Upgrade of the Power Supply Interface Controller Module for SuperKEKB

T. T. Nakamura, A. Akiyama, K. Furukawa, M. Iwasaki, H. Kaji, S. Sasaki, KEK, Ibaraki, Japan

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, the upgrade of KEKB, most of the existing power supplies continue while hundreds of new power supplies are also installed. Although the PSICMs have worked without serious problem for 12 years, it seems too hard to keep maintenance for the next decade because of the discontinued parts. Thus we have developed the upgraded version of the PSICM. The new PSICM has the fully backward compatible interface to the power supply. The enhanced features are high speed ARCNET communication and redundant trigger signals. The design and the status of the upgraded PSICM are presented.

(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.

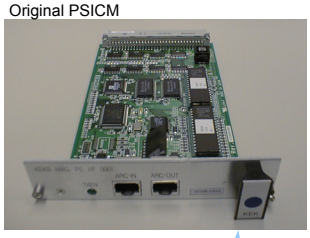
KEKB control system was **EPICS**-based, using more than 100 VME/VxWorks computers as IOC.

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).

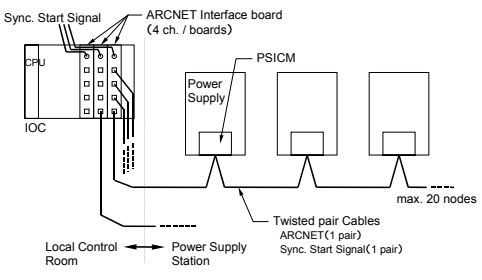
- 3U Euro-card format (100mm x 160mm) with a DIN 64-pin connector
- It can be plugged into the power supply.
- parallel interface to the power supply
- ARCNET interface with HYC2485 media driver
- Up to 20 PSICMs can be connected in a daisy-chain manner using shielded twisted-pair cable.

Original PSICM

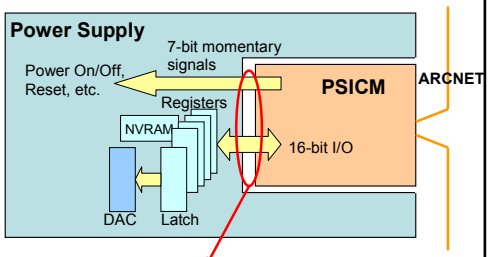


PSICM in the Power Supply

Configuration of the KEKB Magnet Power Supply Control System

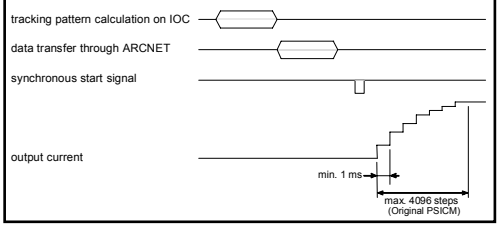


(2) Interface to the Power Supply



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.

(3) 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

(4) New Version of the PSICM

For the **SuperKEKB**, more power supplies are installed. We need more PSICMs.

The PSICMs have worked well for 12 years. But some of the parts have been discontinued. It seems hard to reproduce the PSICM now.

Thus we are developing the next new version of the PSICM.

(5) Compatibility and New Features

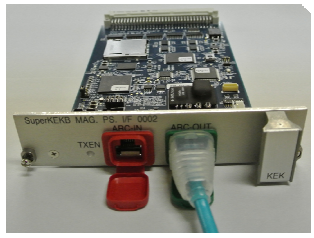
The New PSICM has fully backward compatible interface to the power supply. It can be plugged into any existing power supplies.

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

(6) Prototype of the New PSICM

Prototype #2 has been tested.



First mass production (1000 modules) is in progress. It is scheduled to be completed in March 2014.

(7) ARCNET interface board, ARCNET hub for New PSICM

← 4ch. ARCNET interface board (VME)
Old version (left)
New version for SuperKEKB (right)

ARCNET hub (4 ports x 3) →
New version for SuperKEKB

Test bench →