Prototype of the Ethernet-based Power Supply Interface Controller Module for KEKB

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Overview

Most of the magnet power supplies of the KEKB rings and beam transport lines are connected to the local control computers through ARCNET. For this purpose we have developed the Power Supply Interface Controller Module (PSICM), which is designed to be plugged into the power supply. It has a 16-bit microprocessor, ARCNET interface, trigger pulse input interface, and parallel interface to the power supply. According to the upgrade plan of the KEKB accelerators, more power supplies are expected to be installed. Although the PSICMs have worked without serious problem for 11 years, it seems too hard to keep maintenance for the next decade because some of the parts have been discontinued. Thus we decided to develop the next generation of the PSICM. Its major change is the use of the Ethernet instead of the ARCNET. On the other hand the specifications of the interface to the power supply are not changed at all. The new PSICM is named ePSICM (Ethernet-based Power Supply Interface Controller Module). The design of the ePSICM and the development of the prototype modules are in progress.

(1) Introduction ----- PSICM

KEKB is an asymmetric electron-positron collider at 8 × 3.5 GeV/c for B-meson physics. It started in operation in Dec.1998.

KEKB accelerator control system is **EPICS**-based.

More than 100 VME/VxWorks computers as IOC

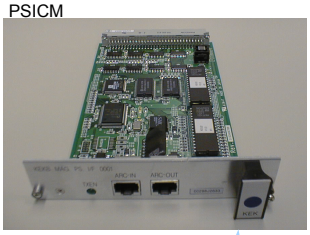
Several workstations of 4 kinds of platform

About 2500 magnet power supplies are installed in the KEKB storage rings and the injection beam transport lines and controlled by 11 IOCs.

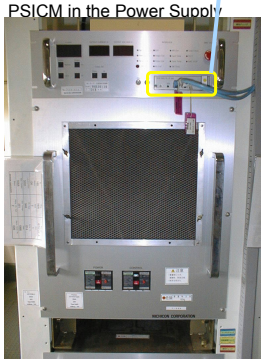
To connect such many power supplies to the IOCs, we adopted **ARCNET** as the field bus and developed the **PSICM** (Power Supply Interface Controller Module) .

- •3U Euro-card format (100mm×160mm) with a DIN 64-pin connector
- •It can be plugged into the power supply.
- •parallel interface to the power supply
- •ARCNET interface with HYC2485 media driver
- •Up to 20 PSICMs can be connected in a daisy-chain manner using shielded twisted-pair cable.

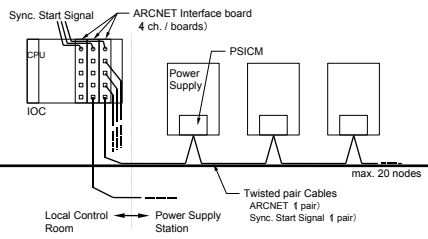
PSICM



PSICM in the Power Supply



Configuration of the Magnet Power Supply Control System



(2) New Generation of the PSICM

For the Super-KEKB, more power supplies are expected to be installed. We need more PSICMs.

The PSICMs have worked well for 11 years. But some of the parts have been discontinued. It seems hard to reproduce the PSICM now.

Thus we start developing the next new generation of the PSICM. It uses **Ethernet** as the field bus.

It is named **ePSICM** (Ethernet-based PSICM)

We think the Ethernet is the most probably surviving technology in the next decade.

(3) Requirements of the Compatibility

Compatibility between ePSICM and the original PSICM are required.

- •The interface to the power supply must be fully compatible.

  The ePSICM must be able to be plugged into any existing power supplies.

- •The higher level protocol of the communication with the IOC should be compatible.

  This requirement minimizes the modification cost of the control software.

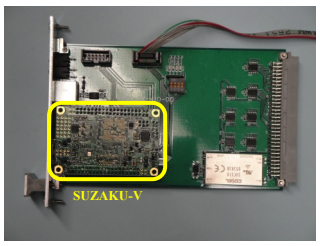
(4) Prototypes of the ePSICM

Table 1: The specification of the PSICM and the ePSICM Prototypes

	Original PSICM	ePSICM Prototype-1 (Using SUZAKU)	ePSICM Prototype-2 (Using Armadillo)
Board computer		SUZAKU-V SZ410-U00	Armadillo-500 A5027-U00Z
Microprocessor (CPU core)	AM186	(PowerPC405)	i.MX31 (ARM11)
Clock frequency	20MHz	350MHz	400MHz
Data memory	256kB SRAM	32MB DDR2 SDRAM × 2	128MB DDR SDRAM
Program memory	256kB EPROM	8MB SPI FLASH	32MB NOR FLASH
Buffer memory			256k × 16bits SRAM
Network interface	2.5Mbps ARCNET Backplane mode	Ethernet 10BASE-T/100BASE-TX	Ethernet 10BASE-T/100BASE-TX
Programmable logic device		FPGA: Xilinx Virtex-4 FX XC4VFX12-SF363	CPLD: Xilinx CoolRunner-II xc2c256

ePSICM Prototype-1

Prototype using SUZAKU-V



SUZAKU: the small board computer with FPGA.

SUZAKU-V has:

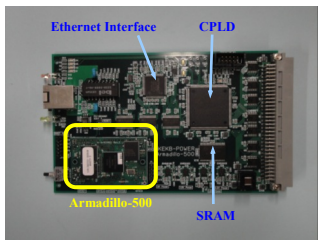
- •Virtex-4 FX FPGA with hardcore PowerPC.
- •Ethernet interface with RJ-45 connector.

SUZAKU-V supports Linux Kernel 2.6.

Few additional chips are required to build the complete module.

ePSICM Prototype-2

Prototype using Armadillo-500



Armadillo: the small simple board computer.

Armadillo-500 has ARM11 CPU core.

Armadillo-500 supports Linux Kernel 2.6.

Some additional chips, CPLD, SRAM and the Ethernet interface are also mounted on the board.

Armadillo is cheaper than SUZAKU.

(5) ePSICM as the General Purpose Embedded I/O Controller with EPICS

For the test purpose, we have installed EPICS in the both prototypes and have successfully run EPICS IOC core program. The ePSICM has the potential to be the general purpose embedded I/O controller.