The Construction of the SuperKEKB Magnet Control System

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Abstract: There were more than 2500 magnet power supplies for KEKB storage rings and injection beam transport lines. For the remote control of such a large number of power supplies, we have developed the Power Supply Interface Controller Module (PSICM), which is plugged into each power supply. It has a microprocessor, ARCNET interface, trigger signal input interface, and parallel interface to the power supply. The PSICM is not only an interface card but also controls synchronous operation of the multiple power supplies with an arbitrary tracking curve. For SuperKEKB we have developed the upgraded version of the PSICM. It has the fully backward compatible interface to the power supply. The enhanced features includes high speed ARCNET communication and redundant trigger signals. Towards the phase 1 commissioning of SuperKEKB, the construction of the magnet control system is ongoing. First mass production of 1000 PSICMs has been completed and their installation is in progress. The construction status of the magnet control system is presented in this report.

(1) Introduction ----- Original PSICM

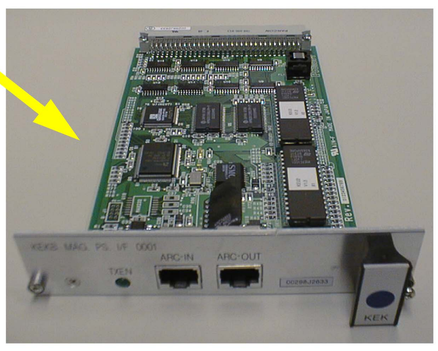
KEKB, the asymmetric electron-positron collider for B-meson physics, started in operation in Dec.1998 and finished in Jun. 2010.

KEKB control system was **EPICS**-based, using more than 100 VME/VxWorks computers as IOC (I/O Controller).

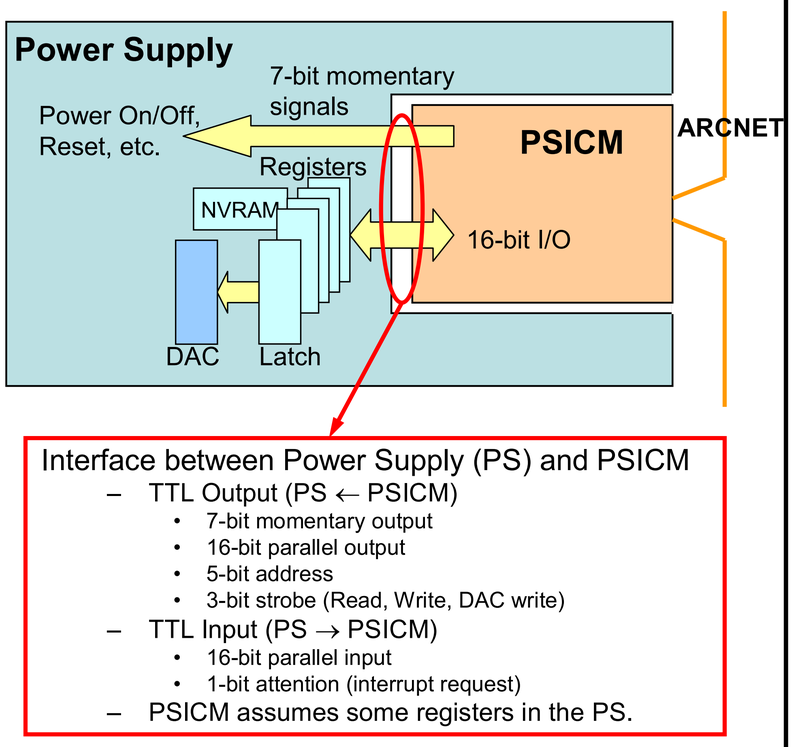
About 2500 magnet power supplies were installed in the KEKB storage rings and the injection beam transport lines and controlled by 11 IOCs.

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).

PSICM for KEKB



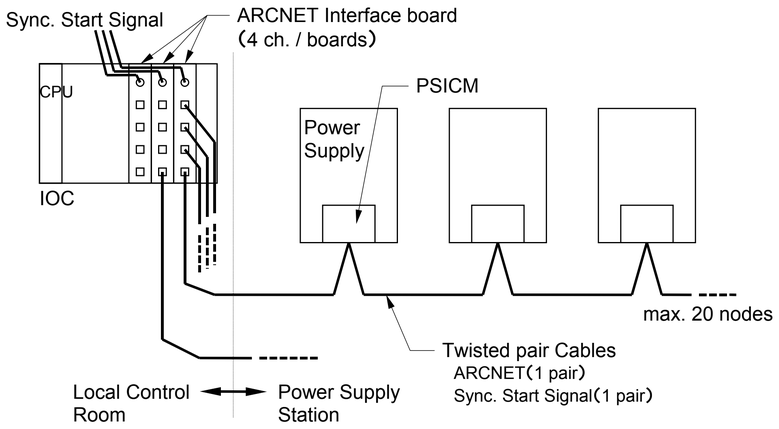
3U Euro-card format with a DIN 64-pin connector



