fig. 4.

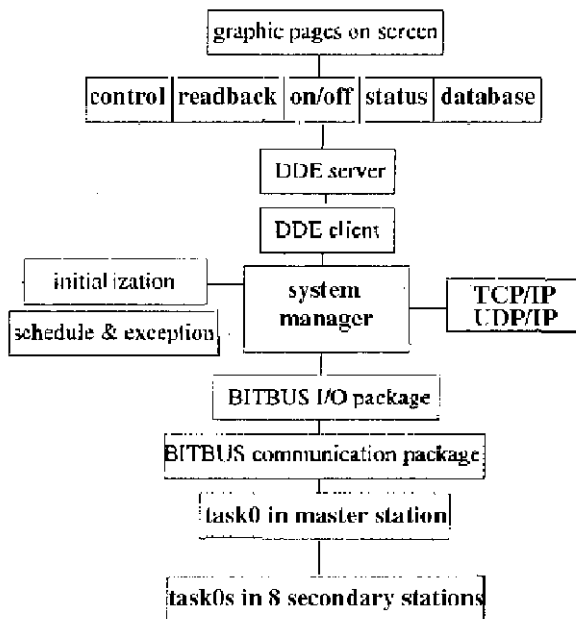


Fig. 4. System application software architecture

Performing control needs a bitbus driver for the network communication, but it is unfortunate that there is no such a driver under iRMX for windows V2.2. we explored a practical bitbus driver to lay the solid foundation for the entire distributed control system.

The another bottleneck for the whole control system is how to transfer the character messages under iRMX for windows into the graphic ones with MS-windows style. As matter of fact, the iRMX-net network communication protocol: Dynamic Data Exchange is used in order to solve the problem and the necessary system software configuration for it is also needed to create a successful communication channel between them.

The PC accesses to secondary stations through the bitbus interconnect by a set of high-level commands and responses: the Remote Access and Control interface, which is built on top of the bitbus message protocol and resides on all stations as a preconfigured task [2]. We call RAC services to access I/O on remote stations directly.

The man-machine interactive graphic interface is the another important characteristic. The console control page

is divided into 4 zones: the analog readback display, the analog setting and trimming and standardizing, the device status display, the device on/off controls. The control page also provides menu selection to view device history records, save useful setting data and choose the suitable trimming steps, etc.

4 PC FUNCTIONS IN THE SYSTEM

The PC is an extension to the bitbus interconnect, therefore, the PC is a PC-BITBUS system controller. All the commands come from the PC, All the real time feedback messages show on the PC screen.

The PC is a gateway to exchange messages between the bitbus interconnect and the Ethernet. We developed a special program under iRMX for windows, it packs the all messages concerning controlled devices to the string format, then sends it to the main computer with TCP/IP protocol, and it also unpacks the messages from the VAX and distributes them to the respective devices. The program is ready to use. Now, through the Ethernet we can logon to the PC to enter the common directory to view history records about the controlled device, even ftp to the directory to copy useful data freely.

The PC is a work platform for the application software development and debugging as well as operating on it.

The PC is also an environment to manage entire system control functions to operate smoothly.

5 CONCLUSION

A variety of fieldbuses has been turned up nowadays, like Canbus, Profibus, Lonworks, etc. As a front-end I/O device control network, fieldbuses are reliable and configurable, are getting more and more popular. The PC will often accompany in the fieldbus applications.

REFERENCES

- [1] h.zhang, others, "a control system for BEPC ring injection power supplies", p1754, EPAC96 proceedings.
- [2] "IPCX344 intelligent bitbus interface user's guide", published by intel corporation, 1987.