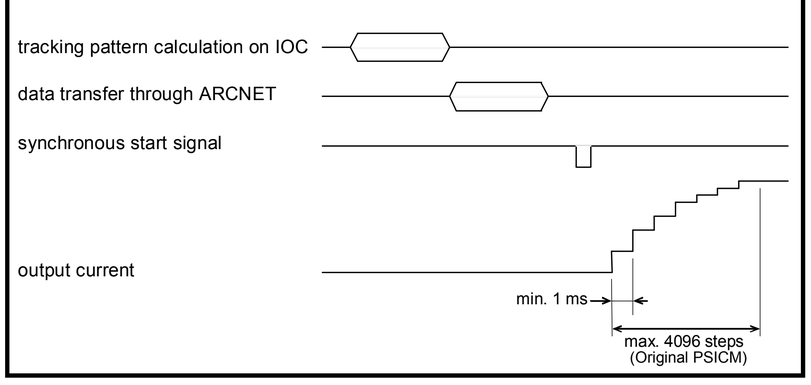
Interface between Power Supply (PS) and PSICM
- TTL Output (PS ← PSICM)
  - 7-bit momentary output
  - 16-bit parallel output
  - 5-bit address
  - 3-bit strobe (Read, Write, DAC write)
- TTL Input (PS → PSICM)
  - 16-bit parallel input
  - 1-bit attention (interrupt request)
- PSICM assumes some registers in the PS.

Configuration of the KEKB Magnet Power Supply Control System

Up to 20 PSICM can be connected in the daisy-chain manner.



(2) Synchronous Operation



Hardware Specification

	Original PSICM	New PSICM
Microprocessor	AM186	MPC8306
Clock frequency	20MHz	133MHz
Data memory	256kB SRAM	128MB DDR2 SDRAM
Program memory	256kB EPROM	64MBit NOR FLASH
ARCNET interface	2.5Mbps Backplane mode	2.5Mbps/5Mbps/10Mbps Backplane mode
Controller	COM20020	COM20022
Media driver	HYC2485	HYC5000
Power required	5V 0.4A	5V 1A

(3) New PSICM for SuperKEKB

The New PSICM has fully backward compatible interface to the power supply. It can be plugged into any existing power supplies.

On the other hand, some features are enhanced.

The high speed ARCNET communication (10Mbps, 5Mbps or 2.5Mbps)

32-bit data handling to support high resolution DAC (24, 20, 18-bit)

Dual trigger inputs for synchronous start signals (redundant trigger signals)

More reliable RJ-45 connectors with the optional protectors against dust

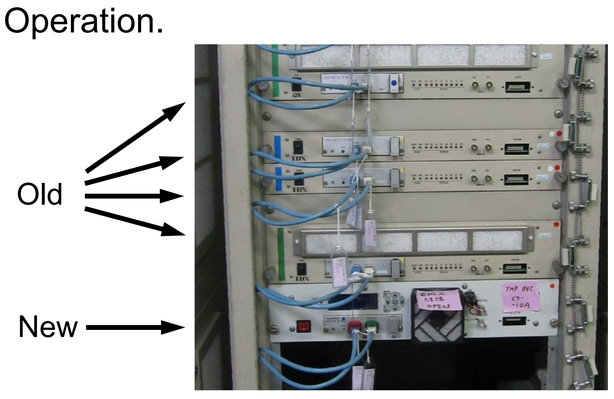
(4) Installation of the New PSICM

We start with the **combination** of **Old** & **New** PSICM because of the limited budget.

First mass production of PSICM: 1000

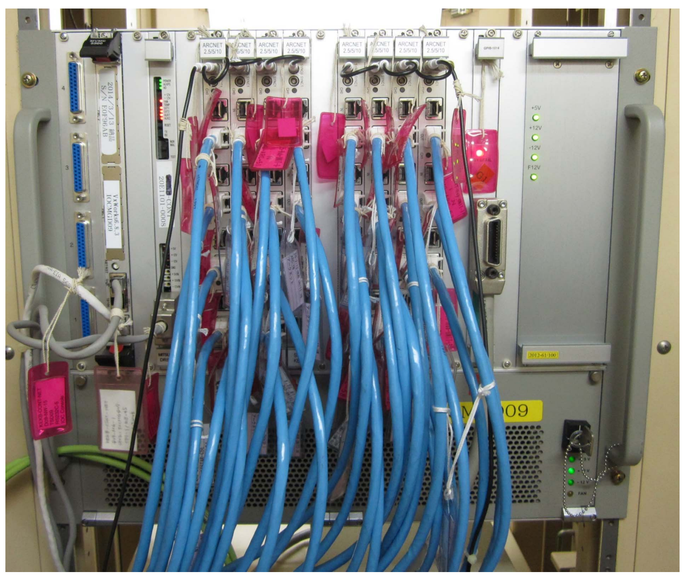
Magnet PS in the Main Rings (Phase 1): 2162

426 New PSICM have been installed for the Phase 1 Operation.



Other 574 are reserved for DR (Damping Ring), DR-BT and Magnets in Phase 2 Operation.

(5) Setting up VME IOC w/ ARCNET I/F



(6) Development of the GUI window programs for the operation

GUI programs for the basic Magnet Operation are written in Python with Tk widgets. Examples are shown below.